



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.

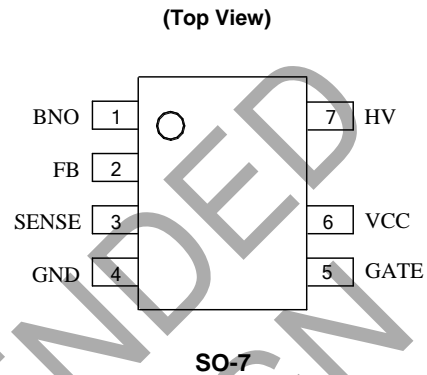
The AP3107Z is available in SO-7 package.

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)**

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.

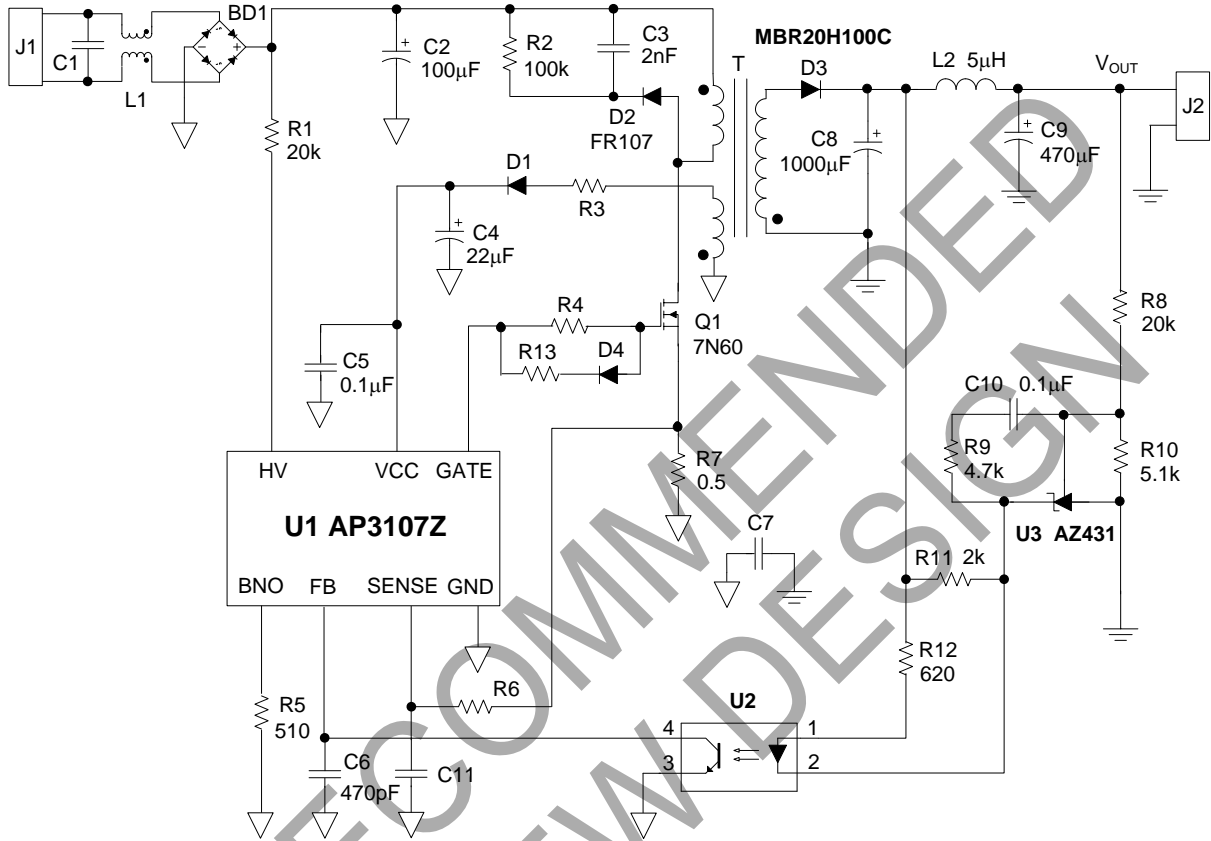
Pin Assignments



Applications

