

## 300KHz, 2A PWM Buck DC/DC Converter

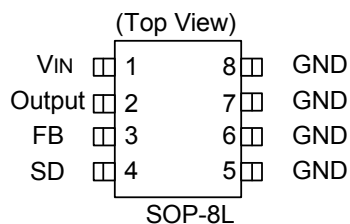
### ■ Features

- Adjustable version output voltage range, 0.8V to 18V $\pm$ 4%
- 300KHz  $\pm$ 15% fixed switching frequency
- Voltage mode non-synchronous PWM control
- Thermal-shutdown and current-limit protection
- ON/OFF shutdown control input
- Operating voltage can be up to 22V
- Output load current: 2A
- SOP-8L **Pb-Free** packages
- Low power standby mode
- Built-in switching transistor on chip

### ■ Applications

- Simple High-efficiency step-down regulator
- On-card switching regulators
- Positive to negative converter

### ■ Pin Assignments



### ■ General Description

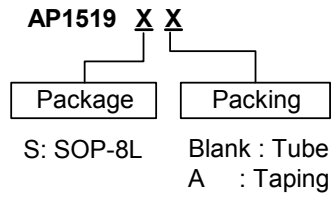
The AP1519 is monolithic IC designed for a step-down DC/DC converter, and own the ability of driving a 2A load without additional transistor. It saves board space. The external shutdown function can be controlled by logic level and then come into standby mode. The internal compensation makes feedback control having good line and load regulation without external design. Regarding protected function, thermal shutdown is to prevent over temperature operating from damage, and current limit is against over current operating of the output switch. If current limit function occurs and  $V_{FB}$  is down below 0.5V, the switching frequency will be reduced. The AP1519 series operates at a switching frequency of 300KHz thus allows smaller sized filter components than what would be needed with lower frequency switching regulators. Other features include a guaranteed  $\pm$ 4% tolerance on output voltage under specified input voltage and output load conditions, and  $\pm$ 15% on the oscillator frequency. The chips are available in a standard 8-lead SOP-8 package.

### ■ Pin Descriptions

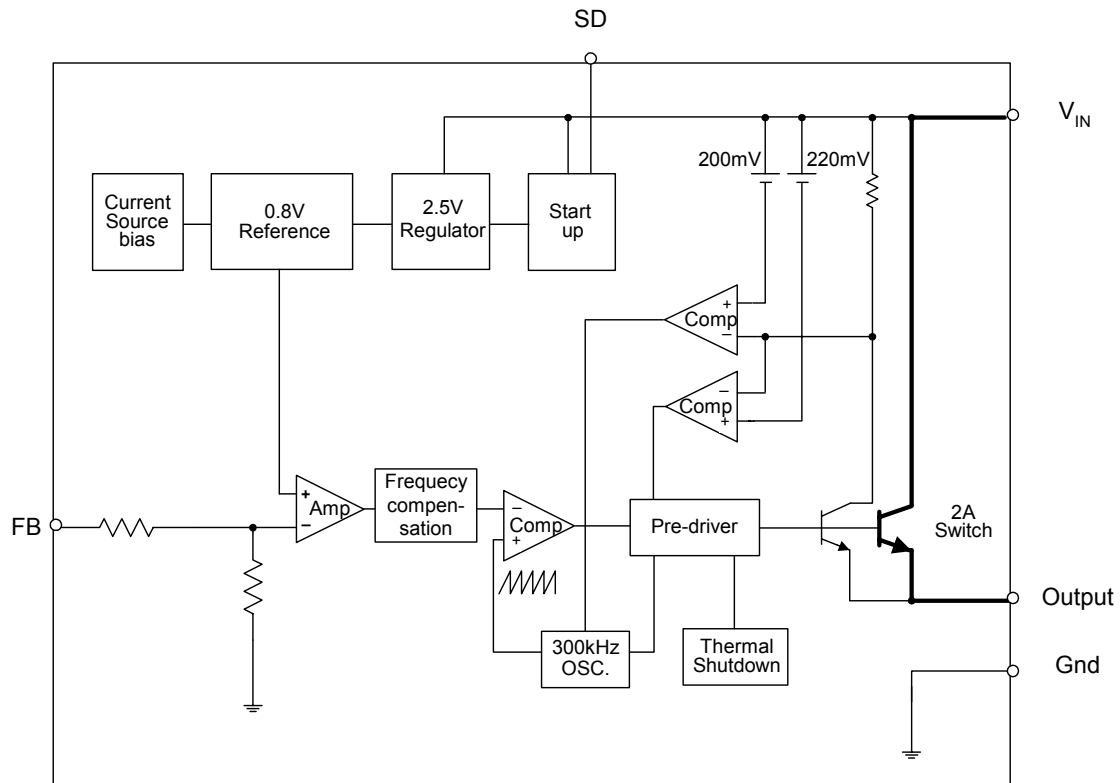
Name	Description
$V_{IN}$	Operating voltage input
Output	Switching output
GND	Ground
FB	Output voltage feedback control
SD	ON/OFF Shutdown

