



Preliminary and Provisional

## ONE-CHANNEL BOOST SWITCHING REGULATOR

### Features

- Under-voltage lockout protection
- Totem pole output
- Output short circuit protection
- Incorporates soft start function
- Wide operating frequency :  
10kHz to 1MHz
- Shut down control
- Low dissipation current :  
Typical 1.6mA in operation
- Sop-8 & Tssop-8 package available

### General Description

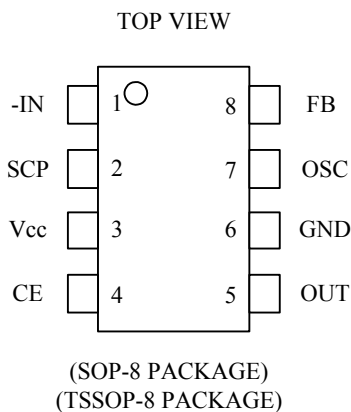
The AAT1109A is a one-channel switching regulator control IC incorporating a soft start function and a short circuit protection function.

Each device consists of an on-chip voltage reference, error amplifier, pulse width modulation controller, under-voltage protection, soft start and short circuit protection circuits. Switching frequencies up to 1MHz are set by an external resistor and capacitor. Soft-start time can be implemented by the SCP capacitor.

Additionally, a chip enable feature is provided to power down reducing the supply current to 10uA.

With a minimum number of external components, the AAT1109A offers a simple and cost effective solution.

### Pin Configuration



**Pin Description**

Pin #	Name	I/O	Description
1	-IN	I	Error amplifier inverting input pin
2	SCP	I	Soft start and SCP capacitor connection pin
3	Vcc		Power supply
4	CE	I	Chip enable input pin ( internal pull "H" )
5	OUT	O	Totem-type output pin
6	GND		Ground
7	OSC	O	Capacitor and resistor connection pin for setting the oscillation frequency
8	FB	O	Error amplifier output pin

**Absolute Maximum Ratings**

CHARACTERISTICS	SYMBOL	VALUE	UNIT
Supply voltage	$V_{DD}$	7	V
Output current	$I_O$	-120/+120	mA
Operating free-air temperature range	$T_{ope}$	-20 to 85	°C
Storage temperature range	$T_{stg}$	-65 to 150	°C
Power dissipation	$P_d$	500	mW

**Recommended Operating Conditions**

	Symbol	Min	Max	Unit
Supply voltage, $V_{DD}$	$V_{DD}$	2.6	6.5	V
Error amplifier input voltage	$V_I$	0.5	1.6	V
OSC capacitor	$C_T$	100	10000	pF
OSC resistor	$R_T$	1.0	10	k
Oscillator frequency	$f_{OSC}$	10	1000	kHz
Output current	$I_O$		+30/-30	mA
Operating free-air temperature	$T_{ope}$	-20	85	°C

**Electrical Characteristics,  $V_{DD} = 3.3V$  (Unless Otherwise Specified) (See Note 1)****Oscillator**

Parameter		Test Condition	Min	Typ	Max	Unit
Oscillation frequency	$f_{OSC}$	$C_T = 270pF, R_T = 4.2k$	400	500	600	KHz
Frequency variation with temperature	$f_{dT}$			5		%
Frequency input stability	$f_{dV}$	$V_{DD} = 2.6V$ to $6.5V$		1		%

**Under-voltage Protection**

Parameter		Test Condition	Min	Typ	Max	Unit
Upper threshold voltage	$V_{UPH}$	$T_A = 25^\circ C$	2.12	2.47	2.85	V
Lower threshold voltage	$V_{UPL}$	$T_A = 25^\circ C$	1.96	2.28	2.63	V
Hysteresis ( $V_{UPH} - V_{UPL}$ )	$V_{HYS}$	$T_A = 25^\circ C$		0.3		V

Note1 : Typical values of all parameters are specified at  $T_A = 25^\circ C$ .

