# LA5744MP

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



# Overview

The LA5744MP 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 $Ta = 25^{\circ}C$

Parameter	Symbol	Conditions	Ratings	Unit
Input voltage	VIN		30	V
Maximum output current	I <sub>O</sub> max		3	А
SW pin application reverse voltage	V <sub>SW</sub>		-1	V
Allowable power dissipation	Pd max	Mounted on a circuit board.*	3.9	W
Operating temperature	Topr		-30 to +125	°C
Storage temperature	Tstg		-40 to +150	°C

\* Specified circuit board : 76.1×114.3×1.6mm<sup>3</sup> : 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 $Ta = 25^{\circ}C$

Parameter	Symbol	Conditions	Ratings	Unit
Input voltage range	VIN		4.5 to 28	V

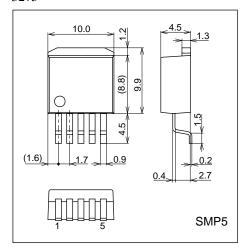
# **Electrical Characteristics** at $Ta = 25^{\circ}C$ , $V_{O} = 5V$

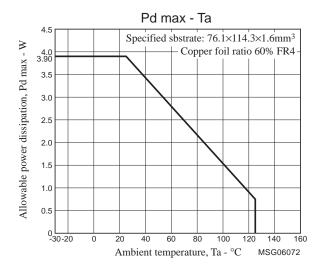
Parameter	Symbol	Conditions	Ratings			1.1
			min	typ	max	Unit
Reference voltage	VOS	V <sub>IN</sub> = 15V, I <sub>O</sub> = 1.0A	1.20	1.23	1.26	V
Efficiency	η	V <sub>IN</sub> = 15V, I <sub>O</sub> = 1.0A		83		%
Switching frequency	f	V <sub>IN</sub> = 15V, I <sub>O</sub> = 1.0A	240	300	360	kHz
Line regulation		V <sub>IN</sub> = 8 to 20V, I <sub>O</sub> = 1.0A		40	100	mV
Load regulation	∆V <sub>O</sub> LOAD	V <sub>IN</sub> = 20V, I <sub>O</sub> = 0.5 to 1.5A		10	30	mV
Output voltage temperature coefficient	ΔV <sub>O</sub> /ΔTa	Designed target value. *		±0.5		mV/°C
Ripple attenuation factor	RREJ	f = 100 to 120Hz		45		dB
Current limiter operating voltage	IS	V <sub>IN</sub> = 15V	3.1			А
Thermal shutdown operating temperature	TSD	Designed target value. *		165		°C
Thermal shutdown Hysteresis width	∆TSD	Designed target value. *		15		°C

\* Design target value : No measurement made.

# **Package Dimensions**

unit : mm (typ) 3275

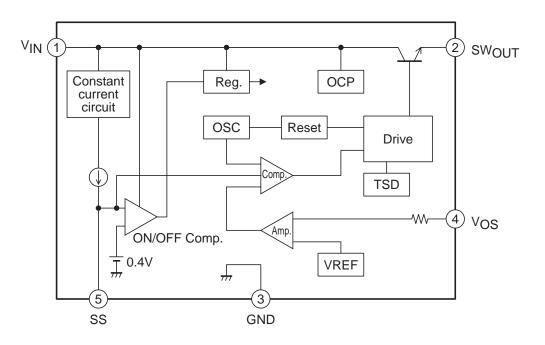




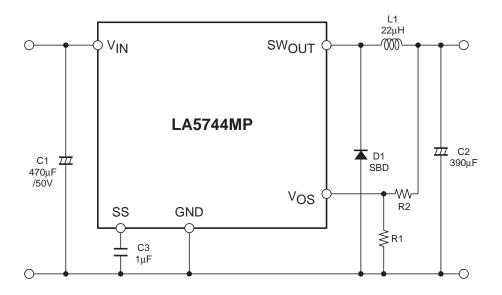
# **Pin Assignment**

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

# **Block Diagram**



# **Application Circuit Example**



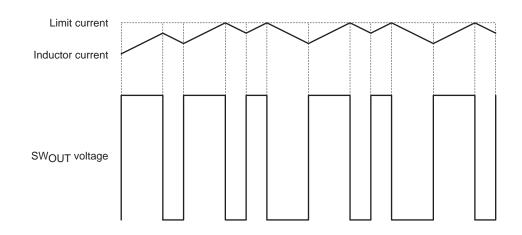
Notes :

- 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 VOS 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 VOS pin voltage falls under 0.8V, the current capacity is reduced. If a load is applied with the VOS pin voltage over 0.8V, the inductance value operates at  $22\mu$ H. 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 VOS pin voltage becomes 1.23V (typ).

The equation to set the output voltage is as follows :

$$V_O = \left(I + \frac{R^2}{RI}\right) \times 1.23V(typ)$$

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

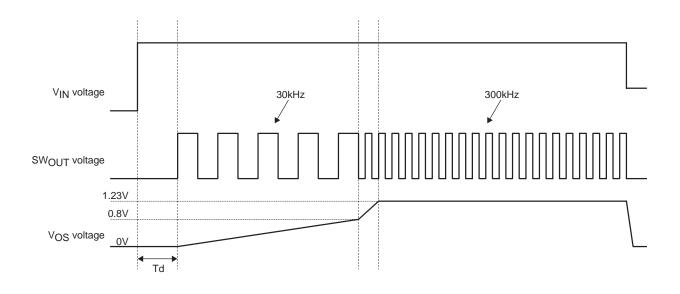
#### 2. Startup Delay Function

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

Example : Assume a  $1\mu$ F capacitor is used.

$$Td = \frac{C \times V}{i} = \frac{I\mu F \times 0.4}{I0\mu A} = 40 \text{ ms}$$

#### **Timing Chart**



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