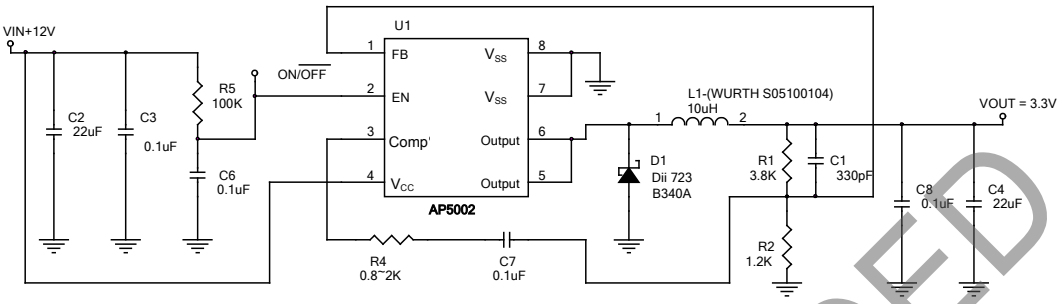
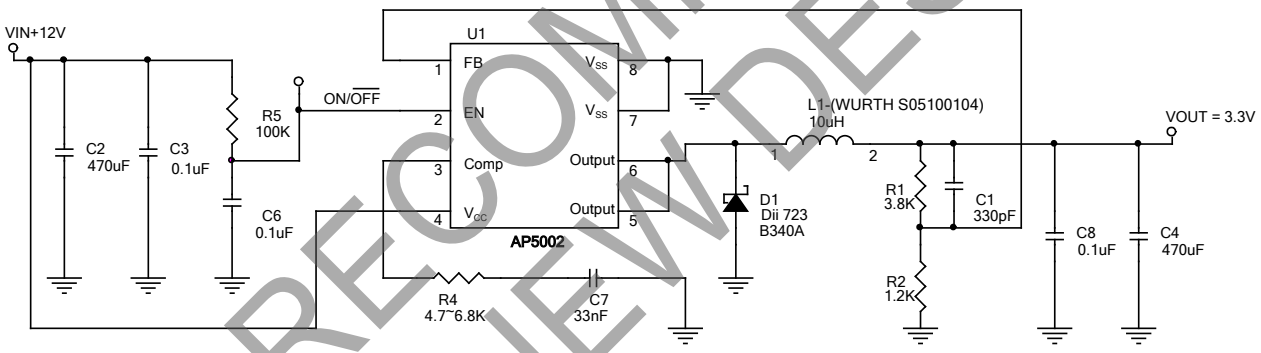
Typical Application Circuit



Compensation Capacitor Selection(MLCC)				
VIN	VOUT	R4	C7	C1
12V	5/ 3.3/ 2.5/ 1.8/ 1.5V	0.8~2K	0.1μF	330pF
5V	3.3/ 2.5/ 1.8/ 1.5V	0.8~2K	27nF	330pF

