



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.

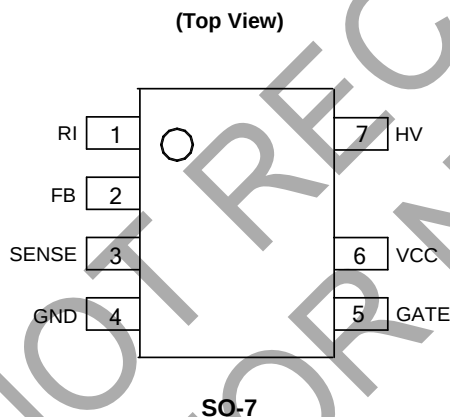
The AP3106 integrates a lot of functions such as the Lead-Edge Blanking (LEB) of the current sensing, internal slope compensation, line compensation, and several protection features that include cycle-by-cycle current limit (OCP), over voltage protection, OTP, OLP and brownout protection.

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

Features

- High-voltage Start-up Circuit
- Low Start-up Current: 15 μ A (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

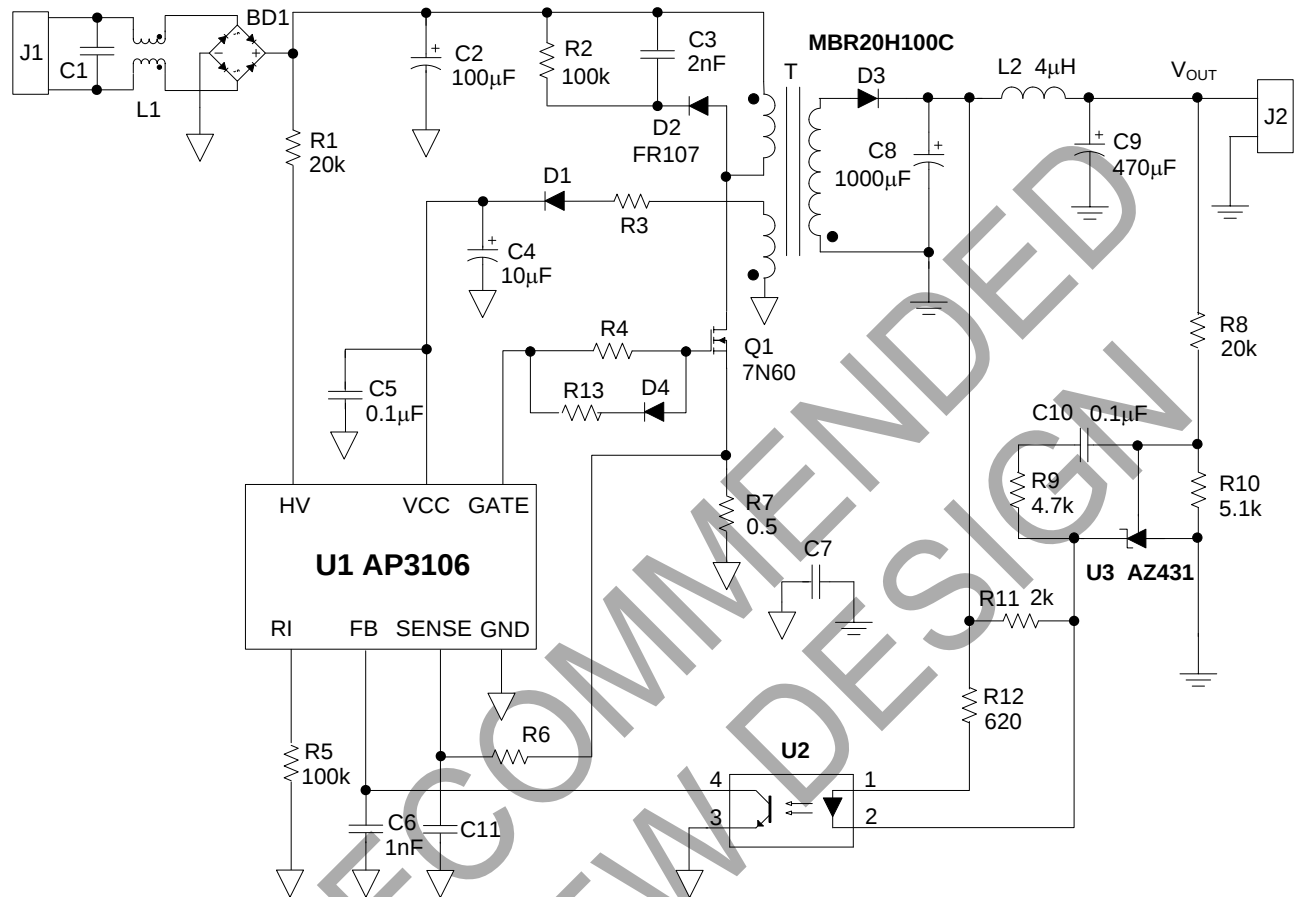


Applications

- 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.

