PWM CONTROL 3.5A STEP-DOWN CONVERTER

FEATURES

- **Input voltage：3.6V to 23V**
- **Output voltage：0.8V to Vcc**
- **Duty ratio：0% to 100% PWM control**
- **Oscillation frequency：330KHz typ.**
- **Current Limit(CL), Enable function.**
- **Thermal Shutdown function.**
- **Short Circuit Protect (SCP).**
- **Built-in internal SW P-channel MOS.**
- **SOP-8L Pb-Free package.**

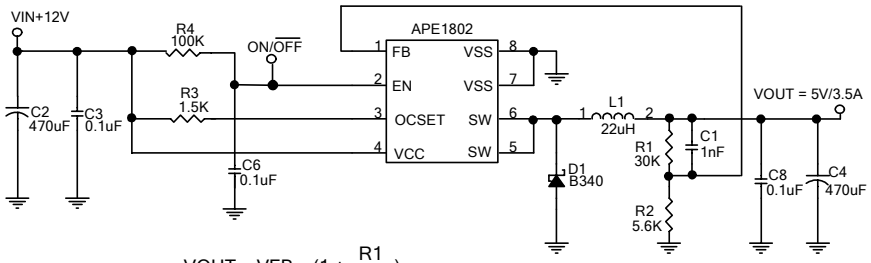
DESCRIPTION

APE1802 consists of step-down switching regulator with PWM control. These devise include a reference voltage source, oscillation circuit, error amplifier, internal PMOS and etc.

APE1802 provides low-ripple power, high efficiency, and excellent transient characteristics. The PWM control circuit is able to the duty ratio linearly form 0 up to 100%. An enable function, an over current protect function and short circuit protect function are built inside, and when OCP or SCP happens, the operation frequency will be reduced. Also, an internal compensation block is built in to minimum external component count.

With the addition of an internal P-channel Power MOS, a coil, capacitors, and a diode connected externally, these ICs can function as step-down switching regulators. They serve as ideal power supply units for portable devices when coupled with the SOP-8L package, providing such outstanding features as low current consumption. Since this converter can accommodate an input voltage up to 23V, it is also suitable for the operation via an AC adapter.

TYPICAL APPLICATION



$$VOUT = VFB \times (1 + \frac{R1}{R2})$$

VFB = 0.8V ; R2 suggest 0.8K ~ 6k

L1 recommend value (V_{IN}=12V)				
V_{OUT}	1.8 V	2.5V	3.3V	5V
I_{OUT}=3.5A	12uH	15uH	18uH	22uH

PACKAGE ORDERING INFORMATION

APE1802X

Package Type

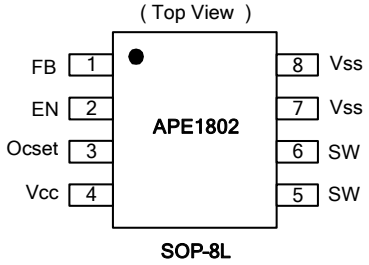
M : SOP-8

ABSOLUTE MAXIMUM RATINGS (at T_A=25°C)

V_{CC} PIN Voltage(V_{CC})	VSS - 0.3 to VSS + 25V
Feedback PIN Voltage(V_{FB})	V_{SS} -0.3V to V_{CC}
ON/OFF PIN Voltage(V_{EN})	V_{SS} -0.3V to V_{CC} + 0.3V
Switch PIN Voltage(V_{SW})	V_{SS} -0.3V to V_{CC} + 0.3V
Power Dissipation(P_D)	Internally Limited
Storage Temperature Range(T_{ST})	-40°C To 150°C
Operating Temperature Range(T_{OP})	-20°C To 125°C
Operating Supply Voltage(VOP)	+3.6V to +23V
Output Current (I_{OUT})	0 to 3.5A
Peak Current (I_{peak})	6A
Thermal Resistance from Junction to Case(Rth_{JC})	25°C/W
Thermal Resistance from Junction to Ambient(Rth_{JA})	70°C/W

