2A 380KHZ 25V PWM Buck DC/DC Converter

General Description

The ME5513 is a 380 KHz fixed frequency monolithic step down switch mode regulator with a built in internal Power MOSFET. It achieves 2A continuous output current over a wide input supply range with excellent load and line regulation.

The device includes a voltage reference, oscillation circuit, error amplifier, internal PMOS and etc.

The PWM control circuit is able to adjust the duty ratio linearly from 0 to 100%. An enable function, an over current protection function and a short circuit protection function are built inside. An internal compensation block is built in to minimize external component count.

The ME5513 serves as ideal power supply units for portable devices.

Features

- 2A Constant Output Current
- 140mΩ RDSON Internal Power PMOSFET Switch
- Up to 95% Efficiency
- Fixed 380KHz Frequency
- Wide 3.6V to 25V Input Voltage Range
- Output Adjustable from 1.20V to21V
- Built in Frequency Compensation
- Built in Thermal Shutdown Function
- Built in Current Limit Function
- SOIC-8 Package is Available
- The minimum dropout up to 0.3V

Applications

- Portable DVD
- LCD Monitor / TV
- Battery Charger
- ADSL Modem
- Telecom / Networking Equipment

Pin Configurations

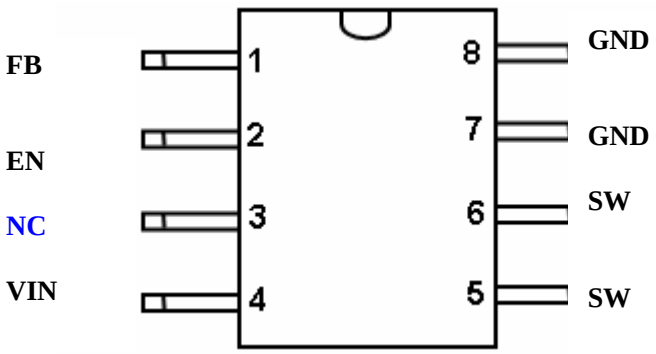
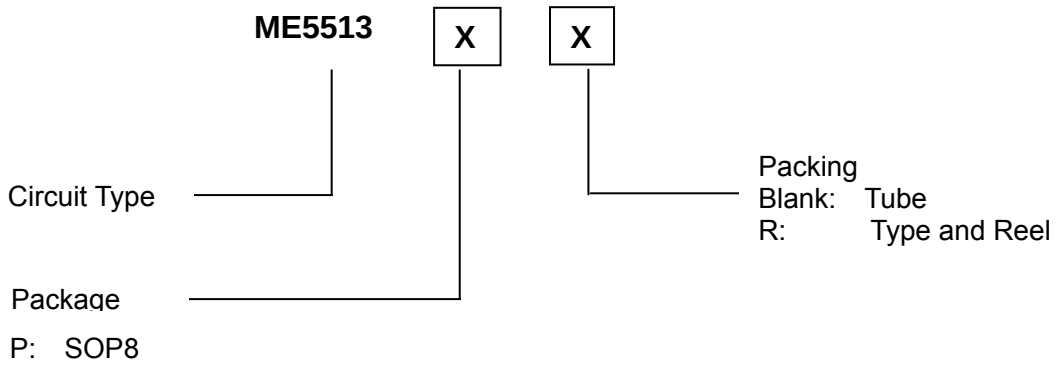


Figure 2 Pin Configuration of ME5513 (Top View)

