

## Description

The DIODES™ AP4312 is a highly integrated solution for a constant voltage/constant current mode SMPS application.

The AP4312 contains one 1.21V voltage reference, one low voltage reference used in current sensing circuit and two operational amplifiers. The 1.21V 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 AP4312 is fully compatible with DIODES™ AP4306 in functionality and electrical characteristics except its lower reference voltage for current control loop, thus higher power efficiency in SMPS applications such as low power charger can be realized with AP4312 compared to AP4306.

The AP4312 is available in SOT26 package.

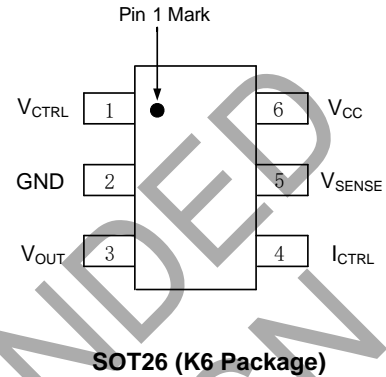
## Features

- Constant Voltage and Constant Current Control
- Precision Internal Voltage Reference
- Low External Component Count
- Easy Compensation
- Low Supply Current: 180μA
- Current Control Loop Reference: 70mV
- Operating Supply Voltage: 1.7V to 18V
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**
- **An automotive-compliant part is available under separate datasheet ([AP4312Q](#))**

Notes: 1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.  
 2. See <https://www.diodes.com/quality/lead-free/> 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

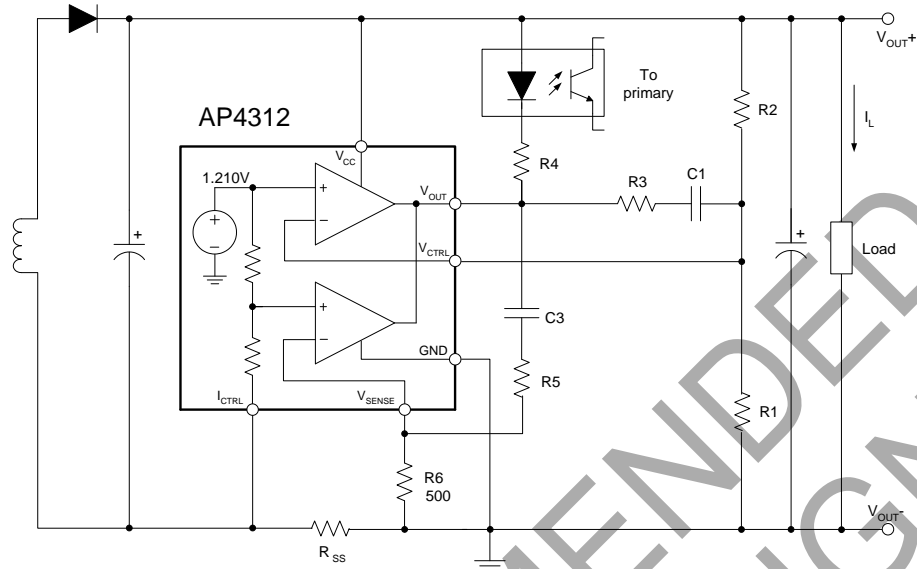
(Top View)



