



Advanced Analog Technology, Inc.

AAT1110

Details are subject to change without notice

ONE-CHANNEL STEP-DOWN PWM CONTROLLER

Features

- Under-Voltage Lockout (UVLO) Protection
- Totem Pole Output
- Output Short Circuit Protection
- Incorporates Soft-Start Function
- Wide Operating Frequency :
10 kHz to 1MHz
- Shutdown Control
- Low Dissipation Current :
Typical 1.6mA in Operation
- SOP-8 & TSSOP-8 Package Available

General Description

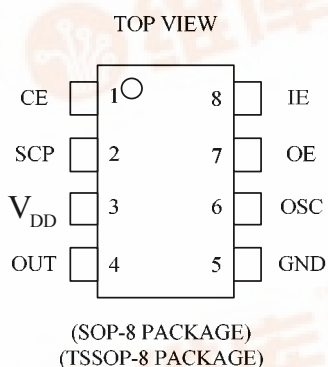
The AAT1110 is a one-channel step-down PWM controller incorporating a soft-start function and a short circuit protection (SCP) function.

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 enabled feature is provided to power down and reduce the supply current to 10 μ A .

With an optimized number of external components, the AAT1110 offers a simple and cost effective solution.

Pin Configuration





Pin Description

Pin No	Name	I/O	Description
1	CE	I	Chip Enable Input Pin (Internal Pull "H")
2	SCP	-	Soft-Start and SCP Capacitor Connection Pin
3	V _{DD}	-	Power Supply
4	OUT	O	Totem-Type Output Pin
5	GND	-	Ground
6	OSC	O	Capacitor and Resistor Connection Pin for Setting the Oscillation Frequency
7	OE	O	Error Amplifier Output Pin
8	IE	I	Error Amplifier Inverting Input 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 _C	– 20 to +85	°C
Storage Temperature Range	T _{storage}	– 45 to +125	°C
Power Dissipation	P _d	500	mW

Recommended Operating Conditions

Characteristics	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 _{OSC}	100	10,000	pF
OSC Resistor	R _{OSC}	1.0	10.0	kΩ
Oscillator Frequency	f _{OSC}	10	1,000	kHz
Output Current	I _O	-	+30/– 30	mA
Operating Free-Air Temperature	T _C	– 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}	$C_{OSC} = 270pF$, $R_{OSC} = 4.2 k\Omega$	400	500	600	kHz
Frequency Variation With Temperature	$f_{\Delta T}$			5		%
Frequency Input Stability	$f_{\Delta V}$	$V_{DD} = 2.6V$ to $6.5V$		1		%

Under-Voltage Protection

Parameter		Test Condition	Min	Typ	Max	Unit
Upper Threshold Voltage	V_{UPH}	$T_C = 25^\circ C$	2.12	2.47	2.85	V
Lower Threshold Voltage	V_{UPL}	$T_C = 25^\circ C$	1.96	2.28	2.63	V
Hysteresis ($V_{UPH} - V_{UPL}$)	V_{HYS}	$T_C = 25^\circ C$		0.19		V

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

Short Circuit Protection Control

Parameter		Test Condition	Min	Typ	Max	Unit
Input Threshold Voltage	V_{r1}		1.160	1.262	1.360	V
Short-Circuit Detect Threshold Voltage	V_{tscd}		1.160	1.262	1.360	V
Charging Current	I_{SCP}	$V_{SCP} = 0V$	-2.15	-1.50	-1.00	μA

Soft-Start

Parameter		Test Condition	Min	Typ	Max	Unit
Charging Current	I_{CS}	$V_{SCP} = 0V$	-2.15	-1.50	-1.00	μA
Voltage at Soft-Start Completion	V_{ts}		1.160	1.262	1.360	V

Shutdown Control

Parameter		Test Condition	Min	Typ	Max	Unit
Shutdown Enable Voltage	V_{SE}				0.5	V
Shutdown Release Voltage	V_{SR}		2.0			V