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### ■ Ordering Information



### ■ Block Diagram





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■ Absolute Maximum Ratings

Symbol	Parameter	Rating	Unit
V <sub>CC</sub>	Supply Voltage	+24	V
V <sub>SD</sub>	ON/OFF Pin input voltage	-0.3 to +18	V
V <sub>FB</sub>	Feedback Pin voltage	-0.3 to +18	V
V <sub>OUT</sub>	Output voltage to Ground	-1	V
P <sub>D</sub>	Power dissipation	Internally limited	W
T <sub>ST</sub>	Storage temperature	-65 to +150	°C
T <sub>OP</sub>	Operating temperature	-40 to +125	°C
V <sub>OP</sub>	Operating voltage	+4.5 to +22	V

■ Electrical Characteristics (All Output Voltage Versions)

Unless otherwise specified, V<sub>IN</sub>=12V, I<sub>LOAD</sub> = 0.5A

Symbol	Parameter		Conditions	Min.	Typ.	Max.	Unit
I <sub>B</sub>	Feedback bias current		V <sub>FB</sub> =0.8V (Adjustable version only)		-10	-50 -100	nA
F <sub>OSC</sub>	Oscillator frequency			255 220	300	345 345	KHz
F <sub>SCP</sub>	Oscillator frequency of short circuit protect		When current limit occurred and V <sub>FB</sub> < 0.5V, Ta=25 °C	10	30	50	KHz
V <sub>SAT</sub>	Saturation voltage		I <sub>OUT</sub> =2A No outside circuit V <sub>FB</sub> =0V force driver on		1.25	1.4 1.5	V
DC	Max. Duty Cycle (ON)		V <sub>FB</sub> =0V force driver on		100		%
	Min. Duty Cycle (OFF)		V <sub>FB</sub> =12V force driver off		0		
I <sub>CL</sub>	Current limit		Peak current No outside circuit V <sub>FB</sub> =0V force driver on	3			A
I <sub>L</sub>	Output = 0	Output leakage current	No outside circuit V <sub>FB</sub> =12V force driver off			-200	uA
	Output = -1		V <sub>IN</sub> =22V		-5		
I <sub>Q</sub>	Quiescent Current		V <sub>FB</sub> =12V force driver off		5	10	mA
I <sub>STBY</sub>	Standby Quiescent Current		ON/OFF pin=5V V <sub>IN</sub> =22V		70	150 200	uA
V <sub>IL</sub>	ON/OFF pin logic input threshold voltage		Low (regulator ON)	-	1.3	0.6	V
V <sub>IH</sub>			High (regulator OFF)	2.0		-	
I <sub>H</sub>	ON/OFF pin logic input current		V <sub>LOGIC</sub> =2.5V (OFF)			-0.01	uA
I <sub>L</sub>	ON/OFF pin input current		V <sub>LOGIC</sub> =0.5V (ON)		-0.1	-1	
θ <sub>JC</sub>	Thermal Resistance		SOP-8L	Junction to case		15	°C/W
θ <sub>JA</sub>	Thermal Resistance With copper area of approximately 3 in <sup>2</sup>		SOP-8L	Junction to ambient		70	°C/W



