



HIGH VOLTAGE GREEN MODE PWM CONTROLLER

Description

The AP3106 is a high voltage start-up, current mode PWM controller with green-mode power-saving operation.

The PWM switching frequency at normal operation is externally programmable and trimmed to a narrow range.

The AP3106 integrates a proprietary internal frequency dithering function that helps to reduce EMI emission of a power supply with minimum line filters used.

To minimize the standby power consumption, a proprietary adaptive green-mode function is available to implement frequency modulation under light-load conditions. To avoid acoustic noise problems, the minimum PWM frequency is set at about 26kHz.

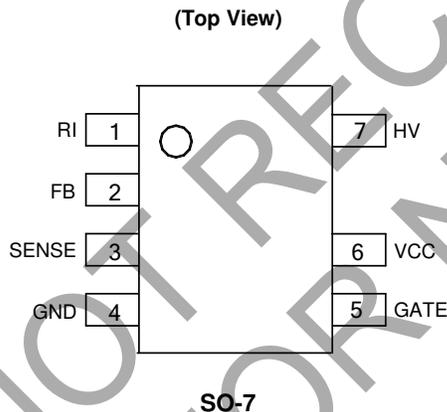
The AP3106 integrates a lot of functions such as the Lead-Edge Blanking (LEB) of the current sensing, internal slope compensation, line compensation, and several protection features that include cycle-by-cycle current limit (OCP), over voltage protection, OTP, OLP and brownout protection.

The AP3106 is available in SO-7 package to realize a compact size.

Features

- High-voltage Start-up Circuit
- Low Start-up Current: 15µA (Max.)
- Current Mode Control
- Programmable PWM Switching Frequency
- Non-audible-noise Green Mode Control
- LEB (Leading-Edge Blanking) on SENSE Pin
- Fast OCP for Abnormal Short Circuit
- Frequency Linearly Decreasing at Light Load
- Soft Driving
- Internal Slope Compensation
- Built-in Brownout Protection
- Useful Pin Fault Protection
 - CS Pin Floating
 - RI Pin Short to Ground
 - RI Pin Floating
- Comprehensive System Protection
 - VCC Over Voltage Protection (VOVP)
 - Over Temperature Protection (OTP)
 - Constant Over Load Protection (COLP)
 - Short Circuit Protection (SCP)
- Compact Size SO-7 Package
- **Totally Lead-free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**

