

## CONSTANT VOLTAGE AND CONSTANT CURRENT CONTROLLER

### Description

The AP4320 is a highly integrated solution for a constant voltage/constant current mode SMPS application.

The AP4320 contains one 2.5V voltage reference and two operational amplifiers. The 2.5V voltage reference, combined with one operational amplifier, makes of an ideal voltage controller for use in adapters and battery chargers. The low voltage reference, combined with another operational amplifier, makes of an ideal current limiter for output low side current sensing.

The AP4320 is available in SOT26 package.

### Features

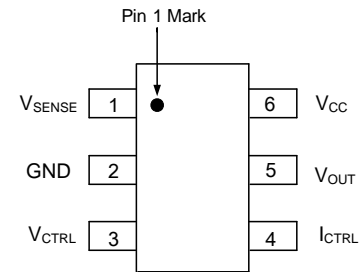
- Constant Voltage and Constant Current Control
- Low External Component Count
- Easy Compensation
- Low Supply Current: 190µA
- Precision Internal Voltage Reference: 2.5V
- Operating Supply Voltage: 3.5V to 36V
- Low Current Sense Threshold: 30mV/50mV
- **Totally Lead-free & Fully RoHS Compliant (Note 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**

Notes:

1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS) & 2011/65/EU (RoHS 2) compliant.
2. See [http://www.diodes.com/quality/lead\\_free.html](http://www.diodes.com/quality/lead_free.html) for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.

### Pin Assignments

(Top View)

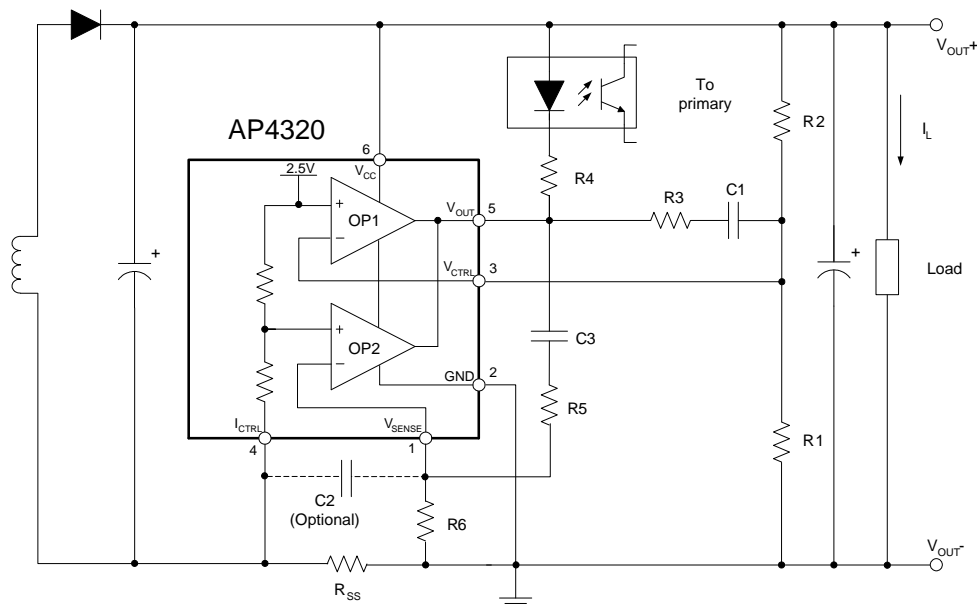


SOT26 (K6 Package)

