PS1541

High Efficiency Step Up DC/DC Converter

FEATURES

- On Board Power MOSFET
- Uses Tiny Capacitor And Inductors
- 12V at 150mA from 5V input
- Up to 92% Efficiency
- Operates with Input Voltage as Low as 2.5V and Output Voltage as High as 22V
- 620KHz Fixed Switching Frequency
- Low 1.1V Feedback Voltage
- Soft Start
- UVLO, Thermal Shutdown
- Internal Current Limit
- Available in SOT-26 packages.

APPLICATIONS

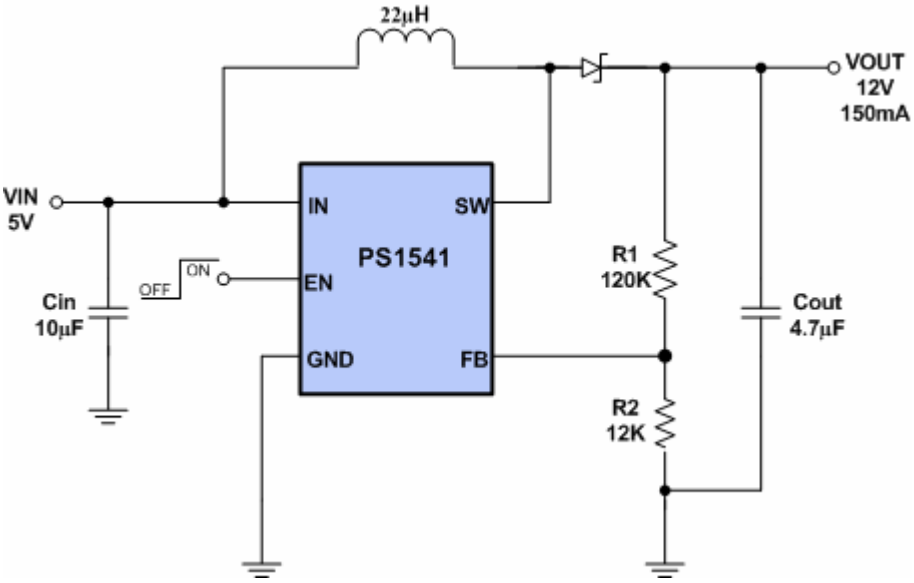
- Cell Phones
- Handheld Computers and PDAs.
- Camera Phone Flash
- Small LCD Displays
- Digital Still and Video Cameras
- White LED Driver
- External Modems

DESCRIPTION

The PS1541 is a current mode step up converter intended for small, low power applications. The PS1541 switches over 600KHz and allows the use of tiny, low cost capacitors and inductors. Internal soft start results in small inrush current and extends battery life. The PS1541 operates from an input voltage as low as 2.5V and can generate 12V at up to 150mA from a 5V supply.

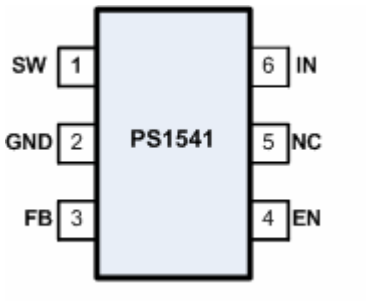
The PS1541 includes under-voltage lockout, current limiting and thermal overload protection preventing damage in the event of an output overload. The PS1541 is available in small 6-pin SOT-26 package.