## Applications

- Adapters
- Battery chargers

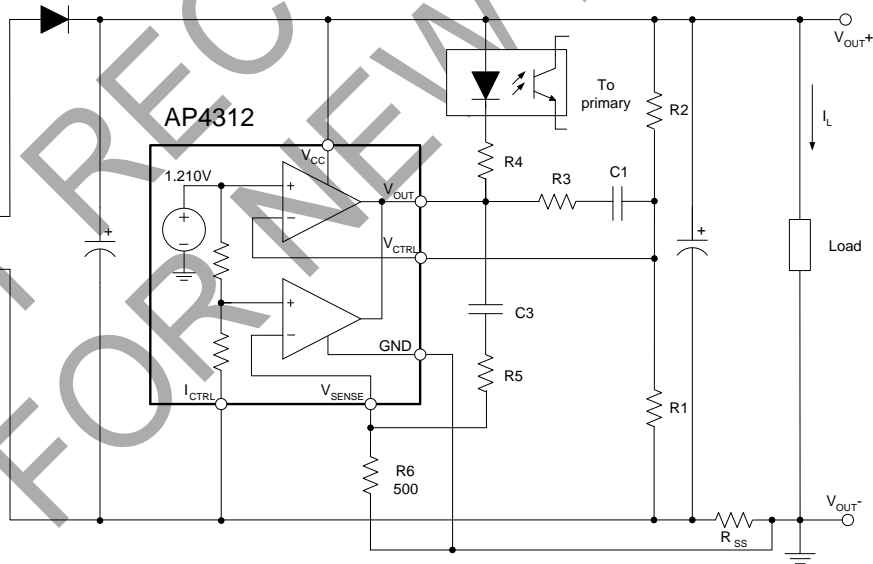
**Typical Applications Circuit**



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

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

Typical Application 1

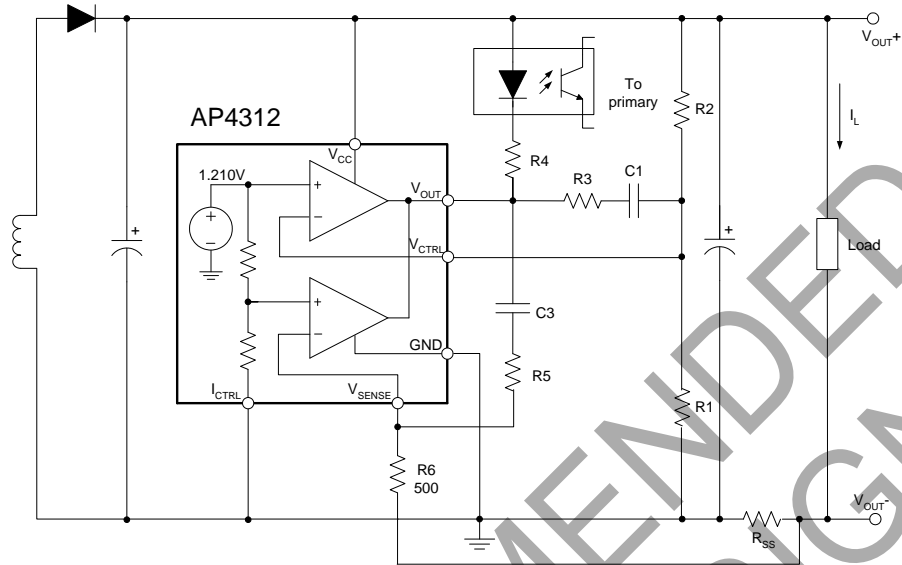


$$V_{OUT} = [V_{REF} + (I_L \times R_{SS})] \times \frac{R1 + R2}{R1} - (I_L \times R_{SS})$$

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

Typical Application 2

**Typical Applications Circuit** (continued)



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

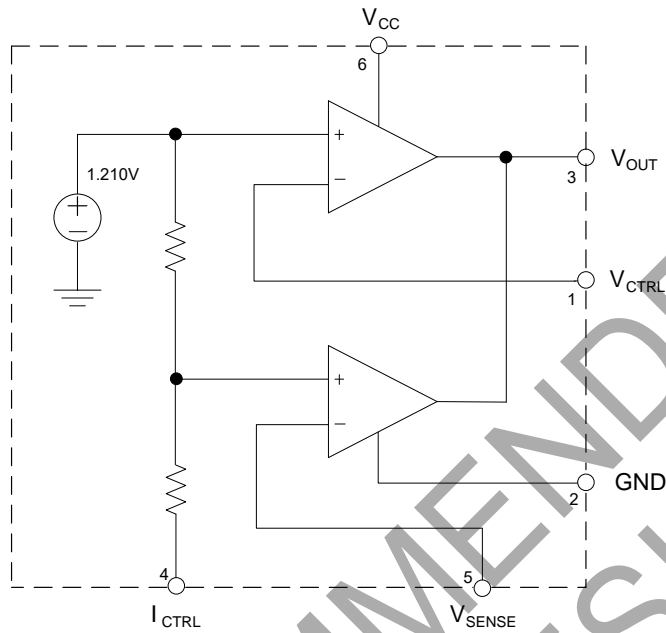
$$CurrentLimit = \frac{V_{SENSE} \times V_{REF}}{(V_{SENSE} + V_{REF}) \times R_{SS}}$$

