Ordering number : ENA0587A

# LA5744MP

ON Semiconductor®

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**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°C

| Parameter | Symbol | Conditions | Ratings | Unit |
|---|---|---|---|---|
| Input voltage | $V_{IN}$ | | 30 | V |
| Maximum output current | $I_O$ max | | 3 | A |
| SW pin application reverse voltage | $V_{SW}$ | | -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$^3$ : 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 Ta = 25°C

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

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

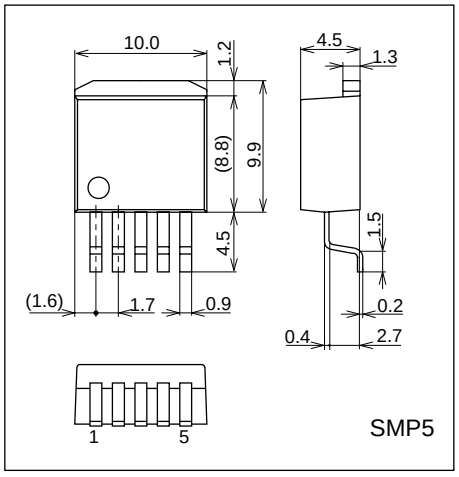
| Parameter | Symbol | Conditions | Ratings | | | Unit |
|---|---|---|---|---|---|---|
| | | | min | typ | max | |
| Reference voltage | $V_{OS}$ | $V_{IN}$ = 15V, $I_O$ = 1.0A | 1.20 | 1.23 | 1.26 | V |
| Efficiency | η | $V_{IN}$ = 15V, $I_O$ = 1.0A | | 83 | | % |
| Switching frequency | f | $V_{IN}$ = 15V, $I_O$ = 1.0A | 240 | 300 | 360 | kHz |
| Line regulation | $\Delta V_O$LINE | $V_{IN}$ = 8 to 20V, $I_O$ = 1.0A | | 40 | 100 | mV |
| Load regulation | $\Delta V_O$LOAD | $V_{IN}$ = 20V, $I_O$ = 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 | 3.1 | | | A |
| Thermal shutdown operating temperature | TSD | Designed target value. * | | 165 | | °C |
| Thermal shutdown Hysteresis width | ΔTSD | Designed target value. * | | 15 | | °C |

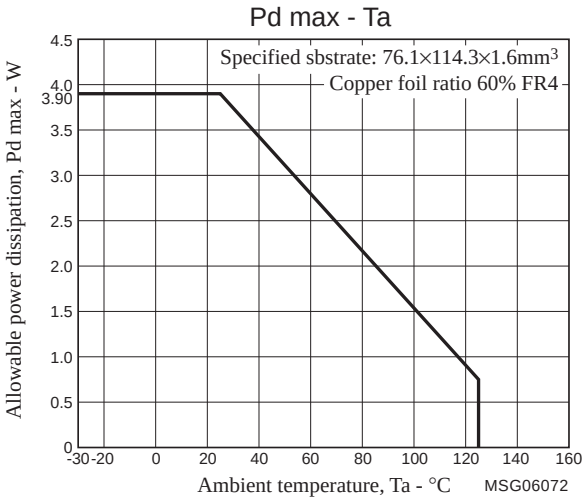
* Design target value : No measurement made.

## Package Dimensions

unit : mm (typ)

