



SANYO Semiconductors

# DATA SHEET

## LA5751 — Monolithic Linear IC Separately-excited Step-down Switching Regulator (3.3V)

### Overview

The LA5751 is a separately-excited step-down switching regulator (3.3V).

### Features

- High efficiency
- Four external parts
- Time-base generator (60kHz) incorporated
- Current limiter incorporated
- Thermal shutdown circuit incorporated
- Soft start circuit incorporated

### Specifications

**Absolute Maximum Ratings** at  $T_a = 25^\circ\text{C}$

Parameter	Symbol	Conditions	Ratings	Unit
Input voltage	$V_{IN\ max}$		30	V
Output current	$I_O\ max$		3	A
SW pin application reverse voltage	$V_{sw}$		-1	V
Allowable power dissipation	$P_d\ max1$	Infinite heat sink.	7.5	W
	$P_d\ max2$	No heat sink.	1.75	W
Junction temperature	$T_j\ max$		150	$^\circ\text{C}$
Operating temperature	$T_{opr}$		-30 to +125	$^\circ\text{C}$
Storage temperature	$T_{stg}$		-40 to +150	$^\circ\text{C}$

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# LA5751

## Recommended Operating Conditions at $T_a = 25^\circ\text{C}$

Parameter	Symbol	Conditions	Ratings	Unit
Input voltage range	$V_{IN}$		5.5 to 28	V
Operating junction temperature range	$T_{j\text{ op}}$		-30 to +150	$^\circ\text{C}$

## Electrical Characteristics at $T_a = 25^\circ\text{C}$

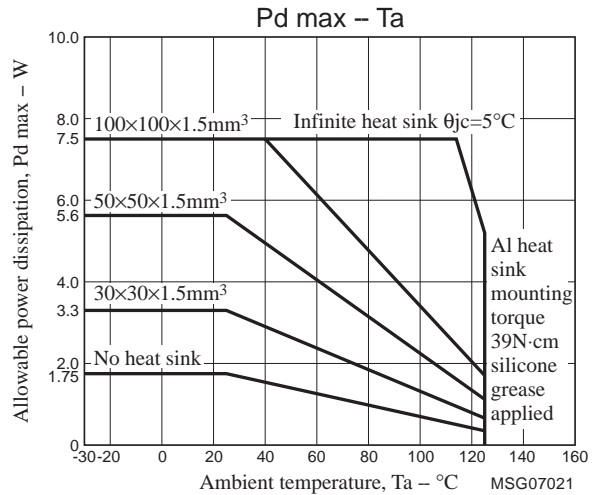
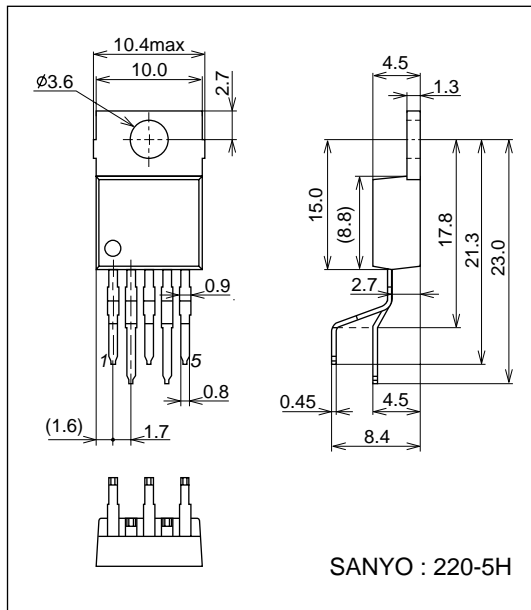
Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Output voltage	$V_O$	$V_{IN} = 15\text{V}$ , $I_O = 1.0\text{A}$	3.17	3.30	3.43	V
Efficiency	$\eta$	$V_{IN} = 15\text{V}$ , $I_O = 1.0\text{A}$		79		%
Switching frequency	f	$V_{IN} = 15\text{V}$ , $I_O = 1.0\text{A}$	48	60	72	kHz
Line regulation	$\Delta V_{OLINE}$	$V_{IN} = 8$ to $20\text{V}$ , $I_O = 1.0\text{A}$		25	80	mV
Load regulation	$\Delta V_{OLOAD}$	$V_{IN} = 15\text{V}$ , $I_O = 0.5$ to $1.5\text{A}$		10	30	mV
Output voltage temperature coefficient	$\Delta V_O/\Delta T_a$			$\pm 0.5$		$\text{mV}/^\circ\text{C}$
Ripple attenuation factor	RREJ	f = 100 to 120Hz		45		dB
Current limiter operating voltage	IS	$V_{IN} = 15\text{V}$	3.1			A
Thermal shutdown operating temperature	TSD	Designed target value*		165		$^\circ\text{C}$
Thermal shutdown hysteresis width	$\Delta TSD$	Designed target value*		15		$^\circ\text{C}$

