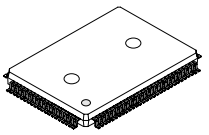
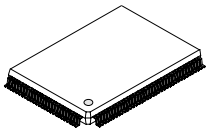
8051 MCU WITH BUILT-IN PLL FOR RADIO AND AUDIO CONTROL SYSTEM

DESCRIPTION

SC9364 adopts 8051 structure, integrates 64K*8FLASH, 8K*8RAM, LDO and RTC modules also provides the function modules of DTS, I^2C, UART, SPI, ADC, LCD, etc. which are applicable in desk-top audio and car audio control.



QFP-100-14x20-0.65



QFP-128-14X20-0.5

FEATURES

* In system programming (ISP)
* 2.7-3.6V power supply, integrate LDO module to power the chip core; external LDO can also be useful.
* Multi low power dissipation mode
* 8051 structure, compatible with standard MCS_51 instructions. 2~4 clock instruction cycle
  Dual data pointer
* Built-in 64Kx8 FLASH can be used as program memory or data memory; The flash can be programmed by on-chip program or the programmer.
* Data memory
  IDATA: 256Byte (compatible with 8051)+64Byte (store data while power down, indirect addressing is available)
  XDATA: 8Kbyte external data memory, where 4K can be used as program memory for supporting FLASH programming.
* Integrate RTC module, provide alarm clock and auto switch function among calendar, clock and leap year, with clock adjusting function.
* 69 GPIO (SC9364C) in maximum
* Provide 32*4 LCD driver outputs.
* 4 8bit timer: T0/T1/T2/T3. T0/T1 are the same with that of 8051, T2 supports PWM/CAPTURE function.
* Extended interrupt module, 8-channel external interrupts, 8-channel internal interrupts.
* 2 UART interfaces.
* 1 SPI interface.
* Integrate 8-channel 8Bits A/D.
* 1 I^2C interface.
* Integrate DTS module with internal PLL.

APPLICATIONS

* Desk-top audio, car audio

ORDERING INFORMATION

Part No.	Package	Marking
SC9364A	QFP-100-14 x 20-0.65	SY5158
SC9364B	QFP-100-14 x 20-0.65	SC9364B
SC9364C	QFP-128-14 x 20-0.5	SC9364C

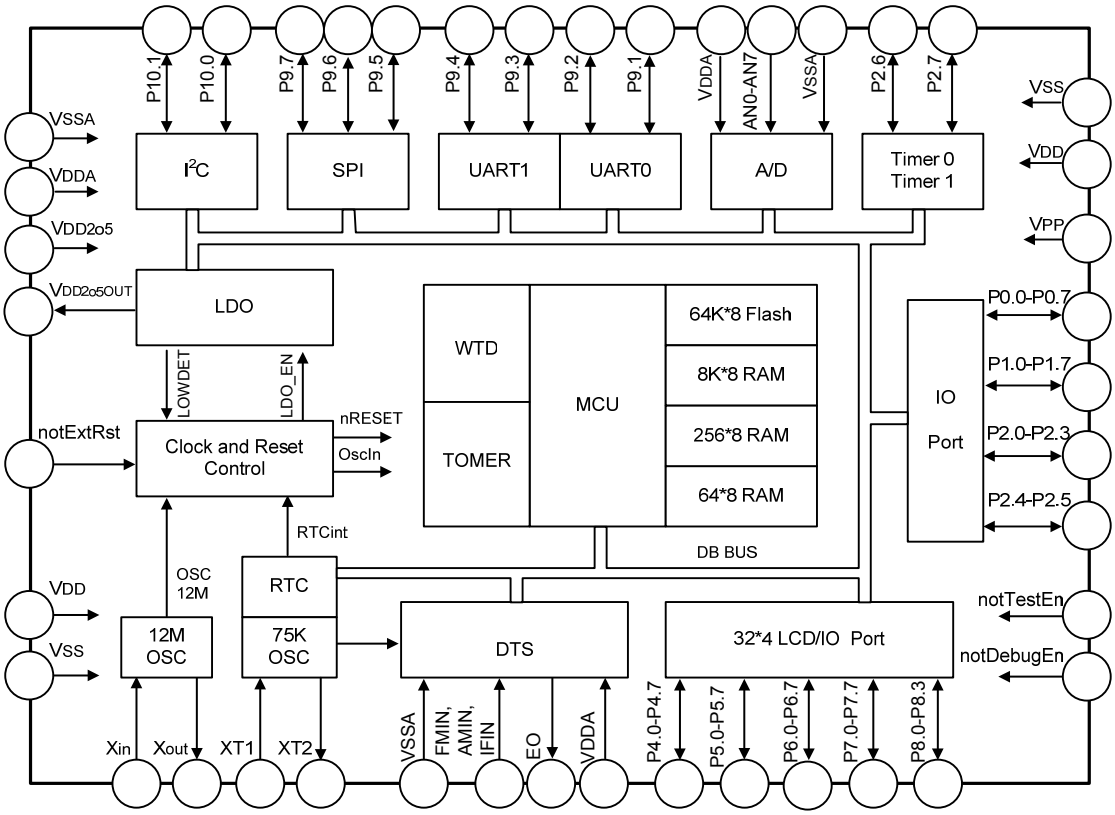
Comparison of different package

Part No. (Note 1)	LCD	ADC channel	SPI	UART	I2C	IO No. (Note 3)	External interrupt
SC9364A	Note2	7	1	2	1	67	8
SC9364B	32X4	6	1	2	1	65	5
SC9364C	32X4	8	1	2	1	69	8

Notes:

1. Capacities of FLASH and RAM in all products are 64KB and 8KB respectively, and S9364C includes all the available source of a chip;
2. LCD drive is not available in SC9364A because there are no pins for VLC0~VLC2.
3. Reused pin SEG is counted in max. IO number and IO number will decrease in application of LCD drive.

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATING

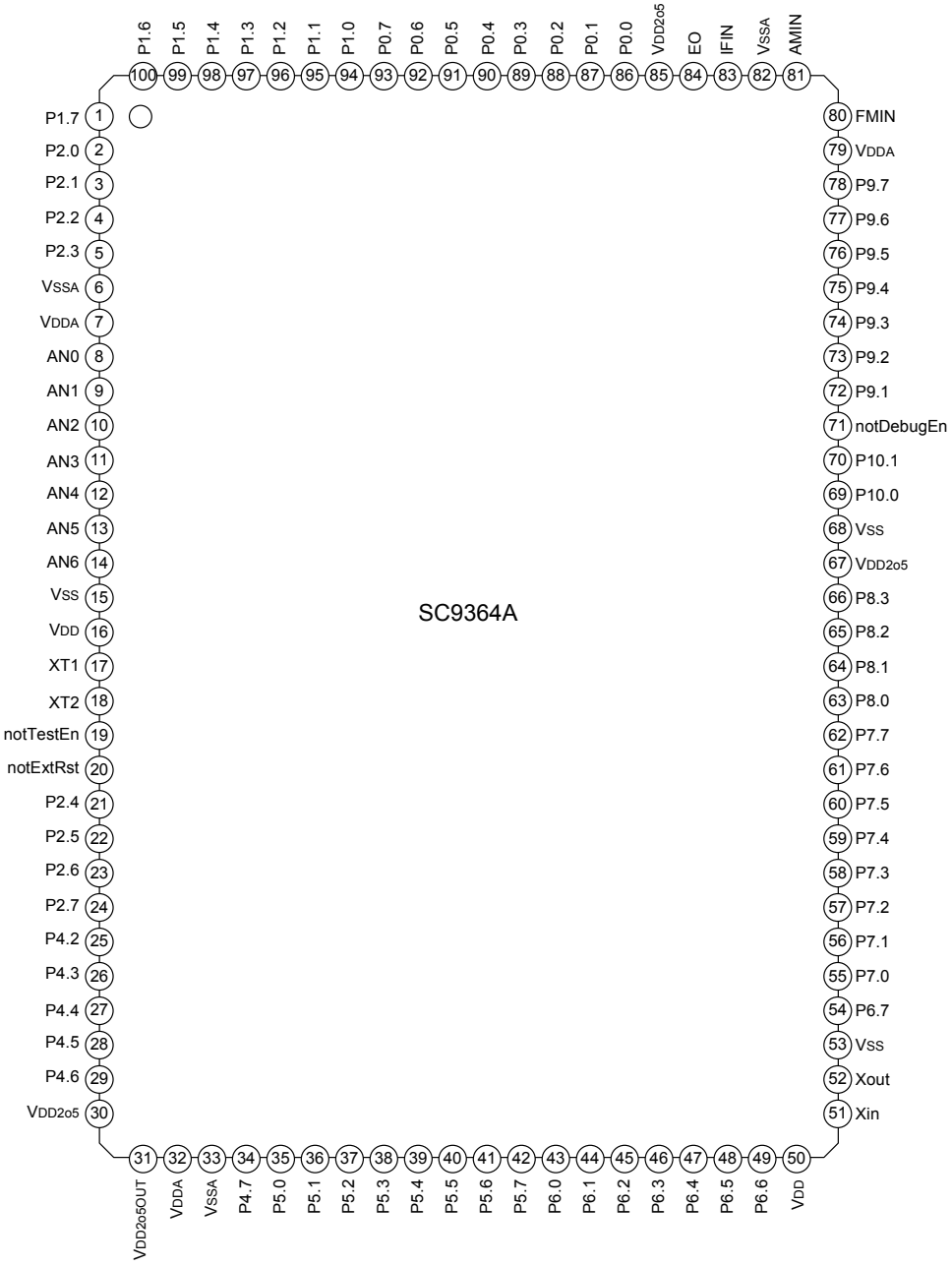
Characteristics	Symbol	Ratings	Unit
Power Supply	V_{DD}	-0.3~+5.0	V
Operating Voltage	V_{IN}	-0.3~V_{DD}+0.3	V
Storage Temperature	T_{STG}	-40~+150	°C
Operating Temperature	T_{OPR}	-40~+85	°C
ESD	Vesd	3	KV