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

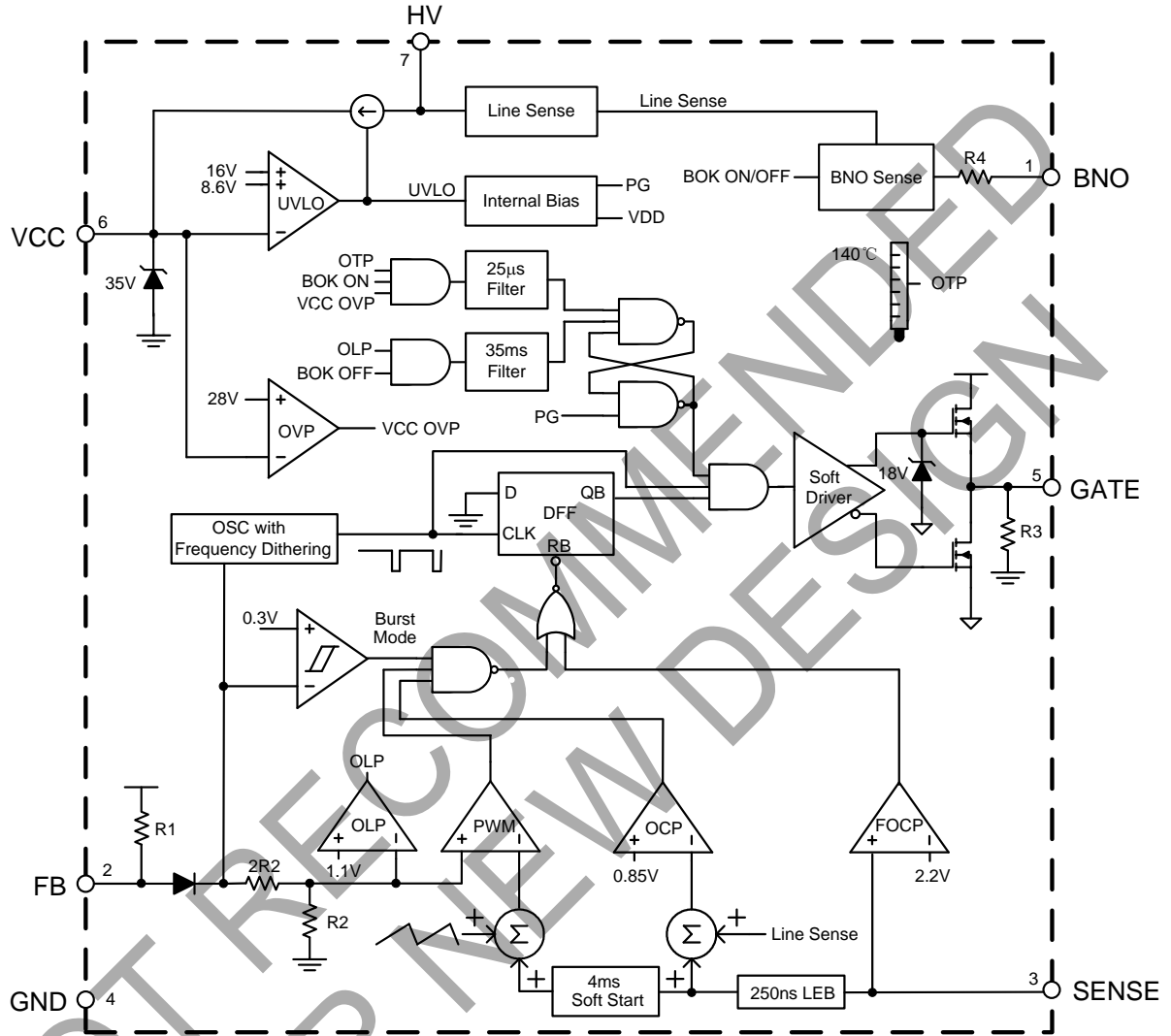
Typical Applications Circuit



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 |

Functional Block Diagram



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 $T_A < 25^\circ\text{C}$ | 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.