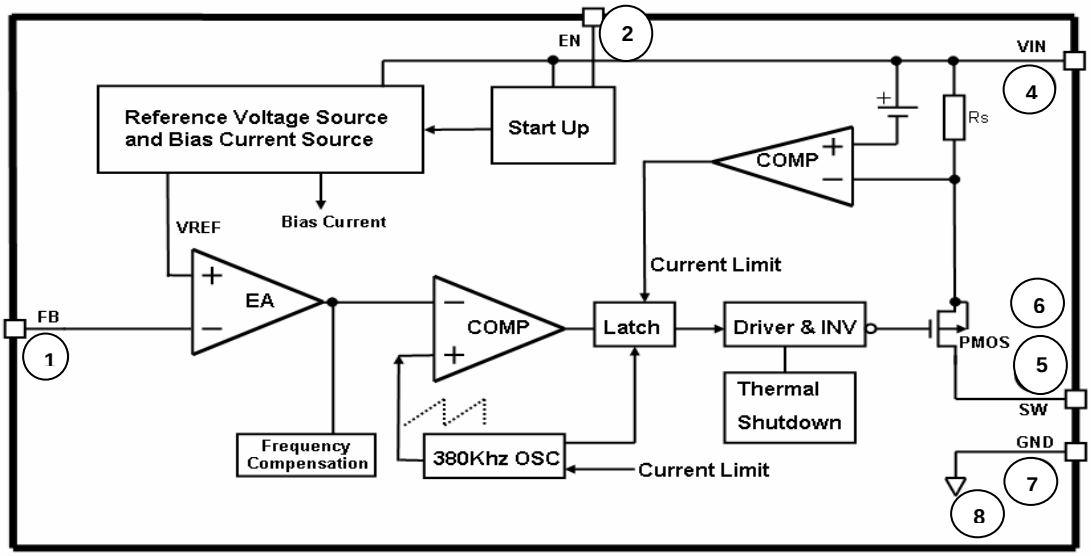
Pin Description

Pin Number	Pin Name	Description
3	NC	Not Connect.
4	Vin	Supply Voltage Input Pin. ME5513 operates from a 3.6V to 25V DC voltage. Bypass Vin to GND with a suitably large capacitor to eliminate noise on the input.
5,6	SW	Power Switch Output Pin. SW is the switch node that supplies power to the output.
7,8	GND	Ground Pin. Care must be taken in layout. This pin should be placed outside of the Schottky Diode to output capacitor ground path to prevent switching current spikes from inducing voltage noise into ME5513.
1	FB	Feedback Pin. Through an external resistor divider network, FB senses the output voltage and regulates it. The feedback threshold voltage is 1.20V.
2	EN	Enable Pin. Drive EN pin high to turn on the device, drive it low to turn it off.

Ordering Information



Function Block



Function Block Diagram of ME5513

Absolute Maximum Ratings

Parameter		Symbol	Value	Unit
Input Voltage		V_{IN}	-0.3 to 25	V
Feedback Pin Voltage		V_{FB}	-0.3 to Vin	V
Enable Pin Voltage		V_{EN}	-0.3 to 12	V
Switch Pin Voltage		V_{SW}	-0.3 to Vin	V
Maximum Power Dissipation	T_A=25℃	P_D	1.25	W
	T_A=70℃		0.9	
Thermal Resistance-Junction to Ambient		$R_{\theta JA}$	85	ºC / W
Thermal Resistance-Junction to Case		$R_{\theta JC}$	45	ºC / W
Maximum Operating Junction Temperature		T_J	150	ºC
Storage Temperature		T_{STG}	-65 to 150	ºC
Lead Temperature (Soldering, 10 sec)		T_{LEAD}	260	ºC
ESD (HBM)			2000	V

Note1: Stresses greater than those listed under Maximum Ratings may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operation is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

Recommended Operating Conditions

Parameter	Symbol	Min.	Max.	Unit
Input Voltage	V_{IN}	3.6	25	V
Operating Junction Temperature	T_J	-40	150	ºC
Operating Ambient Temperature	T_A	-40	85	ºC

Electrical Characteristics (V_{CC} = 12V, T_a = 25℃ unless otherwise specified.)

