3A 380KHZ 28V PWM Buck DC/DC Converter TD1583

General Description

The TD1583 is a 380 KHz fixed frequency monolithic step down switch mode regulator with a built in internal Power MOSFET. It achieves 3A 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 TD1583 serves as ideal power supply units for portable devices.

Features

- 3A Constant Output Current
- 140mΩ R_{DSON} Internal Power PMOSFET Switch
- Up to 95% Efficiency
- Fixed 380KHz Frequency
- Wide 3.6V to 28V Input Voltage Range
- Output Adjustable from 1.235V to 26V
- 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

SOIC-8

Figure 1 Package Type of TD1583

Pin Configurations

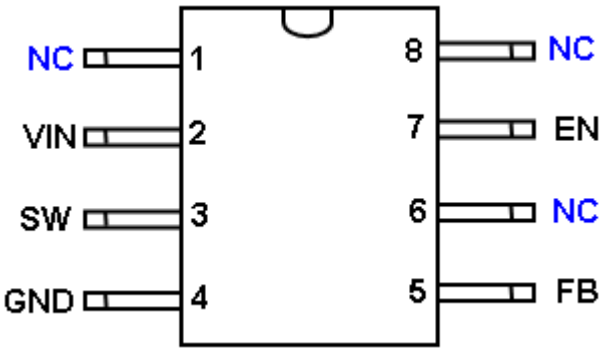
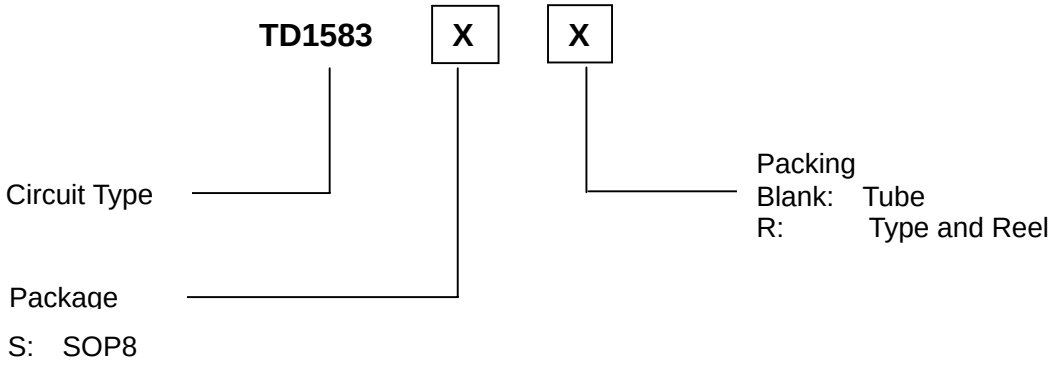


Figure 2 Pin Configuration of TD1583 (Top View)

Pin Description

Pin Number	Pin Name	Description
1,6, 8	NC	Not Connect.
2	Vin	Supply Voltage Input Pin. TD1583 operates from a 3.6V to 28V DC voltage. Bypass Vin to GND with a suitably large capacitor to eliminate noise on the input.
3	SW	Power Switch Output Pin. SW is the switch node that supplies power to the output.
4	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 TD1583.
5	FB	Feedback Pin. Through an external resistor divider network, FB senses the output voltage and regulates it. The feedback threshold voltage is 1.235V.
7	EN	Enable Pin. EN is a digital input that turns the regulator on or off.Drive EN pin high to turn on the device, drive it low to turn it off.