Note. Rth_{JA} is measured with the PCB copper area(need connect to SW pins) of approx. 1 in ^{2} (multi-layers)

PACKAGE INFORMATION



SOP-8L

ELECTRICAL SPECIFICATIONS

(V_{IN}=12V, T_A=25℃, unless otherwise specified)

Parameter	SYM	TEST CONDITION	MIN	TYP	MAX	UNITS
Feedback Voltage	V_{FB}	I_{OUT}=0.1A	0.784	0.8	0.816	V
Quiescent Current	I_{CCQ}	V_{FB}=1.2V force driver off	-	3	5	mA
Feedback Bias Current	I_{FB}	I_{OUT}=0.1A	-	0.1	0.5	uA
Shutdown Supply Current	I_{SD}	V_{EN}=0V	-	2	10	uA
OCSET pin bias current	I_{OCSET}		95	110	140	uA
Switch Current	I_{SW}		45	-	-	A
Line Regulation	$\triangle V_{OUT}/V_{OUT}$	V_{CC}= 8V~23V, I_{OUT}=0.2A	-	1	2	%
Load Regulation	$\triangle V_{OUT}/V_{OUT}$	I_{OUT}= 0.1A to 3.5A	-	0.2	0.5	%
Oscillation Frequency	F_{OSC}	SW PIN	260	330	400	KHz

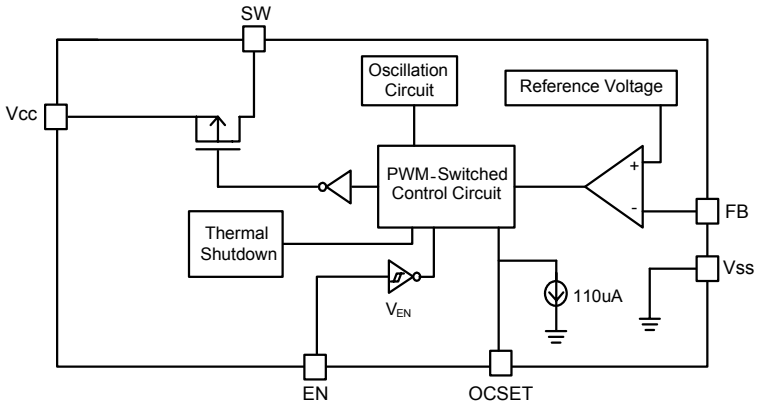
ELECTRICAL SPECIFICATIONS(Cont.)

EN PIN Logic Input Threshold Voltag	V_{SH}	High (regulator ON)		2	-	-	V
	V_{SL}	Low (regulator OFF)		-	-	0.8	V
EN PIN Input Current	I_{SH}	V_{EN}=2.5V(ON)		-	20	-	uA
	I_{SL}	V_{EN}=0.3V(OFF)		-	-10	-	uA
Internal MOSFET $R_{DS(ON)}$	$R_{DS(ON)}$	V_{CC}=5V, V_{FB}=0V		-	80	140	mΩ
		V_{CC}=12V, V_{FB}=0V		-	55	90	
Efficiency	EFFI	V_{CC}=12V V_{OUT}=5V	I_{OUT}=2A	-	92	-	%
			I_{OUT}=3.5A		90		

PIN DESCRIPTIONS

PIN SYMBOL	PIN DESCRIPTION
V_{SS}	GND Pin
FB	Feedback Pin
EN	Power -Off Pin
	H : Normal Operation(Step-down)
	L : Step-down Operation Stopped
	(All circuits deactivated)
OCSET	Add an external resistor to set max switch output current.
SW	Switch Pin. Connect External Inductor & Diode here.
V_{CC}	IC Power Supply Pin

BLOCK DIAGRAM



FUNCTION PIN DESCRIPTION

PWM CONTROL

The APE1802 consists of DC/DC converters that employ a pulse-width modulation (PWM) system. In converters of the APE1802, the pulse width varies in a range from 0 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.

