SD3501

4 Diff Channels Meterage SOC with Display Driver, UART, I²C and Keys

Features

- High precision 24 bits ADC, selectable gain at 1/2/8/16, 4 differential or 7 Pseudo-differential inputs. Measures signal's true RMS value, instantaneous value, and frequency
- 8 bits RISC low power MCU, 49 instructions and 6 stack levels. The MCU current consumption is 400uA typically at 3.3V and 2.097MHz operating clock rate. Standby current is 7.6uA at 32kHz clock, and less than 3uA at sleep
- 16K Bytes OTP, 512 Bytes SRAM
- Built-in low frequency crystal oscillator, RC oscillator, and PLL to provide flexible clock selection
- 18SEG X 4COM LCD drive
- Built-in 1.16V low TC voltage reference
- RTC module together with external 32.768kHz crystal provides calendar/time information including leap year, timing accuracy is adjustable
- Peripheral resources: UART, I²C, PWM, PFD, TIMER, Buzzer, 5 external interrupts, 4 key interrupts
- All I/O have Schmidt trigger inputs and pull up resistors
- Low voltage detection and power on reset circuit
- Operating voltage range: 2.5V~ 3.6V
- Operating temperature range: -40℃~ 85℃

Description

SD3501 is a CMOS SOC with built-in 24 bits ADC. Input channels can be set as four differentials or seven Pseudo-differentials. Input gain factor is selectable. Thus different needs can be satisfied.

AC or DC signals are measured directly. AC signal does not have to go through external rectification circuit.

ADC data output rate is selectable for appropriate choice between speed and precision.

The IC has 18SEG X 4COM LCD driver. It can drive LED directly.

The SOC is highly integrated. Very few external components are needed for AC/DC voltmeter or current meter realization.

Built-in UART and I²C ports simplify communication to computer or other devices.

The OTP can be programmed in situ and the programming voltage is generated internally. Data that do not change frequently such as calibration factors can be stored in OTP in place of external EEPROM.

The IC was designed with ultra-low power technology. Typical total operating current is only 1.2mA.

Three working modes are provided so users can select the optimum choice between speed and power. They are normal mode, standby mode, and sleep mode.

If external oscillator is used but stopped due to interference, the internal RC oscillator becomes the new MCU clock source automatically.

The IC passes 4kV Electrical Fast Transient (EFT) test easily without using any additional protection circuit. It is suitable for applications in harsh environment.

Applications

- Three pairs DC or three phases AC voltmeter or current meter with display and UART/I²C
- Multi-channel DC signal measurement with display and UART/I²C
- Multi-channel AC signal measurement with display and UART/I²C