Ordering Information



Function Block

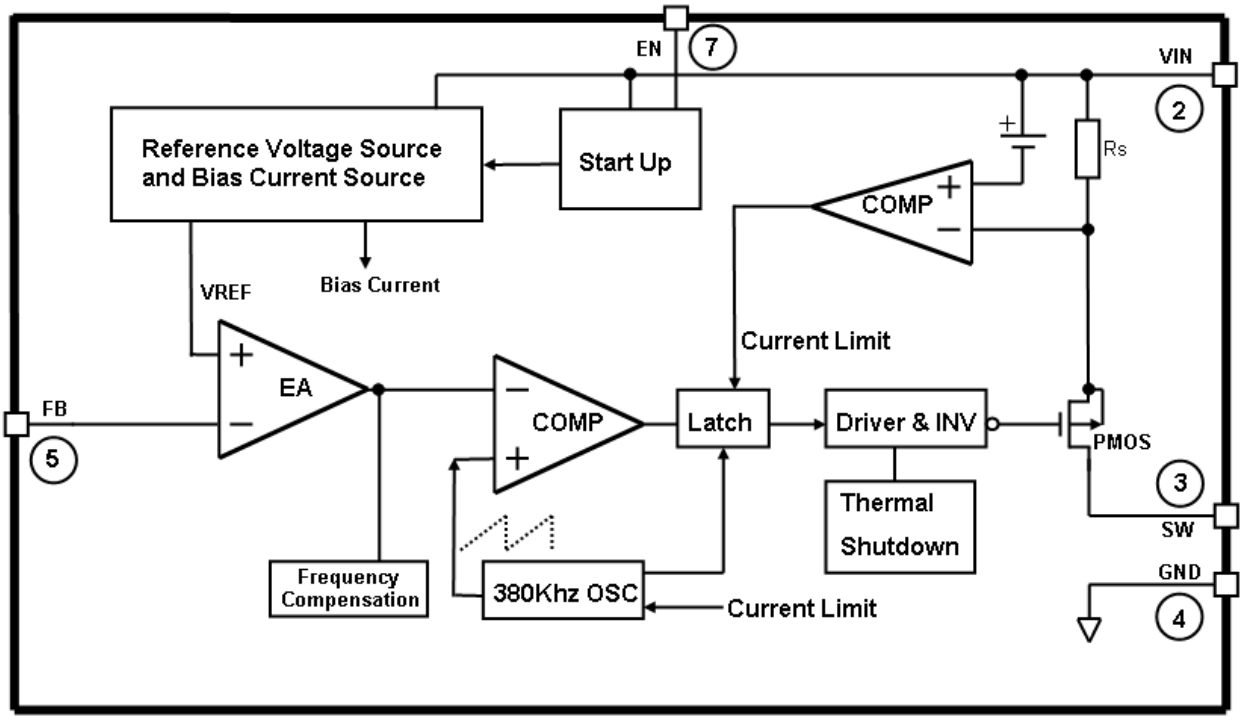


Figure 3 Function Block Diagram of TD1583

Absolute Maximum Ratings

Parameter	Symbol	Value	Unit
Input Voltage	V_{IN}	-0.3 to 28	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
Power Dissipation	P_D	Internally limited	mW
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	28	V
Operating Junction Temperature	T_J	-40	125	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		28	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	1.21	1.235	1.26	V
Feedback Bias Current	I_{FB}	V_{FB}=1.3V		0.1	0.5	uA
Switch Current Limit	I_{LIM}			4	5	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=3A		80		mΩ
Max. Duty Cycle	D_{MAX}	V_{FB}=0V, I_{SW}=0.1A		100		%
Efficiency	η	V_{IN}=12V ,Vout=5V Iout=3A	-	92	-	%
Thermal Shutdown	T_{OTSD}			165		ºC

