

## 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

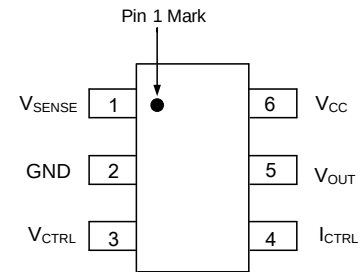
- Constant Voltage and Constant Current Control
- Low External Component Count
- Easy Compensation
- Low Supply Current: 190μA
- Precision Internal Voltage Reference: 2.5V
- Operating Supply Voltage: 3.5V to 36V
- Low Current Sense Threshold: 30mV/50mV
- **Totally Lead-free & Fully RoHS Compliant (Note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

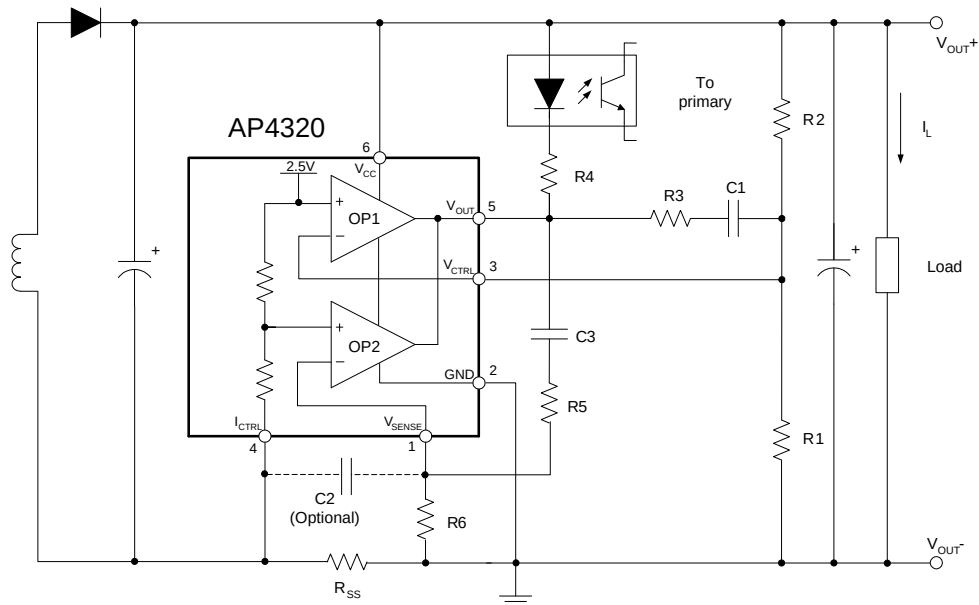


SOT26 (K6 Package)

