680K/1.2MHz, High Voltage, Boost Converter

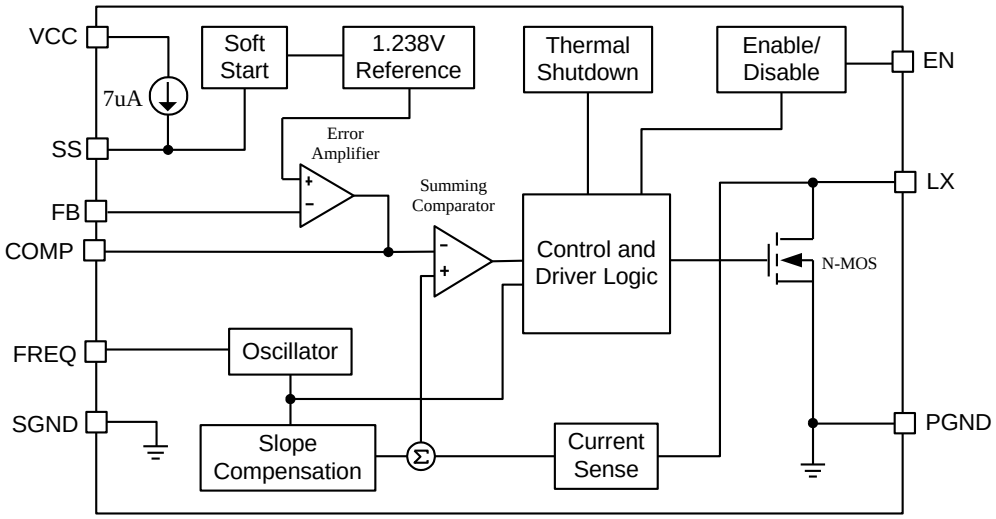
❖ GENERAL DESCRIPTION

The AX5510A is a high performance, high efficiency step up DC-DC Converter with integrated 2A. The AX5510A converter input voltage ranging from 2.6 to 5.5V. The Output voltage can be set up to 27V. The selectable frequency of 680 kHz and 1.2 MHz allows the use of small external inductors and capacitors and provides fast transient response. Current mode control with external compensation network makes it easy to stabilize the system and keep maximum flexibility. Programmable soft start function minimizes impact on the input power system. Internal power MOSFET with very low RDS(ON) provides high efficiency. The AX5510A automatically transits from PWM to PFM during light load condition further increasing efficiency. The converter also provides protection functions such as Current Limit and Thermal shutdown. The AX5510A is available in space-saving MSOP-10L-EP, MOSP-8L-EP, TDFN-10L and SOP-8L-EP packages.

❖ FEATURES

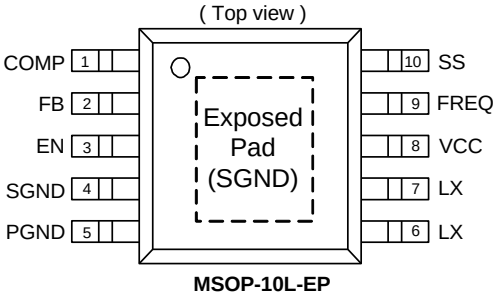
- 2.6V to 5.5V operating input voltage range
- Adjustable output voltage range up to 27V
- Up to 2A output switch current
- 680K/1.2MHz Selectable Switching Frequency
- Programmable soft-start function
- External Compensation Network
- Current limit and Thermal shutdown protection
- Under voltage Lockout
- ≤ 1μA Shutdown Current
- Available in the Pb-Free MSOP-10L-EP, MSOP-8L-EP ,TDFN-10L and SOP-8L-EP Packages
- RoHS and Halogen free compliance.

❖ BLOCK DIAGRAM

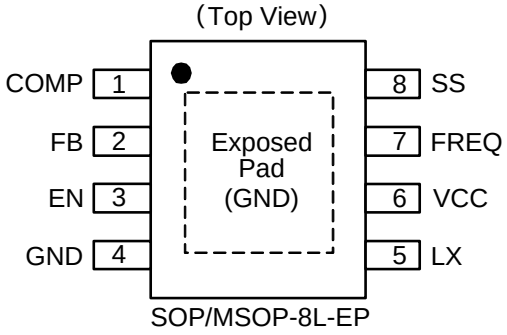


❖ PIN ASSIGNMENT

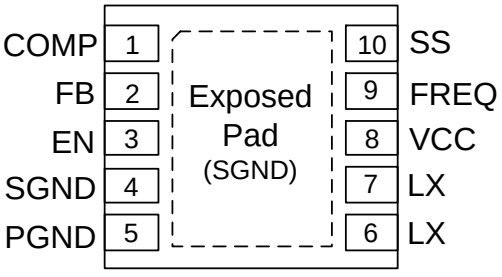
The packages of AX5510A are MSOP-10L-EP, TDFN-10L, SOP-8L-EP and MSOP-8L-EP; the pin assignment is given by:



MSOP-10L-EP



SOP/MSOP-8L-EP



TDFN-10L (3*3)
TOP View

Name	Description
VCC	Power Input pin
EN	Enable Pin
COMP	Compensation Pin
FB	Feedback Pin
SS	Soft start Pin. Connect a capacitor to GND
GND	Ground Pin
SGND	Signal Ground
PGND	Power Ground
LX	Switch Output Pin
FREQ	Frequency select pin. The power switch operates at 680kHz if FREQ is connected to GND and at 1.2MHz if FREQ is connected to VCC

❖ ORDER/MARKING INFORMATION

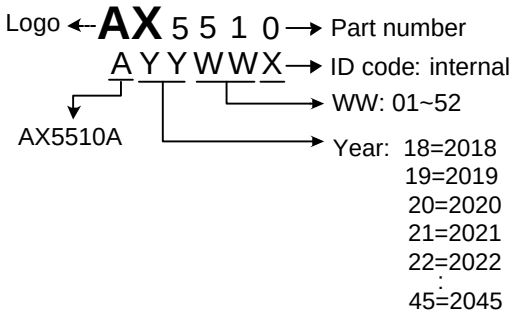
Order Information

AX5510A XXX X

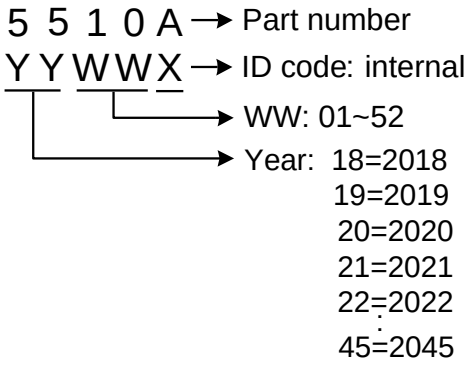
Package Type
ES: SOP-8L-EP
EU: MSOP-10L-EP
EU8: MSOP-8L-EP
J10: TDFN-10L (3*3)

Packing
Blank : Tube
A: Taping

Top Marking (MSOP/SOP)



Top Marking (TDFN-10L)



❖ ABSOLUTE MAXIMUM RATINGS (at T_A=25°C)

Characteristics		Symbol	Rating	Unit
VCC Pin Voltage		V_{CC}	GND - 0.3 to GND + 6	V
EN, FREQ,COMP,FB,SS, Pin Voltage			GND - 0.3 to V_{CC} + 0.3	V
LX Pin Voltage		V_{LX}	30	V
Power Dissipation		PD	(T_J-T_A) / θ_{JA}	mW
Storage Temperature Range		T_{ST}	-65 to +150	°C
Operating Junction Temperature Range		T_{OP}	-40 to +125	°C
Thermal Resistance from Junction to case	MSOP-8/10L-EP	θ_{JC}	30	°C/W
	TDFN-10L		20	
	SOP-8L-EP		15	
Thermal Resistance from Junction to ambient	MSOP-8/10L-EP	θ_{JA}	80	°C/W
	TDFN-10L		55	
	SOP-8L-EP		40	

Note: θ_{JA} is measured with the PCB copper area of approximately 1.5 in^2(Multi-layer). That copper area needs connect to exposed pad.