### Applications

- AC/DC Adapters
- Battery Chargers
- LED Drivers

### Typical Applications Circuit

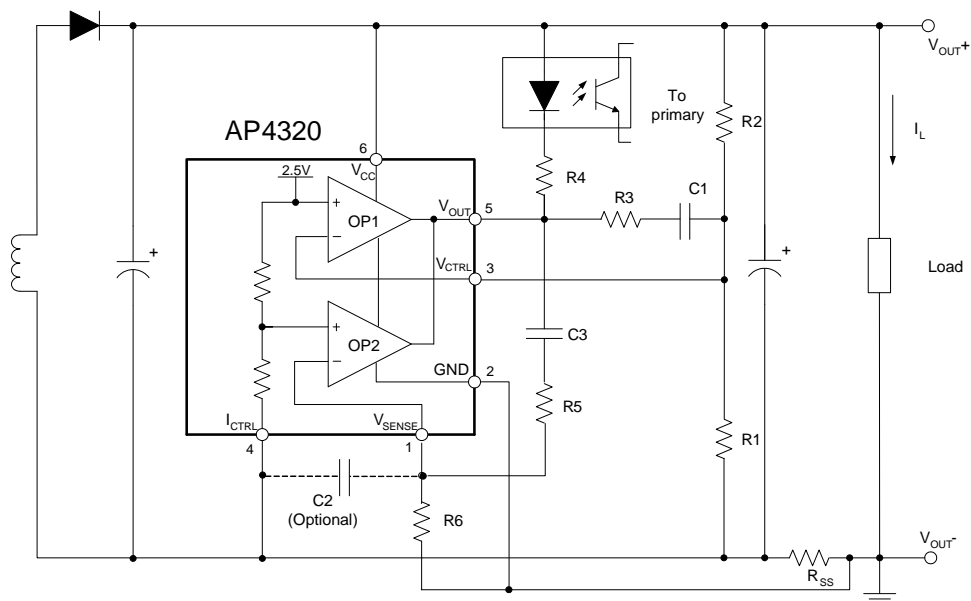


$$V_{OUT} = V_{REF} \times \frac{R1 + R2}{R1}$$

$$CurrentLimit = \frac{V_{SENSE}}{R_{SS}}$$

Typical Application 1

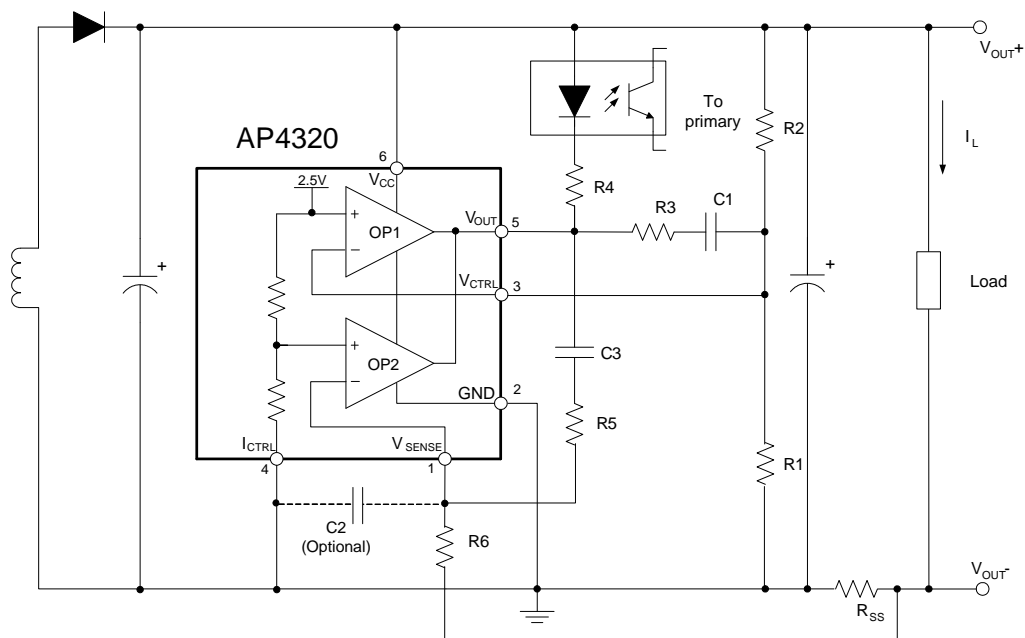
### Typical Applications Circuit (Cont.)