### Applications

- AC/DC Adapters
- Battery Chargers
- LED Drivers

### Typical Applications Circuit

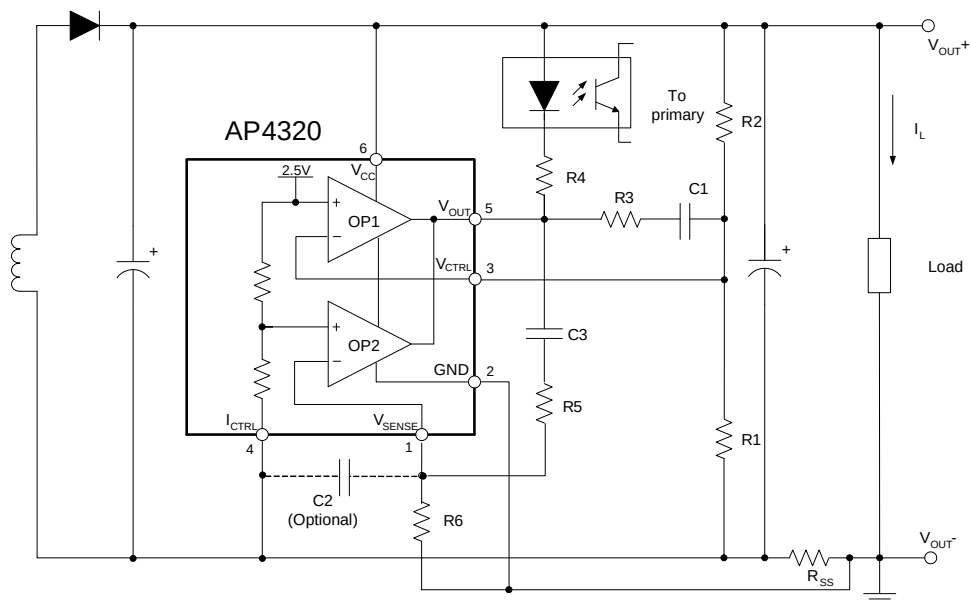


$$V_{OUT} = V_{REF} \times \frac{R1 + R2}{R1}$$

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

Typical Application 1

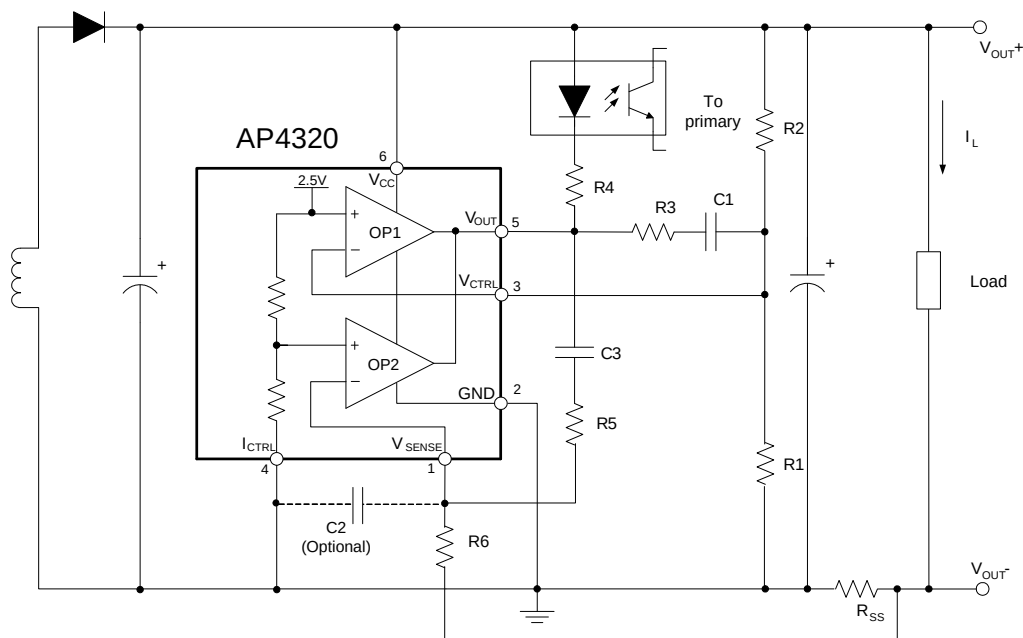
### Typical Applications Circuit (Cont.)



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

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

## Typical Application 2



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

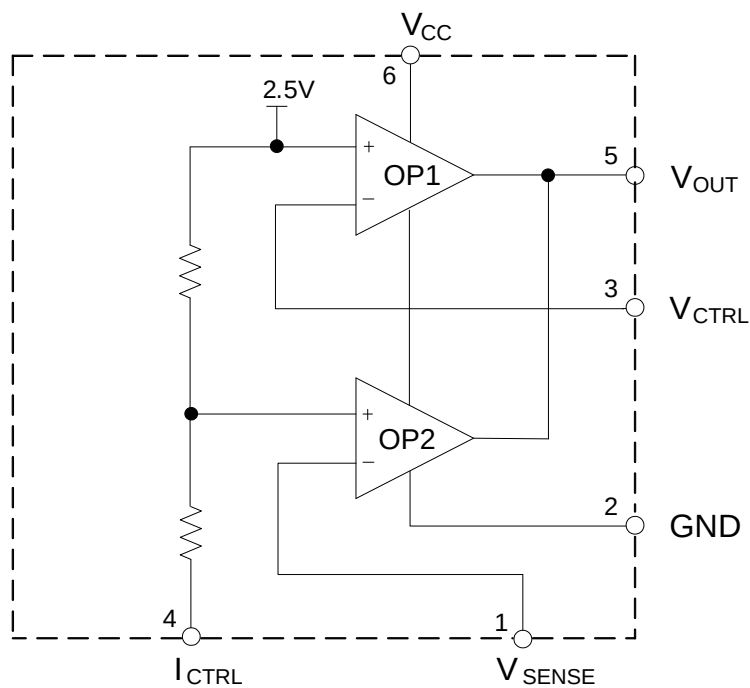
$$CurrentLimit = \frac{V_{SENSE} \times V_{REF}}{(V_{SENSE} + V_{REF}) \times R_{SS}}$$