Typical Application 3

**Pin Descriptions**

Pin Number	Pin Name	Function
1	V_CTRL	Input pin of the voltage control loop
2	GND	Ground
3	V_OUT	Output pin. Sinking current only
4	I_CTRL	Input pin of the current control loop
5	V_SENSE	Input pin of the current control loop
6	V_CC	Power Supply

**Functional Block Diagram**



**Absolute Maximum Ratings** (Note 4)

Symbol	Parameter	Rating	Unit
$V_{CC}$	Power Supply Voltage	20	V
$V_{IN}$	Input Voltage	-0.3 to $V_{CC}$	V
$T_J$	Junction Temperature	+150	°C
$T_{STG}$	Storage Temperature	-65 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* can 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 can affect device reliability.

**Recommended Operating Conditions**

Symbol	Parameter	Min	Max	Unit
$V_{CC}$	Power Supply Voltage	1.7	18	V

**Electrical Characteristics** (@V<sub>CC</sub>=5V, T<sub>A</sub>=+25°C, unless otherwise specified.)

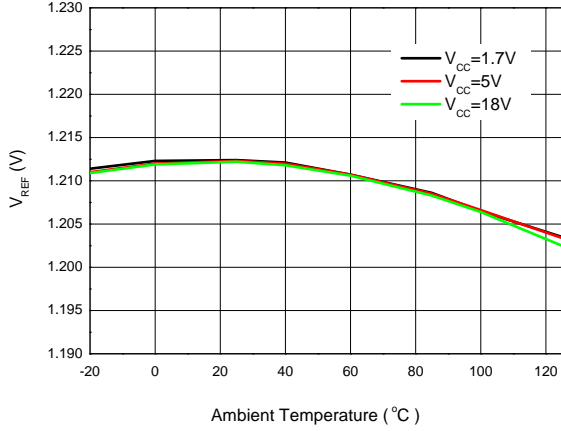
Symbol	Parameters	Conditions	Min	Typ	Max	Unit
<b>TOTAL CURRENT CONSUMPTION</b>						
I <sub>CC</sub>	Total Supply Current Not Including the Output Sinking Current	T <sub>A</sub> =+25°C	–	180	–	μA
		-40°C < T <sub>A</sub> < +105°C	–	–	300	
<b>VOLTAGE CONTROL LOOP</b>						
G <sub>mv</sub>	Transconductance of Voltage Control Loop Op-Amp (Sink Current Only)	T <sub>A</sub> =+25°C	1	3.5	–	mA/mV
		-40°C < T <sub>A</sub> < +105°C	–	2.5	–	
V <sub>REF</sub>	Voltage Control Loop Reference	T <sub>A</sub> =+25°C	1.204	1.21	1.216	V
		-40°C < T <sub>A</sub> < +105°C	1.186		1.234	
I <sub>IBV</sub>	Input Bias Current (V <sub>CTRL</sub> )	T <sub>A</sub> =+25°C	–	50	–	nA
		-40°C < T <sub>A</sub> < +105°C	–	100	–	
<b>CURRENT CONTROL LOOP</b>						
G <sub>mi</sub>	Transconductance of Current Control Loop Op-Amp (Sink Current Only)	T <sub>A</sub> =+25°C	1.5	7	–	mA/mV
		-40°C < T <sub>A</sub> < +105°C	1.5	7	–	
V <sub>SENSE</sub>	Current Control Loop Reference	T <sub>A</sub> =+25°C	67.9	70	72.1	mV
		-40°C < T <sub>A</sub> < +105°C	66		74	
I <sub>IBI</sub>	Current Out of Pin I <sub>CTRL</sub> at V <sub>SENSE</sub>	T <sub>A</sub> =+25°C	–	18	–	μA
		-40°C < T <sub>A</sub> < +105°C	–	35	–	
<b>OUTPUT STAGE</b>						
V <sub>OL</sub>	Low Output Voltage Level	T <sub>A</sub> =+25°C, I <sub>SINK</sub> =2mA	–	100	–	mV
		-40°C < T <sub>A</sub> < +105°C, I <sub>SINK</sub> =2mA	–	100	–	
I <sub>OS</sub>	Output Short Circuit Current. Output to V <sub>CC</sub> Sink Current Only	T <sub>A</sub> =+25°C	–	27	50	mA
		-40°C < T <sub>A</sub> < +105°C	–	35	–	