❖ ELECTRICAL CHARACTERISTICS

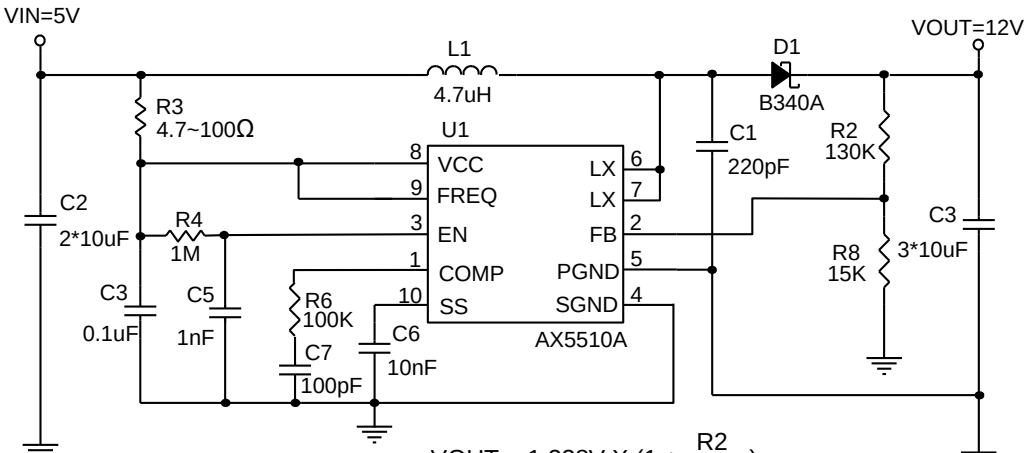
(V_{IN}=5V, V_{OUT}=12V, V_{EN}=V_{IN}, T_A=25°C, unless otherwise noted)

Characteristics	Symbol	Conditions	Min	Typ	Max	Units
Input Voltage range	V_{CC}		2.6	-	5.5	V
Under Voltage Lockout	UVLO	Rising	-	2.35	2.6	V
UVLO Hysteresis			-	-150	-	mV
Step-Up Voltage Adjust Range	V_{OUT}		VCC+0.5	-	27	V
Operating quiescent current	I_{CCQ}	I_{OUT}= 0mA, V_{FB}=1.5V	-	150	250	μA
Shutdown current	I_{SD}	V_{EN}=0V	-	0.1	1	μA
Feedback Voltage	V_{FB}		1.219	1.238	1.257	V
FB Input Leakage Current	I_{FB-LKG}	V_{FB} = 1.5V	-100	0.01	+100	nA
Line Regulation		V_{IN}=2.6 to 5.5V I_{OUT}=20mA	-	0.2	-	%
Load Regulation		V_{IN}=5V I_{OUT}= 1mA to 0.4A	-	0.15	-	%
Oscillator frequency	F_{OSC}	FREQ=High	900	1200	1500	KHz
		FREQ=Low	500	680	850	
FREQ high-level input voltage	V_{FQ-IH}		2	-	-	V
FREQ low-level input voltage	V_{FQ-IL}		-	-	0.5	
FREQ input leakage current	I_{FQ-LKG}	FREQ=GND	-	-	0.1	uA
Soft Start Current	I_{SS}		4	7	13	μA
N-channel MOSFET current limit	I_{LIM}	Duty=40%	2	2.5	-	A
MOSFET on-resistance **(Note)**	$R_{DS(on)}$	V_{IN}=3V, I_{SW}=1A	-	200	280	mΩ
		V_{IN}=5V, I_{SW}=1A	-	160	220	
EN high-level input voltage	V_{IH}		1.0	-	-	V
EN low-level input voltage	V_{IL}		-	-	0.4	V
EN Hysteresis	hys		-	200	-	mV
EN input leakage current	I_{EN-LKG}	V_{EN}=GND or V_{IN}	-	0.01	0.1	μA
Maximum Duty Cycle	Duty	V_{FB}=0V	85	90	-	%
LX Leakage Current	I_{LXL}	V_{LX} = 25V, V_{FB}=1.5V	-	-	10	μA
Thermal Shutdown	TSD		-	150	-	°C
Thermal Shutdown Hysteresis			-	35	-	

Note：Guaranteed by design.

❖ APPLICATION CIRCUIT

(1) FREQ=High (Frequency=1.2MHz) (MSOP-10L and TDFN-10L)

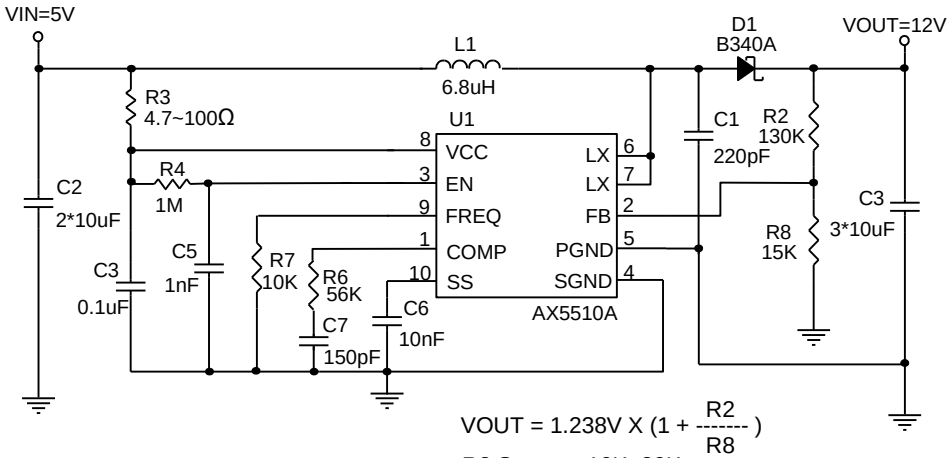


$$VOUT = 1.238V \times \left(1 + \frac{R2}{R8}\right)$$

R8 Suggest 10K~30K

VIN ≦ 4.5V, R3=10Ω
VIN > 4.5V, R3=100Ω

(2) FREQ=Low (Frequency=680KHz) (MSOP-10L and TDFN-10L)

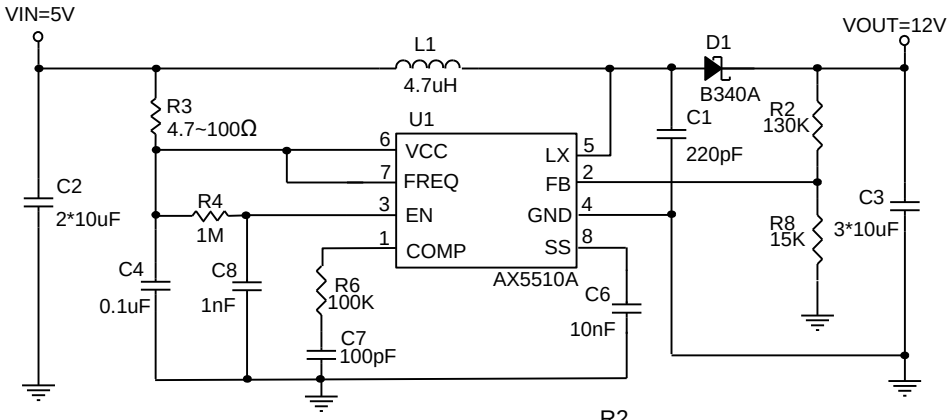


$$VOUT = 1.238V \times \left(1 + \frac{R2}{R8}\right)$$

R8 Suggest 10K~30K

VIN ≦ 4.5V, R3=10Ω
VIN > 4.5V, R3=100Ω

(3) FREQ=High (Frequency=1.2MHz) (SOP-8L/MSOP-8L)



