ONE CHANNEL RAIL-TO-RAIL OPERATIONAL AMPLIFIER

FEATURES

- **4.5V to 20V Input Voltage Range**
- **Rail-to-Rail Output Swing**
- **Maximum Peak Output Current : 1300mA**
- **Slew Rate : 40V/μS**
- **Supply Current : 3.0mA**
- **30MHz Bandwidth**
- **Protections**
  - **Over Current Protection (OCP)**
  - **Short Circuit Protection (SCP)**
  - **Thermal Shutdown (OTP)**
- **Package Available**
  - **TSOT 23-5 Package**
  - **WSON8 3x3x0.75 Package**
  - **MSOP8 (Power Pad) Package**

APPLICATIONS

- **TFT LCD Panel**

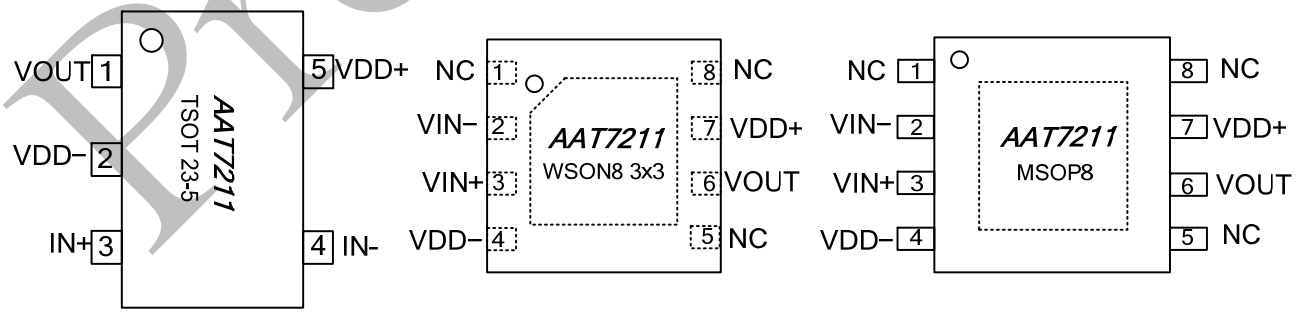
GENERAL DESCRIPTION

The AAT7211 is a device that includes one channel rail-to-rail operational amplifier, designed for use as a buffer in thin film transistor liquid crystal display (TFT LCD). This device has an input voltage range from 4.5V to 20V, exhibits low supply current of 3.0mA. It has rail to rail output swing capability, a slew rate of typically 40V/μs, and a maximum output current capability of 1300mA. A 30MHz open loop -3dB bandwidth allows for fast transient response and fast settling time.

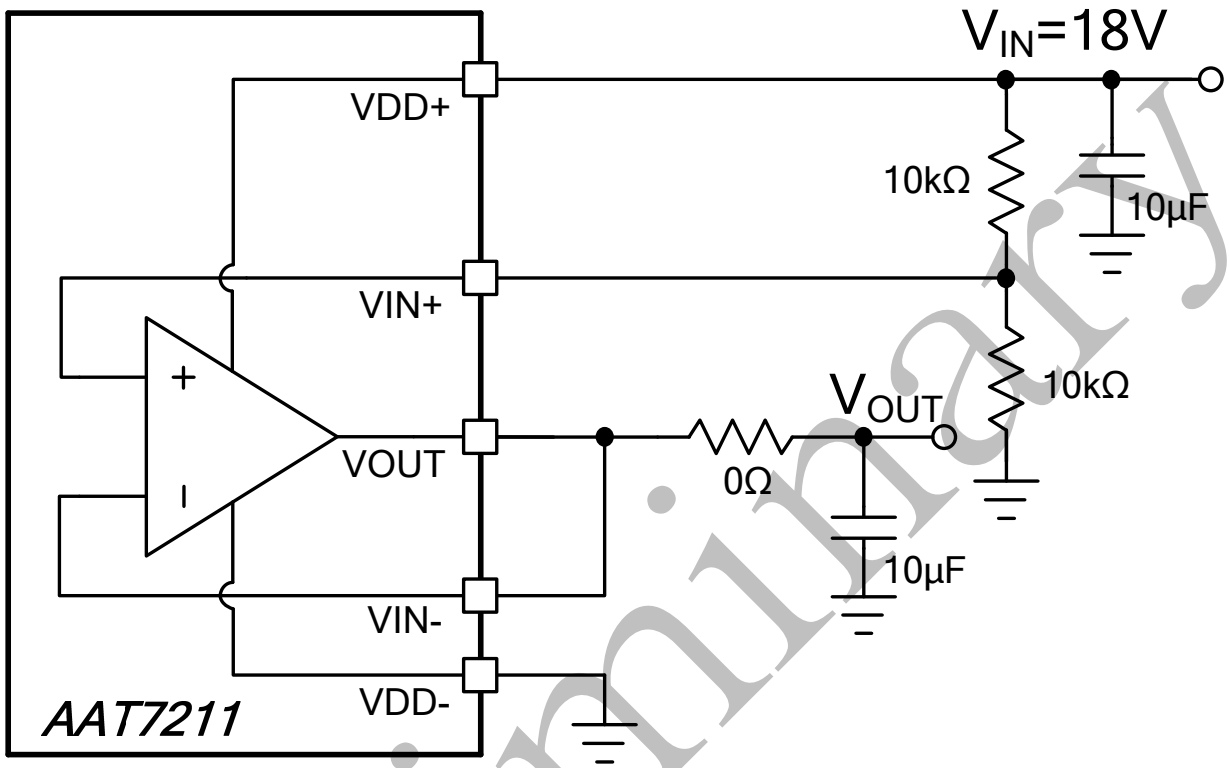
The AAT7211 includes various protection features such as over current protection (OCP), short circuit protection (SCP) and Thermal Shutdown (OTP).