Parameters	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Input voltage	V_{IN}		3.6		25	V
Shutdown Supply Current	I_{STBY}	V_{EN}=0V		30	90	uA
Supply Current	I_{CC}	V_{EN}=2V, V_{FB}=1.3V		3.6	4	mA
Feedback Voltage	V_{FB}	V_{IN} = 3.6V to 23V	1.164	1.20	1.236	V
Feedback Bias Current	I_{FB}	V_{FB}=1.3V		0.1	0.5	uA
Switch Current Limit	I_{LIM}			3	4	A
Oscillator Frequency	F_{OSC}		320	380	440	KHz
Frequency of Current Limit or Short Circuit Protection	F_{OSC1}	V_{FB}=0V		42		KHz
EN Pin Threshold	V_{EN}		0.7	1.2	1.7	V
EN Pin Input Leakage Current	I_H	V_{EN}=2.5V		-0.1	-1	uA
	I_L	V_{EN}=0.5V		-3	-10	uA
Internal PMOS R_{DSON}	R_{DSON}	V_{IN} =12V, V_{FB}=0V V_{EN}=12V, Iout=2A		140		mΩ
Max. Duty Cycle	D_{MAX}	V_{FB}=0V, I_{SW}=0.1A		100		%
Efficiency	η	V_{IN}=12V ,Vout=5V Iout=2A	-	92	-	%
Thermal Shutdown	T_{OTSD}			165		ºC

Typical Performance Characteristics

Switching Frequency vs. Temperature

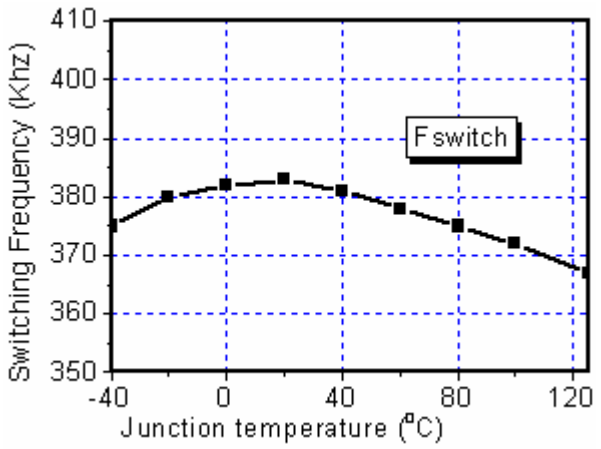


Figure 4. Switching Frequency vs. Temperature

Vfb vs. Temperature

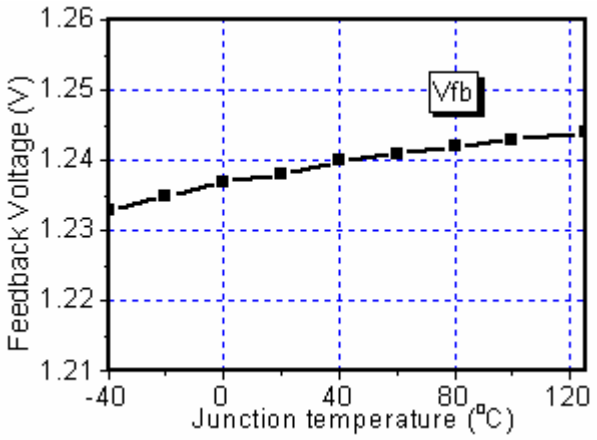


Figure 5. Vfb vs. Temperature

Icc vs. Temperature

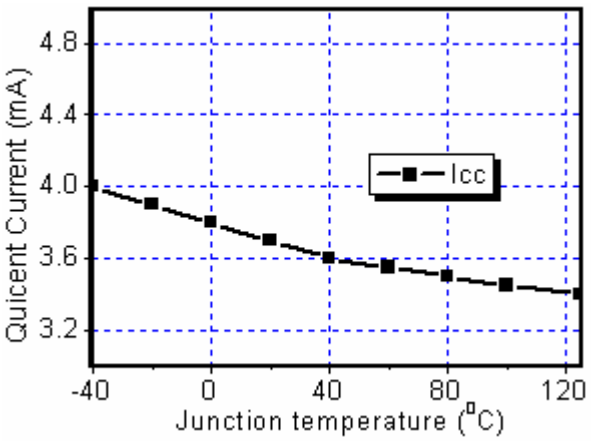


Figure 6. Icc vs. Temperature

Efficiency vs. Load (Vin=10V)

