Ordering number : ENA1439

LA5757TP

ON Semiconductor®

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Monolithic Linear IC

Separately-excited Step-down Switching Regulator (Variable Type)

Overview

The LA5757TP is a separately-excited step-down switching regulator (variable type).

Features

- Output smoothing condenser can use a Low ESR condenser for the reliability improvement
- High efficiency
- Four external parts
- Time-base generator (300kHz) incorporated
- Current limiter incorporated
- Thermal shutdown circuit incorporated
- Soft start circuit incorporated

Specifications

Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Input voltage	V_{IN} max		34	V
Output current	I_O max		1.5	A
SW pin application reverse	V_{SW}		-1	V
Allowable power dissipation	Pd max	Mounted on a specified board*	1.1	W
Operating temperature	Topr		-30 to +125	°C
Storage temperature	Tstg		-40 to +150	°C

* Specified board: 114.3mm × 76.1mm × 1.6mm, glass epoxy board.

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

Recommended Operating Conditions at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Input voltage range	V_{IN}		4.5 to 32	V

Electrical Characteristics at Ta = 25°C, V_O = 5V

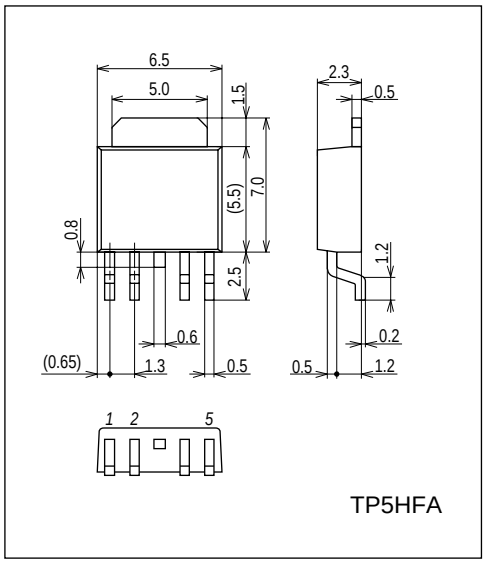
Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Reference voltage	V_{OS}		1.230	1.255	1.280	V
Efficiency	η			83		%
Switching frequency	f	V_{IN} = 15V, I_O = 1.0A	240	300	360	kHz
Line regulation	ΔV_OLINE	V_{IN}= 8 to 20V, I_O=1.0A		40	100	mV
Load regulation	ΔV_OLOAD	V_{IN} = 15V, I_O = 0.5 to 1.5A		10	30	mV
Output voltage temperature coefficient	$\Delta V_O/\Delta Ta$	Designed target value*		±0.5		mV/°C
Ripple attenuation factor	RREJ	f = 100 to 120Hz		45		dB
Current limiter operating voltage	I_S	V_{IN} = 15V	1.6			A
Thermal shutdown operating temperature	TSD	Designed target value*		165		°C
Thermal shutdown hysteresis width	ΔTSD	Designed target value*		15		°C

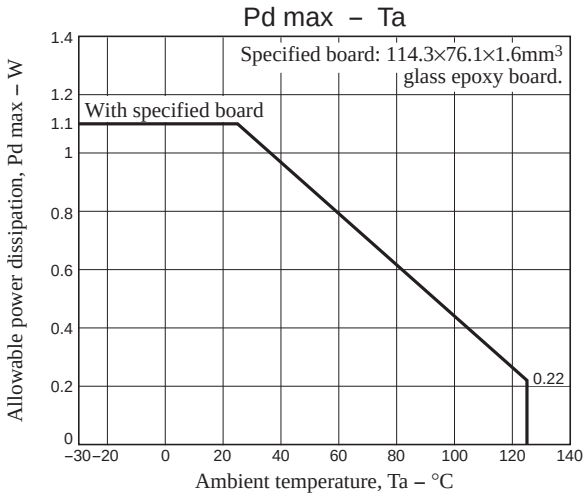
* Designed target value: No measurement made.

Package Dimensions

unit : mm (typ)

