Description

The DIODES™ AP3125A is a current mode PWM controller optimized for high performance, low standby power, and cost-effective offline flyback converters.

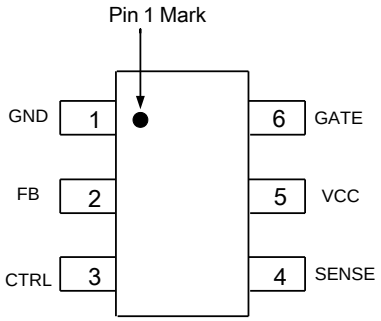
The PWM switching frequency at normal operation is internally fixed (about 65kHz). In middle load, the IC will enter green mode to improve system efficiency with the help of frequency foldback. A minimum switching frequency (about 20kHz) is set to avoid the audible noise. In no load or light load, the IC will enter the burst mode to minimize standby power. Furthermore, the frequency dithering function is built-in to reduce EMI emission.

Internal slope compensation allows more stable Peak-Current Mode control over wide range of input voltage and load conditions. Internal line compensation ensures constant output power limit over entire universal line voltage range.

Comprehensive protection features are included, such as cycle-by-cycle current limit (OCP), VCC Overvoltage Protection (VOVP), internal OTP, Overload Protection (OLP), and pins' fault protection. The versatile latch functions can be implemented using a minimal number of external components.

Pin Assignments

(Top View)



SOT26 (K Package)

Features

- Very Low Start-Up Current
- Current Mode Control
- Non-Audible-Noise Green-Mode Control
- Internal Slope Compensation
- Soft Start During Startup Process
- Frequency Fold Back for High Average Efficiency
- Secondary Winding Short Protection with FOCP
- Soft Switching for Reducing EMI
- VCC Maintain Mode
- Useful Pin Fault Protection:
  SENSE Pin Floating
  CTRL Pin Short to Ground
  FB/Opto-coupler Open/Short
- Comprehensive System Protection Feature:
  VCC Overvoltage Protection (VOVP)
  Overload Protection (OLP)
- Optional Latch Mode for VOVP, OLP, and CTRL Pin Protection
- Mini Size Package of SOT26
- Pin-to-Pin Compatible with AP3105NA/NV/NL/NR
- **Totally Lead-free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**
- **For automotive applications requiring specific change control (i.e. parts qualified to AEC-Q100/101/104/200, PPAP capable, and manufactured in IATF 16949 certified facilities), please contact us or your local Diodes representative. https://www.diodes.com/quality/product-definitions/)**