TYPICAL APPLICATION CIRCUIT



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PIN CONFIGURATION

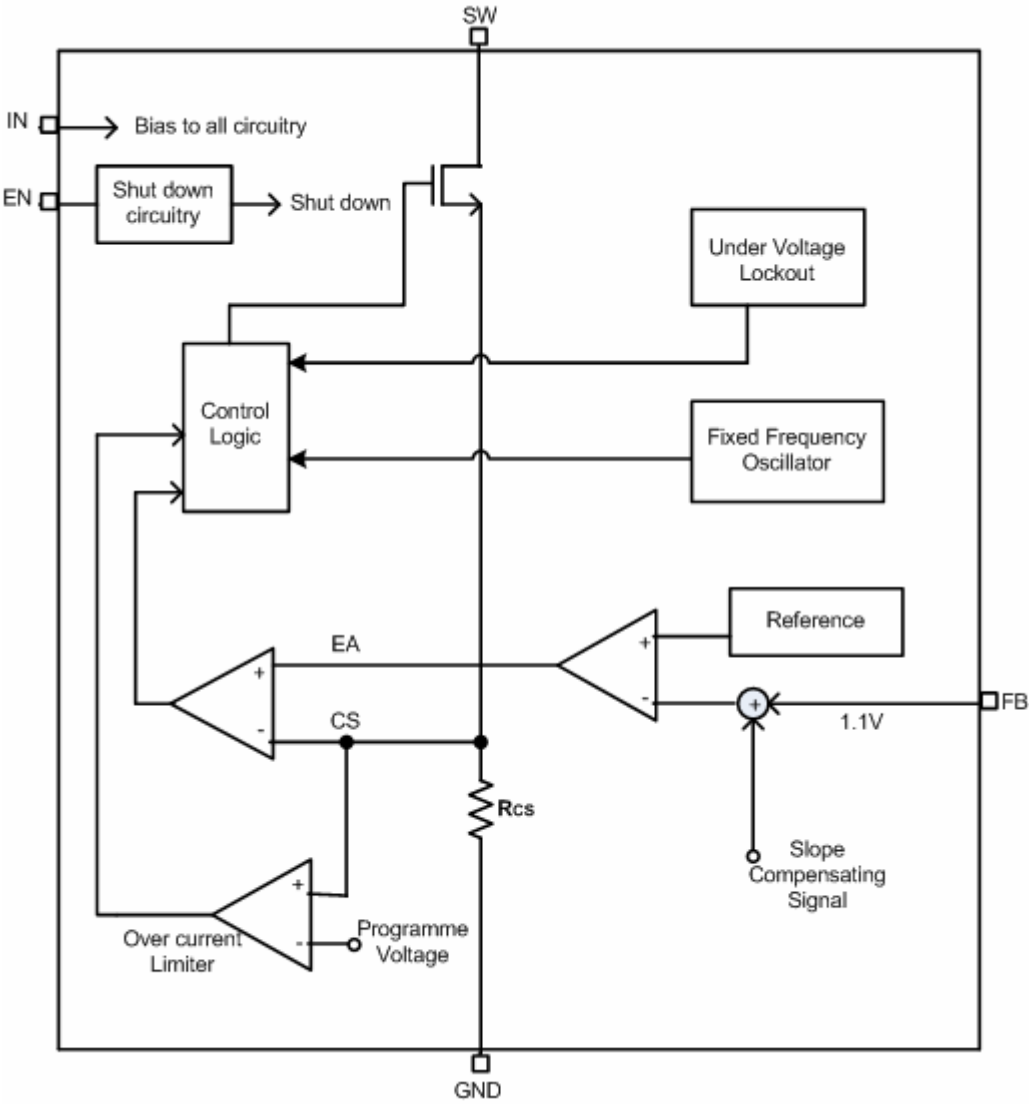


PIN CONFIGURATION

Name	Pin	Type	Function
SW	1	Switch	Connect inductor between SW and IN.
GND	2	Ground	Ground pin
FB	3	Feedback	Adjustable feedback input, connect to resistor voltage divider.
EN	4	Enable input.	EN=High: normal operation. (Supports both TTL and CMOS Logic).
NC	5	Not connected	
IN	6	Battery input.	Boost regulator input.

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BLOCK DIAGRAM



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ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{SW}	DC Voltage at Pin 1	-0.5 to +28	V
V_{EN}	Enable Input Voltage at Pin 2	-0.3 to +6.0	V
P_D	Continuous Power Dissipation	Internally limited	W
T_{STG}	Storage Temperature Range	-65 to +150	°C
$R_{\theta JA}$	Thermal Resistance, Junction-To-Air	235	°C /W
$T_{J,MAX}$	Operating Junction Temperature	-40 to +125	°C
T_L	Lead Temperature (Soldering, 5sec)	260	°C
ESD	ESD Capability, HBM model	2.0	kV

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Value	Unit
V_{IN}	DC Supply Voltage at Pin 1	+2.5 to 6	V
V_{EN}	Enable Input Voltage at Pin 2	0 to V_{IN}	V
T_J	Operating Junction Temperature	-40 to +125	°C

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ELECTRICAL CHARACTERISTICS

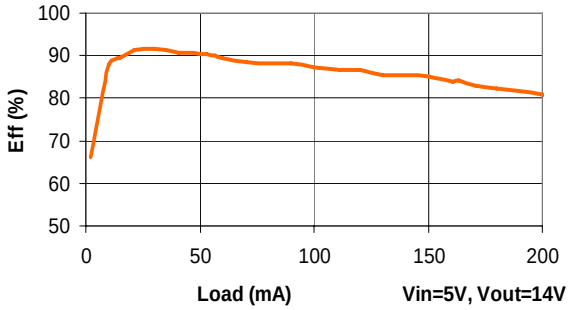
(Vin = 2.5V, T_A = +25°C, unless otherwise noted. Typical values are at T_A = +25°C.)

