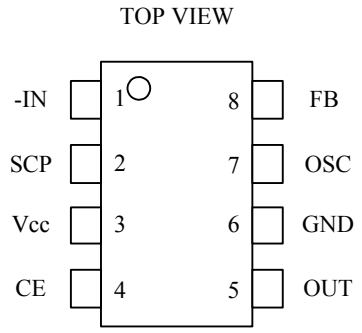
Preliminary and Provisional

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

Pin Configuration



(SOP-8 PACKAGE)
(TSSOP-8 PACKAGE)

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 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	Pd	500	mW

Recommended Operating Conditions

	Symbol	Min	Max	Unit
Supply voltage, V_{DD}	V_{DD}	2.6	6.5	V
Error amplifier input voltage	VI	0.5	1.6	V
OSC capacitor	C_T	100	10000	pF
OSC resistor	R_T	1.0	10	kΩ
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 = 4.2kΩ	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 °C	2.12	2.47	2.85	V
Lower threshold voltage	V_{UPL}	T_A = 25 °C	1.96	2.28	2.63	V
Hysteresis (V_{UPH} – V_{UPL})	V_{HYS}	T_A = 25 °C		0.3		V

Note1 : Typical values of all parameters are specified at T_A =25 °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}	Vscp=0v	-1.0	-1.5	-2.15	µA

Soft start

Parameter		Test Condition	Min	Typ	Max	Unit
Charging current	Ics	Vscp=0v	-1.0	-1.5	-2.15	µA
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 = 4.2kΩ 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 °C to 90 °C		1		%
Input bias current	I_B			0.1	1	μA
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		μA
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 Cscp connected to SCP pin starts charging at a constant current. In the soft start mode, the voltage at SCP pin (VSCP) is input to the PWM comparator, so that the ON duty of the OUT pin is controlled by the VSCP. 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(sec) ~ 0.84 ˟ C_{SCP}(uF)

2.Short circuit protection

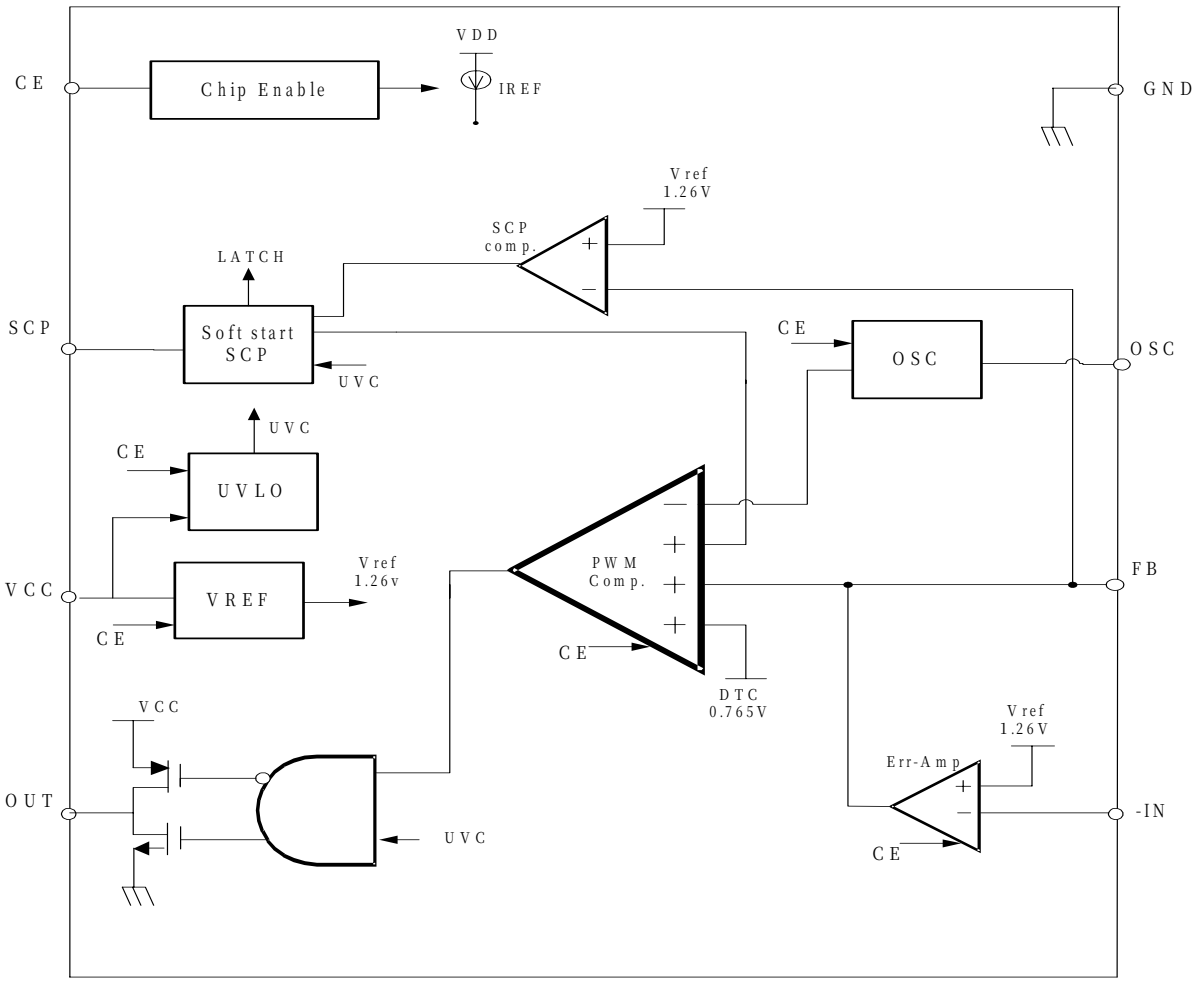
If the switching regulator output suddenly drops due to loading effect , the error amplifier output is fixed at VOM^+ and capacitor C_{SCP} starts charging. When the voltage at the SCP pin reaches approximately 1.26V ,the output pin set low and SCP pin stays low.