Typical Performance Characteristics

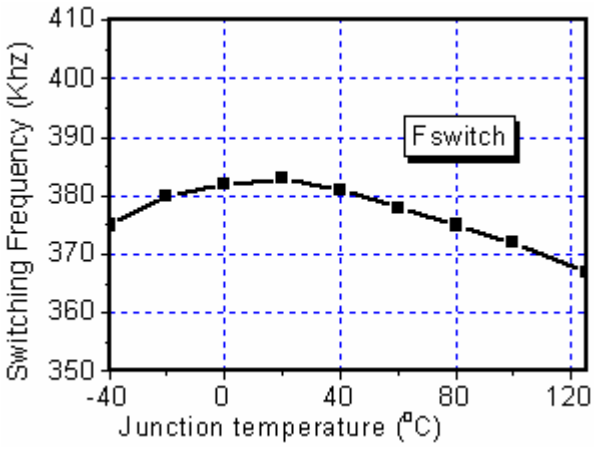


Figure 4. Switching Frequency vs. Temperature

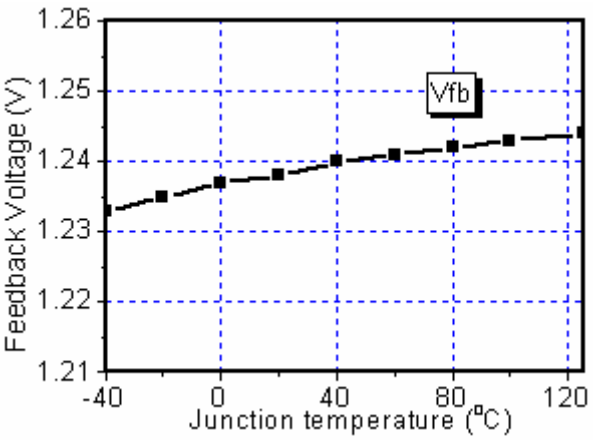


Figure 5. Vfb vs. Temperature

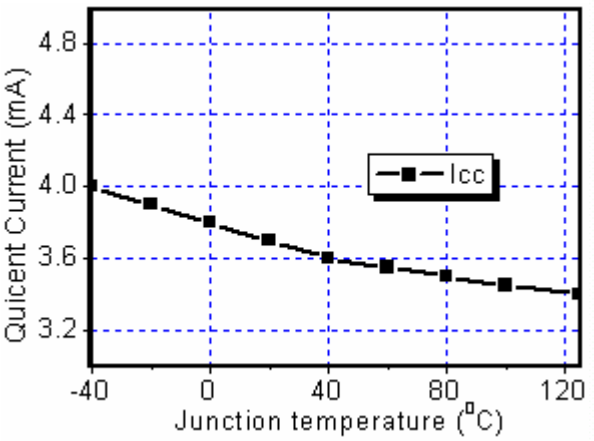


Figure 6. Icc vs. Temperature

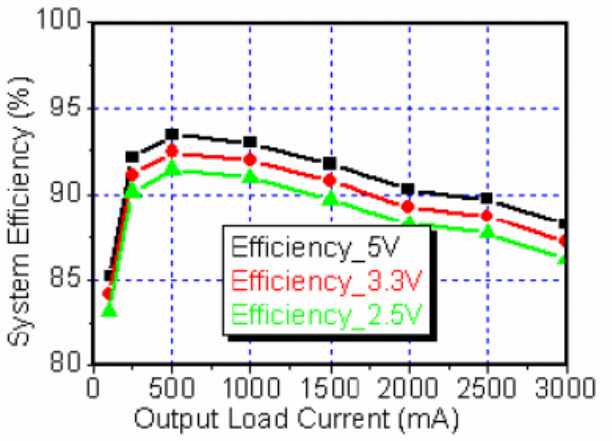


Figure 7. Efficiency vs. Load (Vin=10V)