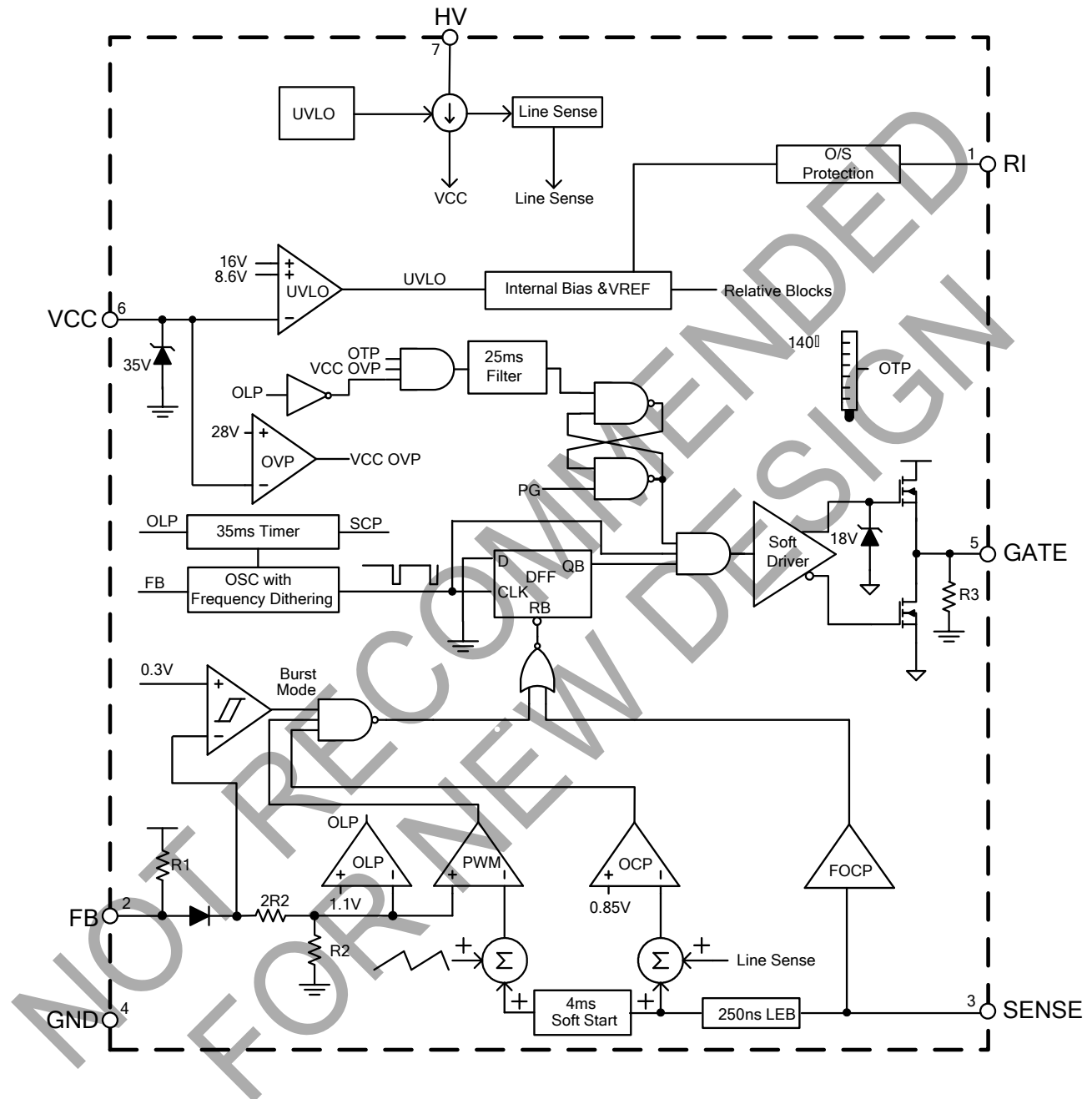
Typical Applications Circuit



Pin Descriptions

Pin Number	Pin Name	Function
1	RI	Set the bias current to determine the normal switching frequency
2	FB	Voltage feedback pin. By connecting an opto-coupler to close the control loop, it can achieve the 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 positive terminal of bulk capacitor to provide the startup current for the controller. When VCC voltage reaches UVLO (on), this HV loop will be turned off to save the power loss of the startup circuit

