3A , 4.5V-18V Input , Synchronous Step Down Regulator

GENERAL DESCRIPTION

The PW2163 is a high efficiency 500 kHz synchronous step-down DC-DC converter capable of delivering 3A current. The PW2163 operates over a wide input voltage range from 4.5V to 18V and integrates main switch and synchronous switch with very low RDS(ON) to minimize the conduction loss. Low output voltage ripple and small external inductor and capacitor sizes are achieved with 500 kHz switching frequency. It adopts the instant PWM architecture to achieve fast transient responses for high step down applications

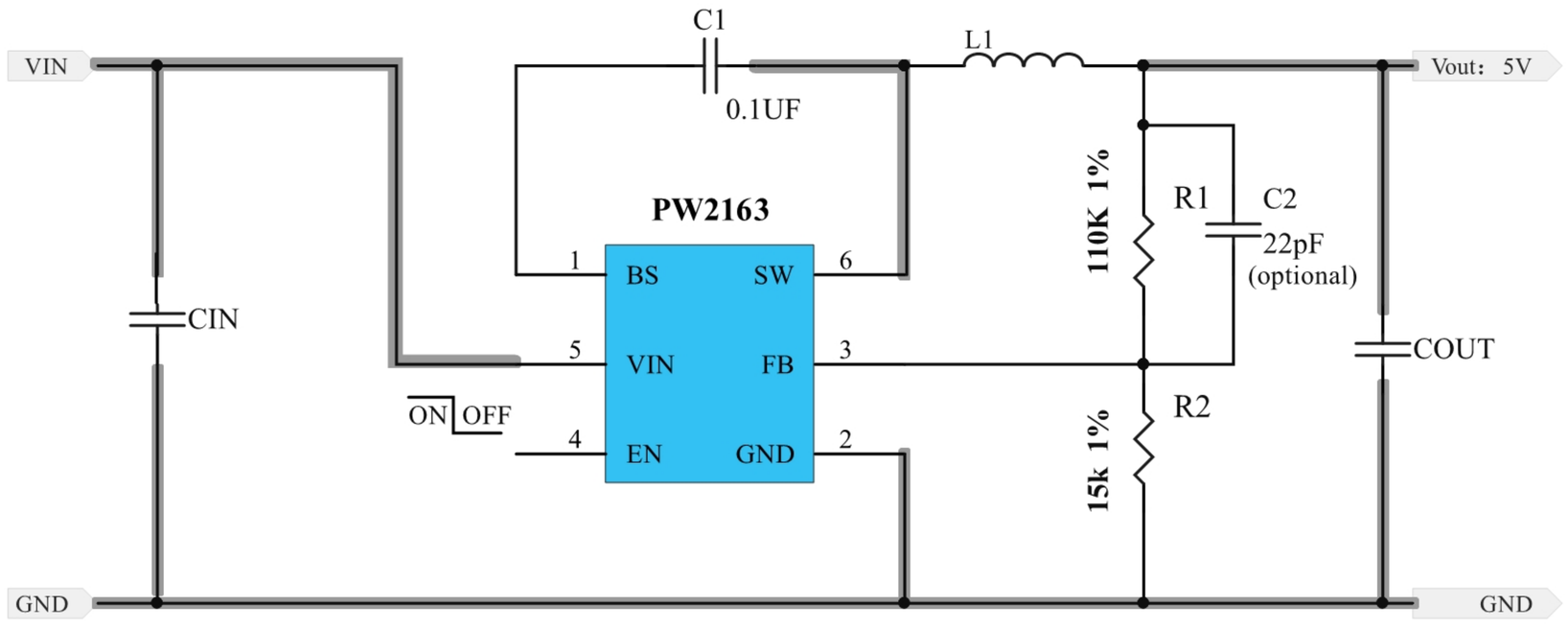
FEATURES

- low RDS(ON) for internal switches (top/bottom):
- 80mΩ/40mΩ
- 4.5-18V input voltage range
- 3A output current capability
- 500 kHz switching frequency
- Instant PWM architecture to achieve fast transient responses.
- Cycle-by-cycle peak current limitation
- Internal softstart limits the inrush current
- SOT23-6 package

APPLICATIONS

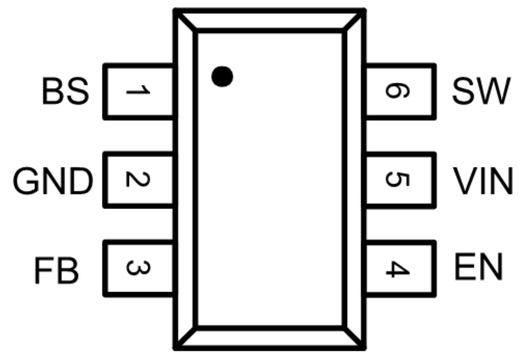
- Set Top Box
- Portable TV
- Access Point Router
- DSL Modem
- LCD TV

TYPICAL APPLICATION CIRCUIT



WWW.PWCHIP.COM

PIN ASSIGNMENT/DESCRIPTION



Pin Number	Pin Name	Function
1	BS	Boot-strap pin. Supply high side gate driver. Decouple this pin to the SW pin with a 0.1μF ceramic capacitor.
2	GND	Ground pin.
3	FB	Output feedback pin. Connect this pin to the center point of the output resistor divider to program the output voltage: $VOUT = \left(1 + \frac{R1}{R2}\right) * 0.6$.
4	EN	Enable control. Pull high to turn on. Do not floating.
5	VIN	Input pin. Decouple this pin to the GND pin with at least a 1μF ceramic capacitor.
6	SW	Inductor pin. Connect this pin to the switching node of the inductor.