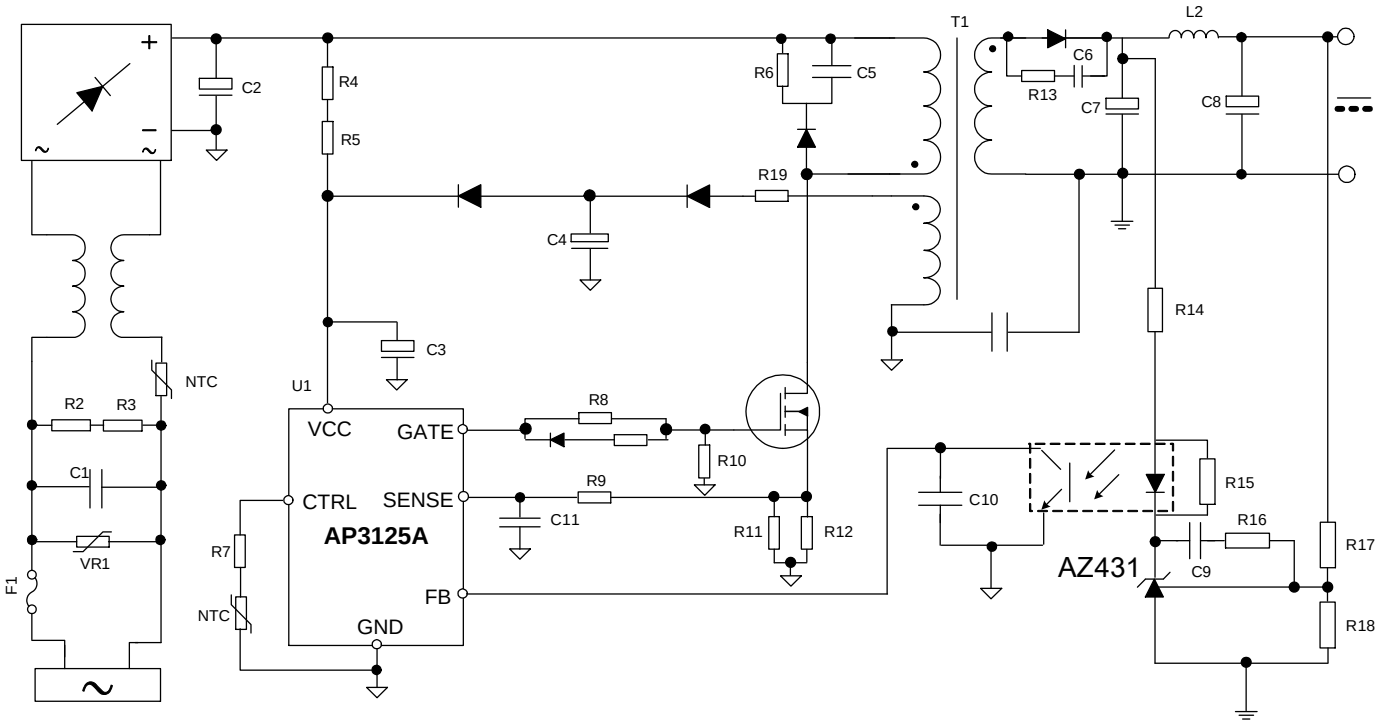
Applications

- Switching AC-DC adaptors/chargers
- ATX/BTX auxiliary power
- Set-top box (STB) power supplies
- Open frame switching power supplies

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.

© Diodes Incorporated

Typical Applications Circuit

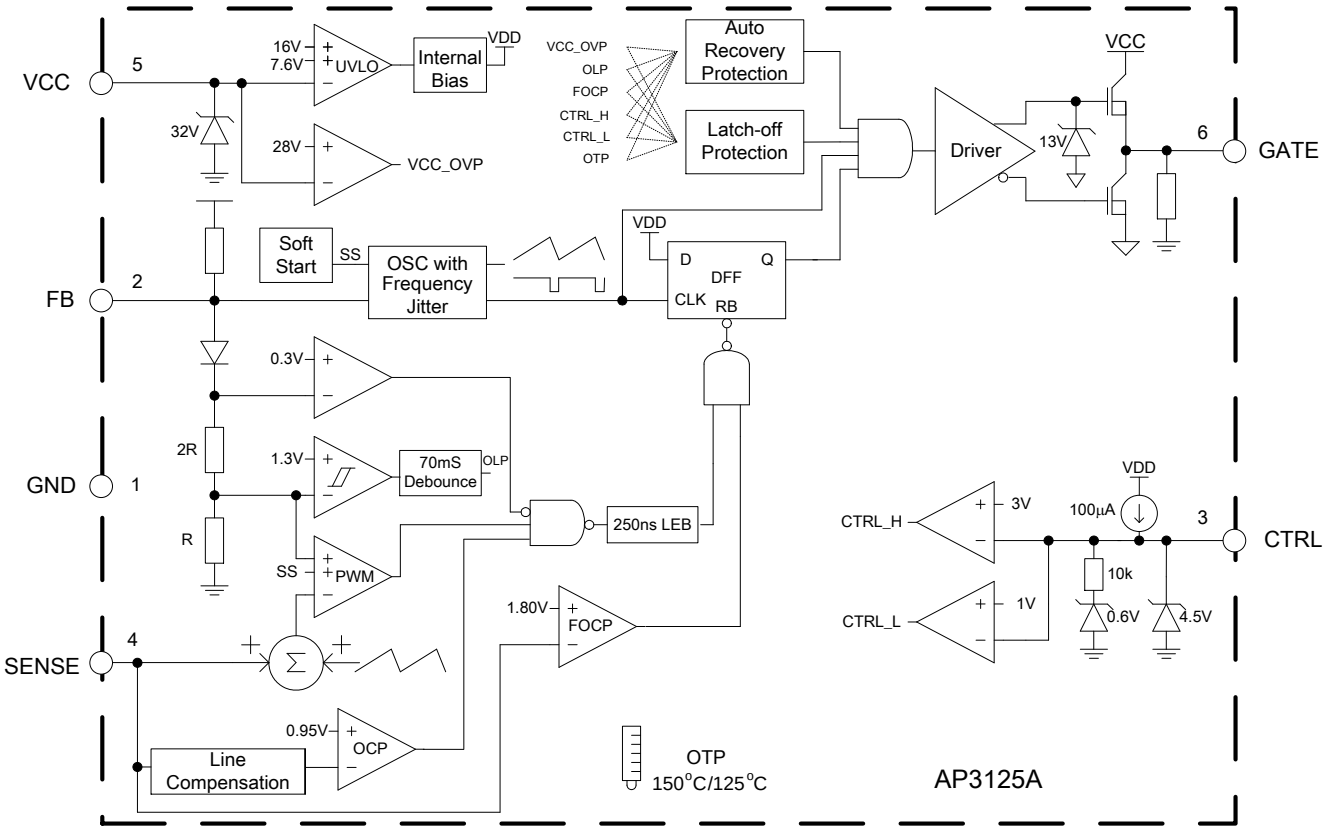


Pin Descriptions

Pin Number	Pin Name	Function
1	GND	Signal ground. Current return for driver and control circuits
2	FB	Feedback. Directly connected to the opto-coupler
3	CTRL	Latch trigger if this pin voltage drops below a threshold or over another threshold, leave CTRL pin open if this function is not needed. Connecting a NTC thermistor to GND can achieve OTP protection
4	SENSE	Current Sense
5	VCC	Supply voltage of driver and control circuits
6	GATE	Gate driver output