### ■ Electrical Characteristics (Continued)

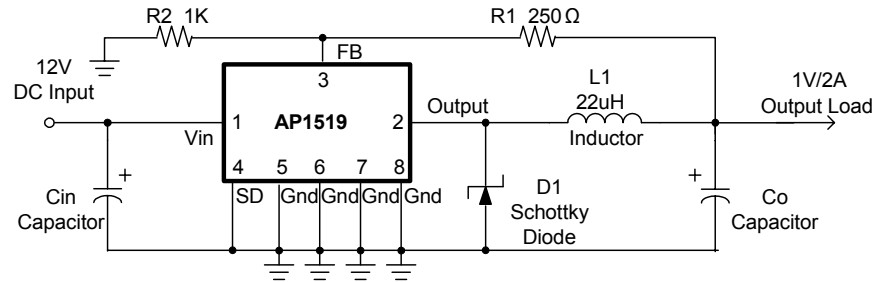
	Sym.	Parameter	Conditions	Typ.	Limit	Unit
AP1519	$V_{FB}$	Output Feedback	$5V \leq V_{IN} \leq 22V$ $0.2A \leq I_{LOAD} \leq 2A$	0.8	<b>0.784/0.768</b> <b>0.816/0.832</b>	V $V_{MIN}$ $V_{MAX}$
	$\eta$	Efficiency	$V_{OUT}$ programmed for 3V $V_{IN} = 12V, I_{LOAD}=2A$	75		%
	$\eta$	Efficiency	$V_{OUT}$ programmed for 3.3V $V_{IN} = 12V, I_{LOAD}=2A$	76		%
	$\eta$	Efficiency	$V_{OUT}$ programmed for 5V $V_{IN} = 12V, I_{LOAD}=2A$	81		%
	$\eta$	Efficiency	$V_{OUT}$ programmed for 12V $V_{IN} = 16V, I_{LOAD} = 2A$	90		%

Specifications with **boldface type** are for full operating temperature range, the other type are for  $T_J=25^\circ C$ .

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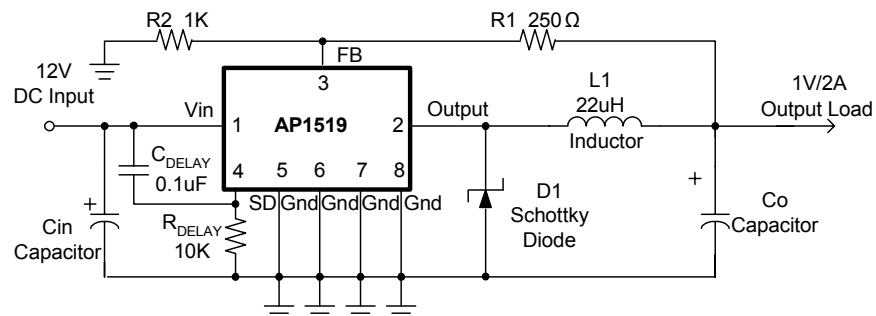
### ■ Typical Application Circuit