Ordering Information

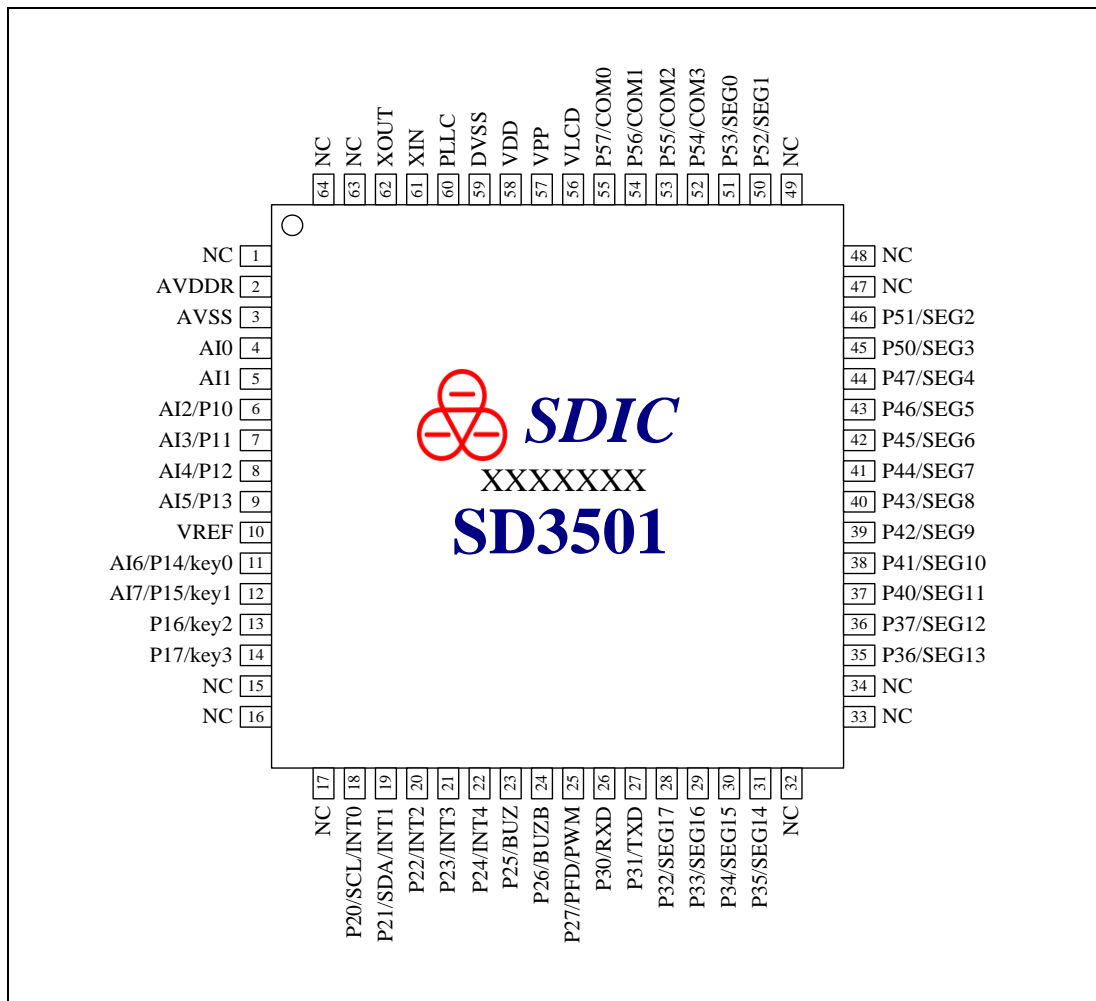LQFP64 package

Pin Diagram and Descriptions

Figure 1. LQFP64 pin out diagram

Table 1. Pin Descriptions

Pin No.	Pin Name	Attribute	Descriptions
1	NC	--	No connect. Float or short to VDD or VSS
2	AVDDR	Analog	Internal LDO output for IC's analog module, connect 1uF capacitor to AVSS
3	AVSS	Ground	Analog ground
4-5	AI0--AI1	Analog input	Analog signal differential or two Pseudo-differential inputs
6-9	AI2/P10--AI5/P13	Analog input, I/O	Two analog differential or four Pseudo-differential inputs, or digital port P10-13
10	VREF	Analog	1.16V reference voltage for ADC, can connect to external reference source, connect 100pF and 10uF capacitor to AVSS
11	AI6/P14/key0	Analog input, I/O	Analog signal input AI6, digital port P14, or external interrupt key0
12	AI7/P15/key1	Analog input, I/O	Analog signal input AI7, digital port P15, or external interrupt key1