$$V_{OUT} = [V_{REF} + (I_L \times R_{SS})] \times \frac{R1 + R2}{R1} - (I_L \times R_{SS})$$

$$CurrentLimit = \frac{V_{SENSE}}{R_{SS}}$$

## Typical Application 2



$$V_{OUT} = V_{REF} \times \frac{R1 + R2}{R1} - (I_L \times R_{SS})$$

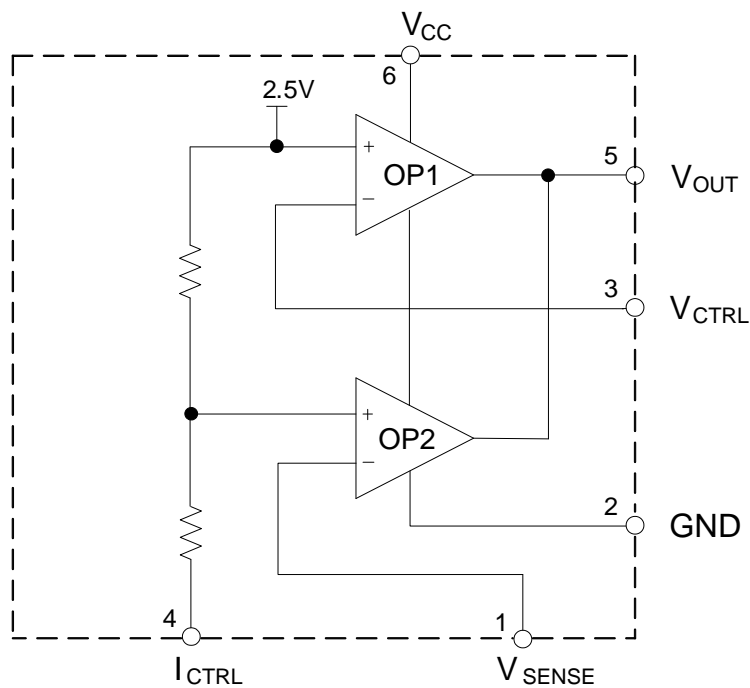
$$CurrentLimit = \frac{V_{SENSE} \times V_{REF}}{(V_{SENSE} + V_{REF}) \times R_{SS}}$$

### Typical Application 3

## Pin Descriptions

Pin Number	Pin Name	Function
1	$V_{SENSE}$	Input pin of the current control loop
2	GND	Ground
3	$V_{CTRL}$	Input pin of the voltage control loop
4	$I_{CTRL}$	Input pin of the current control loop
5	$V_{OUT}$	Output pin. Sinking current only
6	$V_{CC}$	Power Supply

## Functional Block Diagram



## Absolute Maximum Ratings (Note 4)

Symbol	Parameter	Rating	Unit
$V_{CC}$	Power Supply Voltage	-0.3 to 38	V
$V_{OUT}$	Input Voltage ( $V_{OUT}$ Pin)	-0.3 to $V_{CC}$	V
$V_{CTRL}$	Input Voltage ( $I_{CTRL}$ Pin)	-0.3 to 18	V
$V_{SENSE}$	Input Voltage ( $V_{SENSE}$ Pin)	-0.3 to 18	V
$V_{CTRL}$	Input Voltage ( $V_{CTRL}$ Pin)	-0.3 to 18	V
$T_J$	Junction Temperature	+150	°C
$T_{STG}$	Storage Temperature	-55 to +150	°C
$T_{LEAD}$	Lead Temperature (Soldering, 5sec)	+260	°C
$\theta_{JA}$	Thermal Resistance (Junction to Ambient)	250	°C/W

Note 4: Stresses greater than those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "Recommended Operating Conditions" is not implied. Exposure to "Absolute Maximum Ratings" for extended periods may affect device reliability.