Symbol	Parameter	Test Condition	Min	Typ	Max	Units
V_{in}	Operating Input Voltage		2.5		5.5	V
UVLO	Under Voltage Lock-out	Vin going Lo.	2.15	2.2	2.4	V
$V_{out-max}$	Maximum Output Voltage			25		V
I_q	Supply Current (quiescent)	No Switching (Vin=5V, V_{FB}= 1.25V)		135	260	μA
	Supply Current	Switching FB=0		510	750	μA
I_{sh}	Supply Current (shut-down)	V_{EN} =0			1	μA
F_{OSC}	Operation Frequency			620		KHz
D_{MAX}	Maximum Duty Cycle			93		%
V_{FB}	Feedback Voltage		1.05	1.1	1.15	V
	Feedback Input Bias Current	V_{FB}=1.25V		7		nA
$R_{DS(ON)}$	MOSFET ON resistance			0.8		Ω
I_{LIM}	Current Limit	Vin=3		2.3		A
V_{EN}	Enable Threshold	Turn ON	0.95			V
		Turn OFF			0.35	V
I_{EN}	Enable Input Bias Current	V_{EN} =0, 5V			1	μA
	Thermal Shut-down			145		°C

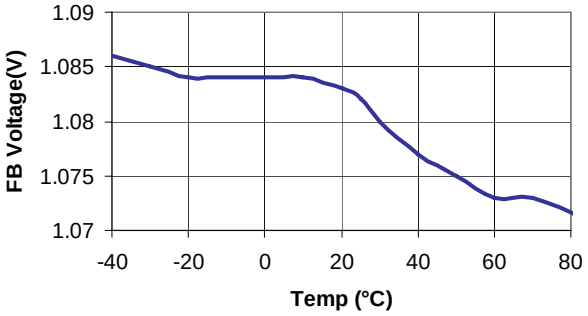
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TYPICAL OPERATING CHARACTERISTICS

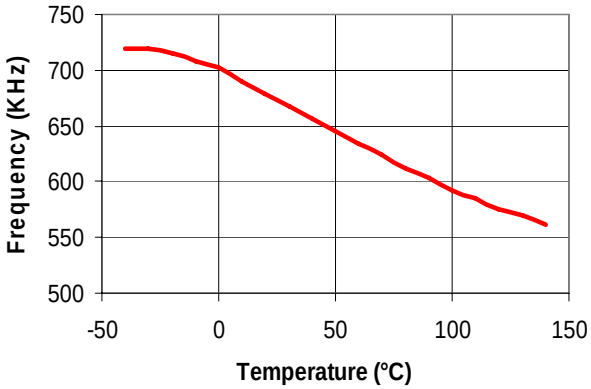
Efficiency vs Load Current



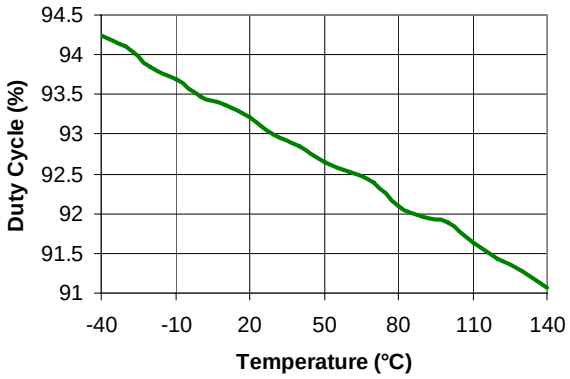
FB Voltage vs Temperature



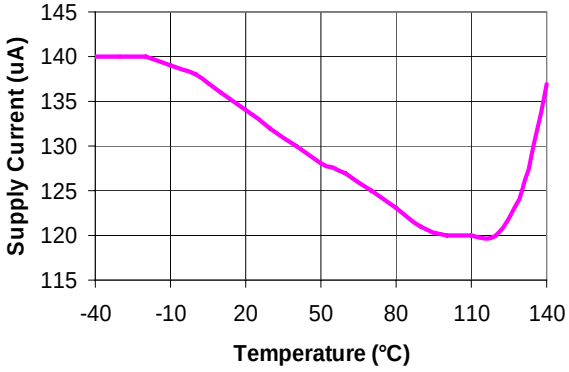
Frquency vs Temperature



Temperature vs Duty Cycle



Temperature vs Supply Current



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TYPICAL OPERATING CHARACTERISTICS (Continued)