Typical Application Circuit

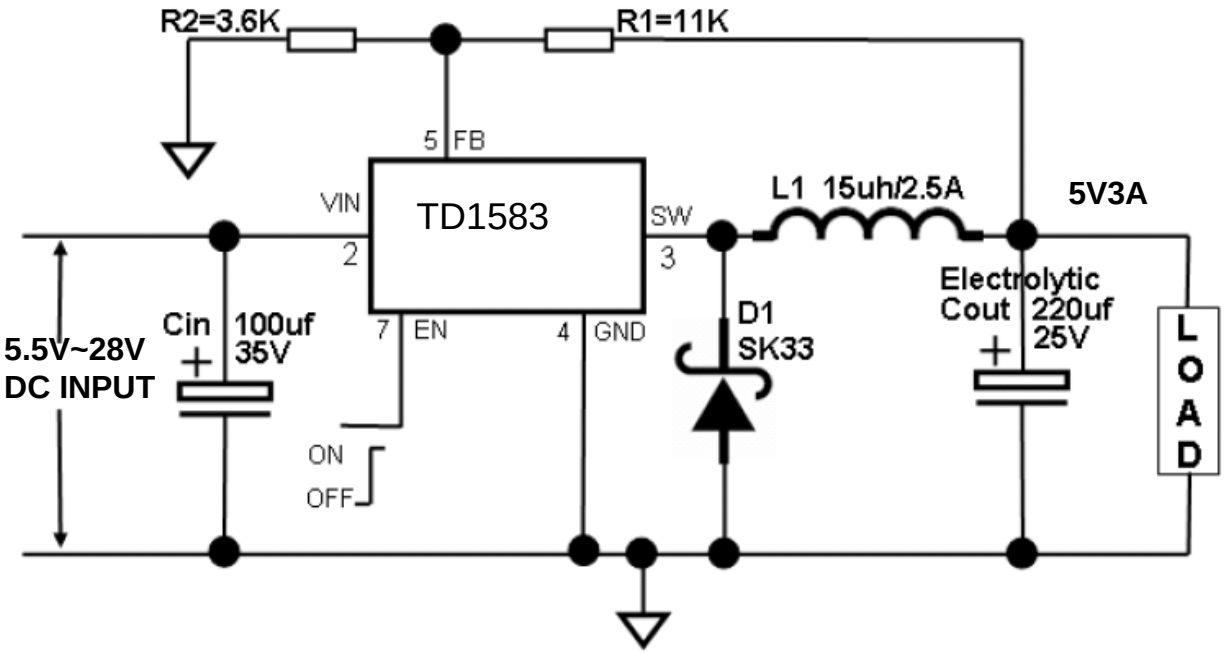


Fig8. TD1583 Typical Application Circuit @ 5V/3A

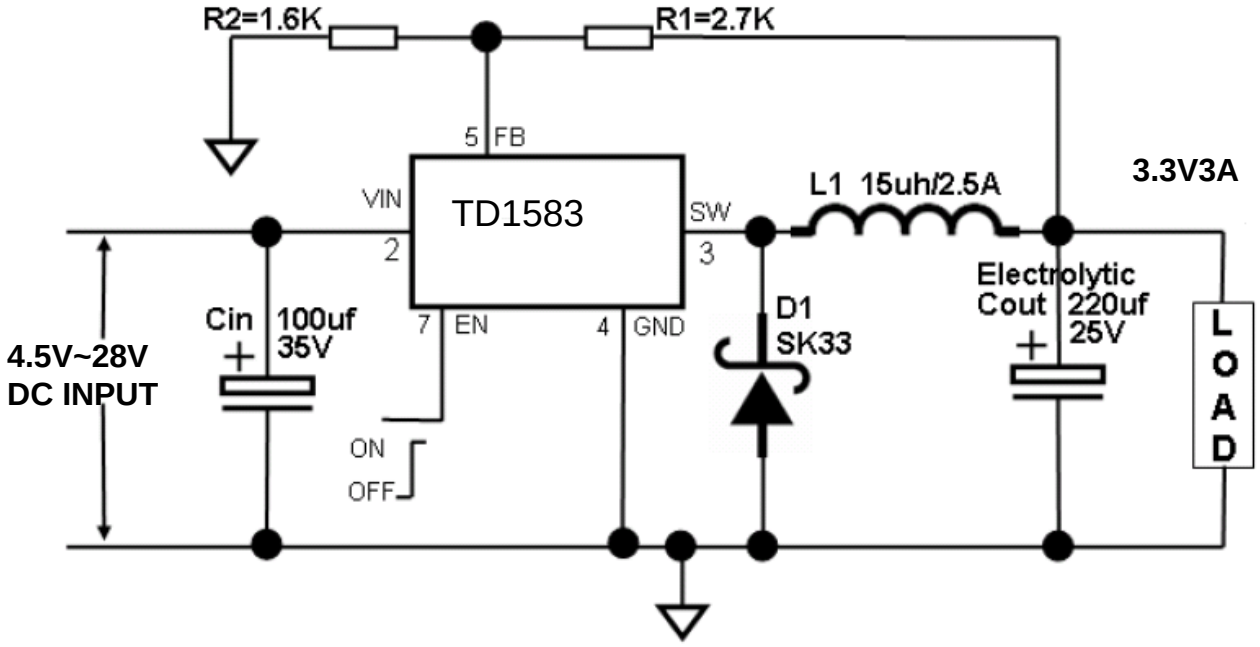


Fig9. TD1583 Typical Application Circuit @ 3.3V/3A