## Recommended Operating Conditions

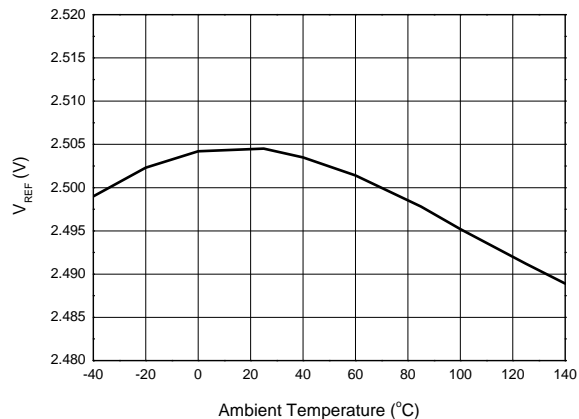
Symbol	Parameter	Min	Max	Unit
$V_{CC}$	Power Supply Voltage	3.5	36	V

**Electrical Characteristics** (@ $V_{CC}=20V$ ,  $-25^{\circ}C < T_A < +125^{\circ}C$ , unless otherwise specified.)

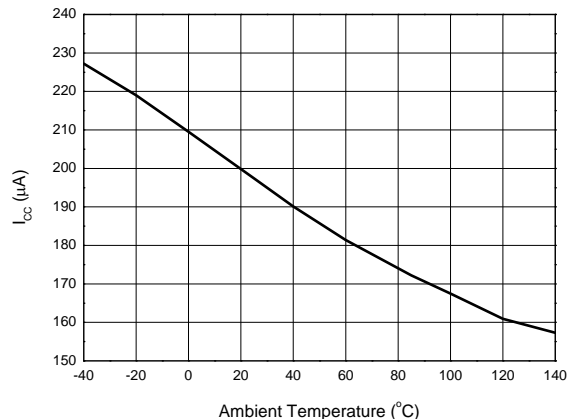
Symbol	Parameters	Conditions	Min	Typ	Max	Unit	
TOTAL CURRENT CONSUMPTION							
I <sub>CC</sub>	Total Supply Current Not Including the Output Sinking Current	V <sub>ICTRL</sub> =V <sub>SENSE</sub> =0V, V <sub>OUT</sub> =Open	–	190	–	μA	
VOLTAGE CONTROL LOOP							
G <sub>mv</sub>	Transconductance Gain (V <sub>CTRL</sub> ). Sink Current Only	–	1	3.5	–	mA/mV	
V <sub>REF</sub>	Voltage Control Loop Reference	T <sub>A</sub> =+25°C	2.488	2.50	2.512	V	
		–	2.48	–	2.52		
I <sub>IBV</sub>	Input Bias Current (V <sub>CTRL</sub> )	–	–	25	–	nA	
CURRENT CONTROL LOOP							
G <sub>mi</sub>	Transconductance Gain (I <sub>CTRL</sub> ). Sink Current Only	–	1.5	7	–	mA/mV	
V <sub>SENSE</sub>	Current Control Loop Reference	AP4320A	T <sub>A</sub> = +25°C	29	30	31	mV
			–	28	30	32	
		AP4320B	T <sub>A</sub> = +25°C	48.5	50	51.5	
			–	46	50	54	
I <sub>IBI</sub>	Current Out of Pin I <sub>CTRL</sub> at V <sub>SENSE</sub>	AP4320A	V <sub>ICTRL</sub> =-30mV	–	16	–	μA
		AP4320B	V <sub>ICTRL</sub> =-50mV	–	16	–	
OUTPUT STAGE							
V <sub>OL</sub>	Low Output Voltage at 2mA Sinking Current	–	–	30	100	mV	
I <sub>OS</sub>	Output Short Circuit Current. Sink Current Only	V <sub>OUT</sub> =4V	–	30	–	mA	