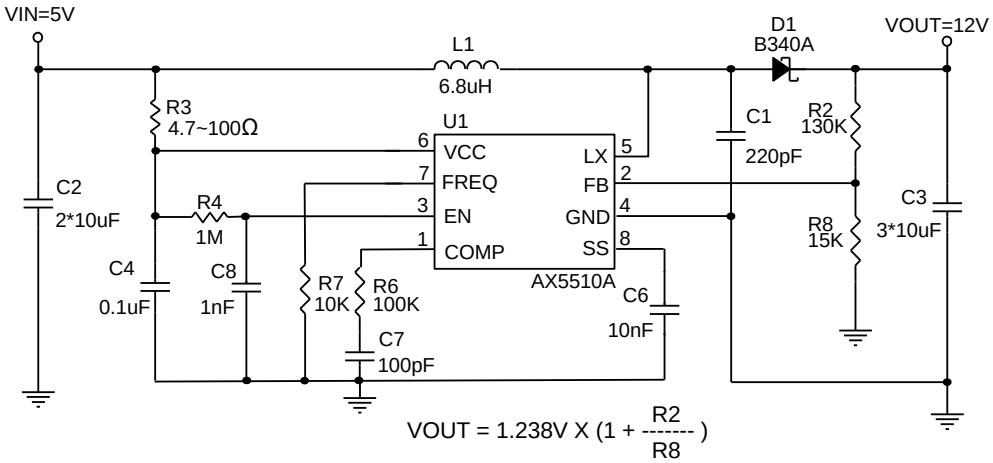
$$VOUT = 1.238V \times \left(1 + \frac{R2}{R8}\right)$$

R8 Suggest 10K~30K

VIN ≦ 4.5V, R3=10Ω

VIN > 4.5V, R3=100Ω

(4) FREQ=Low (Frequency=680KHz) (SOP-8L/MSOP-8L)



$$VOUT = 1.238V \times \left(1 + \frac{R2}{R8}\right)$$

R8 Suggest 10K~30K

VIN ≦ 4.5V, R3=10Ω

VIN > 4.5V, R3=100Ω

❖ COMPENSATION TABLE

Frequency(Hz)	L1 (H)	VIN (V)	VOUT (V)	R6 (Ω)	C7 (F)
680K (FREQ=Low)	6.8u	2.5~4.4	5	10K	1.2n
		2.5~5.5	7	15K	470p
		2.5~5.5	9	27K	270p
		2.5~5.5	12	56K	150p
		2.5~5.5	15	150K	120p
		2.5~5.5	18	110K	100p
		2.5~5.5	21	150K	82p
		2.5~5.5	24	100K	47p
1.2M (FREQ=High)	4.7u	2.5~4.0	5	33K	1n
		2.5~5.5	7	39K	390p
		2.5~5.5	9	39K	220p
		2.5~5.5	12	100K	100p
		2.5~5.5	15	130K	68p
		2.5~5.5	18	150K	56p
		2.5~5.5	21	220K	47p
		2.5~5.5	24	390K	39p

❖ APPLICATION INFORMATION

Setting the Output Voltage

Application circuit item shows the basic application circuit with AX5510A adjustable output version. The external resistor sets the output voltage according to the following equation:

$$V_{OUT} = 1.238V \times \left(1 + \frac{R2}{R8}\right)$$

For most applications, R8 is a suggested a value by 10~30KΩ. Place the resistor-divider as close to the IC as possible to reduce the noise sensitivity.

Soft Start Capacitor

The soft-start function begins from SS pin Voltage=0V to V_{CC} with a 7uA (typ.) constant current charging to the soft-start capacitor, so the capacitor should be large enough to let the output voltage reach regulation inside the soft-start cycle. Typical value of soft-start capacitor range is from 4.7nF to 100nF. After the cycle finished, the load can start to draw maximum current as required.

Frequency Select Pin (FREQ)

The frequency select pin FREQ allows to set the switching frequency of the device to 680 KHz (FREQ = low) or 1.2 MHz (FREQ = high). Higher switching frequency improves load transient response but reduces slightly the efficiency. The other benefits of higher switching frequency are a lower output ripple voltage. Usually, it is recommended to use 1.2 MHz switching frequency unless light load efficiency is a major concern.

Under Voltage Lockout (UVLO)

To avoid mis-operation of the device at low input voltages an under voltage lockout is included that disables the device, if the input voltage falls below (2.35V-150mV).

Input Capacitor Selection

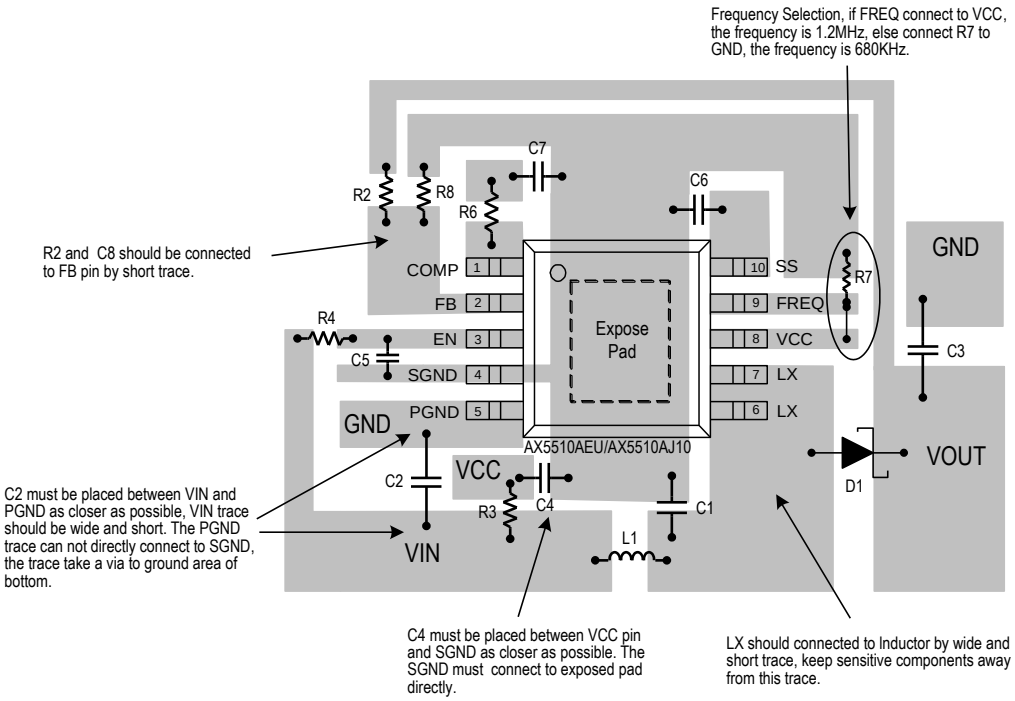
For better input bypassing, low-ESR ceramic capacitors are recommended for performance. Two parallel 10uF (or one 22uF) input capacitor is sufficient for most applications. For a lower output power requirement application, this value can be decreased.

Output Capacitor Selection

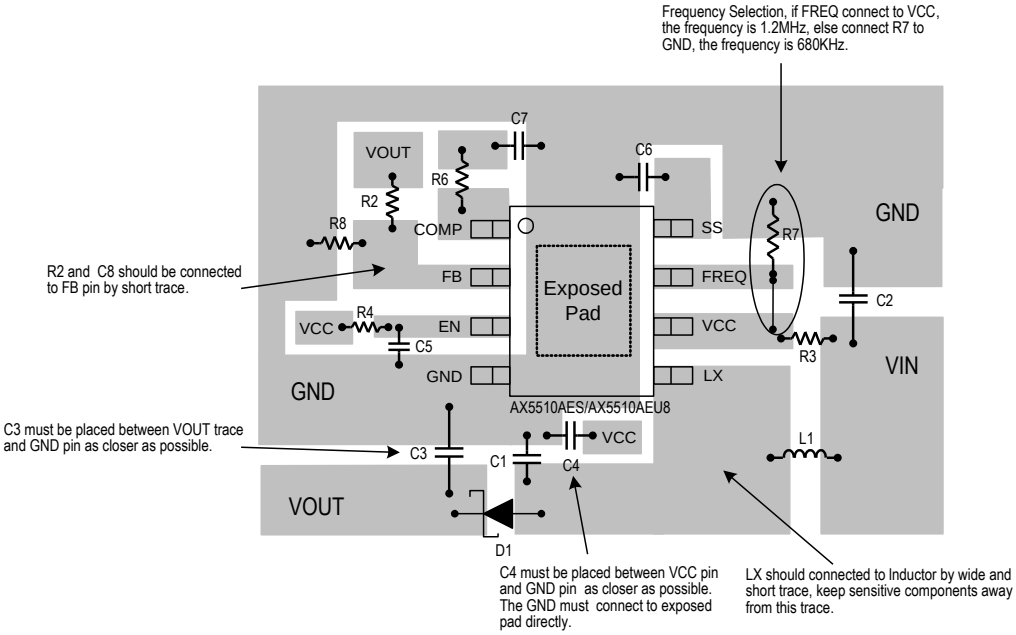
For lower output voltage ripple, low-ESR output capacitor like ceramic capacitor is recommended. Three 10uF ceramic capacitors work for most of the applications. Higher capacitor values can be used to improve the load transient response and reduce output ripple.