13-14	P16/key2--P17/key3	I/O	Digital port P16-17 or external interrupt key2-3
15-17	NC	--	No connect. Float or short to VDD or VSS
18	P20/SCL/INT0	I/O	Digital port P20, I^{2}C port SCL, or external interrupt INT0
19	P21/SDA/INT1	I/O	Digital port P21, I^{2}C port SDA, or external interrupt INT1
20-22	P22/INT2--P24/INT4	I/O	Digital port P22-24 or external interrupt INT2-4
23	P25/BUZ	I/O	Digital port P25 or buzzer output BUZ
24	P26/BUZB	I/O	Digital port P26 or buzzer output BUZB
25	P27/PFD/PWM	I/O	Digital port P27 or PFD/PWM output
26	P30/RXD	I/O	Digital port P30 or UART port RXD
27	P31/TXD	I/O	Digital port P31 or UART port TXD
28-31	P32/SEG17--P35/SEG14	I/O	Digital port P32-35 or LCD SEG17-14
32-34	NC	--	No connect. Float or short to VDD or VSS
35-36	P36/SEG13--P37/SEG12	I/O	Digital port P36-37 or LCD SEG13-12
37-44	P40/SEG11--P47/SEG4	I/O	Digital port P40-47 or LCD SEG11-4
45-46	P50/SEG3--P51/SEG2	I/O	Digital port P50-51 or LCD SEG3-2
47-49	NC	--	No connect. Float or short to VDD or VSS
50-51	P52/SEG1--P53/SEG0	I/O	Digital port P52-53 or LCD SEG1-0
52-55	P54/COM3--P57/COM0	I/O	Digital port P54-57 or LCD COM3-0
56	VLCD	Analog	LCD driver power source, connects internally to VDD or booster voltage through register setting, connect 1uF filter capacitor to VDD
57	VPP	Analog	OTP high voltage programming pin, connect 1uF capacitor to DVSS，internally boosted to 7.5V during programming
58	VDD	Power	Power supply for the IC, connect 0.1uF to DVSS
59	DVSS	Ground	Digital ground
60	PLLC	Analog	PLL capacitor, connect 1nF to DVSS
61	XIN	Analog	Crystal oscillator input
62	XOUT	Analog	Crystal oscillator input
63-64	NC	--	No connect. Float or short to VDD or VSS

Remark: All I/O ports Pnn have internal pull-up option (default OFF) and input hysteresis at 0.3VDD/0.7VDD.
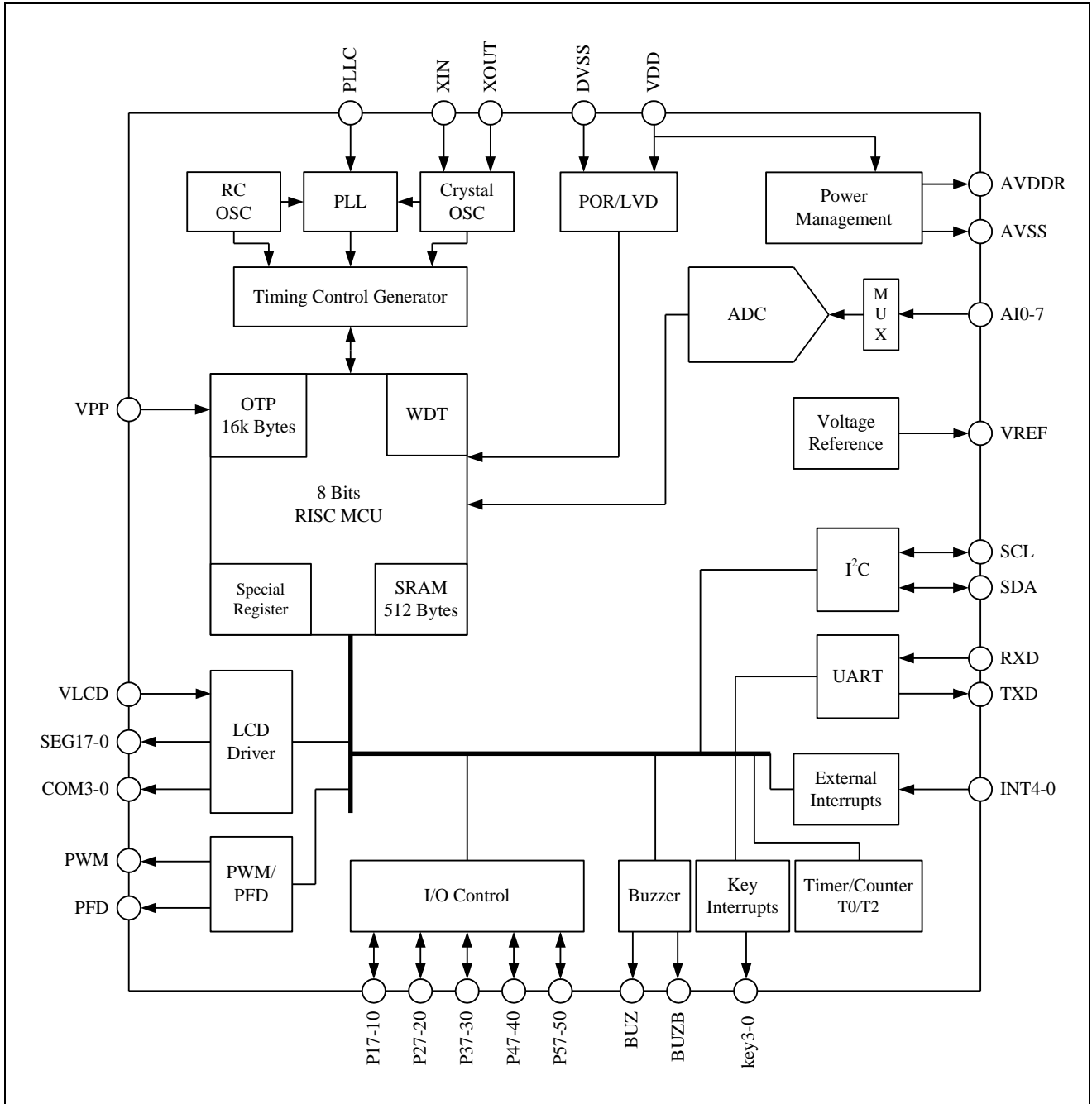
Functional Block