Absolute Maximum Ratings (note1)

Parameter		VALUE	Unit
Supply Input Voltage		19	V
FB Voltage		4	V
Enable Voltage		VIN + 0.3	V
Power Dissipation, PD @ TA = 25°C		1	W
Package Thermal Resistance (Note 2)	θJA	100	°C/W
	θJC	11.2	°C/W
Junction Temperature Range		150	°C
Lead Temperature (Soldering, 10 sec.)		260	°C
Storage Temperature Range		-65 to 150	°C

WWW.PWCHIP.COM

RECOMMANDED OPERATING Conditions (note3)

Parameter	VALUE
Supply Input Voltage	4.5V to 18V
Junction Temperature Range	-40°C to 125°C
Ambient Temperature Range	-40°C to 85°C

Note 1: Stresses beyond the "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Note 2: θJA is measured in the natural convection at TA = 25°C on a low effective 4-layer thermal conductivity test board of JEDEC 51-3 thermal measurement standard. Pin2 of TSOT23-6 packages is the case position for θJC measurement.

Note 3: The device is not guaranteed to function outside its operating conditions

Layout Design:

The layout design of PW2163 regulator is relatively simple. For the best efficiency and minimum noise problem, we should place the following components close to the IC: CIN, L1, R1 and R2.

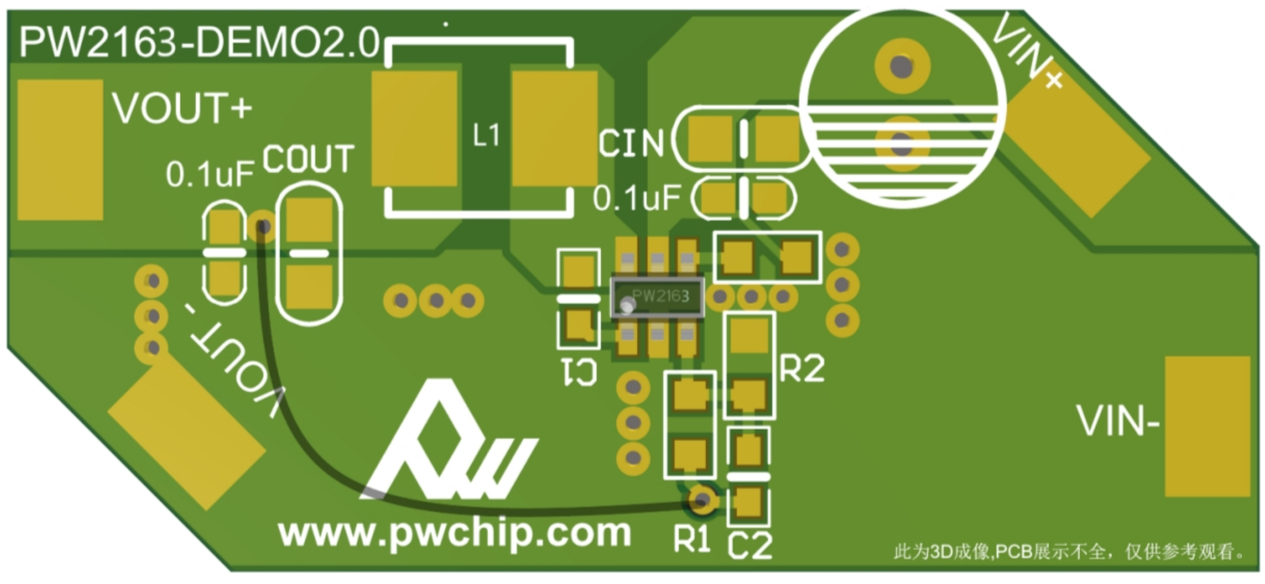
1, It is desirable to maximize the PCB copper area connecting to GND pin to achieve the best thermal and noise performance. If the board space allowed, a ground plane is highly desirable.

2, CIN must be close to Pins VIN and GND. The loop area formed by CIN and GND must be minimized.

3, The PCB copper area associated with SW pin mustbe minimized to avoid the potential noise problem.

4) The components R1 and R2, and the trace connecting to the FB pin must NOT be adjacent to the SW net on the PCB layout to avoid the noise problem.