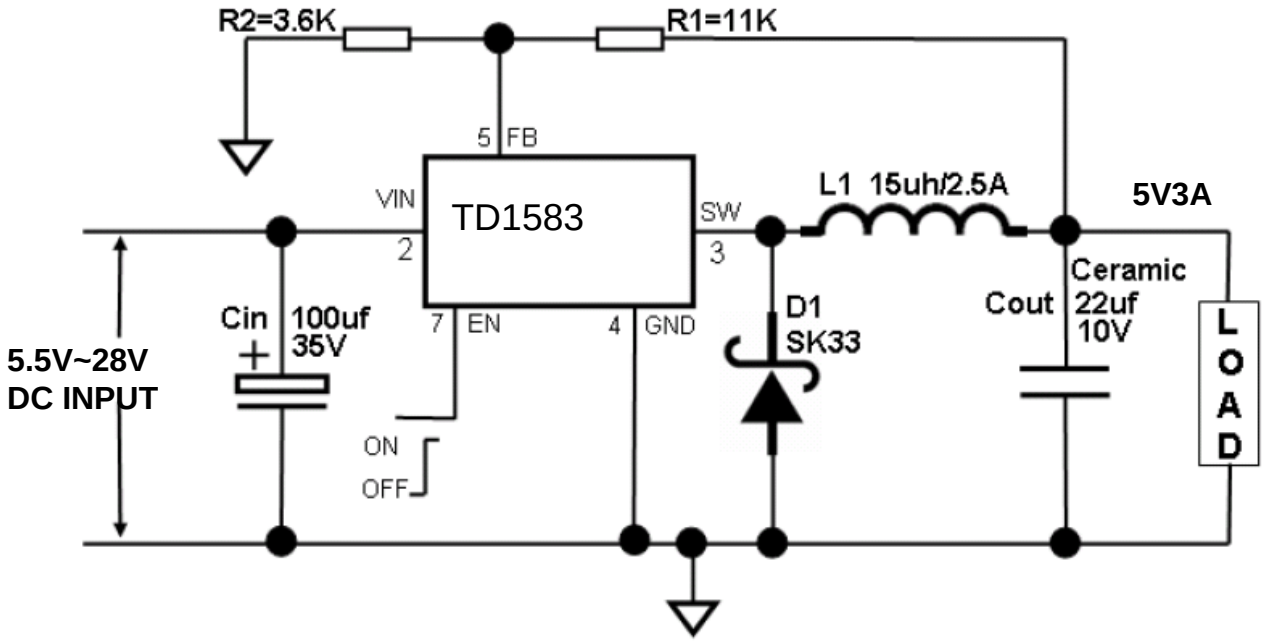


Fig10. TD1583 Typical Application Circuit (with ceramic output capacitor) @ 5V/3A

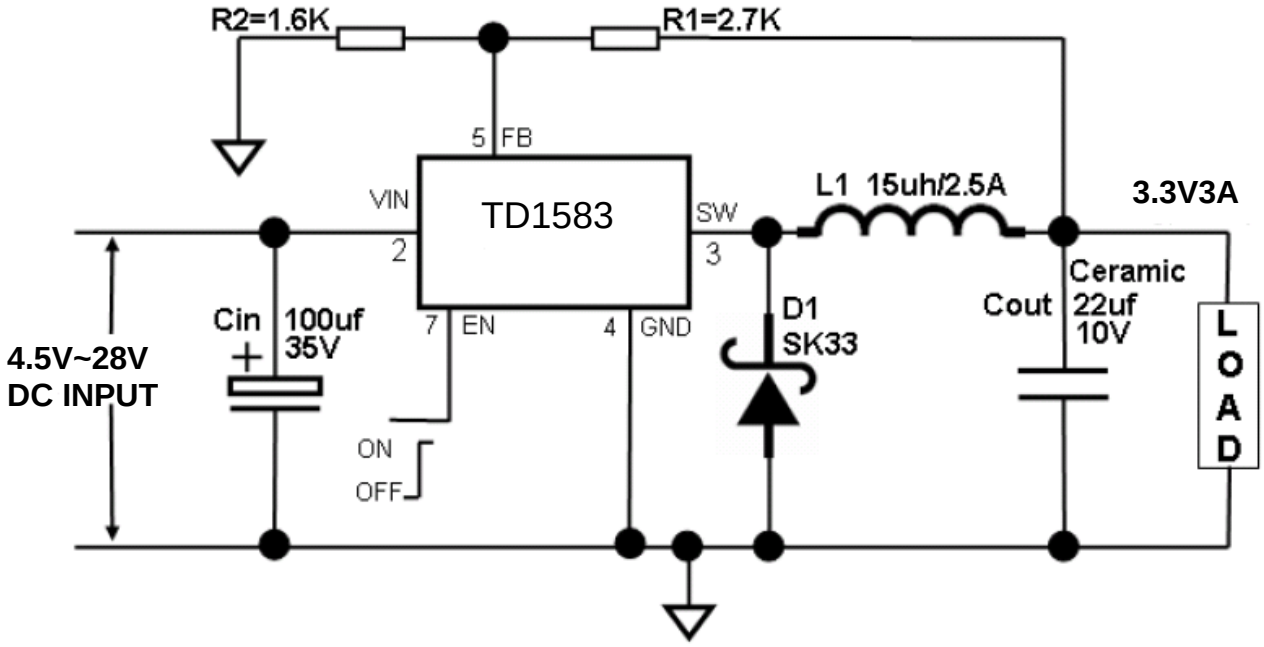


Fig11. TD1583 Typical Application Circuit (with ceramic output capacitor) @ 3.3V/3A