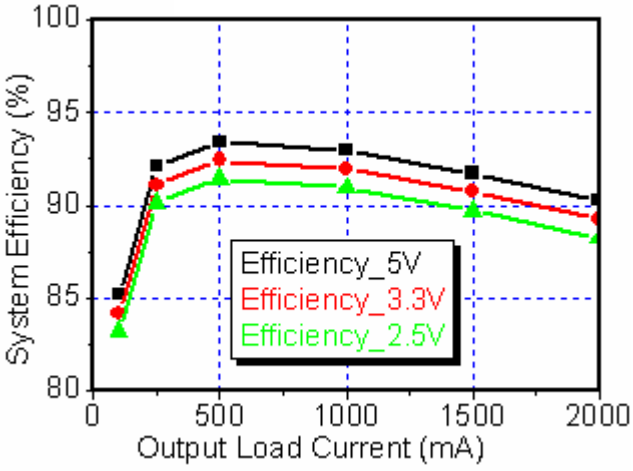
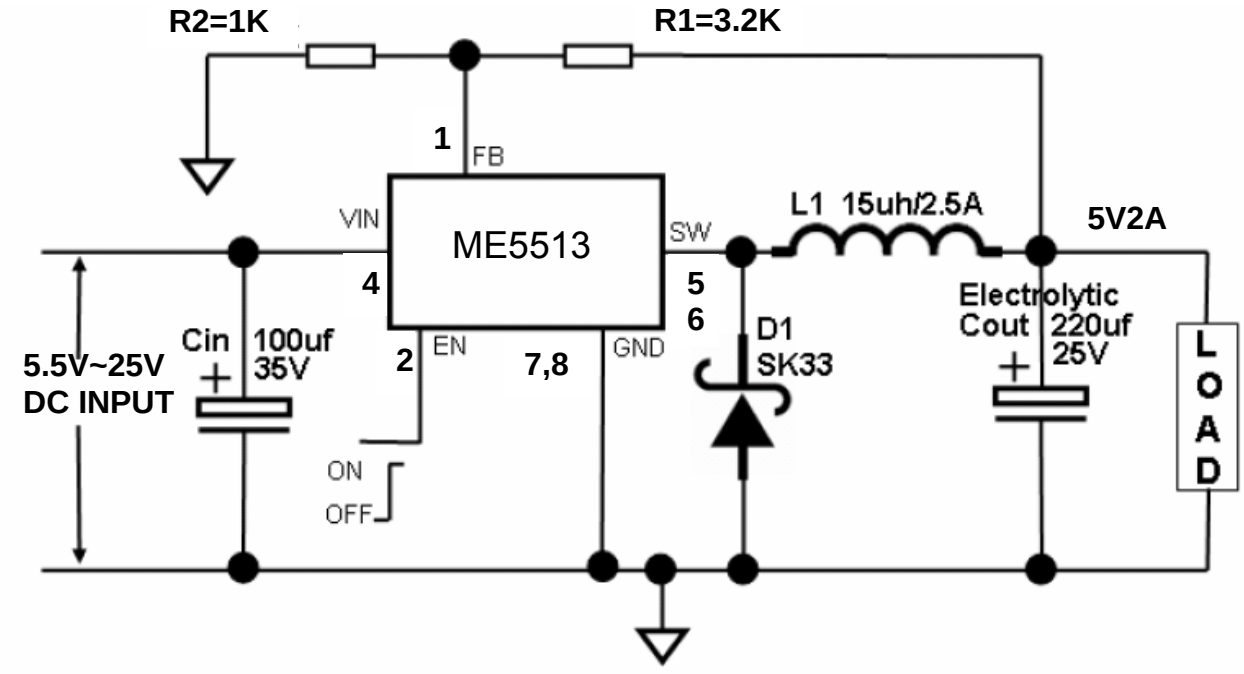
