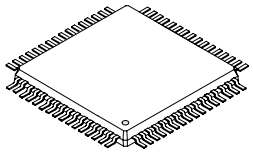
AUDIO SYSTEM CONTROL MCU WITH DTS PLL

DESCRIPTION

SC9321 is an audio system controller which realizes the AM/FM tune receiver (DTS) and other functions. It is based on Silan's 8-bit MCU SC65PX and can be operating under low voltage. Built-in LCD driver which can drive max. 4X23 segments display; 44 configurable I/O ports; three 8-bit counters, where two of them can be together to implement 16-bit timing length, and another timer is equipped with input capture functions; Built-in real time clock ensures the system continuously counting when it is in sleep state; 9 interrupt sources including four external interrupts, which makes the system response to various internal or external events quickly. The serial communication circuit with selectable multiple operating modes enhanced the expansibility of the system. Built-in 3.2MHz RC oscillator with external 75KHz oscillator can make a balance between power dissipation and speed. In high speed application, it can extend external high frequency oscillator through PC.4/5 pin, maximum up to 8MHz.

The chip can be widely applicable in portable audio control system with LCD display.



LQFP-64-10x10-0.5

APPLICATIONS

* Widely applied in portable audio control system with LCD.

ORDERING INFORMATION

Device	Package	Seal
SC9321	LQFP-64-10x10-0.5	SC9321P

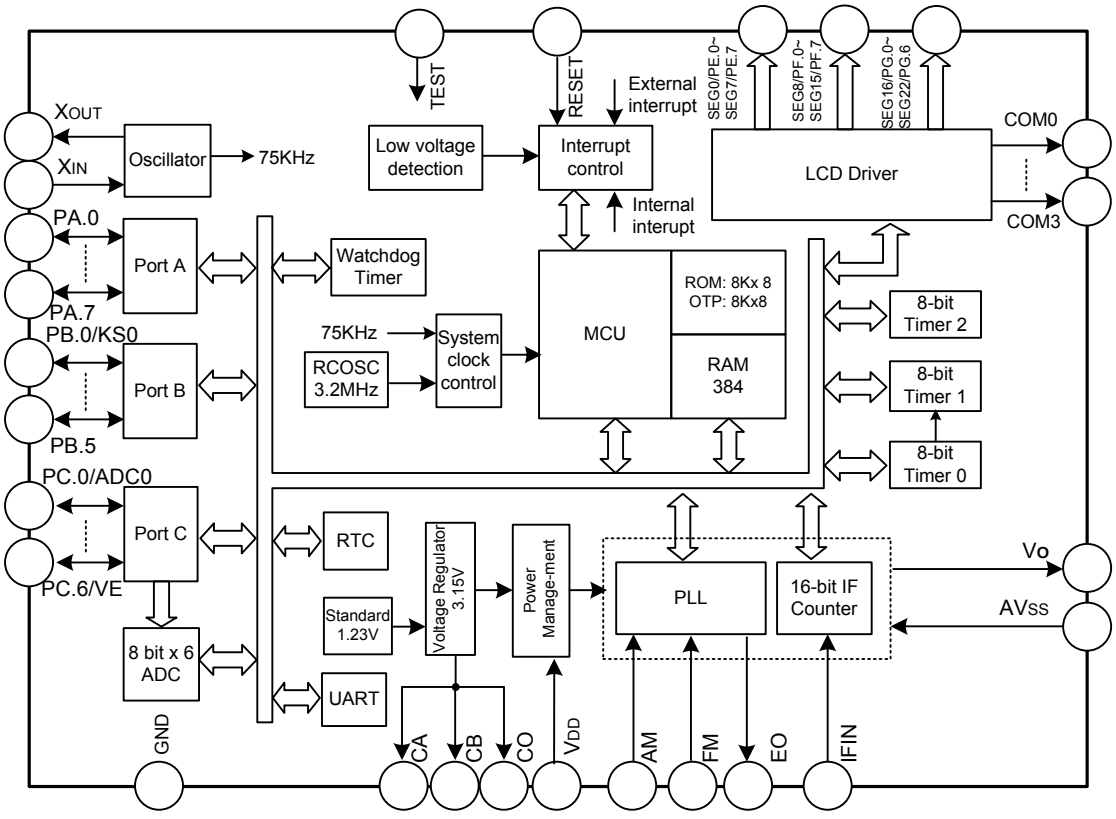
FEATURES

* Memory
  384-byte data memory
  8K-byte (OTP)+ 8K-byte(ROM)
* I/O configuration
  General-purpose I/O: 21 pins with pull up resistor;
  SEG: also can be used as I/O.
* LCD controller/driver
  Drive 11 words display max.
  23 SEG x 4 COM
  Display mode: duty, bias can be programmable
* 8 –bit timer/counter T0/T1/T2
  Timing time can be set by program
  External events counting
  Arbitrary clock frequency output
  T0/T1 can be 16-bit counter
  T2 provides input capture function
* Clock source
  External clock source: 75KHz oscillator
  Built-in RC oscillator: 3.2MHz
  Extension oscillator: 2~8MHz(V_{DD}>2.4V@4MHz)
* RTC
  Year/month/day display
  Provide BCD code data directly
  Leap year auto adjust
  Timing alarm
* PLL frequency synthesizer
  FM/AM
  FM frequency range: 30MHz~150MHz
  AM frequency range: 0.5MHz~30MHz
* 16-bit IF counter
  AMIF range: 100KHz~1MHz
  FMIF range: 5MHz~15MHz
  AMIF&FMIF share one IF input IFIN

FEATURES (Continued)

* A/D converter
  5-channel selection input, 8-bit conversion precision
  External reference voltage selectable
  Battery electricity checking
* Built-in reference
  The operating voltage is changed within the range of 2.0~5.5V, V_{REF}=1.23V±5%.
* UART serial communication interface
  2-line async communication
  Communication speed can be selected flexibly
  Quick interrupt response
* Interrupt source
  4 external interrupts, maskable
  6 internal interrupts, maskable
* Operating voltage range:
  75KHz 2.0~5.5V
  3.2MHz 2.2~5.5V

BLOCK DIAGRAM



Note: V_{PP} pin can be diplexed as RESET when program the OTP memory, this pin is connected to 12V voltage.