**Short Circuit Protection Control**

Parameter		Test Condition	Min	Typ	Max	Unit
Input threshold voltage	$V_{r1}$		1.16	1.262	1.36	V
Short-circuit detect threshold voltage	$V_{r2}$		1.16	1.262	1.36	V
Charging current	$I_{SCP}$	$V_{scp}=0v$	-1.0	-1.5	-2.15	$\mu A$

**Soft start**

Parameter		Test Condition	Min	Typ	Max	Unit
Charging current	$I_{cs}$	$V_{scp}=0v$	-1.0	-1.5	-2.15	$\mu A$
Voltage at soft start completion	$V_{ts}$		1.16	1.262	1.36	V

**Shun Down Control**

Parameter		Test Condition	Min	Typ	Max	Unit
Shut down release voltage	$V_{sdh}$				0.5	V
Shut down enable voltage	$V_{sdl}$		2.0			V



**Electrical Characteristics,  $V_{DD} = 3.3V$  (Unless Otherwise Specified) (See Note 1)**

**Idle period adjustment section**

Parameter		Test Conditions	Min	Typ	Max	Unit
Maximum duty cycle	$t_{DUTY}$	$C_T = 270pF, R_T = 4.2k$ $V_{FB} = 1.12V$	75	85	93	%

**EA (Error Amplifier)**

Parameter		Test Condition	Min	Typ	Max	Unit
Input threshold voltage	$V_T$	$V_{FB} = 0.7V$	1.249	1.262	1.275	V
$V_T$ input stability	$V_{TdV}$	$V_{DD} = 2.6$ to $6.5v$		2	8	mV
$V_T$ variation with temperature	$V_{TdT}$	$T_A = -20^{\circ}C$ to $90^{\circ}C$		1		%
Input bias current	$I_B$			0.1	1	$\mu A$
Output voltage swing	$V_{OM+}$		1.4	1.7		V
	$V_{OM-}$			0.05	0.2	
Output sink current	$I_{OM+}$	$FB=0.7V$	3	20		mA
Output source current	$I_{OM-}$	$FB=0.7V$	-45	-75		$\mu A$
Open-loop voltage amplification	$A_{VD}$		70	85		dB

**Output section**

Parameter		Test Condition		Typ	Max	Unit
High-level output voltage	$V_{OH}$	$I_O = -30mA$	1.9	2.3		V
Low-level output voltage	$V_{OL}$	$I_O = +30mA$		0.8	1.2	V
Rise time	$T_{rise}$	$C_L = 1000pF$		100		nS
Fall time	$T_{fall}$	$C_L = 1000pF$		100		nS

**Operating Current**

Parameter		Test Condition	Min	Typ	Max	Unit
Supply current	$I_{DD-OFF}$	Output "OFF" state		1.3		mA
	$I_{DD-ON}$	$R_T = 4.2k$		1.6		mA



## How to set the time constant for soft start and short circuit protection

### 1. Soft start

At power on, the AAT1109A operates in soft start mode. The capacitor  $C_{scp}$  connected to SCP pin starts charging at a constant current. In the soft start mode, the voltage at SCP pin ( $V_{SCP}$ ) is input to the PWM comparator, so that the ON duty of the OUT pin is controlled by the  $V_{SCP}$ . On completion of soft start operation, the voltage at the SCP pin stays low, the input from soft start circuit to the PWM comparator stay high, and enter the short circuit protection waiting state.

Soft start time

$$T_s(\text{sec}) \sim 0.84 \times C_{SCP}(\mu\text{F})$$

### 2. Short circuit protection

If the switching regulator output suddenly drops due to loading effect, the error amplifier output is fixed at  $V_{OM}^+$  and capacitor  $C_{SCP}$  starts charging. When the voltage at the SCP pin reaches approximately 1.26V, the output pin set low and SCP pin stays low.