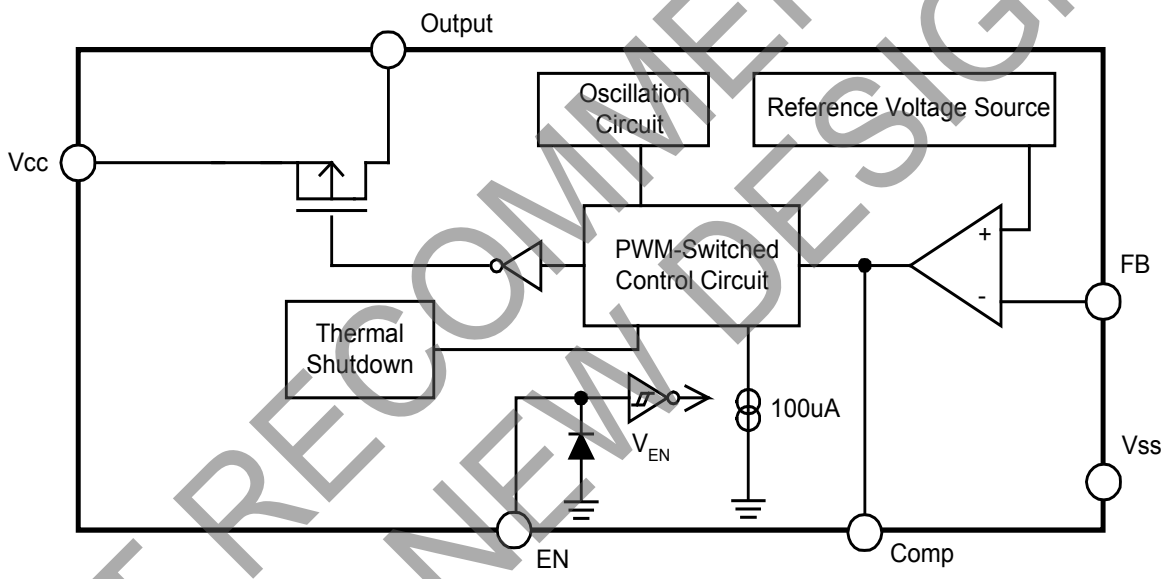


Note: 1. $V_{OUT} = V_{FB} \times (1 + \frac{R1}{R2})$

Pin Descriptions

Name	Pin	Description
FB	1	Feedback pin
EN	2	Power-off pin H: Normal operation (Step-down operation) L: Step-down operation stopped (All circuits deactivated)
Comp	3	Compensation pin
V_{CC}	4	IC power supply pin
Output	5, 6	Switch Pin. Connect external inductor/diode here. Minimize trace area at this pin to reduce EMI.
V_{SS}	7, 8	GND Pin

Block Diagram



Absolute Maximum Ratings

Symbol	Parameter	Rating	Unit
ESD HBM	Human Body Model ESD Protection	5	KV
ESD MM	Machine Model ESD Protection	200	V
V_{CC}	V_{CC} Pin Voltage	V_{SS} - 0.3 to V_{SS} + 22	V
V_{FB}	Feedback Pin Voltage	V_{SS} - 0.3 to V_{CC}	V
V_{EN}	EN Pin Voltage	V_{SS} - 0.3 to V_{IN}	V
V_{OUTPUT}	Switch Pin Voltage	V_{SS} - 0.3 to V_{IN}	V
P_D	Power Dissipation	1000	mW
T_J	Operating Junction Temperature Range	-20 to +125	°C
T_{ST}	Storage Temperature Range	-65 to +150	°C

Caution: The absolute maximum ratings are rated values exceeding which the product could suffer physical damage. These values must therefore not be exceeded under any conditions.

Recommended Operating Conditions

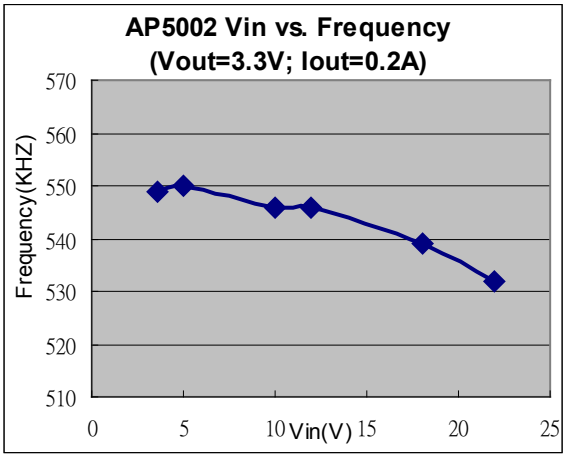
Symbol	Parameter	Min	Max	Unit
V_{IN}	Input Voltage	3.6	20	V
I_{OUT}	Output Current	0	2	A
T_A	Operating Ambient Temperature	-20	+85	°C

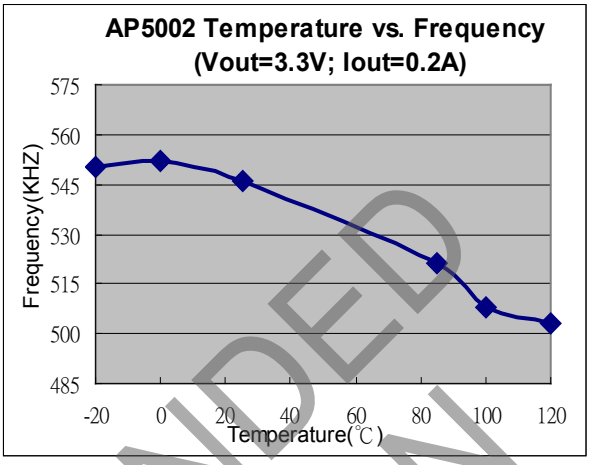
Electrical Characteristics (V_{IN} = 12V, T_A = +25°C, unless otherwise specified)