ELECTRICAL CHARACTERISTICS (Unless otherwise specified, V_{CC}=3.3V, T_{amb}=25°C)

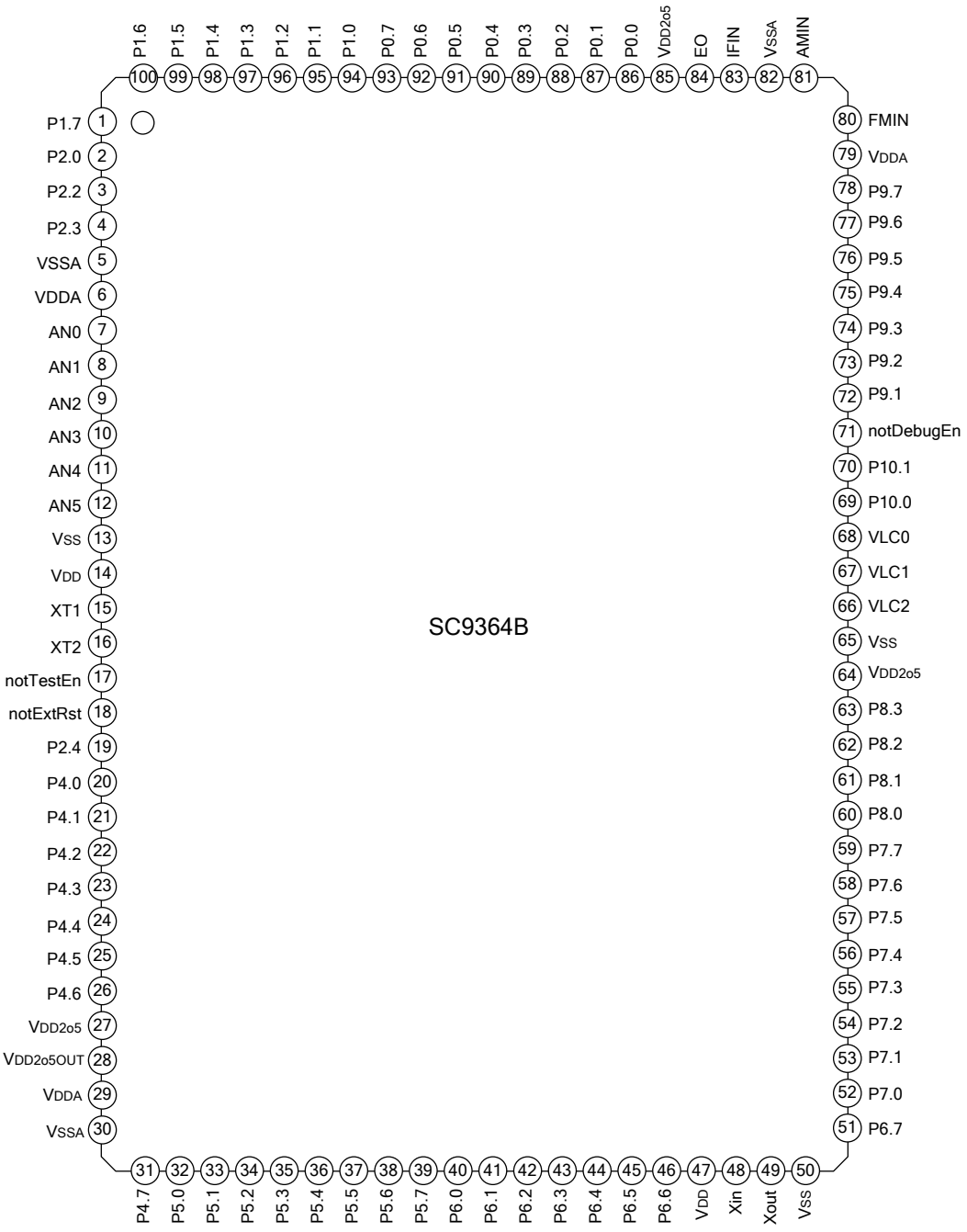
Characteristics	Symbol	Test conditions	Min.	Typ.	Max.	Unit
Power Supply	V_{DD}	Test when use 2-cell battery	2.7	3.3	3.6	V
I/O Pull-Up Resistor	R_{osc}	-	--	50		KΩ
Operating Frequency	f_{CPU}	-		12		MHz
RTC Input Frequency	f_{RTC}	-	--	75		KHz
High Frequency Operating Current1	I_{OPH2}	f_{CPU} = 12MHz (MCU is operating, program memory selects RAM, other modules close.)	--	7.5	--	mA
High Frequency Operating Current 2	I_{OPH1}	f_{CPU} = 12MHz (MCU is operating, program memory selects FLASH, other modules close.)	--	8	10	mA
Low Frequency Operating Current 1	I_{OPL1}	f_{CPU} = 75KHz (MCU is operating, program memory selects RAM, RTC is operating, LCD is operating(voltage split resistor 300kΩ), other modules close, use external LDO power supply(not including LDO power dissipation)	--	30	80	μA
Low Frequency Operating Current 2	I_{OPL2}	f_{CPU} = 75KHz (MCU is operating, program memory selects RAM, RTC is operating, LCD is operating(voltage split resistor 300kΩ), other modules close, use internal LDO power supply)	--	400	--	μA
Low Frequency Operating Current 3	I_{OPL3}	f_{CPU} = 75KHz (MCU is operating, program memory selects FLASH, RTC and LCD are operating(voltage split resistor 300kΩ) other modules close, use internal LDO power supply)	--	1.5	--	mA

Characteristics	Symbol	Test conditions	Min.	Typ.	Max.	Unit
SLEEP Current 1	I_{S1}	f_{CPU} = 75KHz (MCU is in sleep mode, program memory selects RAM, RTC and LCD is operating(voltage split resistor 300kΩ)other modules close, use external LDO power supply(not including LDO power dissipation)	--	30	50	μA
SLEEP Current 2	I_{S2}	f_{CPU} = 75KHz (MCU is in sleep mode, program memory selects RAM, RTC and LCD is operating(voltage split resistor 300kΩ)other modules close, use internal LDO power supply)	--	370	--	μA
SLEEP Current 3	I_{S3}	f_{CPU} = 12MHz (MCU is in sleep mode, program memory selects RAM or FLASH, RTC and LCD are operating(voltage split resistor is 300kΩ), other modules close, use internal LDO power supply)	--	3.5	4	mA
Quiescent Current	I_q	Close main oscillator, RTC adopts 75KHz clock, LDO and other modules are close.	-	12	20	μA
High Level Output Current(I/O Out of I^2C)	I_{OH}	V_{OH} = 3V	-	-3.0	-	mA
Low Level Output Current(I/O Out of I^2C)	I_{OL}	V_{OL} = 0.3V	-	3.0	-	mA
Low Level Output Current (I/O of I^2C)	I_{OL}	V_{OL} = 0.3V	-	6.0	-	mA
Input High Level Voltage	V_{IH}	P0/P1/P2/P9	2.0	-	-	V
Input High Level Voltage	V_{IH}	SEG31~0/COM3~1	1.8			V
Input High Level Voltage	V_{IH}	COM0	2.0			V
Input High Level Voltage	V_{IH}	P10	1.8			V
Input Low Level Voltage	V_{IL}	P0/P1/P2/P9			0.7	V
Input Low Level Voltage	V_{IL}	SEG31~0/COM3~1			0.8	V
Input Low Level Voltage	V_{IL}	COM0			0.7	V
Input Low Level Voltage	V_{IL}	P10			0.8	V
ESD	V_{ESD}	-	3			K V