#### (1) Normal Circuit



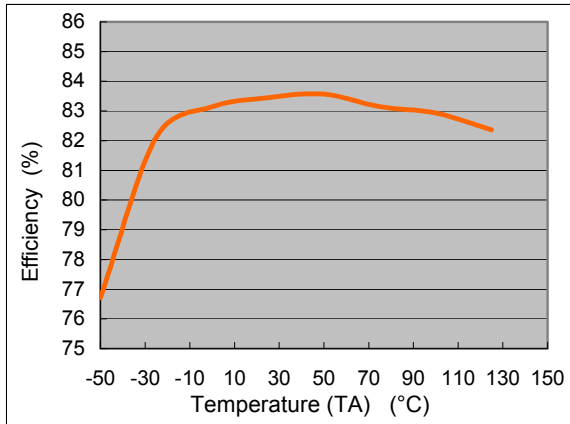
$$V_{out} = V_{FB} \times \left(1 + \frac{R1}{R2}\right)$$

#### (2) Delay Start Circuit

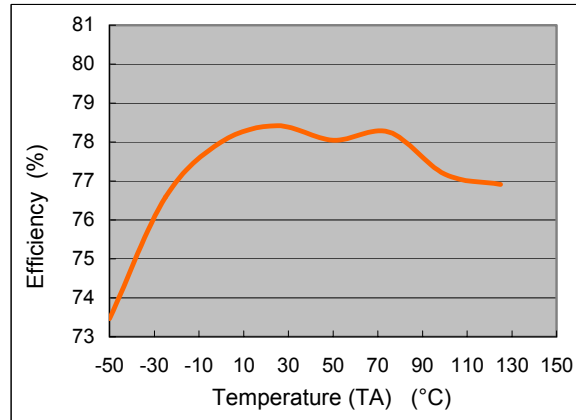


### ■ Typical Performance Characteristics

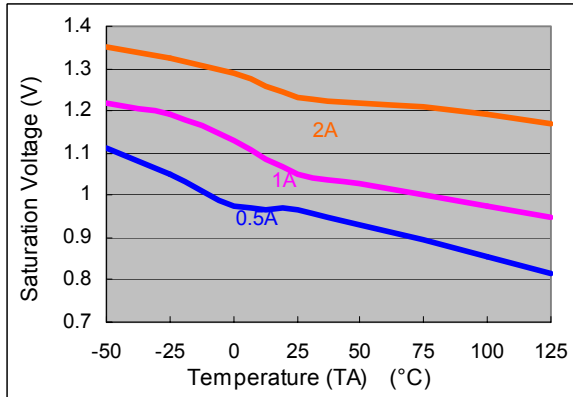
**AP1519 Efficiency v.s. Temperature**  
( $V_{in}=12V, V_{out}=5V, I_o=2A$ )



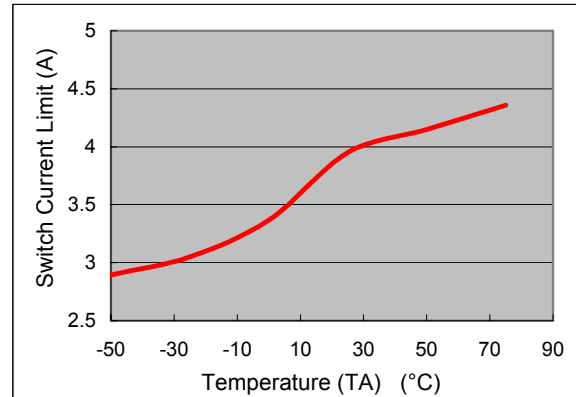
**AP1519 Efficiency v.s. Temperature**  
( $V_{in}=12V, V_{out}=3.3V, I_o=2A$ )