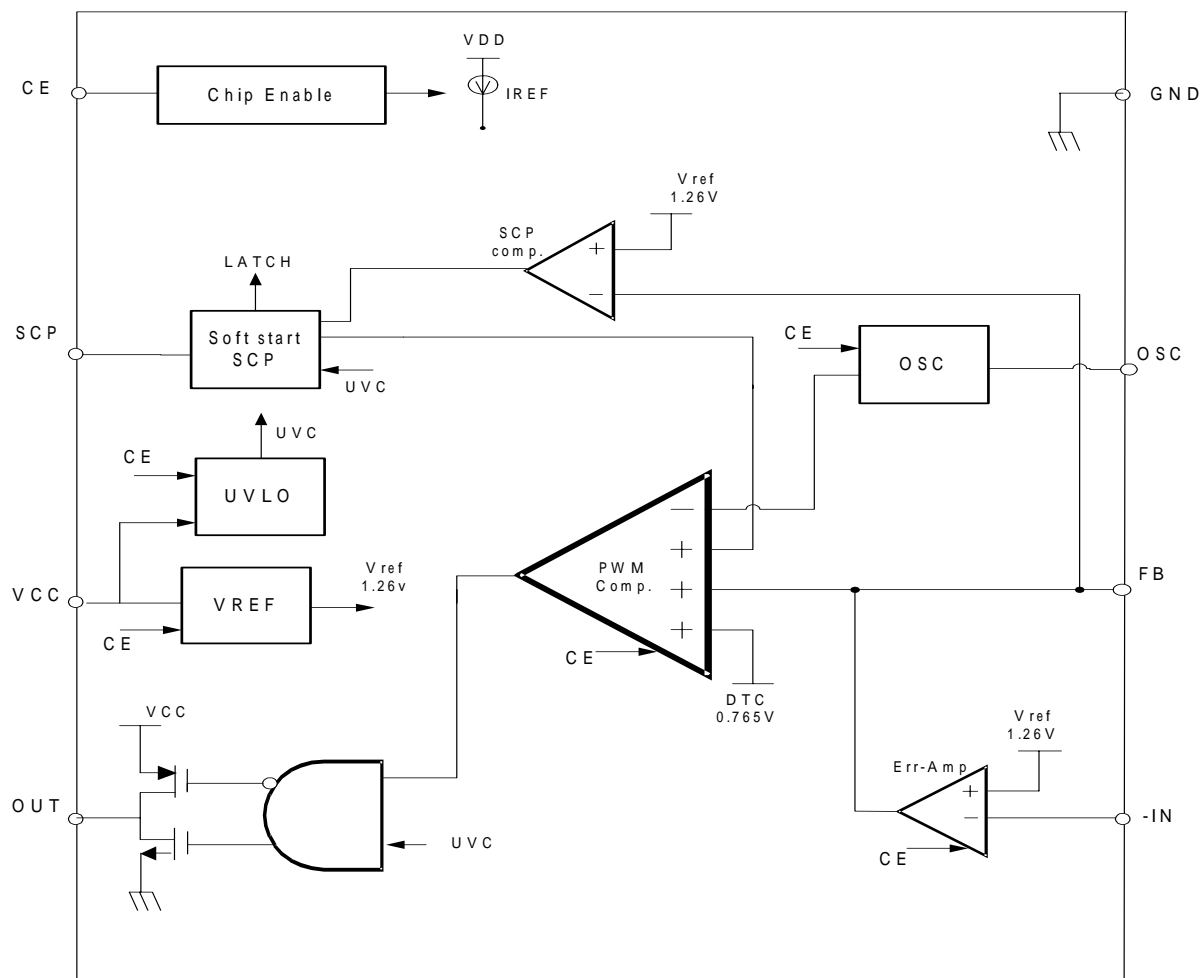
Once the protection circuit operates, the circuit can be recovered by setting the power supply.