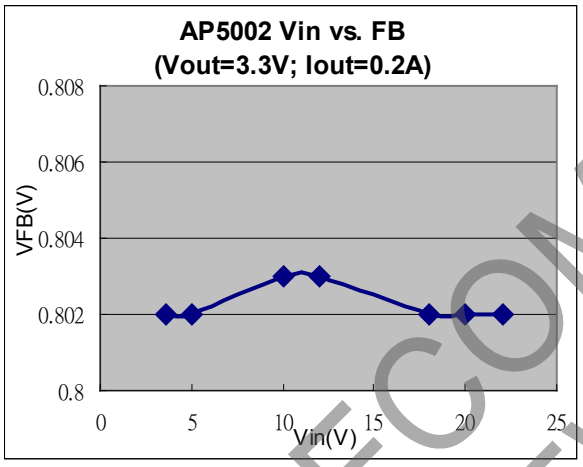
Symbol	Parameter	Conditions	Min	Typ.	Max	Unit
V_{FB}	Feedback Voltage	I_{OUT} = 0.1A	0.784	0.8	0.816	V
I_{FB}	Feedback Bias Current	I_{OUT} = 0.1A	—	0.1	0.5	μA
I_{CCQ}	Quiescent Current	V_{FB} = 1.2 force drive off	—	3	5	mA
I_{SW}	Switch Current	—	3.5	—	—	A
I_{SD}	Shutdown Supply Current	V_{EN} = 0V	—	10	—	μA
ΔV_{OUT} /V_{OUT}	Line Regulation	V_{IN} = 4V~20V, I_{OUT} = 0.2A	—	1	2	%
ΔV_{OUT} /V_{OUT}	Load Regulation	I_{OUT} = 0.1 to 2A	—	0.5	1	%
f_{OSC}	Oscillation Frequency	Measure waveform at SW pin	400	500	600	KHz
V_{SH}	EN Pin Input Voltage	Evaluate oscillation at SW pin	2.0	—	—	V
V_{SL}		Evaluate oscillation stop at SW pin	—	—	0.8	
I_{SH}	EN Pin Input Leakage Current	Ven = 2V	-10	—	10	μA
I_{SL}		Ven = 0.8V	-10	—	10	μA
T_{SS}	Soft-Start Time	—	—	3	—	ms
R_{DSON}	Internal MOSFET Rdson	V_{IN} = 5V, V_{FB} = 0V	—	110	150	mΩ
		V_{IN} = 12V, V_{FB} = 0V	—	70	100	
—	Thermal shutdown	—	—	+140	—	°C
—	Minimum Duty Cycle	—	—	6.5	—	%
θ_{JA}	Thermal Resistance Junction-to-Ambient	SOP-8L (Note 2)	—	124	—	°C/W
θ_{JC}	Thermal Resistance Junction-to-Case	SOP-8L (Note 2)	—	25	—	°C/W

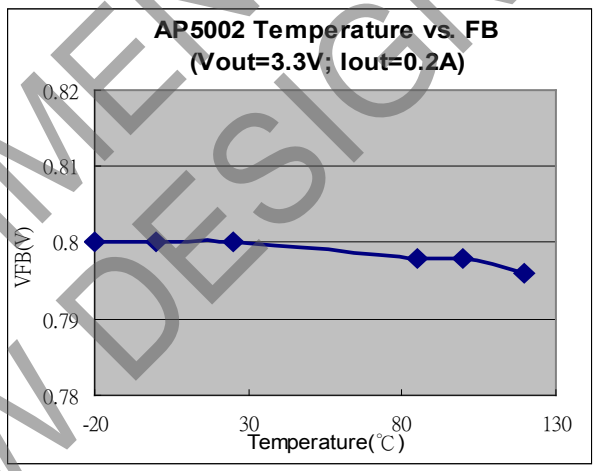
Note: 2. Test condition: Device mounted on 2oz copper, minimum recommended pad layout, FR-4 PCB.