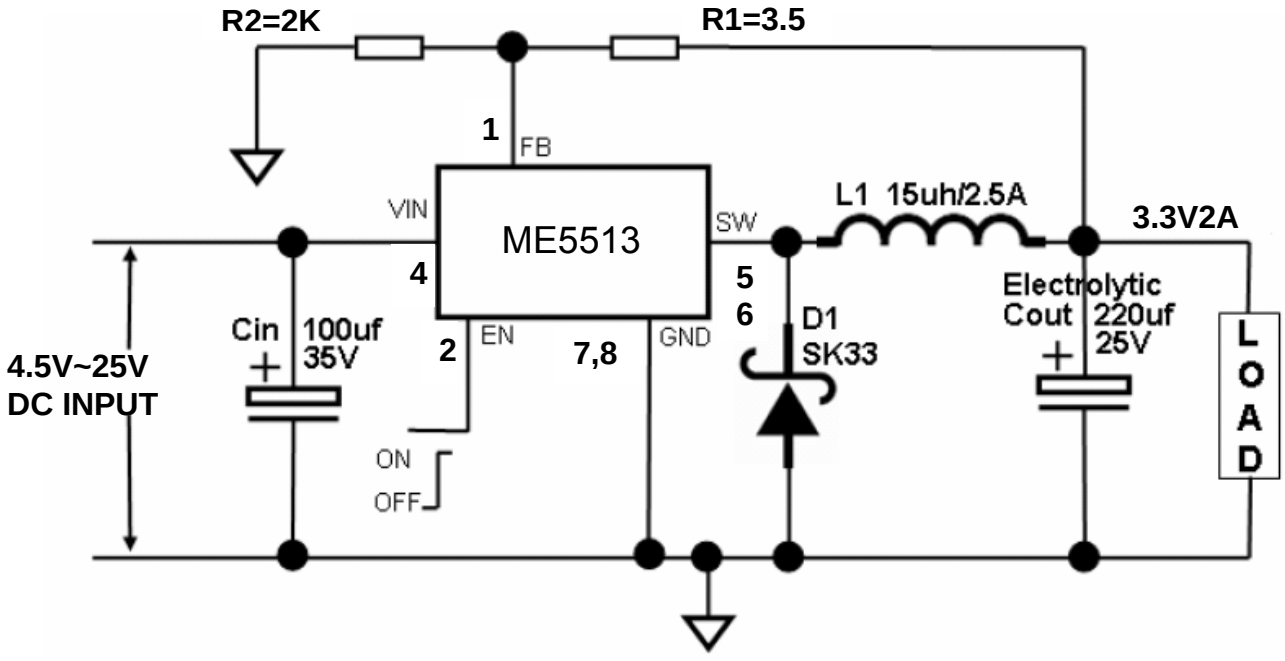