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

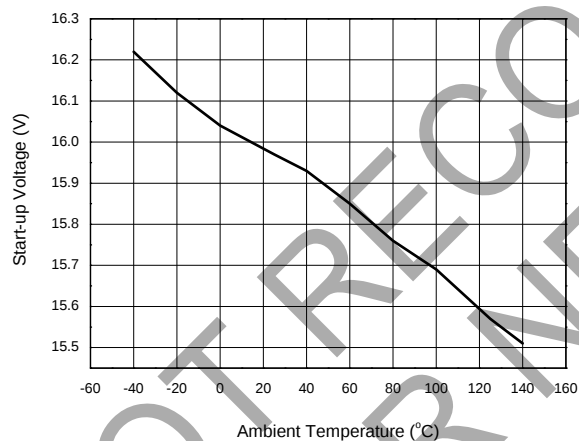
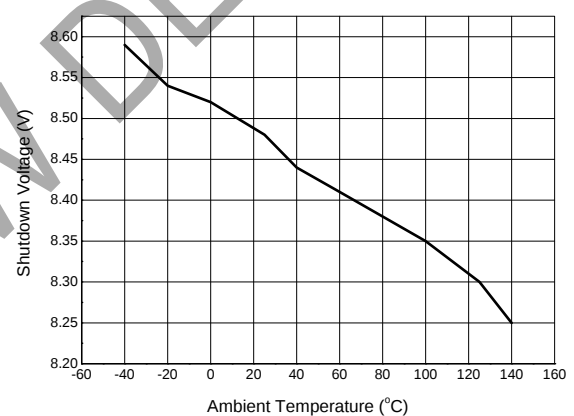
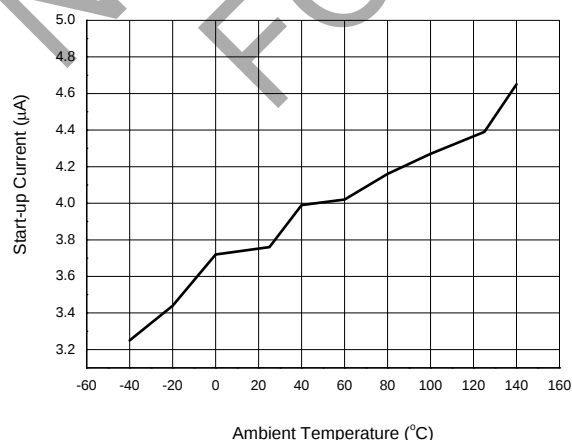
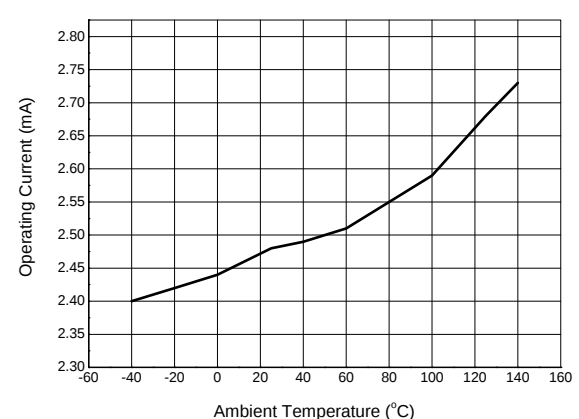
Symbol	Parameter	Min	Max	Unit
V_{CC}	Supply Voltage	10	25	V
T_A	Ambient Temperature	-40	+85	°C

