DESCRIPTION

The TSP1942 is a monolithic step-down switch mode converter with a built-in power MOSFET. It achieves 1.5A peak output current over a wide input supply range with excellent load and line regulation. Current mode operation provides fast transient response and eases loop stabilization. Fault condition protection includes cycle-by-cycle current limiting and thermal shutdown.

The TSP1942 requires a minimum number of readily available standard external components. The TSP1942 is available in SOP-8 packages.

EVALUATION BOARD REFERENCE

Board Number	Dimensions
TSP1942DJ-00B	2.1"X x 1.9"Y x 0.4"Z

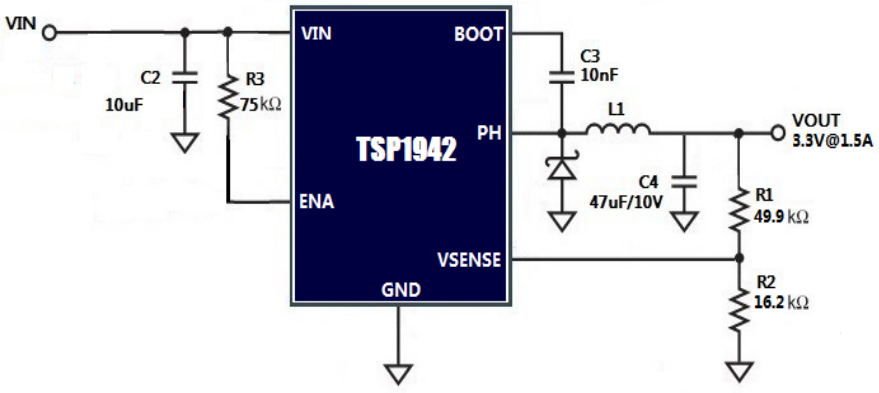
FEATURES

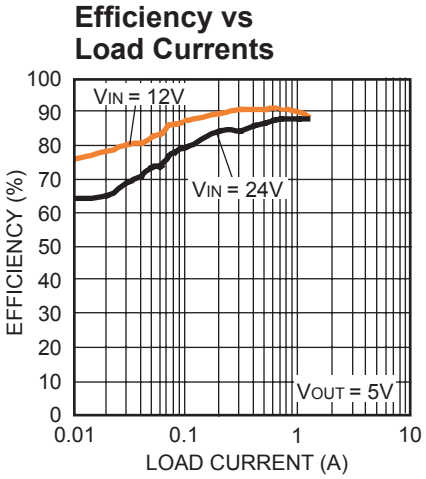
- 1.5A Peak Output Current
- 0.35Ω Internal Power MOSFET Switch
- Stable with Low ESR Output Ceramic Capacitors
- Up to 92% Efficiency
- 0.1μA Shutdown Mode
- Fixed 1.5MHz Frequency
- Thermal Shutdown
- Cycle-by-Cycle Over Current Protection
- Wide 4.5V to 18V Operating Input Range
- Output Adjustable from 0.81V to 12V
- Available in SOP-8 Packages

APPLICATIONS

- Distributed Power Systems
- Battery Charger
- Pre-Regulator for Linear Regulators
- WLED Drivers

TYPICAL APPLICATION

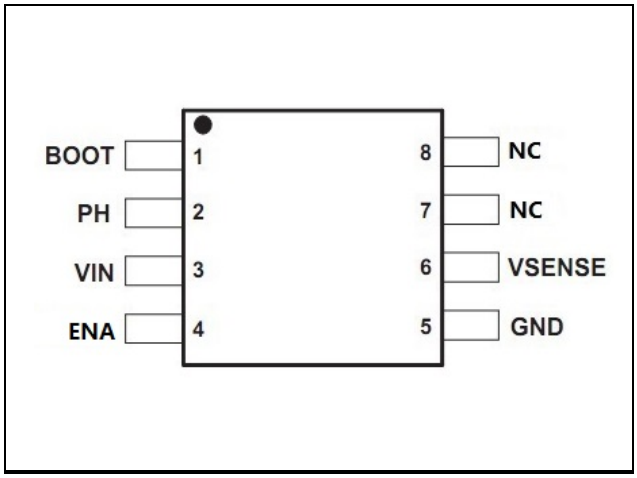




ORDERING INFORMATION

Part Number	Package	Top Marking	Free Air Temperature (T^A)
TSP1942DT**	SOP-8	J6	-40°C to +85°C