**Thermal Impedance**

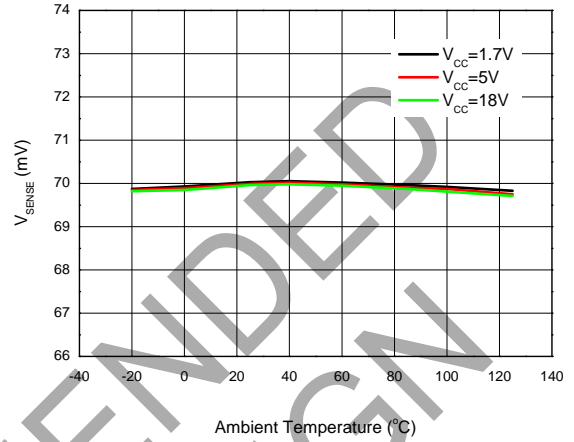
Symbol	Parameter	Value	Unit
θ <sub>JC</sub>	Thermal Resistance (Junction to Case)	84	°C/W

**Performance Characteristics**

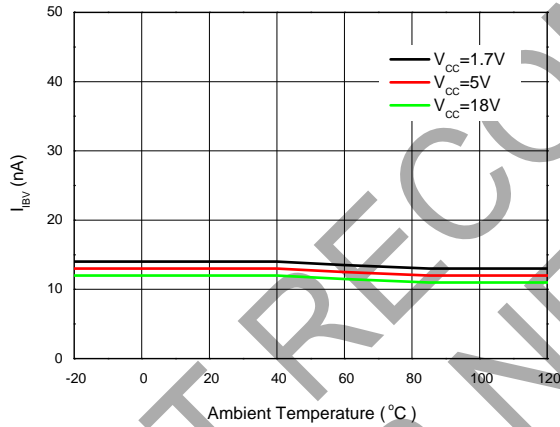
**Voltage Control Loop Reference vs. Ambient Temperature**



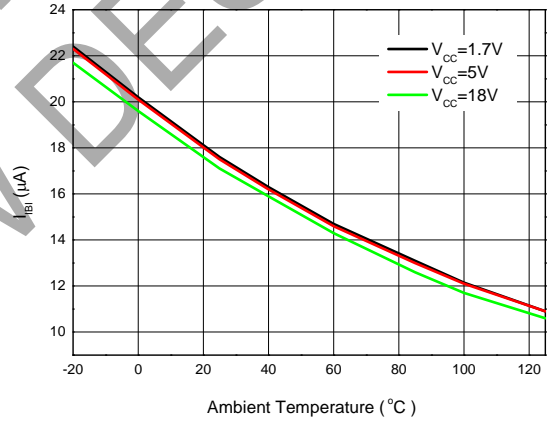
**Current Control Loop Reference vs. Ambient Temperature**



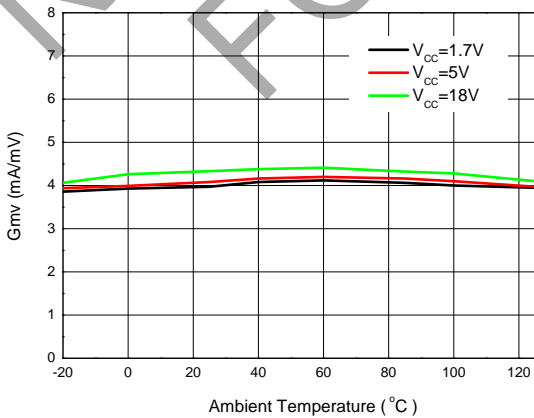
**Input Bias Current ( $V_{CTRL}$ ) vs. Ambient Temperature**



