Lead-free Green

HIGH VOLTAGE GREEN MODE PWM CONTROLLER

Description

The AP3107Z is the high voltage start-up, current mode PWM controller with green mode power-saving operation.

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

The AP3107Z features proprietary frequency dithering function internally that helps to reduce EMI emission of a power supply with minimum line filters used.

The AP3107Z also integrates a lot of functions such as Leading-Edge Blanking (LEB) of the current sensing, internal slope compensation, line compensation and several protection features. The protection functions include cycle-by-cycle current limit (OCP), over voltage protection, OTP, OLP and brownout protection.

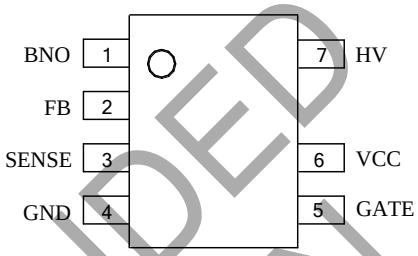
The AP3107Z is available in SO-7 package.

Features

- High-voltage Start-up Circuit
- Low Start-up Current: 15μA Max.
- Fixed Oscillation Frequency: 65kHz
- Ultra Low Standby Power Application
- Non-audible-noise Green Mode Control
- LEB (Leading-edge Blanking) on SENSE Pin
- Soft Driving
- Fast OCP for Abnormal Short Circuit
- Frequency Linearly Decreasing at Light Load
- Internal Slope Compensation
- Programmable Brownout Protection
- Useful Pin Fault Protections
  - SENSE, FB Pins Floating
  - FB Short to Ground
- Comprehensive System Protections
  - 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

(Top View)



SO-7

Applications

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

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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.

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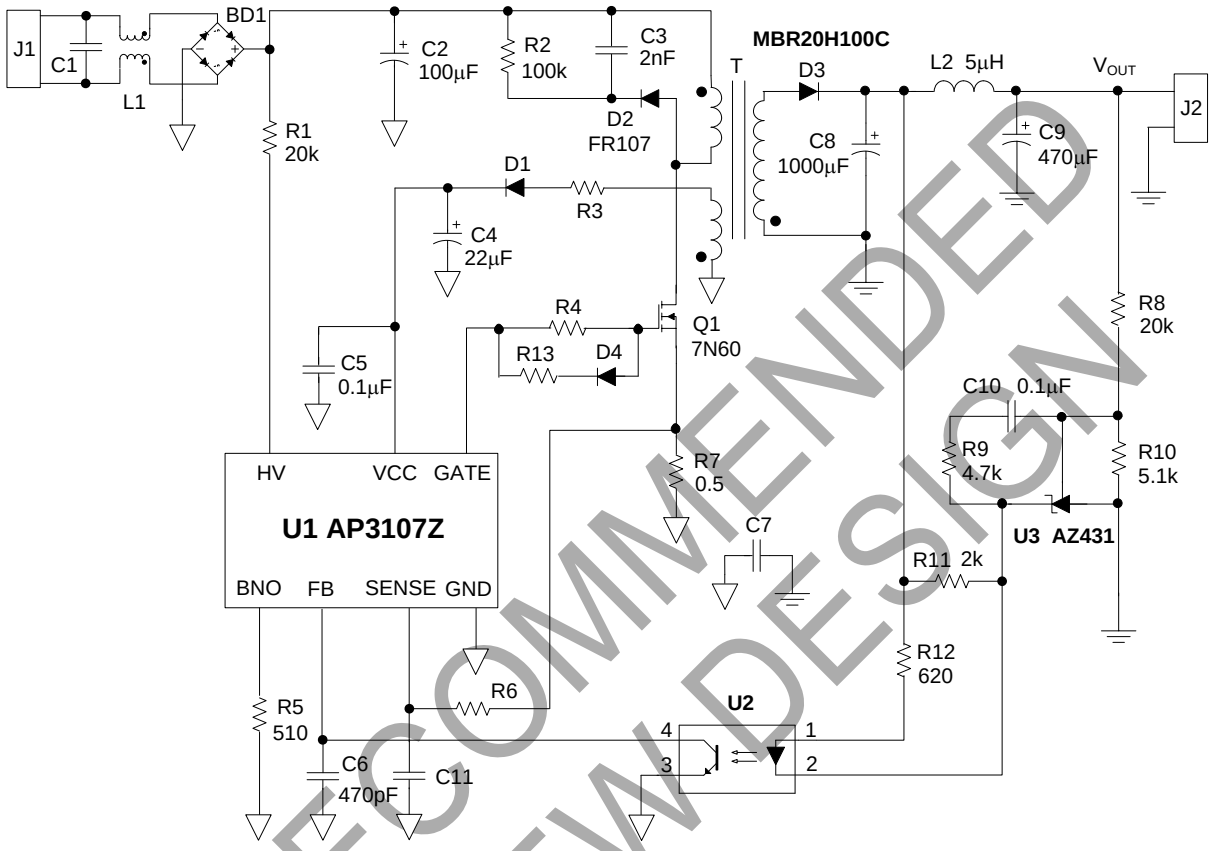
Typical Applications Circuit