### 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

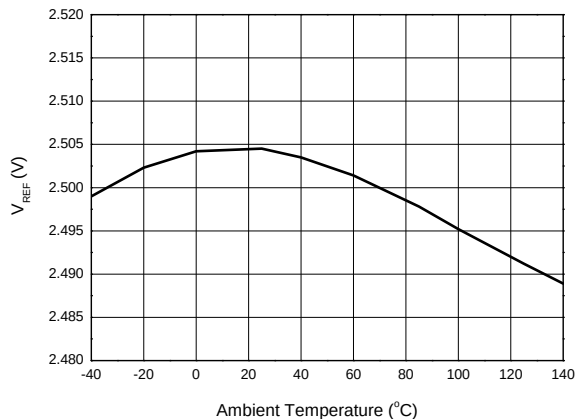
| Symbol   | Parameter            | Min | Max | Unit |
|----------|----------------------|-----|-----|------|
| $V_{CC}$ | Power Supply Voltage | 3.5 | 36  | V    |

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

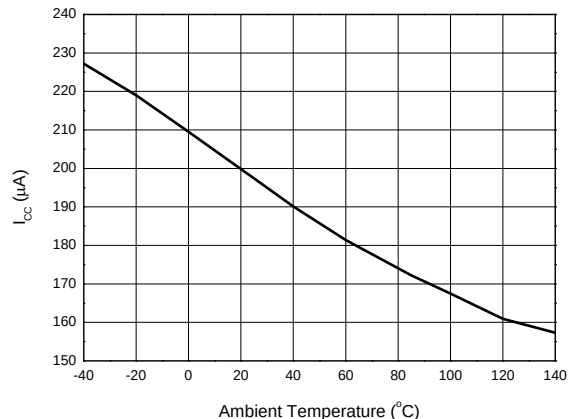
| Symbol                    | Parameters                                                    | Conditions                                                         | Min                       | Typ  | Max   | Unit  |    |
|---------------------------|---------------------------------------------------------------|--------------------------------------------------------------------|---------------------------|------|-------|-------|----|
| 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

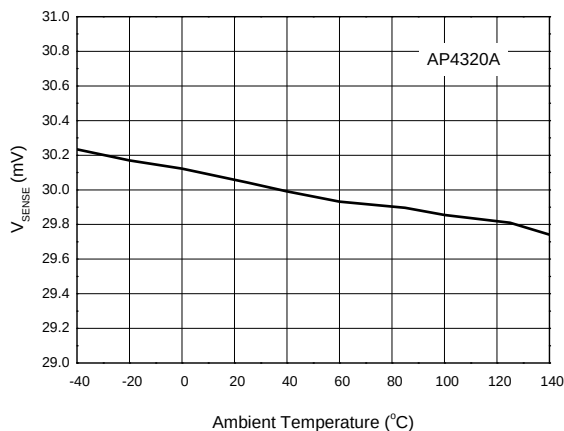
**V<sub>REF</sub> vs. Ambient Temperature**



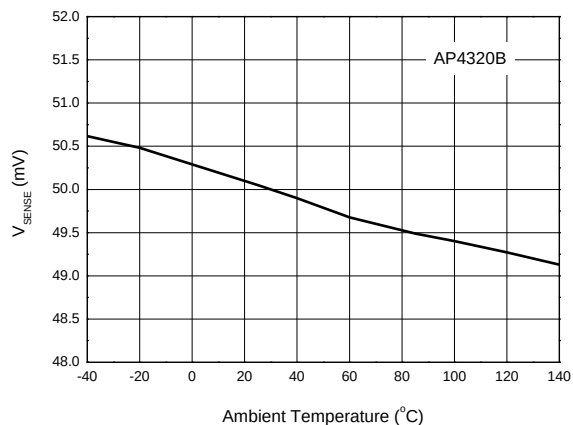
**I<sub>CC</sub> vs. Ambient Temperature**