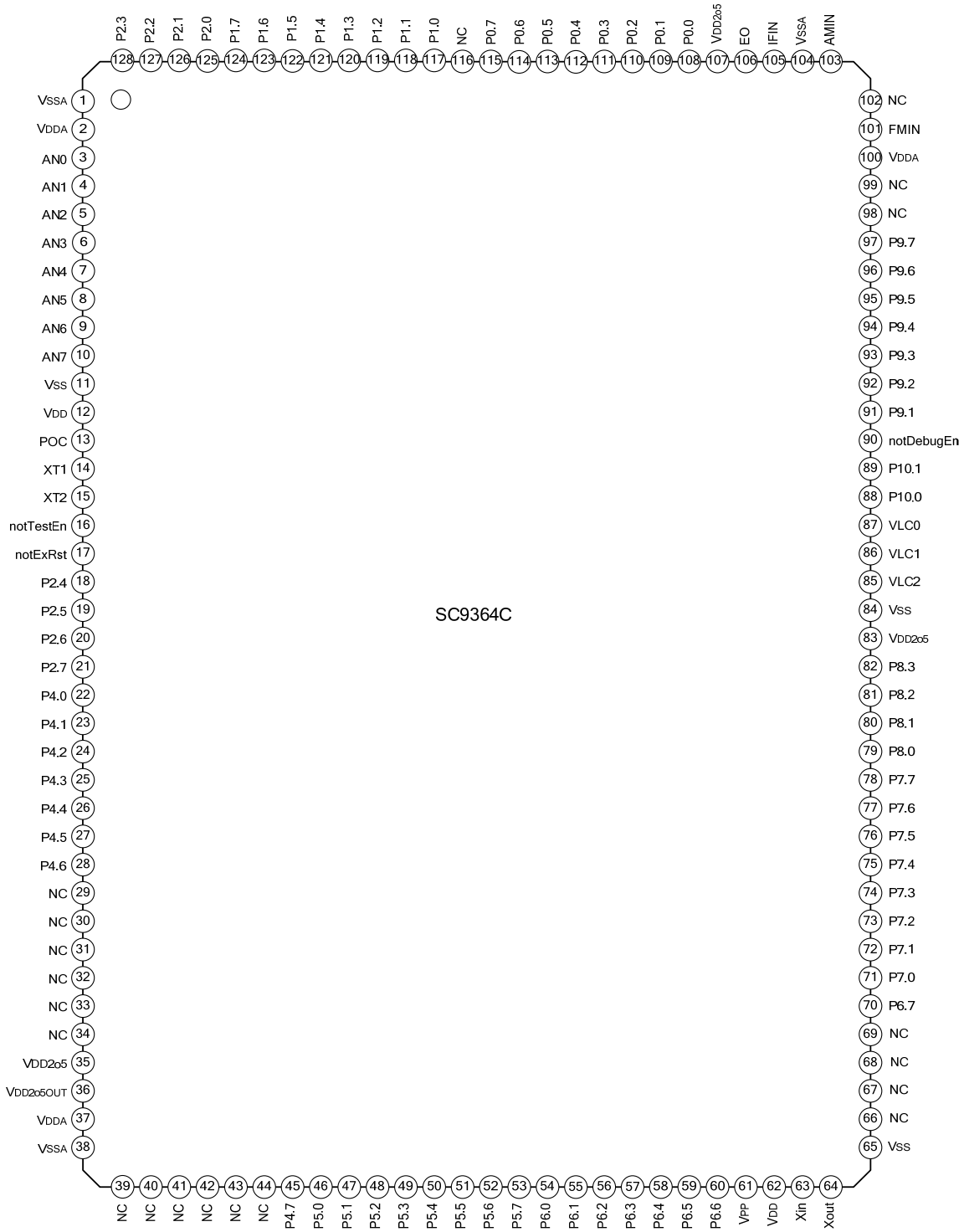
PIN CONFIGURATION



PIN CONFIGURATION (CONTINUED)



PIN CONFIGURATION (CONTINUED)



PIN DESCRIPTION

SC9364A:QFP100-14*20-0.65

Pin No.	Pin Name	I/O	Pin Function
1	P1.7	I/O	In extended bus mode, can also be used as external interrupt Int7.
2	P2.0	I/O	In extended bus mode, output ALE; can also be used as BUZ output
3	P2.1	I/O	In extended bus mode, output notWE.
4	P2.2	I/O	In extended bus mode, output notDMRD. Can also be used as external interrupt Int2
5	P2.3	I/O	In extended bus mode, output notPMRD. Can also be used as external interrupt Int3.
6	VSSA	--	Ground of ADC module.
7	VDDA	--	Power supply of ADC module.
8~14	AN0~AN6	I	Analog input pin of ADC module.
15	VSS	--	Ground.
16	VDD	--	Power supply of IO, RTC and 64*8RAM.
17	XT1	I	75KHz oscillator input pin.
18	XT2	O	75KHz oscillator output pin.
19	notTestEn	I	Test mode control pin with internal pull-up resistor; notTestEn=0, test mode.
20	notExtRst	I	Reset pin with internal pull-up resistor; notExtRst=0, circuit is reset.
21	P2.4	I/O	Can also be used as external interrupt input Int0.
22	P2.5	I/O	Can also be used as external interrupt input Int1.
23	P2.6	I/O	Can also be used as pulse input of T2 and external interrupt Int4.
24	P2.7	I/O	Can also be used as pulse input of T3 and external interrupt Int5.
25~29	P4.2~P4.6	I/O	Can also be used as LCD driver SEG2~SEG6.
30	VDD2o5	I	2.5V voltage input.
31	VDD2o5OUT	O	2.5V voltage output of LDO, connects capacitor filter and input from pin VDD2o5, provide 2.5V power supply to the chip.
32	VDDA	--	Power supply of LDO module.
33	VSSA	--	Ground of LDO module.
34	P4.7	I/O	Can also be used as LCD driver SEG6.
35~42	P5.0~P5.7	I/O	Can also be used as LCD driver SEG8~SEG15.
43~45	P6.0~P6.2	I/O	Can also be used as LCD driver SEG16~SEG18.
46	P6.3	I/O	Can also be used as LCD driver SEG19.
47	P6.4	I/O	Can also be used as LCD driver SEG20.
48	P6.5	I/O	Can also be used as LCD driver SEG21.
49	P6.6	I/O	Can also be used as LCD driver SEG22.
50	VDD	--	Power supply of IO, RTC and 64*8RAM.
51	Xin	I	12MHz oscillator input.
52	Xout	O	12MHz oscillator output.

Pin No.	Pin Name	I/O	Pin Function
53	VSS	--	Ground.
54	P6.7	I/O	Can also be used as LCD driver SEG23.
55	P7.0	I/O	Can also be used as LCD driver SEG24.
56	P7.1	I/O	Can also be used as LCD driver SEG25.
57	P7.2	I/O	Can also be used as LCD driver SEG26.
58	P7.3	I/O	Can also be used as LCD driver SEG27.
59	P7.4	I/O	Can also be used as LCD driver SEG28.
60	P7.5	I/O	Can also be used as LCD driver SEG29; In debug mode, it is used as input pin of serial communication.
61	P7.6	I/O	Can also be used as LCD driver SEG30. In debug mode, it is used as output pin of serial communication.
62	P7.7	I/O	Can also be used as LCD driver SEG31. In debug mode, it is used as synchronous clock input pin.
63~66	P8.0~P8.3	I/O	Can also be used as LCD driver COM0~COM3.
67	VDD2o5	I	2.5V power input pin.
68	VSS	--	Ground.
69	P10.0	I/O	Can also be used as SDA of I^2C.
70	P10.1	I/O	Can also be used as SCL of I^2C.
71	notDebugEn	I	Debug mode control pin, with pull-up resistor; When notDebugEn =0, Debug mode.
72	P9.1	I/O	Can also be used as TXD of UART0.
73	P9.2	I/O	Can also be used as RXD of UART0.
74	P9.3	I/O	Can also be used as TXD of UART1.
75	P9.4	I/O	Can also be used as RXD of UART1.
76	P9.5	I/O	Can also be used as SPIIN of SP1.
77	P9.6	I/O	Can also be used as SPIOUT of SPI.
78	P9.7	I/O	Can also be used as SPICLK of SPI.
79	VDDA	--	Power supply of DTS module.
80	FMIN	I	FM signal input.
81	AMIN	I	AM signal input.
82	VSSA	--	Ground of DTS module.
83	IFIN	I	IF input.
84	EO	O	Analog output pin of DTS, used by external PLL.
85	VDD2o5	I	2.5V power supply input pin.
86~93	P0.0~P0.7	I/O	In extended bus mode, output low 8-bit address, and as 8-bit data input pin.
94~100	P1.0~P1.6	I/O	In extended bus mode, output address A8~A14. Where P1.6 is also used as external interrupt Int6. P1.0 is also used as PWM output.

SC9364B:QFP100-14*20-0.65

Pin No.	Pin Name	I/O	Pin Function
1	P1.7	I/O	Can also be used as external interrupt input Int7;
2	P2.0	I/O	Can also be used as BUZ output
3	P2.2	I/O	Can also be used as external interrupt input Int2
4	P2.3	I/O	Can also be used as external interrupt input Int3
5	VSSA	--	Ground of ADC module.
6	VDDA	--	Power supply of ADC module
7~12	AN0~AN5	I	Analog input pin of ADC module
13	VSS	--	Ground
14	VDD	--	Power supply of IO, RTC and 64*8RAM.
15	XT1	I	75KHz oscillator input pin.
16	XT2	O	75KHz oscillator output pin.
17	notTestEn	I	Test mode control pin with internal pull-up resistor; notTestEn=0, test mode
18	notExtRst	I	Reset pin with internal pull-up resistor; notExtRst=0, circuit is reset.
19	P2.4	I/O	Can also be used as external interrupt input Int0.
20~26	P4.0~P4.6	I/O	Can also be used as LCD driver SEG0~SEG6.
27	VDD2o5	I	2.5V power supply input.
28	VDD2o5OUT	O	2.5V output pin of LDO, connects with capacitor filter and input from VDD2o5 pin, provide 2.5V power supply to the chip.
29	VDDA	--	Power supply of LDO module.
30	VSSA	--	Ground of LDO module.
31	P4.7	I/O	Can also be used as LCD driver SEG7.
32~39	P5.0~P5.7	I/O	Can also be used as LCD driver SEG8~SEG15.
40~42	P6.0~P6.2	I/O	Can also be used as LCD driver SEG16~SEG18.
43	P6.3	I/O	Can also be used as LCD driver SEG19.
44	P6.4	I/O	Can also be used as LCD driver SEG20.
45	P6.5	I/O	Can also be used as LCD driver SEG21.
46	P6.6	I/O	Can also be used as LCD driver SEG22.
47	VDD	--	Power supply of IO, RTC and 64*8RAM.
48	Xin	I	12MHz oscillator input.
49	Xout	O	12MHz oscillator output.
50	VSS	--	Ground.
51	P6.7	I/O	Can also be used as LCD driver SEG23.
52	P7.0	I/O	Can also be used as LCD driver SEG24.
53	P7.1	I/O	Can also be used as LCD driver SEG25.
54	P7.2	I/O	Can also be used as LCD driver SEG26.
55	P7.3	I/O	Can also be used as LCD driver SEG27.
56	P7.4	I/O	Can also be used as LCD driver SEG28.