Figure 7. Efficiency vs. Load (Vin=10V)

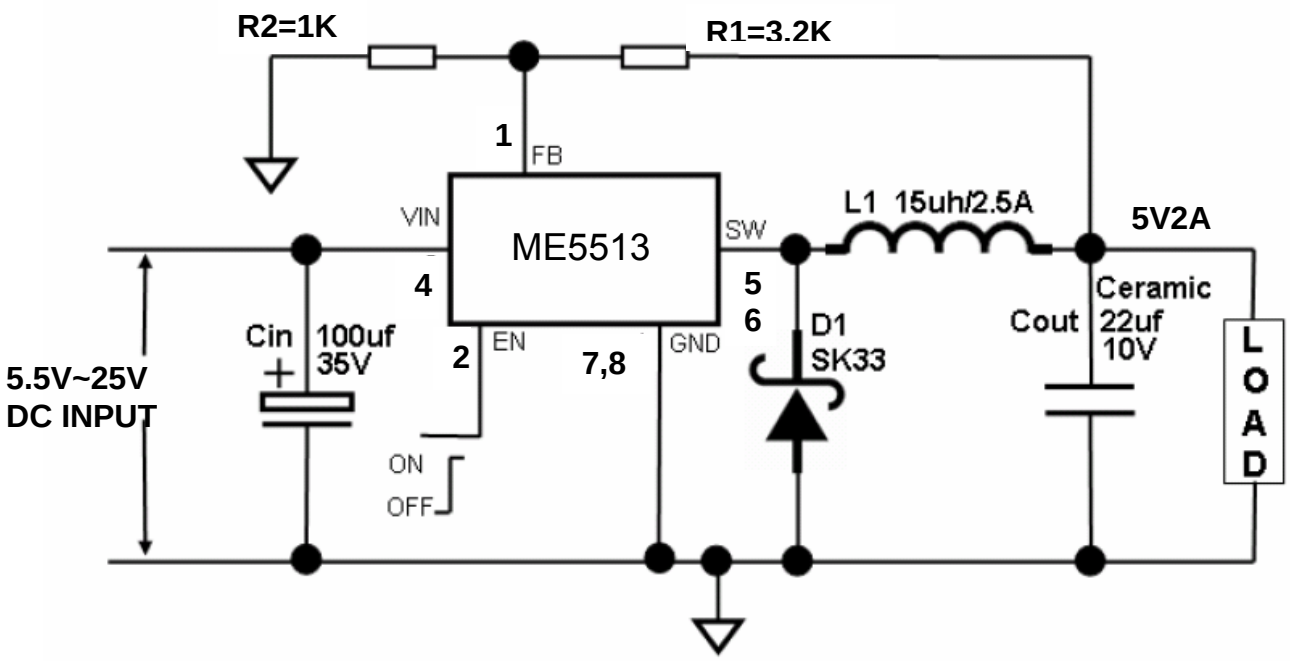
Typical Application Circuit



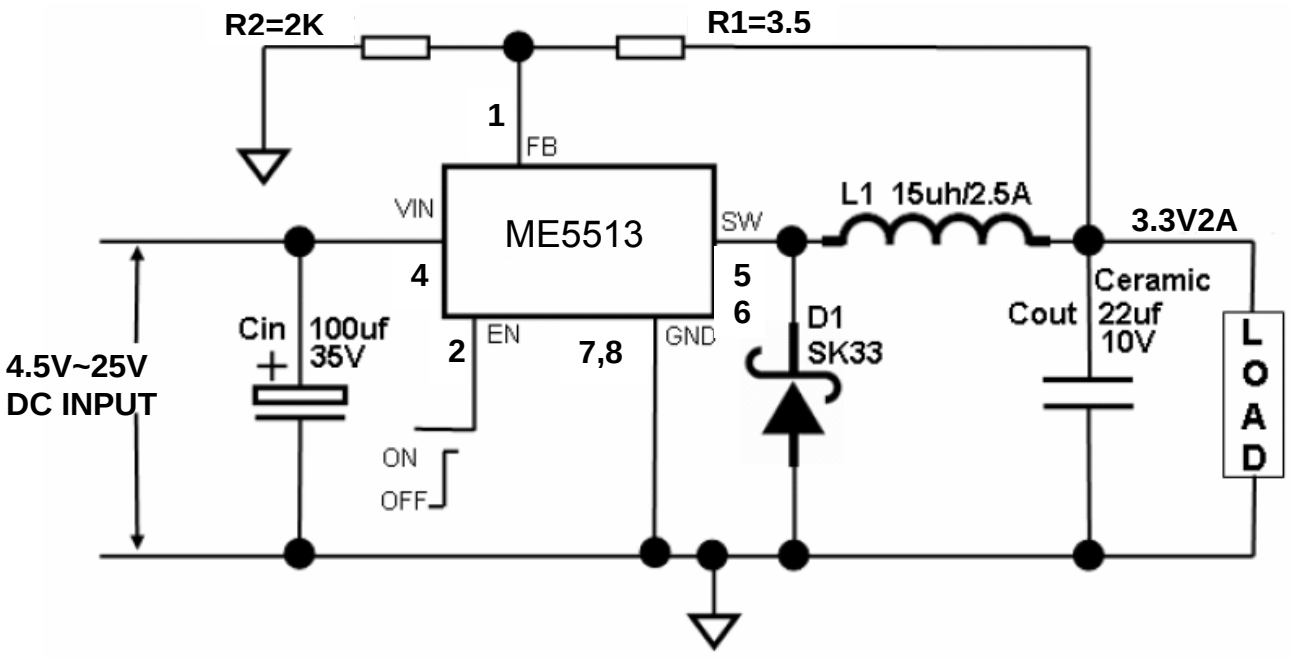
ME5513 Typical Application Circuit @ 5V/2A