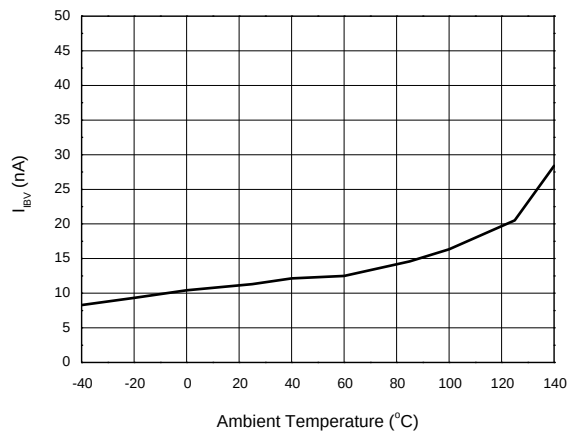
**V<sub>SENSE</sub> vs. Ambient Temperature**



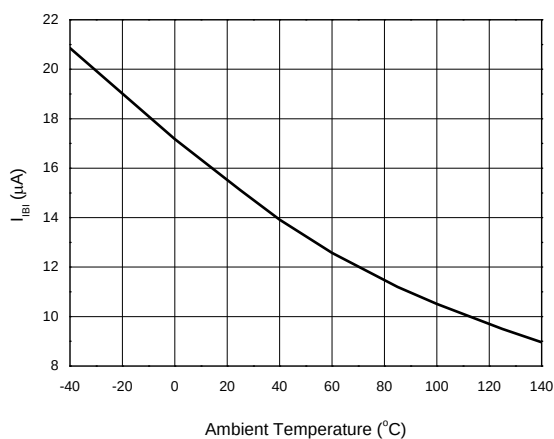
**V<sub>SENSE</sub> vs. Ambient Temperature**



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

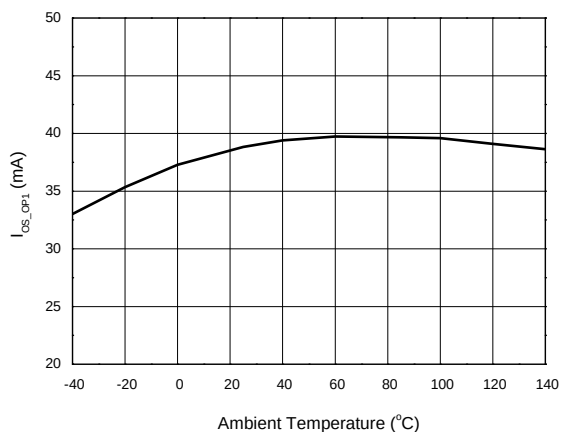


**I<sub>IBI</sub> vs. Ambient Temperature**

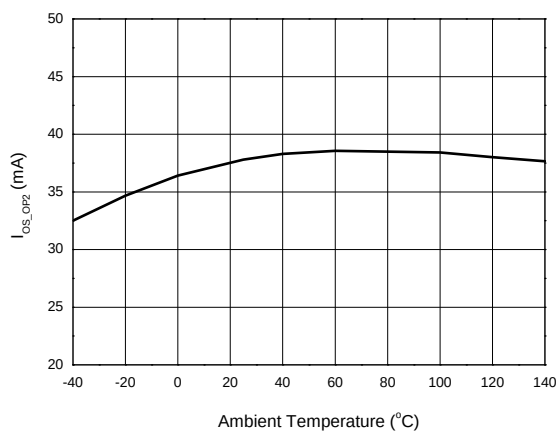


## Performance Characteristics (Cont.)

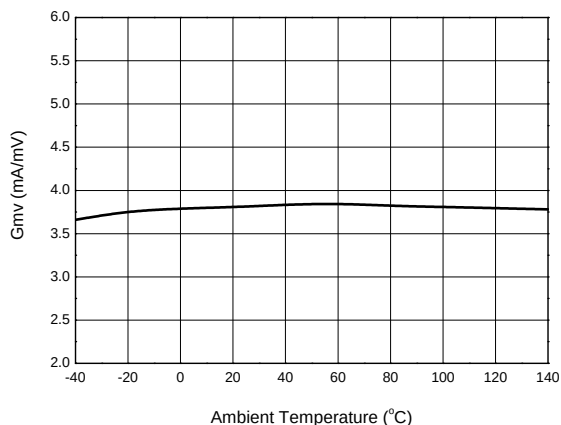
**$I_{OS\_OP1}$  vs. Ambient Temperature**