5) If the system chip interfacing with the EN pin has a high impedance state at shutdown mode and the VIN pin is connected directly to a power source such as a Li-Ion battery, it is desirable to add a pull down 1Mohm resistor between the EN and GND pins to prevent the noise from falsely turning on the regulator at shutdown mode.



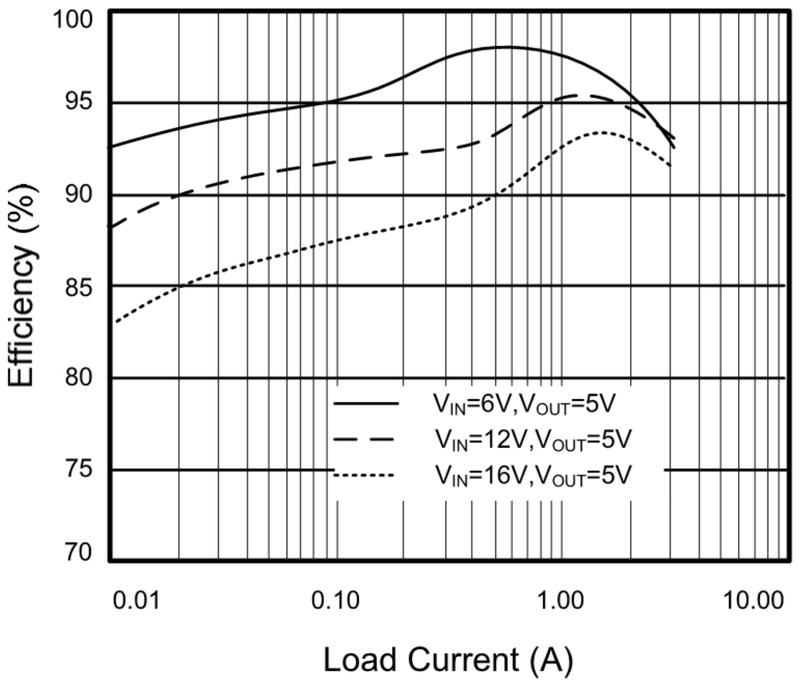
ELECTRICAL CHARACTERISTICS

(VIN = 12V, VOUT = 1.2V, L = 2. H, COUT = 10uF, TA = 25°C, IOUT =1.0A unless otherwise specified.)

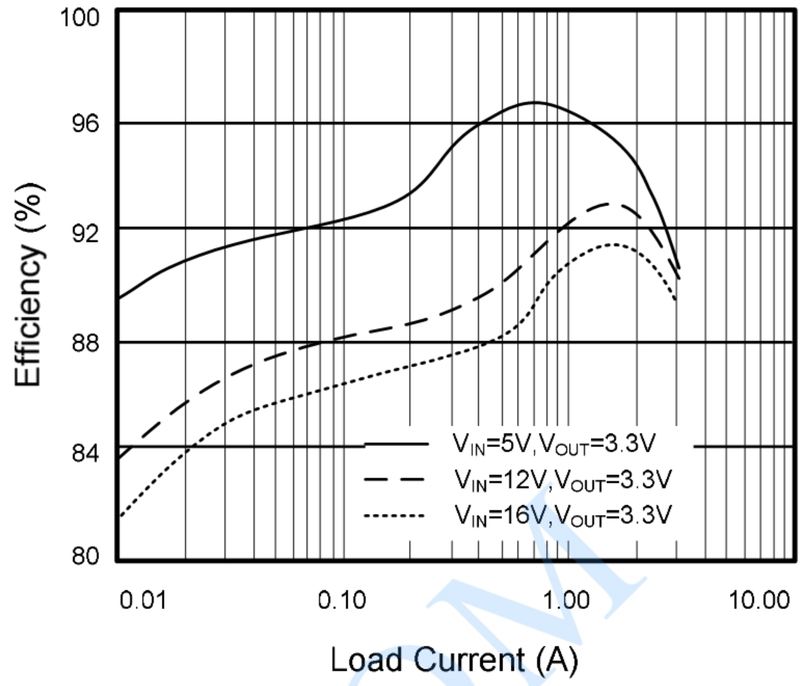
Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Input Voltage Range	VIN		4.5		18	V
Quiescent Current	IQ	IOUT=0, VFB=VREF*105%		100		μA
Shutdown Current	ISHDN	EN=0		5	10	μA
Feedback Reference Voltage	VREF		0.591	0.6	0.609	V
FB Input Current	IFB	VFB=3.3V	-50		50	nA
Top FET RON	RDS(ON)1			80	90	mΩ
Bottom FET RON	RDS(ON)2			40	50	mΩ
Top FET PeakCurrent Limit	ILIM,TOP				6	A
Bottom FET Valley Current Limit	ILIM		3		4.25	A
EN Rising Threshold	VENH		1.5			V
EN Falling Threshold	VENL				0.4	V
Input UVLO Threshold	VUVLO				4.5	V
UVLO Hysteresis	VHYS			0.3		V
Switching Frequency	FSW			0.5		MHz
Min ON Time	tON		50	80	120	ns
Min Off Time	tOFF		140	170	220	ns
Soft-start Time	tSS			800		ms
Thermal Shutdown Temperature	TSD			150		°C
Thermal Shutdown Hysteresis	THYS			15		°C