© Diodes Incorporated

Functional Block Diagram



© Diodes Incorporated

Absolute Maximum Ratings (Note 4)

Symbol	Parameter	Rating	Unit
V_{CC}	Power Supply Voltage	30	V
I_O	Gate Output Current	350	mA
V_{FB}, V_{SENSE}, V_{CTRL}	Input Voltage to FB, SENSE, CTRL	-0.3 to 7	V
θ_{JA}	Thermal Resistance (Junction to Ambient)	250	°C/W
P_D	Power Dissipation at T_A < +25°C	500	mW
T_J	Operating Junction Temperature	-40 to +150	°C
T_{STG}	Storage Temperature Range	+150	°C
–	ESD (Human Body Model)	3000	V
–	ESD (Machine Model)	300	V

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}	Supply Voltage	10	25	V

© Diodes Incorporated

Electrical Characteristics (@T_A = +25°C, V_{CC} = 16V, unless otherwise specified.)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Supply Voltage (VCC Pin)						
$I_{STARTUP}$	Startup Current	–	–	1	10	μA
I_{CC}	Operating Supply Current	V_{FB}=0V, C_L=1nF	0.5	0.7	1	mA
		V_{FB}=3V, C_L=0nF	0.6	1.2	2.0	
–	$U_{VLO (on)}$	–	14.5	15.8	16.5	V
–	V_{CC} Maintain	–	8.6	9.1	9.6	V
–	$U_{VLO (off)}$	–	7.1	7.6	8.1	V
–	V_{CC} OVP	–	27	28.5	30	V
–	V_{CC} Clamp	I_{CC}=5mA	31	34	–	V
PWM Section/Oscillator Section						
–	Maximum Duty Cycle	–	70	75	80	%
–	Oscillation Frequency	–	60	65	70	kHz
–	Green Mode Frequency	–	20	–	30	kHz
–	Frequency Temperature Stability	-20°C to 125°C (Note 5)	–	–	5	%
–	Frequency Voltage Stability	V_{CC}=12V to 30V	–	–	3	%
–	Frequency Dithering	–	±4	±6	±8	%
Current Sense Section (SENSE Pin)						
V_{CS}	Maximum SENSE Voltage	V_{FB}=4.5V	0.9	0.95	1	V
–	FOCP Voltage	–	1.5	1.7	1.9	V
–	LEB Time of SENSE	–	150	250	350	ns
–	Delay to Output (Note 5)	–	–	100	–	ns
–	Soft-start Time	–	3	5	8	ms
Feedback Input Section (FB Pin)						
–	The Ratio of Input Voltage to Current Sense Voltage	–	2.5	3	3.5	V/V
–	Input Impedance	–	12	15	18	kΩ
–	Source Current	V_{FB}=0V	-0.2	-0.27	-0.34	mA
–	Green Mode Threshold	–	–	2.1	–	V
–	Input Voltage for Zero Duty	–	1.3	1.55	1.8	V
Output Section (GATE Pin)						
–	Output Low Level	I_O=20mA, V_{CC}=12V	–	–	1	V
–	Output High Level	I_O=20mA, V_{CC}=12V	8	–	–	V
–	Output Clamping Voltage	–	11	13	15	V
–	Rising Time (Note 5)	C_L=1nF, V_{CC}=13V	–	150	250	ns
–	Falling Time (Note 5)	C_L=1nF, V_{CC}=13V	–	50	100	ns

Note: 5. Guaranteed by design.

© Diodes Incorporated

Electrical Characteristics (Cont.) (@T_A = +25°C, V_{CC} = 16V, unless otherwise specified.)

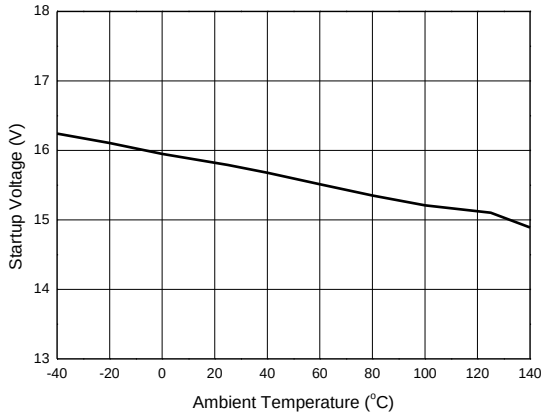
Protection Section (CTRL Pin)						
–	Source Current	–	90	100	110	μA
–	Internal Reference Voltage	–	–	1.9	–	V
–	Low Threshold Trigger for Latch	–	0.94	1	1.06	V
–	High Threshold Trigger for Latch	–	2.85	3	3.15	V
–	Pull-up Current (Note 6)	–	–	–	2	mA
Delay Time Section						
–	Delay of Short Circuit Protection	–	–	70	–	ms
–	Delay of Hiccup Protection	VCC OVP	–	5	–	Cycles
Internal OTP Section						
–	OTP Enter	–	–	150	–	°C
–	OTP Exit	–	–	125	–	°C