Short circuit detection time

$$T_{scp}(\text{sec}) \sim 0.84 \times C_{SCP}(\mu\text{F})$$

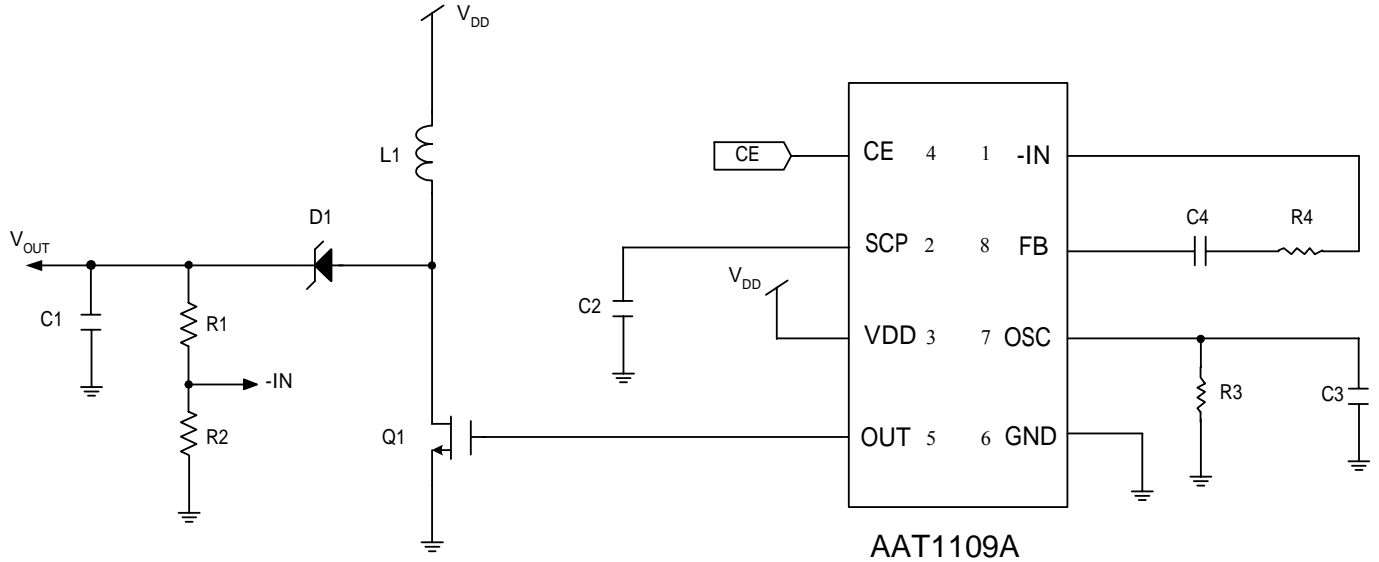


Function Block Diagram

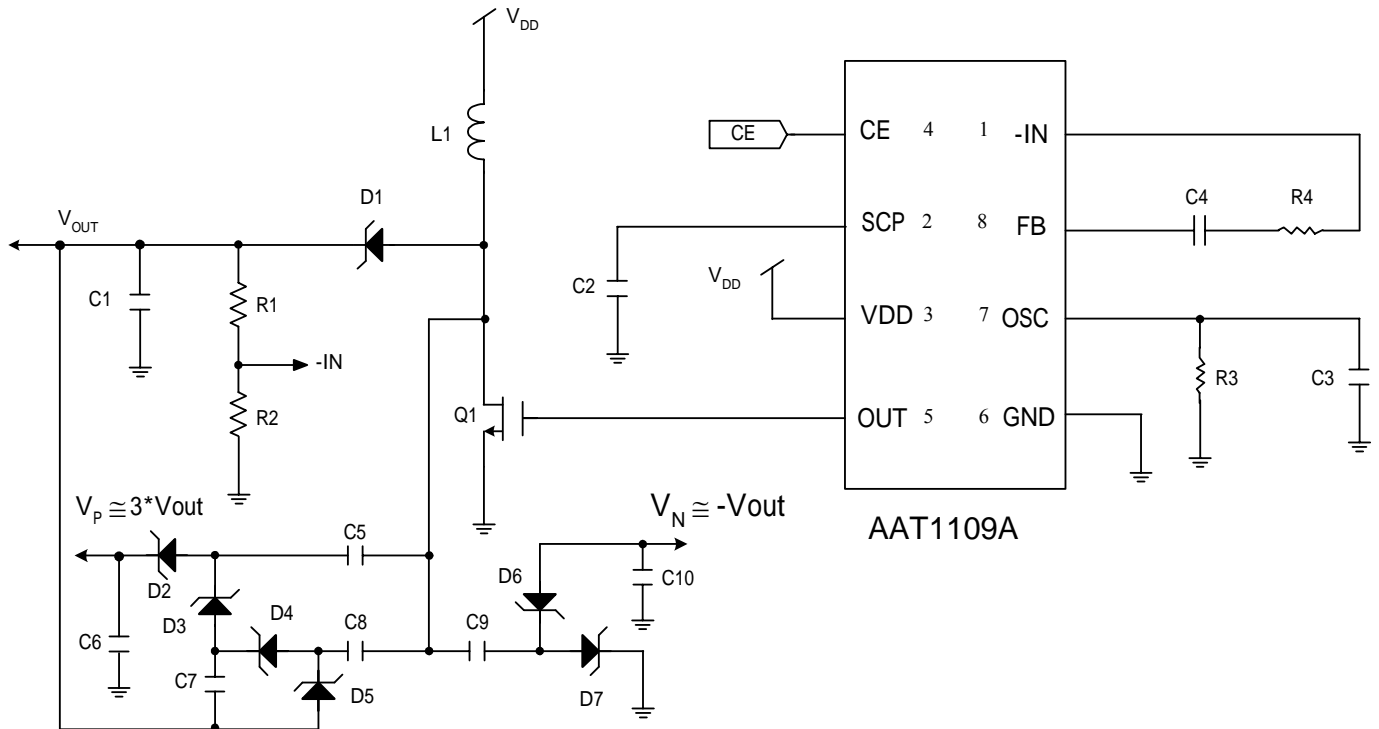




**Application Circuit 1 BOOST(step-up)**

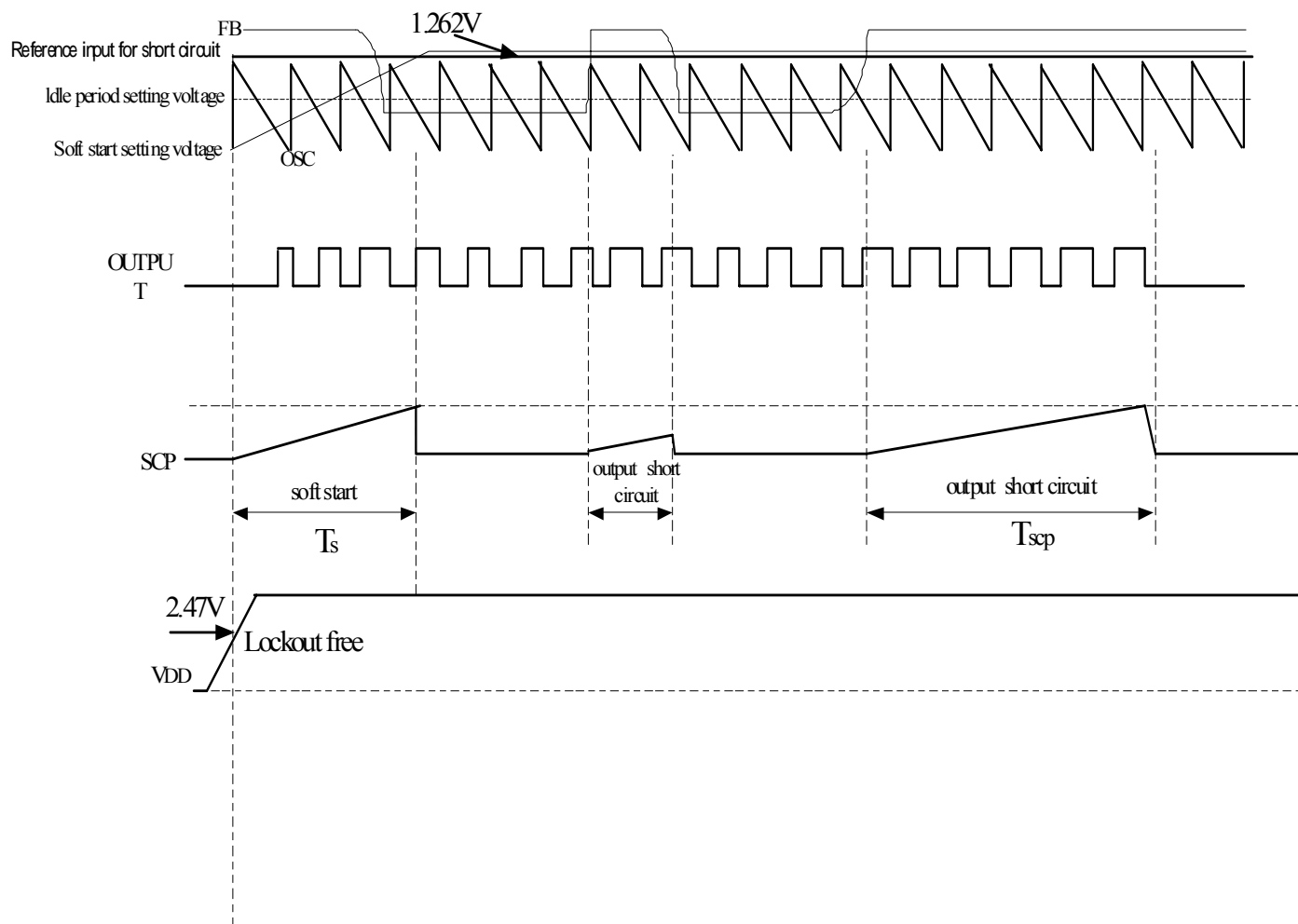


**Application Circuit 2 (with charge pump)**





### Boost ( Step-up ) Timing Chart

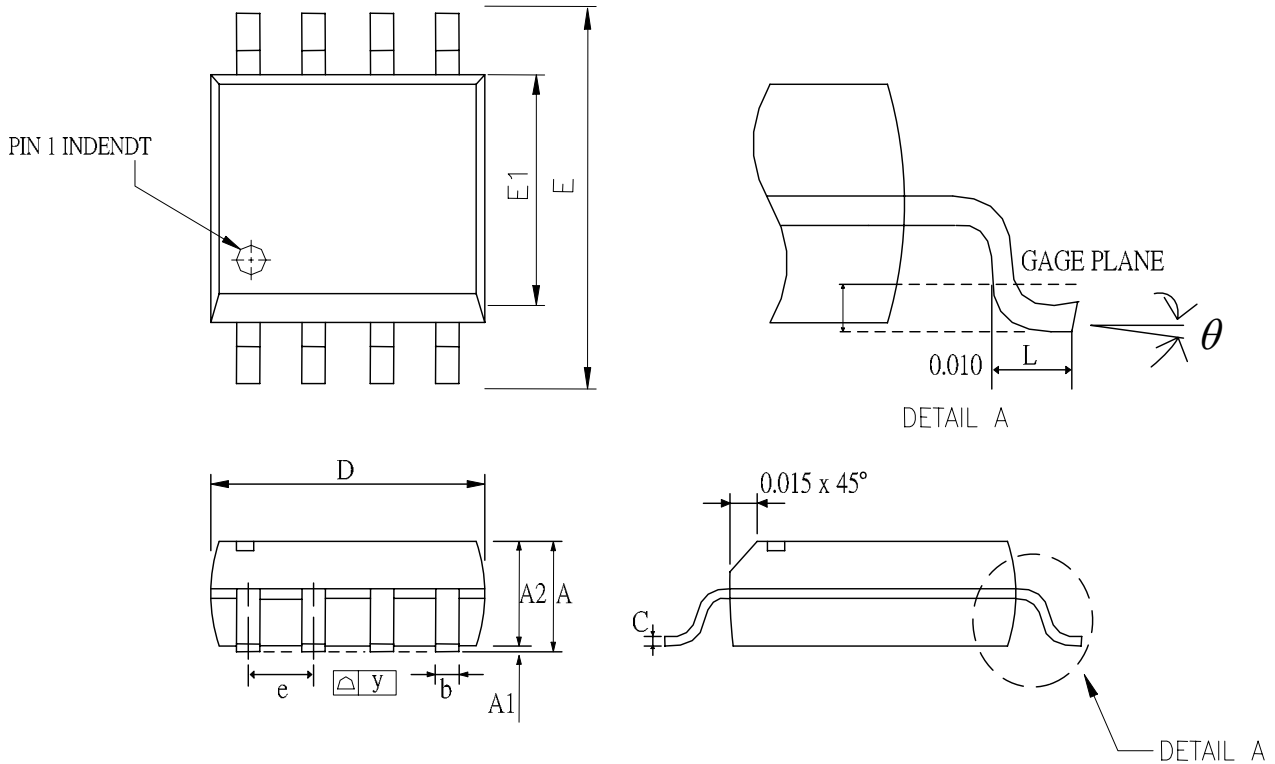