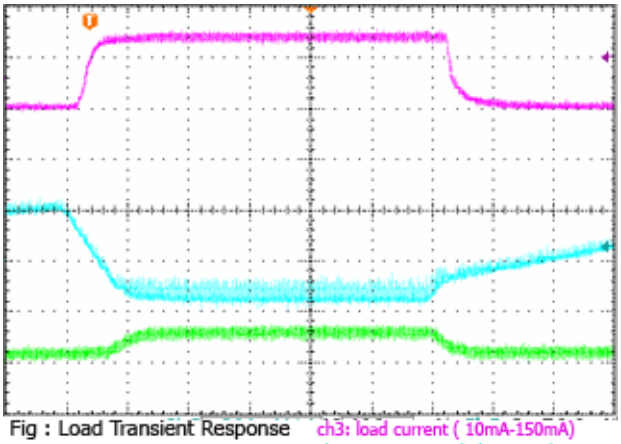


Fig : Load Transient Response
Vin=5V, Vout=14V Cout=33uF+1uF
x-axis (time): 100uS/DIV
ch3: load current (10mA-150mA)
ch2: Vout, ac coupled, 200mV/DIV
ch4: inductor current, 1A/DIV

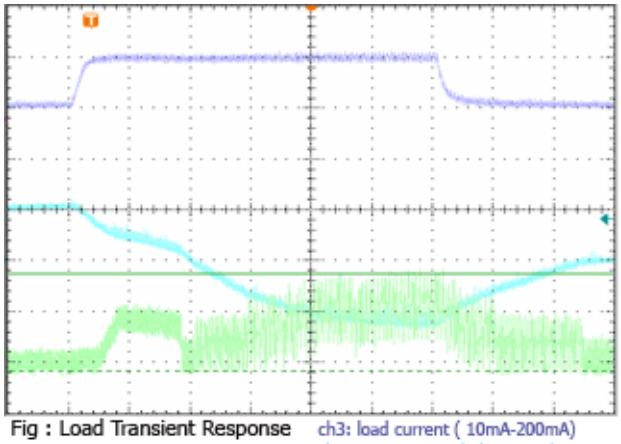


Fig : Load Transient Response
Vin=5V, Vout=14V Cout=33uF+1uF
x-axis (time): 200uS/DIV
ch3: load current (10mA-200mA)
ch2: Vout, ac coupled, 200mV/DIV
ch4: inductor current, 500mA/DIV