ABSOLUTE MAXIMUM RATINGS

Characteristics	Symbol	Ratings	Unit
Operating Voltage	V_{DD}	-0.3~5.5	V
Input Voltage (All The I/O Pins)	V_{IN1}	-0.3~V_{DD}+0.3	V
Input Voltage (RESET)	V_{IN1}	-0.3~V_{DD}+0.3	V
Output Voltage	V_{OUT}	-0.3~V_{DD}+0.3	V
Output High Level Current	I_{OH}	-15	mA
Output Low Level Current	I_{OL}	30	mA
Operating Ambient Temperature	T_{amb}	-20~+75	°C
Storage Temperature	T_{STG}	-40~+125	°C

ELECTRICAL CHARACTERISTICS (T_{amb}=25 °C,V_{DD}=3V)

Characteristics	Symbol	Test conditions	Min.	Typ.	Max.	Unit
Input High Voltage	V_{IH1}	PA/B/C		1.73		V
	V_{IH2}	PE/F/G		1.53		
Input Low Voltage	V_{IL1}	PA/B/C		-	1.57	V
	V_{IL2}	PE/F/G (Note1)		-	1.4	
Output High Voltage	V_{OH1}	V_{DD}=3V,EO,I_{OH}=-1mA		2.0		V
	V_{OH2}	V_{DD}=3V,PA/B/C,I_{OH}=-1mA	2.8			
	V_{OH3}	V_{DD}=3V,PE/F/G,I_{OH}=-1mA	2.8			
Output Low Voltage	V_{OL1}	V_{DD}=3V,EO,I_{OH}=0.5mA		0.9		V
	V_{OL2}	V_{DD}=3V,PA/B/C,I_{OH}=1mA			0.2	
	V_{OL3}	V_{DD}=3V,PE/F/G,I_{OH}=1mA			0.2	
Input High Leakage Current	I_{LIH}	V_{IN}=V_{DD}, all the input pins			1	μA
Input Low Leakage Current	I_{LIL}	VIN=0V,all the input pins			1	
Output High Leakage Current	I_{LOL}	V_{OUT}=V_{DD}, all the input pins			1	
75KHz Crystal Oscillator Feedback Resistor	R_{osc}	V_{DD} =3.0V,X_{IN}=V_{DD}, X_{OUT}=0V	5000	6000	7000	KΩ
75KHz Crystal Oscillator Input Current	I_{Hosc}	V_{DD} =3.0V,X_{IN}= X_{OUT}=V_{DD}		180		μA
75KHz Crystal Oscillator Input Current	I_{Losc}	V_{DD} =3.0V,X_{IN}= X_{OUT}=0		120		μA
Pull-Down Resistor	R_{L1}	V_{DD}=3.0V,V_{IN}(FM/AM/IFIN)=V_{DD}	9	10.5	12	KΩ
	R_{L2}	V_{DD}=3.0V,Test = VDD	81	84	87	
Pull-Up Resistor	R_{H1}	V_{DD}=3.0V,V_{IN}=0,PA/B/C		27	58	KΩ
	R_{H2}	V_{DD}=3.0V,V_{reset} = 0	64	67	70	

(To be continued)