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Pin Descriptions

Pin Number	Pin Name	Function
1	BNO	Brownout Protection Pin. Connected to GND by a resistor to set the brownout level. This pin is shortened to the ground to set the maximum brownout voltage
2	FB	Voltage Feedback Pin., Connecting it with an opto-coupler to close the control loop can achieve system regulation
3	SENSE	Current Sense Pin. Connect it to sense the MOSFET current
4	GND	Ground
5	GATE	Gate drive output to drive the external MOSFET
6	VCC	Supply Voltage Pin
7	HV	Connect this pin to the positive terminal of bulk capacitor to provide start-up current for the controller. When VCC voltage reaches UVLO (on), this HV loop will be turned off to save the power loss of the start-up circuit

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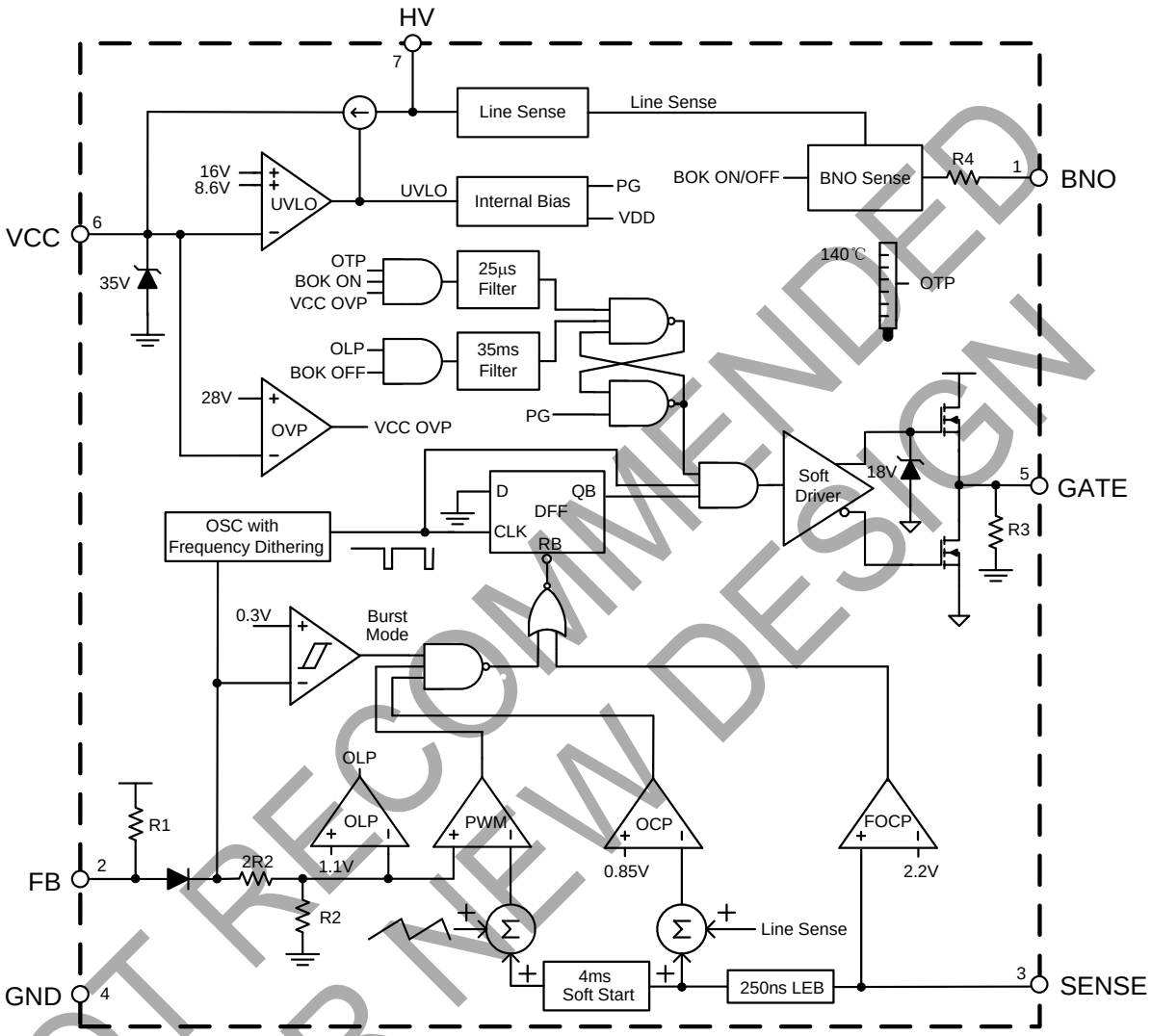
Functional Block Diagram