3332

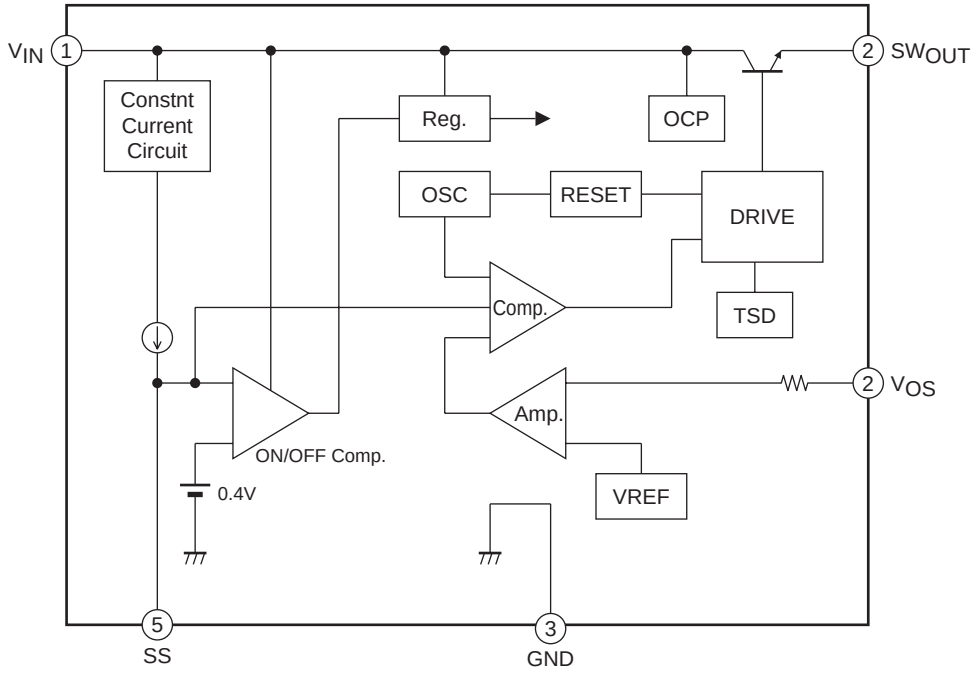




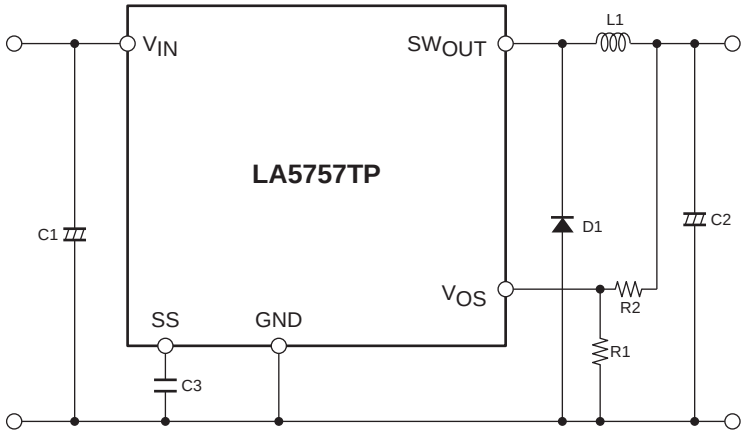
Pin Assignment

(1)V_{IN} (2)SW_{OUT} (3)GND (4)V_{OS} (5)SS

Block Diagram



Application Circuit Example



Notes: C3 is for the soft start function. Delete C3 and keep the SS pin open when the soft function is not necessary.

Description of Functional Settings

1. Calculation equation to set the output voltage

   This IC controls the switching output so that the V_{OS} pin voltage becomes 1.255V (typ).

   The equation to set the output voltage is as follows:

$$V_O = \left(1 + \frac{R2}{R1}\right) \times 1.255V(typ)$$

   The V_{OS} pin has the inrush current of 1μA (typ). Therefore, the error becomes larger when R1 and R2 resistance values are large.

2. Start delay function

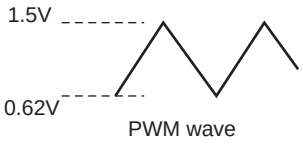
The SS pin has the internally-connected 10μA (typ) constant-current supply. When the voltage of SS pin exceeds the threshold voltage, the regulator starts operation. As the threshold is 0.62V(typ), the start delay time can be calculated as follows:

ex. For setting at 1μF

$$Td = \frac{C \times V}{i} = \frac{1\mu \times 0.62}{22\mu} = 28.2\ msec$$

3. Soft start function

The internal PWM waveform has the voltage value as shown in the right.
If down-conversion from the voltage of V_{IN} = 15V to 3.3V output to be made, for example, the PWM-ON duty has the value as shown below.



$$PWMduty = \frac{V_{OUT} + VF}{V_{IN} - Vsat + VF} = 25\%$$

(Note that calculation is made with Vsat = 1V and VF = 0.2V)

The output voltage of error amplifier, which is 3.3V, is the value with PWM = 25%, as calculated in the above equation, so that this voltage is determined as follows:

$$Ver = (\Delta VPWM) \times PWMduty + VPWML = 0.88V \times 0.25 + 0.62V = 0.84V$$

(ΔVPWM is the PWM amplitude value or 0.88V(typ) while VPWML is the lower limit voltage of PWM waveform or 0.62V(typ))