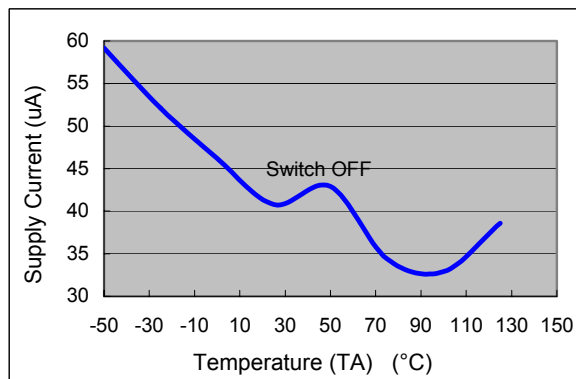
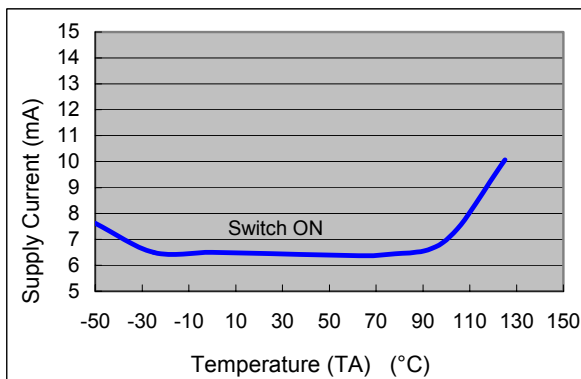
**AP1519 Saturation Voltage v.s. Temperature**  
( $V_{cc}=12V, V_{fb}=0V, V_{SD}=0$ )



**AP1519 Switch Current Limit v.s. Temperature**  
( $V_{cc}=12V, V_{fb}=0V$ )

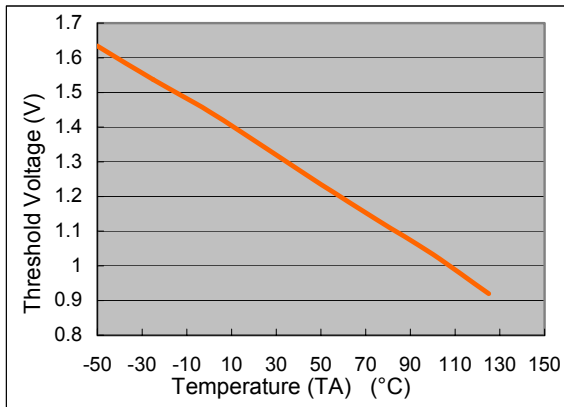


**AP1519 Supply Current v.s. Temperature**  
( $V_{cc}=12V$ , No Load,  $V_{on/off}=0V$ (Switch ON),  $V_{on/off}=5V$ (Switch OFF))

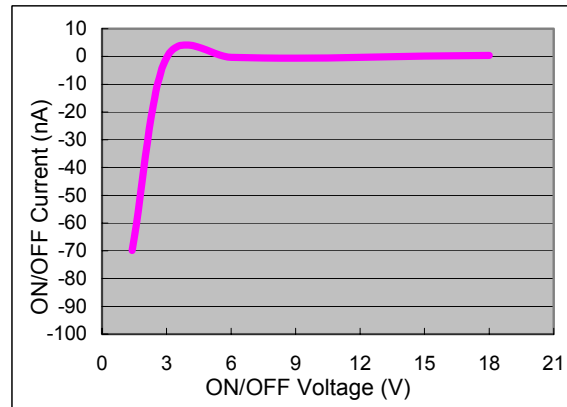


### ■ Typical Performance Characteristics (Continued)

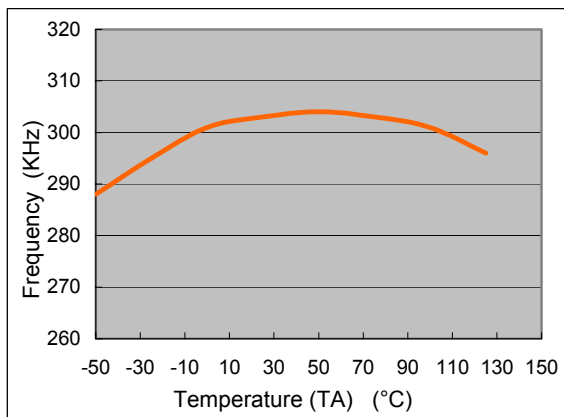
**AP1519 Threshold Voltage v.s. Temperature**  
( $V_{cc}=12V$ ,  $I_o=100mA$ )