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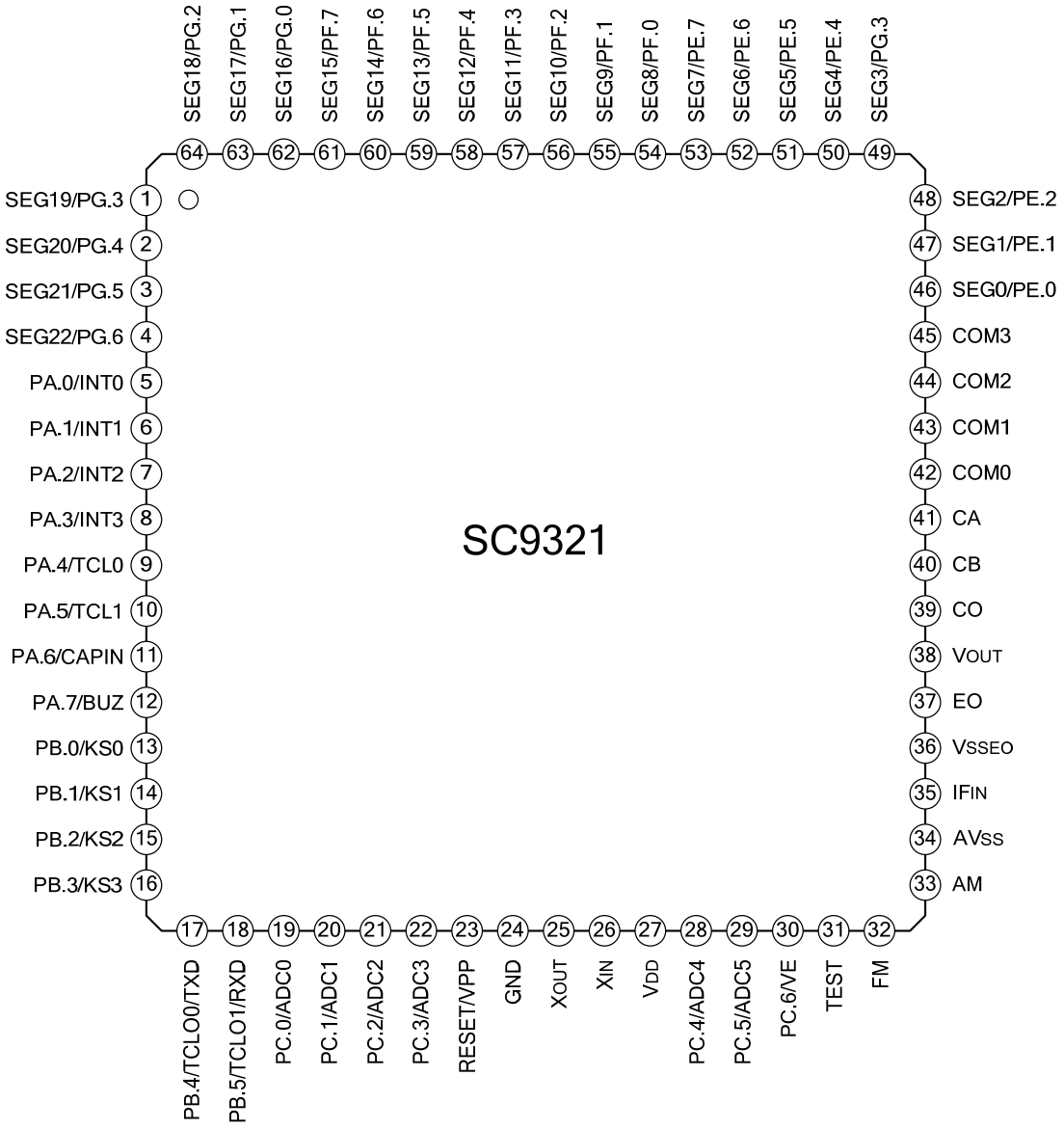
Characteristics	Symbol	Test conditions	Min.	Typ.	Max.	Unit
Operating Current	I_{DD1}	OSC 75KHz stop, CPU Clk stop			1	μA
	I_{DD2}	OSC=75KHz,CPU Clk=75KHz Sleep (Note 2)		4.8	8	μA
Operating Current	I_{DD3}	OSC=75KHz,CPU Clk=3.2MHz, all the modules start			3.0	mA

Note 1: CMOS input, when input voltage is 1.6V, the state of read port is uncertain.

Note 2: Only 75KHz crystal oscillator and RTC are working.

PIN CONFIGURATION



PIN DESCRIPTION

Pin No.	Pin Name	Diplex pin	I/O	Pin Descriptions
1	SEG19	PG.3	I/O	Segments scan signal output, maximum output 4-bit data each pin. Drive LCD screen together with COM signal. Can be as general-purpose input/output port.
2	SEG20	PG.4		
3	SEG21	PG.5		
4	SEG22	PG.6		
5	PA.0	INT0	I/O	General-purpose input/output port; 8bit read/write; Configurable bit operation.
6	PA.1	INT1		
7	PA.2	INT2		
8	PA.3	INT3		
9	PA.4	TCL0		
10	PA.5	TCL1		
11	PA.6	CAPIN		
12	PA.7	BUZ		
13	PB.0	KS0		
14	PB.1	KS1		
15	PB.2	KS2		
16	PB.3	KS3		
17	PB.4	TCLO0		
18	PB.5	TCLO1		
19	PC.0	ADC0	I/O AD conversion analog channel	
20	PC.1	ADC1		
21	PC.2	ADC2		
22	PC.3	ADC3		
23	RESET	VPP	—	System reset pin
24	GND	—	—	Digital ground
25	XIN	—	I	Low frequency oscillator input
26	XOUT	—	O	Low frequency oscillator output
27	VDD	—	—	Digital power supply
28	PC.4	ADC4	I/O	PC4/5 can also be used as ADC input channel; PC6 can also be used as external reference input of ADC
29	PC.5	ADC5		
30	PC.6	External reference voltage		
31	TEST	—	—	Test enable pin, internal pull-down resistor
32	FM	—	I	FM signal input
33	AM	—	O	AM signal output
34	AVSS	—	—	Analog ground
35	IFIN	AMIF/ FMIF	I	IF signal input
36	VSSEO	—	—	Analog ground

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Pin No.	Pin Name	Diplex pin	I/O	Pin Descriptions
37	EO	—	O	Phase discrimination error signal output
38	VOUT	—	O	3.3V voltage regulator output
39	CO	—	O	2*VDD voltage doubler output
40	CB	—	—	External capacitor pin of charge pump
41	CA	—	—	External capacitor pin of charge pump
42~45	COM0~ COM3	—	O	LCD display scan common signal
46~48	SEG0~2	PE.0~2	O	Segments scan signal output, maximum output 4-bit data each pin. Drive LCD screen together with COM signal. Can be as general-purpose input/output port.
49	SEG2	PE.3	O	Segments scan signal output, maximum output 4-bit data each pin. Drive LCD screen together with COM signal. Can be as common input/output port. (Refer to LCD module description)
50	SEG3	PE.4		
51	SEG5	PE.5		
52	SEG6	PE.6		
53	SEG7	PE.7		
54	SEG8	PF.0		
55	SEG9	PF.1		
56	SEG10	PF.2		
57	SEG11	PF.3		
58	SEG12	PF.4		
59	SEG13	PF.5		
60	SEG14	PF.6		
61	SEG15	PF.7		
62	SEG16	PG.0		
63	SEG17	PG.1		
64	SEG18	PG.2		