Pin No.	Pin Name	I/O	Pin Function
57	P7.5	I/O	Can also be used as LCD driver SEG29; In debug mode, it is used as input pin of communication.
58	P7.6	I/O	Can also be used as LCD driver SEG30; In debug mode, it is used as output pin of communication.
59	P7.7	I/O	Can also be used as LCD driver SEG31; In debug mode, it is used as synchronous clock input pin.
60~63	P8.0~P8.3	I/O	IO pin; Can also be used as LCD driver COM0~COM3.
64	VDD2o5	I	2.5V power supply input pin.
65	VSS	--	Ground.
66~68	VLC2~VLC0	I	Level input pin of LCD module.
69	P10.0	I/O	Can also be used as SDA of I^2C.
70	P10.1	I/O	Can also be used as SCL of I^2C.
71	notDebugEn	I	Debug mode control pin, with pull-up resistor; When notDebugEn =0, Debug mode.
72	P9.1	I/O	Can also be used as TXD of UART0.
73	P9.2	I/O	Can also be used as RXD of UART0.
74	P9.3	I/O	Can also be used as TXD of UART1.
75	P9.4	I/O	Can also be used as RXD of UART1.
76	P9.5	I/O	Can also be used as SPIIN of SP1.
77	P9.6	I/O	Can also be used as SPIOUT of SPI.
78	P9.7	I/O	Can also be used as SPICLK of SPI.
79	VDDA	--	Power supply of DTS module.
80	FMIN	I	FM signal input.
81	AMIN	I	AM signal input.
82	VSSA	--	Ground of DTS module.
83	IFIN	I	IF input.
84	EO	O	Analog output pin of DTS, used by external PLL.
85	VDD2o5	--	2.5V power supply input pin.
86~93	P0.0~P0.7	I/O	IO pin.
94~100	P1.0~P1.6	I/O	P1.6 is also used as external interrupt Int6. P10 is also used as PWM output.

SC9364C: PQFP-128-14x20-0.5

Pin No.	Pin Name	I/O	Pin Function
1	VSSA	--	Ground of ADC module.
2	VDDA	--	Power supply of ADC module.
3~10	AN0~AN7	I	Analog input pin of ADC module.
11	VSS	--	Ground.
12	VDD	--	Power supply of IO, RTC, 64*8RAM and Levershift.
13	POC	--	Power supply of POC module, connects to VDD.

Pin No.	Pin Name	I/O	Pin Function
14	XT1	I	75KHz oscillator input pin.
15	XT2	O	75KHz oscillator output pin.
16	notTestEn	I	Test mode control pin, with pull-up resistor; notTestEn=0, test mode.
17	notExtRst	I	Reset pin, with pull-up resistor; When notExtRst=0, the circuit is reset.
18	P2.4	I/O	Can also be used as external interrupt input Int0.
19	P2.5	I/O	Can also be used as external interrupt input Int1.
20	P2.6	I/O	Can also be used as the pulse input of T2 and external interrupt Int4.
21	P2.7	I/O	Can also be used as the pulse input of T3 and external interrupt Int5.
22~28	P4.0~P4.6	I/O	Can also be used as LCD driver SEG0~SEG6.
29~34	NC	--	NC
35	VDD2o5	--	2.5V power supply input pin.
36	VDD2o5OUT	--	2.5v output pin of LDO, connects capacitor filter and input from VDD2o5 pin, provide 2.5V power supply to the chip.
37	VDDA	--	Power supply of LDO and LCD analog module.
38	VSSA	--	Ground of LDO module.
39~44	NC	--	NC
45	P4.7	I/O	Can also be used as LCD driver SEG7.
46~53	P5.0~P5.7	I/O	Can also be used as LCD driver SEG8~SEG15.
54~56	P6.0~P6.2	I/O	Can also be used as LCD driver SEG16~SEG18.
57	P6.3	I/O	Can also be used as LCD driver SEG19.
58	P6.4	I/O	Can also be used as LCD driver SEG20.
59	P6.5	I/O	Can also be used as LCD driver SEG21.
60	P6.6	I/O	Can also be used as LCD driver SEG22.
61	VPP	I	FLASH high voltage pin used for testing.
62	VDD	--	Power supply of IO, RTC and 64*8RAM.
63	Xin	I	12MHz oscillator input pin.
64	Xout	O	12MHz oscillator output pin.
65	VSS	--	Ground.
66~69	NC	--	NC
70	P6.7	I/O	Can also be used as LCD driver SEG23.
71	P7.0	I/O	Can also be used as LCD driver SEG24.
72	P7.1	I/O	Can also be used as LCD driver SEG25.
73	P7.2	I/O	Can also be used as LCD driver SEG26.
74	P7.3	I/O	Can also be used as LCD driver SEG27.
75	P7.4	I/O	Can also be used as LCD driver SEG28.
76	P7.5	I/O	Can also be used as LCD driver SEG29; In debug mode, it is used as input pin of serial communication.
77	P7.6	I/O	Can also be used as LCD driver SEG30. In debug mode, it is used as output pin of serial communication.

Pin No.	Pin Name	I/O	Pin Function
78	P7.7	I/O	Can also be used as LCD driver SEG31. In debug mode, it is used as synchronous clock input pin.
79~82	P8.0~P8.3	I/O	Can also be used as LCD driver COM0~COM3.
83	VDD2o5	I	2.5V power supply input pin.
84	VSS	--	Ground.
85-87	VLC2~VLC0	I	Level input pin of LCD module.
88	P10.0	I/O	Can also be used as SDA of I^2C, open-drain.
89	P10.1	I/O	Can also be used as SCL of I^2C, open-drain.
90	notDebugEn	I	Debug mode control pin, connects pull-up resistor; When notDebugEn =0, Debug mode.
91	P9.1	I/O	Can also be used as TXD of UART0.
92	P9.2	I/O	Can also be used as RXD of UART0.
93	P9.3	I/O	Can also be used as TXD of UART1.
94	P9.4	I/O	Can also be used as RXD of UART1.
95	P9.5	I/O	Can also be used as SPIIN of SP1.
96	P9.6	I/O	Can also be used as SPIOUT of SPI.
97	P9.7	I/O	Can also be used as SPICLK of SPI.
98~99	NC	--	NC
100	VDDA	--	Power supply of DTS module.
101	FMIN	I	FM signal input.
103	AMIN	I	AM signal input.
104	VSSA	--	Ground of DTS module.
105	IFIN	I	IF input.
106	EO	O	Analog output pin of DTS module to supplied for PLL.
107	VDD2o5	--	2.5V power supply input.
108~115	P0.0~P0.7	I/O	In extended bus mode, output low 8-bit address, and used as 8-bit data input pin.
116	NC	--	NC
117~124	P1.0~P1.7	I/O	In extended bus mode, output high 8-bit address. Where, P1.6 can also be used as external interrupt Int6; P1.7 can also be used as external interrupt Int7; P1.0 can also be used as PWM output.
125	P2.0	I/O	In extended bus mode, output ALE, can also be used as BUZ output.
126	P2.1	I/O	In extended bus mode, output notWE.
127	P2.2	I/O	In extended bus mode, output notDMRD, can also be used as external interrupt Int2.
128	P2.3	I/O	In extended bus mode, output notPMRD, can also be used as external interrupt Int3.

FUNCTION DESCRIPTIONS

1 MCU Function Description

1.1 MCU Introduction

SC9364 adopts synchronous 8051 core, with embedded 64K FLASH, supports external instruction memory and data memory extended. 4 hardware breaks in maximum are supported in Debug mode for convenient in design.

1.2 Address Space Introduction

Instruction and data address space is programmed separately and each occupies 64K address space.

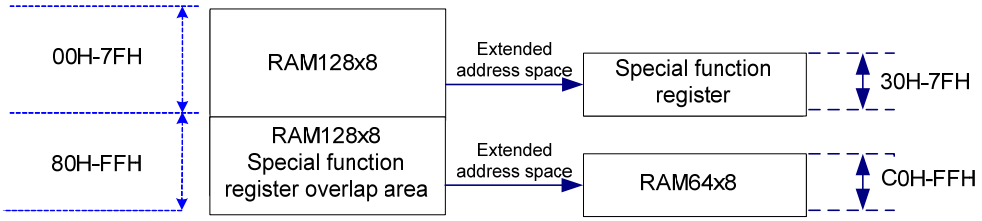
- **Data memory address space assignment**

  Compatible with general 8051, it also includes internal data memory and external data memory address, and access the internal data memory by MOV instruction, while access the external data memory by MOVX instruction.