Note: 6. The sourcing current of CTRL pin must be limited below 5mA. Otherwise it may cause permanent damage to the device.

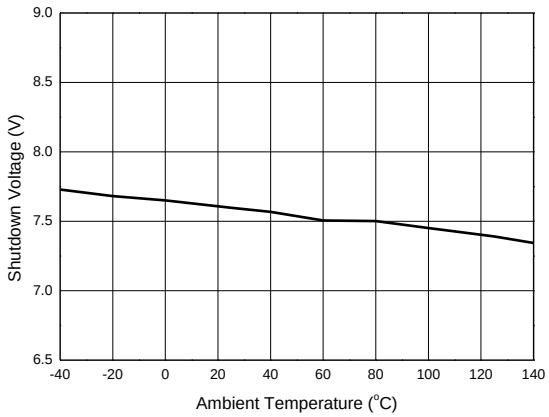
© Diodes Incorporated

Performance Characteristics

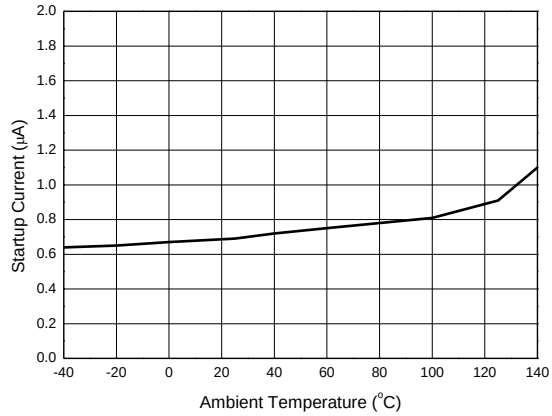
Startup Voltage vs. Ambient Temperature



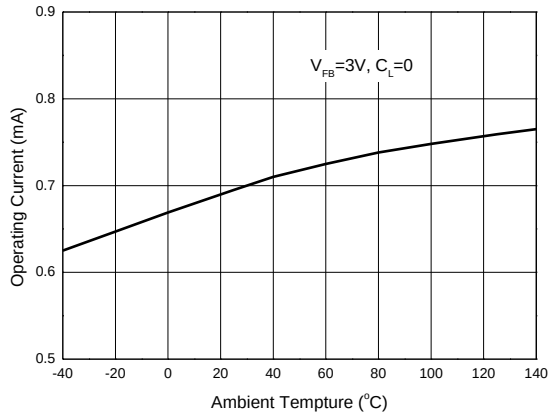
Shutdown Voltage vs. Ambient Temperature



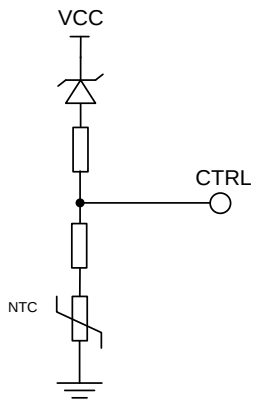
Startup Current vs. Ambient Temperature



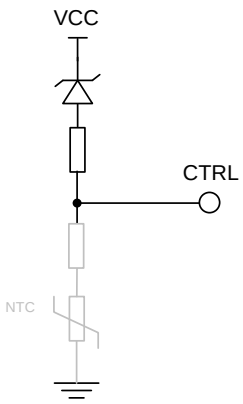
Operating Current vs. Ambient Temperature



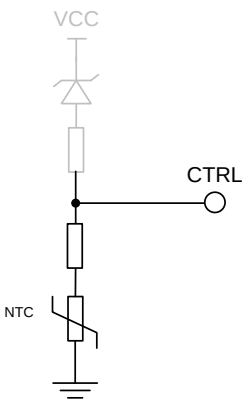
CTRL Utilization for Latch



OVP and OTP



OVP



OTP

© Diodes Incorporated

Operation Description

The AP3125A is specifically designed for off-line AC-DC power supply used in LCD monitor, notebook adapter and battery charger applications. It offers a cost effective solution with a versatile protection function.

Start-up Current and UVLO

The start-up current of AP3125A is optimized to realize ultra low current (1μA typical) so that VCC capacitor can be charged more quickly. The direct benefit of low start-up current is the availability of using large start-up resistor, which minimizes the resistor power loss for high voltage AC input.