Schottky Rectifier Selection Guide

Vin (Max)	3A Load Current		3A Load Current	
	Part Number	**Vendor**	**Part Number**	**Vendor**
20V	B220	1	B320	1
	SK23	6	SK33	1,6
	SR22	6	SS32	3
30V	20BQ030	4	B330	1
	B230	1	B340L	1
	SK23	6	MBRD330	4,5
	SR23	3,6	SK33	1,6
	SS23	2,3	SS33	2,3

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

$$Vout = (1+R1/R2)*1.235V$$

Vout	R1	R2
1.8V	5.1K	11K
2.5V	5.1K	5K
3.3V	2.7K	1.6K
5V	11K	3.6K
9V	43K	6.8K
12V	13K	1.5K

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 (V_{IN} – V_{GS}) and approximately – 0.5V, with a duty cycle of approximately V_{OUT} / V_{IN}. 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. Forautomatic starup condition , can be implemented by the addition of a resistive voltage divider from V_{IN} to GND.

Thermal Considerations

The TD1583 is available in SOP8 package.

The SOP8 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 TD1583 junction temperature rises above ambient temperature for a 3A load and different input and output voltages. The data for these curves was taken with the TD1583 (SOP8 package) operating as a buck-switching regulator in an ambient temperature of 25^{o}C (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.

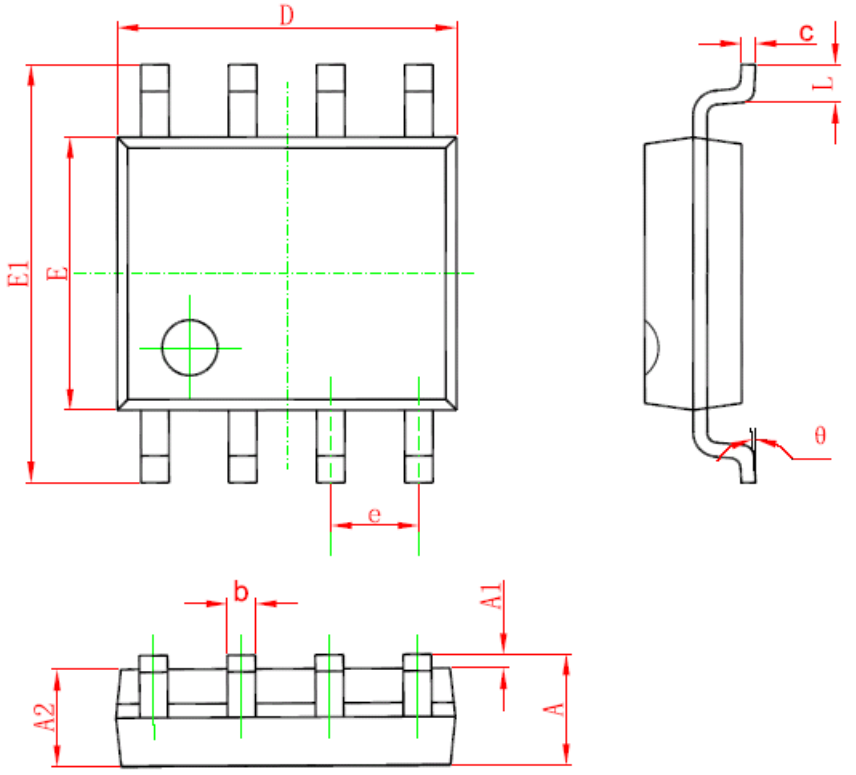
For the best thermal performance, wide copper traces and generous amounts of printed circuit board copper should be used in the board layout. (Once exception to this is the output (switch) pin, which should not have large areas of copper.) Large areas of copper provide the best transfer of heat (lower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

Package Information

SOP8 Package Outline Dimensions



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.270(BSC)		0.050(BSC)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°