## Performance Characteristics

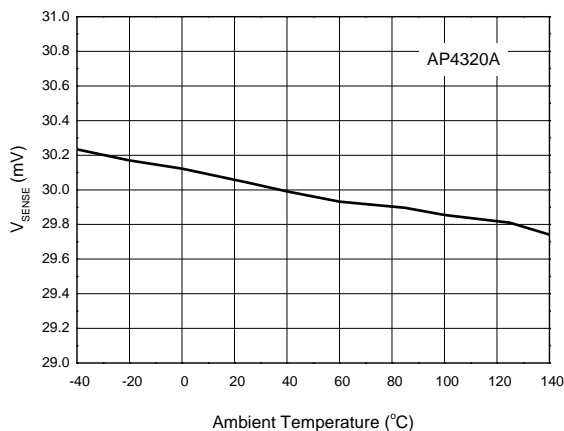
**V<sub>REF</sub> vs. Ambient Temperature**



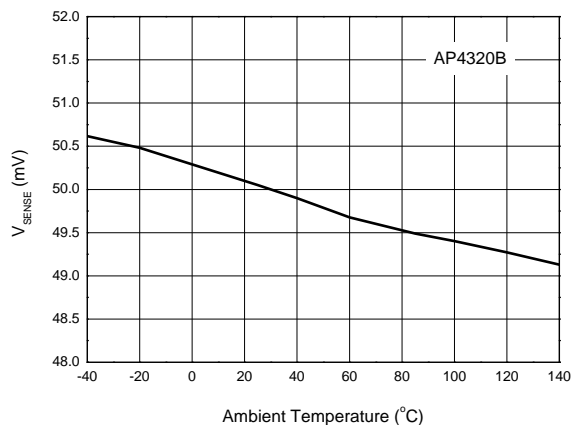
**I<sub>CC</sub> vs. Ambient Temperature**



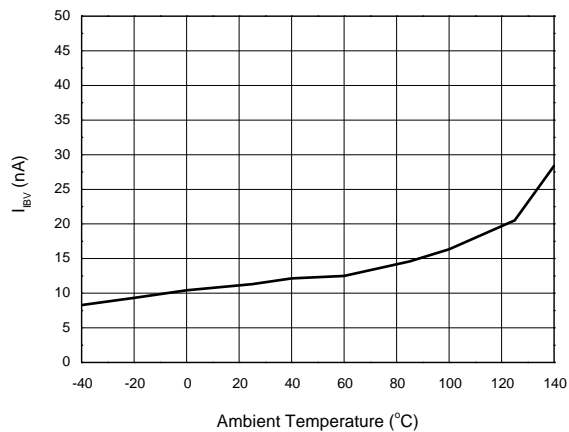
**V<sub>SENSE</sub> vs. Ambient Temperature**



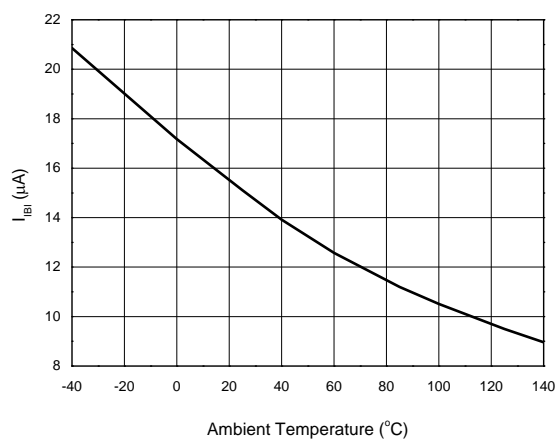
**V<sub>SENSE</sub> vs. Ambient Temperature**