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

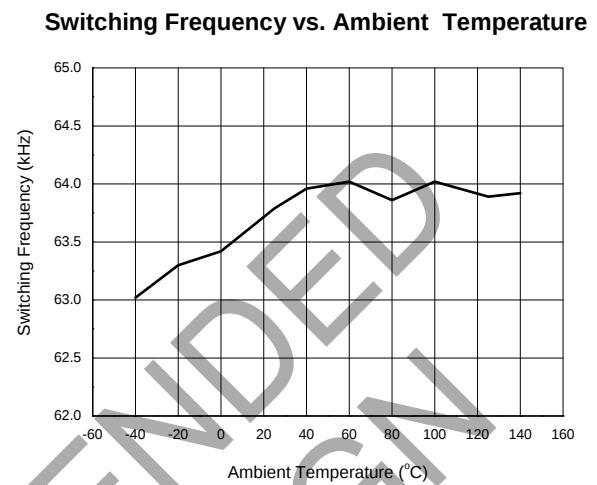
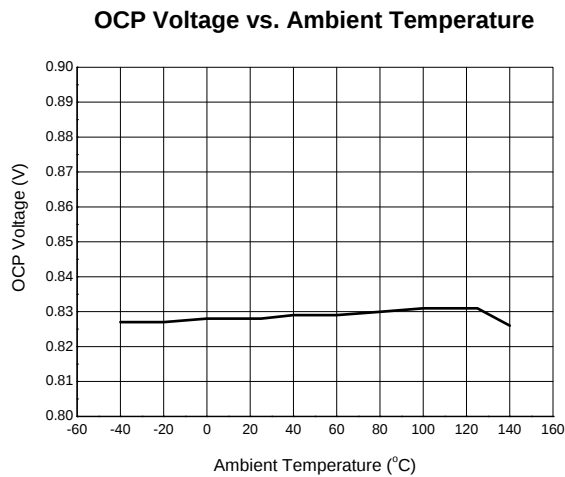
Parameter	Conditions	Min	Typ	Max	Unit
HIGH-VOLTAGE SUPPLY (HV Pin)					
High-Voltage Current Source	V _{CC} <UVLO (on) , V _{HV} =400V	1	2	3.5	mA
Off-State Leakage Current	V _{CC} >UVLO (off), V _{HV} =100V	–	2.5	–	μA
	V _{CC} >UVLO (off), V _{HV} =400V	–	10	18	
SUPPLY VOLTAGE (VCC Pin)					
Start-up 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 =100kΩ	60	65	70	kHz
Green Mode Frequency	R _I =100kΩ	–	28	–	kHz
Frequency Temperature Stability	-40 to +85°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 =100kΩ	150	250	350	ns
Delay to Output	–	–	100	–	ns
Soft Start Time	R _I =100kΩ	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 Impedence	–	10	16	22	kΩ
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.)

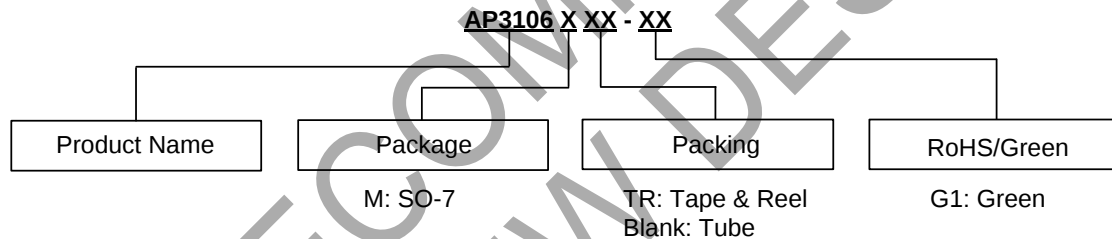
Parameter	Conditions	Min	Typ	Max	Unit
BROWNOUT PROTECTION					
Turn-on DC Input (HV), V_{ON}	$R=0k$	97	105	113	V
Turn-off DC Input (HV), V_{OFF}	$R=0k$	–	$V_{ON}-5$	–	V
De-bounce Time of Enable	–	–	25	–	μs
De-bounce Time of Turn Off	$V_{FB}=3V$, $R_I=100k\Omega$	25	35	45	ms
OVER-TEMPERATURE PROTECTION 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.)

