



LA5754

Monolithic Linear IC
— Separately-excited Step-down
Switching Regulator (Variable Type)

Overview

The LA5754 is a separately-excited step-down switching regulator (variable type).

Features

- High efficiency
- Four external parts
- Time-base generator (125kHz) 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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LA5754

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

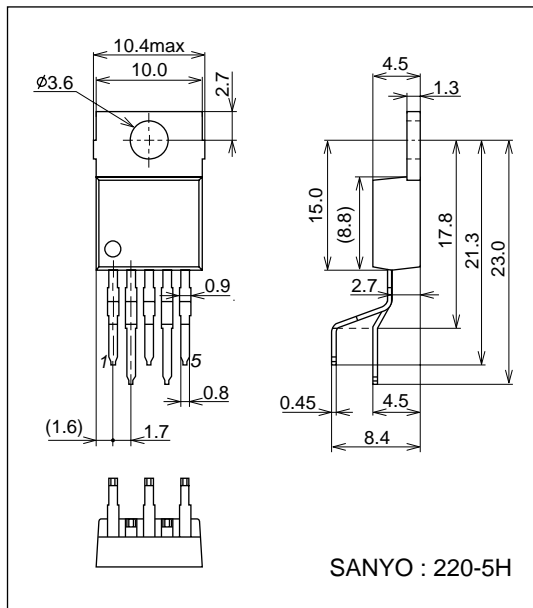
| Parameter | Symbol | Conditions | Ratings | | | Unit |
|--|-------------------------|--|---------|-----------|------|----------------------|
| | | | min | typ | max | |
| Output voltage | V_O | $V_{IN} = 15\text{V}, I_O = 1.0\text{A}$ | 2.53 | 2.66 | 2.76 | V |
| Switching frequency | f | $V_{IN} = 15\text{V}, I_O = 1.0\text{A}$ | 100 | 125 | 150 | kHz |
| Line regulation | ΔV_{OLINE} | $V_{IN} = 8 \text{ to } 20\text{V}, I_O = 1.0\text{A}$ | | 25 | 80 | mV |
| Load regulation | ΔV_{OLOAD} | $V_{IN} = 15\text{V}, I_O = 0.5 \text{ to } 1.5\text{A}$ | | 10 | 30 | mV |
| Output voltage temperature coefficient | $\Delta V_O/\Delta T_a$ | | | ± 0.5 | | 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 | ΔTSD | Designed target value* | | 15 | | $^\circ\text{C}$ |

* Designed target value: No measurement made.

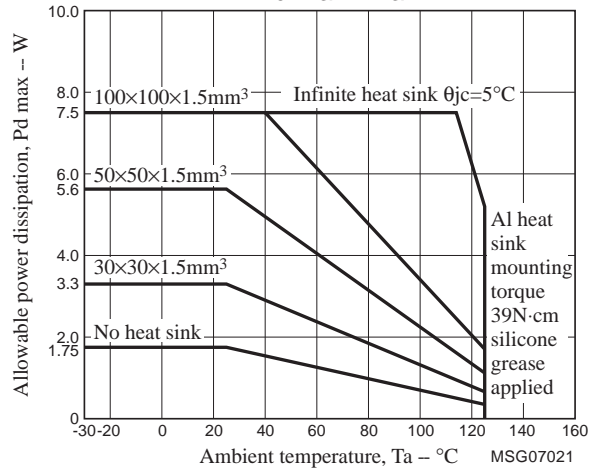
Package Dimensions

unit : mm (typ)