\* Designed target value: No measurement made.

## Package Dimensions

unit : mm (typ)

3079C

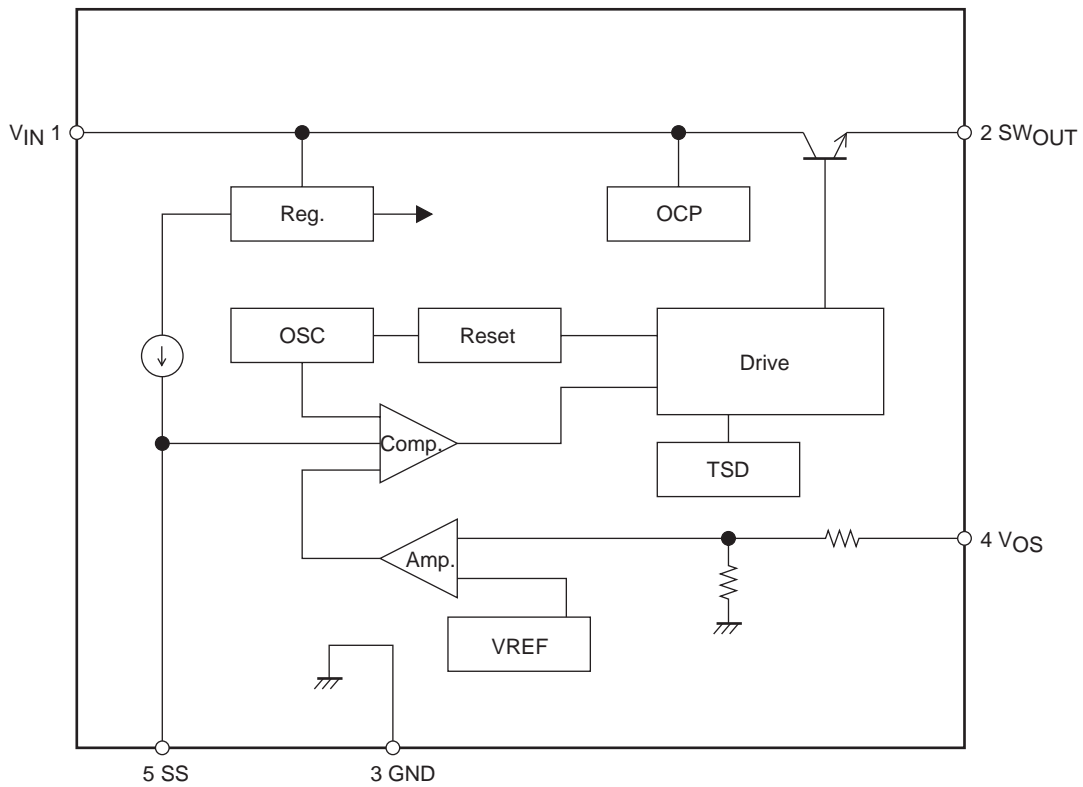


## Pin Assignment

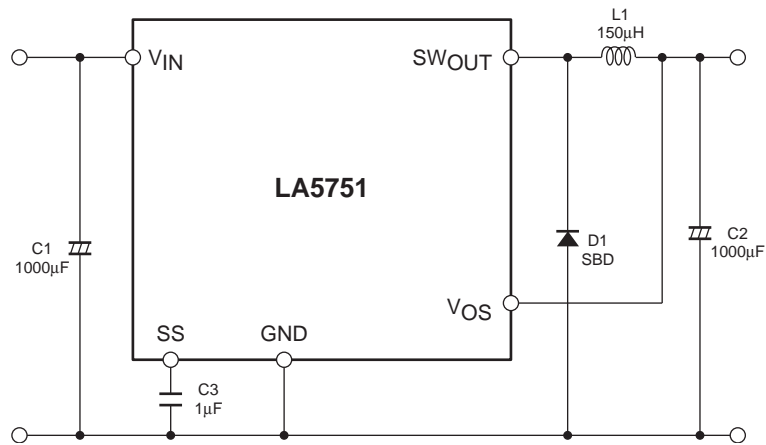
(1) $V_{IN}$  (2) $SW_{OUT}$  (3)GND (4) $V_{OS}$  (5)SS

# LA5751

## 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. Start delay function

The SS pin has the internally-connected 22μA (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

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

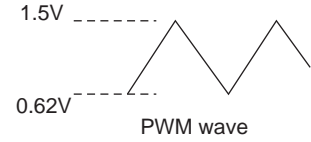
### 2. Soft start function

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.

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

(Note that calculation is made with  $V_{sat} = 1V$  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:

$$V_{er} = (\Delta VPWM) \times PWMduty + VPWML = 0.88V \times 0.25 + 0.62V = 0.84V$$

( $\Delta VPWM$  is the PWM amplitude value or 0.88V(typ) while  $VPWML$  is the lower limit voltage of PWM waveform or 0.62V(typ))

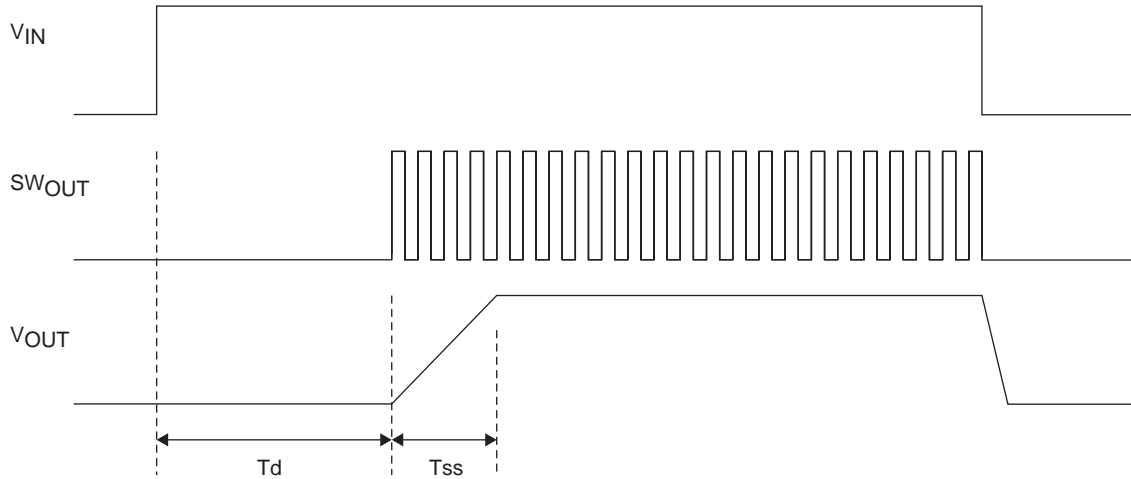
SS pin and error amplifier output voltages are designed to prefer the lower voltages, so that  $V_{OUT}$  will reach the designed regulation voltage in timing when the SS pin voltage exceeds the error amplifier output. Therefore, the soft start time is calculated as follows:

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

For the set conditions of  $C = 1\mu F$  and  $PWMduty = 25\%$ :

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

## Timing Chart



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