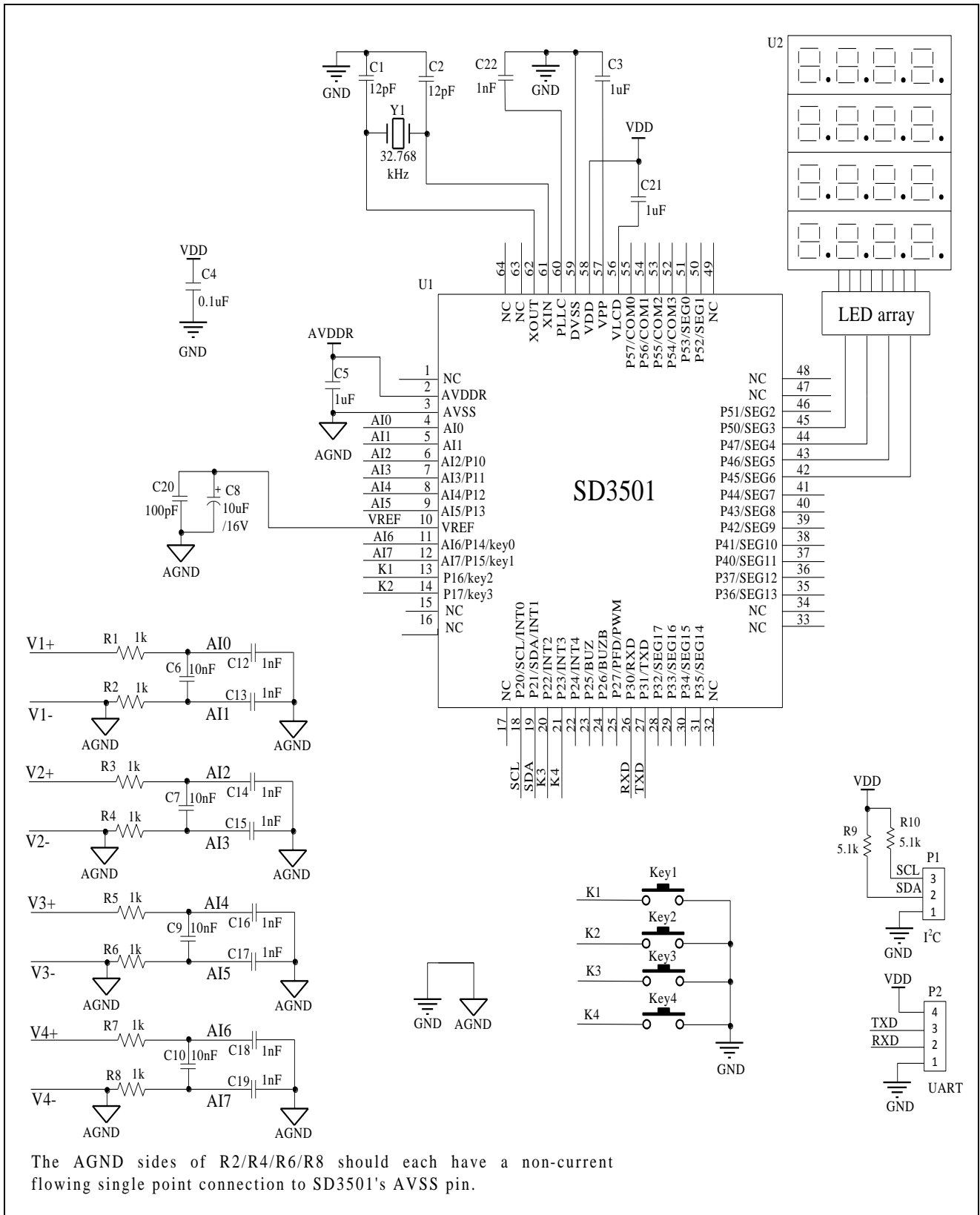*Figure 2. Functional block diagram*

Typical Application

Figure 3.   Four digits Voltage meter/Current meter typical application diagram

The AGND sides of R2/R4/R6/R8 should each have a non-current flowing single point connection to SD3501's AVSS pin.

Electrical Specifications

Table 2. Absolute Maximum Ratings

Symbol	Parameter	Minimum	Maximum	Unit
T_A	Operating temperature	-40	+85	℃
T_S	Storage temperature	-55	+150	℃