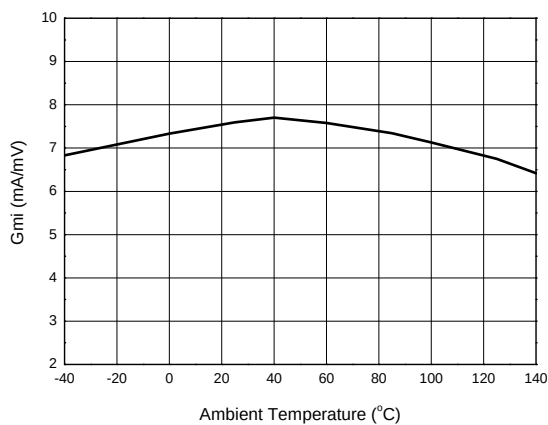
**$I_{OS\_OP2}$  vs. Ambient Temperature**



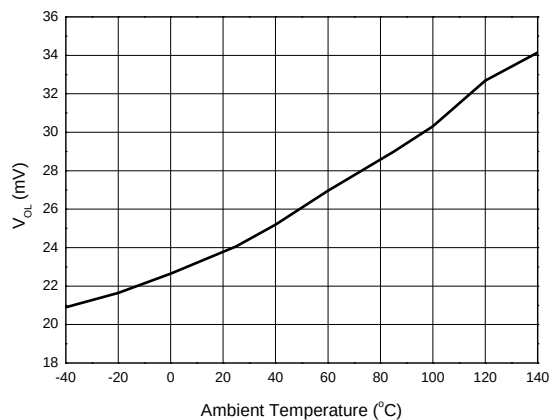
**Gmv vs. Ambient Temperature**



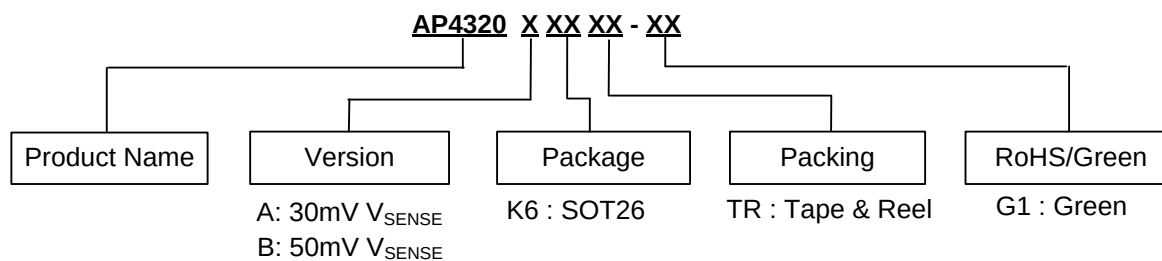
**Gmi vs. Ambient Temperature**



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



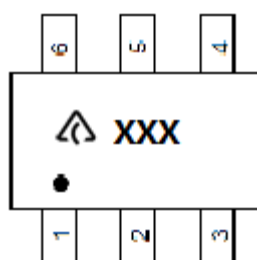
## Ordering Information



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 <sub>SENSE</sub> | AP4320AK6TR-G1 | GJZ        | 3000/Tape and Reel |
|         | 50mV V <sub>SENSE</sub> | AP4320BK6TR-G1 | GKW        |                    |