PACKAGE REFERENCE



ABSOLUTE MAXIMUM RATINGS (1)

Supply Voltage V_{IN} 26V
V_{SW} 27V
V_{BS} ..... V_{SW} + 6V
All Other Pins .....-0.3V to +6V
Continuous Power Dissipation (T_A = +25°C) (2)
SOP-8 .... 0.568W
Junction Temperature .....150°C
Lead Temperature .....260°C
Storage Temperature..... -65°C to +150°C

Recommended Operating Conditions (3)

Supply Voltage V_{IN} .....4.5V to 18V
Output Voltage V_{OUT}.....0.81V to 12V
Ambient Temperature ..... -40°C to +85°C
Max input current into the EN pin..... 300μA

Thermal Resistance (4) θ_{JA} θ_{JC}

SOP-8	220	110..	°C/W

ELECTRICAL CHARACTERISTICS

V_{IN} = 12V, T_A = +25°C, unless otherwise noted.

Parameters	Symbol	Condition	Min	Typ	Max	Units
Feedback Voltage	V_{FB}	4.5V ≤ V_{IN} ≤ 18V	0.790	0.810	0.830	V
Feedback Current	I_{FB}	V_{FB} = 0.8V		0.1		μA
Switch-On Resistance (5)	$R_{DS(ON)}$			0.35		Ω
Switch Leakage		V_{EN} = 0V, V_{SW} = 0V			10	μA
Current Limit (5)				1.6		A
Oscillator Frequency	f_{SW}	V_{FB} = 0.6V		1.5		MHz
Fold-back Frequency		V_{FB} = 0V		460		kHz
Maximum Duty Cycle		V_{FB} = 0.6V		87		%
Minimum On-Time (5)	t_{ON}			100		ns
Under Voltage Lockout Threshold Rising			2.5	2.8	3.1	V
Under Voltage Lockout Threshold Hysteresis				150		mV
EN Input Low Voltage					0.4	V
EN Input High Voltage			1.2			V
EN Input Current		V_{EN} = 2V		2.1		μA
		V_{EN} = 0V		0.1		
Supply Current (Shutdown)	I_S	V_{EN} = 0V		0.1	1.0	μA
Supply Current (Quiescent)	I_Q	V_{EN} = 2V, V_{FB} = 1V		0.8	1.0	mA
Thermal Shutdown (5)				150		°C

Note:
5) Guaranteed by design.

PIN FUNCTIONS

Pin #	Name	Description
1	BOOT	High-Side Gate Drive Boost Input. BOOT supplies the drive for the high-side N-channel MOSFET switch. Connect a 1 0nF or greater capacitor from SW to BS to power the switch.
2	PH	Power Switching Output. PH is the switching node that supplies power to the output. Connect the output LC filter from PH to the output load. Note that a capacitor is required from PH to BOOT to power the high-side switch.
3	IN	Power Input. IN supplies the power to the IC, as well as the step-down converter switch. Drive In with a 4.75 to 18V power source. Bypass IN to GND with a suitably large capacitor to eliminate noise on the input to the IC. ***See Input Capacitor.***
4	ENA	On/Off Control Input. Pull EN above 1.2V to turn the device on. For automatic enable, connect a 100kΩ resistor between this pin and Vin pin.
5	GND	This pin is the voltage reference for the regulated output voltage. For this reason care must be taken in its layout.This node should be placed outside of the D1 to C1 ground path to prevent switching current spikes from inducing voltage noise into the part.
6	VENTER	Feedback Input. VSENSE senses the output voltage to regulate that voltage. Drive VSENSE with a resistive voltage divider from the output voltage. The feedback threshold is 0 .810V. ***See Setting the Output Voltage.***
7	NC	No Connect.
8	NC	No Connect.