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

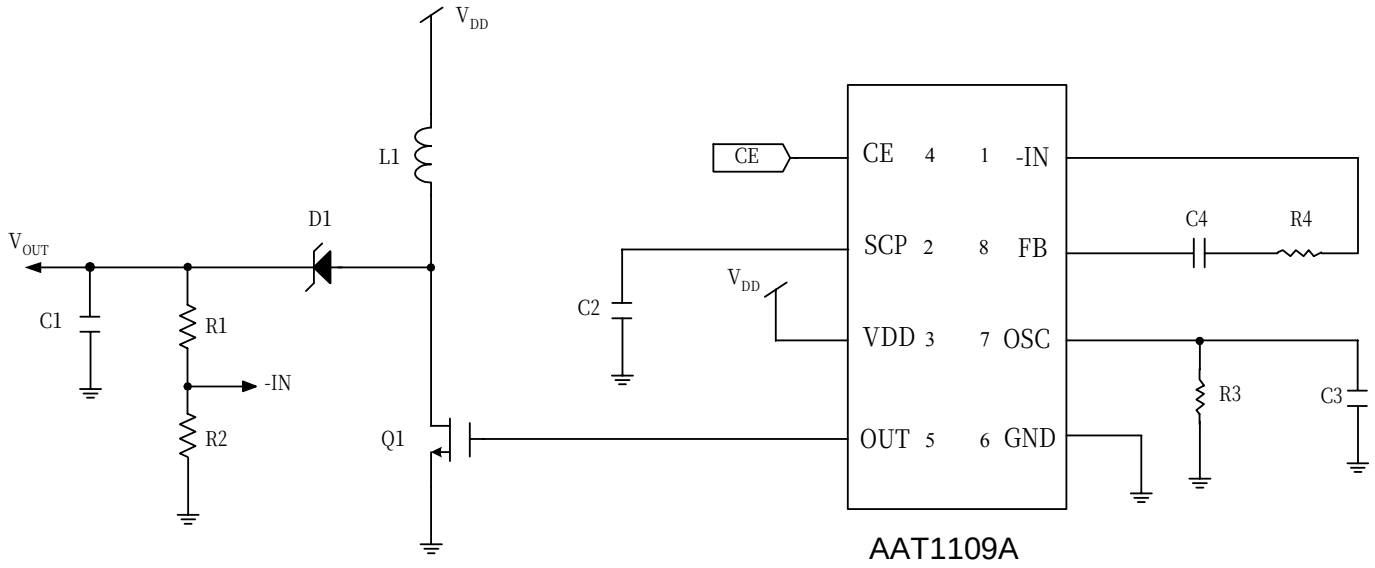
Short circuit detection time

T_{scp}(sec) ~ 0.84 ˟ C_{SCP}(uF)