The AAT7211 is available in a TSOT 23-5, a small 3x3x0.75mm, ultra-thin WSON8 package, and 8 pin MSOP8 (Power Pad) package. WSON8 & MSOP8 (Power Pad) packages have a bottom side exposed thermal pad to provide optimal heat dissipation. The packages offered for the AAT7211 make it an ideal component for use in space-sensitive designs of LCD panel. The device is rated to operate from –40°C to +85°C ambient temperature range.

PIN CONFIGURATION



TYPICAL APPLICATION



ORDERING INFORMATION

DEVICE TYPE	PART NUMBER	PACKAGE	PACKING	TEMP. RANGE	MARKING	MARKING DESCRIPTION
AAT7211	AAT7211 -S18-T	S18:TSOT 23-5	T: Tape and Reel	–40°C to +85°C	E02YY	E02=AAT7211, YY= tracing code, AA, AB, AC…
AAT7211	AAT7211 -Q42-T	Q42:WSON8	T: Tape and Reel	–40°C to +85°C	AAT7211 XXXXXX	Device Type Lot no. (6~9 Digits)
AAT7211	AAT7211 -M3-T	M3 : MSOP8 (Power Pad)	T: Tape and Reel	–40°C to +85°C	AAT7211 XXXXX	Device Type Lot no. (6~9 Digits)

Note: All AAT products are lead free and halogen free.

ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	VALUE	UNIT
VDD+ to GND	V_{IN}	–0.3 to +22.0	V
VDD+ to VDD-	V_{IN_G}	20	V
Input Voltage (VIN+, VIN–)	V_{IN+} , V_{IN-}	–0.3 to (V_{IN} +0.3)	V
Output Voltage (VOUT)	V_{OUT}	–0.3 to (V_{IN} +0.3)	V
Maximum Peak Output Current	I_{PEAK_MAX}	1,500	mA
Operating Ambient Temperature Range	T_A	–40 to +85	°C
Operating Junction Temperature Range	T_J	–40 to +150	°C
Storage Temperature Range	$T_{STORAGE}$	–65 to +150	°C
Package Thermal Resistance – TSOT 23-5	θ_{JA}	275	°C /W
Power Dissipation, @ T_A = +25°C , T_J = +125°C – TSOT 23-5	P_d	0.364	W
Package Thermal Resistance – WSON8	θ_{JA}	47	°C /W
Power Dissipation, @ T_A = +25°C , T_J = +125°C – WSON8	P_d	2.128	W
Package Thermal Resistance – MSOP8 (Power Pad)	θ_{JA}	128.3	°C /W
Power Dissipation, @ T_A = +25°C , T_J = +125°C – MSOP8	P_d	0.779	W
ESD Susceptibility Human Body Mode		2K	V
ESD Susceptibility Machine Mode		200	V

Note: Stresses above those listed under ABSOLUTE MAXIMUM RATINGS may cause permanent damage to the devices. Exposure to ABSOLUTE MAXIMUM RATINGS conditions for extended periods may affect device reliability.

RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	MIN	MAX	UNIT
Operating Ambient Temperature	T_A	–40	+85	°C
Power Supply Voltage (VIN)	V_{IN}	4.5	20.0	V

ELECTRICAL CHARACTERISTICS

(VDD+ = 18V, VDD- = 0V, V_{IN+} = V_{OUT} = (VDD+)/2, R_L = 0Ω and C_L = 10µF, Typical values are tested at +25°C ambient temperature.)

Operational Amplifier

PARAMETER	SYMBOL	TEST CONDITION	MIN	TYP	MAX	UNIT
Supply Voltage Range	V_{IN}		4.5	-	20.0	V
Supply Current	I_{QS}	No Load	-	3.0	-	mA
Input Offset Voltage	V_{OS}	V_{IN+} = 9V	–15	±2	+15	mV
Input Bias Current	I_B	V_{IN+} = 9V	–40	-	+40	nA
Output Swing Low	V_{OL}	V_{IN+} = 0V, I_L = −5mA	-	50	150	mV
Output Swing High	V_{OH}	V_{IN+} = 18V, I_L = +5mA	17.85	17.95	-	V
Continuous Output Current	I_O	V_{DD+} = 16V , V_{IN+} = 8V	±300	±350	-	mA
Transient Peak Output Current	I_{O_PEAK}		±1,100	±1,300	-	mA
Slew Rate	SR	+0.5V < V_{OUT} < 17.5V; 20% to 80%	25	40	-	V/µS
Setting Time	ts		-	200	-	nS
Bandwidth	BW	–3dB	-	30	-	MHz
Voltage Gain	A_V	R_L = 10kΩ, C_L = 50pF	0.99	-	1.01	V/V
Open-Loop Gain	A_{VOL}		60	70	-	dB
Power Supply Rejection Ratio	PSRR	+6V < VDD+ < +18V	54	80	-	dB
Common-Mode Input Range	CMIR		–0.5	-	+17.5	V
Common-Mode Rejection Ratio	CMRR		50	70	-	dB
Over Current Protection	I_{OCP}	V_{DD+} = 16V , V_{IN+} = 8V	-	550	-	mA
Thermal Shutdown	T_{SD}		-	150	-	°C

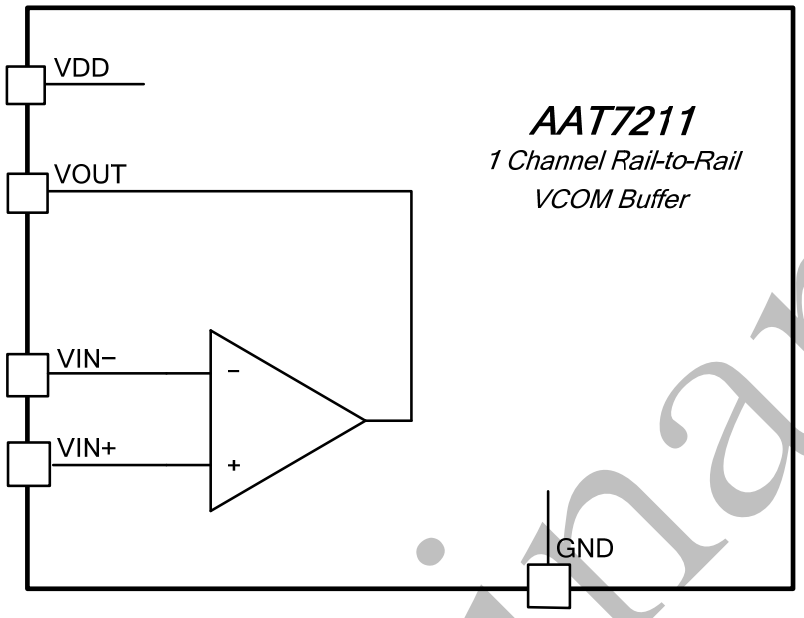
PIN DESCRIPTION

PIN TSOT23-5	NAME	I/O	FUNCTION
1	VOUT	O	Output of the Amplifier
2	VDD−	-	Negative Power Supply
3	VIN+	I	Non-Inverted input Pin of the Amplifier
4	VIN−	I	Inverted Input Pin of the Amplifier
5	VDD+	I	Positive Power Supply