Recommended Operating Conditions

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

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

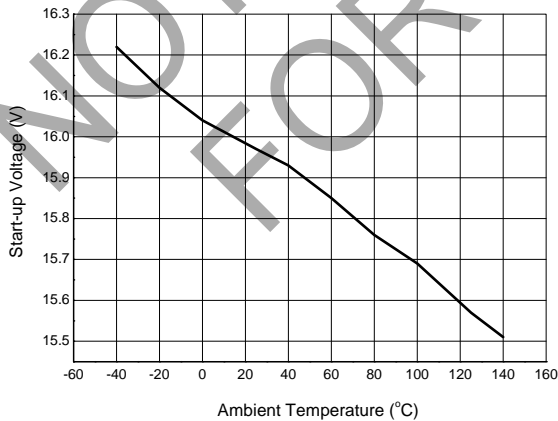
| Parameter | Conditions | Min | Typ | Max | Unit |
|-----------------------------------------------------|------------------------------------|-----|---------|-----|------------|
| High-voltage Supply (HV Pin) | | | | | |
| High-voltage Current Source | $V_{CC}<UVLO$ (on), $V_{HV}=400V$ | 1 | 2 | 3.5 | mA |
| Off-state Leakage Current | $V_{CC}>UVLO$ (off), $V_{HV}=100V$ | – | 2.5 | – | μA |
| | $V_{CC}>UVLO$ (off), $V_{HV}=400V$ | – | 10 | 18 | 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 $+85^{\circ}C$ | – | – | 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 | 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 Impedence | – | – | 26 | – | k Ω |

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

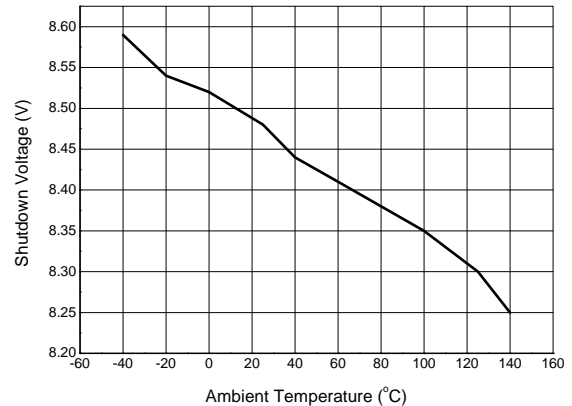
| Parameter | Conditions | Min | Typ | Max | Unit |
|------------------------------------------|-----------------------------------------------|------|--------------------|------|------|
| Output Section (GATE Pin) | | | | | |
| Output Low Level | I _{GATE} =50mA, V _{CC} =12V | – | – | 1 | V |
| Output 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 | – | °C |
| Temperature Hysteresis | – | – | +20 | – | °C |
| Delay Time Section | | | | | |
| Delay 1 | Center frequency Short circuit, OLP | 25 | 35 | 45 | ms |
| Delay 2 | Center frequency VCC OVP | – | 25 | – | µs |

Performance Characteristics

Start-up Voltage vs. Ambient Temperature

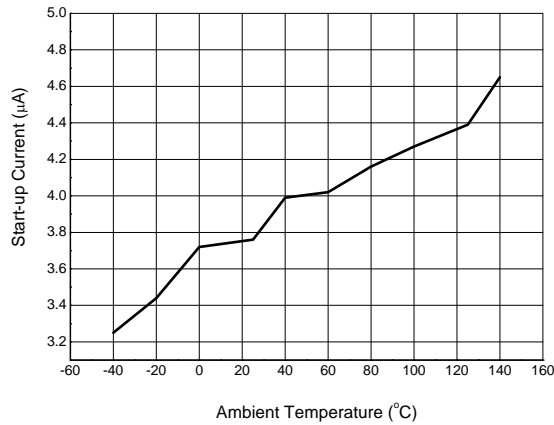


Shutdown Voltage vs. Ambient Temperature

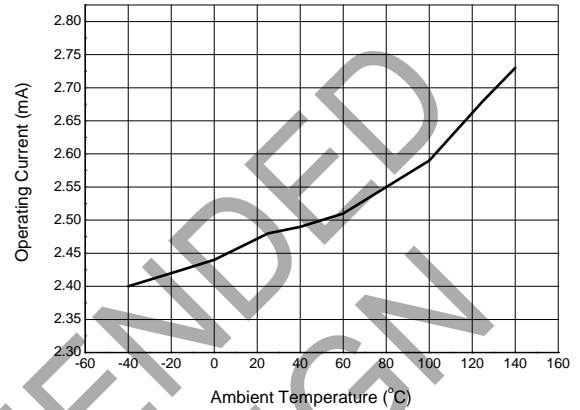


Performance Characteristics (Cont.)