V_{DD}	Supply voltage	-0.2	+4.0	V
Vpp	Programming voltage	-0.2	+7.5	V
V_{IN}, V_{OUT}	Digital input/output voltage	-0.2	V_{DD}+0.3	V
T_L	Reflow temperature profile	Per IPC/JEDECJ-STD-020C		℃

Remarks:
1. CMOS device can easily be damaged by electrostatics. It must be stored in conductive foam, and careful not to exceed the operating voltage range.
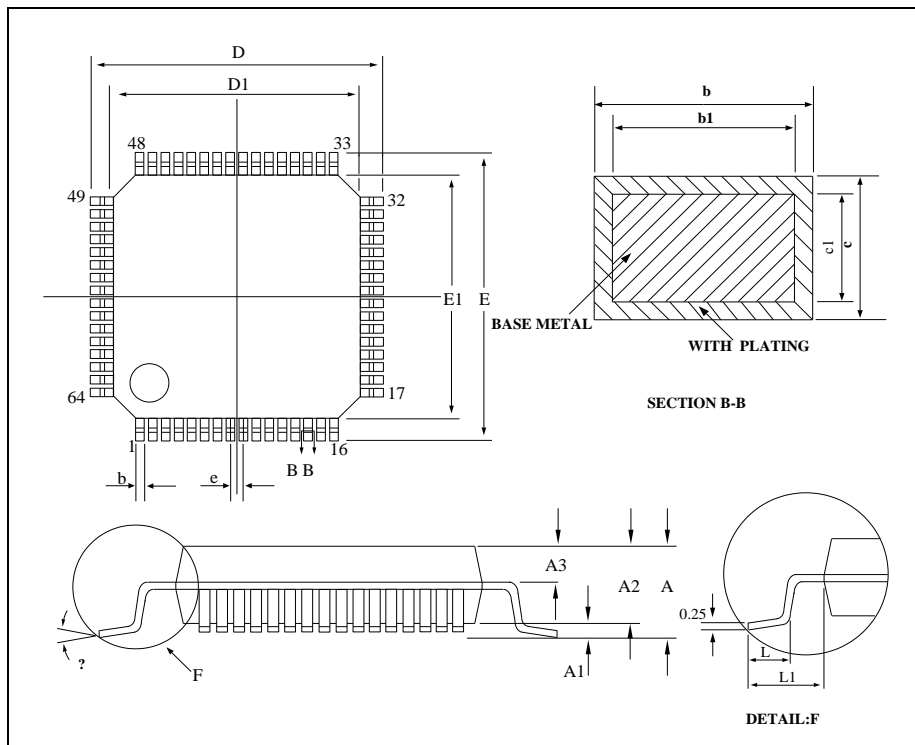2. Turn off power before insert or remove the device.