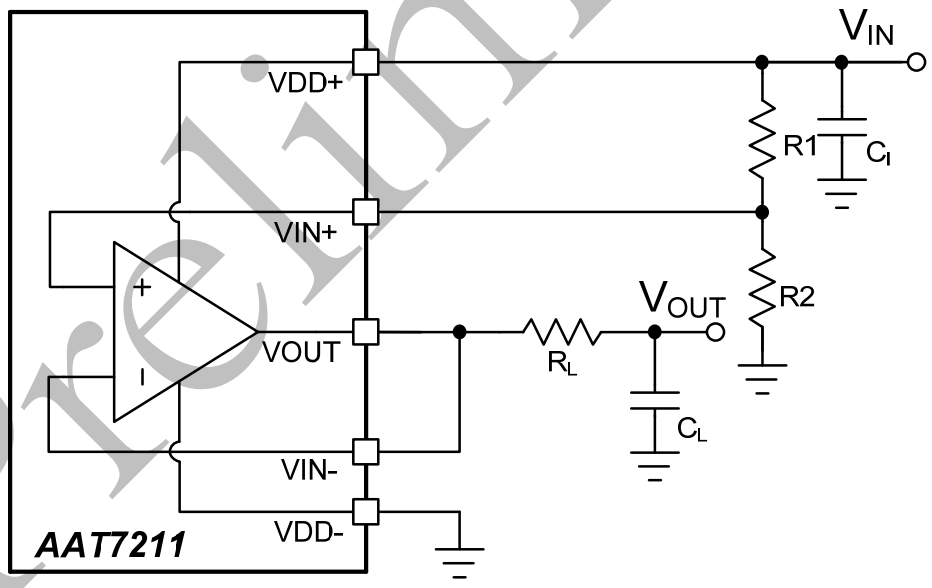
PIN WSON8	NAME	I/O	FUNCTION
1	NC	-	No Connected
2	VIN−	I	Inverted Input Pin of the Amplifier
3	VIN+	I	Non-Inverted Input Pin of the Amplifier
4	VDD−	-	Negative Power Supply
5	NC	-	No Connected
6	VOUT	O	Output of the Amplifier
7	VDD+	I	Positive Power Supply
8	NC	-	No Connected

PIN MSOP8	NAME	I/O	FUNCTION
1	NC	-	No Connected
2	VIN−	I	Inverted Input Pin of the Amplifier
3	VIN+	I	Non-Inverted Input Pin of the Amplifier
4	VDD−	-	Negative Power Supply
5	NC	-	No Connected
6	VOUT	O	Output of the Amplifier
7	VDD+	I	Positive Power Supply
8	NC	-	No Connected

FUNCTION BLOCK DIAGRAM



TYPICAL APPLICATION CIRCUIT



APPLICATION NOTE

The operational amplifier drives the LCD backplane VCOM divider string. The Op Amp is capable of rail-to-rail input and output, ±1,300mA maximum peak output current, and a 40V/μs slew rate. In typical application, the inverting input is shorted to the output for a unity-gain (voltage follower) configuration.

In the unity-gain configuration, the capacitive load adds a pole to the loop gain that impacts the stability of the system and leads to output peaking, ringing and oscillation. A higher pole frequency results in greater stability. In fact, if the pole frequency is lower than or close to the unity gain frequency, the pole can have a significant negative impact on phase and gain margins. Therefore, the stability decreases when the capacitive load increases. One method of improving capacitive load drive is to insert a 2Ω to 20Ω resistor (R_L) in series with the output, as shown in Figure 1.