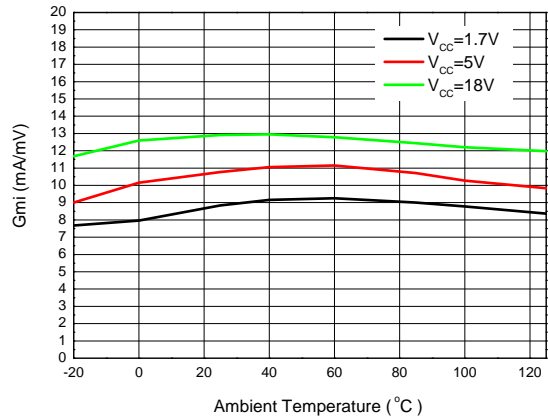
**Current Out of Pin I\_CTRL at  $V_{SENSE}$  vs. Ambient Temperature**



**Transconductance of Voltage Control Loop Op-Amp vs. Ambient Temperature**

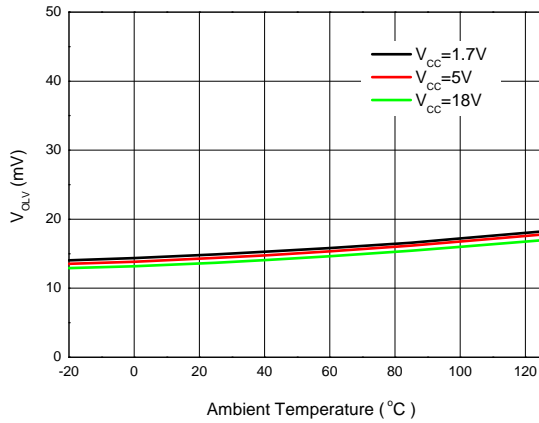


**Transconductance of Current Control Loop Op-Amp vs. Ambient Temperature**

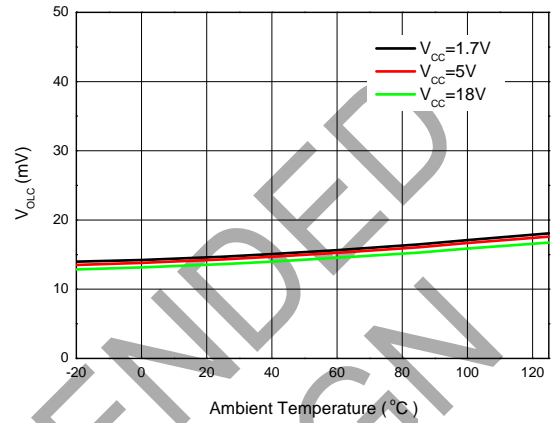


**Performance Characteristics** (continued)

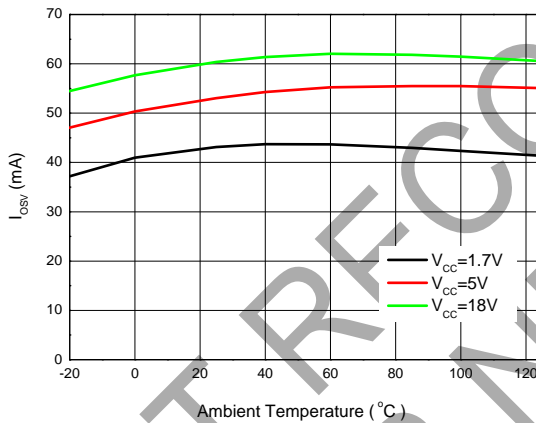
**Low Output Level of Voltage Control Loop Op-Amp vs. Ambient Temperature**



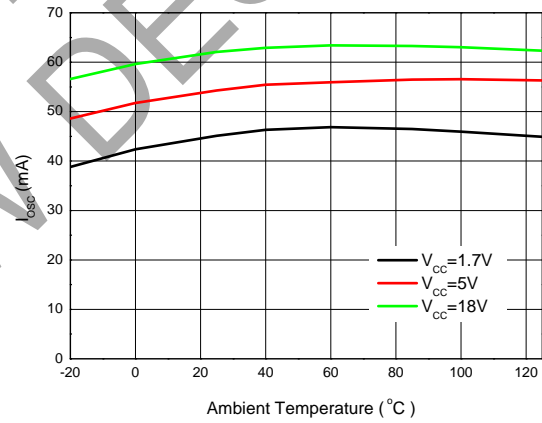
**Low Output Level of Current Control Loop Op-Amp vs. Ambient Temperature**