RDS(ON) CURRENT LIMITING

The current limit threshold is setting by the external resistor (R3) connecting from VCC supply to OCSET pin. The internal 110uA sink current crossing the resistor sets the voltage at pin of OCSET. When the PWM voltage is less than the voltage at OCSET, an over-current condition is triggered. Please refer to the formula for setting the current limit value:

$$I_{SW(MIN)} = \frac{I_{OCSET} \times R3 + 0.08}{R_{DS(ON)}}$$

(Normally, The $I_{SW(MAX)}$ setting more than I_{OUT} 1.0A).

Example:

I_{SW} = (110u x 1.5K + 0.08)/ 55m= 4.75A (Vin=12V)

I_{SW} = (110u x 2.7K + 0.08)/ 80m= 4.7A (Vin=5V)

SETTING THE OUTPUT VOLTAGE

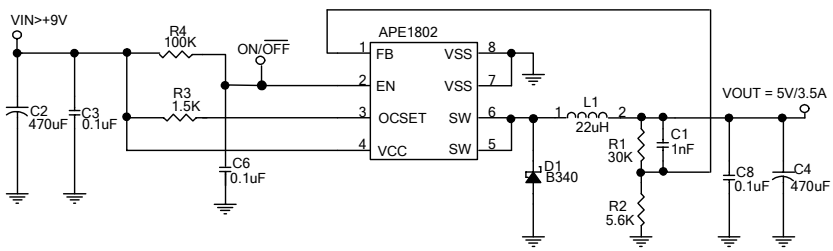
Application circuit item shows the basic application circuit with APE1803 adjustable output version. The external resistor sets the output according to the following equation :

V_{OUT} = 0.8V x (1+R1/R2)

Table1 Resistor select for output voltage setting

V_{OUT}	R2	R1
5V	1.3K	6.8K
	5.6K	30K
3.3V	1.5K	4.7K
	5.6K	18K
2.5V	2.2K	4.7K
	5.6K	12K
1.8V	2K	2.5K
1.5V	2.2K	2K
1.2V	3K	1.5K
1.0V	3K	0.75K

R2 setting 5.6k that System Operation Current (No load) can be reducing to under 4mA.



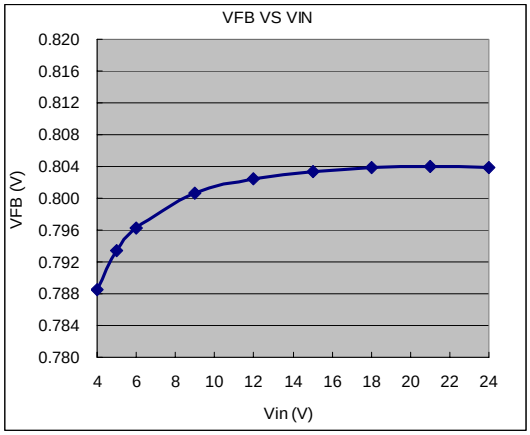
PCB LAYOUT GUIDE

If you need low T_C & T_J or large PD(Power Dissipation), The dual SW pins (5 & 6) 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.

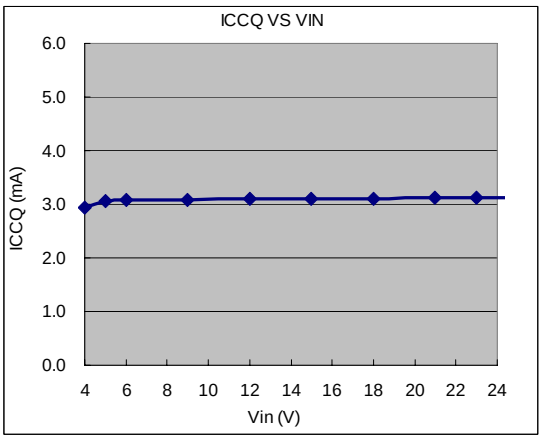
1. Connect C3 to VCC PIN as closely as possible to get good power filter effect.
2. Connect R3 to VCC PIN as closely as possible.
3. Connect ground side of the C2 & D1 as closely as possible.