SHARED PIN DESCRIPTION

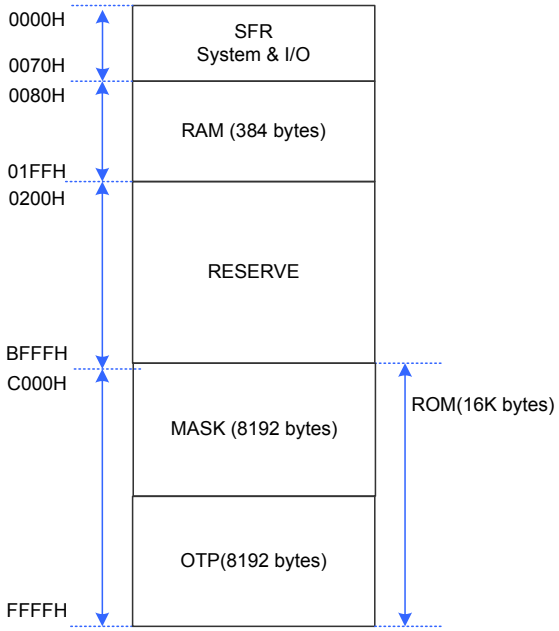
Pin no.	Shared pin	I/O	Descriptions
17	Txd	O	Serial communication data output
18	Rxd	I	Serial communication data input
5-8	INT0-INT3	I	External interrupt input
9	TCL0	I	External counting pulse/clock input of timer 0
10	TCL1	I	External counting pulse/clock input of timer 1
11	CAPIN	I	Capture signal input
12	BUZ	O	Buzzer signal output
13~16	KS0-KS3	I	Key scan input, can generate interrupt
17	TCLO0	O	Frequency division output of timer 0
18	TCLO1	O	Frequency division output of timer 1
23	VPP	—	High voltage pin, when download OTP, connects to 12V voltage
46~53	PE0~PE7	I/O	General purpose I/O port PORTE
54~61	PF0~PF7	I/O	General purpose I/O port PORTF
62~64 1~4	PG0~PG6	I/O	General purpose I/O port PORTG
28	XIN4M	I	High frequency oscillator input<ADC channel forbids>
29	XOUT4M	O	High frequency oscillator output <ADC channel forbids >

FUNCTION DESCRIPTION

SC9321 has embedded SC65PX core, and 16 K-byte program memory, where 8K-Byte is OTP, 8K-Byte is MASK ROM. The data memory is 384-byte. Built-in RC oscillator generates 3.2MHz clock frequency and 1/2,1/4 divided frequency. It can also be used as system main clock together with external 75KHz crystal oscillator to implement applications in different modes, thus to reduce the power dissipation. It adopts built-in PLL and IF counting circuit to reduce the periphery components and implement the digital radio function. In addition, it has three 8-bit counters T0/T1/T2. T0/T1 can be used separately and also be used as 16-bit counter. The built-in RTC module can provides powerful calendar/alarm function, and BUZ signals of 4 kinds of frequency. PA/B/C/E/F/G can provide max. 44 I/O ports, where PA/B has pull-up configuration and selectable open-drain output function, PC can be shared as ADC analog pin of ADC, PE/F/G can be used as LCD display data scan output. LCD driver can drive eleven 8-segment display, and bias voltage 1/3 and 1/2 are selectable, duty is 1/2, 1/3, 1/4 programmable control to meet the various display requirements.

MCU Address Space

MCU uses 16-bit address bus, the maximum addressing space is 64-kByte (0000H~FFFFH). The address assignment of memory space is as follows:



SFR: Special function registers. This block includes system control, state register and the mapping of ports and display data block.

Register Mapping Table

0000H~007FH is assigned to I/O and some function registers. Where 0000H~000FH is assigned to the core. Function registers and I/O ports configuration of used address space is as follows:

Module	Register	I/O	Address	Function descriptions
Used Address Space				
Interrupt Control	IRQIP	W/R	00H	Maskable interrupt enable register
	IRQDP	W/R	01H	Maskable interrupt source register
	NMIIP	W/R	02H	Non-maskable interrupt enable register
	NMIDP	W/R	03H	Non-maskable interrupt source register
	INTCON	W/R	47H	Interrupt control register
	NMI is not used in the circuit, reserved. Forbid it by SEN instruction of program			
Watchdog Timer	WDTCON	W	04H	Watchdog timer setting and enable register
	WDT CLR0	W	09H	Watchdog clear register(Write 53H to 09H and 0AH,ACH can clear WDT)
	WDT CLR1	W	0AH	
MCU Control	MCU_SLP	W	06H	MCU sleep control register
	MCU_STATUS	R	07H	MCU state register
Bit Operation Control	BITCTRL	W/R	08H	Bit operation address space selection register(refer to 《SC65PX instructions》 for details)
System Control	SYSCON	WR	45H	System function control register
Clock Control	CLKCON	WR	46H	System clock control register