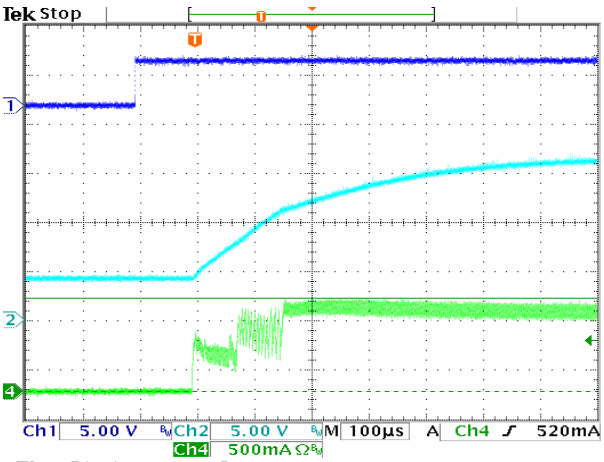


Fig: Start-up wave form
Vin=4V
Ch1: En, Ch2: Vout, Ch4: Isw

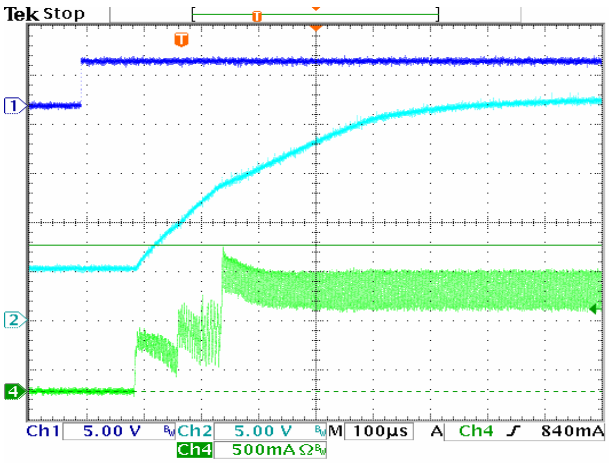


Fig: Start-up wave form
Vin=5V
Ch1: En, Ch2: Vout, Ch4: Isw

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OPERATION DESCRIPTION

The PS1541 is a high efficiency, fixed frequency, peak current mode boost regulator. It has the architecture to regulate the voltage at the feedback pin, so that a regulated fixed current is achieved. The power MOS is turned ON through the control circuitry, at the start of each oscillator cycle and thus the charging phase is initiated. The error amplifier, consisting of a voltage comparator and current sense amplifier, is basically, a PWM comparator. The voltage comparator amplifies the difference between the reference and feed back voltage. When the output of the current sense amplifier, reaches the output of the voltage comparator, the POWER MOS is turned OFF and thus the charging phase is terminated. To prevent sub-harmonic oscillations at duty cycles greater than 50 percent, a stabilizing ramp is added to the current sense signal. In this way the peak current level keeps the output in regulation. The PS1541 has internal soft start mechanism, to limit the inrush current at startup and to limit the amount of overshoot on the output, also. An internal blanking time is provided during start up, to prevent the start of switching before all the circuitry become ready for operation. The current limit is increased by a fourth every 60μs giving a total soft start time of 240μs.

Setting the Output Voltage

Set the output voltage by selecting the resistive voltage divider ratio. Use 12kΩ for the low side resistor R2 of the voltage divider. Determine the high-side resistor R1 by the equation:

$$R_1 = R_2(V_{OUT} - V_{FB})/V_{FB}$$

Where VOUT is the output voltage.

Current Limit

The PS1541 includes a current limiter. It monitors the peak current through the inductor and controls gate of the power device.

Enable Input

The PS1541 features an active-high Enable input (EN) pin that allows on/off control of the regulator. The PS1541 bias current reduces to less than microampere when it is shutdown. The Enable input is TTL/CMOS compatible.

Under Voltage Lockout

When the input supply goes too low (below 2.2V) the PS1541 produces an internal UVLO (under voltage lockout) signal that shuts down the chip. This mechanism protects the chip from producing false logic due to low input supply.

Thermal Overload Protection

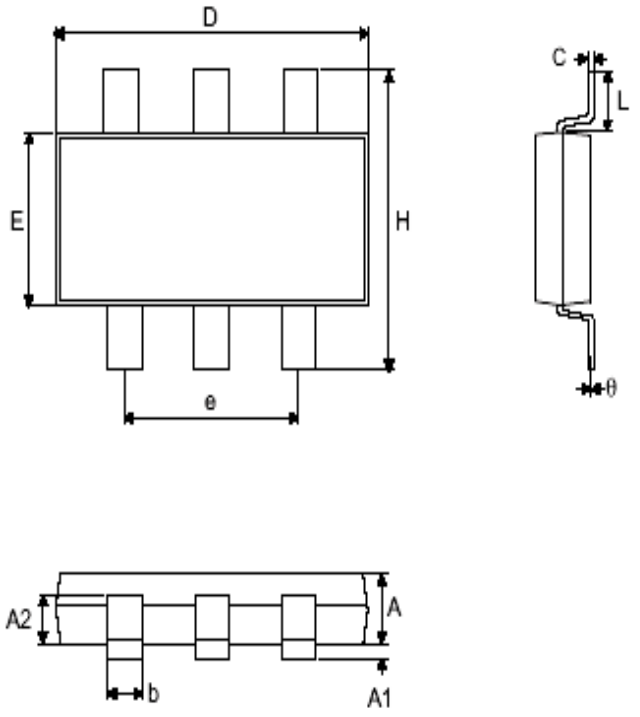
Thermal-overload protection limits total power dissipation in the PS1541. When the junction temperature exceeds T_j= +145°C, the thermal sensor signals the shutdown logic and turning off most of the internal circuitry. The thermal sensor turns internal circuitry on again after the IC's junction temperature drops by 20°C. The regulator then starts functioning in the required mode based on the supply voltage.

Thermal-Overload protection is designed to protect the PS1541 in the event of a fault condition. For continual operation, do not exceed the absolute maximum junction temperature rating of Tj = +125°C.

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PACKAGE INFORMATION

SOT-26 Outline Dimensions (Unit: mm)



Pin	Parameter										
	A	A1	A2	b	C	D	E	e	H	L	θ
6	1~1.3	0.1 max.	0.7~0.9	0.35~0.5	0.1~0.25	2.7~3.1	1.4~1.8	1.9 typ.	2.6~3	0.37 min.	1°~9°

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