3079C



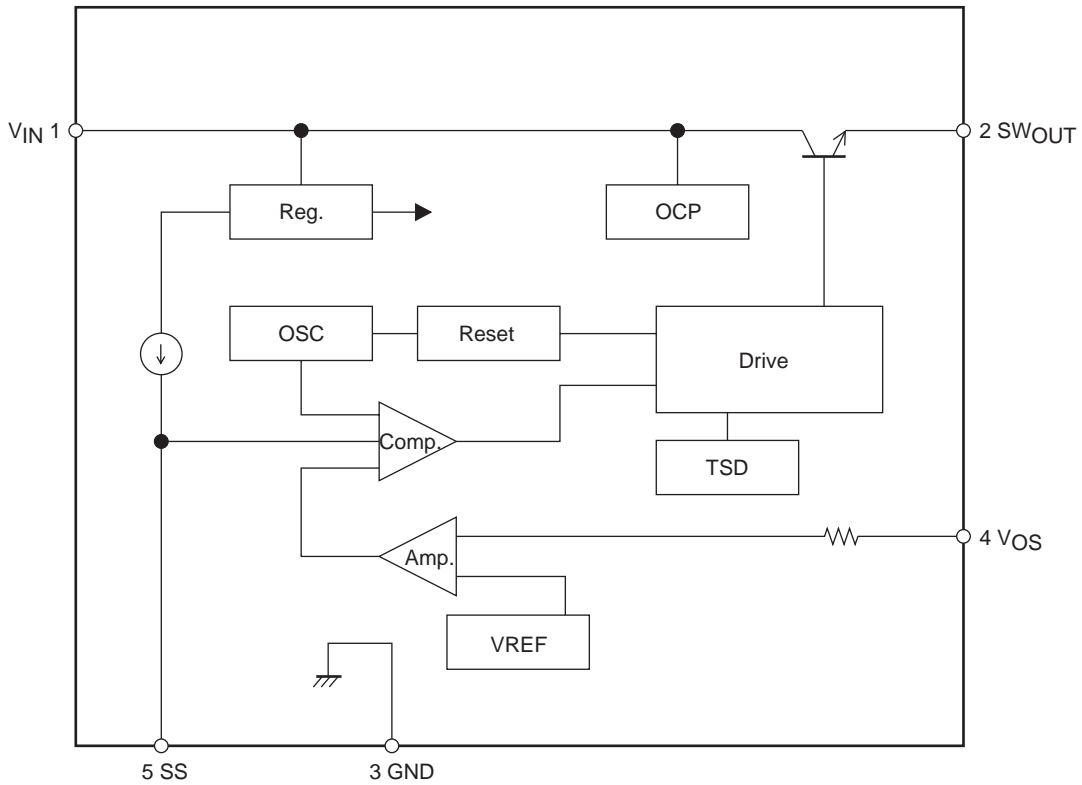
$P_d \text{ max} - T_a$



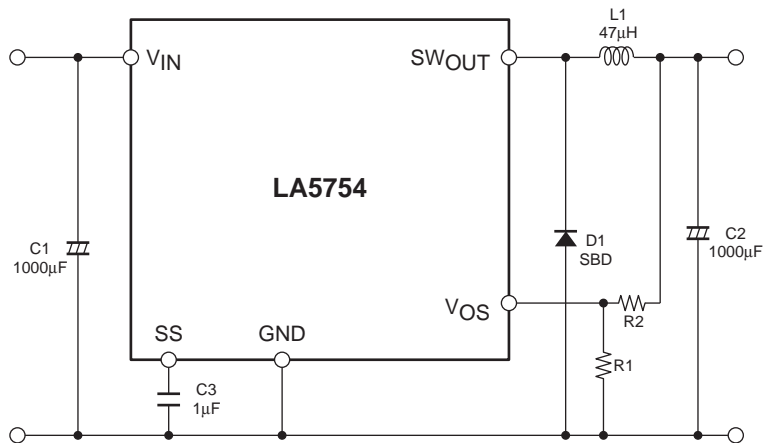
Pin Assignment

(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.

Calculation equation to set the output voltage

This IC controls the switching output so that the VOS pin voltage becomes 2.66V (typ). The equation to set the output voltage is as follows:

$$V_O = \left(1 + \frac{R_2}{R_1}\right) \times 2.66V(\text{typ})$$

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

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:

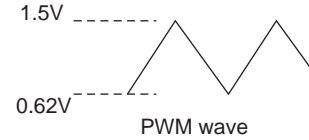
ex. For setting at 1μF

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

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))

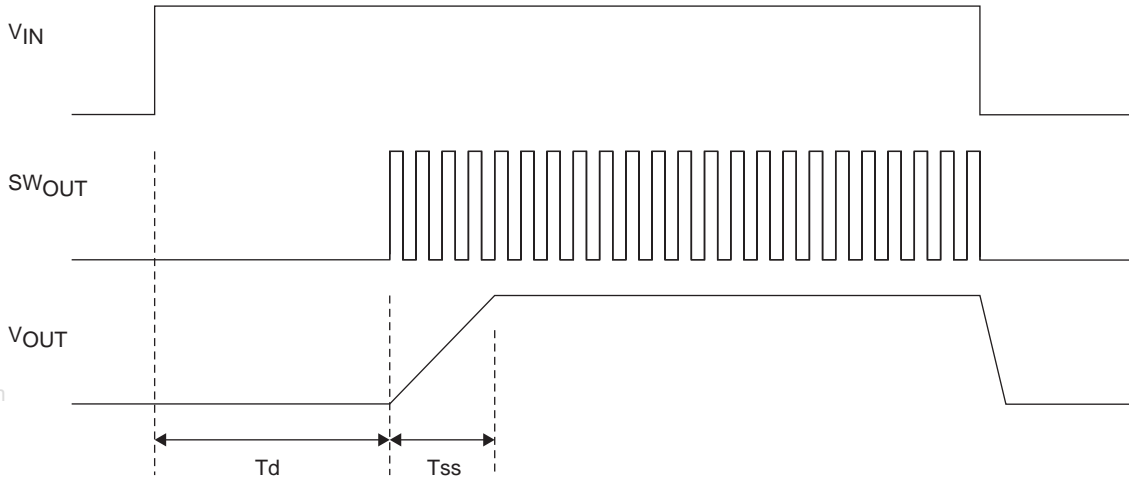
SS pin and error amplifier output voltages are designed to prefer the lower voltages, so that V_{OUT} will reach the designed regulation voltage in timing when the SS pin voltage exceeds the error amplifier output. Therefore, the soft start time is calculated as follows:

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

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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