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Module	Register	I/O	Address	Function descriptions
Block Signal Selection Control	CLKSEL	W/R	4BH	Block signal selection control register
RTC Data and Control	RTC_CS	WR	30H	RTC control register
	YEARH	WR	31H	MSB of year data(BCD: 00~99)
	SECOND	WR	32H	Second data(BCD: 00~59)
	MIN	WR	33H	Minute data(BCD: 00~59)
	HOUR	WR	34H	Hour data(BCD: 00~23)
	DAY	WR	35H	Day data(BCD: 01~31)
	WEEK	WR	36H	Week data(BCD: 0~6)
	MON	WR	37H	Month data(BCD: 01~12)
	YEARL	WR	38H	LSB of year data(BCD: 00~99)
	MIN_ALARM	WR	39H	Minute alarm setting
	HOUR_ALARM	WR	3AH	Hour alarm setting
	DAY_ALARM	WR	3BH	Day alarm setting
	WEEK_ALARM	WR	3CH	Week alarm time setting
	CKO_CS	WR	3DH	BUZ signal control
TIMER2	TC2CR_PP	W/R	48H	Control register
	TREG2A_PP	W/R	49H	Preassign register/capture register
	TREG2B_PP	R	4AH	Capture register
TIMER0	T0CON	W	4CH	Control register
	T0REF	W	4DH	Preassign register
TIMER1	T1CON	W	4EH	Control register
	T1REF	W	4FH	Preassign register
UART	UART_BUF_ADDR	W	62H	Transmitting/receiving data buffer
	SCON_ADDR	W/R	63H	UART control register
	BRCON_ADDR	W/R	64H	Baud rate control register
	BRTIMER_ADDR		65H	Baud rate counting initial value setting register
Analog/Digital Convertor	ADDATA	R	50H	Conversion result of 8-bit storage
	ADCON	W/R	51H	Analog/digital control and state
PLL	PLLCON	W/R	52H	PLL 1 control register
	PLLD0	W/R	53H	Low 8-bit of PLL frequency division coefficient
	PLLD1	W/R	54H	High 8-bit of PLL frequency division coefficient
IF Counter	IFMOD	W/R	55H	IF counting mode control register
	IFCNT0	W/R	56H	Low 8-bit of IF counting data
	IFCNT1	W/R	57H	High 8-bit of IF counting data

(To be continued)

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Module	Register	I/O	Address	Function descriptions
Port and Direction Control	TRISA	W/R	59H	Direction control register of port A
	PORTA	W/R	5DH	Data temporary storage register of port A
	TRISB	W/R	5AH	Direction control register of port B
	PORTB	W/R	5EH	Data temporary storage register of port B
	TRISC	W/R	5BH	Direction control register of port C
	PORTC	W/R	5FH	Data temporary storage register of port C
	APCON	W/R	5CH	Port and A/D input diplex selection control
Pull-up Configuration	PUA	W/R	60H	I/O port pull-up mode selection register
	PUB	W/R	61H	I/O port pull-up mode selection register
SEG Diplex Port	PORTE	W/R	68H	Data temporary storage register of port E
	PORTF	W/R	69H	Data temporary storage register of port F
	PORTG	W/R	6AH	Data temporary storage register of port G
	Refer to LCD module description for details			
SEG Diplex Control	SEG_CTRL0	W	6BH	SEG0~3 pin configuration register
	SEG_CTRL1	W	6CH	SEG4~7 pin configuration register
	SEG_CTRL2	W	6DH	SEG8~11 pin configuration register
	SEG_CTRL3	W	6EH	SEG12~15 pin configuration register
	SEG_CTRL4	W	6FH	SEG16~19 pin configuration register
	SEG_CTRL5	W	70H	SEG20~24 pin configuration register
68－69H Unused				
LCD Interface Control	LCDCON	W	67H	LCD control register
	LCDPWR	W	66H	LCD control register
	Display RAM			
	LCDREG0	R/W	72H	LCD display register 0
	LCDREG1	R/W	73H	LCD display register 1
	LCDREG2	R/W	74H	LCD display register 2
	LCDREG3	R/W	75H	LCD display register 3
	LCDREG4	R/W	76H	LCD display register 4
	LCDREG5	R/W	77H	LCD display register 5
	LCDREG6	R/W	78H	LCD display register 6
	LCDREG7	R/W	79H	LCD display register 7
	LCDREG8	R/W	7AH	LCD display register 8
	LCDREG9	R/W	7BH	LCD display register 9
	LCDREG10	R/W	7CH	LCD display register 10
	LCDREG11	R/W	7DH	LCD display register 11

Interrupt Control

SC65PX supports two kinds of interrupts: Non-maskable interrupt NMI; maskable interrupt IRQ. Where PRI of non-maskable interrupt NMI is higher than maskable interrupt IRQ. However, this circuit does not implement NMI interrupt.

1. Maskable interrupts

SC9321 has 9 maskable interrupts in total without PRI; Setting IRQIP register to determine if the interrupt is enable. All the maskable interrupts use the same entry address FFF8H.

2. Non-maskable interrupts(reserved)

Non-maskable interrupt NMI, high active. Entry address is FFFCH/FFFDH. This circuit does not implement NMI function. There is no need to set NMIIP and NMIDP registers.

3. External interrupts

SC9321 has 4 external interrupts ExtInt0～3, input through PA port 0～3. Where ExtInt2 and key interrupt KSINT share one interrupt source corresponding to IRQDP.6. ExtInt3 and IF interrupt IRQIFC share one interrupt source, corresponding to IRQDP.7. In addition, RTC and Timer2 share one interrupt source.

