



Step-up PWM DC/DC Converter

Features

- Input Voltage: 3V to 20V
- Output Voltage: 3.3V to 32V
- Duty Ratio: 0% to 85% PWM Control
- Operating Frequency: 500KHz.
- Enable and Thermal Shutdown Functions
- Internal Current Limit
- Built-in N-channel MOSFET
- RoHS-compliant, halogen-free ESOP-8

Description

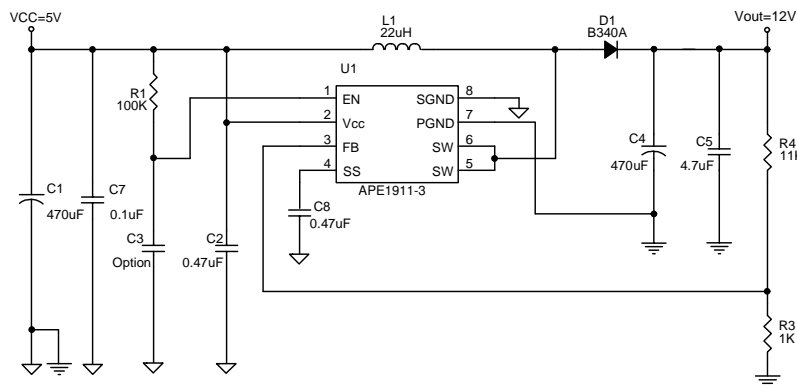
The APE1911 is a high-efficiency step-up DC/DC converter, providing high output current using an internal internal N-channel MOSFET, and an external coil and diode.

The APE1911 can be operated at switching frequencies of 500 kHz allowing easy filtering and low noise, with a reduction in the size of the external components. Output voltage is programmable using external components, with 1.0V of standard voltage supply internal.

The soft-start time can be programmed with an outside capacitor, which can help prevent overshoot at start-up and help with sequencing. Built-in current-limiting, thermal shutdown and enable functions are also provided.

The APE1911-3 is available in an ESOP-8 package which features the small size of SO-8 with an exposed pad to reduce the junction-to-case thermal resistance, making it suitable for 2~3W applications.

Typical Application Circuit



$$V_{OUT} = V_{FB} \times (1 + R4/R3), V_{FB} = 1.0V, R3 = 1k \sim 3k\Omega$$

Ordering Information

Package Type
 MP: RoHS-compliant halogen-free ESOP-8
APE1911MP-HF-3TR

Packing TR : Products in ESOP-8 are shipped on tape and reel.
 The device is rated MSL3 for moisture sensitivity,
 and the reel is packed in a moisture barrier bag.



Absolute Maximum Ratings (at $T_A=25^\circ\text{C}$)

VCC Pin Voltage (V_{CC})	-----	GND - 0.3V to GND + 22V
Feedback Pin Voltage (V_{FB})	-----	GND - 0.3V to 6V
ON/OFF Pin Voltage (V_{EN})	-----	GND - 0.3V to VCC
Switch Pin Voltage (V_{SW})	-----	GND - 0.3V to 34V
SS Pin Voltage (V_{SS})	-----	GND - 0.3V to 6V
Power Dissipation (PD)	-----	Internally limited
Storage Temperature Range (T_{ST})	-----	-40°C to +150°C
Operating Junction Temperature (T_{OPJ})	-----	-20°C to +125°C
Thermal Resistance from Junction to Case ($R_{th_{JC}}$)		15°C/W
Thermal Resistance from Junction to Ambient ($R_{th_{JA}}$)		40°C/W

Note: $R_{th_{JA}}$ is measured with the PCB copper area (connected to the exposed pad) of approximately 1.5 in² (Multi-layer)

Electrical Specifications

($V_{IN}=5\text{V}$, $V_{OUT}=12\text{V}$, $T_A=25^\circ\text{C}$, unless otherwise specified)