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

Parameter		Test Condition	Min	Typ	Max	Unit
Input Threshold Voltage	V_T	$V_{OE} = 0.7V$	1.249	1.262	1.275	V
V_T Input Stability	V_{TAV}	$V_{DD} = 2.6$ to $6.5V$	-	2	8	mV
V_T Variation with Temperature	V_{TAT}	$T_C = -20$ °C to 90 °C	-	1	-	%
Input Bias Current	I_B		-	0.1	1.0	μA
Output Voltage Swing	V_{OS+}		1.4	1.7	-	V
	V_{OS-}		-	0.05	0.20	
Output Sink Current	I_{OS+}	$V_{OE} = 0.7V$	3	20	-	mA
Output Source Current	I_{OS-}	$V_{OE} = 0.7V$	-45	-75	-	μA
Open-Loop Voltage Gain	A_{VO}		70	85	-	dB

Output Section

Parameter		Test Condition	Min	Typ	Max	Unit
High-Level Output Voltage	V_{OH}	$I_O = -30$ mA	1.9	2.3	-	V
Low-Level Output Voltage	V_{OL}	$I_O = +30$ mA	-	0.8	1.2	V
Rise Time	t_{RISE}	$C_L = 1,000$ pF	-	100	-	ns
Fall Time	t_{FALL}	$C_L = 1,000$ pF	-	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}	$R_T = 4.2$ k Ω	-	1.6	-	mA



How to Set the Time Constant for Soft-Start and Short Circuit Protection

1. Soft-Start

At power on, the AAT1110 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} . At completion of the soft-start operation, the voltage at the SCP pin stays low; the input from soft-start circuit to the PWM comparator stays high, and enters 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 will be fixed at V_{OM+} and capacitor C_{SCP} will start charging. When the voltage at the SCP pin reaches approximately 1.26V, the output pin will set low and SCP pin will remain low.

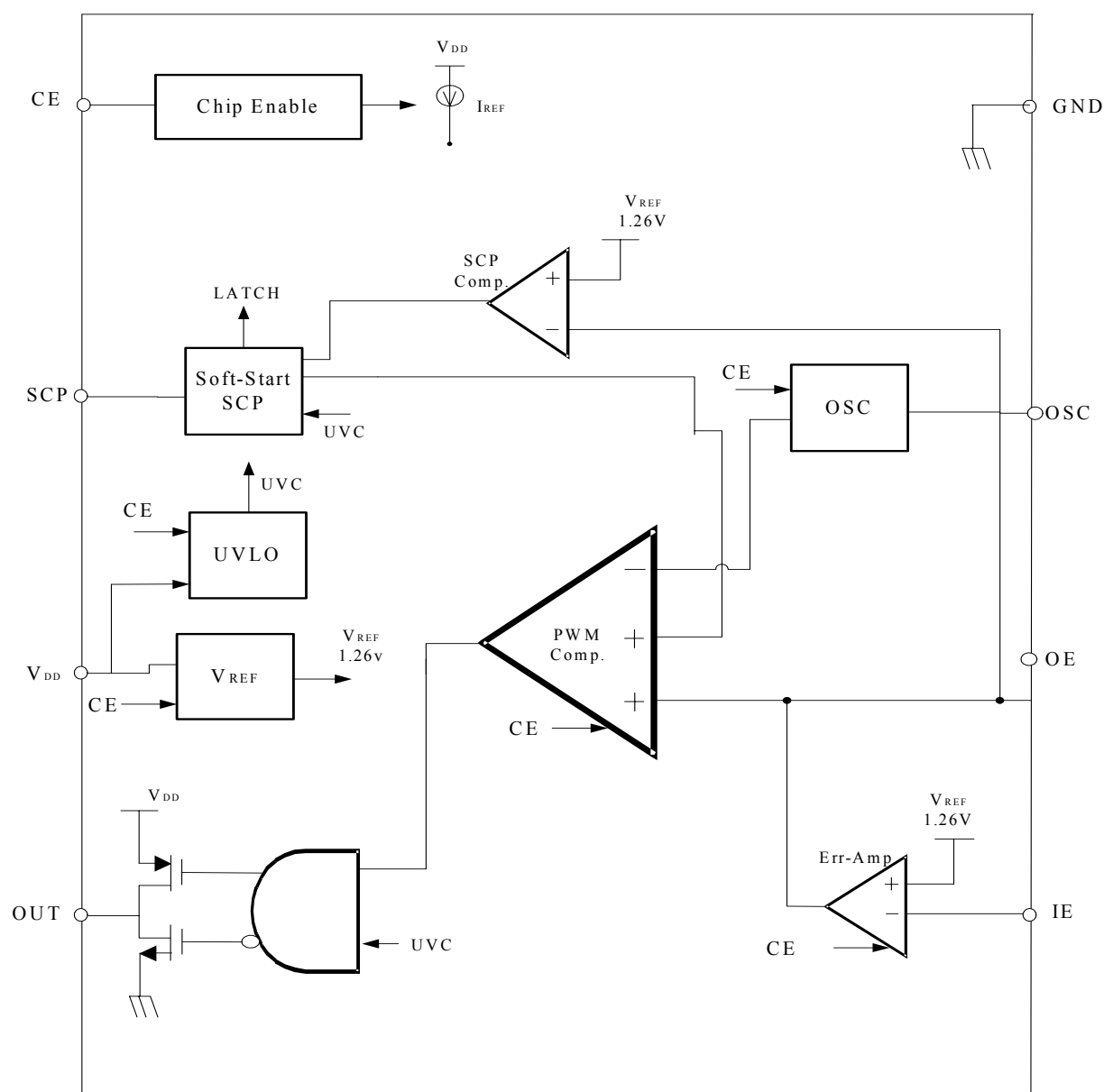
Once the protection circuit starts operating, the circuit can be recovered by setting the power supply.