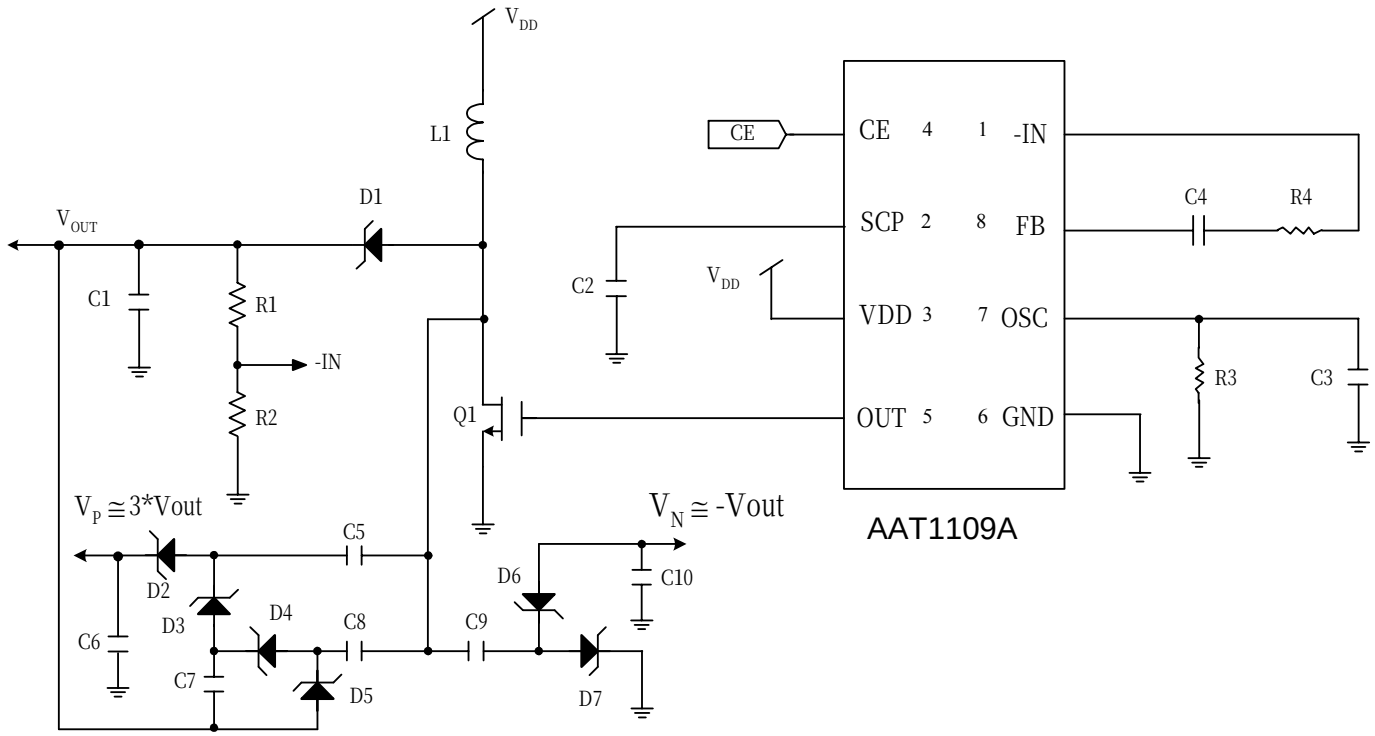
Function Block Diagram



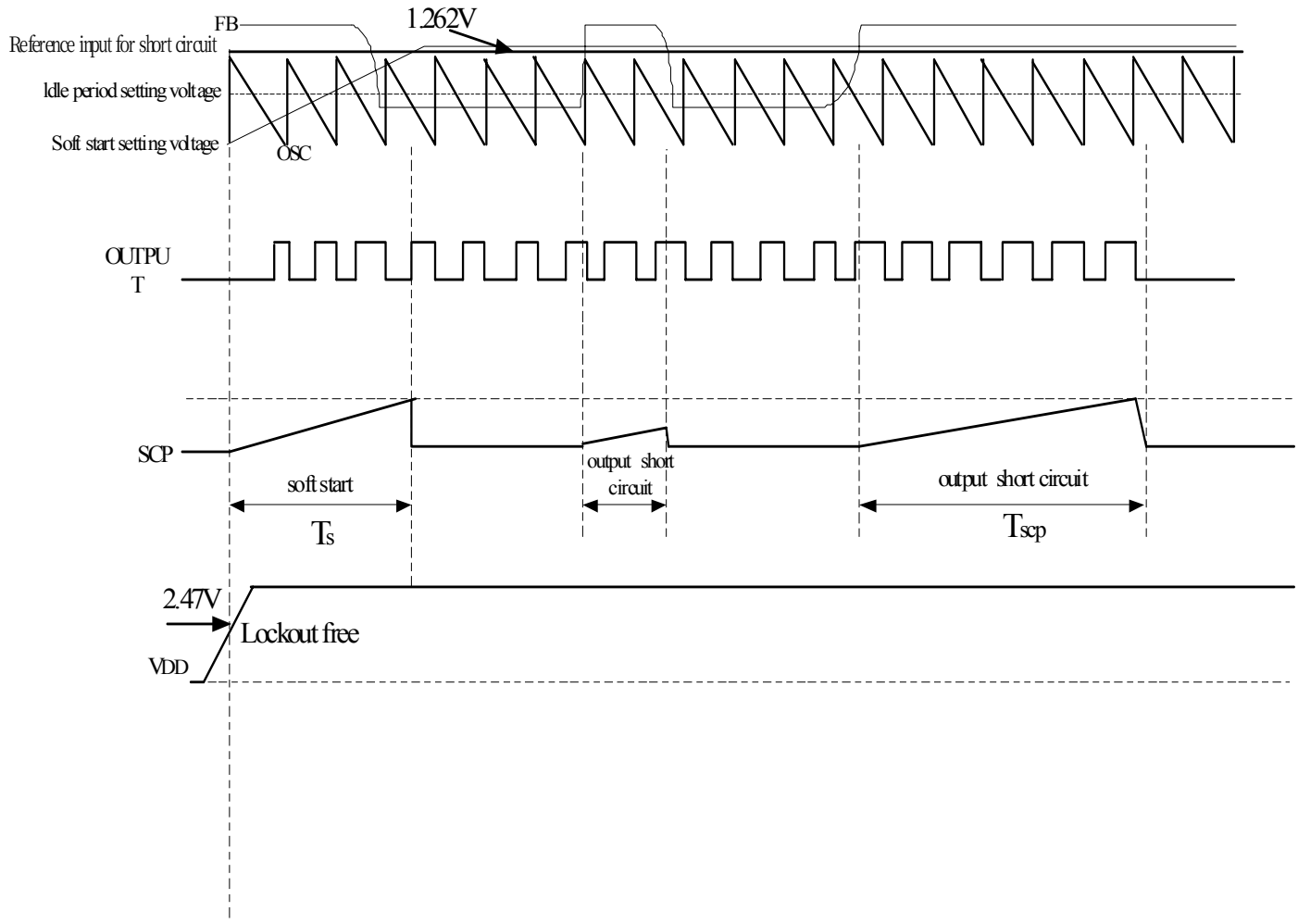
Application Circuit 1 BOOST(step-up)



Application Circuit 2 (with charge pump)