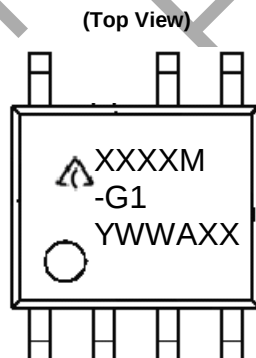


Ordering Information



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

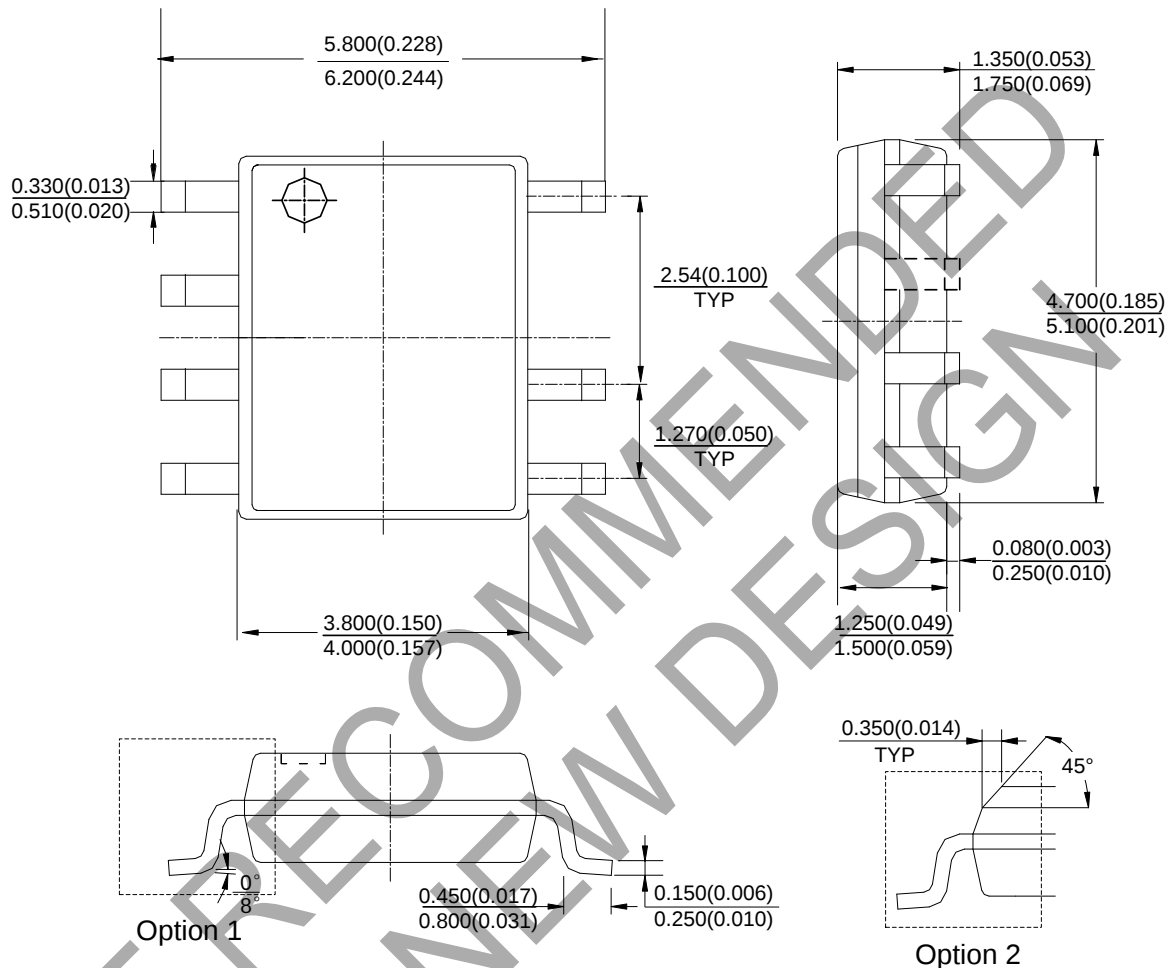
Marking Information



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).)

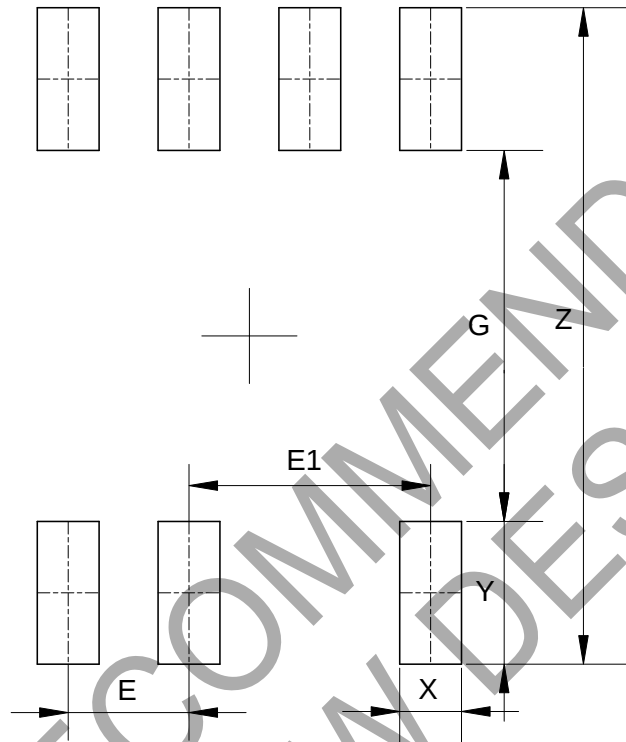
(1) Package Type: SO-7



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

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