  ➢ Internal data memory

  The address space of internal data memory is 0000H~00FFH. It includes several memory areas which is different in physical characteristics. The 128 bytes address from 00H to 7FH is the RAM. Different with general 8051, the 80 bytes address from 30H to 7FH can be extended as special function register, and the addressing method is the same as RAM.

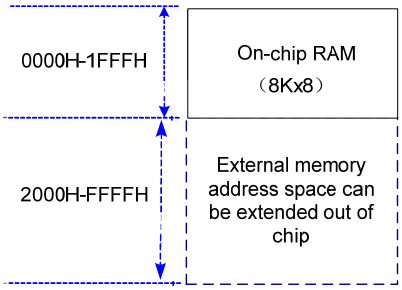
  The 128 bytes from 80H to FFH is the overlap area of RAM and special function register, and they are distinguished by their different addressing method (Direct addressing commands access the special function register, indirect addressing commands access the RAM). Different with general 8051, the 64 bytes from C0H to FFH can be extended as extra RAM that can be accessed by indirect addressing commands.



Address space of internal data memory

  ➢ External data memory

  The external data memory can only be accessed by MOVX instruction, and the address is 0000H~FFFFH. SC9364 integrates 8K bytes RAM as external data memory, and the address is 0000H~1FFFH. The customer can extend it to 64K according to the requirements.



Address space of external data memory

1.3 External Data Memory Extending

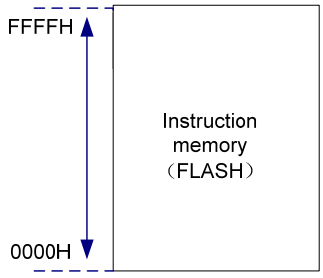
When CPU read/write the data memory by MOVX instruction, if the address is within the range of 0X0000~0X1FFF, then read/write internal 8K bytes RAM; if the access address is over 0X1FFF, then read/write external data memory.

P0 is the address output of low 8-bit address and data input, P1 is the address output of high 8-bit address, P2.0 output ALE, P2.1 output notWE, and P2.2 output notDMRD.

You can only use “MOVX@DPTR, A” or “MOVX A, @DPTR” commands.

- **Instruction memory address space assignment**

  Same as general 8051, the address space of instruction memory is 64K. SC9364 integrates 64K bytes FLASH as internal instruction memory.



Address space of instruction memory

1.4 DPTR Introduction

DPTR is a 16-bit data pointer, which can be used by MOVX instruction as indirect addressing register to access the external data memory from 0000H to FFFFH. General 8051 has only one DPTR, which is not enough for accessing the external data memory frequently. So SC9364 adopts two DPTRs to access the external data memory conveniently.

The two DPTRs occupy the same address (DPH: 83H; DPL: 82H). The address and behavior of DPTR are not changed, you can get different DPTR operation only through DPS control bit.

2. Special Function Register (SFR)

Address	Name	R/W	Description
Special register for 8051			
81H	SP	R/W	Stack pointer
82H	DPL	R/W	Data pointer lower byte
83H	DPH	R/W	Data pointer higher byte
87H	PCON	R/W	Power control register
88H	TCON	R/W	Timer/counter control register
89H	TMOD	R/W	Timer/counter mode control register
98H	SCON	R/W	Serial control register
99H	SBUF	R/W	Serial buffer
8AH	TL0	R/W	Timer/counter 0 (Low byte)
8BH	TL1	R/W	Timer/counter 1 (Low byte)
8CH	TH0	R/W	Timer/counter 0 (High byte)
8DH	TH1	R/W	Timer/counter 1 (High byte)
8EH	TIMPS	R/W	TIMER pre-divider control register
A2H	AUXR1	R/W	DPTR data pointer select register
A8H	IE	R/W	Interrupt enable register
B8H	IP	R/W	Interrupt priority register
D0H	PSW	R/W	Program status word register
E0H	ACC	R/W	CPU Accumulator
F0H	B	R/W	CPU register B
Working mode register (extended register)			
31H	PSM_OSCREF	W	75K oscillator control register
32H	PDN_OSCREF	W	75K oscillator control register
33H	MCLKSEL	W	MCLK clock control register
34H	PDN_OSCIN	W	12M oscillator control register
35H	PDN_VDDCORE	W	LDO control register
36H	OSCRSTCTRL	R	Clock status register
37H	MCLKSEL2	W	MCLK clock control register 2
38H	LBDCTRL	R/W	LBD control register
External interrupt register (extended register)			
39H	EXTINTFLAG	R/W	External interrupt flag
3AH	EXTINTENABLE	W	External interrupt enable
3BH	EXTINTCTRL	W	External interrupt control register
3CH	IPLSR3_E	R/W	Interrupt priority register 4
3DH	IPLSR2_E	R/W	Interrupt priority register 3
3EH	IPLSR1_E	R/W	Interrupt priority register 2
3FH	IPLSR0_E	R/W	Interrupt priority register 1
40H	IER_E	R/W	External interrupt (INT0 extension) enable register
41H	IPR_E	R/W	Interrupt priority register
42H	ISR_E	R/W	Interrupt status register
43H	ICR_E	R/W	Interrupt control register

Address	Name	R/W	Description
IO Register (Extended register)			
46H	P10OD	R/W	Not used
47H	P10PU	R/W	Port P10 pull-up register
48H	P10_IOConfig	R/W	Not used
49H	P10	R/W	Port P10 register
4BH	P9OD	R/W	Port P9 open-drain control
4CH	P9PU	R/W	Port P9 pull-up register
4DH	P9_IOConfig	R/W	I/O control register at P9
C0H	P9	R/W	Port P9 register
4FH	P8OD	R/W	Port P8 open-drain control
50H	P8PU	R/W	Port P8 pull-up register
51H	P7OD	R/W	Port P7 open-drain control
52H	P7PU	R/W	Port P7 pull-up register
53H	P6OD	R/W	Port P6 open-drain control
54H	P6PU	R/W	Port P6 pull-up register
55H	P5OD	R/W	Port P5 open-drain control
56H	P5PU	R/W	Port P5 pull-up register
57H	P4OD	R/W	Port P4 open-drain control
58H	P4PU	R/W	Port P4 pull-up register
5A~5DH	--		Reserved
5FH	P2OD	R/W	Port P2 open-drain control
60H	P2PU	R/W	Port P2 pull-up register
D4H	P2_IOConfig	R/W	Port P2 I/O control register
A0H	P2	R/W	Port P2 register
64H	P1OD	R/W	Port P1 open-drain control
65H	P1PU	R/W	Port P1 pull-up register
66H	P1_IOConfig	R/W	Port P1 I/O control register
90H	P1	R/W	Port P1 register
69H	P0D	R/W	Port P0 open-drain control
6AH	P0PU	R/W	Port P0 pull-up register
6BH	P0_IOConfig	R/W	Port P0 I/O control register
80H	P0	R/W	Port P0 register
RTC Register (extended register)			
6DH	SECADJL	R/W	Second adjust register
6EH	SECADJH	R/W	Second adjust register
6FH	SECADJCON	R/W	Sec adjust control register
70H	RTC_CS	R/W	RTC status register
71H	YEARH	R/W	Year high 8-bit Register
72H	SEC	R/W	Second Register
73H	MIN	R/W	Minute Register
74H	HOUR	R/W	Hour Register
75H	DAY	R/W	Day Register
76H	WEEK	R/W	Week Register

Address	Name	R/W	Description
77H	MON	R/W	Month Register
78H	YEARL	R/W	Year low 8-bit Register
79H	MIN_ALARM	R/W	MIN_Alarm register
7AH	HOUR_ALARM	R/W	HOUR_Alarm Register
7BH	DAY_ALARM	R/W	DAY_Alarm Register
7CH	WEEK_ALARM	R/W	WEEK_Alarm Register
7DH	CLKOUT_CTRL	R/W	CLKOUT_Control Register
7EH	TMCON	R/W	RTC built-in 8bit TIMER control register
7FH	TIMER	R/W	RTC built-in 8bit TIMER reload register
WDT Register			
84H	WDT_CTRL	R/W	WDT control register
85H	WDT_CLR0	W	WDT clear register 0
86H	WDT_CLR1	W	WDT clear register 1
91H	SLEEP_CTRL	R/W	Sleep control register
92H	SYS_STATUS	R/W	system status register
Register extension select register			
93H	CS_SFR	W	Data area 30~7F access switch control register
RAM extension select register			
94H	CS_INTDM	W	Data area C0~FFH access switch control register
IO multiplex control register			
96H	IOMUX	R/W	IOPort multiplex control register
Internal interrupt register			
97H	ICR_I	R/W	Interrupt control register
9AH	ISR_I	R	Interrupt status register
9BH	IPR_I	R	Interrupt priority status register
9CH	IER_I	R/W	INT1 extension interrupt (generated by internalmodules) enable control
9DH	IPLSR0_I	R/W	Interrupt priority register 4
9EH	IPLSR1_I	R/W	Interrupt priority register 3
9FH	IPLSR2_I	R/W	Interrupt priority register 2
A1H	IPLSR3_I	R/W	Interrupt priority register 1
Flash programming register			
A5H	FSHWRADRH	R/W	FLASH write high 8-bit address register
A6H	FSHWRADRL	R/W	FLASH write low 8-bit address register
A7H	FSHWRDATA	R/W	FLASH write data register
A9H	FSHWRCON1	R/W	FLASH write data register 1
AAH	FSHWRCON2	R/W	FLASH write data register 2
ABH	FSHERSCON1	R/W	FLASH Erase control register 1
ACH	FSHERSCON2	R/W	FLASH Erase control register 2
ADH	FSHTIMER	R/W	FLASH write/erase prescale control register
AEH	FlashCtrl	R/W	FLASH switch control register
SPI register			
B1H	SPICR	R/W	SPI control register