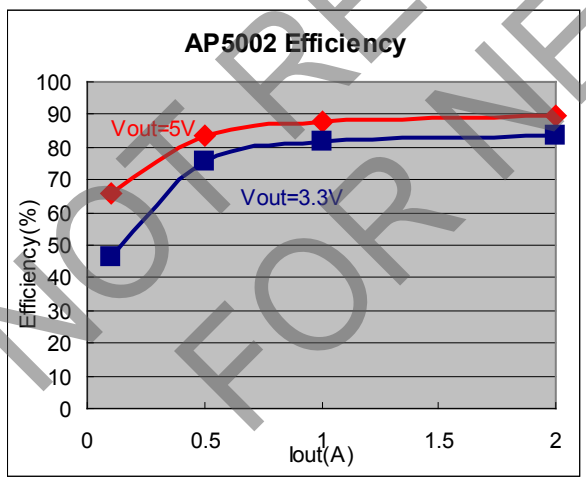
Typical Performance Characteristics



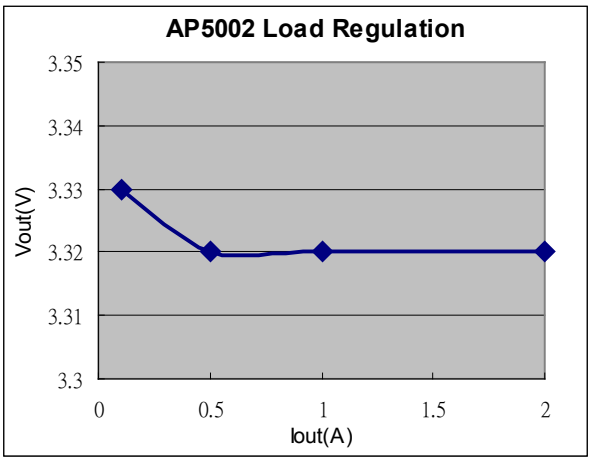


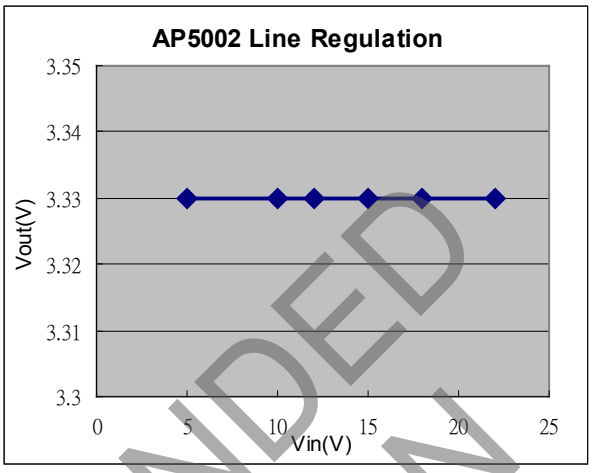


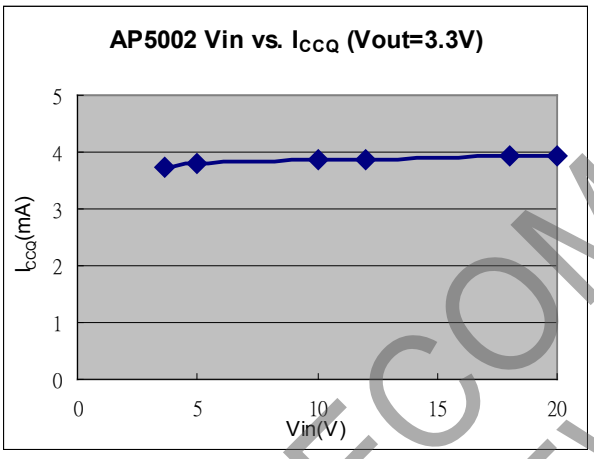


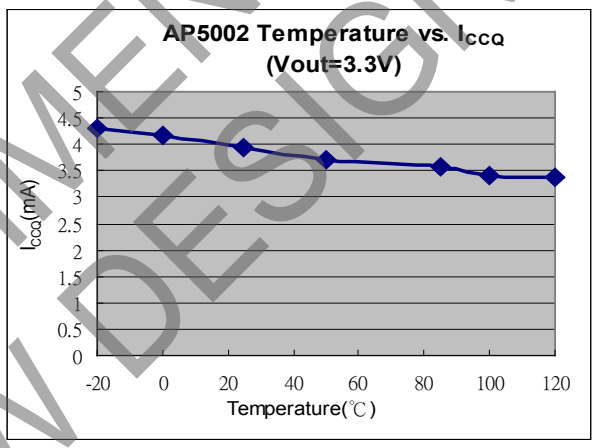


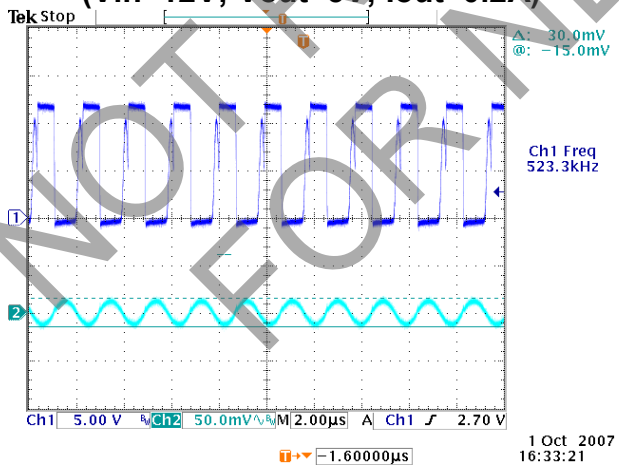
Typical Performance Characteristics (continued)