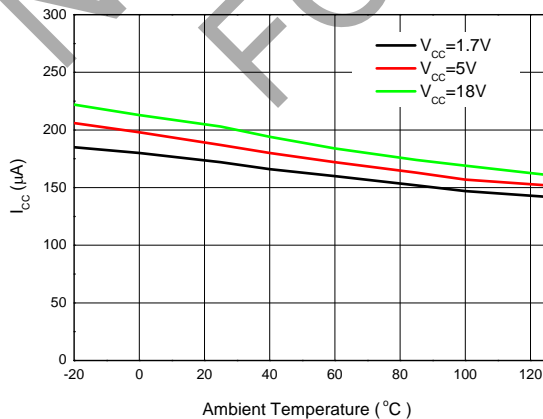
**Output Short Circuit Current of Voltage Control Loop Op-Amp vs. Ambient Temperature**



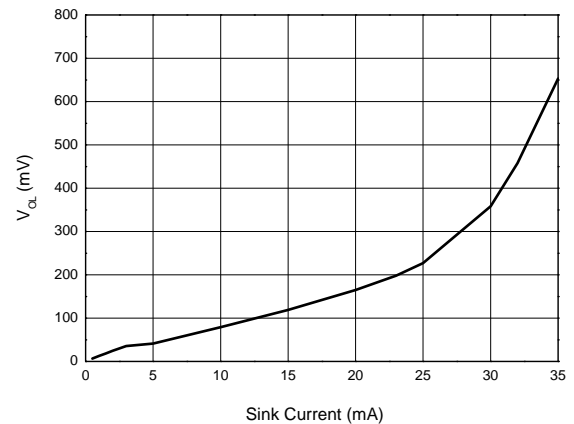
**Output Short Circuit Current of Current Control Loop Op-Amp vs. Ambient Temperature**



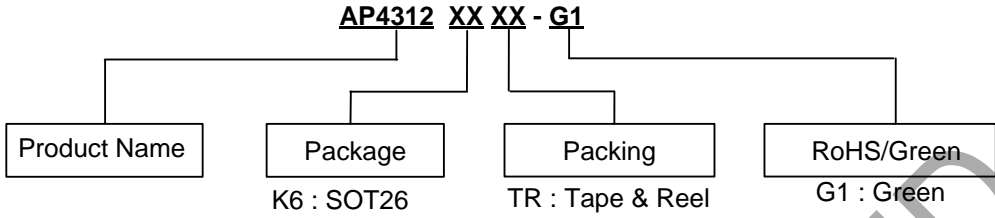
**Total Supply Current Not Including the Output Sinking Current vs. Ambient Temperature**



**Low Output Voltage Level vs. Sink Current**

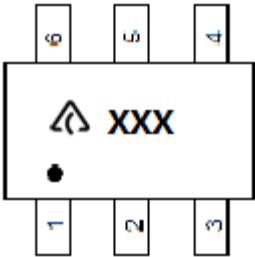


**Ordering Information**



Part Number	Package	Marking ID	Packing	
			Qty.	Carrier
AP4312K6TR-G1	SOT26	GKD	3000	Tape & Reel

**Marking Information**



 : Logo  
 XXX: Marking ID (See ordering information)