Table 3.　Electrical Specifications（VDD=3.3V, T_A=25℃）

Symbol	Parameter	Minimum	Typical	Maximum	Unit	Conditions/Remarks
VDD	Power supply	2.0	3.3	3.6	V	Digital circuits operate down to 2.0V
FOSC	Operating frequency	0.032	2.097	4.194	MHz	FOSC must be around 2MHz when read/write tables in OTP
ILRC	Internal RC oscillator frequency		32		kHz	Frequency value after calibration
CRYXT	Crystal oscillator frequency		32.768		kHz	
FPLL	PLL output frequency		4.194		MHz	CRYXT clock source, can select ILRC instead
IDD1	Operating current 1		1.2		mA	FPLL/2 freq for MCU clock PLL input clock = CRYXT Analog modules active
IDD2	Operating current 2		7.6		uA	Internal RC oscillator for MCU clock MCU at standby mode Analog modules inactive
IDD3	Operating current 3		3		uA	MCU at sleep mode Analog modules inactive
Fsam	ADC sampling rate	--	1.05	--	MHz	
OSR	Over sampling rate	128	--	16384		Can select between 128 to 16384
GAIN	ADC gain	1	--	16		1/2/8/16 selectable
ENOB	Effective number of bits	--	19.5	--	bits	Gain=1
NMbit	No missing code	24	--	--	bits	
INL	Integral nonlinearity	--	0.002	--	%FSR	With external VREF
VINdif	ADC differential input voltage range	-0.6	--	+0.6	V	Gain=1
VINabs	ADC absolute input voltage range	-0.2	--	AVDDR+0.2	V	Gain=1
ACFreq	AC input signal frequency	40	--	400	Hz	
Vnrms	RMS noise	--	2.2	--	uVrms	Gain=1

VREF	Voltage reference		1.16		V	
Rvref	VREF output resistance	--	4	--	kΩ	
TCvref	Vref TC	--	±50	--	ppm/℃	-40℃-85℃
Vavddr	AVDDR output voltage	--	2.4	--	V	avddrx[1:0]=00
		--	2.6	--		avddrx[1:0]=01
		--	2.9	--		avddrx[1:0]=10
		--	3.3	--		avddrx[1:0]=11
Iavddr	AVDDR output current	--	10	--	mA	
POR	Power on reset voltage	--	2.0	--	V	
LVD	Low voltage detect threshold	--	1.9	--	V	
THlbt	LVD hysteresis	--	200	--	mV	
Vlcd	LCD charge pump output voltage	--	2.1	--	V	vlcdx[2:0]=000
		--	2.3	--		vlcdx[2:0]=001
		--	2.5	--		vlcdx[2:0]=010
		--	2.7	--		vlcdx[2:0]=011
		--	2.9	--		vlcdx[2:0]=100
		--	3.1	--		vlcdx[2:0]=101
		--	3.3	--		vlcdx[2:0]=110
		--	3.5	--		vlcdx[2:0]=111
Ilcd	LCD charge pump current output[1]	--	--	500	uA	
Digital I/O parameter						
IOH	High output current source	--	12	--	mA	VOH=VDD-0.3V
IOL	Low output current sink	--	12	--	mA	VOL=0.3V
VIH	Input high voltage	0.7VDD	--	--	V	
VIL	Input low voltage	--	--	0.3VDD	V	
VOH	Output high voltage	VDD-0.3	--	--	V	
VOL	Output low voltage	--	--	VSS+0.3	V	
Rpu	Pull up resistance	--	50	--	kΩ	VDD = 3.0, P15-10
		--	200	--		VDD = 3.0, other I/O

Note:

1. Charge pump current drive capability is related to its working frequency. Higher frequency has stronger drive.

Package Information

Dimensions: mm

Symbol	Min.	Nom.	Max.
A	——	——	1.60
A1	0.05	——	0.20
A2	1.35	1.40	1.45
A3	0.59	0.64	0.69
b	0.19	——	0.27
b1	0.18	0.20	0.23
c	0.13	——	0.18
c1	0.12	0.13	0.14
D	11.80	12.00	12.20
D1	9.90	10.00	10.10
E	11.80	12.00	12.20
E1	9.90	10.00	10.10
e	0.50BSC		
L	0.45	——	0.75
L1	1.00BSC		
θ	0	——	7

Figure 4. LQFP64 mechanical specification