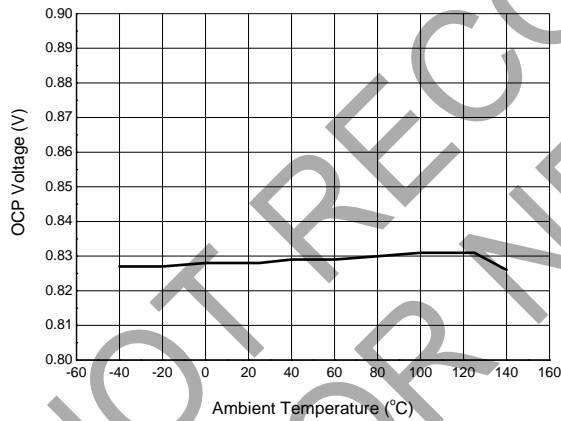
Start-up Current vs. Ambient Temperature



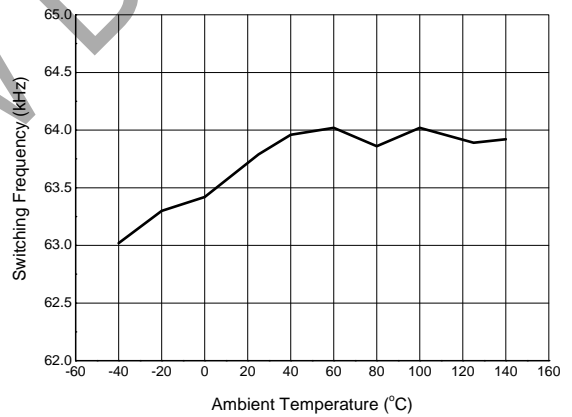
Operating Current vs. Ambient Temperature