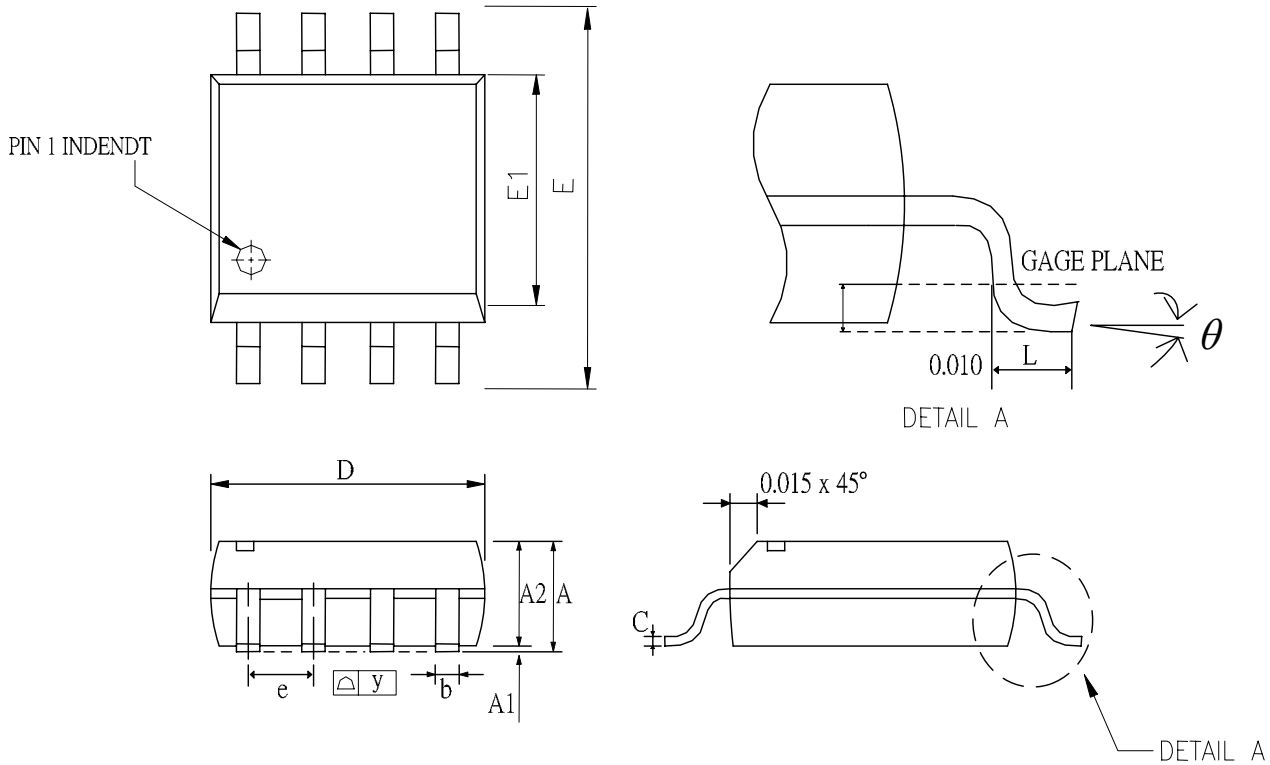


Boost （Step-up）Timing Chart



Package Dimension (Unit: Mil)

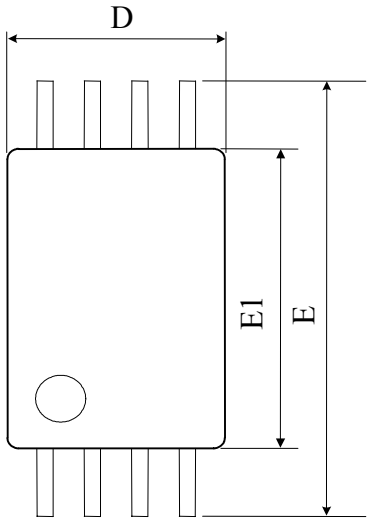
8-pin SOP

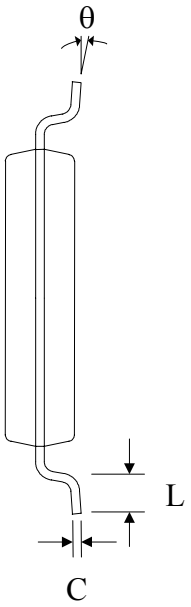


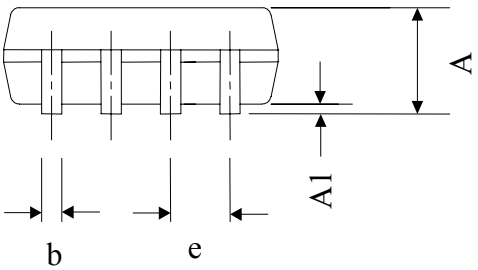
SYMBOLS	DIMENSIONS IN MILLIMETERS			DEMINSIONS IN INCHES		
	MIN	NOM.	MAX	MIN	NOM.	MAX
A	1.47	1.60	1.73	0.058	0.063	0.068
A1	0.10	---	0.22	0.004	---	0.008
A2	---	1.45	---	---	0.057	---
b	0.33	0.41	0.51	0.013	0.016	0.020
C	0.19	0.20	0.25	0.0075	0.008	0.0098
D	4.80	4.85	4.95	0.189	0.191	0.195
E	5.80	6.00	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
θ	0°	3°	8°	0°	3°	8°