WWW.PWCHIP.COM

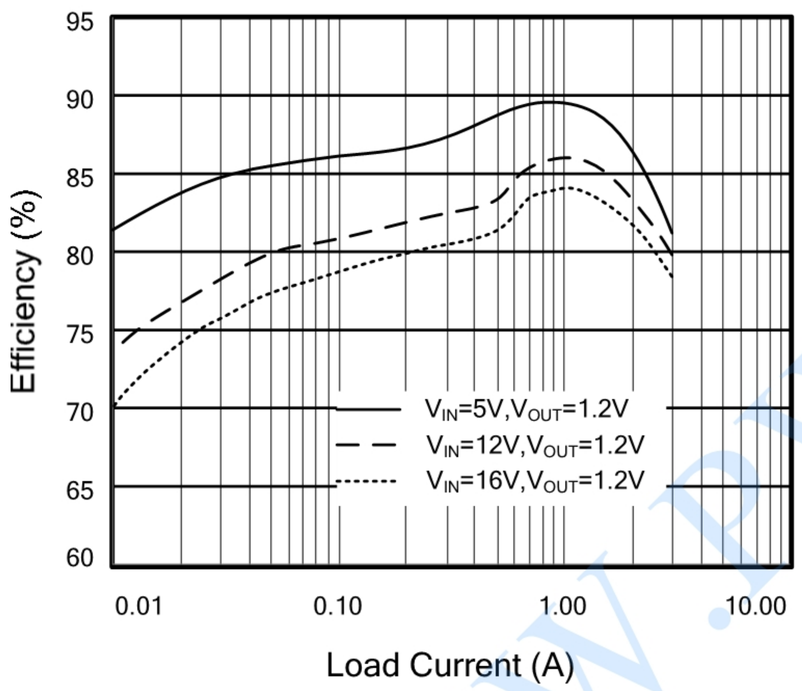
Typical Performance Characteristics



Efficiency vs. Load Current

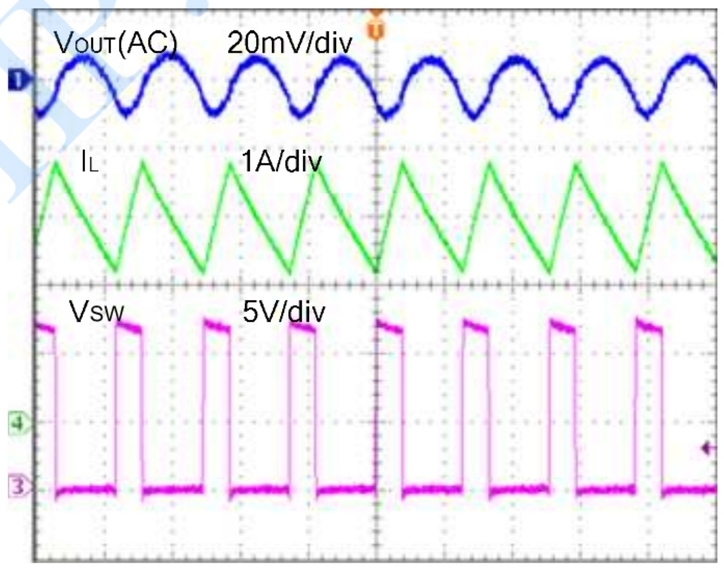


Efficiency vs. Load Current



Efficiency vs. Load Current

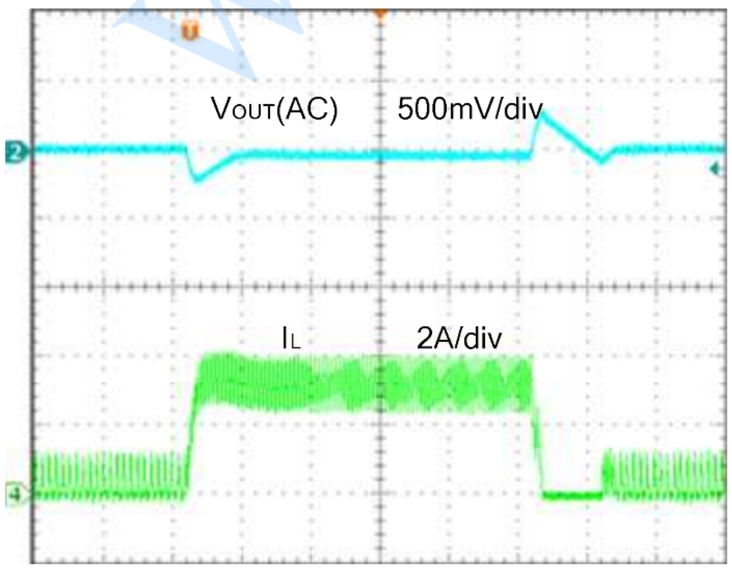
(VIN=12V, VOUT=3.3V, ILOAD=3A)



