

### Features

- High precision ADC, 4 effective digits display, 1 differential input. Measures DC value and AC signal's true RMS value
- 1.2mA typically current consumption at 3.3V
- 8SEG X 4COM LCD drive or 4 digits LED drive, LCD drive voltage at 3.0V
- Support software calibration, internal OTP for calibration factors storage, up to 80 re-calibrations
- 1.16V low TC voltage reference output
- Low voltage detection and power on reset circuit
- Operating voltage range: 2.5V~ 3.6V
- Operating temperature range: -40°C~ 85°C

### Description

SD3102F is a meterage SOC with built-in 24 bits ADC and one differential input.

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

The IC can drive 8SEG X 4COM LCD or 4 digits LED directly.

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

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

- Single pair DC or single phase AC voltmeter or current meter with display
- DC signal measurement with display
- AC signal measurement with display

### Ordering Information

SSOP28 package

### Pin Diagram and Descriptions

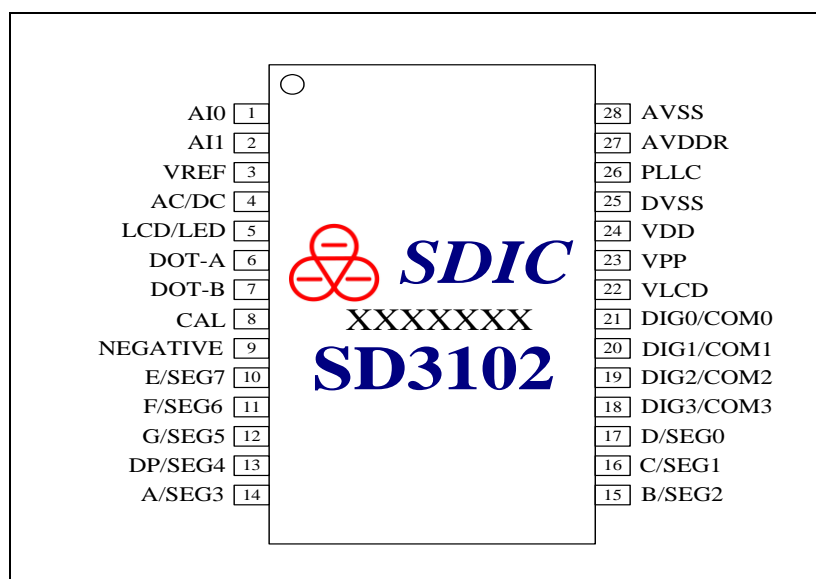


Figure 1. Pin out diagram

Table 1. Pin Descriptions

Pin No.	Pin Name	Attribute	Descriptions															
1-2	AI0--AI1	Analog input	Analog signal differential input															
3	VREF	Analog	1.16V reference voltage for ADC, can connect to external reference source, connect 100pF and 10uF capacitor to AVSS															
4	AC/DC	I	AC/DC measurement selection. Internal pull up. Connect to DVSS for AC measurement, and floating for DC measurement															
5	LCD/LED	I	LED/LCD display selection. Internal pull up. Connect to DVSS for LCD display, and floating for LED display															
6	DOT-A	I	Decimal point position selection. Internal pull up. Connect to DVSS for “0”, and floating for”1”															
7	DOT-B	I	<table border="1"> <tr> <td>DOT-B</td> <td>0</td> <td>0</td> <td>1</td> <td>1</td> </tr> <tr> <td>DOT-A</td> <td>0</td> <td>1</td> <td>0</td> <td>1</td> </tr> <tr> <td>Decimal</td> <td>0 (9999)</td> <td>1 (999.9)</td> <td>2 (99.99)</td> <td>3 (9.999)</td> </tr> </table>	DOT-B	0	0	1	1	DOT-A	0	1	0	1	Decimal	0 (9999)	1 (999.9)	2 (99.99)	3 (9.999)
DOT-B	0	0	1	1														
DOT-A	0	1	0	1														
Decimal	0 (9999)	1 (999.9)	2 (99.99)	3 (9.999)														
8	CAL	I	Calibration control. Internal pull up. Connect to DVSS for calibration, and floating for normal measurement operation															
9	NEGATIVE	O	Negative number indicator. Low voltage for negative number, high voltage for positive number															
10	E/SEG7	O	LED segment E or LCD SEG7															
11	F/SEG6	O	LED segment F or LCD SEG6															
12	G/SEG5	O	LED segment G or LCD SEG5															
13	DP/SEG4	O	LED segment DP or LCD SEG4															
14	A/SEG3	O	LED segment A or LCD SEG3															
15	B/SEG2	O	LED segment B or LCD SEG2															
16	C/SEG1	O	LED segment C or LCD SEG1															
17	D/SEG0	O	LED segment D or LCD SEG0															
18	DIG3/COM3	O	LED digit3 or LCD COM3															
19	DIG2/COM2	O	LED digit2 or LCD COM2															
20	DIG1/COM1	O	LED digit1 or LCD COM1															
21	DIG0/COM0	O	LED digit0 or LCD COM0															
22	VLCD	Analog	LCD driver power source, connect 1uF filter capacitor to VDD															
23	VPP	Analog	OTP high voltage programming pin, connect 1uF capacitor to DVSS															
24	VDD	Power	Power supply for the IC, connect 0.1uF to DVSS															
25	DVSS	Ground	Digital ground															
26	PLL	Analog	External PLL capacitor, connect 1nF to DVSS															
27	AVDDR	Analog	Internal LDO output for IC’s analog modules, connect 1uF to AVSS															
28	AVSS	Ground	Analog ground															