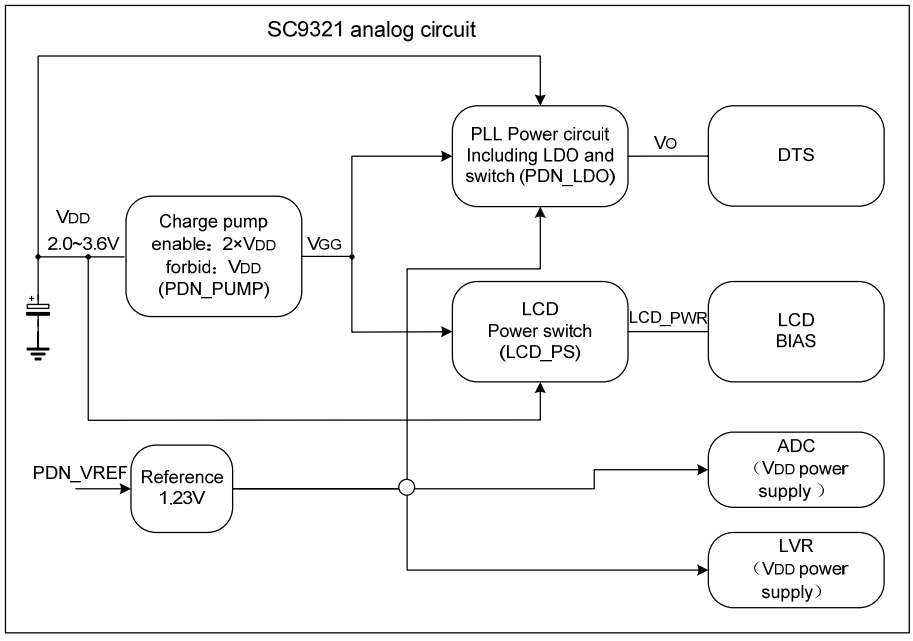
Watchdog Timer

Watchdog timer adopts independent counter. Watchdog (WDT) is mainly used for program monitor, after counting overflows, generates reset signal to avoid endless loop or other error execution state. When 75K crystal oscillator is operating, the longest overflow time is 873.6ms.

System Power Control

SC9321 optimizes the design for low power dissipation requirements of 3V supply voltage. The system designer can flexibly make the system meet the requirements and reduce the power dissipation according to the operating conditions.

Module configuration includes voltage reference, RC oscillator, charge pump, voltage regulator and power switching circuit. The structure is as follows:



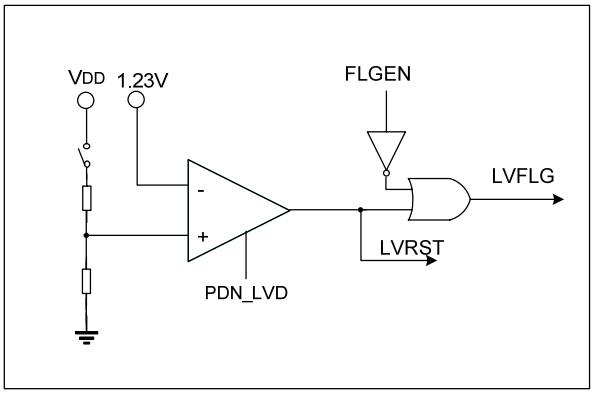
In above figure, DTS module is the combination of PLL and IFC. When RC oscillator, ADC circuit, low voltage detecting circuit (does not show in above figure), LDO circuit are working, the voltage reference module should be turn on. The details refer to register SYSCON,CLKCON,LCDPWR descriptions.

Recommended power supply modes

1. When VDD >2.5V, power supply can ensure the luminance of LCD. If DTS circuit is not working, the charge pump is off. At this time, no matter what value of LCD_PS (Power select) signal, the power supply of LCD BIAS and DTS is VDD. If DTS circuit is working, the charge pump is on (PDN_PUMP = 0),LDO will start to power the DTS circuit(PDN_LDO = 0). So the LCD_PS should be set 1,VDD will power the LCD BIAS circuit.
2. When VDD<2.5V, power supply can not ensure the luminance of LCD. So no matter DTS is working or not, the charge pump is on. LCD_PS is set 1,VDD is doubled to power the LCD BIAS, and the voltage range is 3.6~5V, so a voltage division control resistor is needed to select proper BIAS level. Generally, you can check the power voltage using internal voltage reference and ADC, and then set LCDPWR register to ensure the maximum voltage drop of LCD BIAS is 2.75 ± 0.25.
3. If DTS starts, the charge pump and LDO are all working to provide 3.3V stable power supply. However, in low voltage (<2.5V) operating clock mode, LDO can be turn off. The power supply of DTS switches to VDD automatically. (If 3.3V voltage provides to the system, then the charge pump and LDO are off to reduce the power dissipation).

Low voltage detecting

The low voltage detecting circuit can implement the real time monitor for the power supply. When supply voltage is lower than a set value, output a reset signal to make the circuit return to normal operating state.



When the supply voltage is lower to 1.75V, LVFLAG output low level, if LVREN is set 1, then the system resets. When the supply voltage is up to 1.85V, LVFLAG output high level. The system resets normally and then enters the main program.

Sleep mode

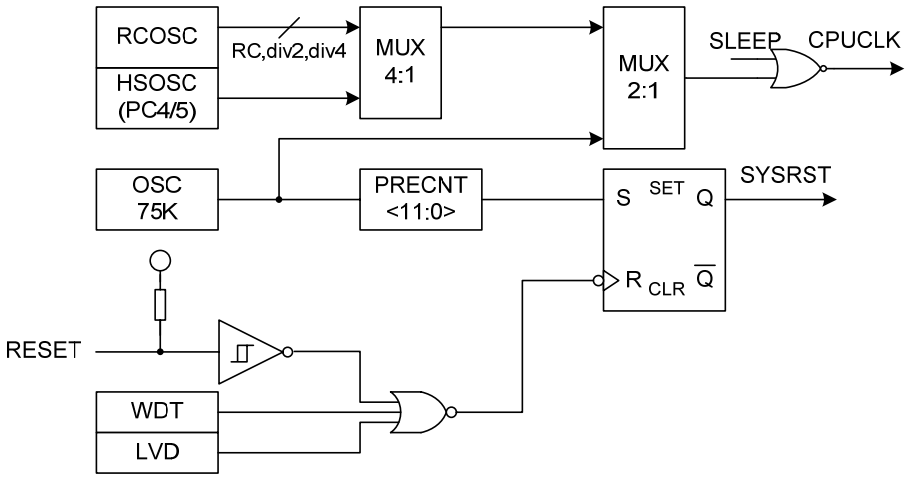
SC9321 has sleep mode which can reduce the system standby power dissipation (75KHz crystal oscillator operating, when RTC enables, typical power dissipation current <8μA).