Time (2μs/div)

Output Ripple

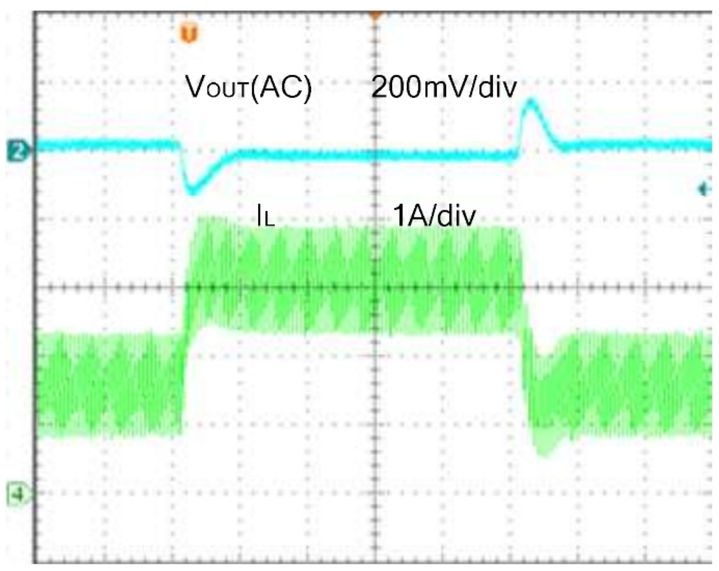
(VIN=12V, VOUT=3.3V, ILOAD=0.3-3A)



Time (40μs/div)

Load Transient

(VIN=12V, VOUT=3.3V, ILOAD=1.5-3A)

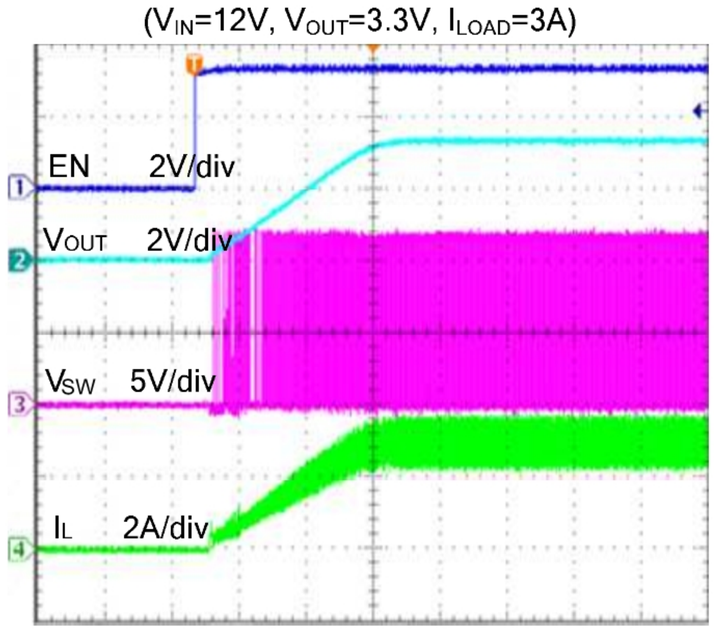


Time (40μs/div)

Load Transient

WWW.PWCHIP.COM

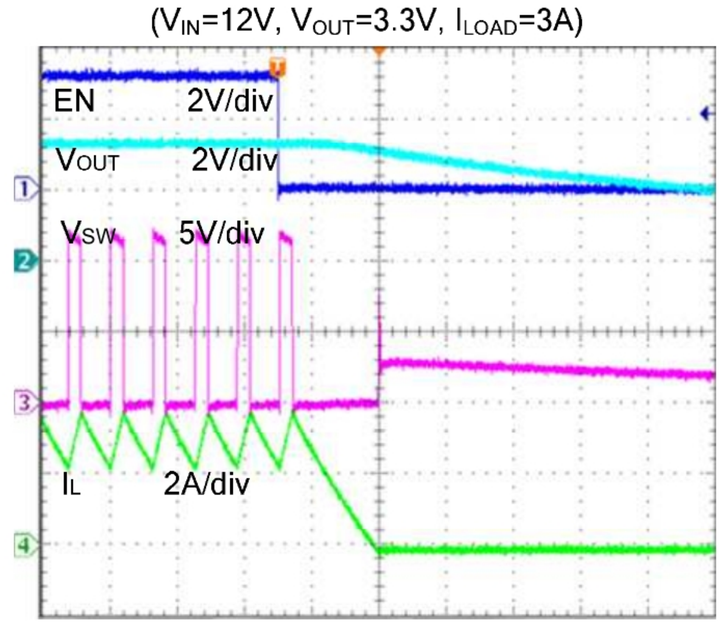
(V_{IN}=12V, V_{OUT}=3.3V, I_{LOAD}=3A)



Time (400µs/div)