Parameter	SYM	TEST CONDITION	MIN	TYP	MAX	UNITS
Operating Supply Voltage	V_{CC}		3	-	20	V
Output Voltage Range	V_{OUT}		3.3	-	32	V
Feedback Voltage	V_{FB}	$I_{OUT}=0.1\text{A}$	0.98	1	1.02	V
Feedback Bias Current	I_{FB}	$I_{OUT}=0.1\text{A}$	-	0.1	0.5	uA
Quiescent Current	I_{CCQ}	$V_{FB}=1.5\text{V}$ force driver off	-	4	6	mA
Shutdown Supply Current	I_{SD}	$V_{EN}=0\text{V}$	-	1	10	uA
Oscillation Frequency	F_{OSC}	SW pin	400	500	600	KHz
Line Regulation		$V_{CC}=3\sim 0.8 \cdot V_{out}$	-	1	-	%
Load Regulation		$I_{OUT}=50\text{mA}\sim 1\text{A}$	-	1	-	%
EN Pin Logic input threshold voltage	V_{SH}	High (regulator ON)	2	-	-	V
	V_{SL}	Low (regulator OFF)	-	-	0.8	
EN Pin Input Current	I_{SH}	$V_{EN}=2.5\text{V}$ (ON)	-	20	-	uA
	I_{SL}	$V_{EN}=0.3\text{V}$ (OFF)	-	-1	-	uA
SS pin Current	I_{SS}		-	8	-	uA
Switching Current Limit	I_{LIM-sw}		2.8	3	-	A
Internal MOSFET R_{DSON}	R_{DSON}	$V_{CC}=5\text{V}$	-	40	80	mΩ
		$V_{CC}=12\text{V}$	-	30	60	
Efficiency	EFFI	$V_{CC}=5\text{V}$, $V_{OUT}=12\text{V}$, $I_{OUT}=0.5\text{A}$	-	92	-	%
Maximum Duty Cycle	DC_{MAX}	$V_{FB}=0\text{V}$	-	85	-	%
Minimum Duty Cycle	DC_{MIN}	$V_{FB}=1.5\text{V}$	-	0	-	
Thermal Shutdown Temp	TSD		-	145	-	°C

THIS PRODUCT IS SENSITIVE TO ELECTROSTATIC DISCHARGE, PLEASE HANDLE WITH CAUTION.

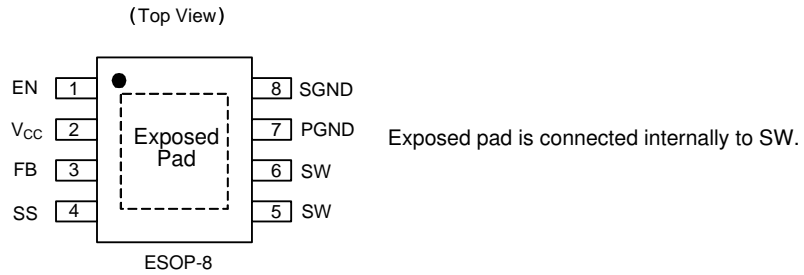
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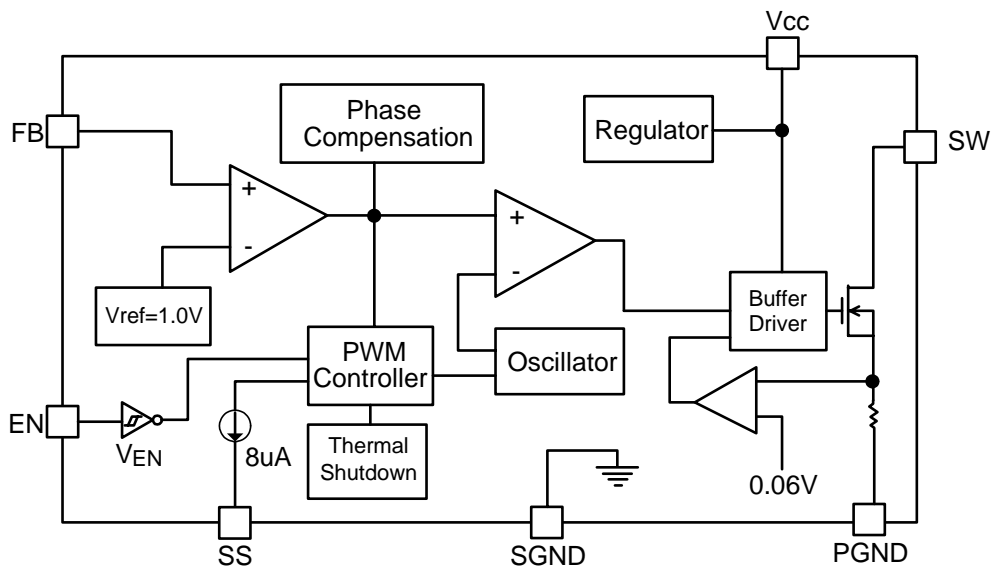
Pin Configuration



Pin Descriptions

PIN SYMBOL	PIN DESCRIPITON
VCC	IC Power Supply Pin
SW	Switch pin. Connect external inductor & diode here
FB	Feedback Pin
EN	Shutdown Pin
	H : Normal operation L : Shutdown
SS	Soft-Start Pin.
PGND	Power Ground pin
SGND	Signal Ground pin.