Pin Assignments



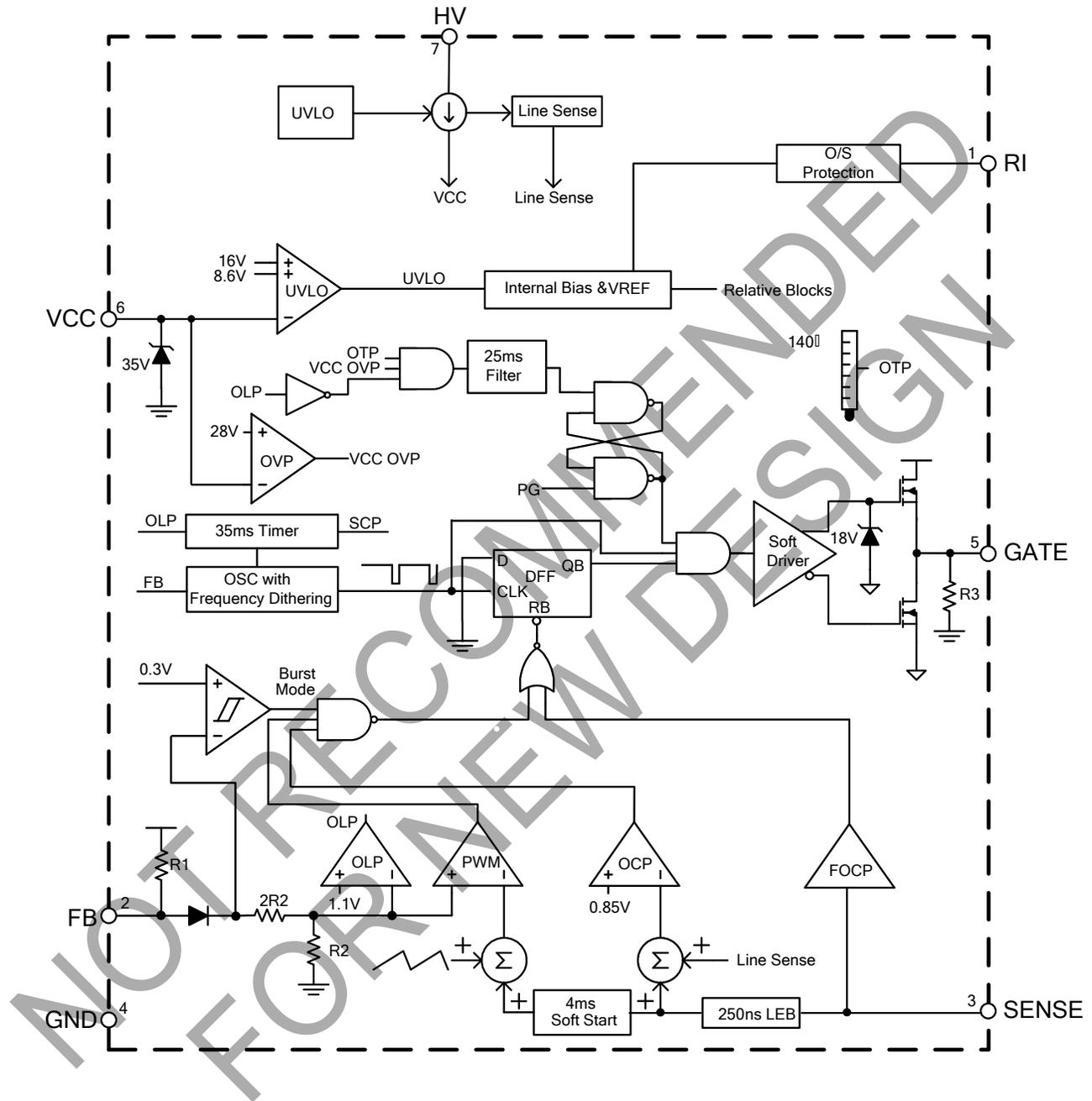
Applications

- Switching AC/DC Adaptor
- LCD Monitor/TV Power
- Open Frame Switching Power Supply

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 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.

Functional Block Diagram



Absolute Maximum Ratings (Note 4)

Symbol	Parameter	Rating	Unit
V_{CC}	Power Supply Voltage	30	V
V_{HV}	Input Voltage to High Voltage Pin (HV)	600	V
I_{GATE}	GATE Output Current	500	mA
V_{FB}, V_{SENSE}	Input Voltage to FB, SENSE	-0.3 to 7	V
θ_{JA}	Thermal Resistance(Junction to Ambient)	186	°C/W
P_D	Power Dissipation at $T_A < +25^\circ\text{C}$	550	mW
T_J	Operating Junction Temperature	-40 to +150	°C
T_{STG}	Storage Temperature	+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
T_A	Ambient Temperature	-40	+85	°C

Electrical Characteristics ($V_{IN}=16V$, $T_A=+25^{\circ}C$, unless otherwise specified.)