Address	Name	R/W	Description
B2H	SPISR	R	SPI status register
B3H	SPIBUF	W/R	SPI Transmitter/receiver buffer
B4H	SPIBR	R/W	SPI baud rate set register
DTS_ADDR			
B5H	PLLCTRL	W	PLL control register
B6H	PLLSET0	W	PLLD0 data register
B7H	PLLSET1	W	PLLD1 data register
B9H	IFCTRL	W/R	IF count (IFC) control register
BAH	IFCNT0	R	IFCNT0 IF count store register
BBH	IFCNT1	R	IFCNT1 IF count store register
BDH	BUZCR	W/R	BUZZER output control register
I^2C_ADDR			
BEH	I^2CRXB	R	Data receive secondary buffer register
BFH	I^2CSR	R	Status register
DFH	I^2CCR	W/R	Control register
C1H	I^2CSLA	W/R	Slave/Host baud rate set register
C2H	I^2CBUF	W/R	Transmitter/receiver buffer register
UART0 register			
C3H	UART_BUF0	W/R	Receiver/transmitter buffer register
C4H	SCON0	W/R	Control register
C5H	BRCON0	W/R	Baud rate control register
C6H	BRTIMER0	W/R	Baud rate set register
UART1 register			
C7H	UART_BUF1	W/R	Receiver/transmitter buffer register
C9H	SCON1	W/R	Control register
CEH	BRCON1	W/R	Baud rate control register
CFH	BRTIMER1	W/R	Baud rate set register
ADC register			
D1H	ADATA	R	AD result register
D2H	ADCON	W	Control register
D3H	ADCIS	W	AD channel select register
T2/T3 register			
D5H	T0CON	R/W	TIMER0 control register
D6H	T0REF	R/W	TIMER0 preset register
D7H	T0LCAP	R/W	Capture data low 8-bit register
D9H	T0HCAP	R/W	Capture data high 8-bit register
DAH	T1CON	R/W	TIMER1 control register
DBH	T1REF	R/W	TIMER1 preset register
LCD register			
DEH	DATA_P8	R/W	P8 data register
B0H	DATA_P4	R/W	P4 data register
E1H	DATA_P5	R/W	P5 data register
E2H	DATA_P6	R/W	P6 data register

Address	Name	R/W	Description
E8H	DATA_P7	R/W	P7 data register
E4H	SEG_CTRL0	R/W	SEG0-3 and P4[3:0] control register
E5H	SEG_CTRL1	R/W	SEG4-7 and P4[7:4] control register
E6H	SEG_CTRL2	R/W	SEG8-11 and P5[3:0] control register
E7H	SEG_CTRL3	R/W	SEG12-15 and P5[7:4] control register
E3H	SEG_CTRL4	R/W	SEG16-19 and P6[3:0] control register
E9H	SEG_CTRL5	R/W	SEG20-23 and P6[7:4] control register
EAH	SEG_CTRL6	R/W	SEG24-27 and P7[3:0] control register
EBH	SEG_CTRL7	R/W	SEG28-31 and P7[7:4] control register
ECH	COM_CTRL	R/W	COM0-3 and P8[3:0] control register
EDH	VLCDSEL	R/W	VLCD select register
EEH	LCD_CTRL	R/W	LCD control register
EFH	SEG01_SEG00	R/W	SEG1-0 data register
F1H	SEG03_SEG02	R/W	SEG3-2 data register
F2H	SEG05_SEG04	R/W	SEG5-4 data register
F3H	SEG07_SEG06	R/W	SEG7-6 data register
F4H	SEG09_SEG08	R/W	SEG9-8 data register
F5H	SEG11_SEG10	R/W	SEG11-10 data register
F6H	SEG13_SEG12	R/W	SEG13-12 data register
F7H	SEG15_SEG14	R/W	SEG15-14 data register
F8H	SEG17_SEG16	R/W	SEG17-16 data register
F9H	SEG19_SEG18	R/W	SEG19-18 data register
FAH	SEG21_SEG20	R/W	SEG21-20 data register
FBH	SEG23_SEG22	R/W	SEG23-22 data register
FCH	SEG25_SEG24	R/W	SEG25-24 data register
FDH	SEG27_SEG26	R/W	SEG27-26 data register
FEH	SEG29_SEG28	R/W	SEG29-28 data register
FFH	SEG31_SEG30	R/W	SEG31-30 data register

3. Operating mode introduction

SC9364 provides various operating modes: high frequency mode, low frequency mode, Sleep mode and power down holding mode. And all these will be described in detail as follows:

3.1 High Frequency Mode

In high frequency mode, 12MHz oscillator provides high speed clock (12MHz/6MHz are both available through software) for CPU, while 75KHz oscillator provides clock for DTS and RTC, and all the function modules such as I^2C, SPI, UART, ADC, TIMER, WDT, etc. adopt clock same as CPU. It is available to change into Low frequency mode, Sleep mode and power down holding mode by software.

3.2 Low Frequency Mode

In low frequency mode, 75KHz oscillator provides clock for CPU, DTS and RTC. Change into other modes only by software setting.

In low frequency mode, the 75KHz oscillator also provides the clock for the function modules of I^2C, SPI, UART, ADC, TIMER, WDT, etc.

Note: 1. During switching to the low frequency mode, 12MHz oscillator will not close automatically; it needs to be closed by software.

2. Before Switching into High frequency mode from Low frequency mode, it is necessary to turn on high-frequency oscillator and hold for 1ms at least for stable.

3.3 Sleep Mode

In Sleep mode, the clock of CPU and WDT is closed, the oscillator is working, while the interrupt system is still working under the clock, which make CPU can be waked up from Sleep mode by interrupt event.

In Sleep mode, the clock of I^2C, SPI, UART and ADC are closed, while TIMER, RTC, LCD, DTS, IO ports and interrupt extended module intc_e, intc_i will still work under the clock, so CPU can be waked up by external interrupt Int0~Int7, RTC, TIMER, DTS etc., then returns to former operating mode to execute the interrupt service routine.

Only the interrupt events that are allowed can wake up the CPU, and the CPU will execute the interrupt service routine first after it is waked up.

3.4 Power Down Holding Mode

This mode is for the chip that uses internal LDO working (if using external LDO, this operating mode is not existed). When the LDO is closed, it will not provide 2.5V power supply for MCU, 64Kx8FLASH, 8Kx8RAM, 256x8RAM, I^2C, SPI, UART, ADC, TIMER, WDT and LCD. While 12MHz oscillator, 75KHz oscillator, RTC, 64x8RAM, IO ports and interrupt extended module intc_e can still work powered by external power supply.

In power down holding mode, 75KHz oscillator provides clock for RTC, 12MHz or 75KHz oscillator provides clock for IO and interrupt extended module intc_e. RTC interrupt and external interrupt Int0~Int7 can open LDO again and reset CPU, and system exits the power down holding mode, then returns to the former operating mode to work.

In power down holding mode, 64x8RAM can store the data.

4. Module Function Description

4.1 Clock

There are two oscillators for clock in SC9364: 75KHz and 12MHz. 75KHz provides clock for CPU in Low frequency mode while 12MHz provides in High frequency mode (12MHz/6MHz).

- 75KHz/12MHz oscillators can be programmable controlled;
- 12MHz oscillator can be turned off in power down holding mode, 75KHz oscillator can be used for providing clock for RTC and external interrupt extended module.

4.2 Reset

SC9364 has power-on/external button reset and low-voltage detect reset. In power-off holding mode, RTC interrupt and external interrupt will also reset CPU.

- In power-off holding mode, internal LDO is turned off. External interrupt and RTC interrupt will reset CPU and turn on LDO, with no effect on registers for RTC, oscillator, clock and interrupt extended control circuits. A delay period (about 15ms) is needed for power (2.5V) stable from LDO start.
- In other modes (high frequency mode, Low frequency mode, Sleep mode), LDO is normal working, and RTC and external interrupt only generate the interrupt, not the reset signal.
- Power-on reset is available through connecting external resistor/capacitor at pin notExtRst. And external button reset is also feasible through connecting external button.
- LDO low-voltage detect signal will direct reset MCU, without effect on RTC module.
- WDT overflow reset will reset CPU, without effect on LDO, RTC, clock, working mode or interrupt extension.

4.3 Interrupt

There are 22 interrupt sources for SC9364 except reset signal, which are processed through the same 5 channels as 8051.

8 external interrupts are from different IO pins and can be programmable set as rising/falling edge triggered, with different priority (0~7). Only response to interrupt whose priority is higher than CPU is available through interrupt priority level control register (ICR) setting (the bigger number, the higher priority). In this interrupt group, all the interrupt are at the same level, high priority interrupt will not be responded during low priority interrupt processing, but after processing. CPU will respond the interrupt as soon as interrupt flag is active. And entry address for all the external interrupts is 0003H (INT0 entry address of 8051).