Block Diagram





Function Descriptions

PWM Control

The APE1911 is a DC/DC converter that employs a pulse-width modulation (PWM) system. In converters like the APE1911, the pulse width varies in a range from 0 to 85%, according to the load current. The ripple voltage produced by the switching can be easily removed through a filter because the switching frequency remains constant. As a result, these converters provide a low-ripple power over broad ranges of input voltage and load current.

Setting the Output Voltage

The application circuit section shows the basic application circuit for the APE1911 with adjustable output voltage. The external resistor sets the output voltage according to the following equation:

$$V_{OUT} = 1.0V \times (1 + R4/R3)$$

Table 1: Resistor selection for setting output voltage

V _{OUT}	R3	R4
12V	1k	11k
15V	1.3k	18k
18V	1.3k	22k
24V	1.3k	30k
32V	2.2k	68k

Inductor Selection

For most designs, low inductance values are physically smaller but require faster switching, which results in some efficiency loss. The inductor value can be derived from the following equation:

$$L = [V_{IN} \times (V_{OUT} - V_{IN})] / V_{OUT} \times \Delta I_L \times f_{Lx}$$

Inductor ripple current - large value inductors have lower ripple current and smaller value inductors result in higher ripple currents. Choose an inductor with ripple current of approximately 15% of the maximum input current, e.g. at 2.4A, that is $\Delta I_L = 0.18A$.

V _{OUT}	9V	12V	15V	18V
L1 Value	18uH	22uH	25uH	33uH

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 $(2.4A + 0.18/2A) = 2.49A$.

Input Capacitor Selection

The input capacitor reduces both the surge current drawn from the input and the switching noise from the device. The input capacitor impedance at the switching frequency should be less than the input source impedance to prevent high frequency switching current passing to the input. A low ESR input capacitor sized for maximum RMS current must be used. The capacitor voltage rating should be at least 1.5 times greater than the input voltage, and often much higher voltage ratings may be needed.



Function Descriptions (cont.)

Output Capacitor Selection

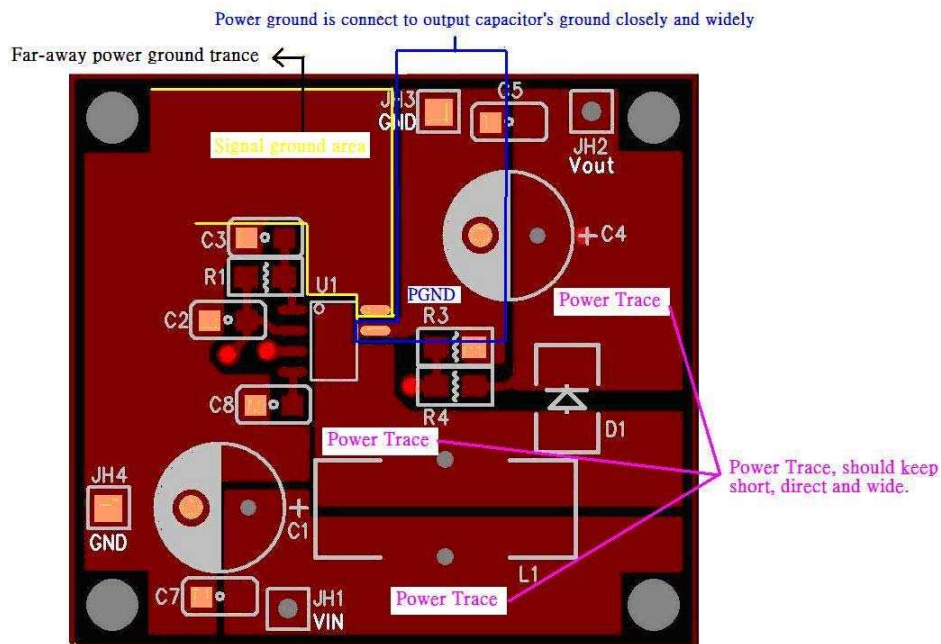
The output capacitor is required to keep the output voltage ripple small and to ensure regulation loop stability. The output capacitor must have low impedance at the switching frequency. A low ESR capacitor sized for maximum RMS current must be used. The low ESR requirements are needed for low output ripple voltage.