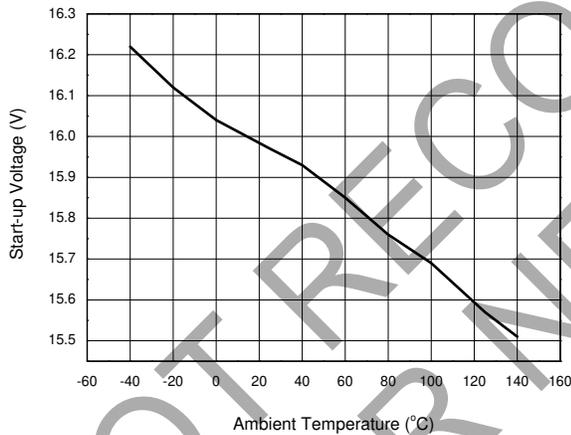
Parameter	Conditions	Min	Typ	Max	Unit
HIGH-VOLTAGE SUPPLY (HV Pin)					
High-Voltage Current Source	$V_{CC}<UVLO$ (on), $V_{HV}=400V$	1	2	3.5	mA
Off-State Leakage Current	$V_{CC}>UVLO$ (off), $V_{HV}=100V$	-	2.5	-	μA
	$V_{CC}>UVLO$ (off), $V_{HV}=400V$	-	10	18	
SUPPLY VOLTAGE (VCC Pin)					
Start-up Current	$V_{CC}=14.8V$	-	5	15	μA
Operating Supply Current	$V_{FB}=0V$, $C_L=1nF$	0.2	0.6	1	mA
	$V_{FB}=3V$, $C_L=1nF$	1.5	2.5	3.5	
UVLO (on)	-	15	16	17	V
UVLO (off)	-	7.6	8.6	9.6	V
VCC OVP	-	27	28	30	V
VCC Clamp	$I_{CC}=5mA$	-	35	-	V
De-latch VCC	-	3.8	5.7	7	V
OSCILLATOR SECTION					
Maximum Duty Cycle	-	70	75	80	%
Minimum Duty Cycle	-	-	0	-	
Oscillation Frequency	$R_i=100k\Omega$	60	65	70	kHz
Green Mode Frequency	$R_i=100k\Omega$	-	28	-	kHz
Frequency Temperature Stability	-40 to +85 $^{\circ}C$	-	-	5	%
Frequency Voltage Stability	$V_{CC}=12V$ to 30V	-	-	5	%
Frequency Dithering	Δf /center frequency	-	± 6	-	%
CURRENT SENSE SECTION (SENSE Pin)					
Maximum SENSE Voltage	$V_{HV}=100V$	0.8	0.85	0.9	V
The Ratio of Input Voltage to Current Sense Voltage	-	2.5	3	3.5	V/V
LEB Time of SENSE	$R_i=100k\Omega$	150	250	350	ns
Delay to Output	-	-	100	-	ns
Soft Start Time	$R_i=100k\Omega$	3	4	5	ms
FEEDBACK INPUT SECTION (FB Pin)					
Short Circuit Current	$V_{FB}=0V$	-0.6	-0.3	-	mA
Green Mode Threshold VFB	-	-	2.1	-	V
Burst Mode Threshold VFB	-	0.89	1.15	1.41	V
Open Loop Voltage	FB pin open	4.8	5.4	6	V
Input Impedance	-	10	16	22	$k\Omega$
Output Low Level	$I_{GATE}=50mA$, $V_{CC}=12V$	-	-	1	V
Output High Level	$I_{GATE}=50mA$, $V_{CC}=12V$	8	-	-	V
Output Clamping	-	15.5	17.5	19.5	V
Rising Time	$C_L=1nF$	150	250	350	ns
Falling Time	$C_L=1nF$	30	50	90	ns

Electrical Characteristics ($V_{IN}=16V$, $T_A=+25^{\circ}C$, unless otherwise specified.) (Cont.)