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Absolute Maximum Ratings (Note 4)

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

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Recommended Operating Conditions

Parameter	Symbol	Min	Max	Unit
Supply Voltage	V_{CC}	10	25	V
Ambient Temperature	T_A	-40	+85	°C

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Electrical Characteristics (@V_{CC}=16V, T_A=+25ºC, 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	μA
Supply Voltage (VCC Pin)					
Start-up Current	V_{CC}=14.8V	–	5	15	μA
Operation Supply Current	V_{FB}=0V, C_L=1nF	0.1	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	Center frequency	60	65	70	kHz
Green Mode Frequency	–	–	28	–	kHz
Frequency Temperature Stability	-40 to +85ºC	–	–	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	Center frequency	150	250	350	ns
Delay to Output	–	–	100	–	ns
Soft Start Time	Center frequency	3	4	5	ms
Feedback Input Section (FB Pin)					
Short Circuit Current	V_{FB}=0V	–	-0.18	–	mA
Green Mode Threshold, V_{FB}	–	–	2.1	–	V
Burst Mode Threshold, V_{FB}	–	–	1.35	–	V
Open Loop Voltage	FB pin open	–	4.6	–	V
Input Impendence	–	–	26	–	kΩ

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

Parameter	Conditions	Min	Typ	Max	Unit
Output Section (GATE Pin)					
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
Brownout Protection					
Turn-on DC Input (HV), V_{ON}	R=0k	92	99	106	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	25	35	45	ms
Over-temperature Protection					
Shutdown Temperature	–	–	+140	–	ºC
Temperature Hysteresis	–	–	+20	–	ºC
Delay Time Section					
Delay 1	Center frequency Short circuit, OLP	25	35	45	ms
Delay 2	Center frequency VCC OVP	–	25	–	µs