Short Circuit Detection Time

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

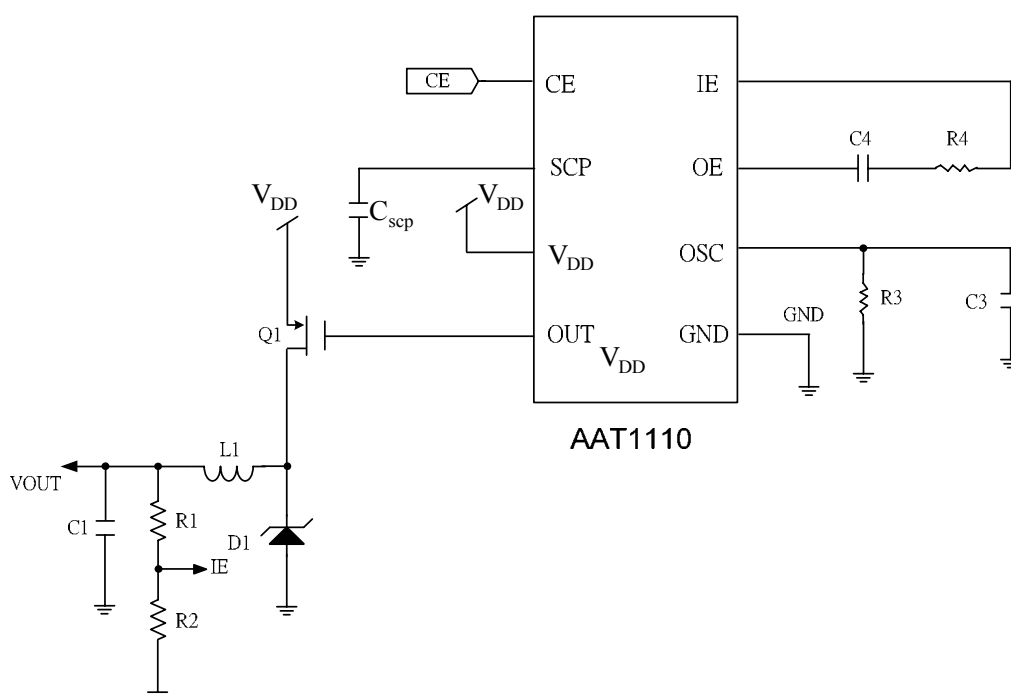