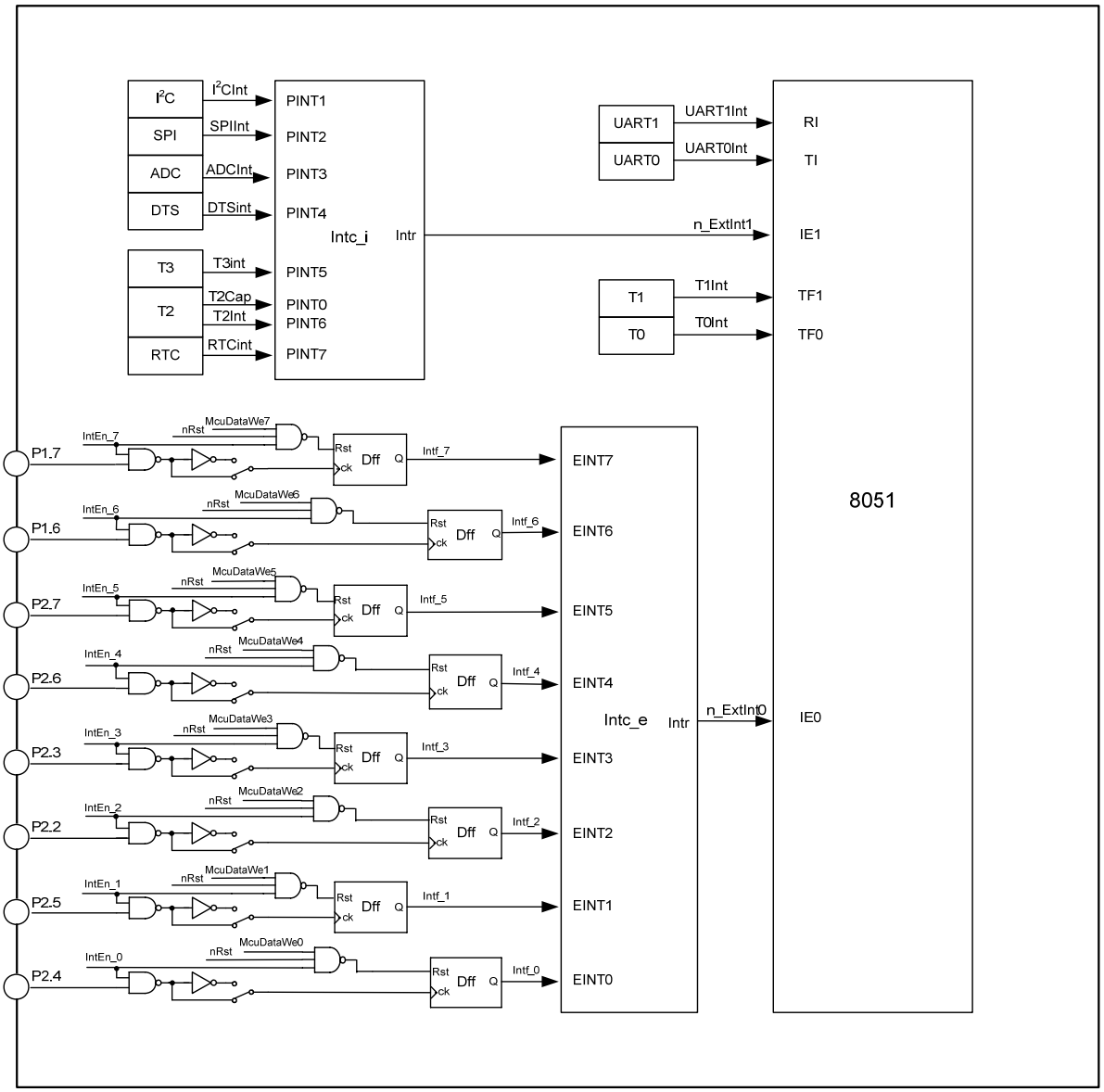
Internal interrupt sources mainly are I^2C, SPI, DTS, ADC, T2, T3, RTC and etc. And INT1 entry address of 8051 (0013H) is for internal interrupts.

SC9364 integrates 2 UART modules, and TI of 8051 is used both by RI and TI requests of UART0 while RI of 8051 is used both by RI and TI request of UART1. Hence, it is necessary to inquire corresponding flag for the interrupt source. RI and TI will be cleared by hardware after interrupt response.

Table 1: SC9364 interrupts

Interrupt module	Interrupt source		8051 entry	Address
External interrupt (8-channel)	EINT0	P2.4	INT0	0003H
	EINT1	P2.5		
	EINT2	P2.2		
	EINT3	P2.3		
	EINT4	P2.6		
	EINT5	P2.7		
	EINT6	P1.6		
	EINT7	P1.7		
Timer 0	T0 overflow interrupt		TF0	000BH
Internal module interrupt	PINT0	T2 capture interrupt	INT1	0013H
	PINT1	I^2C interrupt		
	PINT2	SPI interrupt		
	PINT3	ADC interrupt		
	PINT4	DTS interrupt		
	PINT5	T2 overflow interrupt		
	PINT6	T3 overflow interrupt		
	PINT7	RTC interrupt		
Timer 1	T1 overflow interrupt		TF1	001BH
Port interrupt	UART0(RI0,TI0)		TI	0023H
	UART1(RI1,TI1)		RI	

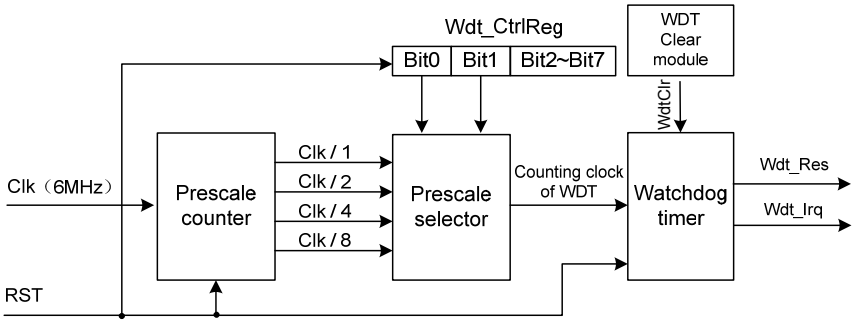
Figure 1: SC9364 interrupt structure



4.4 WDT Module

Watchdog (WDT) is mainly used for program monitor, and generates reset signal after the counting overflows to avoid the error execution state. Clock frequency for WDT is 6MHz. In Sleep mode, the clock of WDT is closed, WDT is not working.

WDT default count time is 175ms and can be programmable controlled to be 1398ms in mximum.



IP_WDT structure diagram

Note: In debug mode (notDebugEn=0), WDT is not working during MCU single-step running, and working during MCU full-speed running.

4.5 Timer/Counter

The operating mode is the same as 8051, and a programmable control prescale module is added to control the clock frequency of TIMER, which is different from 12 divider of 8051.

MCLK/2, MCLK/4, MCLK/8, MCLK/16, MCLK/32, MCLK/64, MCLK/128 and MCLK/256 can be used as timer/counter clock, and 12MHz, 6MHz and 75KHz can be used as MCLK clock according to MCU working mode.

Note: In SC9364 circuit, T0 is connected to 0, T1 is connected to 1, so there is no counter mode.

4.6 T2/T3

T2 working mode: internal timer/counter, external counter, PWM mode, capture mode;

T3 working mode: internal timer/counter, external counter mode.

According to different working modes, there are 8 different clocks for T2 and T3:

- MCLK/16
- MCLK/64
- OSC75K
- MCLK /256
- MCLK /512,
- MCLK /1024
- Clock/counting pulse input from P2.6, rising edge active
- Clock/counting pulse input from P2.6, falling edge active

4.7 I²C

The I^2C interface of SC9364 has configurable host and slave modes, 7-bit device addressing function, with max. bandrate of 400Kbps; however, it does not support multiple hosts and the relevant arbitration processing, etc. It has mainly three operating modes: Host transmitting, slave receiving; host receiving, slave transmitting current; host receiving, slave transmitting random.

4.8 UART

Two independent UARTs with the same function are used for serial communication. Support the following working modes

- 8-bit asynchronous communication mode, baud rate adjustable;
- 9-bit asynchronous communication mode, baud rate is fixed(MCLK/16, MCLK/32);
- 9-bit asynchronous communication mode, baud rate adjustable.

4.9 SPI

SPI adopts three-line system transmission method, including SCK(clock line bi-direction), SDI(data output)and SDO(data input), supports simplex, half duplex, full duplex transmission modes; Including:

1. Internal (clock)transmitting——external (clock)receiving
2. Internal receiving——external transmitting
3. Internal receiving/transmitting——external receiving/transmitting

4.10 LCD

LCD driver provides 4*32 driving outputs, and the driving output and IO ports share IO pins. Support the following modes:

- **LCD_FREQ:LCD drive frame frequency**
  - ✓ 1K Hz;
  - ✓ 512 Hz;
  - ✓ 256 Hz;
  - ✓ 128 Hz
- **DUTY mode**
  - ✓ Static(COM0);
  - ✓ 1/2(COM0—COM1);
  - ✓ 1/3(COM0—COM2);
  - ✓ 1/4(COM0—COM3)

4.11 ADC

8-bit ADC is mainly used for keyboard scan, electronic volume and low-speed data sample. Conversion level can be input to 1 of 8-channel (AN0~7) and the data after conversion is stored in 8-bit register. There are four different clock frequencies (75KHz, MCLK/8, MCLK/16, MCLK/32) and internal reference voltage and external power (VDD) can be used as reference voltage.