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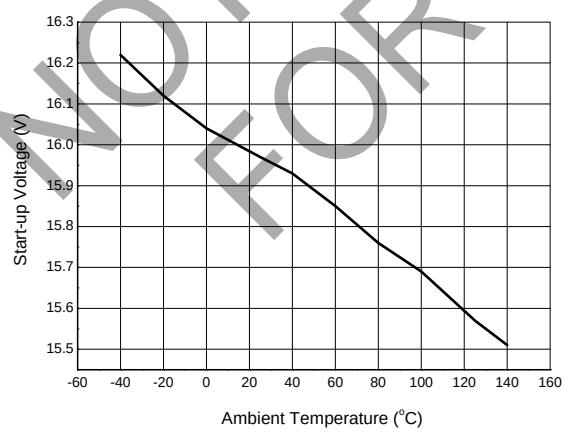
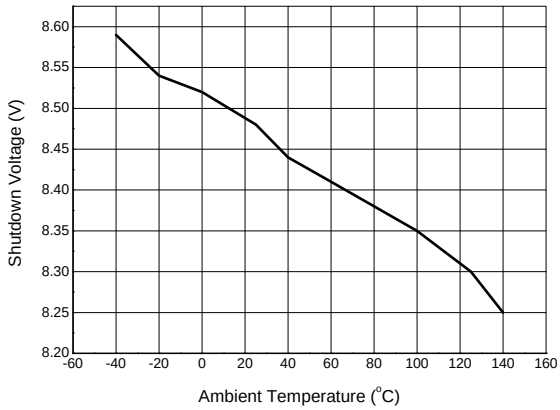
Performance Characteristics

Start-up Voltage vs. Ambient Temperature



Shutdown Voltage vs. Ambient Temperature



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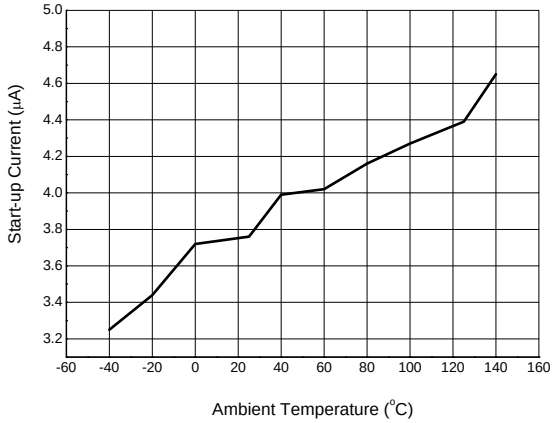
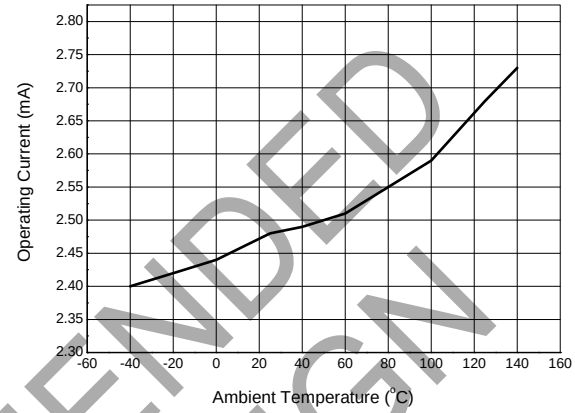
Performance Characteristics (Cont.)

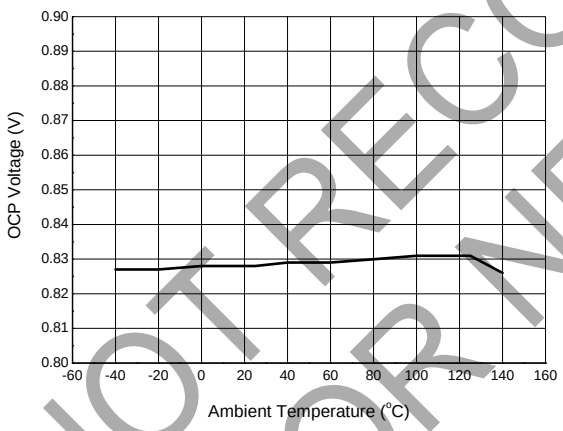
Start-up Current vs. Ambient Temperature