Block Diagram



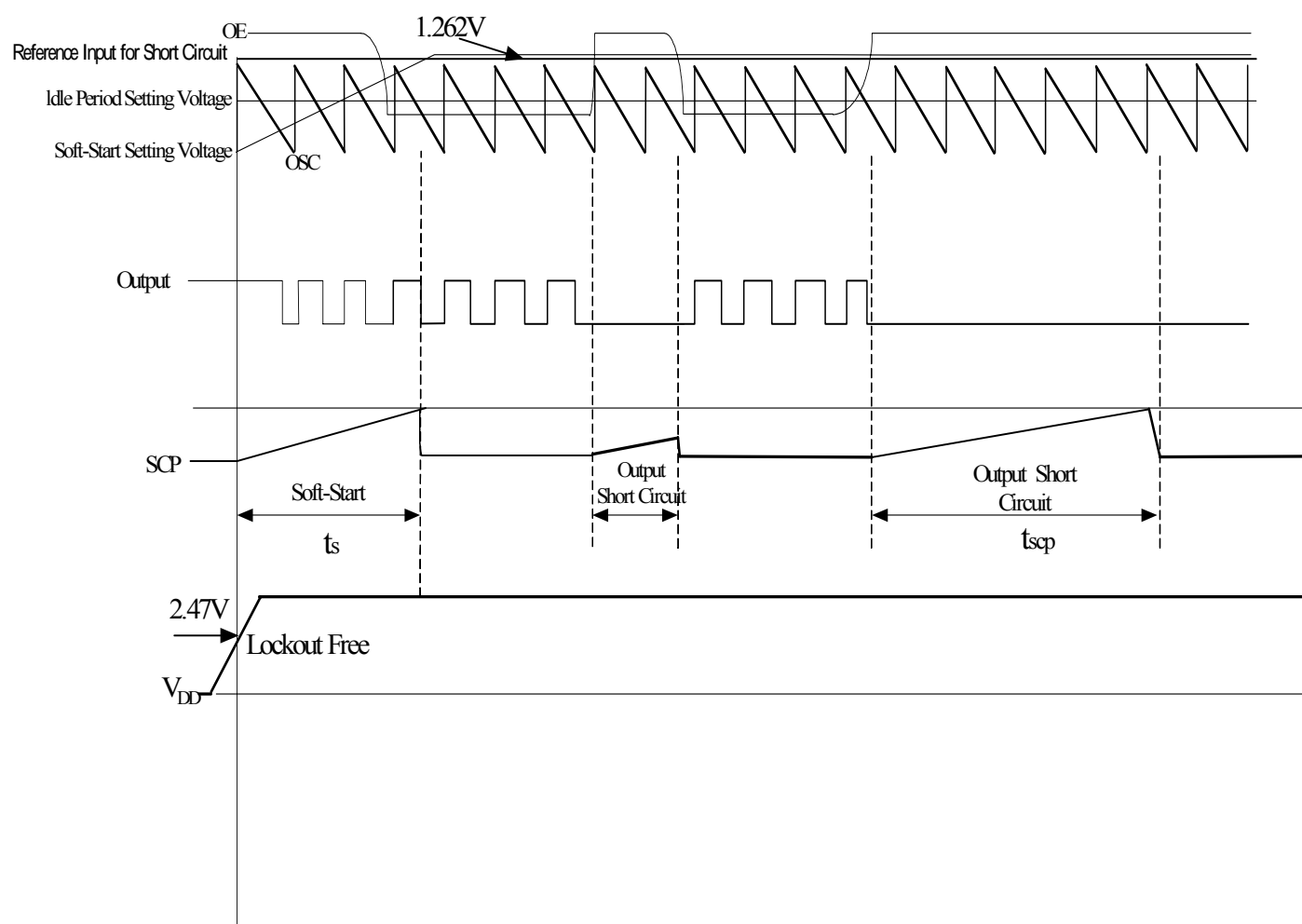


Application Circuit Buck (Step-Down)