It takes 11 clock cycle for one AD conversion, and it is about 7.3μs with 12MHz system and clock frequency of MCLK/8.

4.12 DTS

DTS module includes two parts: PLL and IFC. PLL sets the prescale coefficients according to reference frequency and program to make the external VCO generate a local oscillation signal with fixed frequency. The program can search among different frequency ranges by changing the prescale coefficients or reference frequency. Only if the VCO local oscillation signal is input a stable frequency, PLL will be locked. The program will start IFC to count for IF signal, if the IF counting result is 10.7MHz in FM mode or 450KHz in AM mode; it denotes a station signal is detected. The circular running program can search all the stations automatically.

4.13 IO Ports

SC9364 (128-pin) has 69 IO ports in total, supporting multiple extending functions. The power on default state of all the ports are high impedance state (The port is input state, pull-up resistor is closed).

Table xxx: SC9364 IO pin arrangement

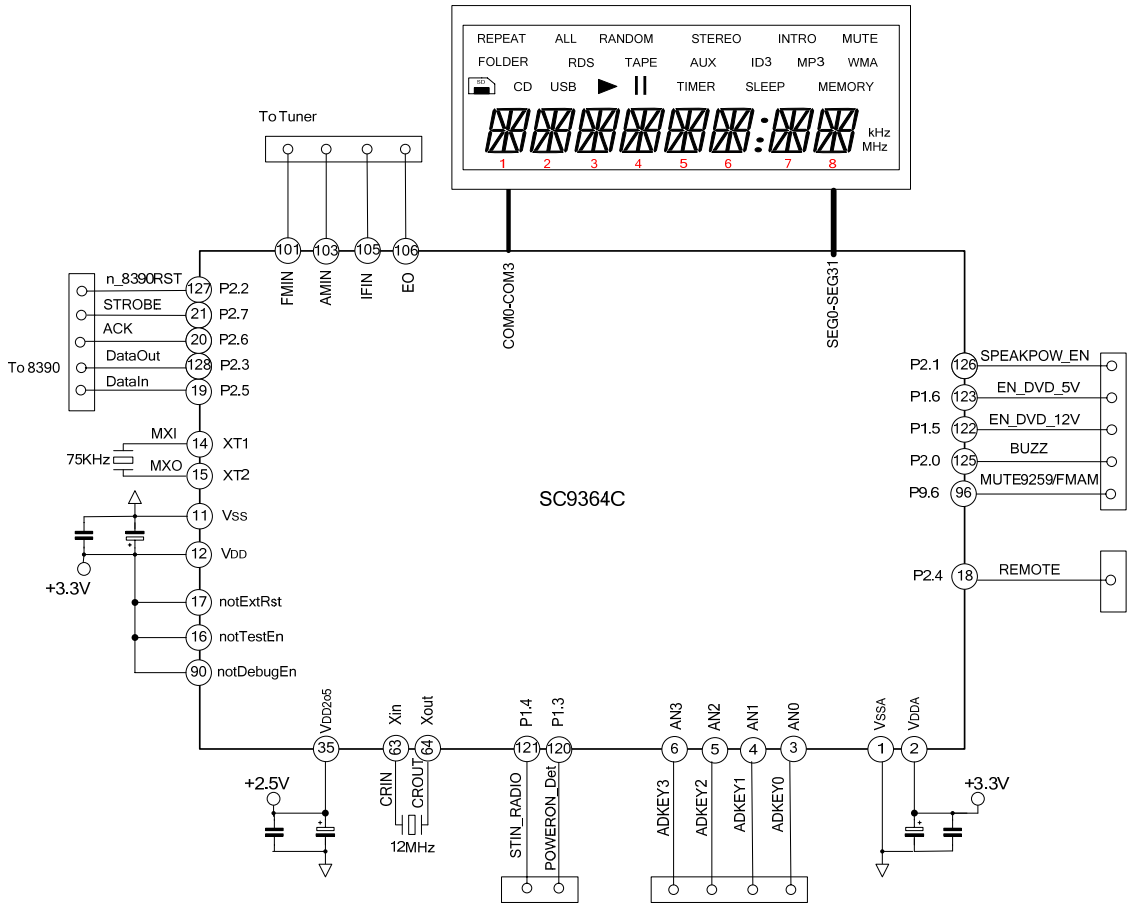
Port	Input	Output
P0/P1/P2/P9	Programmable pull-up, smit input	Push-pull output, open-drain output
P10	Programmable pull-up, smit input	Open-drain output
P8	Programmable pull-up, smit input	Push-pull output, open-drain output, LCD COM scan level output
P4~P7	Programmable pull-up, smit input	Push-pull output, open-drain output, LCD SEG scan level output

4.14 RTC

The real time clock is driven by 2 prescale of 75KHz clock, provides clock and calendar function of year, month, week, hour, minute and second and the leap year auto switch function. The alarm clock function can generate alarm interrupt at setting week, day, hour and minute which can close or start some function of alarm clock by corresponding alarm control bit.

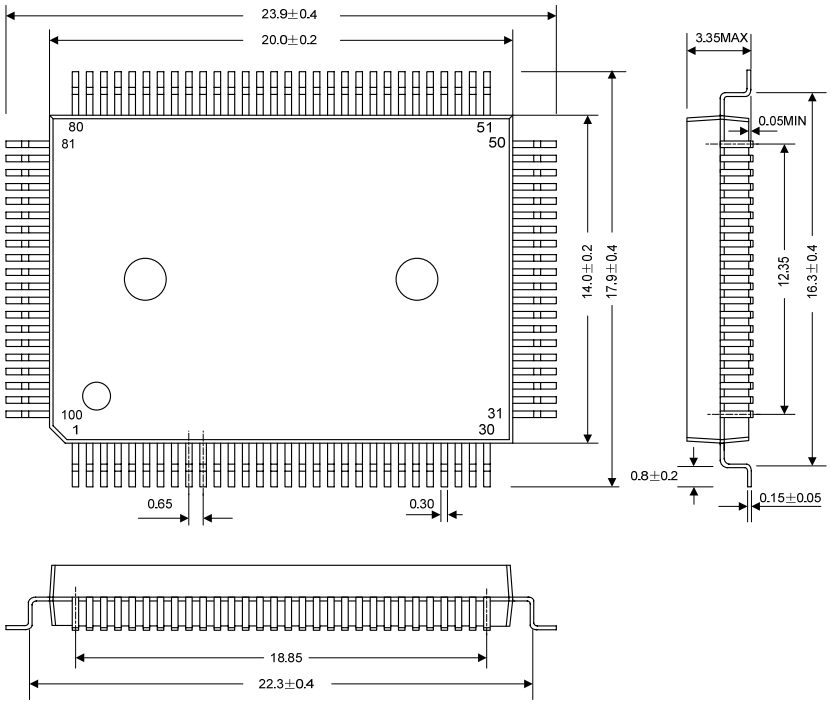
In standby state, RTC module is fed by the battery to keep its working state.

TYPICAL APPLICATION CIRCUIT

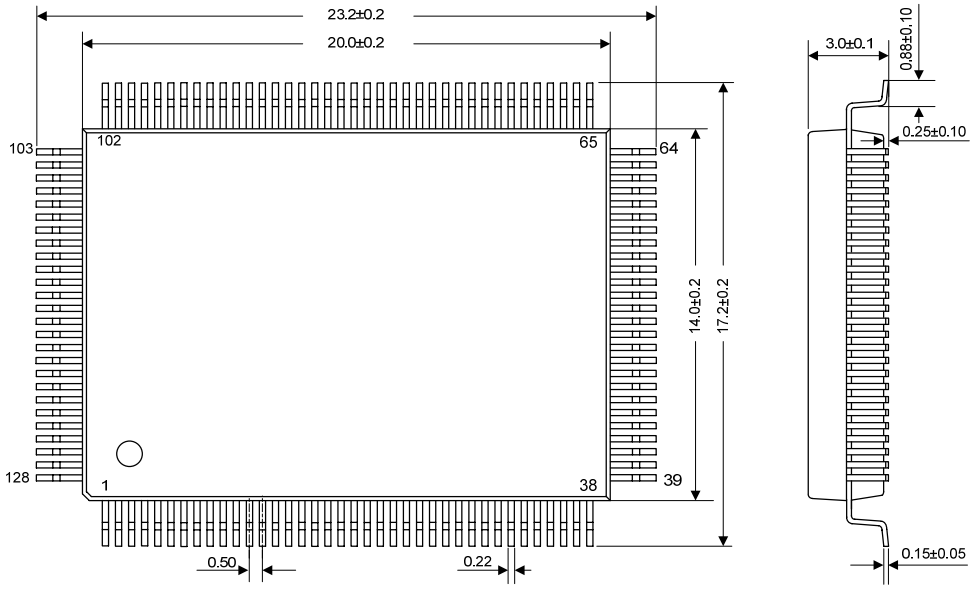


PACKAGE OUTLINE

QFP-100-14x20-0.65 Unit: mm



QFP-128-14x20-0.5 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.