**I<sub>IBV</sub> vs. Ambient Temperature**

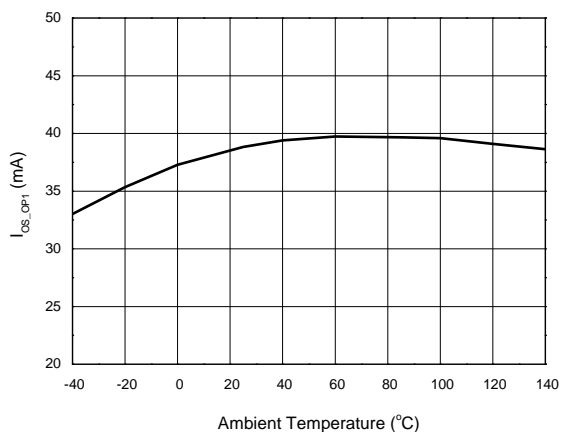


**I<sub>IBI</sub> vs. Ambient Temperature**

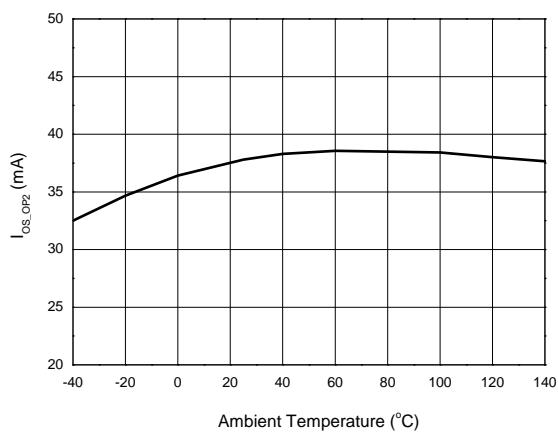


## Performance Characteristics (Cont.)

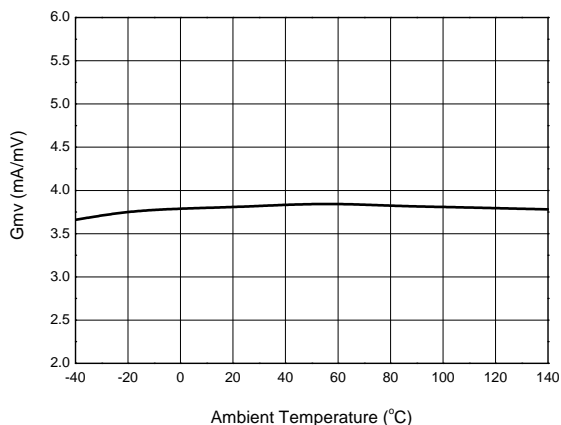
**$I_{OS\_OP1}$  vs. Ambient Temperature**



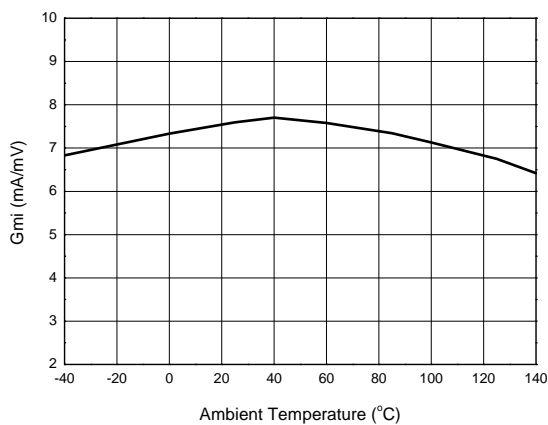
**$I_{OS\_OP2}$  vs. Ambient Temperature**