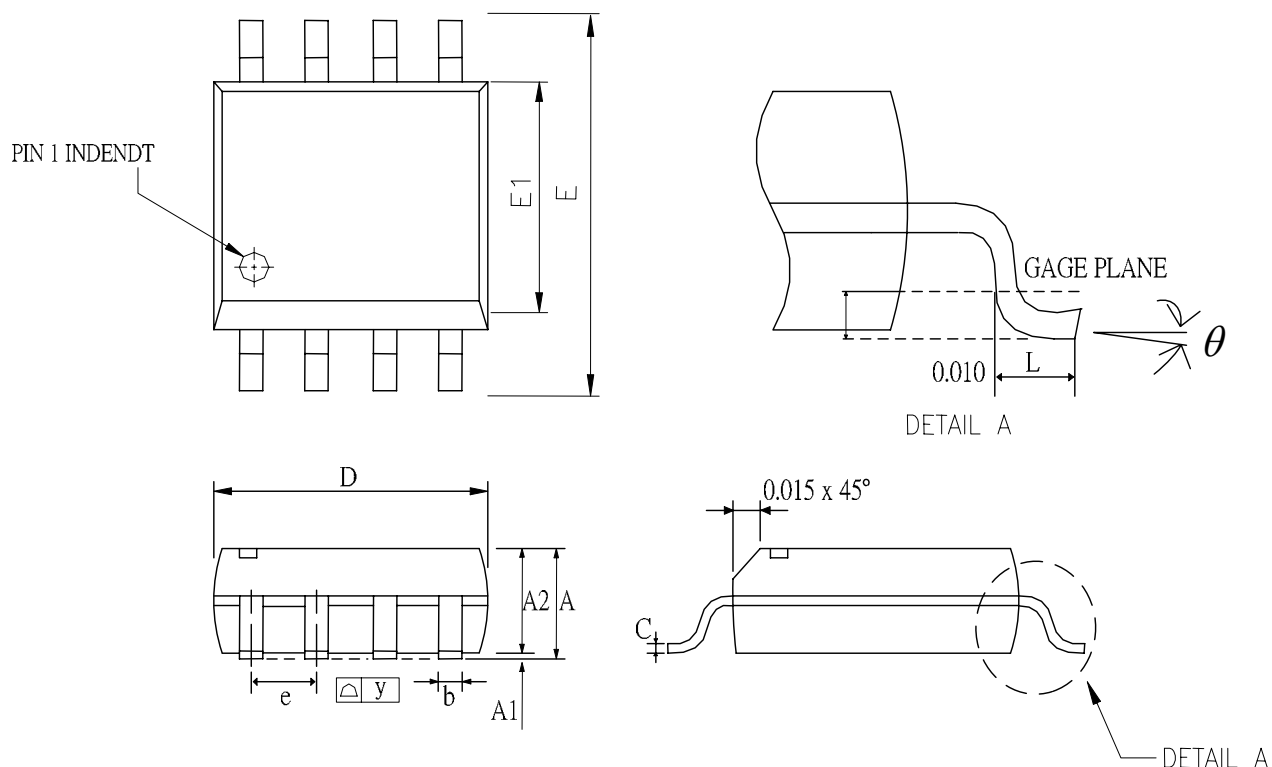


Buck (Step-Down) Timing Chart





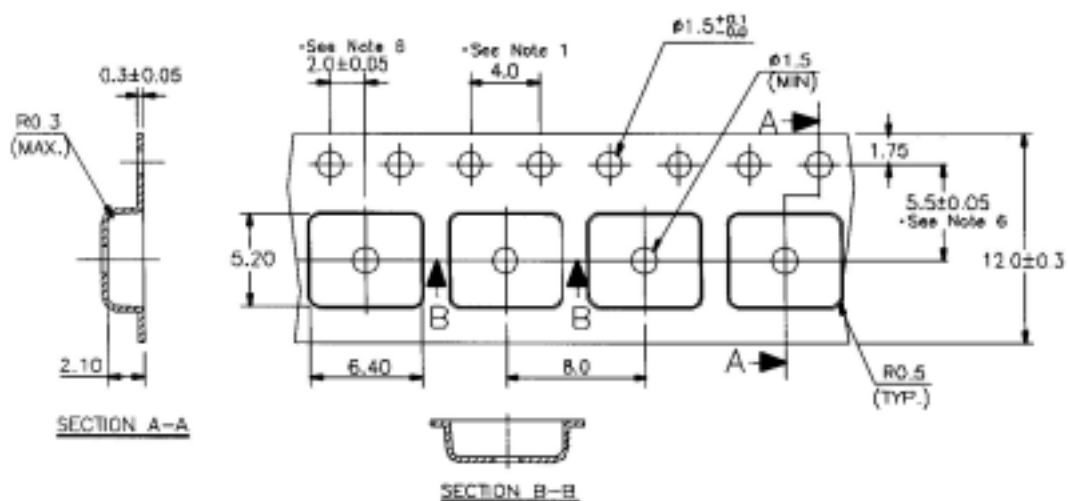
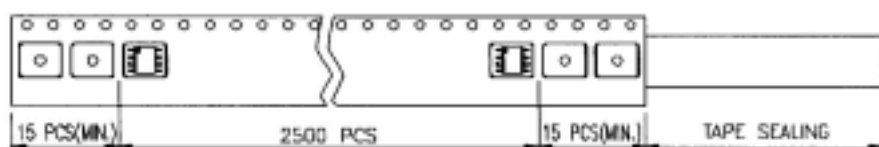
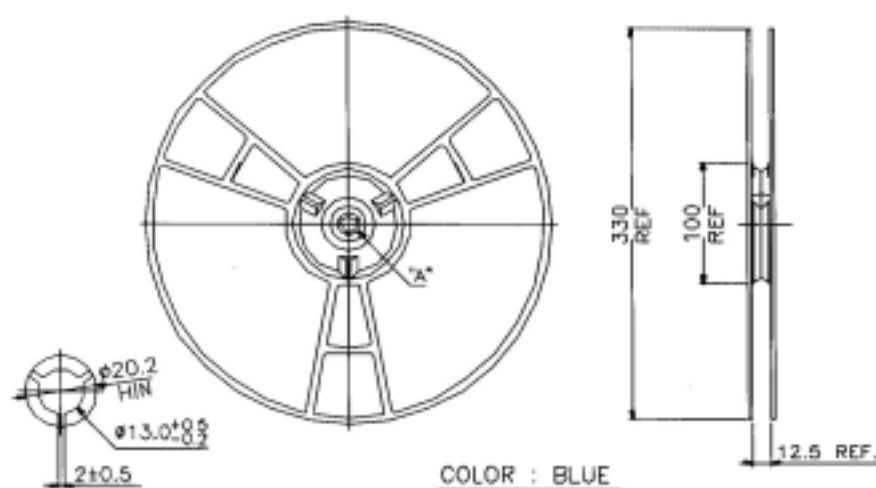
Package Dimension
8-Pin SOP



SYMBOLS	DIMENSIONS IN MILLIMETERS			DEMINSIONS IN INCHES		
	MIN	TYP	MAX	MIN	TYP	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
θ	0	---	0	0	---	0

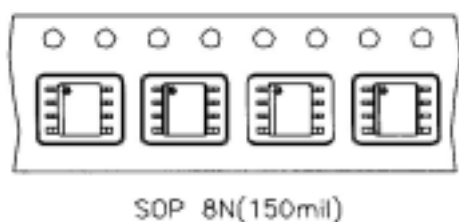


Tape and Reel
8-PinSOP





Tape and Reel
8-Pin SOP (Cont.)