An UVLO comparator is included in AP3125A to detect the voltage on VCC pin. It ensures that AP3125A can draw adequate energy from hold-up capacitor during power-on. The turn-on threshold is 16V and the turn-off threshold is 7.6V.

Current Sense Comparator and PWM Latch

The AP3125A operates as a current mode controller, the output switch conduction is initiated by every oscillator cycle and is terminated when the peak inductor current reaches the threshold level established by the FB pin. The inductor current signal is converted to a voltage signal by inserting a reference sense resistor R_S. The inductor current under normal operating conditions is controlled by the voltage at FB pin. The relation between peak inductor current (I_{PK}) and V_{FB} is:

$$I_{PK} = (V_{FB} - 0.8) / 3R_S$$

Moreover, FOCP with 1.8V threshold is only about 100ns delay, which can avoid some catastrophic damages such as secondary rectifier short test. Few drive cycles can alleviate the destruction range and get better protection.

Leading-edge Blanking

A narrow spike on the leading edge of the current waveform can usually be observed when the power MOSFET is turned on. A 250ns leading-edge blank is built-in to prevent the false-triggering caused by the turn-on spike. During this period, the current limit comparator is disabled and the gate driver can not be switched off.

At the time of turning off the MOSFET, a negative undershoot (maybe larger than -0.3V) can occur on the SENSE pin. So it is strongly recommended to add a small RC filter or at least connect a resistor "R" on this pin to protect the IC (Shown as Figure 1).

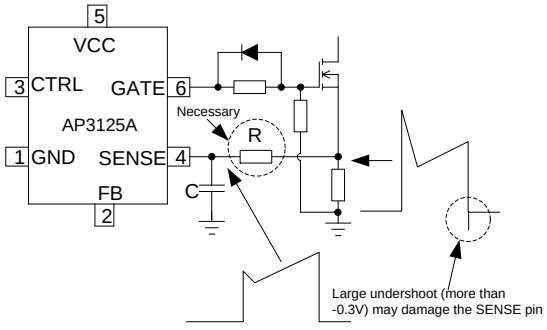


Figure 1

Built-in Slope Compensation

It is well known that a continuous current mode SMPS may become unstable when the duty cycle exceeds 50%. The built-in slope compensation can improve the stability, so there is no need for design engineer to spend much time on that.

FB Pin and Short Circuit Protection

This pin is normally connected to the opto-coupler and always paralleled with a capacitor for loop compensation. When the voltage at this pin is greater than 4.5V and lasts for about 70ms, the IC will enter the protection mode. For AP3125A, the system will enter hiccup mode to wait the V_{CC} decreasing to low UVLO level, then the IC will try to restart until the failure removed. And when this voltage is less than 1.55V, the IC will stop the drive pulse immediately. Therefore, this feature can be used for short circuit protection, which makes the system immune from damage. Normally, output short makes the V_{FB} value to the maximum because the opto-coupler is cut off.

V_{CC} Maintain Mode

During light load or step load, V_{FB} will drop and be lower than 1.55V, thus the PWM drive signal will be stopped, and there is no more new energy transferred due to no switching. Therefore, the IC supply voltage may reduce to the shutdown threshold voltage and system may enter the unexpected restart mode. To avoid this, the AP3125A hold a so-called V_{CC} maintain mode which can supply energy to VCC.

When V_{CC} decreases to a setting threshold, the V_{CC} maintain comparator will output some drive signal to make the system switch and provide a proper energy to VCC pin. The V_{CC} maintain function will cooperate with the PWM and burst mode loop which can make the output voltage variation be within the regulation. This mode is very useful for reducing startup resistor loss and achieving a better standby performance with a low value VCC capacitor. The V_{CC} is not easy to touch the shutdown threshold during the startup process and step load. This will also simplify the system design. The minimum VCC voltage is suggested to be designed a little higher than V_{CC} maintain threshold thus can achieve the best balance between the standby and step load performance。

System Protection and Pin Fault Protection

The AP3125A provides versatile system and pin fault protections. The OCP comparator realizes the cycle-by-cycle current limiting (OCP). In universal input line voltage, the IC realizes the constant over load protection (OLP). VCC over voltage protection can be applied as the primary OVP or opto-coupler broken protection. The AP3125A also has pin fault connection protection including floating and short connection. The floating pin protection includes the SENSE, FB, etc. The short pin protection includes the CTRL pin short protection. When these pins are floated or CTRL pin is shorted to ground, PWM switching will be disabled, thus protecting the power system.