Layout Guide

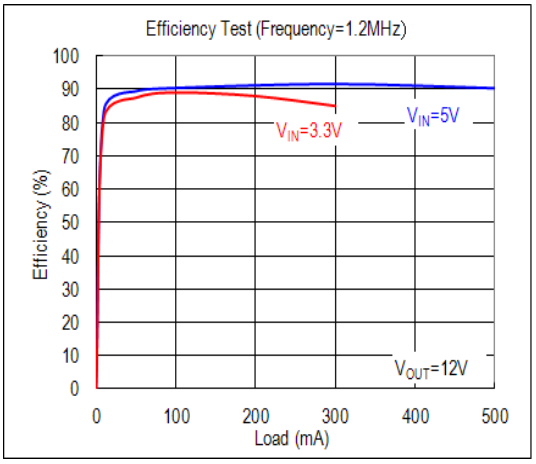
(1) MSOP-10L-EP/TDFN-10L

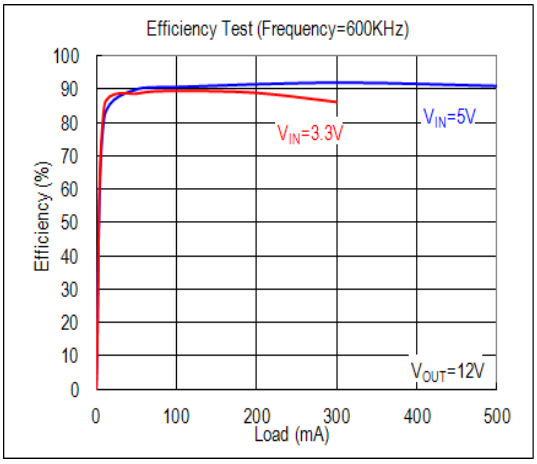


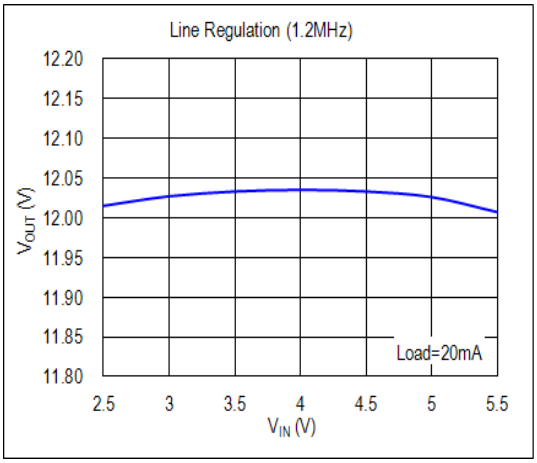
(2) MSOP/SOP-8L-EP

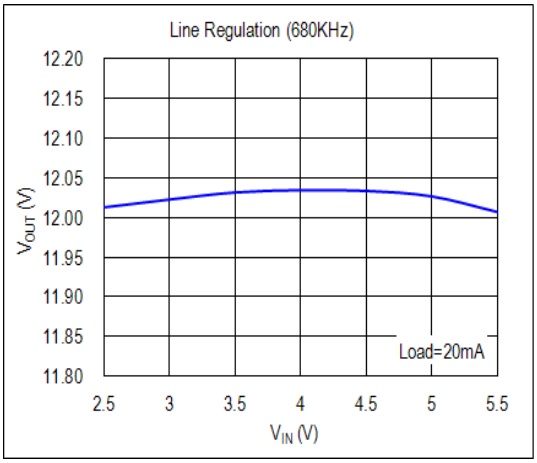


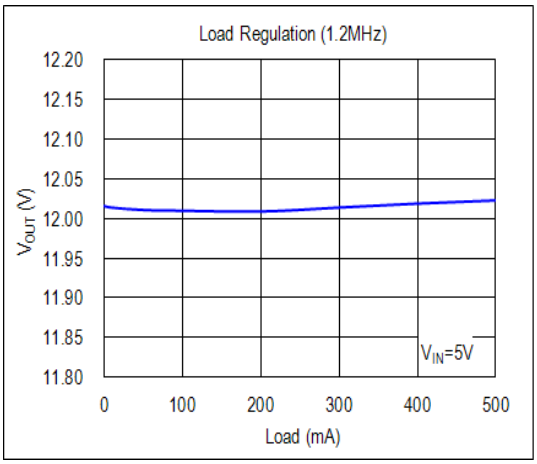
❖ TYPICAL CHARACTERISTICS

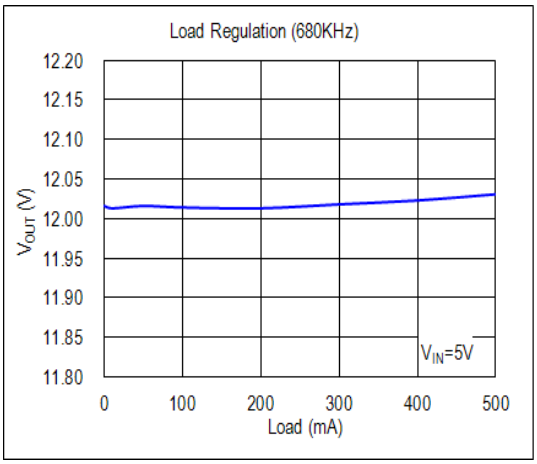




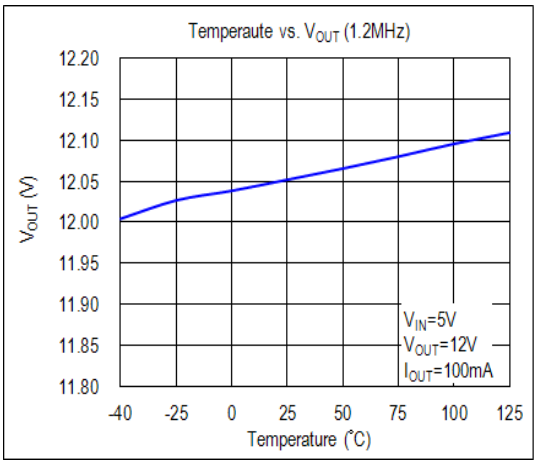


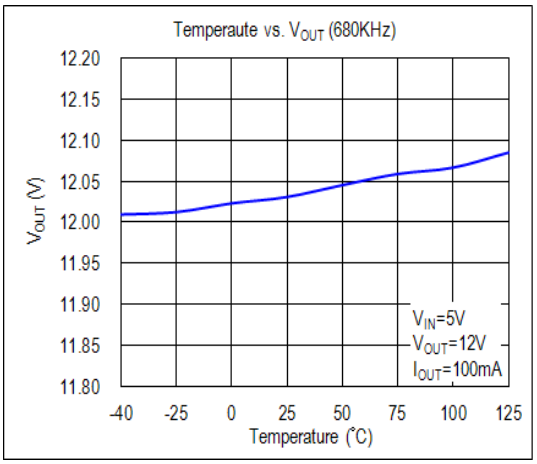