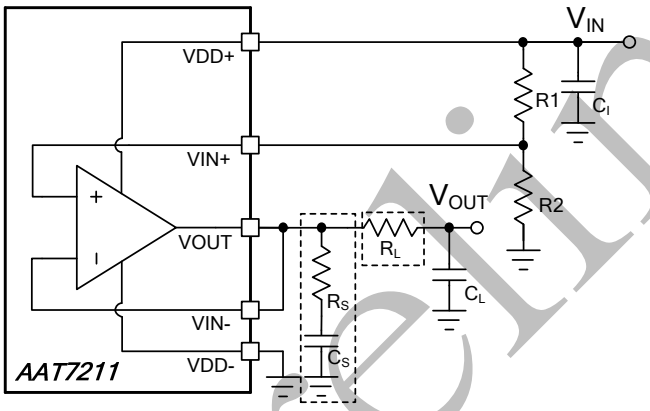


Figure 1. Operational Amplifier Functional Block Diagram

This reduces ringing with large capacitive loads while maintaining DC accuracy. However, for typical applications, the AAT7211 should be able to handle the capacitive load with sufficient phase margin. Thus, adding the resistor R_L is usually not critical.

Another method for improving transient response is to add a snubber circuit at the output. A snubber circuit consists of a resistor (R_S) in series with a capacitor (C_S), which improves output settling time and reduces peaking. The advantage of this topology is that it draws no DC current nor does it reduce the gain.

Bypass Capacitors

For stability while driving load transients, and to minimize the noise to the system, use a 10μF capacitor for the VDD Pin supply. Connect this bypass capacitor as close as possible to the input VDD+.

Protection

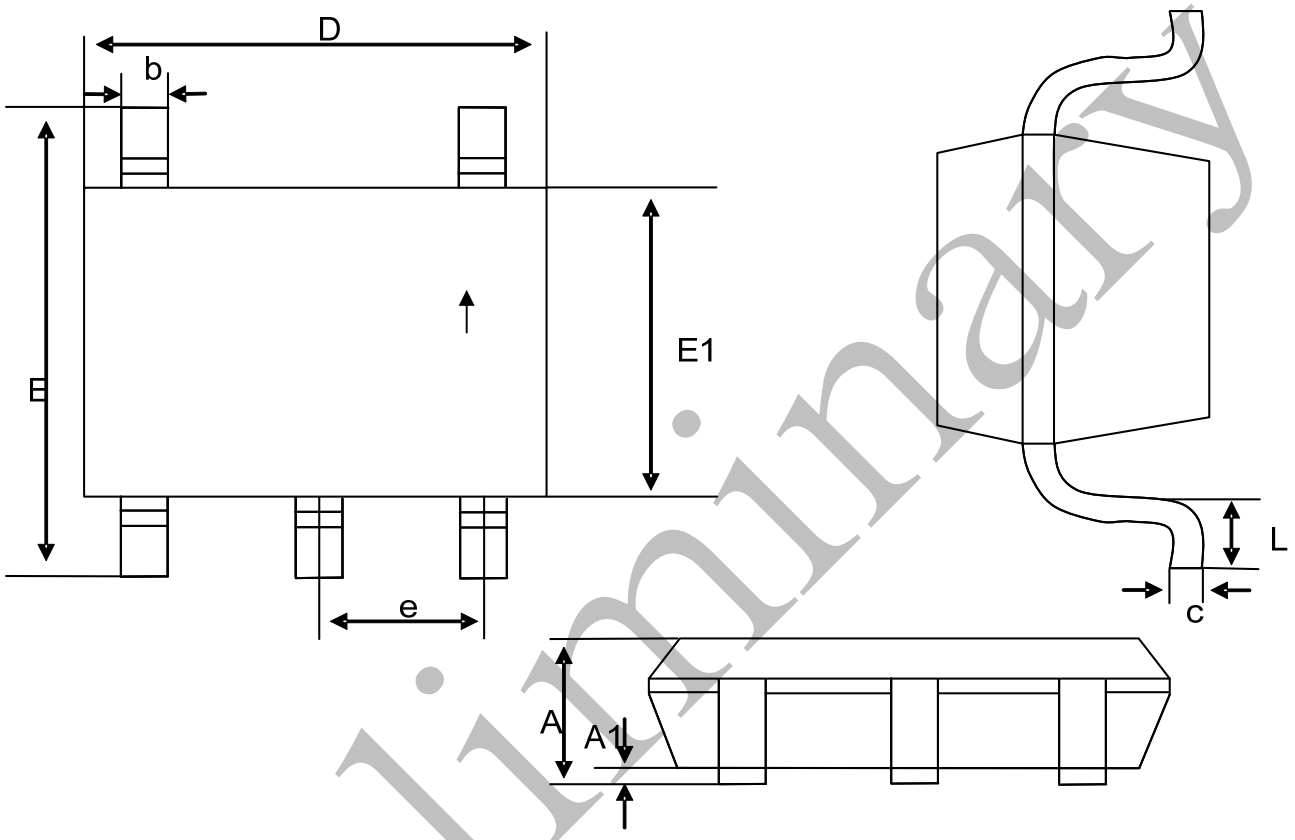
When one of the three protection mechanism (OCP, SCP, OTP) is triggered, shutdown mode will be latched. For the device to resume operation when nominal conditions have returned, the power VDD+ must be recycled to restart.