The MCU enters sleep mode by setting SLEEP flag of MCU sleep control register MCU_SLP as 1. After the MCU enters sleep mode, external 75KHz oscillator still works, and CPU clock will be turned off.

Note: The clock should be switch to 75KHz before entering the sleep mode. Turn off the power reference circuit and other relative circuits to reduce the power dissipation.

Clock and Reset

SC9321 supports many selectable operating clocks. The clock source can be external 75KHz crystal oscillator, and can also be the clock generated by internal RC oscillator. When need high precision and high speed application, it can extend high frequency external oscillator through PC4/5. The structure is as follows:



Internal reset signal is derived from watchdog overflow flag or low voltage detecting signal. External RESET pin can input low level. After power on, the system release reset state when the 75K crystal oscillator counting 2048 cycles. The circuit jumps to the start address of the program from reset address FFFAH and begins working normally.

SC9321 has built in RC oscillator, and frequency of RC oscillator is about 3.2MHz when supply voltage is 3V. If you need to fast response to internal and external events without high precision, adopt RC oscillator as CPU clock to make the system process the events quickly. When use async communication interface, you need PC4/5 to extend external high speed oscillator.

RC oscillator begins to work after reset, and CPU clock selects the RC oscillator.

Real time Clock (RTC)

RTC module can provides powerful timing function. When it starts, it will work separately from CPU. It can provides minute, hour and year/month/day, etc. in BCD formats. Minute, hour, week, day alarm can be set, and the alarm function can be triggered by interrupt or inquiring the alarm flag by software. At the same time, it will generates 0.5s real time clock signal, which can trigger interrupt. This interrupt shares one channel with alarm interrupt. It is used together with INTCON register. At the same time, it provides 4 BUZ signals to driver the buzzer.

Timer T0/T1/T2

SC9321 includes three 8-bit timers Timer0, Timer1 and Timer2. Where, T0 and T1 timers can be together used as 16-bit timer. When T0 or T1 are used separately, their functions are as follows:

- 8-bit programmable timing, generate interrupt after setting the time interval
- Arbitrary frequency output
- External clock frequency division

T0/T1 has one control register and one preassign register.

T2 timer has input capture except for the similar functions as T0/T1. capture signal input are all diplex with PA6 pin.

UART

SC9321 has built-in full duplex async communication interface. Communication port with three modes: 8bit variable baud rate, 9bit fixed baud rate or variable baud rate communication.

- Tx pin diplex with PB4, RX pin diplex with PB5
- Baud rate presetting register can adjust baud rate freely
- Transmitting and receiving interrupt cooperation double buffer can make sure the high speed communication stable and reduce the CPU load.

8-bit ADC

8-bit AD convertor is mainly used for keyboard scan or electronic volume display. It has 6 input channels (PC0~5). Select a channel and input switch level by program and the result is stored in an 8-bit register. Conversion clock has 4 selectable clock sources. The reference voltage can directly adopts internal power supply, or inputs through PC6. Input internal reference voltage through channel 6 of ADC to detect the battery voltage. PC4/5 can also be used to extend high frequency oscillator pin, if it is not connected to oscillator, do not effect ADC input channel. If connects the oscillator, clkcon.6 should be set 1 to make the oscillator stop before entering the sleep mode. At the same time, make sure PC4/5 is input state, which can reduce the power dissipation. Adopt 75KHz clock, one AD conversion needs 12 clock cycles, and the typical conversion time of ADC is 160μs.

DTS Module

DTS module includes two parts: PLL and IFC. PLL circuit sets frequency division coefficient according to reference frequency and program to make external VCO generate a local oscillate signal of fixed frequency. The program searches in different frequency range by changing frequency division coefficient or reference frequency. If VCO input a stable frequency, PLL will be locked. When the program is running, IFC begins to count IF signal, if the counting result is 10.7M in FM mode, or 450K in AM mode, denotes that a station is detected. The program is running circularly to search all the stations automatically.

I/O Port

SC9321 has 6 groups of I/O ports: PA,PB,PC,PE,PF,PG.PB port has 6 pins, PC and PG port has 7 pins, and other ports have 8 pins, 21 pins in total. And PC port can be used as ADC input. PE/F/G can diplex as SEG. The configuration refers to LCD driver description.

PA/B ports configured three registers. Data register PORTx latchs the output data, direction register TRISx controls the dataflow direction (set 1 to be output). PUA register and TRISA register can implement input pull-up or output open-drain of port A. PB port has only 6 pins, PC port of PUB register is controlled by 3 registers, TRISC realizes direction selection, PORTC stores output data, APCON realizes the switch of analog channel and digital channel.

Register PORTx is readable/writable. When PORTx is set as output, read the last writing data of this register; when it is set as input, read the pin state.

