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# LA5744

Monolithic Linear IC

## Separately-Excited Step-Down Switching Regulator (Variable Type)

### Overview

The LA5744 is a separately-excited step-down switching regulator (variable type).

### Functions

- High efficiency.
- Time-base generator (300kHz) incorporated.
- Current limiter incorporated.
- Thermal shutdown circuit incorporated.
- Soft start circuit incorporated.

### Specifications

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

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

\* Specified circuit board :  $76.1 \times 114.3 \times 1.6 \text{ mm}^3$  : Copper foil ratio 60% FR4

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  $T_a = 25^\circ\text{C}$

Parameter	Symbol	Conditions	Ratings	Unit
Input voltage range	$V_{IN}$		4.5 to 28	V

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## Electrical Characteristics at $T_a = 25^\circ\text{C}$ , $V_O = 5\text{V}$

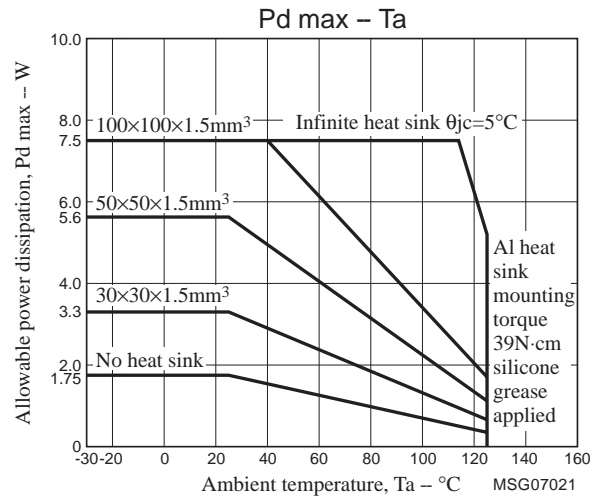
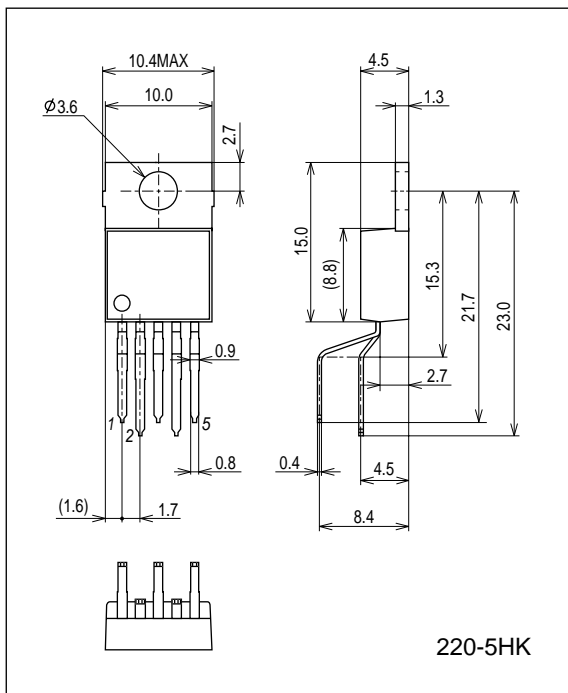
Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Reference voltage	$V_{OS}$	$V_{IN} = 15\text{V}$ , $I_O = 1.0\text{A}$	1.20	1.23	1.26	V
Efficiency	$\eta$	$V_{IN} = 15\text{V}$ , $I_O = 1.0\text{A}$		83		%
Switching frequency	$f$	$V_{IN} = 15\text{V}$ , $I_O = 1.0\text{A}$	240	300	360	kHz
Line regulation	$\Delta V_{O\text{LINE}}$	$V_{IN} = 8 \text{ to } 20\text{V}$ , $I_O = 1.0\text{A}$		40	100	mV
Load regulation	$\Delta V_{O\text{LOAD}}$	$V_{IN} = 20\text{V}$ , $I_O = 0.5 \text{ to } 1.5\text{A}$		10	30	mV
Output voltage temperature coefficient	$\Delta V_O/\Delta T_a$	Designed target value. *		$\pm 0.5$		mV/ $^\circ\text{C}$
Ripple attenuation factor	RREJ	$f = 100 \text{ to } 120\text{Hz}$		45		dB
Current limiter operating voltage	$I_S$	$V_{IN} = 15\text{V}$	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		$^\circ\text{C}$

\* Design target value : No measurement made.