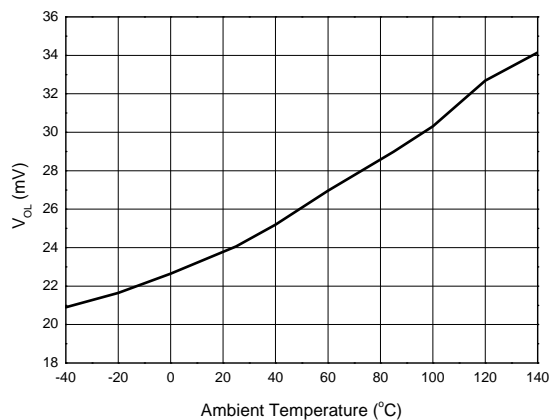
**Gmv vs. Ambient Temperature**



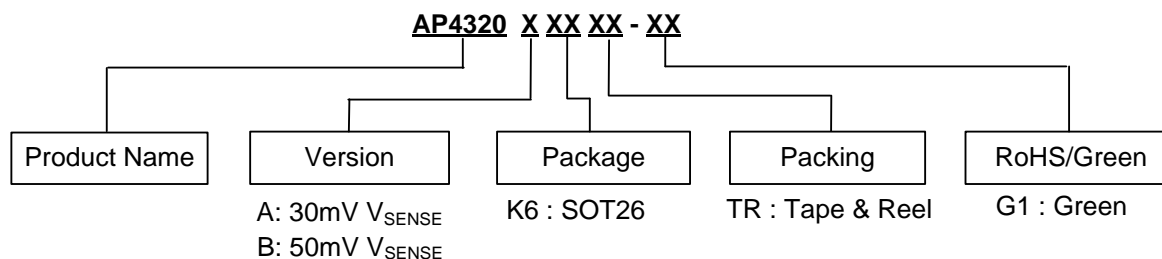
**Gmi vs. Ambient Temperature**



**$V_{OL}$  vs. Ambient Temperature**



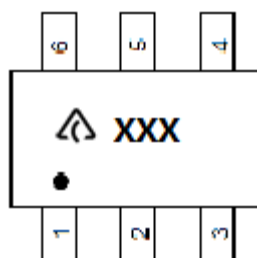
## Ordering Information




Diodes IC's Pb-free products with "G1" suffix in the part number, are RoHS compliant and green.

Package	Version	Part Number	Marking ID	Packing
SOT26	30mV $V_{SENSE}$	AP4320AK6TR-G1	GJZ	3000/Tape and Reel
	50mV $V_{SENSE}$	AP4320BK6TR-G1	GKW	