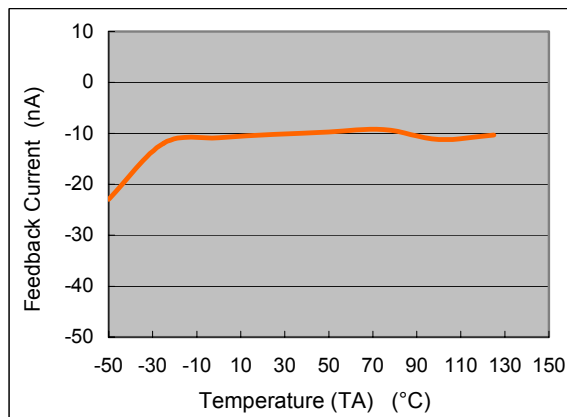
**AP1519 ON/OFF Current v.s. ON/OFF Voltage**  
( $V_{in}=12V$ )



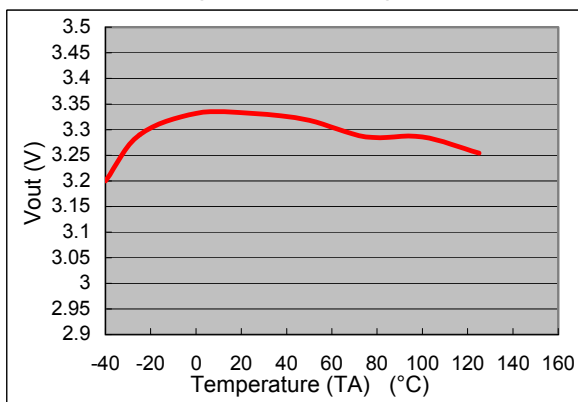
**AP1519 Frequency v.s. Temperature**  
( $V_{cc}=12V$ ,  $I_o=500mA$ ,  $V_{out}=5V$ )



**AP1519 Feedback Current v.s. Temperature**  
( $V_{cc}=12V$ ,  $V_{out}=5V$ ,  $V_{fb}=0.8V$ )



**AP1519 Output Voltage v.s. Temperature**  
( $V_{in}=12V$ ,  $I_o=2A$ )



## ■ Function Description

### Pin Functions

#### **+V<sub>IN</sub>**

This is the positive input supply for the IC switching regulator. A suitable input bypass capacitor must be presented at this pin to minimize voltage transients and to supply the switching currents needed by the regulator.

#### **Ground**

Circuit ground.

#### **Output**

Internal switch. The voltage at this pin switches between (+V<sub>IN</sub> - V<sub>SAT</sub>) and approximately - 0.5V, with a duty cycle of approximately V<sub>OUT</sub> / V<sub>IN</sub>. To minimize coupling to sensitive circuitry, the PC board copper area connected to this pin should be minimized.

#### **Feedback**

Senses the regulated output voltage to complete the feedback loop.

#### **SD**

Allows the switching regulator circuit to be shutdown using logic level signals thus dropping the total input supply current to approximately 150uA. Pulling this pin below a threshold voltage of approximately 1.3V turns the regulator on, and pulling this pin above 1.3V (up to a maximum of 18V) shuts the regulator down. If this shutdown feature is not needed, the SD pin can be wired to the ground pin.

### Thermal Considerations

The SOP-8 package needs a heat sink under most conditions. The size of the heatsink depends on the input voltage, the output voltage, the load current and the ambient temperature. The AP1519 junction temperature rises above ambient temperature for a 2A load and different input and output voltages. The data for these curves was taken with the AP1519 (SOP-8 package) operating as a buck-switching regulator in an ambient temperature of 25°C (still air). These temperature increments are all approximate and are affected by many factors. Higher ambient temperatures require more heat sinker.