## Marking Information

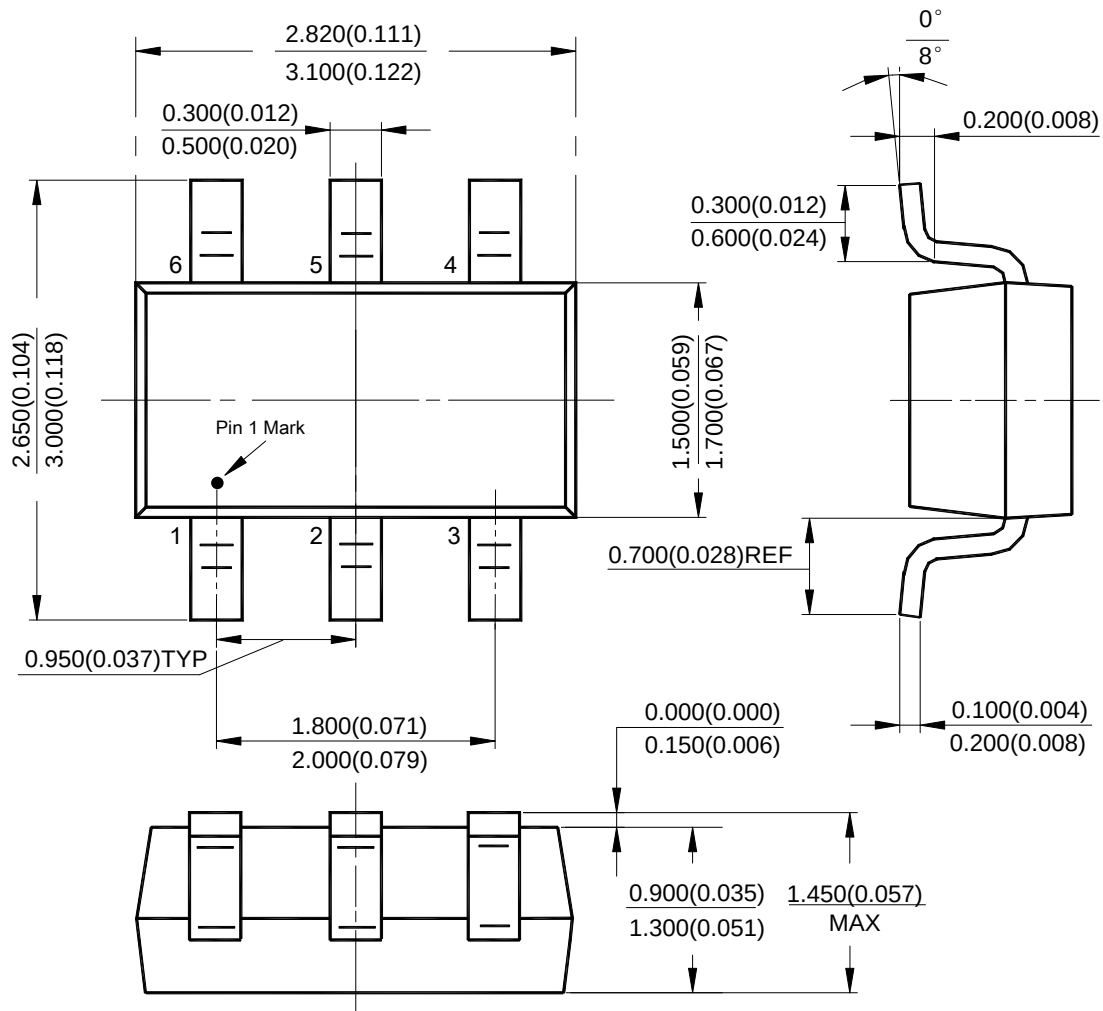


 : Logo  
XXX: Marking ID (See details from ordering information)



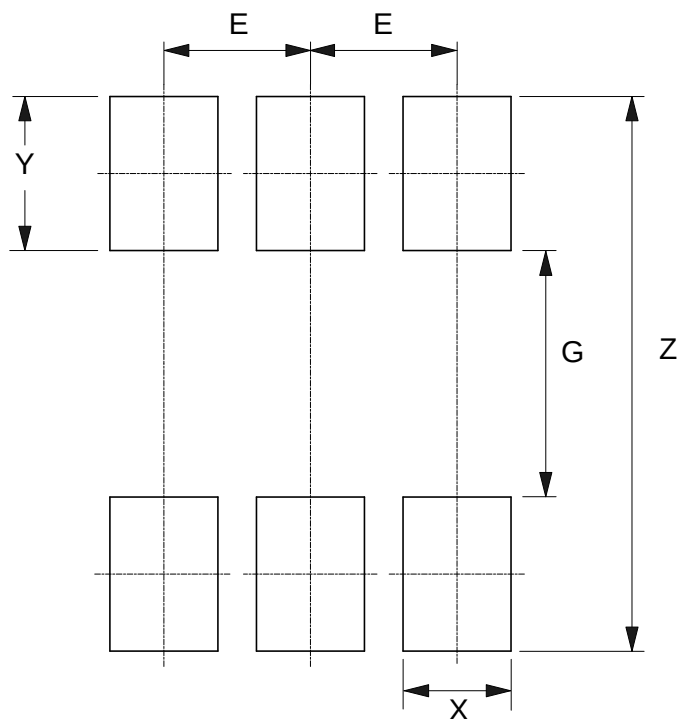
**Package Outline Dimensions** (All dimensions in mm(inch).)