## Marking Information

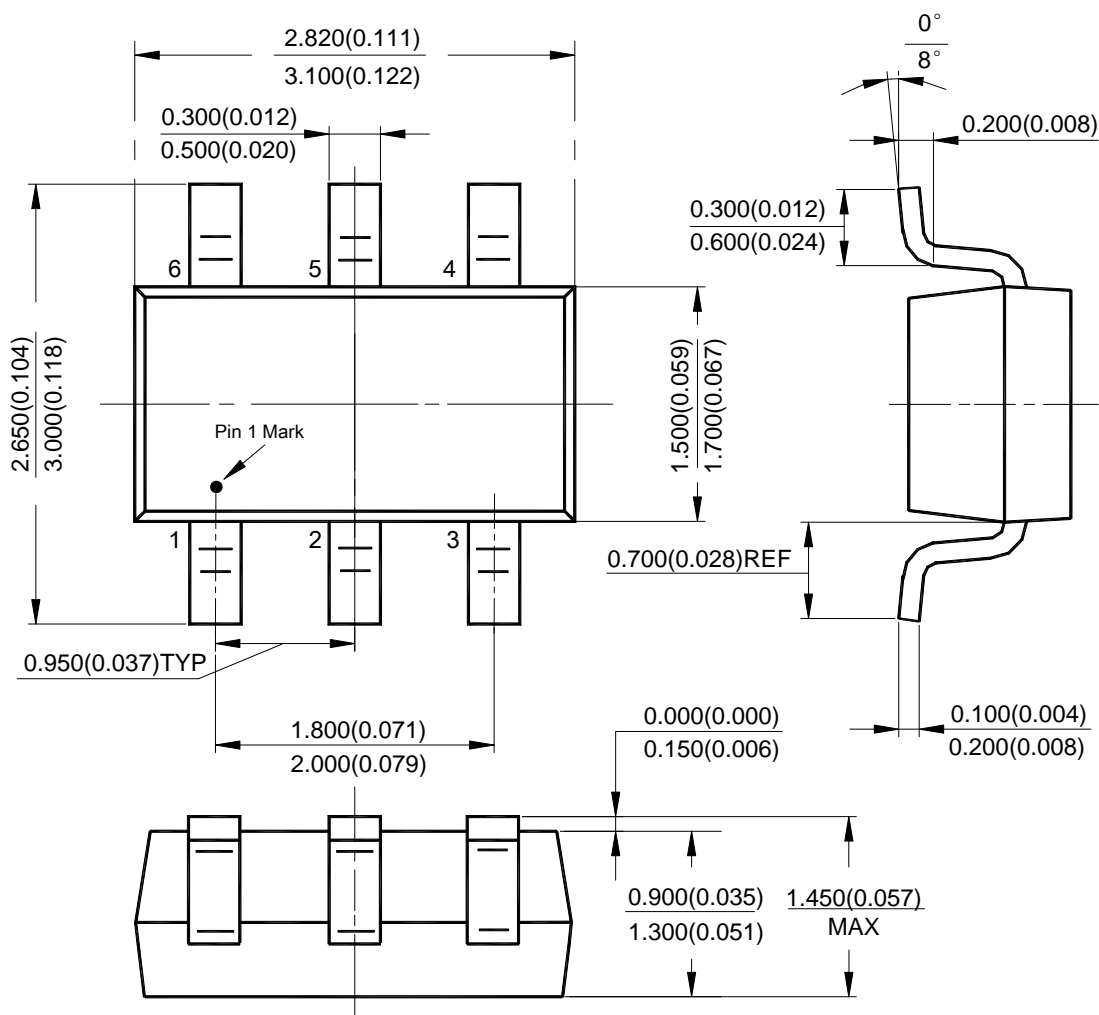


 : Logo  
 XXX: Marking ID (See details from ordering information)



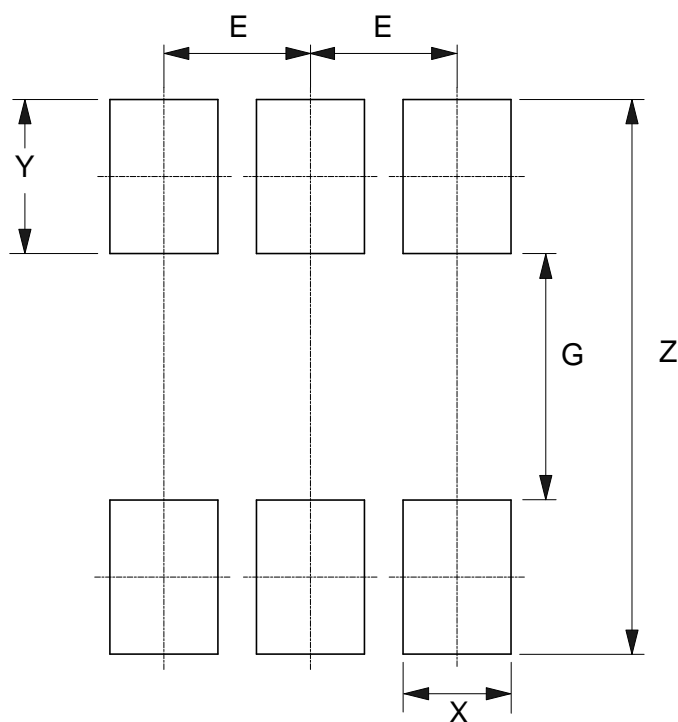
**Package Outline Dimensions** (All dimensions in mm(inch).)

(1) Package Type: SOT26



## Suggested Pad Layout

(1) Package Type: SOT26



Dimensions	Z (mm)/(inch)	G (mm)/(inch)	X (mm)/(inch)	Y (mm)/(inch)	E (mm)/(inch)
Value	3.600/0.142	1.600/0.063	0.700/0.028	1.000/0.039	0.950/0.037

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