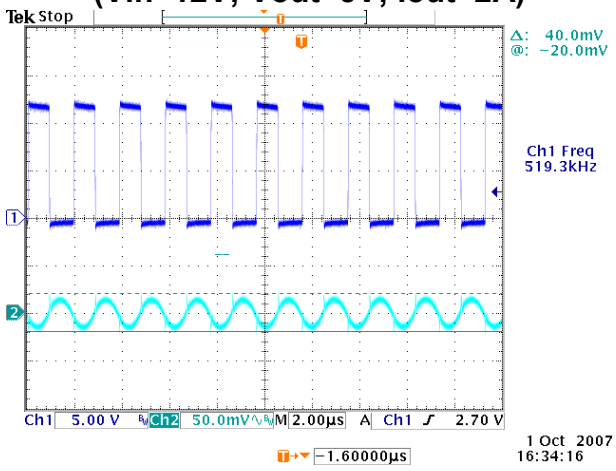




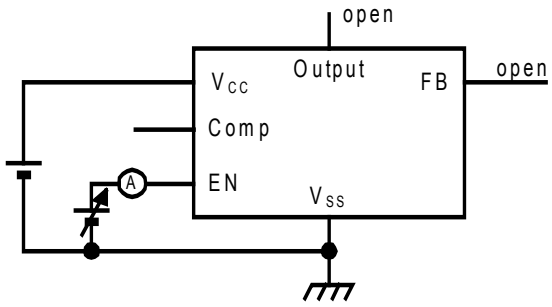




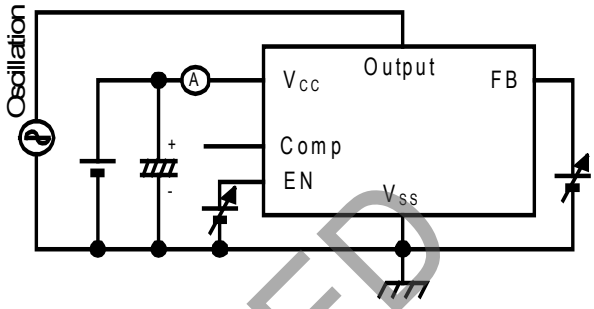




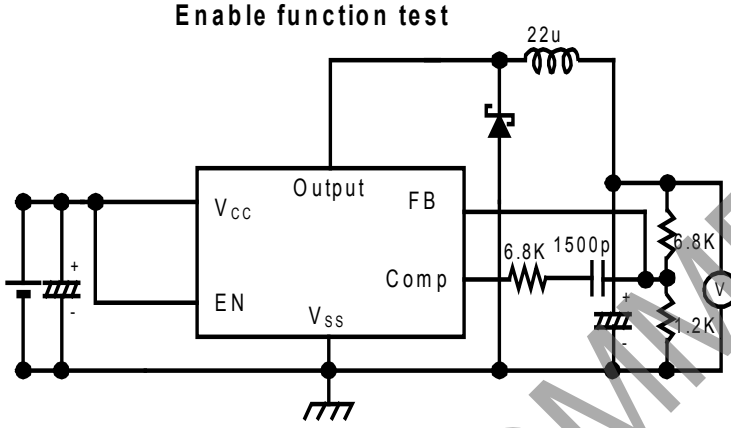
Test Circuit



Enable function test



Feedback function test



Operation function test

Functional Description

PWM Control
The AP5002 consists of DC/DC converters that employ a pulse-width modulation (PWM) system.
In converters of the AP5002, the pulse width varies in a range up to 100%, according to the load current. The ripple voltage produced by the switching can easily be removed through a filter because the switching frequency remains constant. Therefore, these converters provide a low-ripple power over broad ranges of input voltage and load current.

$R_{DS(ON)}$ Current Limiting
The current limit threshold is set by the internal circuit.

Setting the Output Voltage
Application circuit item shows the basic application circuit with adjustable output version. The external resistor sets the output voltage according to the following equation:

V_{OUT} (V)	R1 (KΩ)	R2 (KΩ)
5	6.4	1.2
3.3	3.8	1.2
2.5	2.6	1.2
1.8	3.3	2.6
1.5	3.3	3.7
1.2	3.3	6.5
1	3.3	13

Inductor Selection
For most designs, the operates with inductors of 10μH to 22μH. The inductor value can be derived from the following equation:

$$L = \frac{(V_{IN} - V_{OUT})T_{ON}}{2 \times \Delta I_L \times f_{osc}}$$

Where is inductor Ripple Current. Large value inductors lower ripple current and small value inductors result in high ripple currents. Choose inductor ripple current approximately 15% of the maximum load current 2A, ΔIL=0.3A. The DC current rating of the inductor should be at least equal to the maximum load current plus half the ripple current to prevent core saturation (2A+0.15A).