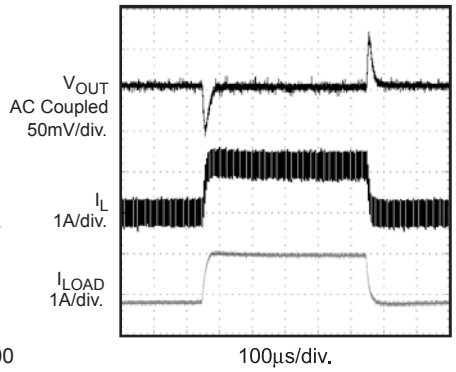
TYPICAL PERFORMANCE CHARACTERISTICS *(continued)*

V_{IN} = 12V, V_{OUT} = 3.3V, L = 4.7µH, C1 = 10µF, C2 = 22µF, T_A = +25ºC, unless otherwise noted.

Current Limit vs Duty Cycle

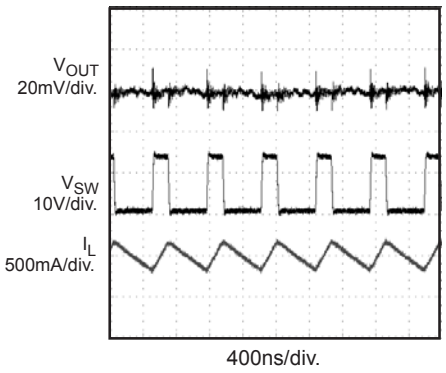
Load Transient Test

I_{OUT} = 0.2A to 0.8A step at 0.8A/µs

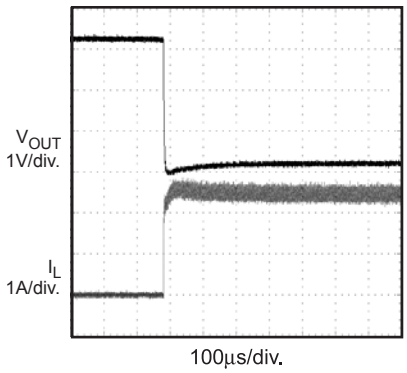


Steady State Test

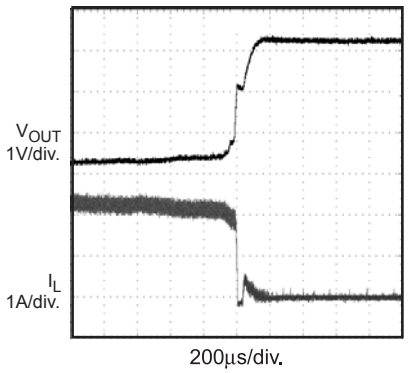
I_{OUT} = 0.5A



Short Circuit Entry

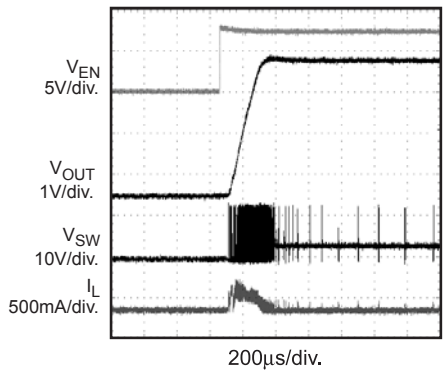


Short Circuit Recovery



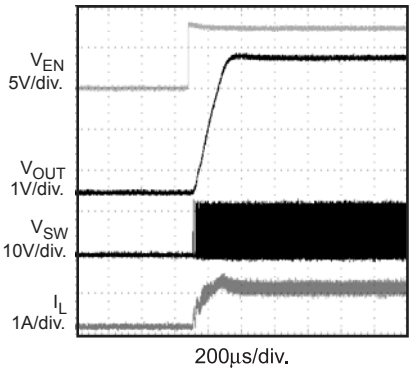
Start-up through Enable

No Load



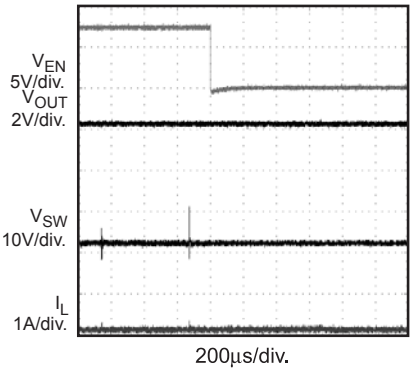
Start-up through Enable

I_{OUT} = 1A Resistive Load



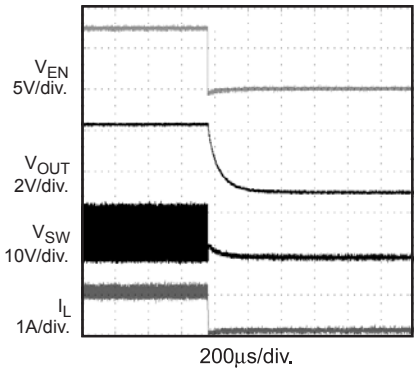
Shut-down through Enable

No Load



Shut-down through Enable

I_{OUT} = 1A Resistive Load



APPLICATION INFORMATION

Setting Output Voltage

The external resistor divider is used to set the output voltage (see the schematic on front page). Table 1 shows a list of resistor selection for common output voltages. The feedback resistor R1 also sets the feedback loop bandwidth with the internal compensation capacitor (see Figure 1). R2 can be determined by:

$$R2 = \frac{R1}{\frac{V_{OUT}}{0.81V} - 1}$$

Table 1—Resistor Selection for Common Output Voltages

V_{OUT} (V)	R1 (kΩ)	R2 (kΩ)
1.8	80.6 (1%)	64.9 (1%)
2.5	49.9 (1%)	23.7 (1%)
3.3	49.9 (1%)	16.2 (1%)
5	49.9 (1%)	9.53 (1%)

Selecting the Inductor

A 1μH to 10μH inductor with a DC current rating of at least 25% percent higher than the maximum load current is recommended for most applications. For highest efficiency, the inductor's DC resistance should be less than 200mΩ. Refer to Table 2 for suggested surface mount inductors. For most designs, the required inductance value can be derived from the following equation.

$$L = \frac{V_{OUT} \times (V_{IN} - V_{OUT})}{V_{IN} \times \Delta I_L \times f_{SW}}$$