## Package Dimensions

unit : mm (typ)

3343

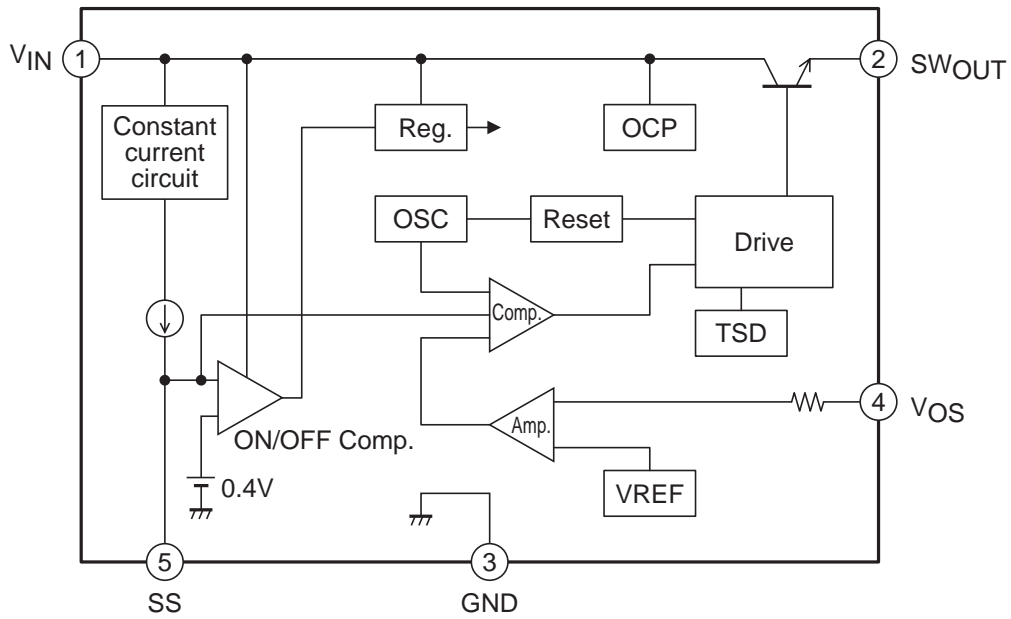


## Pin Assignment

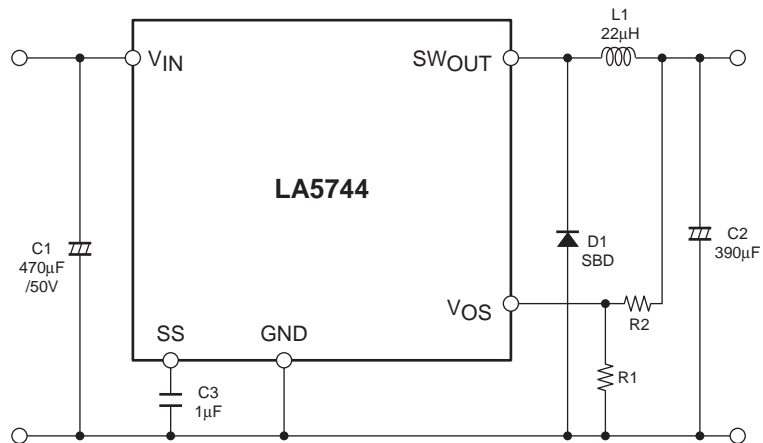
(1)  $V_{IN}$  (2)  $SW_{OUT}$  (3) GND (4)  $V_{OS}$  (5) SS

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## Block Diagram



## Application Circuit Example



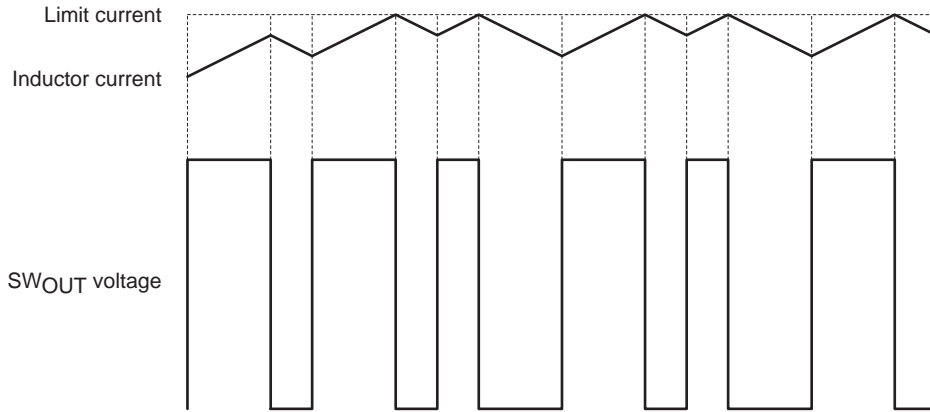
### Notes :

1.  $C3$  is for the soft start function. Delete  $C3$  and keep the  $SS$  pin open when the soft start function is not necessary.
2. In some cases, the output may not turn on if power is applied when a load is connected. If this is a problem, increase the value of the inductor.