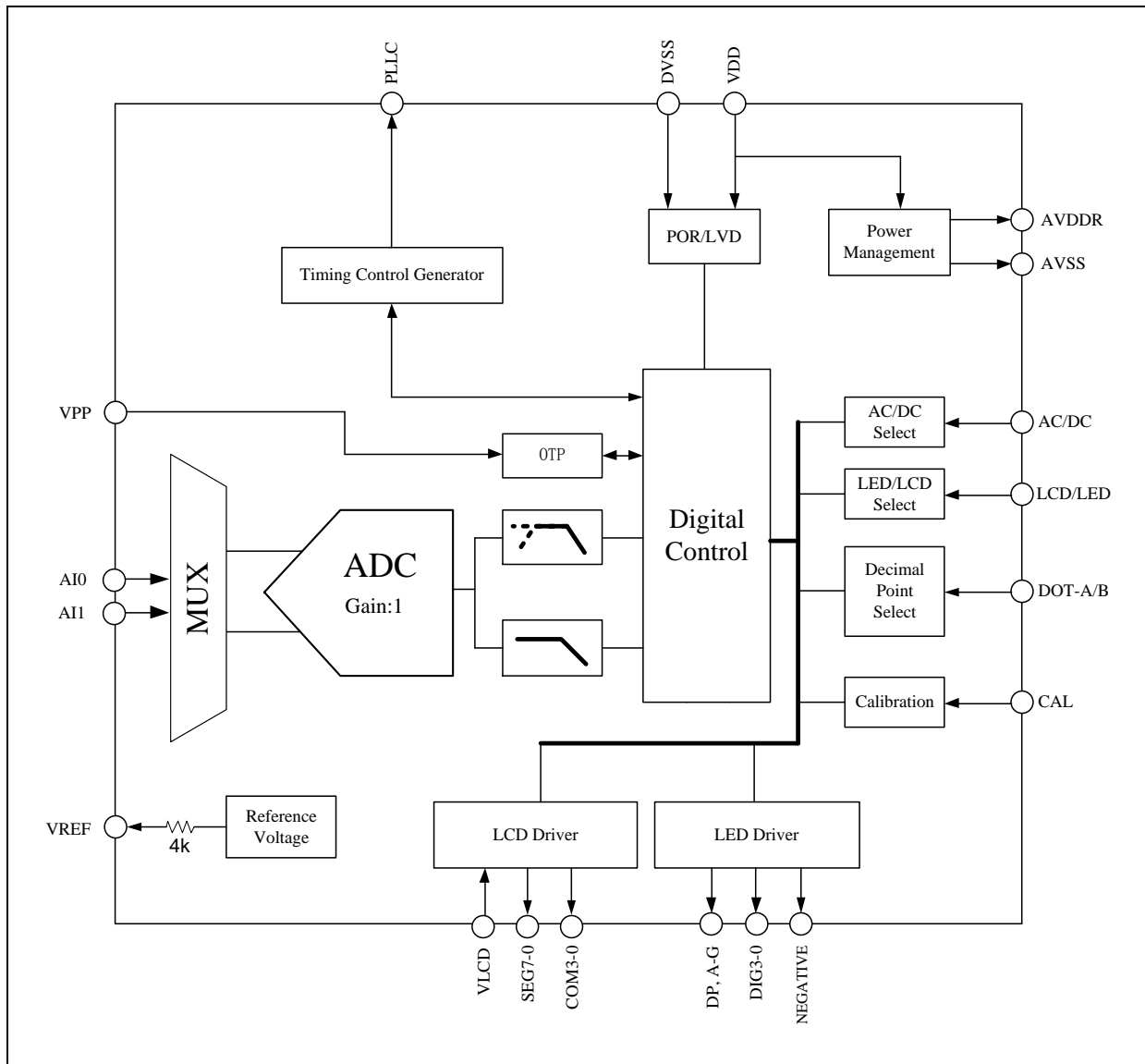
**Functional Block**


Figure 2. Functional block diagram

## AC Measurement with LED Display Setup and Calibration Method

AC signal effective value should be within 200mV. The setup and calibration method are:

- (1) LCD/LED pin floating to select LED display;
- (2) AC/DC pin shorted to DVSS to select AC measurement;
- (3) Turn on IC power, all LED segments will be on for 2s. Measured value will be displayed if the IC was calibrated already, and it is at normal measurement operation;
- (4) The display turns into “nCAL” if the IC was not yet calibrated. Follow steps 5-7 for calibration;
- (5) Connect pure sine wave calibration signal to AI0-AI1 ports (50mV-100mV/50Hz-400Hz, e.g. 100mV/50Hz), recommend the signal effective value to be half of full scale range;
- (6) Connect CAL pin to DVSS. LED will display “CAL” during calibration. It changes into “PASS” when calibration is completed. Float CAL pin then, and the IC enters into normal measurement operation;
- (7) If the measured display is not accurate, please check the hardware and re-calibrate.

## DC Measurement with LCD Display Setup and Calibration Method

DC signal range should be within +/- 200mV. The setup and calibration method are:

- (1) LCD/LED pin shorted to DVSS to select LCD display;
- (2) AC/DC pin floating to select DC measurement;
- (3) Turn on IC power, all LCD segments will be on for 2s. Measured value will be displayed if the IC was calibrated already, and it is at normal measurement operation;
- (4) The display turns into “nCAL” if the IC was not yet calibrated. Follow steps 5-7 for calibration;
- (5) Connect DC calibration signal to AI0-AI1 ports (50mV-100mV, e.g. 100mV), recommend the signal amplitude to be half of full scale range;
- (6) Connect CAL pin to DVSS. LED will display “CAL” during calibration. It changes into “PASS” when calibration is completed. Float CAL pin then, and the IC enters into normal measurement operation;
- (7) If the measured display is not accurate, please check the hardware and re-calibrate.