Package Dimension (Unit: Mil)

8-pin SOP

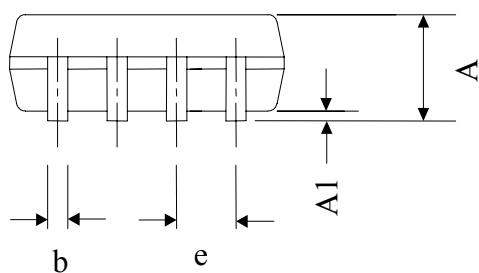
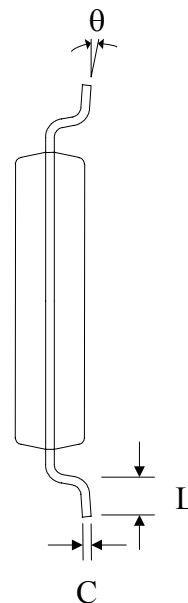
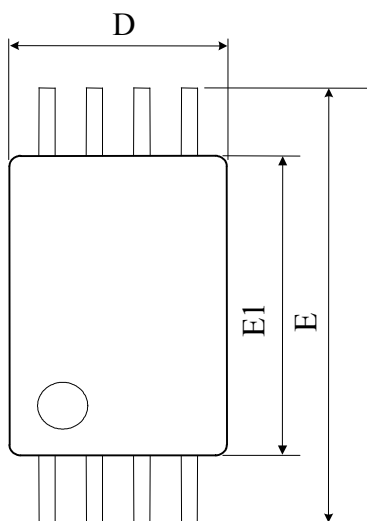


SYMBOLS	DIMENSIONS IN MILLIMETERS			DEMINSIONS IN INCHES		
	MIN	NOM.	MAX	MIN	NOM.	MAX
A	1.47	1.60	1.73	0.058	0.063	0.068
A1	0.10	---	0.22	0.004	---	0.008