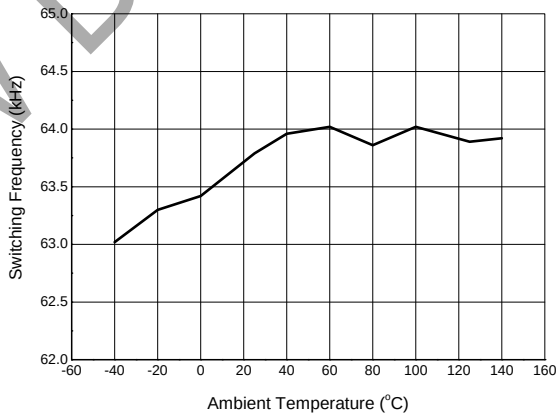
Operating Current vs. Ambient Temperature



OCP Voltage vs. Ambient Temperature



Switching Frequency vs. Ambient Temperature



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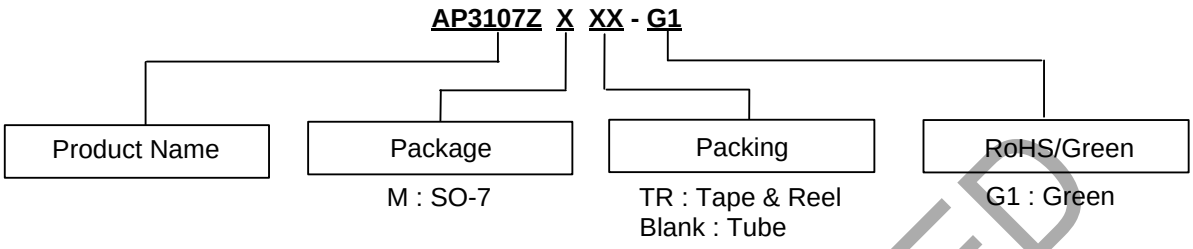
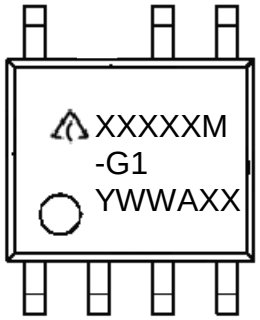
Ordering Information



Package	Temperature Range	Part Number	Marking ID	Packing
SO-7	-40 to +85°C	AP3107ZM-G1	3107ZM-G1	100/Tube
		AP3107ZMTR-G1	3107ZM-G1	4000/Tape & Reel

Marking Information

(Top View)



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 and8th Digits of Batch No.