Remark:

1. Decimal point display is set by DOT-A and DOT-B, refer to table 1.
2. Each IC can calibrate up to 80 times.

## Display vs Input Signal (Calibrated with 100mV DC or AC sine wave)

Table 2. Input Signal and its Corresponding Display

Signal effective value(mV)	0 decimal points	1 decimal points	2 decimal points	3 decimal points	Inaccuracy (at cal temperature)	Inaccuracy (-40°C-85°C)
0.000	0	0.0	0.00	0.000	0.1% ± 3 counts	0.5% ± 3 counts
10.00	500	50.0	5.00	0.500		
20.00	1000	100.0	10.00	1.000		
50.00	2500	250.0	25.00	2.500		
100.0	5000	500.0	50.00	5.000		
150.0	7500	750.0	75.00	7.500		
190.0	9500	950.0	95.00	9.500		
>=200.0	Or	Or	Or	Or	--	--

Remark: The above inaccuracy is measured with internal voltage reference.

### Typical Application

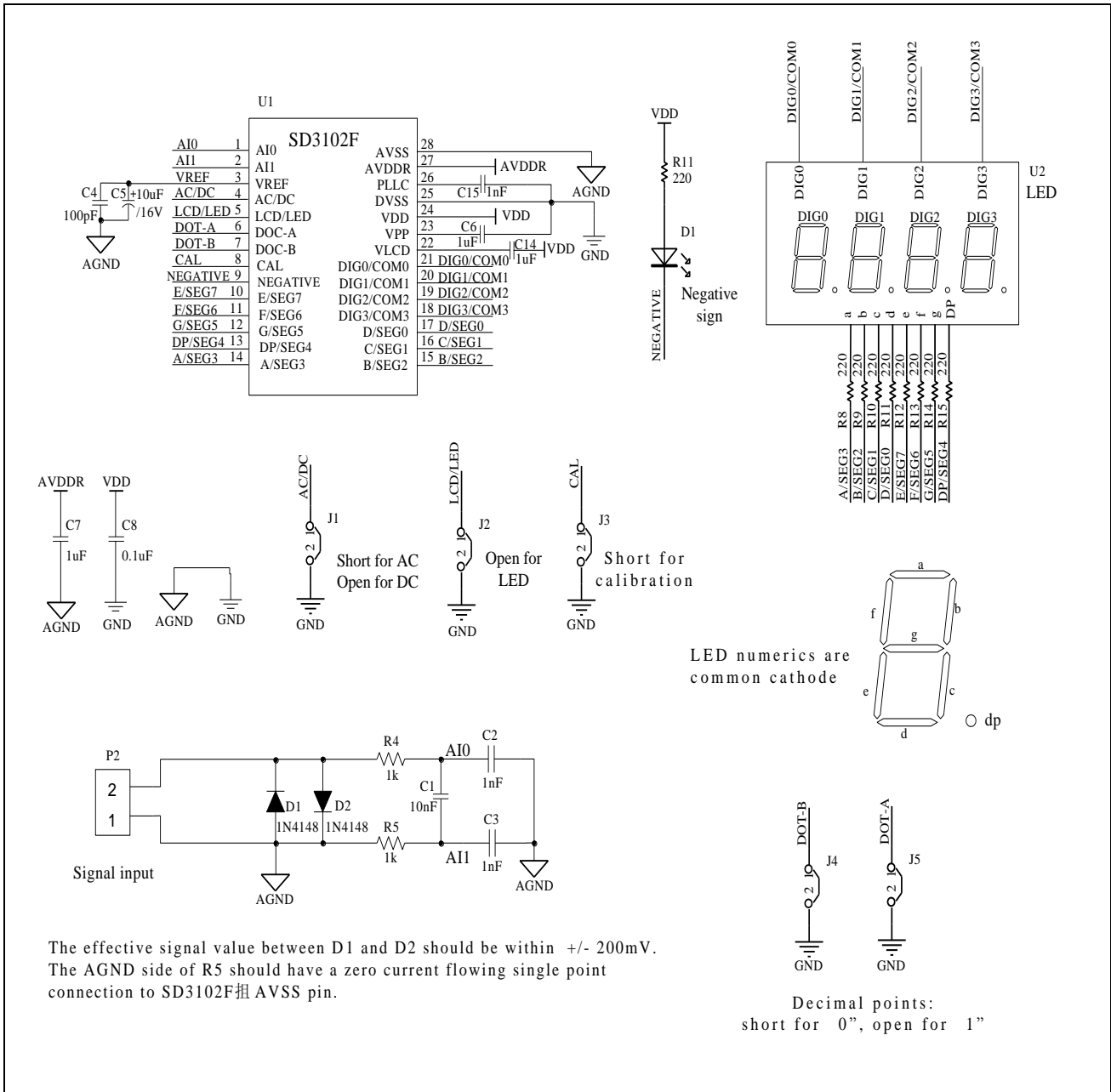


Figure 3. Single phase voltage meter/Current meter with LED display typical application diagram