3275

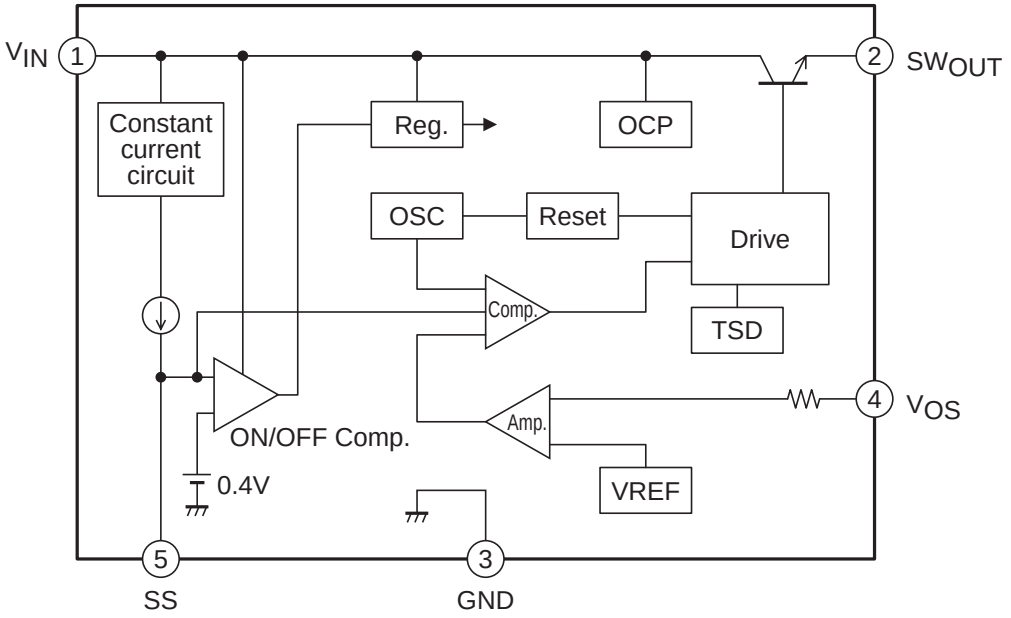


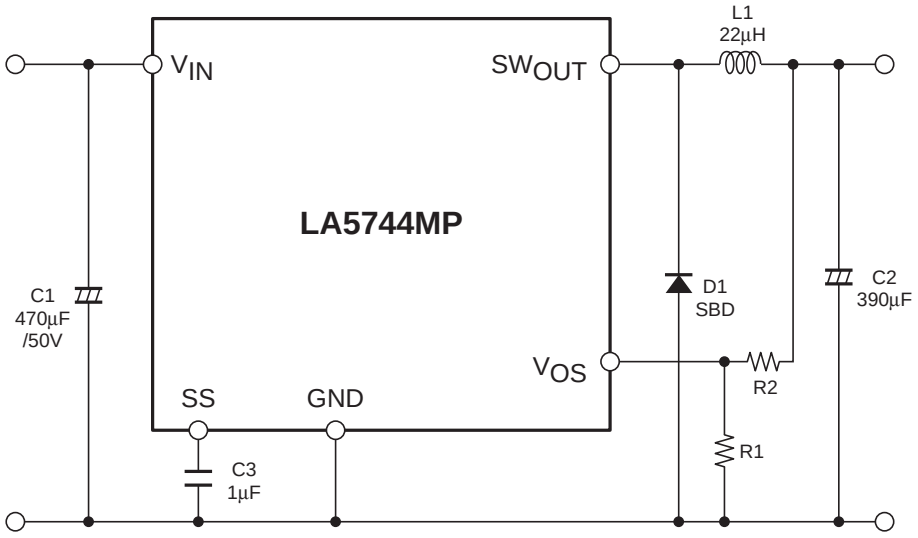

## Pin Assignment

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

## Block Diagram




## Application Circuit Example

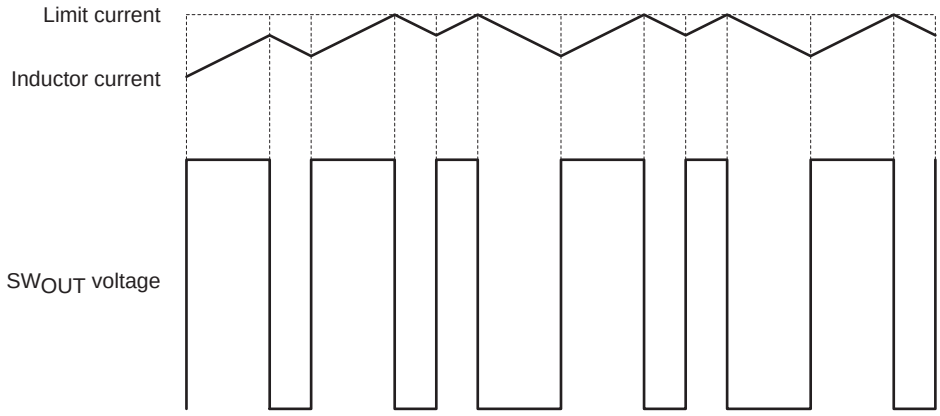



Notes :

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 $V_{OS}$ 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 $V_{OS}$ pin voltage falls under 0.8V, the current capacity is reduced. If a load is applied with the $V_{OS}$ 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 $V_{OS}$ pin voltage becomes 1.23V (typ).
   The equation to set the output voltage is as follows :

$$V_O = \left(1 + \frac{R2}{R1}\right) \times 1.23V(typ)$$

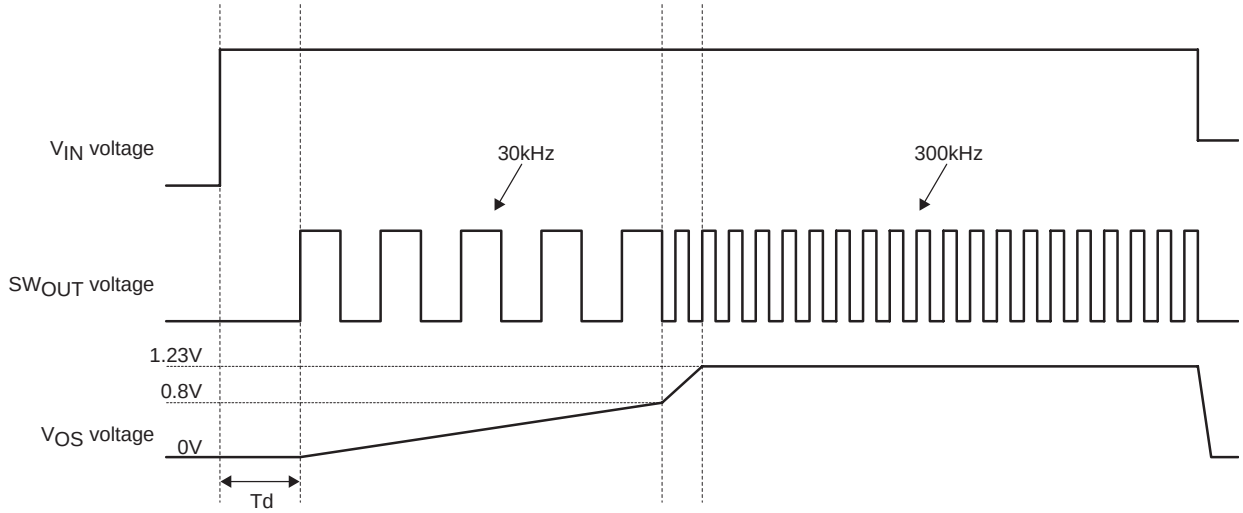
   The $V_{OS}$ pin has the inrush current of 1µA (typ). Therefore, the error becomes larger when R1 and R2 resistance values are large.

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 10µA (typical) constant-current supply. The startup delay time can be calculated as shown below

   Example : Assume a 1µF capacitor is used.

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

## Timing Chart




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