Layout

Connect the exposed pad of the device to the VDD- or GND plane for best thermal dissipation performance, or low thermal resistance. In typical application, VDD– is connected to ground.

PACKAGE DIMENSION

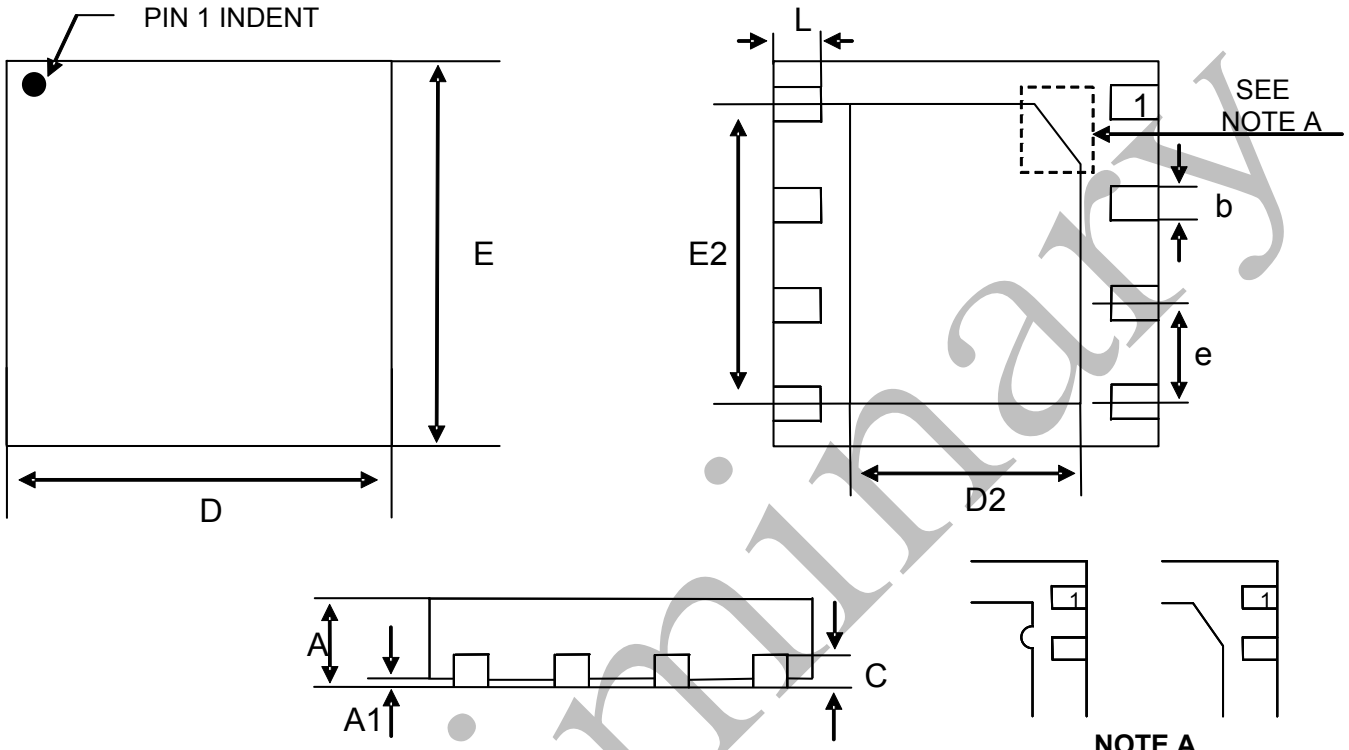
TSOT23-5 (TSOT25)