ME5513 Typical Application Circuit @ 3.3V/2A



ME5513 Typical Application Circuit (with ceramic output capacitor) @ 5V/2A



ME5513 Typical Application Circuit (with ceramic output capacitor) @ 3.3V/2A

Schottky Rectifier Selection Guide

Vin (Max)	2A Load Current	
	Part Number	Vendor
25V	B220	1
	SK23	6
	SR22	6

Table 1 lists some rectifier manufacturers.

No.	Vendor	Web Site
1	Diodes, Inc.	www.diodes.com
2	Fairchild Semiconductor	www.fairchildsemi.com
3	General Semiconductor	www.gensemi.com
4	International Rectifier	www.irf.com
5	On Semiconductor	www.onsemi.com
6	Pan Jit International	www.panjit.com.tw

Table 2 Schottky Diode manufacturers.

Output Voltage VS R1, R2 Resistor Selection Guide

Vout = (1+R1/R2)*1.20V

Vout	R1	R2
1.2V	0	NC
1.8V	2K	1K
2.5V	2K	2.2K
3.3V	3.5K	2K
5V	3.2K	1K
9V	13K	2K
12V	18K	2K

Table 3. Vout VS. R1, R2 Select Table

Function Description

Pin Functions

V_{IN}

This is the positive input supply for the IC switching regulator. A suitable input bypass capacitor must be present at this pin to minimize voltage transients and to supply the switching currents needed by the regulator

Gnd

Circuit ground.

SW

Internal switch. The voltage at this pin switches between (VIN – VGS) and approximately – 0.5V, with a duty cycle of approximately VOUT / VIN. To minimize coupling to sensitive circuitry, the PC board copper area connected to this pin should be kept a minimum.

FB

Senses the regulated output voltage to complete the feedback loop.

EN

Allows the switching regulator circuit to be shutdown using logic level signals thus dropping the total input supply current to approximately 30uA. Pulling this pin below a threshold voltage of approximately 1.3V turns the regulator down, and pulling this pin above 1.3V (up to a maximum of 12V) shuts the regulator on. If this shutdown feature is not needed, the EN pin can be wired to the Vin pin or it can be left open, in either case the regulator will be in the ON condition.

Thermal Considerations

The ME5513 is available in SOP-8 package.