The capacitor voltage rating should be at least 1.5 times greater than the input voltage, and often much higher voltage ratings may be needed.

Output Capacitor Selection

When laying out the PC board, the following suggestions should be taken to ensure proper operation of the APE1911. These items are also illustrated graphically below.

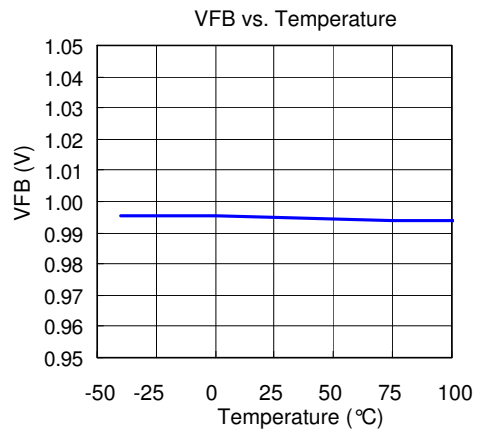
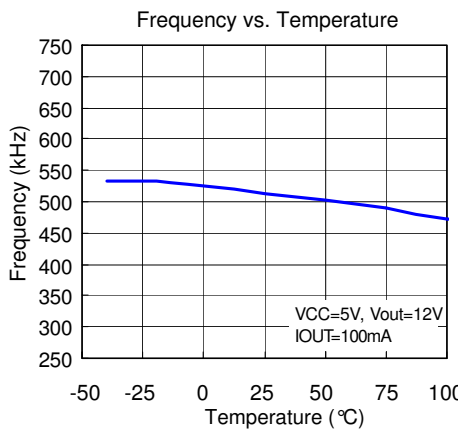
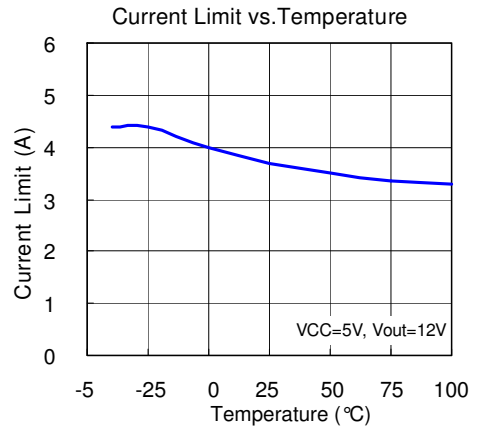
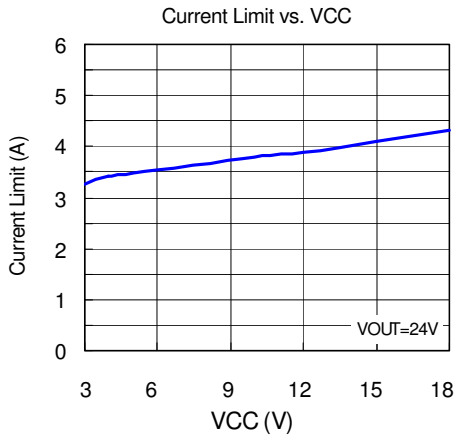
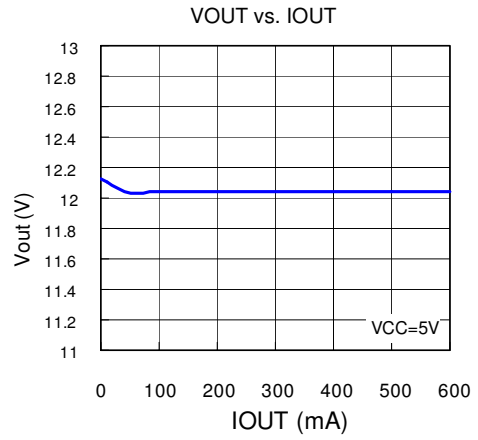
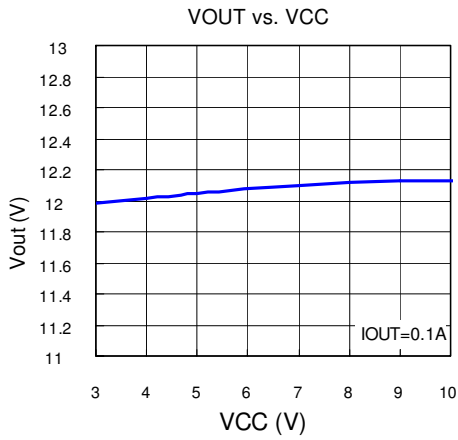
1. The power traces, including the source trace, the Schottky and the C1 trace should be kept short, direct and wide to allow large current flow.
2. The power ground is kept close to C4's ground and far away from the signal ground.
3. The signal ground trace is kept distant from the power ground trace.
4. The exposed pad is connected to the SW trace with a short wide trace. (Reduces IC temperature)
5. Do not run any signal line trace under inductor.