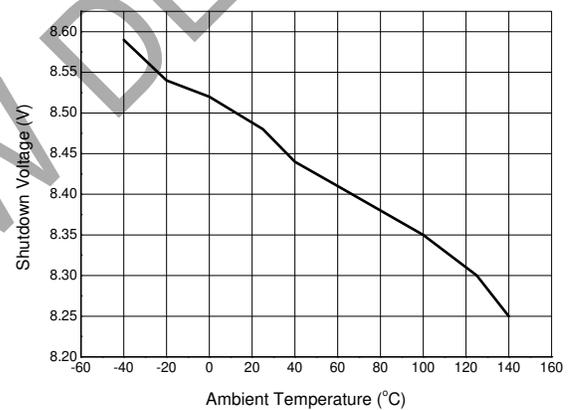
Parameter	Conditions	Min	Typ	Max	Unit
BROWNOUT PROTECTION					
Turn-on DC Input (HV), V_{ON}	$R=0k$	97	105	113	V
Turn-off DC Input (HV), V_{OFF}	$R=0k$	-	$V_{ON}-5$	-	V
De-bounce Time of Enable	-	-	25	-	μs
De-bounce Time of Turn Off	$V_{FB}=3V$, $R_I=100k\Omega$	25	35	45	ms
OVER-TEMPERATURE PROTECTION SECTION					
Shutdown Temperature	-	-	+140	-	$^{\circ}C$
Temperature Hysteresis	-	-	+20	-	$^{\circ}C$
DELAY TIME SECTION					
Delay 1	Short circuit, OLP, $R_I=100k\Omega$	25	35	45	ms
Delay 2	VCC OVP, brown out, $R_I=100k\Omega$	-	25	-	μs

Performance Characteristics

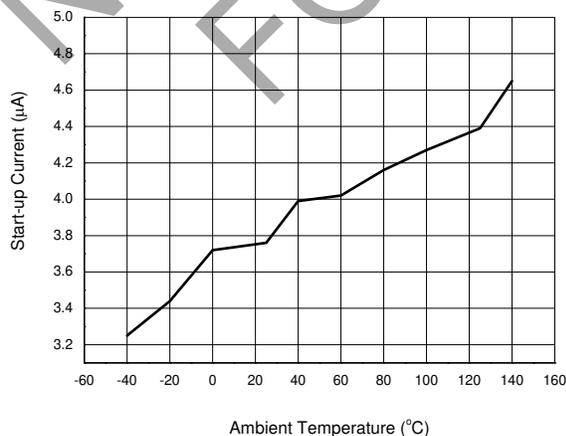
Start-up Voltage vs. Ambient Temperature



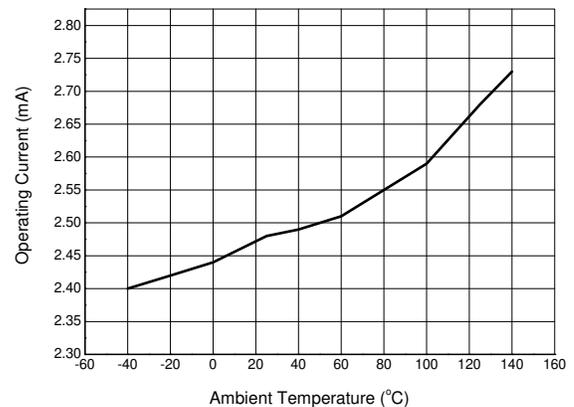
Shutdown Voltage vs. Ambient Temperature



Start-up Current vs. Ambient Temperature

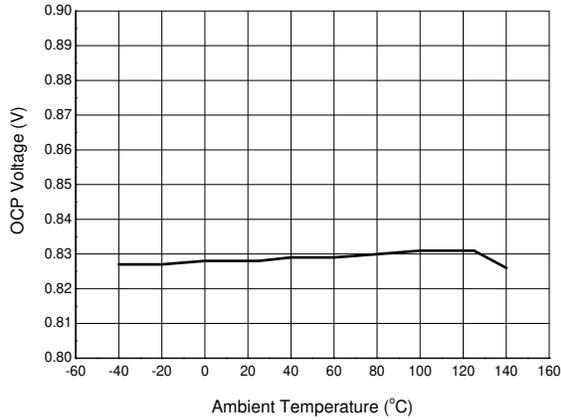


Operating Current vs. Ambient Temperature

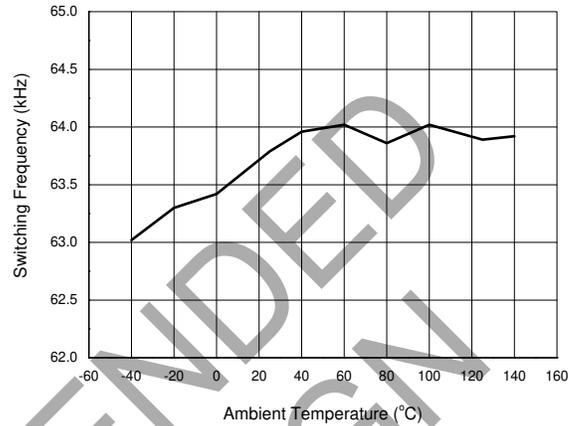


Performance Characteristics (Cont.)