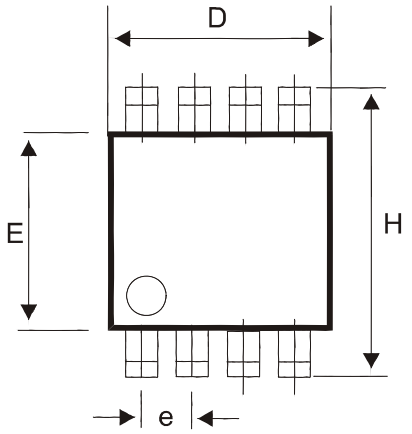
The SOP-8 package needs a heat sink under most conditions. The size of the heat sink depends on the input voltage, the output voltage, the load current and the ambient temperature. The ME5513 junction temperature rises above ambient temperature for a 2A load and different input and output voltages. The data for these curves was taken with the ME5513 (SOP-8 package) operating as a buck-switching regulator in an ambient temperature of 25 ℃ (still air). These temperature rise numbers are all approximate and there are many factors that can affect these temperatures. Higher ambient temperatures require more heat sinking.

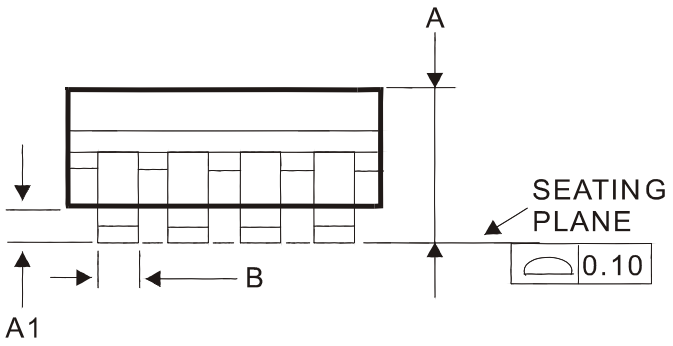
For the best thermal performance, wide copper traces and generous amounts of printed circuit board copper should be used in the board layout. (Once exception to this is the output (switch) pin, which should not have large areas of copper.) Large areas of copper provide the best transfer of
heat (lower thermal resistance) to the surrounding air, and moving air lowers the thermal resistance even further.

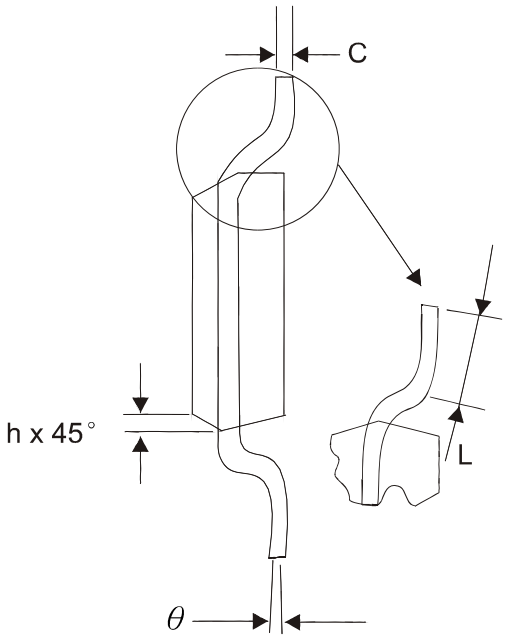
Package thermal resistance and junction temperature rise numbers are all approximate, and there are many factors that will affect these numbers. Some of these factors include board size, shape, thickness, position, location, and even board temperature. Other factors are, trace width, total printed circuit copper area, copper thickness, single or double-sided, multi-layer board and the amount of solder on the board.

The effectiveness of the PC board to dissipate heat also depends on the size, quantity and spacing of other components on the board, as well as whether the surrounding air is still or moving. Furthermore, some of these components such as the catch diode will add heat to the PC board and the heat can vary as the input voltage changes. For the inductor, depending on the physical size, type of core material and the DC resistance, it could either act as a heat sink taking heat away from the board, or it could add heat to the board.

SOP-8 Package Outline







DIM	MILLIMETERS	
	MIN	MAX
A	1.35	1.75
A1	0.10	0.25
B	0.35	0.49
C	0.18	0.25
D	4.80	5.00
E	3.80	4.00
e	1.27 BSC	
H	5.80	6.20
h	0.25	0.50
L	0.40	1.25
θ	0°	7°