Startup

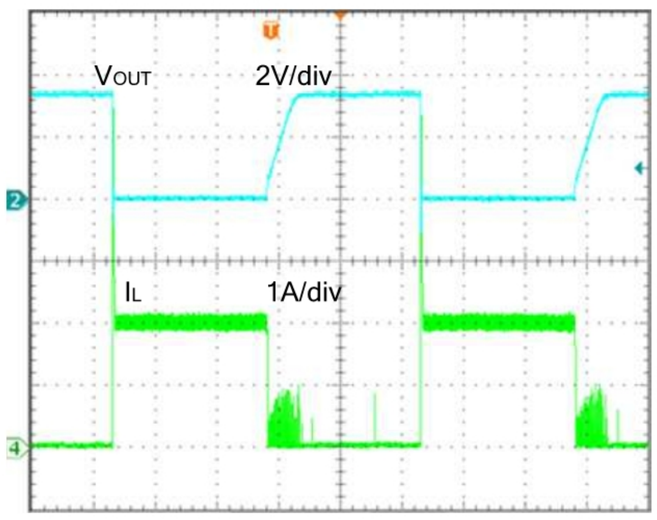
(V_{IN}=12V, V_{OUT}=3.3V, I_{LOAD}=3A)



Time (4µs/div)

Shutdown

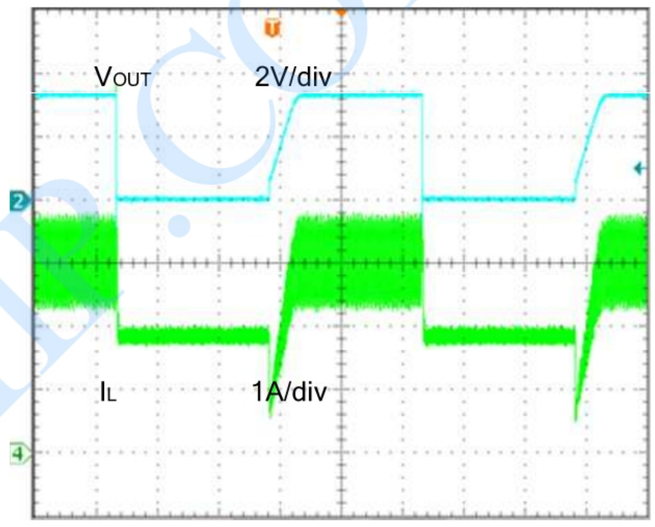
(V_{IN}=12V, V_{OUT}=3.3V, Open to Short)



Time (2ms/div)

Short Circuit Protection

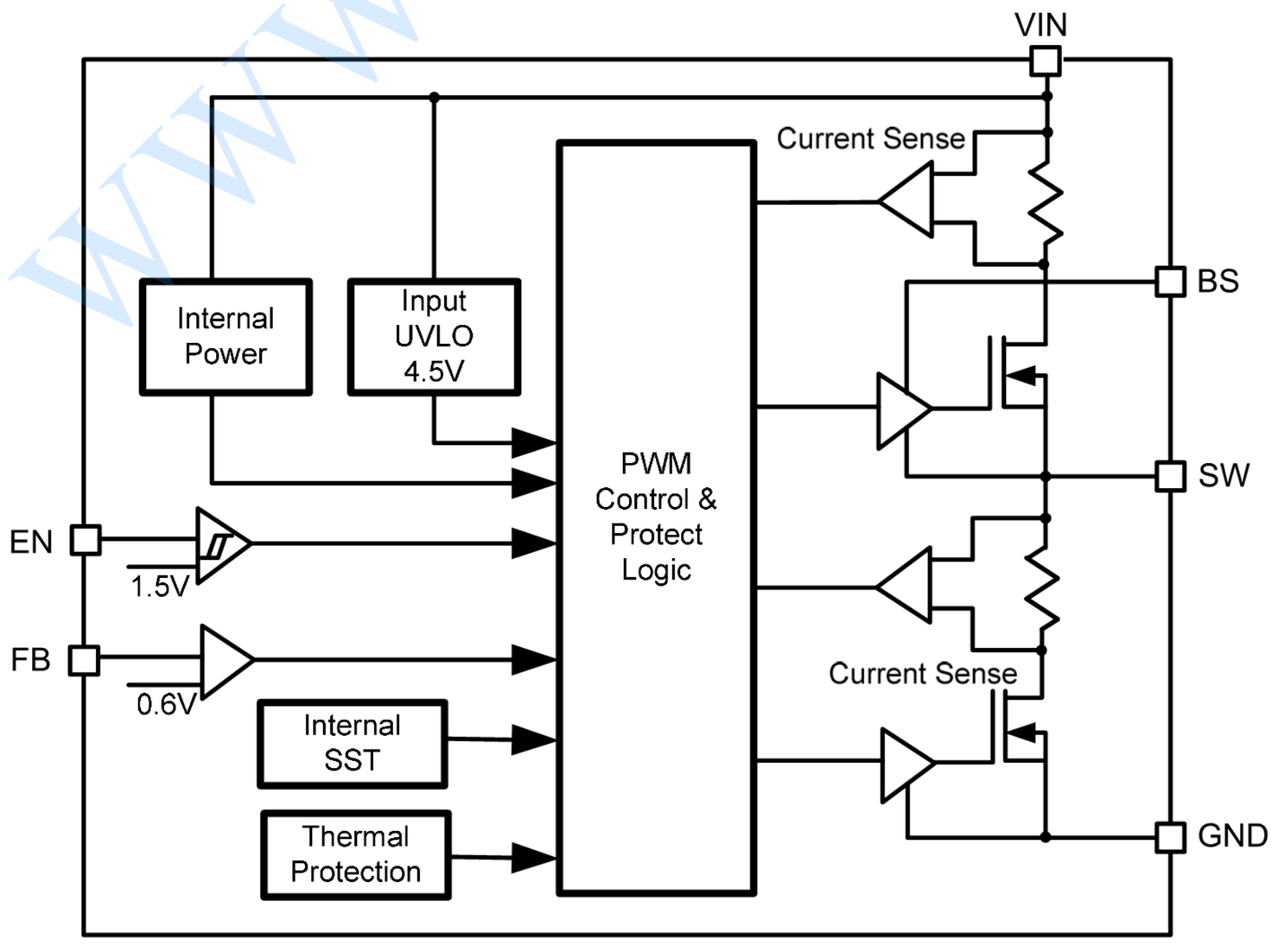
(V_{IN}=12V, V_{OUT}=3.3V, 3A to Short)