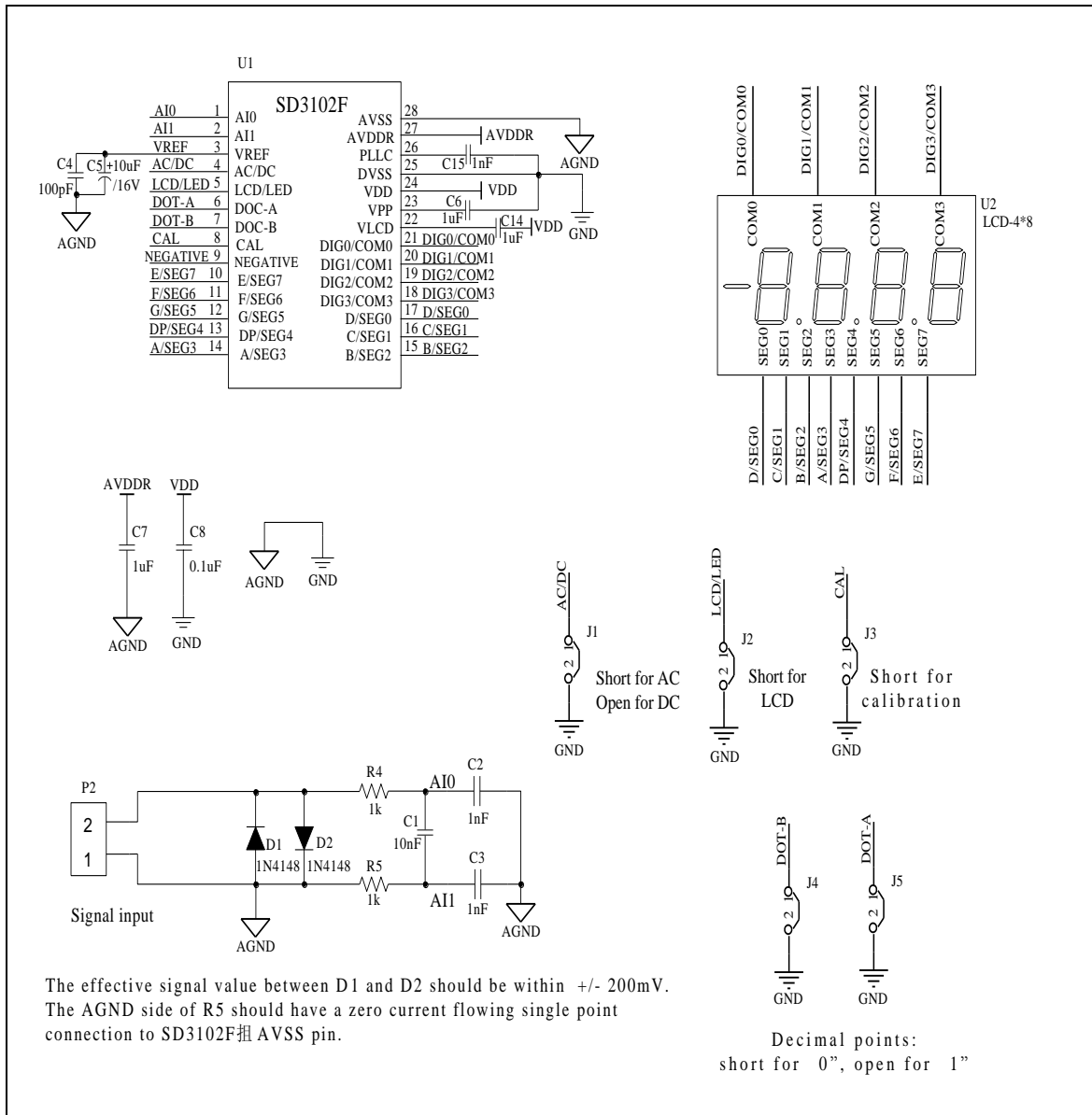


Figure 4. Single phase voltage meter/Current meter with LCD display typical application diagram

## LCD Pin Names and Truth Table

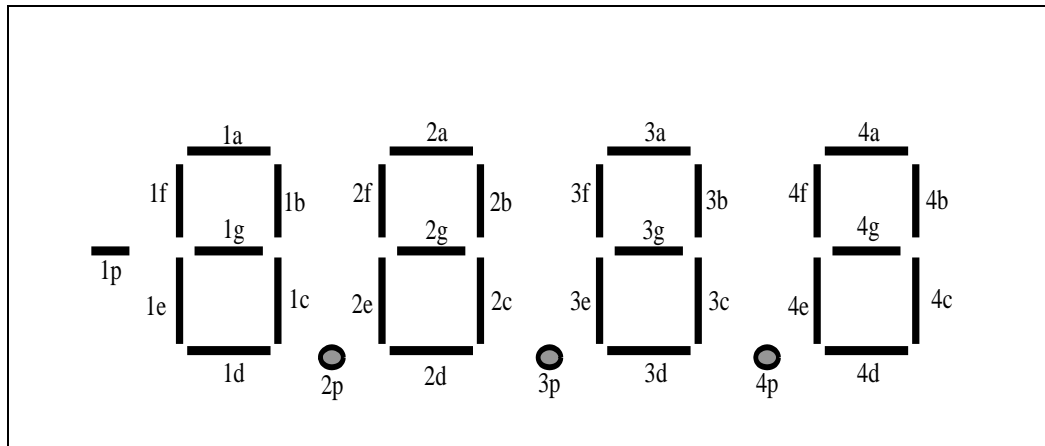


Figure 5. LCD pin names

Table 3. LCD Truth Table

	SEG0	SEG1	SEG2	SEG3	SEG4	SEG5	SEG6	SEG7
COM0	4a	4f	3a	3f	2a	2f	1a	1f
COM1	4b	4g	3b	3g	2b	2g	1b	1g
COM2	4c	4e	3c	3e	2c	2e	1c	1e
COM3	4d	4p	3d	3p	2d	2p	1d	1p

## Electrical Specifications

Table 4. Absolute Maximum Ratings

Symbol	Parameter	Minimum	Maximum	Unit
$T_A$	Operating temperature	-40	+85	°C
$T_S$	Storage temperature	-55	+150	°C
$V_{DD}$	Supply voltage	-0.2	+4.0	V
$V_{pp}$	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		°C