TYPICAL CHARACTERISTICS

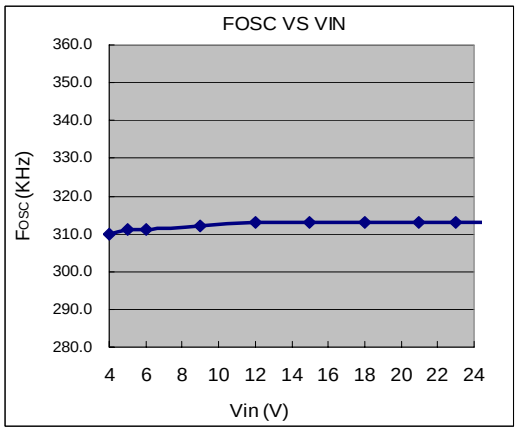
VFB VS VIN



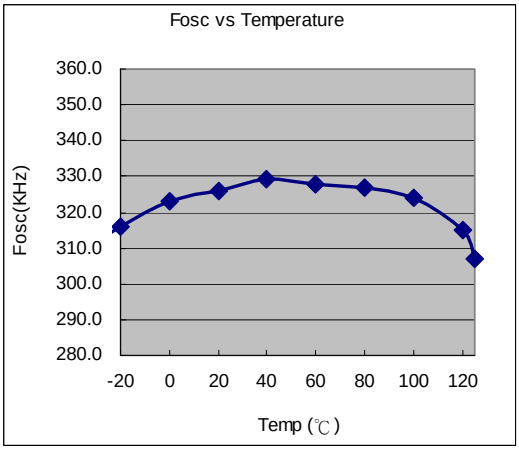
ICCQ VS VIN



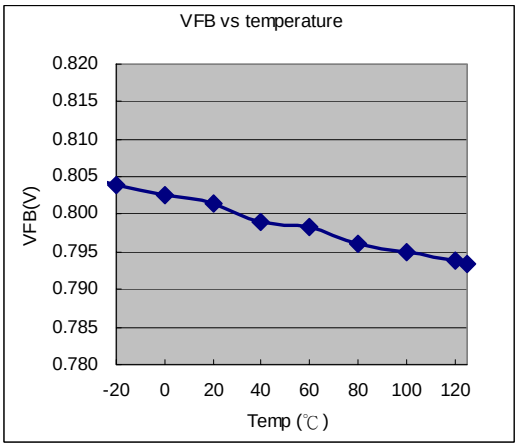
FOSC VS VIN



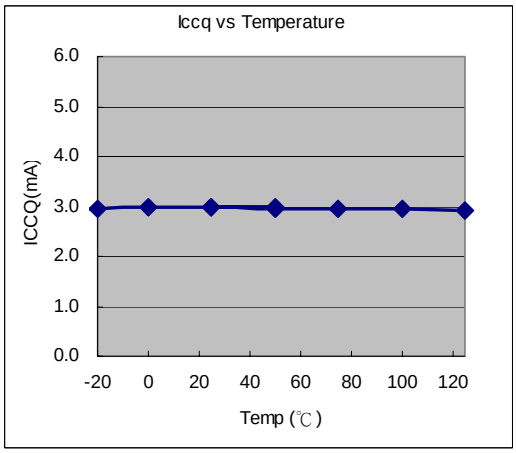
FOSC VS TEMPERATURE



VFB VS TEMPERATURE



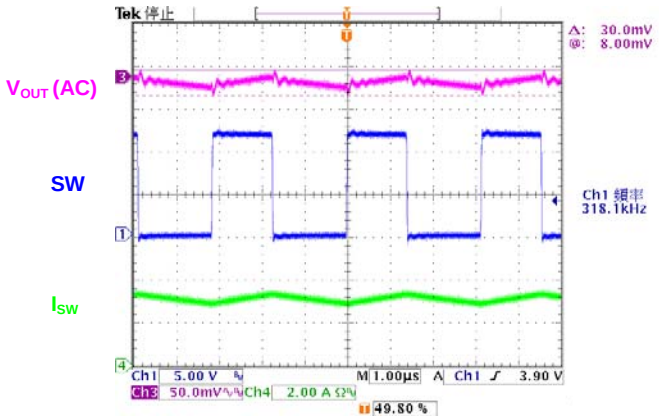
ICCQ VS TEMPERATURE



TYPICAL CHARACTERISTICS

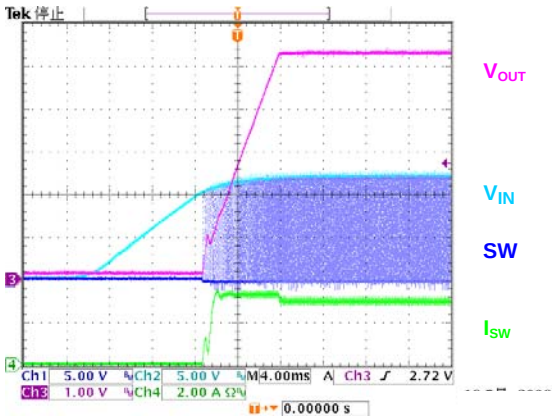