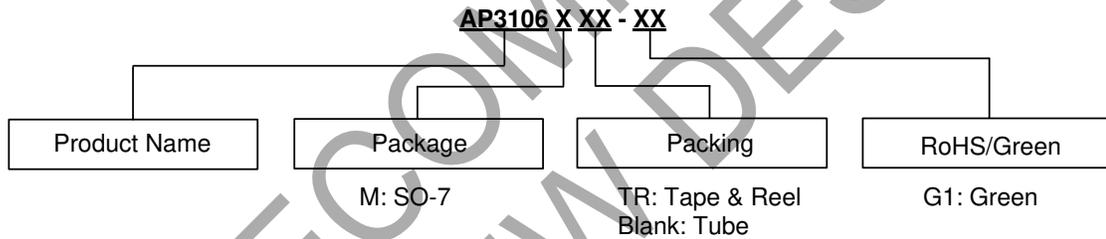
OCP Voltage vs. Ambient Temperature



Switching Frequency vs. Ambient Temperature

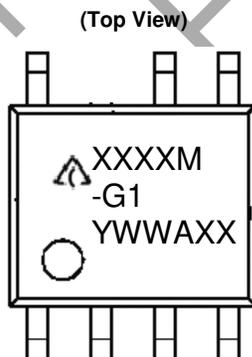


Ordering Information



Package	Temperature Range	Part Number	Marking ID	Packing
SO-7	-40 to +85°C	AP3106M-G1	3106M-G1	100/Tube
		AP3106MTR-G1	3106M-G1	4000/Tape & Reel