Input Capacitor Selection
EL CAP
This capacitor should be located close to the IC using short leads and the voltage rating should be approximately 1.5 times the maximum input voltage. The RMS current rating requirement for the input capacitor of a buck regulator is approximately 1⁄2 the DC load current. A low ESR input capacitor sized for maximum RMS current must be used. A 470μF low ESR capacitor for most applications is sufficient.

MLCC CAP
A 22μF MLCC capacitor for most applications is sufficient.

Output Capacitor Selection
EL CAP
The output capacitor is required to filter the output voltage and provides regulator loop stability. The important capacitor parameters are the 100KHz Equivalent Series Resistance (ESR), the RMS ripples current rating, voltage rating and capacitance value. For the output capacitor, the ESR value is the most important parameter. The output ripple can be calculated from the following formula.

$$V_{RIPPLE} = \Delta I_L \times ESR$$

The bulk capacitor's ESR will determine the output ripple voltage and the initial voltage drop after a high slew-rate transient.

An aluminum electrolytic capacitor's ESR value is related to the capacitance and its voltage rating. In most case, higher voltage electrolytic capacitors have lower ESR values. Most of the time, capacitors with much higher voltage ratings may be needed to provide the low ESR values required for low output ripple voltage.

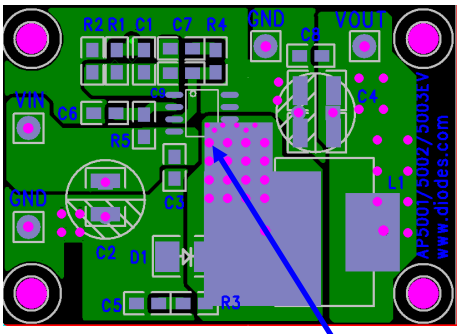
MLCC CAP
A 22μF MLCC capacitor for most applications is sufficient.