Latch Protection Function

For some applications, the system requires the latch protection function. The CTRL pin has two kinds of modes to trigger the latch protection: high level trigger and low level trigger. The low threshold is 1V and high threshold voltage is 3V. Some version will have only one mode. Once the latch protection is triggered, the IC will disable the output signal, and the bulk capacitor provides the energy to IC through the startup resistor to ensure the IC disable the output (latch mode). This mode will be not released until the AC input is shut off. So, the de-latch time is mainly depending on the HV startup bulk capacitor value. Therefore, if the system wants a short de-latch time, it is better for the startup resistor take power from the point before the rectifier bridge as illustrated in Figure 2.

© Diodes Incorporated

Operation Description (Cont.)

Internal OTP Protection Function

The AP3125A integrates an internal temperature sensor. It has a trigger window of +150°C enter and +125°C exit. The internal OTP protection mode is auto-recovery mode.

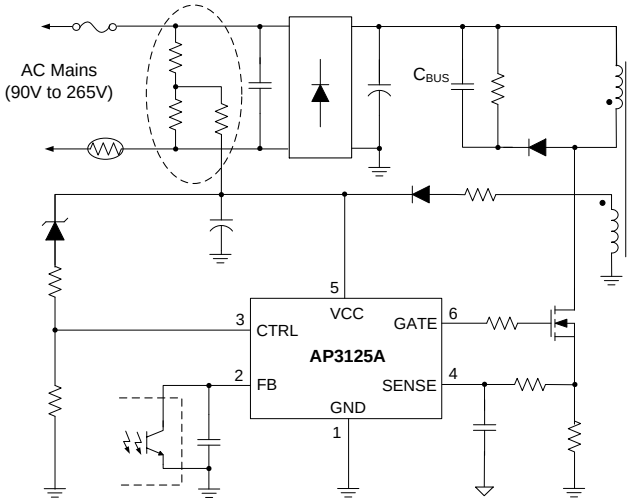
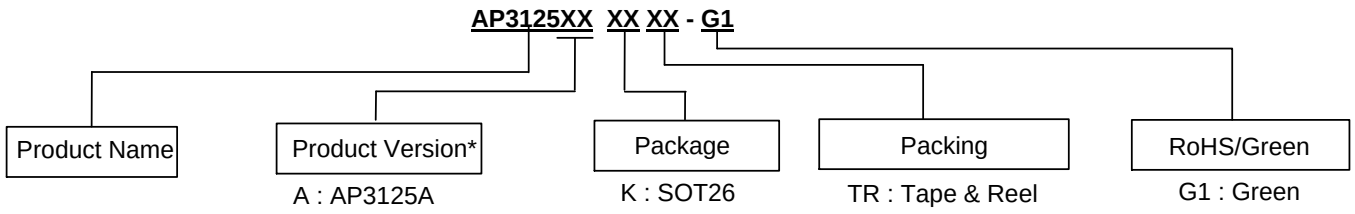


Figure 2

© Diodes Incorporated

Ordering Information (Note 7, 8)



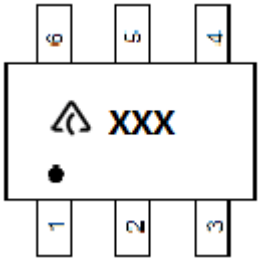
Part Number	Marking ID	Package	Packing	
			Quantity	Carrier
AP3125AKTR-G1	GLS	SOT26	3000	Tape & Reel

Notes: 7. Diodes' IC's Pb-free products with "G1" suffix in the part number are RoHS compliant and green.
8. For packaging details, go to our website at https://www.diodes.com/design/support/packaging/diodes-packaging/.

Product Version Classification (with Different Protection Functions)

Product Version	Frequency	VOVP	OLP & SOCP	CTRL (Low)	CTRL (High)
AP3125A	65kHz	Auto-Recoverable	Auto-Recoverable	Latch	Auto-Recoverable