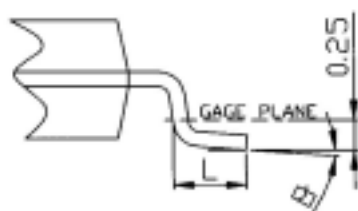
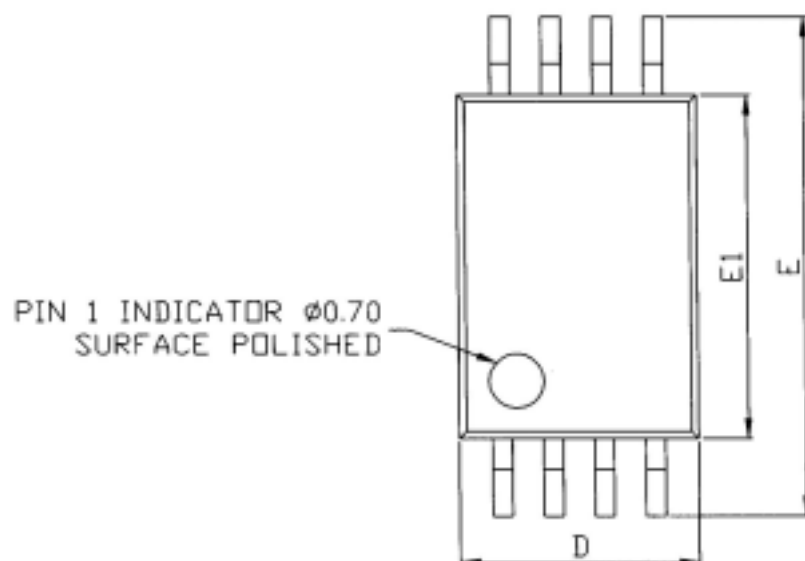


NOTE:

1. 10 SPROCKET HOLE PITCH CUMULATIVE TOLERANCE ± 0.2 MILLIMETERS.
2. CAMBER NOT TO EXCEED 1 MILLIMETER IN 100 MILLIMETERS
3. MATERIAL: ANTI-STATIC BLACK ADVANTEK POLYSTYRENE.
4. A_0 AND B_0 ARE MEASURED ON A PLANE 0.3 MILLIMETERS ABOVE THE BOTTOM OF THE POCKET.
5. K_0 IS MEASURED FROM A PLANE ON THE INSIDE BOTTOM OF THE POCKET TO THE TOP SURFACE OF THE CARRIER.
6. POCKET POSITION RELATIVE TO SPROCKET HOLE IS MEASURED AS TRUE POSITION OF POCKET, NOT POCKET HOLE.