PCB Layout Guide
If you need low T_C & T_J or large PD(Power Dissipation), The dual SW pins(5& 6) and V_{SS} pins(7& 8)on the SOP-8L package are internally connected to die pad, The PCB layout should allow for maximum possible copper area at the SW pins.
1. Connect C3 to V_{CC} and V_{SS} pin as closely as possible to get good power filter effect.
2. Connect R4 to V_{CC} and OCSET pin as closely as possible.
3. Connect ground side of the C2 & D1 as closely as possible.

Functional Description (continued)

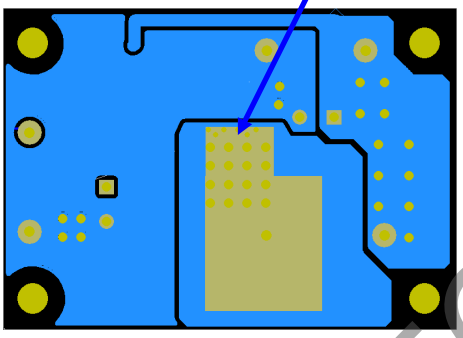
Typical PC Board Layout

Top Side Layout Guide

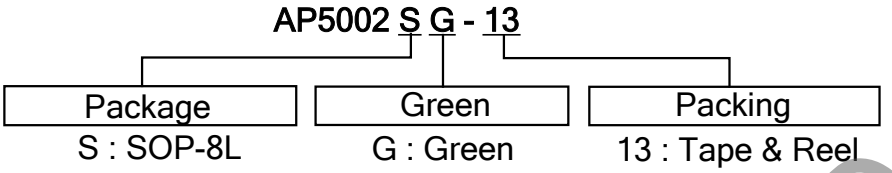


Use vias to conduct the heat into the backside of PCB layer. The PCB heat sink copper area should be solder-painted without masked. This approaches a "best case" pad heat sink.

Bottom Side Layout Guide



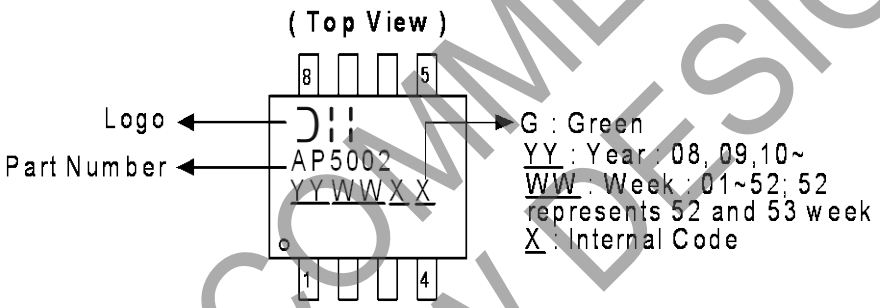
Ordering Information



Device	Package Code	Packaging (Note 3)	13" Tape and Reel	
			Quantity	Part Number Suffix
AP5002SG-13	S	SOP-8L	2500/Tape & Reel	-13

Note: 3. Pad layout as shown in Diodes Incorporated's package outline PDFs, which can be found on our website at http://www.diodes.com/package-outlines.html.

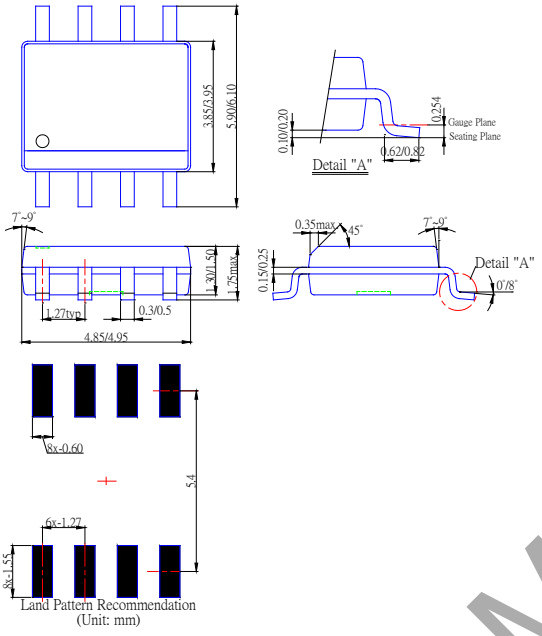
Marking Information



Package Outline Dimensions (All Dimensions in mm)

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

(1) Package type: SOP-8L



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.

www.diodes.com