Symbol	Dimensions In Millimeters		
	MIN	TYP	MAX
A	0.70	-----	1.00
A1	0.05	-----	0.10
b	0.30	-----	0.50
c	0.08	-----	0.20
D	2.70	2.90	3.10
E	2.60	2.80	3.00
E1	1.40	1.60	1.80
e	0.85	0.95	1.05
L	0.30	0.45	0.60

PACKAGE DIMENSION

WSON8-3X3

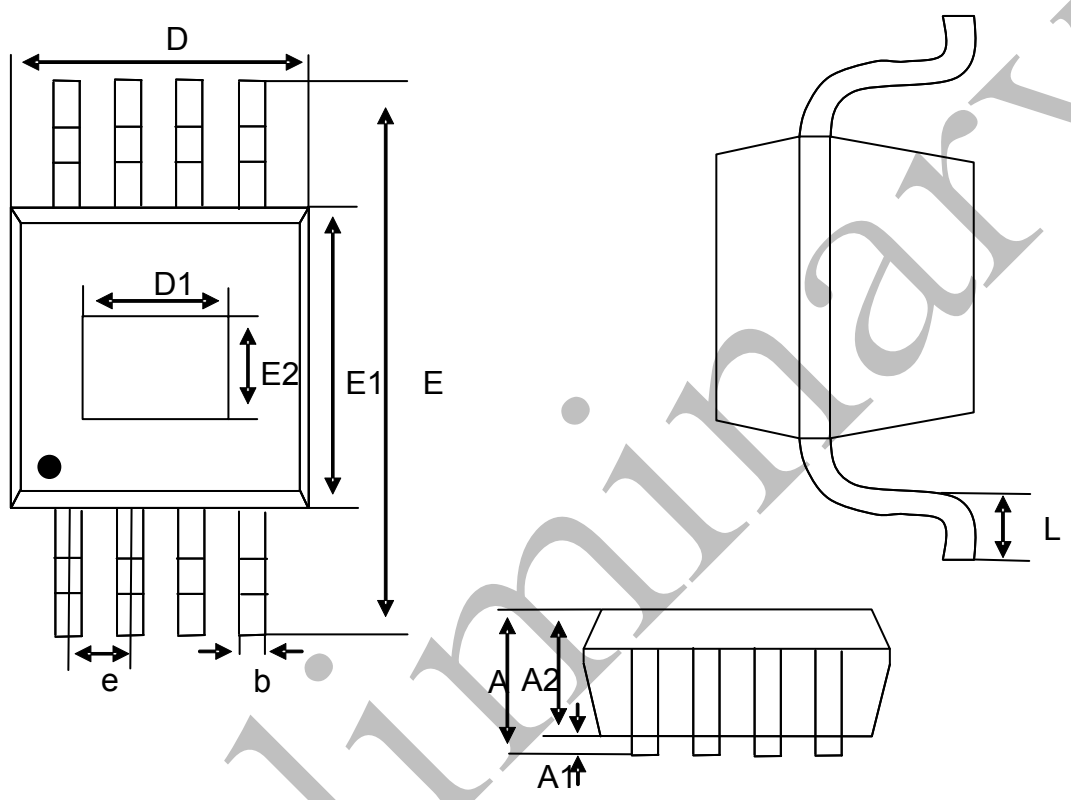


NOTE A
The tie bar mark of Pin#1 is optional as the above configuration

Symbol	Dimensions In Millimeters		
	MIN	TYP	MAX
A	0.7	0.75	0.8
A1	0	0.02	0.05
b	0.2	0.25	0.3
C	-----	0.2	-----
D	2.95	3	3.05
D2	1.45	1.5	1.55
E	2.95	3	3.05
E2	2.25	2.3	2.35
e	-----	0.65	-----
L	0.425	0.475	0.525

PACKAGE DIMENSION

MSOP8 Exposed Pad



Symbol	Dimensions In Millimeters		
	MIN	TYP	MAX
A	-----	-----	1.1000
A1	0.0500	-----	0.1500
A2	0.7600	0.8500	0.9500
b	0.2500	0.3000	0.3500
D	2.9000	3.0000	3.1000
D1	-----	1.2800	-----
E	4.8000	4.9000	5.0000
E1	2.9000	3.0000	3.1000
E2	-----	1.2192	-----
e	-----	0.6500	-----
L	0.4000	0.5300	0.6600