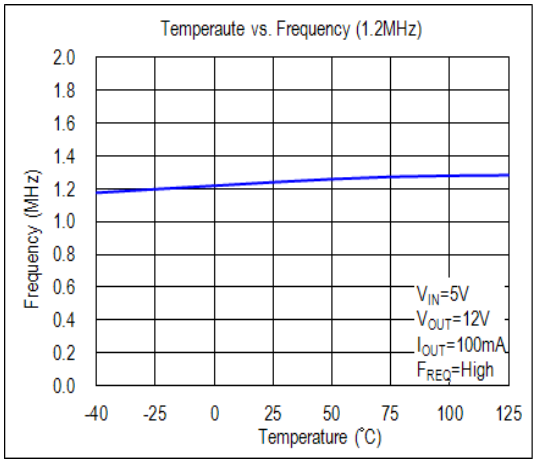


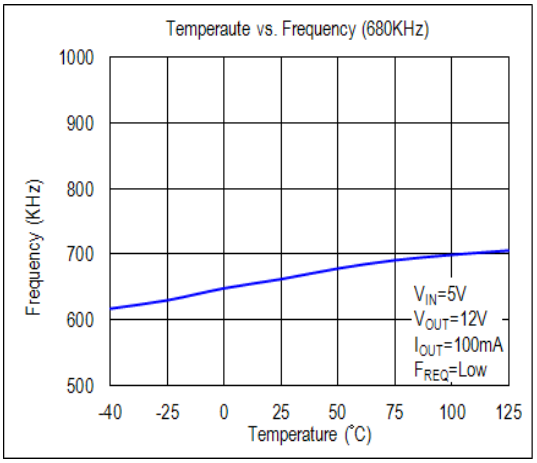


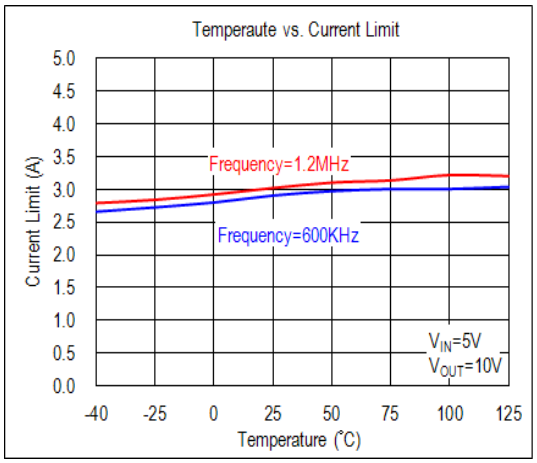
❖ TYPICAL CHARACTERISTICS (CONTINUOUS)

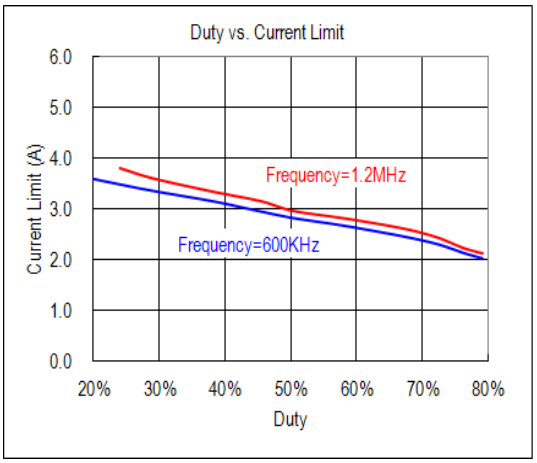




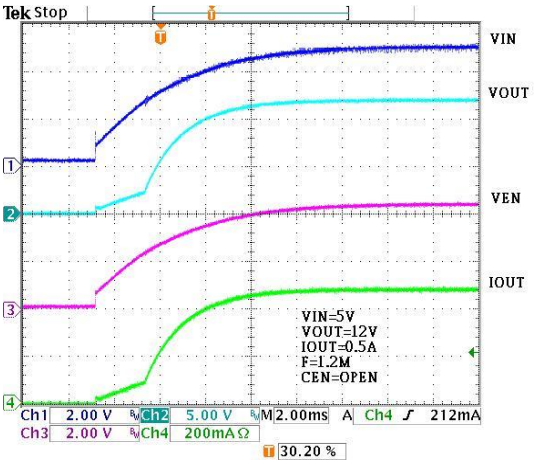


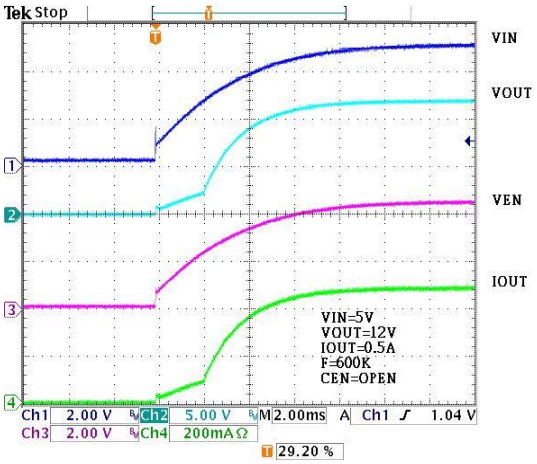


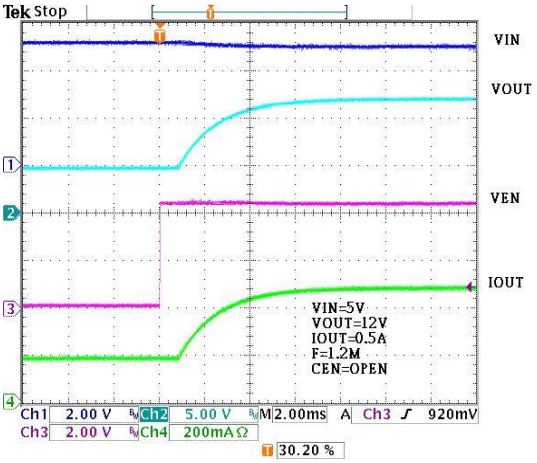


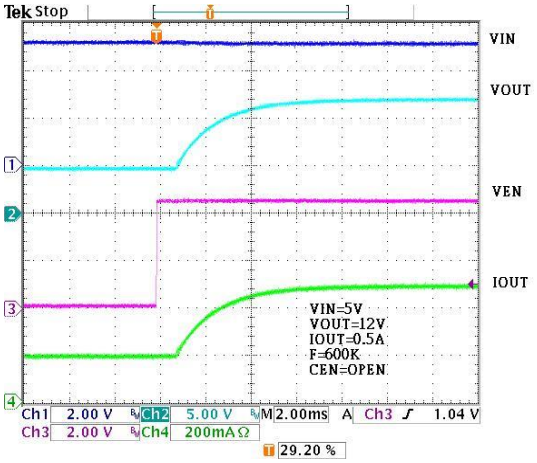


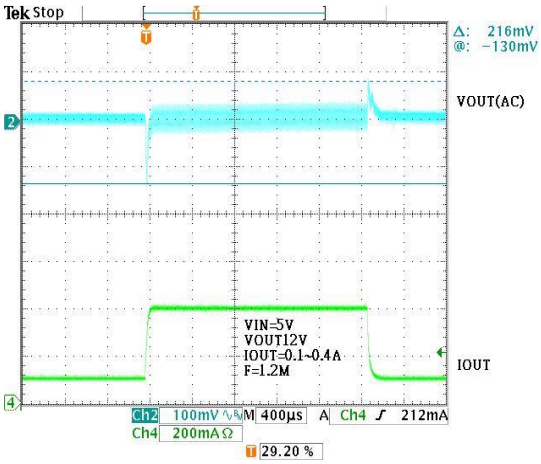
❖ TYPICAL CHARACTERISTICS (CONTINUOUS)