**Protection Circuit Functional Descriptions**

1. Overcurrent protection function

The overcurrent protection function detects, on a cycle-by-cycle basis, the output transistor current and turns off that output transistor current if it exceeds 3.1A.



2. Short circuit protection function

This IC prevents the current from increasing when the outputs are shorted by setting the switching frequency to 30kHz if the V<sub>OS</sub> pin voltage falls below 0.8V.

Note 3 : If the soft start function is not used, the IC will start up with the overcurrent protection function operating. At this time, the switching frequency will be cut in half. This means that the switching frequency will be 15kHz at startup.

Note 4 : Since the switching frequency becomes 30kHz when the V<sub>OS</sub> pin voltage falls under 0.8V, the current capacity is reduced. If a load is applied with the V<sub>OS</sub> pin voltage over 0.8V, the inductance value operates at 22μH. If a load is to be applied when this voltage is under 0.8V, the inductance value must be increased.

**Description of Functional Settings**

1. Calculation equation to set the output voltage

This IC controls the switching output so that the V<sub>OS</sub> pin voltage becomes 1.23V (typ).

The equation to set the output voltage is as follows :

$$V_O = \left(1 + \frac{R_2}{R_1}\right) \times 1.23V(typ)$$

The V<sub>OS</sub> pin has the inrush current of 1μA (typ). Therefore, the error becomes larger when R<sub>1</sub> and R<sub>2</sub> resistance values are large.

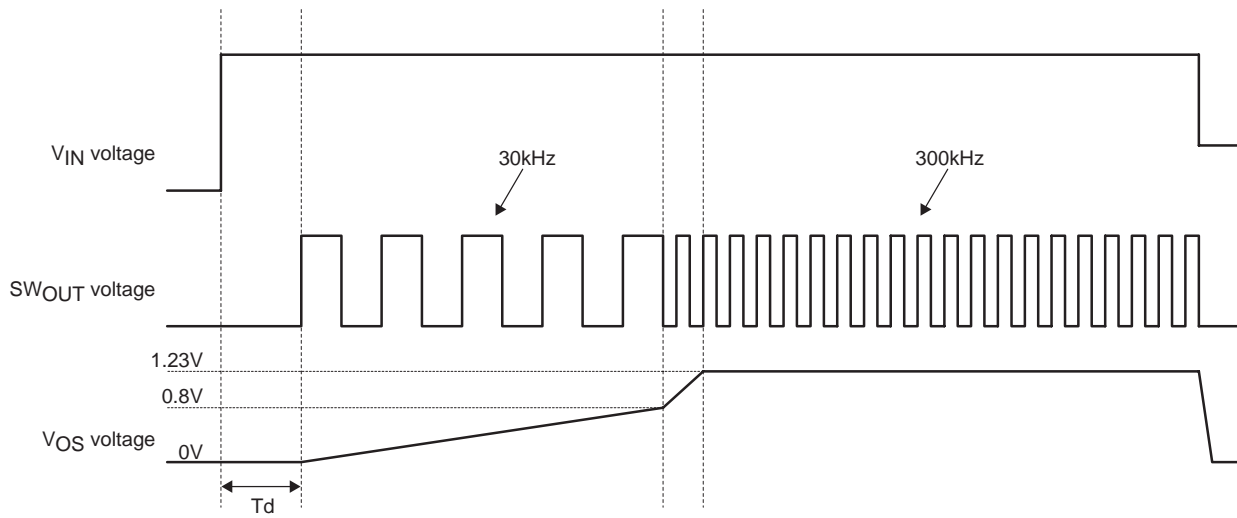
2. Startup Delay Function

The output voltage rises when the internal voltage reaches 0.4V (typical). Until that point, a capacitor is charged from an internal 10μA (typical) constant-current supply. The startup delay time can be calculated as shown below

Example : Assume a 1μF capacitor is used.

$$T_d = \frac{C \times V}{i} = \frac{1\mu F \times 0.4}{10\mu A} = 40 ms$$

Timing Chart



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