Output Ripple

(V_{IN}=12V, V_{OUT}=5V, I_{OUT}=3A)



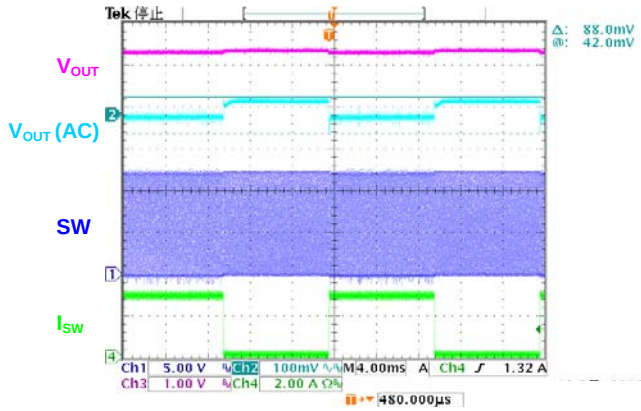
Power on test wave

(V_{IN}=12V, V_{OUT}=5V, I_{OUT}=3A)



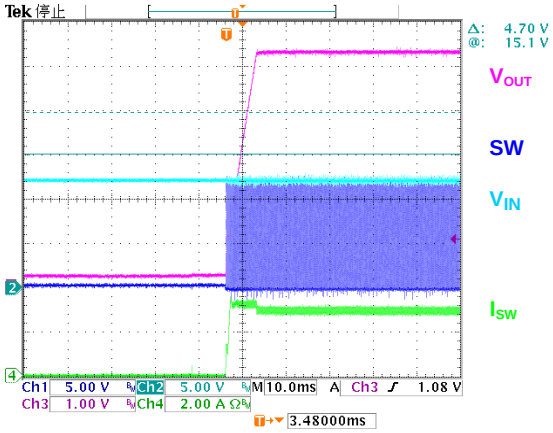
Load Transient Response

(V_{IN}=12V, V_{OUT}=5V, I_{OUT}=0.1~3A)



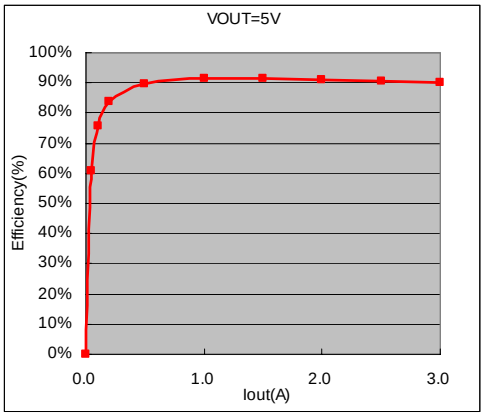
EN PIN on test wave

(V_{IN}=12V, V_{OUT}=5V, I_{OUT}=3A)