(1) Package Type: SOT26



## Suggested Pad Layout

(1) Package Type: SOT26



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

**IMPORTANT NOTICE**

DIODES INCORPORATED MAKES NO WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, WITH REGARDS TO THIS DOCUMENT, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION).

Diodes Incorporated and its subsidiaries reserve the right to make modifications, enhancements, improvements, corrections or other changes without further notice to this document and any product described herein. Diodes Incorporated does not assume any liability arising out of the application or use of this document or any product described herein; neither does Diodes Incorporated convey any license under its patent or trademark rights, nor the rights of others. Any Customer or user of this document or products described herein in such applications shall assume all risks of such use and will agree to hold Diodes Incorporated and all the companies whose products are represented on Diodes Incorporated website, harmless against all damages.

Diodes Incorporated does not warrant or accept any liability whatsoever in respect of any products purchased through unauthorized sales channel. Should Customers purchase or use Diodes Incorporated products for any unintended or unauthorized application, Customers shall indemnify and hold Diodes Incorporated and its representatives harmless against all claims, damages, expenses, and attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized application.

Products described herein may be covered by one or more United States, international or foreign patents pending. Product names and markings noted herein may also be covered by one or more United States, international or foreign trademarks.

This document is written in English but may be translated into multiple languages for reference. Only the English version of this document is the final and determinative format released by Diodes Incorporated.

**LIFE SUPPORT**

Diodes Incorporated products are specifically not authorized for use as critical components in life support devices or systems without the express written approval of the Chief Executive Officer of Diodes Incorporated. As used herein:

A. Life support devices or systems are devices or systems which:

1. are intended to implant into the body, or
2. support or sustain life and whose failure to perform when properly used in accordance with instructions for use provided in the labeling can be reasonably expected to result in significant injury to the user.

B. A critical component is any component in a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or to affect its safety or effectiveness.

Customers represent that they have all necessary expertise in the safety and regulatory ramifications of their life support devices or systems, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of Diodes Incorporated products in such safety-critical, life support devices or systems, notwithstanding any devices- or systems-related information or support that may be provided by Diodes Incorporated. Further, Customers must fully indemnify Diodes Incorporated and its representatives against any damages arising out of the use of Diodes Incorporated products in such safety-critical, life support devices or systems.

Copyright © 2013, Diodes Incorporated

[www.diodes.com](http://www.diodes.com)

## Данный компонент на территории Российской Федерации

**Вы можете приобрести в компании MosChip.**

Для оперативного оформления запроса Вам необходимо перейти по данной ссылке:

<http://moschip.ru/get-element>

Вы можете разместить у нас заказ для любого Вашего проекта, будь то серийное производство или разработка единичного прибора.

В нашем ассортименте представлены ведущие мировые производители активных и пассивных электронных компонентов.

Нашей специализацией является поставка электронной компонентной базы двойного назначения, продукции таких производителей как XILINX, Intel (ex.ALTERA), Vicor, Microchip, Texas Instruments, Analog Devices, Mini-Circuits, Amphenol, Glenair.

Сотрудничество с глобальными дистрибьюторами электронных компонентов, предоставляет возможность заказывать и получать с международных складов практически любой перечень компонентов в оптимальные для Вас сроки.

На всех этапах разработки и производства наши партнеры могут получить квалифицированную поддержку опытных инженеров.

Система менеджмента качества компании отвечает требованиям в соответствии с ГОСТ Р ИСО 9001, ГОСТ РВ 0015-002 и ЭС РД 009

### Офис по работе с юридическими лицами:

105318, г.Москва, ул.Щербаковская д.3, офис 1107, 1118, ДЦ «Щербаковский»

Телефон: +7 495 668-12-70 (многоканальный)

Факс: +7 495 668-12-70 (доб.304)

E-mail: [info@moschip.ru](mailto:info@moschip.ru)

Skype отдела продаж:

moschip.ru

moschip.ru\_4

moschip.ru\_6

moschip.ru\_9