Time (2ms/div)

Short Circuit Protection

Function Block



WWW.PWCHIP.COM

Operation

PW2163 is a synchronous buck regulator IC that integrates the PWM control, top and bottom switches on the same die to minimize the switching transition loss and conduction loss. With ultra low Rds(on) power switches and proprietary PWM control, this regulator IC can achieve the highest efficiency and the highest switch frequency simultaneously to minimize the external inductor and capacitor size, and thus achieving the minimum solution footprint.

PW2163 provides protection functions such as cycle by cycle current limiting and thermal shutdown protection. PW2163 will sense the output voltage conditions for the fault protection.

Application Information

Because of the high integration in the PW2163 IC, the application circuit based on this regulator IC is rather simple. Only input capacitor CIN, output capacitor COUT, output inductor L and feedback resistors (R1 and R2) need to be selected for the targeted applications specifications.

External Boostrap Cap

This capacitor provides the gate driver voltage for internal high side MOSEFET. A 100nF low ESR ceramic capacitor connected between BS pin and SW pin is recommended.

Load Transient Considerations:

The PW2163 regulator IC integrates the compensation components to achieve good stability and fast transient responses. In some applications, adding a 22pF ceramic cap in parallel with R1 may further speed up the load transient responses and is thus recommended for applications with large load transient step requirements

Feedback Resistor Divider R1 and R2

Choose R1and R2 to program the proper output voltage. To minimize the power consumption under light loads, it is desirable to choose large resistance values for both R1 and R2. A value of between 10kΩ and 1MΩ is highly recommended for both resistors. If Vout is 3.3V, R1=100k is chosen, then using following equation, R2 can be calculated to be 22.1k:

$$VOUT = \left(1 + \frac{R1}{R2}\right) * 0.6$$

Input capacitor CIN:

The ripple current through the input capacitor is calculated as:

$$I_{CIN_RMS} = I_{OUT} \sqrt{D(1-D)} \cdot$$

To minimize the potential noise problem, place a typical X5R or better grade ceramic capacitor really close to the VIN and GND pins. Care should be taken to minimize the loop area formed by CIN, and VIN/GND pins. In this case, a 10uF low ESR ceramic capacitor is recommended.

WWW.PWCHIP.COM

Output capacitor COUT:

The output capacitor is selected to handle the output ripple noise requirements. Both steady state ripple and transient requirements must be taken into consideration when selecting this capacitor. For the best performance, it is recommended to use X5R or better grade ceramic capacitor greater than 22uF capacitance.

Output inductor L:

There are several considerations in choosing this inductor.

1) Choose the inductance to provide the desired ripple current. It is suggested to choose the ripple current to be about 40% of the maximum output current. The inductance is calculated as:

$$L = \frac{V_{OUT}(1 - V_{OUT}/V_{IN,MAX})}{F_{SW} \times I_{OUT,MAX} \times 40\%}$$

where Fsw is the switching frequency and IOUT,MAX is the maximum load current.

The PW2163 regulator IC is quite tolerant of different ripple current amplitude. Consequently, the final choice of inductance can be slightly off the calculation value without significantly impacting the performance.

2) The saturation current rating of the inductor must be selected to be greater than the peak inductor current under full load conditions.