For the best thermal performance, wide copper traces and generous amounts of printed circuit board copper should be used in the board layout. (One exception is the output (switch) pin, which should not have large areas of copper.) Large areas of copper provide the best transfer of heat (lower thermal resistance) to the surrounding air, and moving air lowers the thermal resistance even further.

Package thermal resistance and junction temperature increments are all approximate. The increments are affected by a lot of factors. Some of these factors include board size, shape, thickness, position, location, and even board temperature. Other factors are, trace width, total printed circuit copper area, copper thickness, single or double-sided, multi-layer board and the amount of solder on the board.

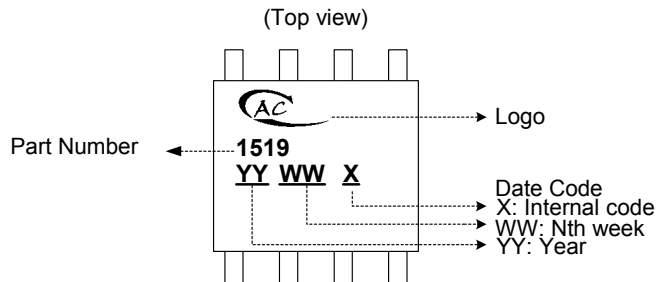
The effectiveness of the PC board to dissipate heat also depends on the size, quantity and spacing of other components on the board, as well as whether the surrounding air is still or moving. Furthermore, some of these components such as the catch diode will add heat to the PC board and the heat can vary as the input voltage changes. For the inductor, depending on the physical size, type of core material and the DC resistance, it could either act as a heat sink taking heat away from the board, or it could add heat to the board.



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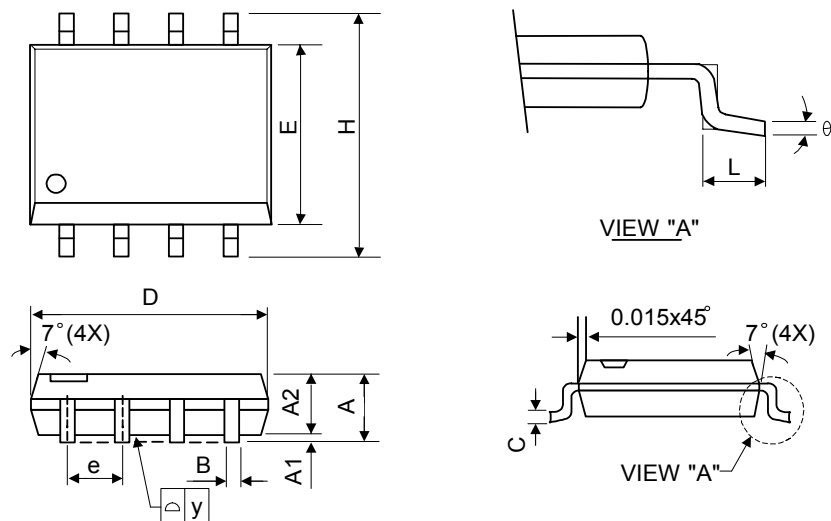
### ■ Marking Information

SOP-8L



### ■ Package Information

Package Type: SOP-8L



Symbol	Dimensions In Millimeters			Dimensions In Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	1.40	1.60	1.75	0.055	0.063	0.069
A1	0.10	-	0.25	0.040	-	0.100
A2	1.30	1.45	1.50	0.051	0.057	0.059
B	0.33	0.41	0.51	0.013	0.016	0.020
C	0.19	0.20	0.25	0.0075	0.008	0.010
D	4.80	5.05	5.30	0.189	0.199	0.209
E	3.70	3.90	4.10	0.146	0.154	0.161
e	-	1.27	-	-	0.050	-
H	5.79	5.99	6.20	0.228	0.236	0.244
L	0.38	0.71	1.27	0.015	0.028	0.050
y	-	-	0.10	-	-	0.004
θ	0°	-	8°	0°	-	8°