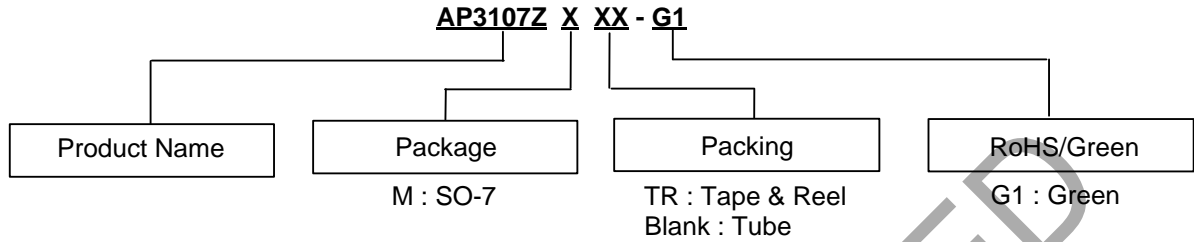
OCP Voltage vs. Ambient Temperature



Switching Frequency vs. Ambient Temperature



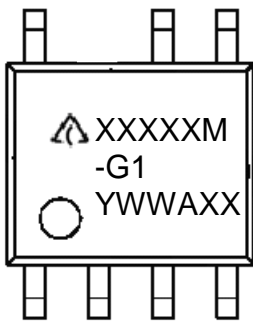
Ordering Information



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

Marking Information

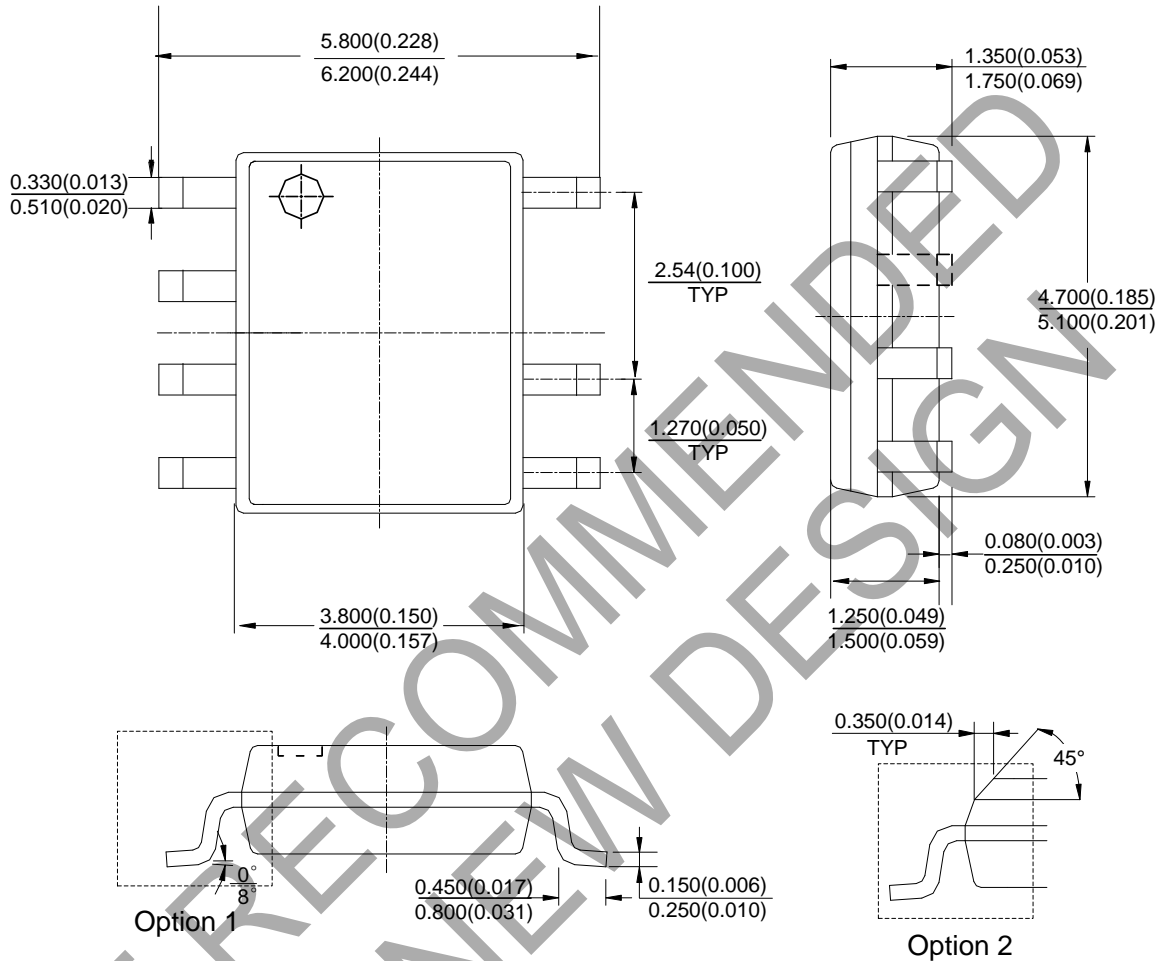
(Top View)



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 and 8th Digits of Batch No.

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

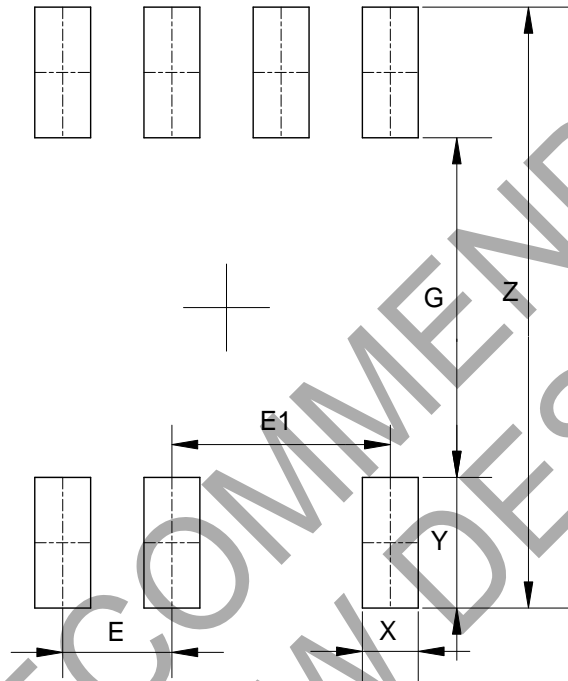
(1) Package Type: SO-7



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 |

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