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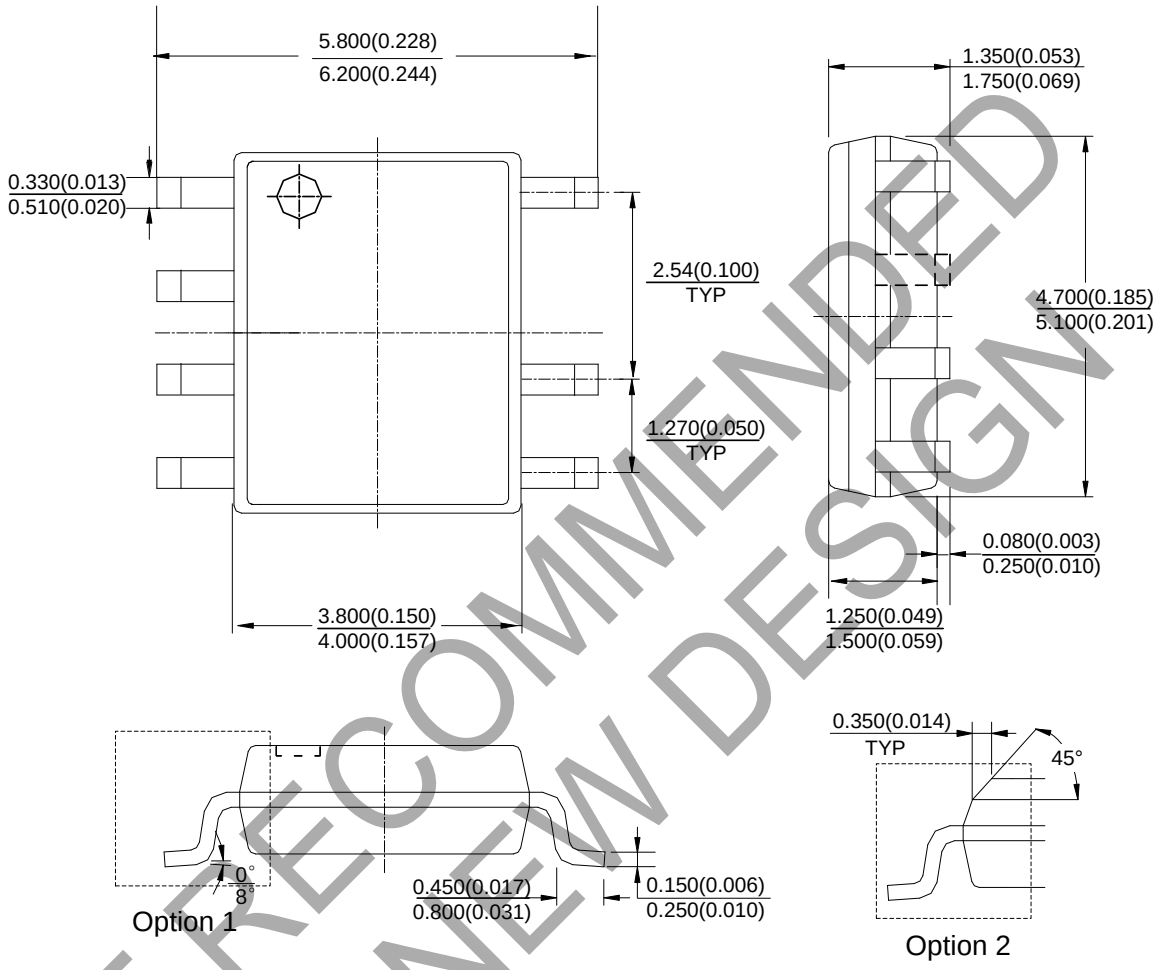
Package Outline Dimensions (All dimensions in mm(inch).)

(1) Package Type: SO-7



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

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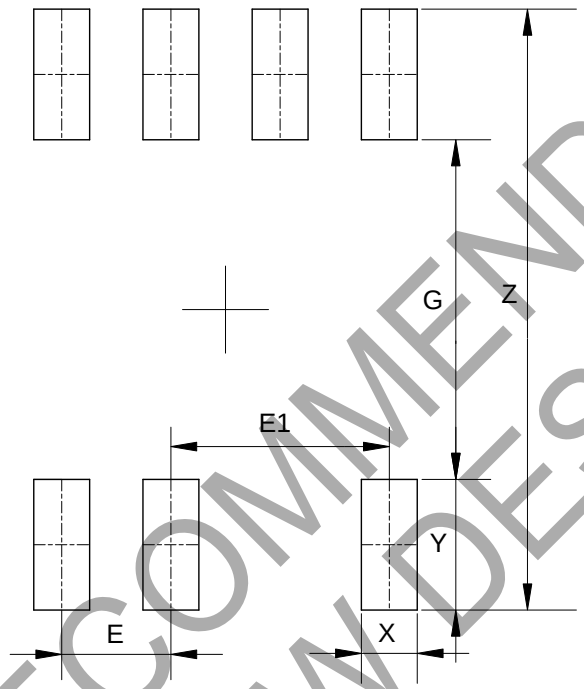
Suggested Pad Layout

(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

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