(APE1911 PCB Layout -Top View)



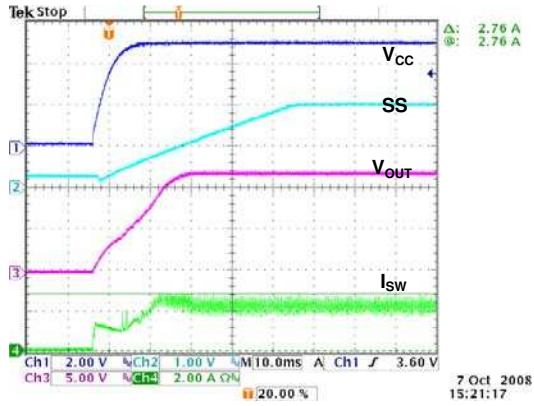
Typical Performance Characteristics



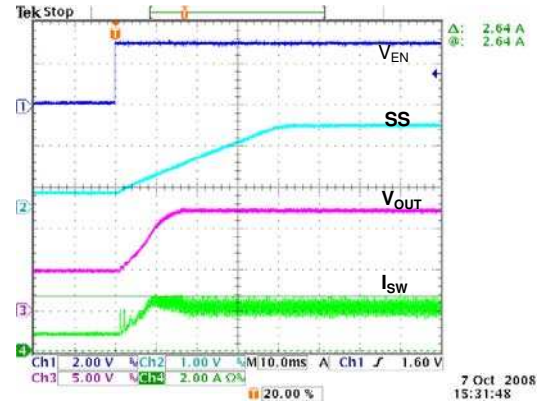


Typical Performance Characteristics (cont.)

Power-ON Waveform
(VCC=5V, Vout=12V, Load=0.8A, SS=0.47uF)

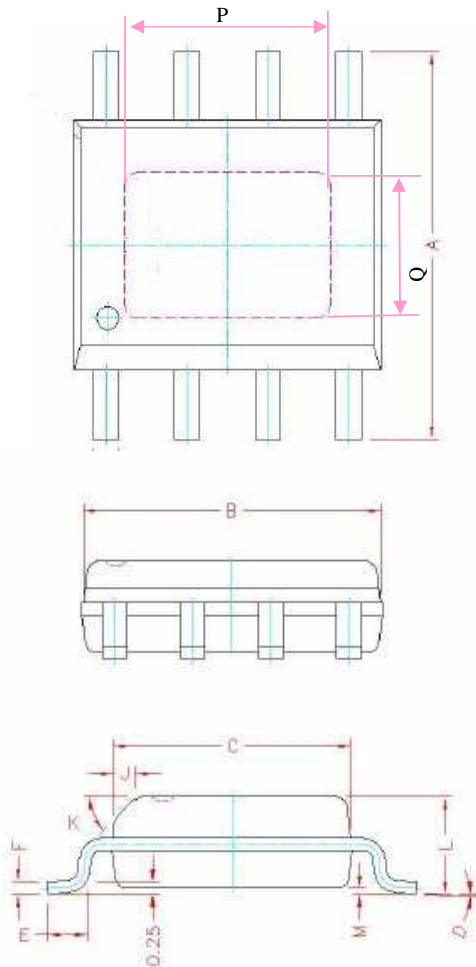


Enable-ON Waveform
(VCC=5V, Vout=12V, Load=0.8A, SS=0.47uF)





Package Dimensions: ESOP-8



SYMBOLS	Millimeters		
	MIN	NOM	MAX
A	5.80	6.00	6.20
B	4.80	4.90	5.00
C	3.80	3.90	4.00
D	0°	4°	8°
E	0.40	0.65	0.90
F	0.19	0.22	0.25
M	0.00	0.08	0.15
H	0.35	0.42	0.49
L	1.35	1.55	1.75
J	0.375 REF.		
K	45°		
G	1.27 TYP.		
P	3.15	3.25	3.35
Q	2.25	2.35	2.45

1. All dimensions are in millimeters.
2. Dimensions do not include mold protrusions.

Marking Information