Package Dimension
TSSOP-8



DETAIL A





Package Dimension
TSSOP-8



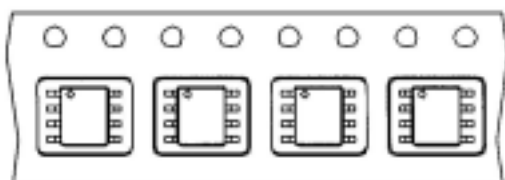
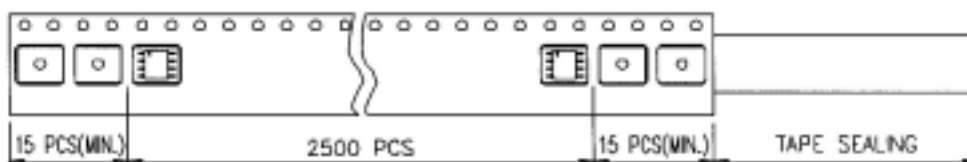
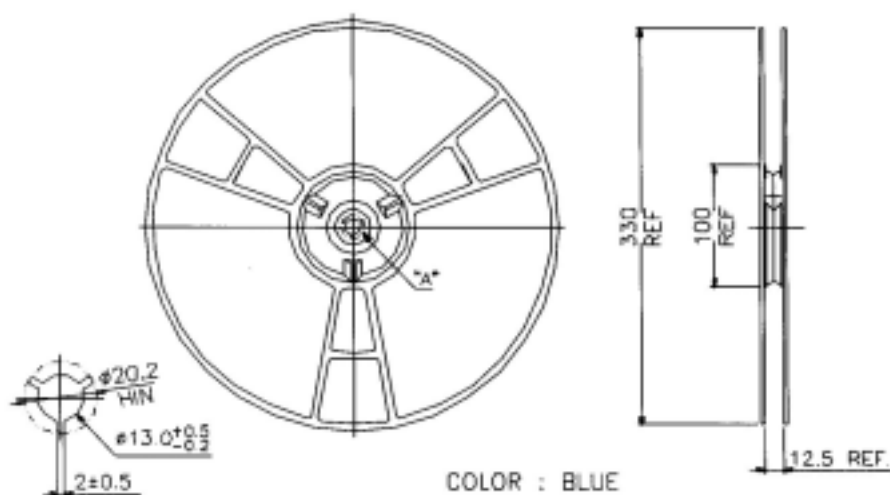
SYMBOL	DIMENSION IN MILLIMETERS			DIMENSION IN INCHES		
	MIN	TYP	MAX	MIN	TYP	MAX
A	1.05	1.10	1.20	0.041	0.043	0.047
A1	0.05	0.10	0.15	0.002	0.004	0.006
A2	-----	1.00	1.05	-----	0.039	0.041
b	0.25	-----	0.30	0.010	-----	0.012
C	-----	0.127	-----	-----	0.005	-----
D	2.90	3.05	3.10	0.114	0.120	0.122
E	6.20	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	0.50	0.60	0.70	0.020	0.024	0.028
y	-----	-----	0.076	-----	-----	0.003
θ	0°	4°	8°	0°	4°	8°

NOTE:

1. CONTROLLING DIMENSION: MILLIMETERS.
2. LEAD FRAME MATERIAL: OLIN C7025/EFTEC 64T.
3. DIMENSION "D" DOES NOT INCLUDE MOLD FLASH, TIE BAR BURRS AND GATE BURRS. MOLD FLASH, TIE BAR BURR AND GATE BURR SHALL BE 0.006" [0.15 MILLIMETERS] PER END. DIMENSION "E1" DOES NOT INCLUDE INTERLEAD FLASH. INTERLEAD FLASH SHALL BE 0.006" [0.15 MILLIMETERS] PER SIDE.
4. DIMENSION "b" DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.002" [0.05 MILLIMETERS] PER SIDE. "b" DIMENSION AT MAXIMUM MATERIAL CONDITION. DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OF THE LEAD. DAMBAR PROTRUSION AND AN ADJACENT LEAD TO BE 0.0028" [0.07 MILLIMETERS].
5. TOLERANCE: ± 0.010 " [0.25 MILLIMETERS] UNLESS OTHERWISE SPECIFIED.
6. OTHERWISE DIMENSION FOLLOW ACCEPTABLE SPEC.
7. REFERENCE DOCUMENT: JEDEC SPEC MO-153.

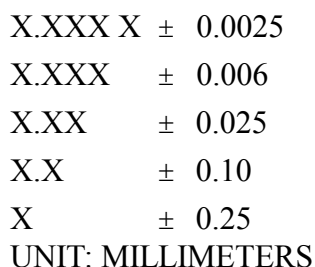


Tape and Reel
TSSOP-8





Tape and Reel TSSOP-8 (Cont.)



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Part Marking

SOP8 Top Marking

AAT1110
XXXXXX

SOP8 Back Marking

YYWW

Part Marking

TSSOP8 Top Marking

AAT1110
XXXXXX

TSSOP8 Back Marking

YYWW



Ordering Information