Marking Information



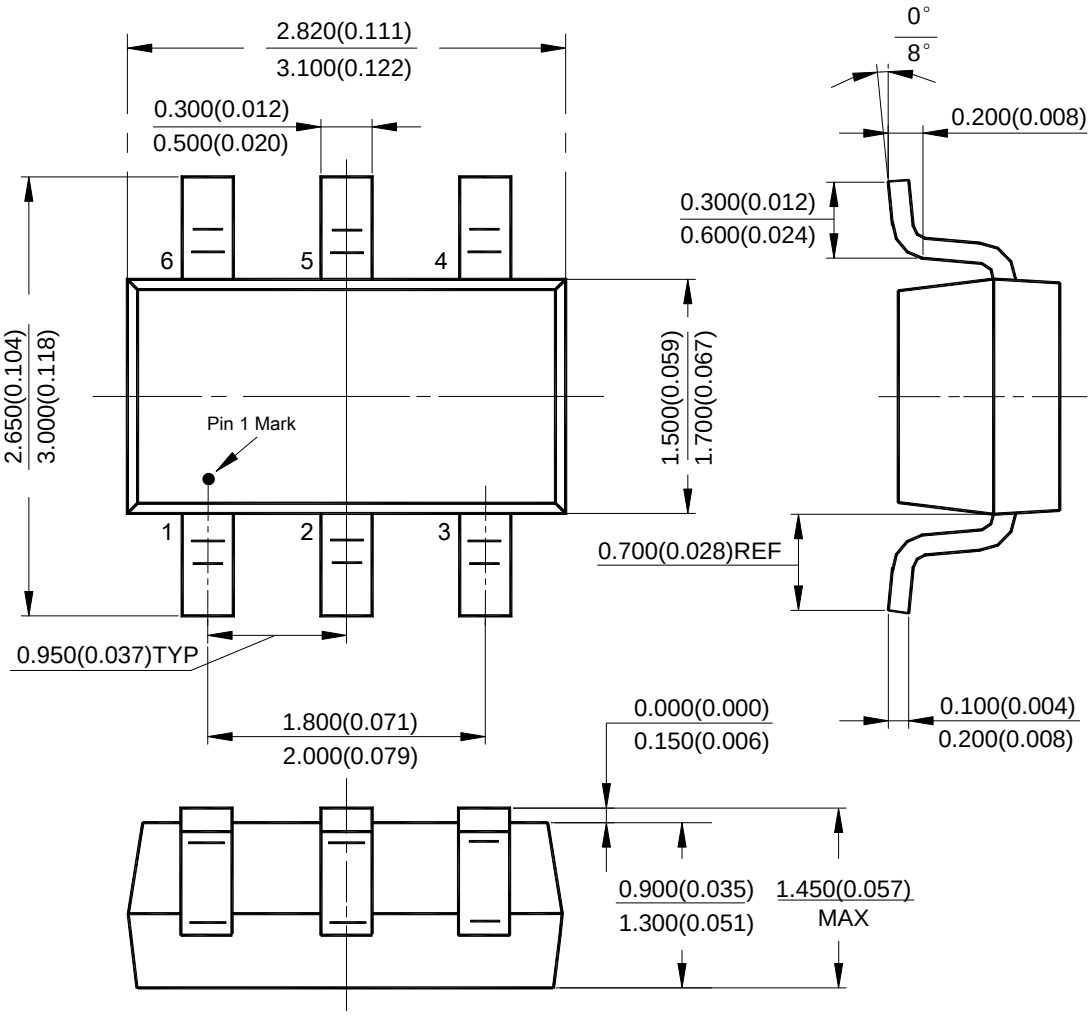
: Logo
XXX: Marking ID (See Ordering Information)

© Diodes Incorporated

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

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

Package Type: SOT26

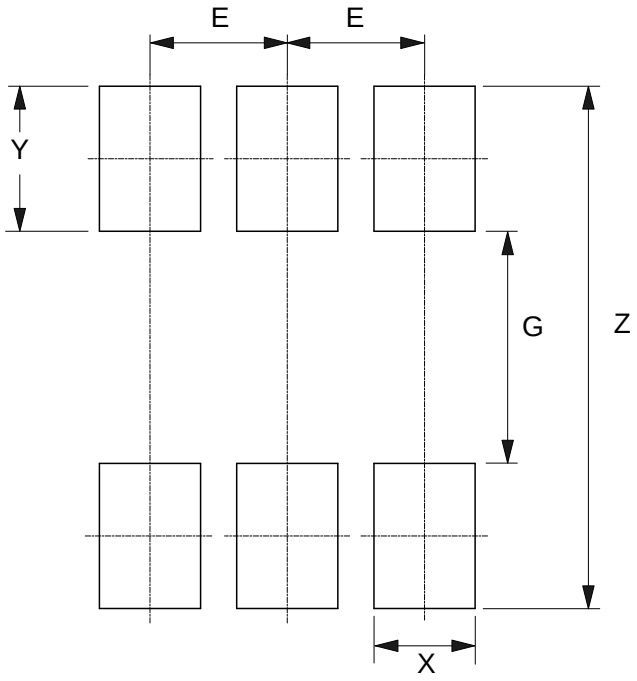


© Diodes Incorporated

Suggested Pad Layout

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

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

Mechanical Data

- Moisture Sensitivity: Level 3 per J-STD-020
- Terminals: Finish – Matte Tin Plated Leads, Solderable per JESD22-B102 e3
- Weight: 0.016 grams (Approximate)

© Diodes Incorporated

IMPORTANT NOTICE

1. DIODES INCORPORATED (Diodes) AND ITS SUBSIDIARIES MAKE NO WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, WITH REGARDS TO ANY INFORMATION CONTAINED IN THIS DOCUMENT, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION).