Where ΔI_L is the inductor ripple current.

Choose the inductor ripple current to be 30% of the maximum load current. The maximum inductor peak current is calculated from:

$$I_{L(MAX)} = I_{LOAD} + \frac{\Delta I_L}{2}$$

Under light load conditions below 100mA, a larger inductance is recommended for improved efficiency. See Table 2 for suggested inductors.

Also note that the maximum recommended load current is 1A if the duty cycle exceeds 35%.

Selecting the Input Capacitor

The input capacitor reduces the surge current drawn from the input supply and the switching noise from the device. The input capacitor impedance at the switching frequency should be less than the input source impedance to prevent high frequency switching current from passing through the input. Ceramic capacitors with X5R or X7R dielectrics are highly recommended because of their low ESR and small temperature coefficients. For most applications, a 4.7μF capacitor is sufficient.

Selecting the Output Capacitor

The output capacitor keeps the output voltage ripple small and ensures feedback loop stability. The output capacitor impedance should be low at the switching frequency. Ceramic capacitors with X5R or X7R dielectrics are recommended for their low ESR characteristics. For most applications, a 22μF ceramic capacitor will be sufficient.

External Bootstrap Diode

An external bootstrap diode may enhance the efficiency of the regulator, the applicable conditions of external BOOT diode are:

- V_{OUT}=5V or 3.3V; and
- Duty cycle is high: D= $\frac{V_{OUT}}{V_{IN}}$ >65%

In these cases, an external BOOT diode is recommended from the output of the voltage regulator to BOOT pin, as shown in Fig.3

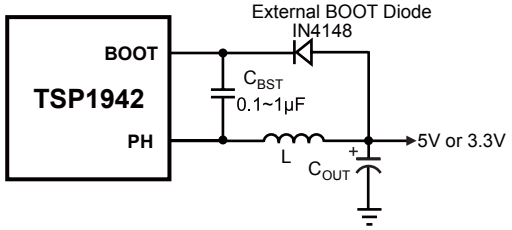


Figure 3—Add Optional External Bootstrap Diode to Enhance Efficiency

The recommended external BOOT diode is IN4148, and the BST cap is 0.1~1μF.

PACKAGE INFORMATION