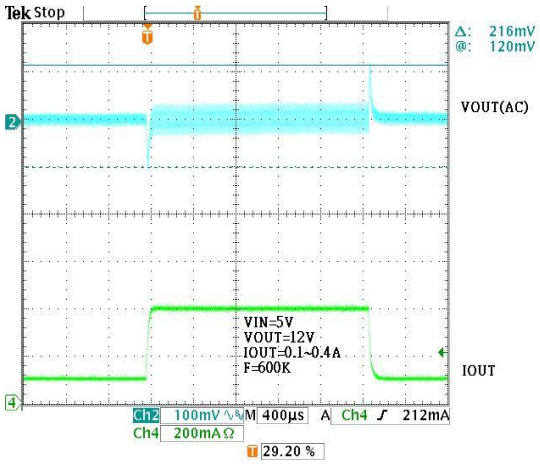






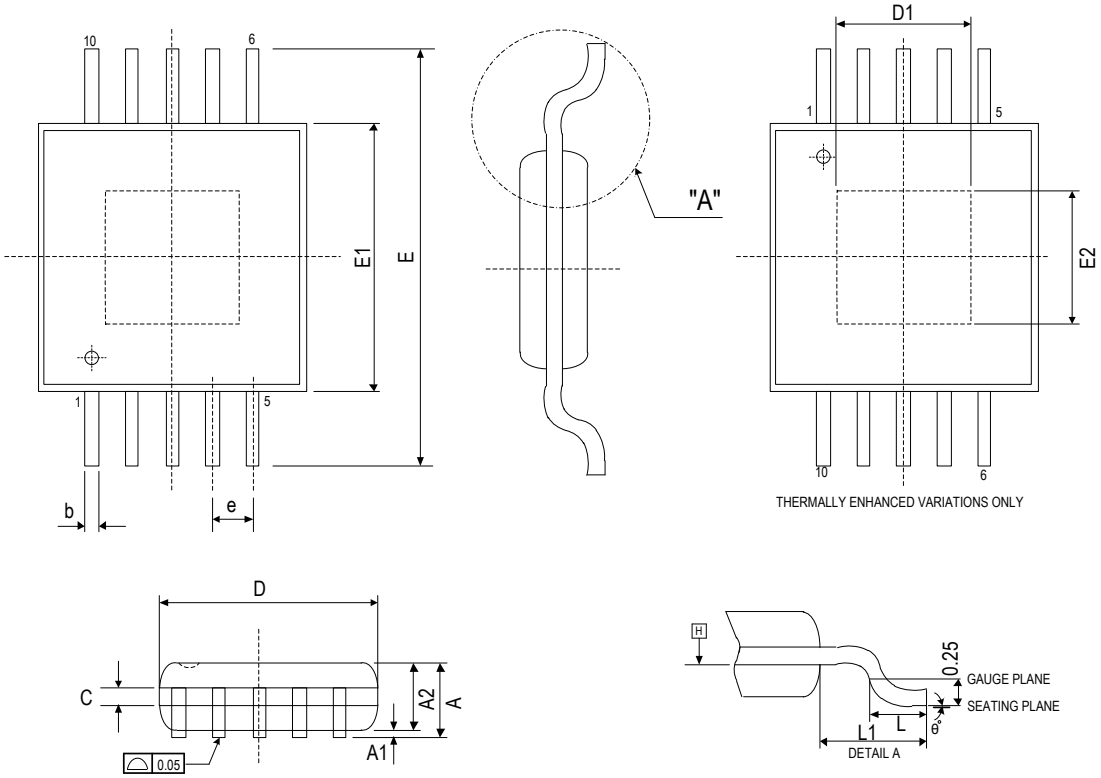






❖ PACKAGE OUTLINES

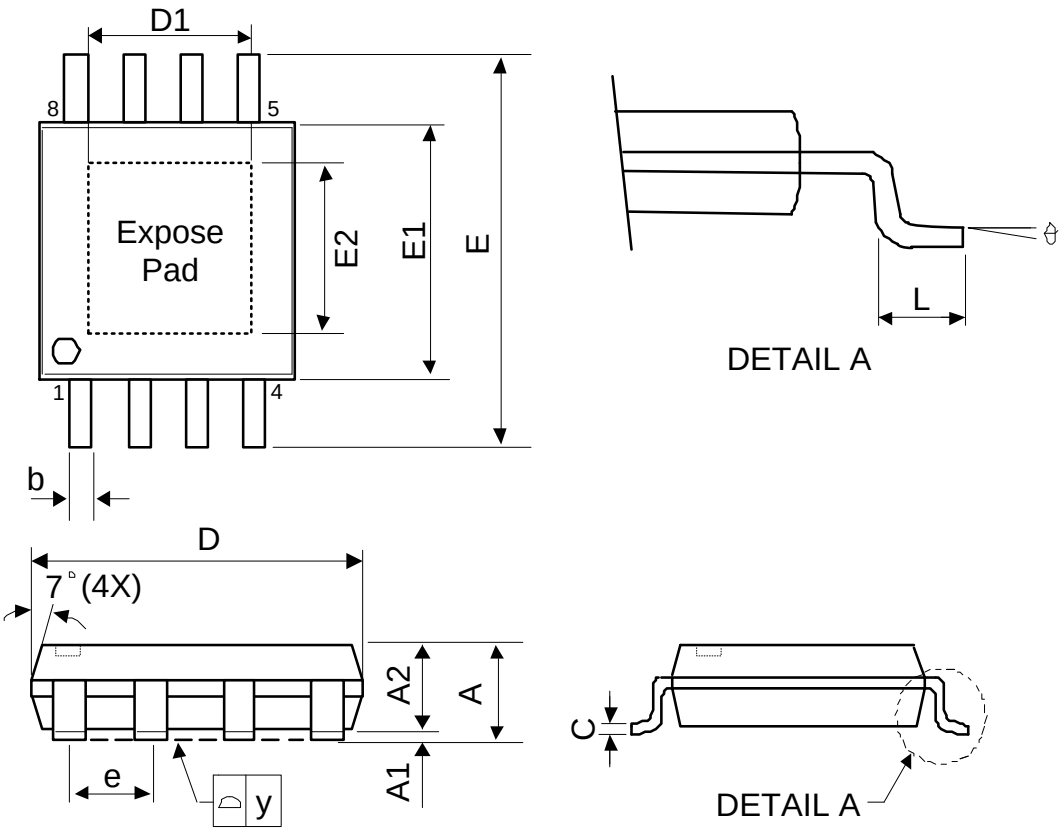
(1) MSOP-10L-EP



Symbol	Dimensions in Millimeters			Dimensions in Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	-	-	1.1	-	-	0.043
A1	0	0.08	0.15	0	0.003	0.006
A2	0.75	0.85	0.95	0.03	0.034	0.038
C	0.08	0.15	0.23	0.003	0.006	0.009
D	2.9	3	3.1	0.114	0.118	0.122
D1	0.75	1.63	2.5	0.03	0.064	0.098
E	4.8	4.9	5	0.189	0.193	0.197
E1	2.9	3	3.1	0.114	0.118	0.122
E2	0.75	1.63	2.5	0.03	0.064	0.098
L	0.4	0.6	0.8	0.016	0.024	0.031
b	0.22	0.3	0.38	0.009	0.012	0.015
e	0.50 BSC			0.020 BSC		
y	-	-	0.1	-	-	0.004
θ	0^O	-	8^O	0^O	-	8^O