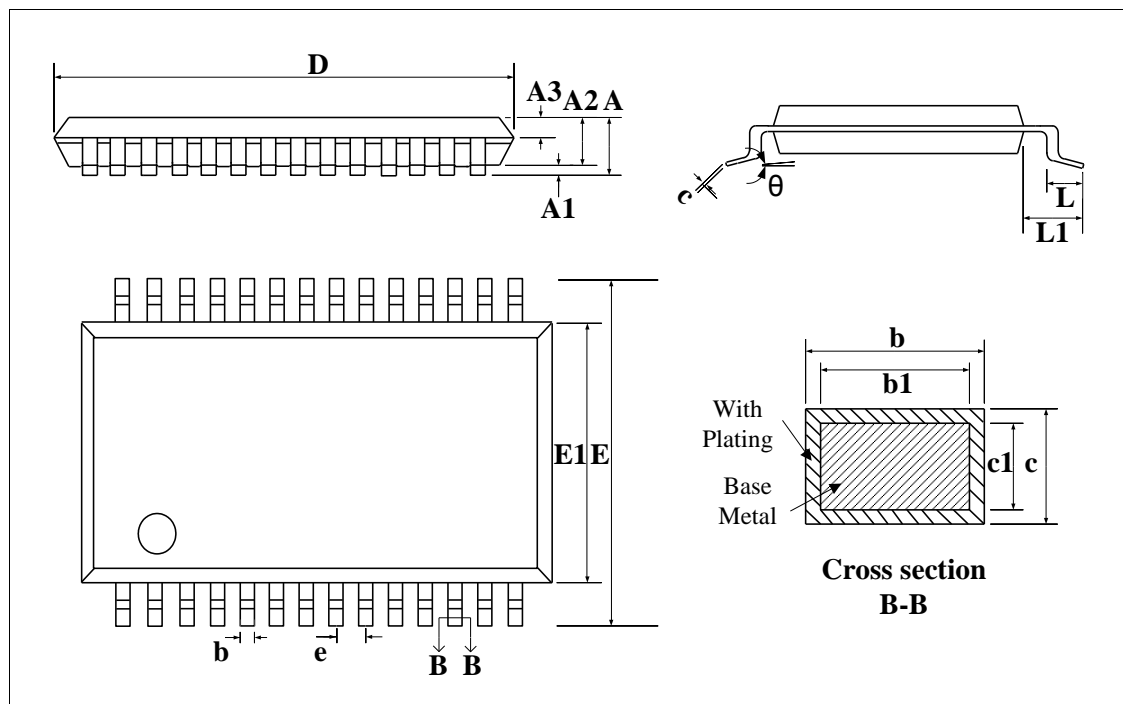
Remarks:

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 5. Electrical Specifications (VDD=3.3V, T<sub>A</sub>=25°C)

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
IDD	Operating current I	--	1.2	--	mA	
VINdif	ADC differential input voltage range	-200	--	+200	mV	Effective value
VINabs	ADC absolute input voltage range	-0.2	--	AVDDR+0.2	V	
ACFreq	AC input signal frequency	40	--	400	Hz	
DataRate	Data display renew rate	--	4	--	sps	
Vnrms	RMS noise	--	2.2	--	uVrms	
VREF	Voltage reference	--	1.16	--	V	Generated internally
Rvref	VREF output resistance	--	4	--	kΩ	
TCvref	VREF TC	--	±50	--	ppm/°C	-40°C-85°C
Vavddr	AVDDR output voltage	--	3.0	--	V	
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	--	3.0	--	V	
Ilcd	LCD charge pump current output	--	--	500	uA	
<b>Digital I/O parameter</b>						
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	--	200	--	kΩ	VDD = 3.3V



**Package Information**


*Dimensions: mm*

Symbol	Min.	Nom.	Max.
A	—	—	2.00
A1	0.05	—	0.25
A2	1.65	1.75	1.85
A3	0.75	0.80	0.85
D	10.00	10.20	10.40
E	7.60	7.80	8.00
E1	5.10	5.30	5.50
L	0.55	0.75	0.95
L1	1.25BSC		
b	0.29	—	0.37
b1	0.28	0.30	0.33
c	0.15	—	0.20
c1	0.14	0.15	0.16
e	0.65BSC		
θ	0°	—	8°

*Figure 6. SSOP28 mechanical specification*