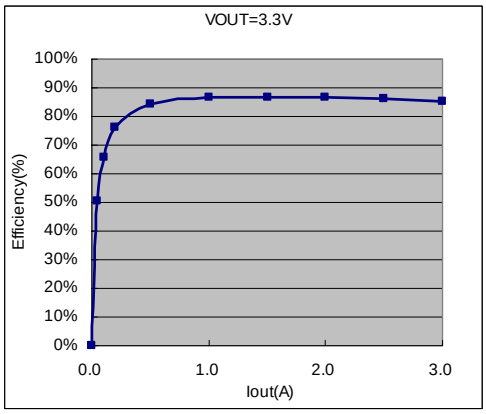
Efficiency

(V_{IN}=12V, V_{OUT}=5V)

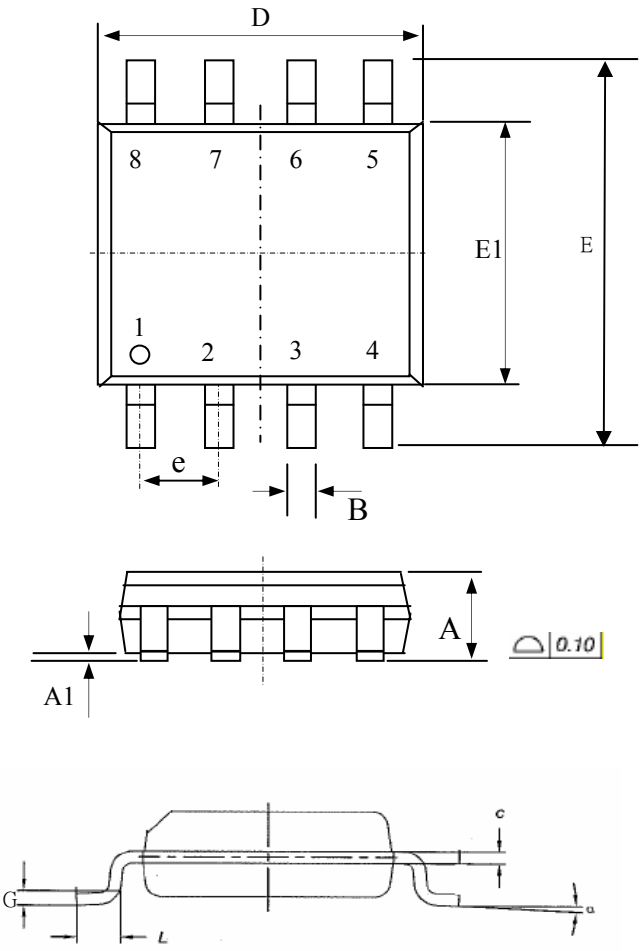


Efficiency

(V_{IN}=12V, V_{OUT}=3.3V)



Package Outline : SO-8

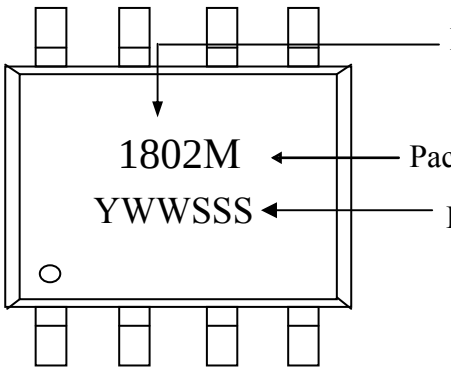


		Millimeters	
SYMBOLS	MIN	NOM	MAX
A	1.35	1.55	1.75
A1	0.10	0.18	0.25
B	0.33	0.41	0.51
c	0.19	0.22	0.25
D	4.80	4.90	5.00
E	5.80	6.15	6.50
E1	3.80	3.90	4.00
e	1.27 TYP		
G	0.254 TYP		
L	0.38	—	0.90
α	0.00	4.00	8.00

1.All Dimension Are In Millimeters.

2.Dimension Does Not Include Mold Protrusions.

Part Marking Information & Packing : SO-8



Part Number

Package Code

Date Code (YWWSSS)

Y：Last Digit Of The Year

WW：Week

SSS：Sequence