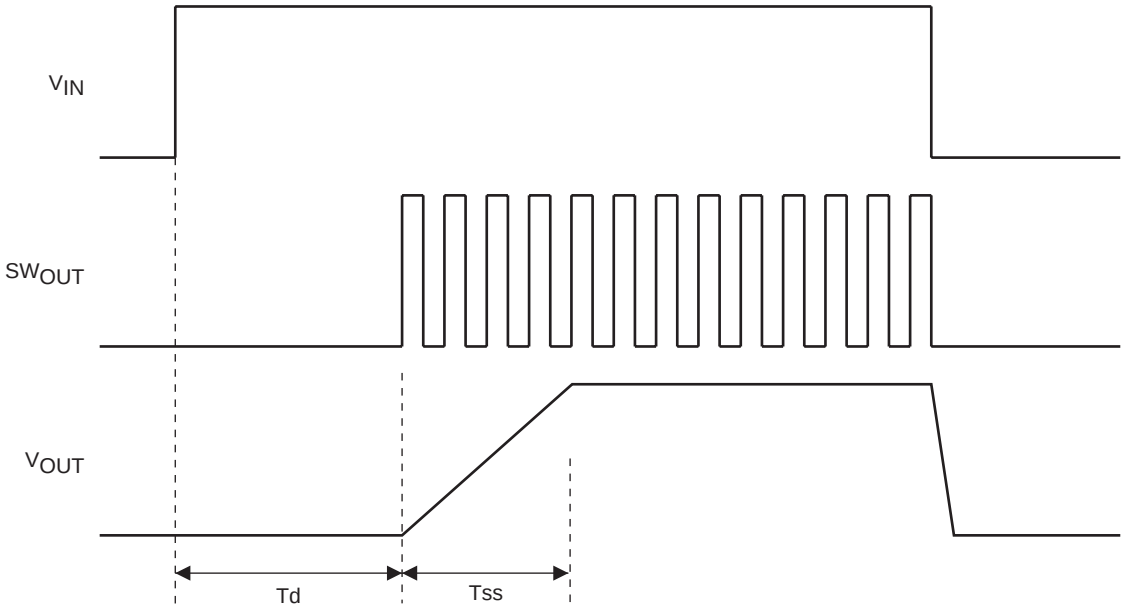
SS pin and error amplifier output voltages are designed to prefer the lower voltages, so that V_{OUT} will reach the designed regulation voltage in timing when the SS pin voltage exceeds the error amplifier output. Therefore, the soft strt time is calculated as follows:

$$Tss = \frac{C \times \Delta VPWM \times PWMduty}{i} = \frac{C \times 0.88 \times PWMduty}{22\mu A}$$

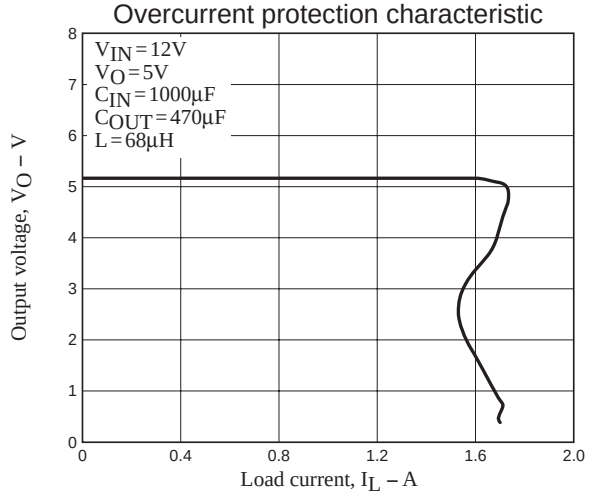
For the set conditions of C = 1μF and PWMduty = 25%:

$$Tss = \frac{1\mu \times 0.88V \times 0.25}{22\mu A} = 10msec$$

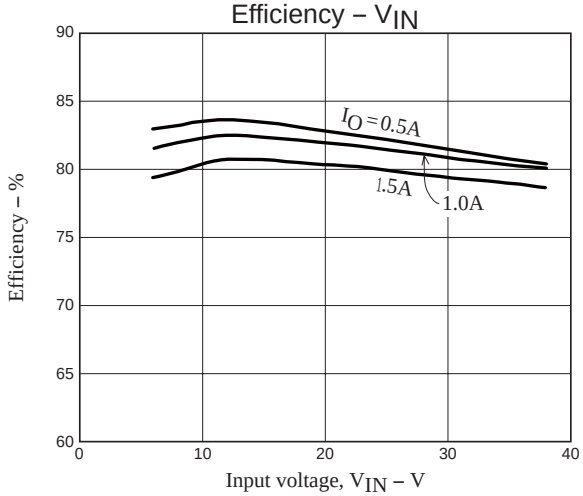
Timing Chart



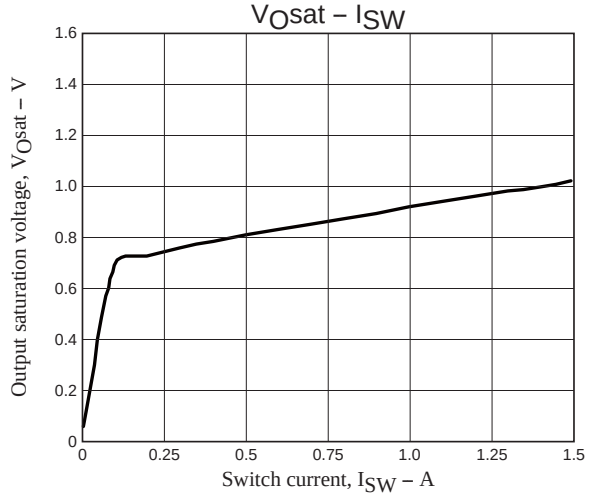
Overcurrent protection characteristic



Efficiency – V_{IN}



$V_O$sat – I_{SW}



I_{STB} – V_{IN}