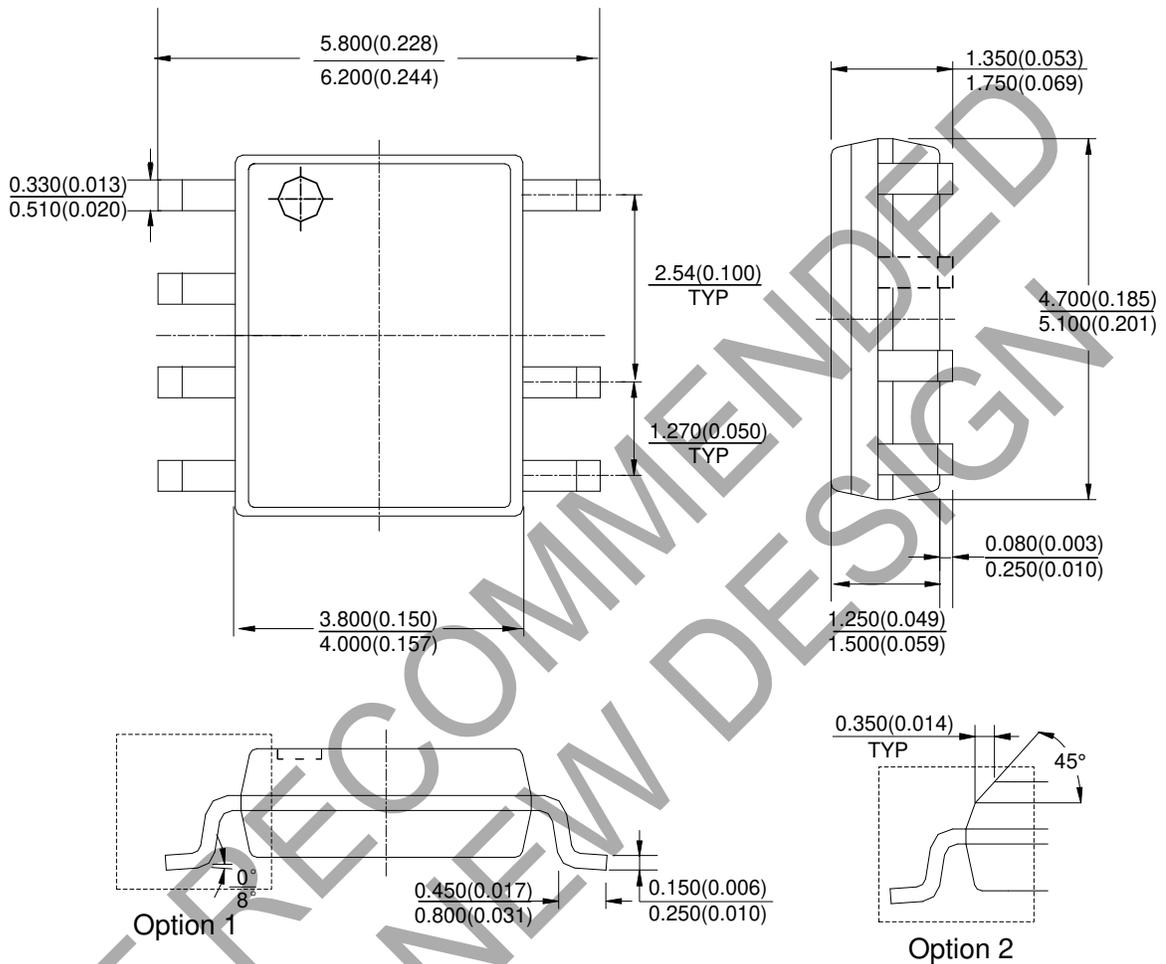
Marking Information



First and Second Lines: Logo and Marking ID
(See Ordering Information)
Third Line: Date Code
Y: Year
WW: Work Week of Molding
A: Assembly House Code
XX: 7th and 8th Digits of Batch No.

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

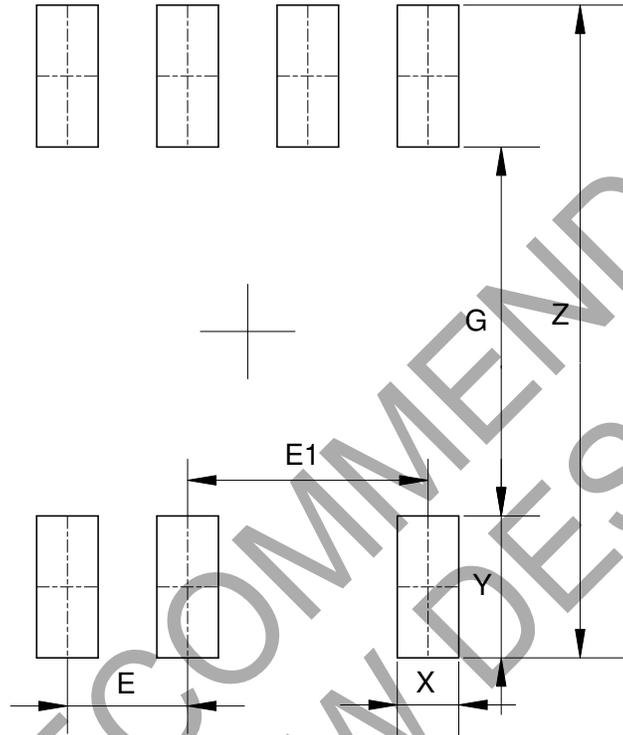
(1) Package Type: SO-7



Note: Eject hole, oriented hole and mold mark is optional.

Suggested Pad Layout

(1) Package Type: SO-7



Dimensions	Z (mm)/(inch)	G (mm)/(inch)	X (mm)/(inch)	Y (mm)/(inch)	E (mm)/(inch)	E1 (mm)/(inch)
Value	6.900/0.272	3.900/0.154	0.650/0.026	1.500/0.059	1.270/0.050	2.540/0.100

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 © 2015, Diodes Incorporated

www.diodes.com