JEDEC outline: MO-187 BA-T

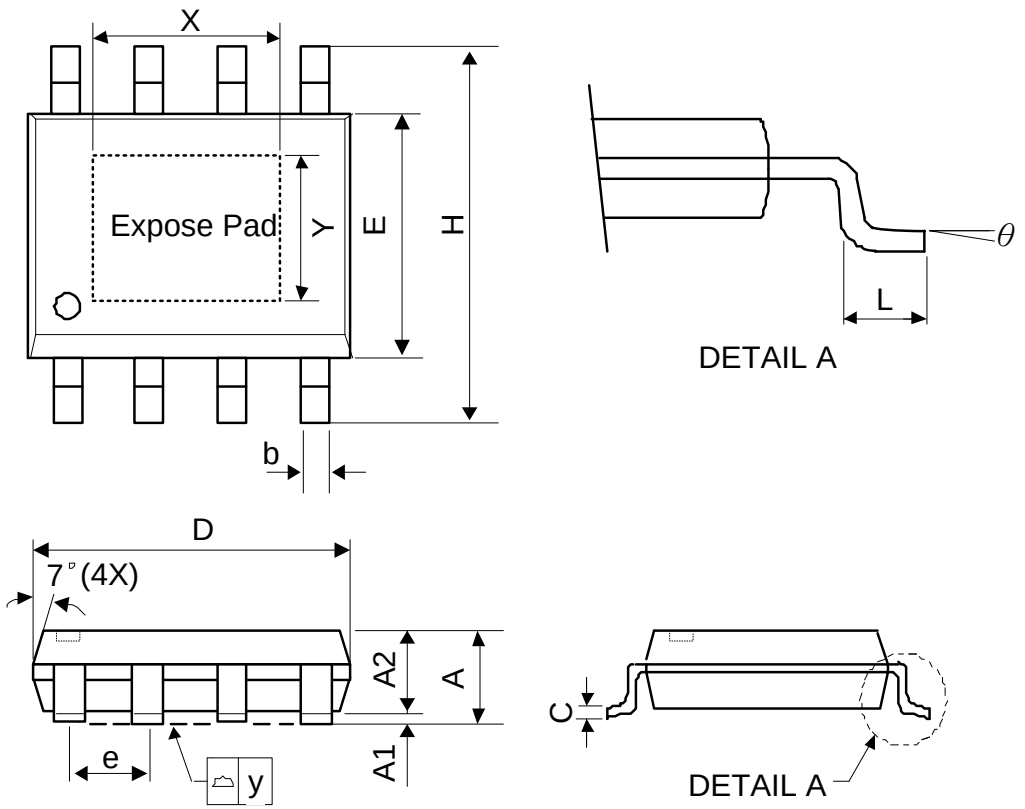
(2) MSOP-8L-EP



Symbol	Dimensions in Millimeters			Dimensions in Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	-	-	1.1	-	-	0.043
A1	0	0.08	0.15	0	0.003	0.006
A2	0.75	0.85	0.95	0.03	0.034	0.038
C	0.08	0.15	0.23	0.003	0.006	0.009
D	2.9	3	3.1	0.114	0.118	0.122
D1	0.75	1.63	2.5	0.03	0.064	0.098
E	4.8	4.9	5	0.189	0.193	0.197
E1	2.9	3	3.1	0.114	0.118	0.122
E2	0.75	1.63	2.5	0.03	0.064	0.098
L	0.4	0.6	0.8	0.016	0.024	0.031
b	0.22	0.3	0.38	0.009	0.012	0.015
e	0.65 BSC			0.026 BSC		
y	-	-	0.1	-	-	0.004
θ	0°	-	8°	0°	-	8°

JEDEC outline: MO-187 AA-T

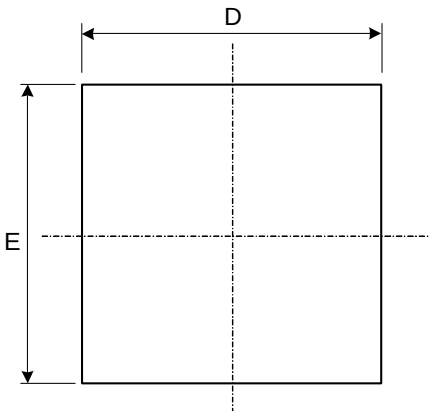
(3) SOP-8L-EP



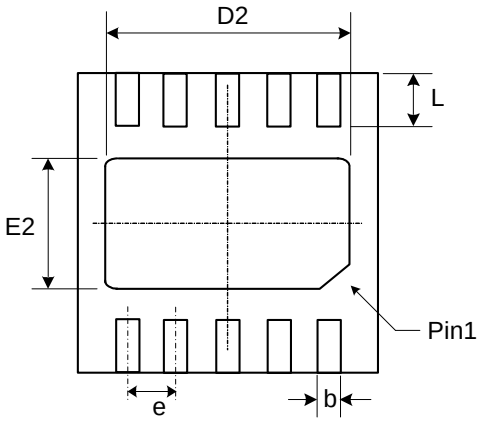
Symbol	Dimensions in Millimeters			Dimensions in Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	-	-	1.75	-	-	0.069
A1	0	-	0.15	0	-	0.06
A2	1.25	-	-	0.049	-	-
C	0.1	0.2	0.25	0.0075	0.008	0.01
D	4.7	4.9	5.1	0.185	0.193	0.2
E	3.7	3.9	4.1	0.146	0.154	0.161
H	5.8	6	6.2	0.228	0.236	0.244
L	0.4	-	1.27	0.015	-	0.05
b	0.31	0.41	0.51	0.012	0.016	0.02
e	1.27 BSC			0.050 BSC		
y	-	-	0.1	-	-	0.004
X	-	2.34	-	-	0.092	-
Y	-	2.34	-	-	0.092	-
θ	0°	-	8°	0°	-	8°

Mold flash shall not exceed 0.25mm per side
JEDEC outline: MS-012 BA

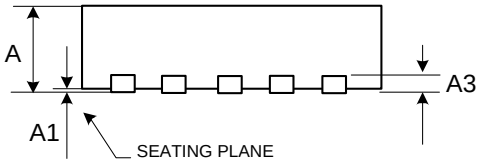
(4) TDFN-10L (3*3 0.75mm)



(Top View)



(Bottom View)

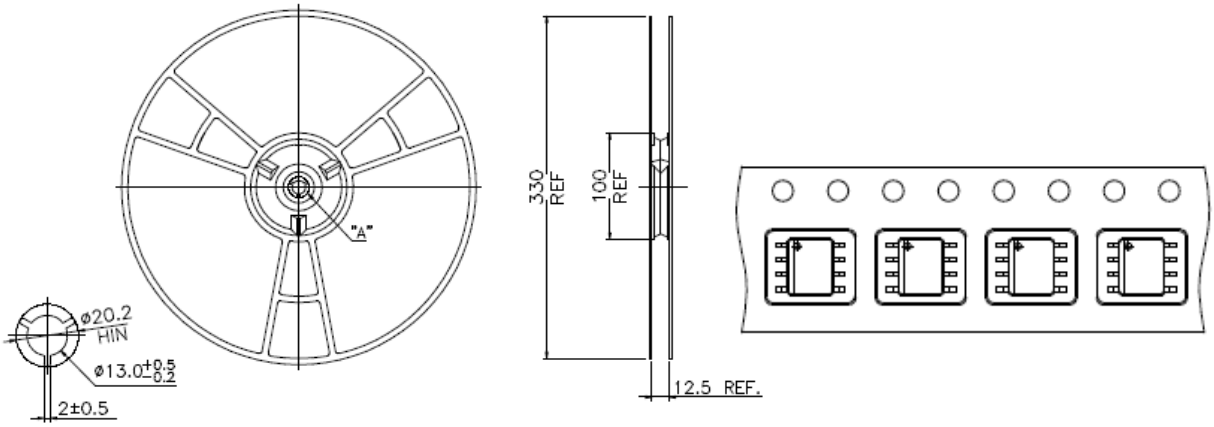


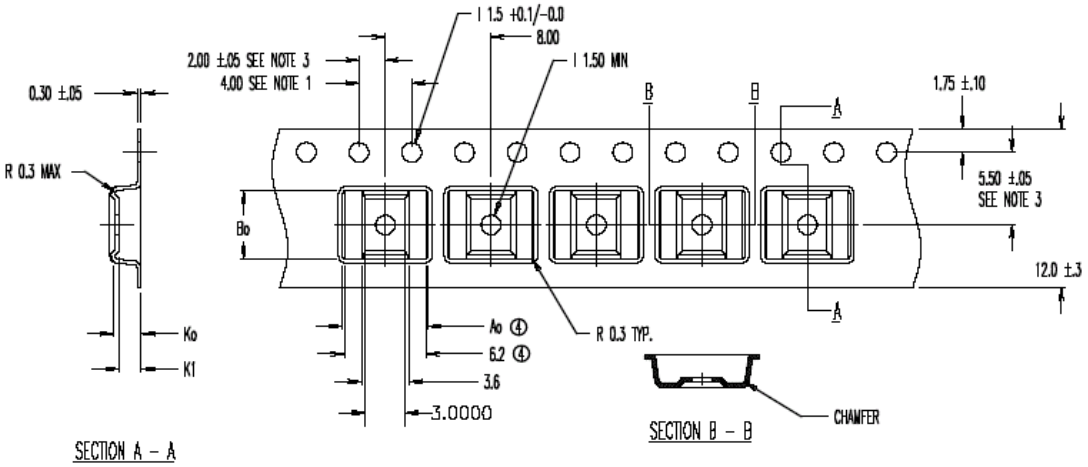
(SIDE View)

Symbol	Dimensions in Millimeters			Dimensions in Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	0.7	0.75	0.8	0.028	0.03	0.031
A1	0	0.02	0.05	0	0.001	0.002
A3	0.20 REF.			0.008 REF.		
b	0.18	0.25	0.3	0.007	0.01	0.012
D	2.9	3	3.1	0.114	0.118	0.122
D2	2.2	2.4	2.5	0.087	0.094	0.098
E	2.9	3	3.1	0.114	0.118	0.122
E2	1.5	1.6	1.7	0.059	0.063	0.07
e	0.50 BSC.			0.020 BSC.		
L	0.3	0.4	0.5	0.012	0.016	0.02