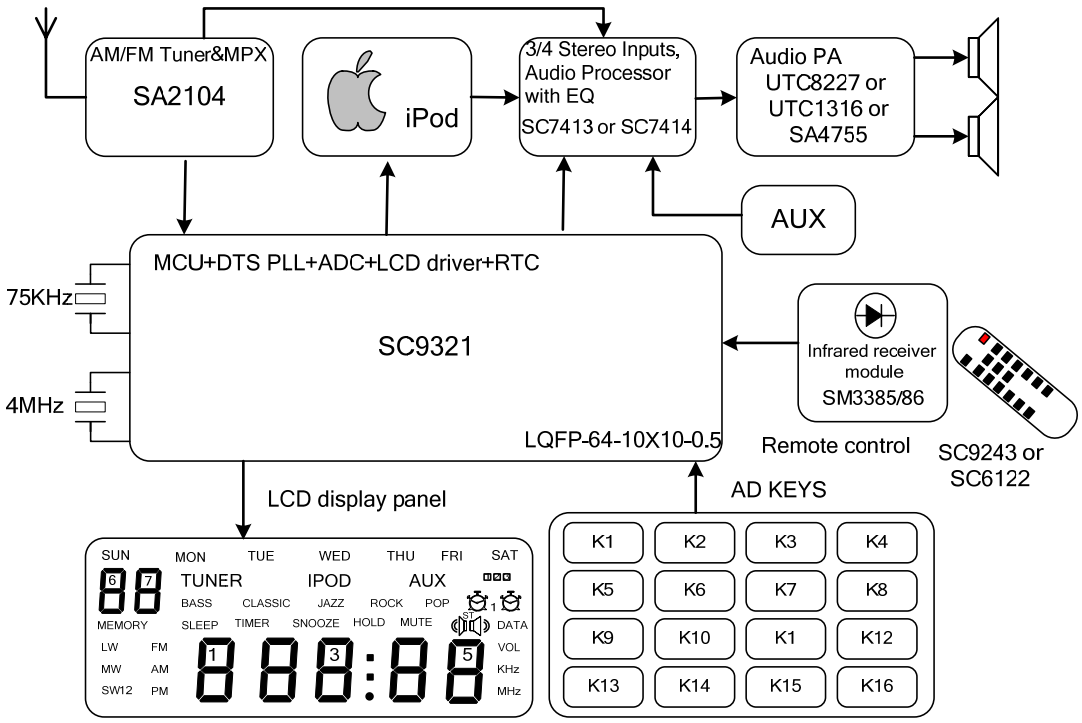
Display Driver

LCD module can drive maximum 23SEG x 4 COM LCD board. It is mainly composed of the following parts:

- Control circuit
- 12 display data memory registers are all readable/writable
- 23 SEG outputs
- 4 COM outputs

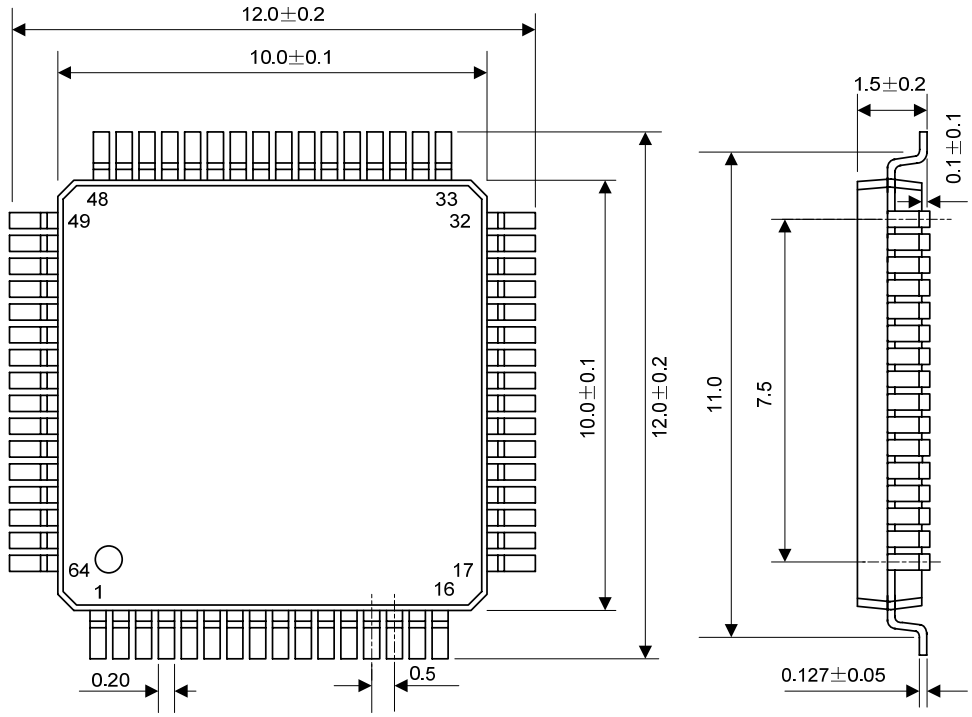
Each SEG can be used as I/O port.

TYPICAL APPLICATION DIAGRAM



PACKAGE OUTLINE

LQFP-64-10x10-0.5 Unit: mm



HANDLING MOS DEVICES:

Electrostatic charges can exist in many things. All of our MOS devices are internally protected against electrostatic discharge but they can be damaged if the following precautions are not taken:

- Persons at a work bench should be earthed via a wrist strap.
- Equipment cases should be earthed.
- All tools used during assembly, including soldering tools and solder baths, must be earthed.
- MOS devices should be packed for dispatch in antistatic/conductive containers.

Note：Silan reserves the right to make changes without notice in this specification for the improvement of the design and performance. Silan will supply the best possible product for customers.