A2	---	1.45	---	---	0.057	---
b	0.33	0.41	0.51	0.013	0.016	0.020
C	0.19	0.20	0.25	0.0075	0.008	0.0098
D	4.80	4.85	4.95	0.189	0.191	0.195
E	5.80	6.00	6.20	0.228	0.236	0.244
E1	3.80	3.90	4.00	0.150	0.154	0.157
e	---	1.27	---	---	0.050	---
L	0.38	0.71	1.27	0.015	0.028	0.050
y	---	---	0.076	---	---	0.00.
θ	0	---	0	0	---	0



Package Dimension (Unit: Mil)

8-pin TSSOP



Dimension	Millimeters			Inches		
	Min	Nom	Max	Min	Nom	Max
A	1.00	1.10	1.20	0.039	0.043	0.047
A1	0.025	0.10	0.175	0.002	0.004	0.006
b	-----	0.22	-----	-----	0.008	-----
C	-----	0.127	-----	-----	0.005	-----
D	2.90	3.00	3.10	0.114	0.118	0.122
E	6.20	6.40	6.60	0.244	0.252	0.260
E1	4.30	4.40	4.50	0.169	0.173	0.177
e	---	0.65	---	---	0.026	---
L	0.45	0.60	0.75	0.020	0.024	0.028
$\theta$	0°	3°	8°	0°	3°	8°