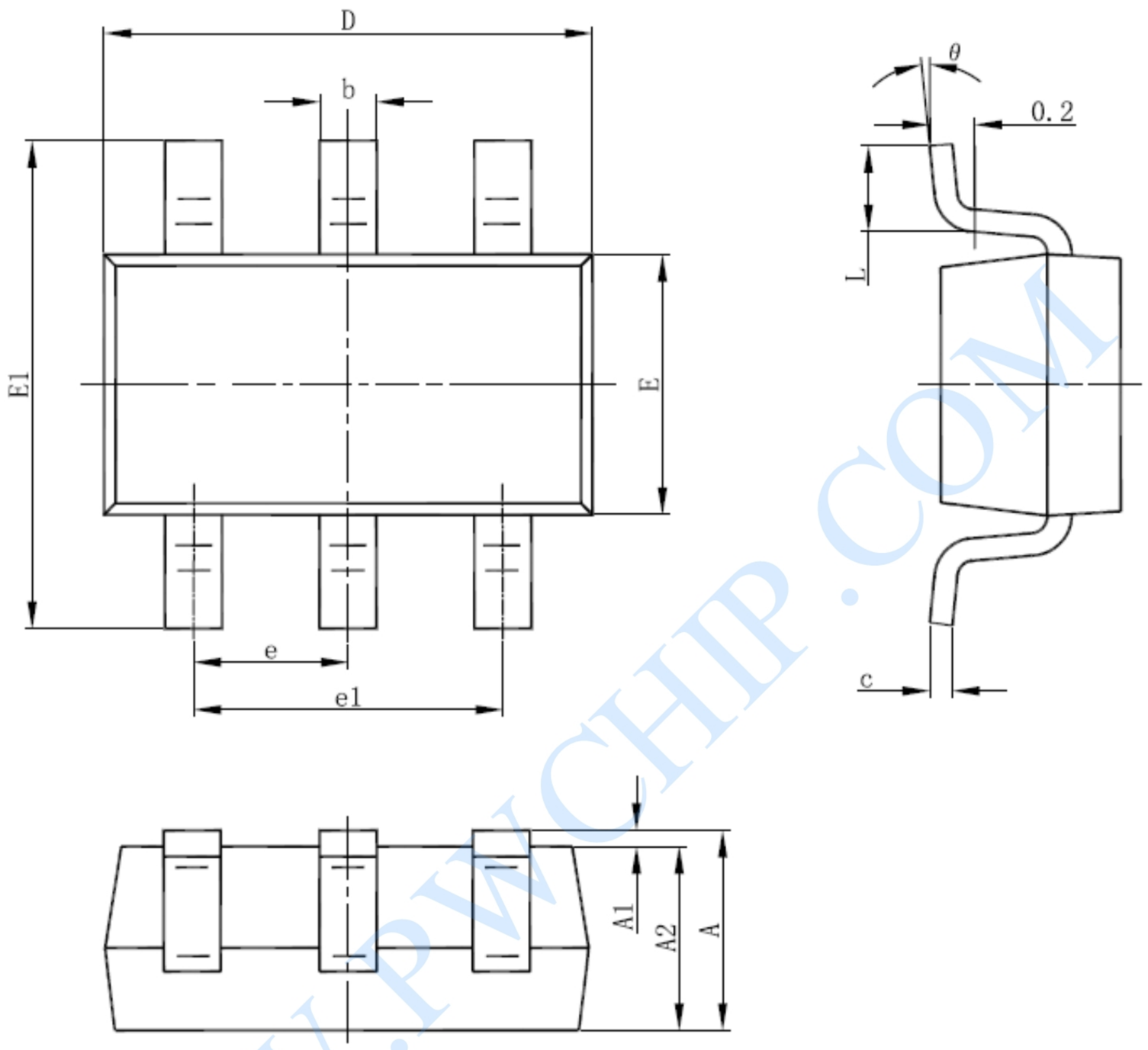
$$I_{SAT,MIN} > I_{OUT,MAX} + \frac{V_{OUT}(1-V_{OUT}/V_{IN,MAX})}{2\ F_{SW}\ L}$$

3)The DCR of the inductor and the core loss at the switching frequency must be low enough to achieve the desired efficiency requirement. It is desirable to choose an inductor with DCR<50mΩ to achieve a good overall efficiency.

WWW.PWCHIP.COM

PACKAGE DESCRIPTION

SOT23-6L



Symbol	Dimensions In Millimeters	
	Min	Max
A	0.900	1.450
A1	0.000	0.150
A2	0.900	1.300
b	0.300	0.500
c	0.100	0.200
D	2.800	3.000
E	1.500	1.700
E1	2.650	2.950
e	0.950(BSC)	
e1	1.800	2.000
L	0.300	0.600
θ	0°	8°

WWW.PWCHIP.COM

IMPORTANT NOTICE

Wuxi PWChip Semi Technology CO., LTD (PW) reserves the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any products or services. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete.

PW assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using PW components.

PW products are not authorized for use in safety-critical applications (such as life support devices or systems) where a failure of the PW product would reasonably be expected to affect the safety or effectiveness of that devices or systems.

The information included herein is believed to be accurate and reliable. However, PW assumes no responsibility for its use; nor for any infringement of patents or other rights of third parties which may result from its use.

WWW.PWCHIP.COM