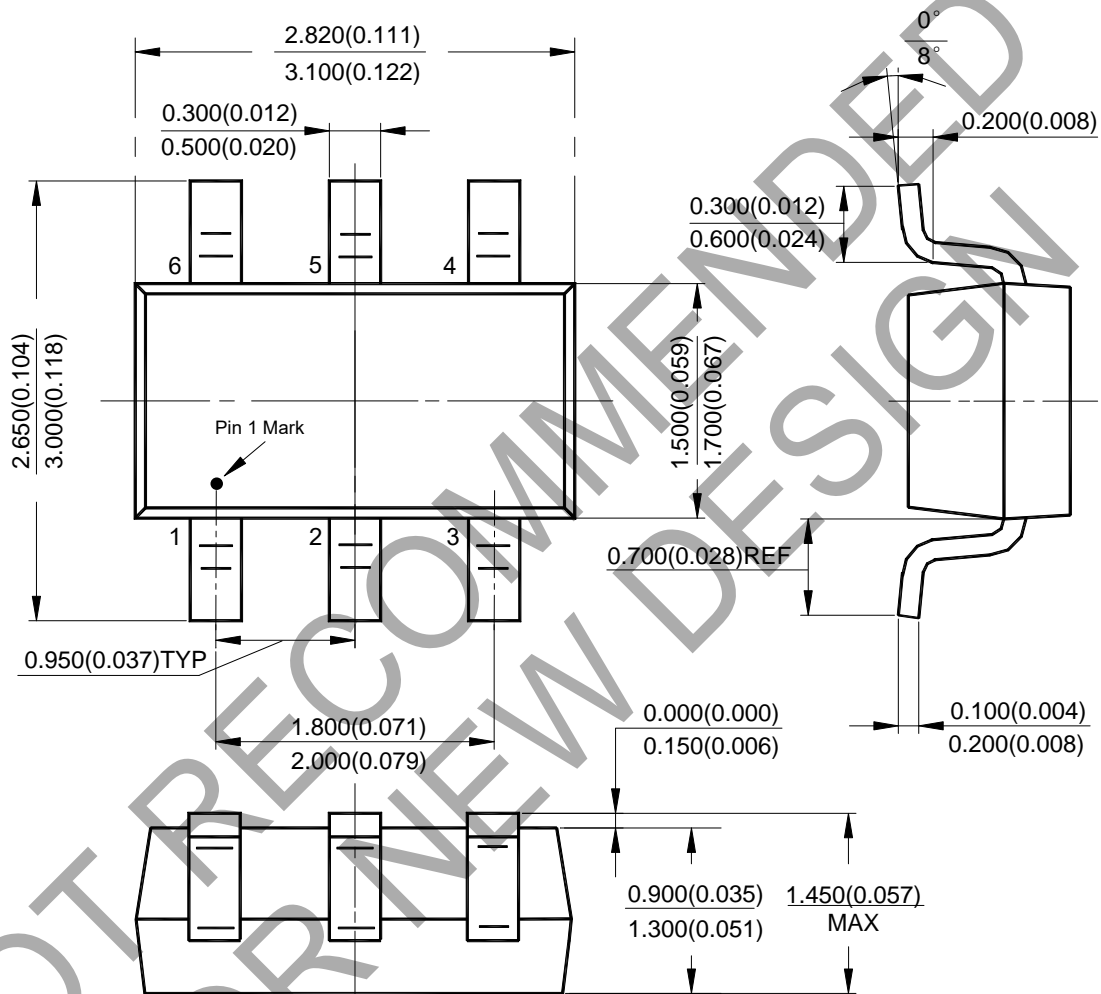
NOT RECOMMENDED FOR NEW DESIGN



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

Please see <http://www.diodes.com/package-outlines.html> for the latest version.

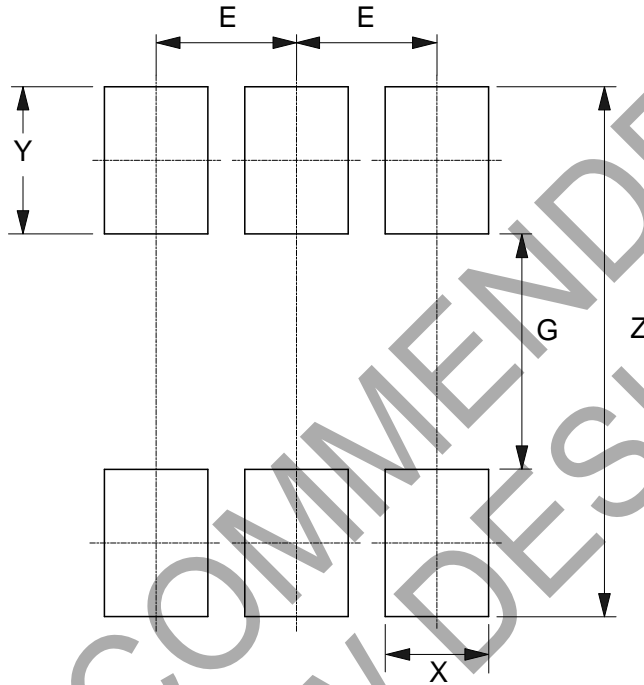
(1) Package Type: SOT26



**Suggested Pad Layout**

Please see <http://www.diodes.com/package-outlines.html> for the latest version.

(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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