2. The Information contained herein is for informational purpose only and is provided only to illustrate the operation of Diodes' products described herein and application examples. Diodes does not assume any liability arising out of the application or use of this document or any product described herein. This document is intended for skilled and technically trained engineering customers and users who design with Diodes' products. Diodes' products may be used to facilitate safety-related applications; however, in all instances customers and users are responsible for (a) selecting the appropriate Diodes products for their applications, (b) evaluating the suitability of Diodes' products for their intended applications, (c) ensuring their applications, which incorporate Diodes' products, comply the applicable legal and regulatory requirements as well as safety and functional-safety related standards, and (d) ensuring they design with appropriate safeguards (including testing, validation, quality control techniques, redundancy, malfunction prevention, and appropriate treatment for aging degradation) to minimize the risks associated with their applications.

3. Diodes assumes no liability for any application-related information, support, assistance or feedback that may be provided by Diodes from time to time. Any customer or user of this document or products described herein will assume all risks and liabilities associated with such use, and will hold Diodes and all companies whose products are represented herein or on Diodes' websites, harmless against all damages and liabilities.

4. Products described herein may be covered by one or more United States, international or foreign patents and pending patent applications. Product names and markings noted herein may also be covered by one or more United States, international or foreign trademarks and trademark applications. Diodes does not convey any license under any of its intellectual property rights or the rights of any third parties (including third parties whose products and services may be described in this document or on Diodes' website) under this document.

5. Diodes' products are provided subject to Diodes' Standard Terms and Conditions of Sale (https://www.diodes.com/about/company/terms-and-conditions/terms-and-conditions-of-sales/) or other applicable terms. This document does not alter or expand the applicable warranties provided by Diodes. Diodes does not warrant or accept any liability whatsoever in respect of any products purchased through unauthorized sales channel.

6. Diodes' products and technology may not be used for or incorporated into any products or systems whose manufacture, use or sale is prohibited under any applicable laws and regulations. Should customers or users use Diodes' products in contravention of any applicable laws or regulations, or for any unintended or unauthorized application, customers and users will (a) be solely responsible for any damages, losses or penalties arising in connection therewith or as a result thereof, and (b) indemnify and hold Diodes and its representatives and agents harmless against any and all claims, damages, expenses, and attorney fees arising out of, directly or indirectly, any claim relating to any noncompliance with the applicable laws and regulations, as well as any unintended or unauthorized application.

7. While efforts have been made to ensure the information contained in this document is accurate, complete and current, it may contain technical inaccuracies, omissions and typographical errors. Diodes does not warrant that information contained in this document is error-free and Diodes is under no obligation to update or otherwise correct this information. Notwithstanding the foregoing, Diodes reserves the right to make modifications, enhancements, improvements, corrections or other changes without further notice to this document and any product described herein. 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.

8. Any unauthorized copying, modification, distribution, transmission, display or other use of this document (or any portion hereof) is prohibited. Diodes assumes no responsibility for any losses incurred by the customers or users or any third parties arising from any such unauthorized use.

9. This Notice may be periodically updated with the most recent version available at https://www.diodes.com/about/company/terms-and-conditions/important-notice

DIODES is a trademark of Diodes Incorporated in the United States and other countries.
The Diodes logo is a registered trademark of Diodes Incorporated in the United States and other countries.
© 2022 Diodes Incorporated. All Rights Reserved.

www.diodes.com

ENTEGRECİ

Bu belge www.entegreci.com üzerinden sunulmaktadır.

Elektronik komponent tedarikinde Entegreci

Entegreci, Eskişehir merkezli, Türkiye geneline satış yapan bir elektronik komponent mağazasıdır. Entegreler (IC), mikrodenetleyiciler, transistörler, diyotlar, pasif elemanlar, konnektörler, modüller ve geliştirme kartları tek adetten seri üretim adetlerine kadar satılır. Ürün sayfalarında güncel stok durumunu, fiyatı ve datasheet bağlantısını bulabilirsiniz.

Parça koduyla arama

Üretici parça numarasını yazın; stok ve fiyatı hemen görün.

www.entegreci.com

Ürün kategorileri

Entegreden kapasitöre tüm elektronik komponent kategorileri.

Kategorilere göz atın

Üreticiler

Aradığınız üreticinin ürünlerini tek sayfada inceleyin.

Üreticileri görün

Toplu alım ve teklif

Listede olmayan ya da yüksek adetli parçalar için teklif isteyin.

Teklif isteyin

www.entegreci.com | **destek@entegreci.com** | **0850 305 90 34**

Entegreci is an online electronic components store based in Türkiye. Search by manufacturer part number to see stock, prices and datasheets for integrated circuits, microcontrollers, transistors, passive components and connectors, or request a quote for parts that are not listed.

Bu sayfa Entegreci tarafından eklenmiştir. Belgenin önceki sayfaları asıl yayıncısına aittir ve içeriği değiştirilmemiştir; en güncel sürüm için belgenin yayıncısına başvurun.