❖ Carrier tape dimension

ESOP8L



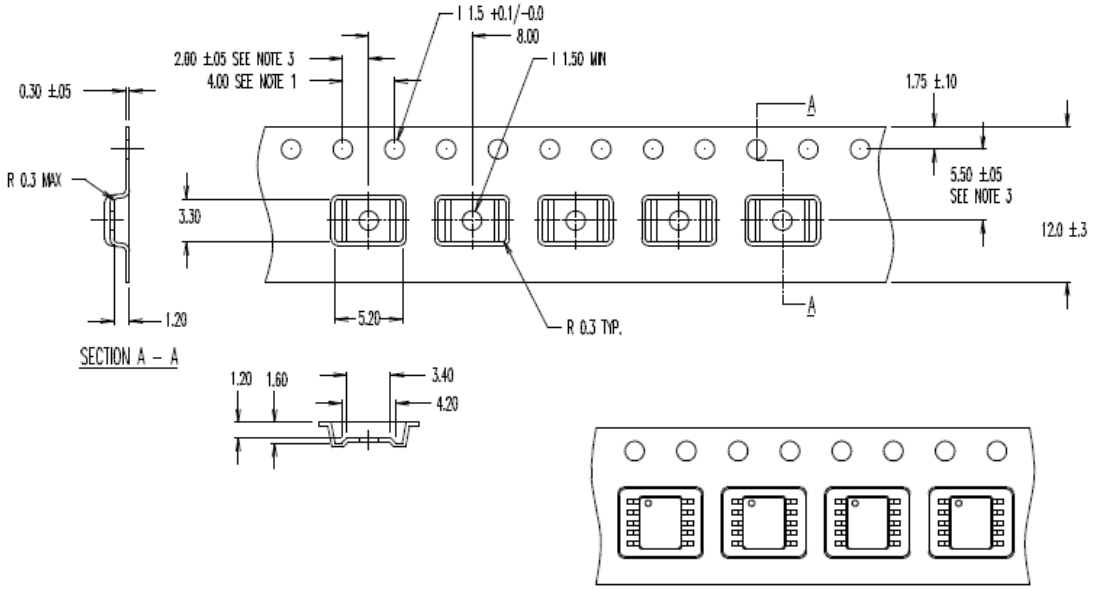


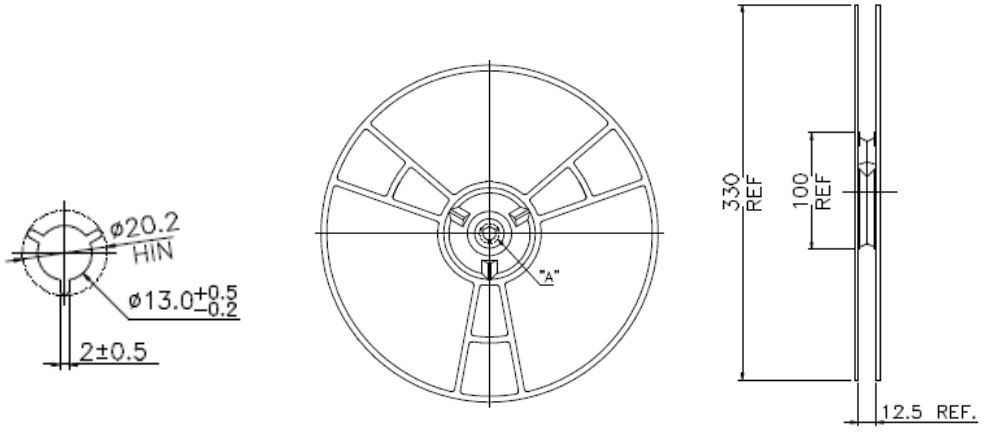
④① Ao = 6.50
Bo = 5.20
Ko = 2.10
K1 = 1.70

Notes:

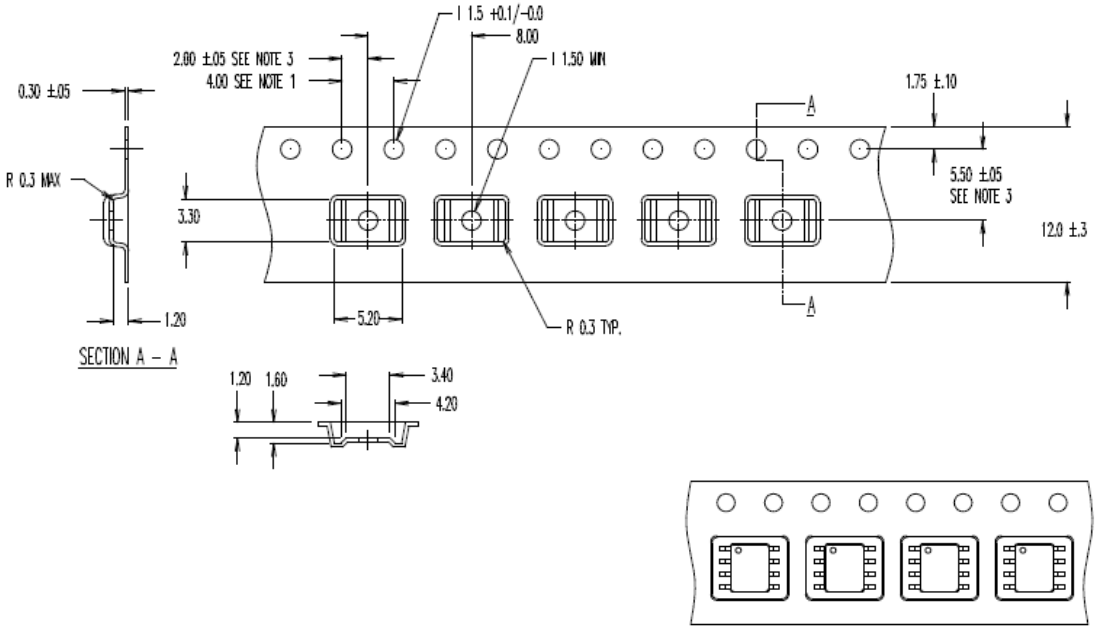
1. 10 sprocket hole pitch cumulative tolerance ± 0.2mm
2. Camber not to exceed 1mm in 100mm.
3. Material: Anti–Static Black Advantek Polystyrene.
4. Ao and Bo measured on a plane 0.3mm above the bottom of the pocket.
5. Ko measured from a plane on the inside bottom of the pocket to the top surface of the carrier.
6. Pocket position relative to sprocket hole measured as true position of pocket, not pocket hole.

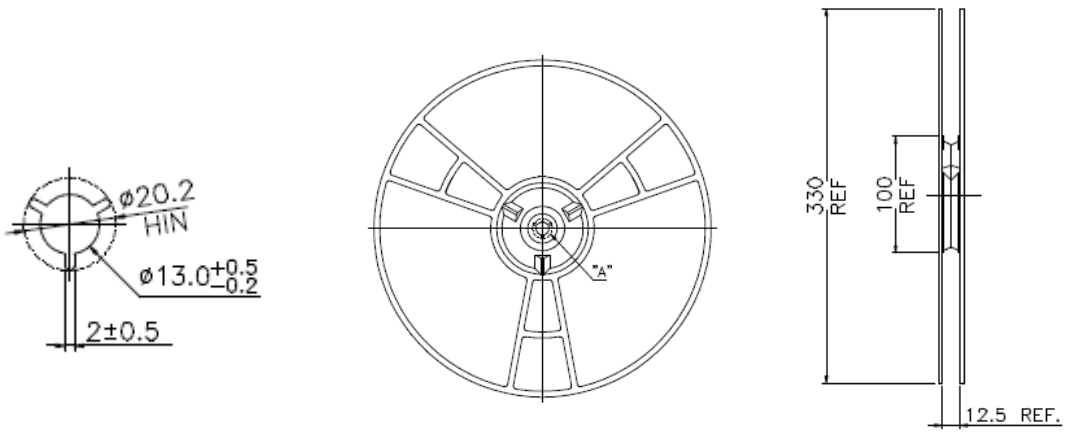
MSOP-10 exposed pad





MSOP-8 exposed pad





TDFN-10L (3x3)