



LA5753

Monolithic Linear IC — Separately-excited Step-down Switching Regulator (12V)

Overview

The LA5753 is a separately-excited step-down switching regulator (12V).

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

Parameter	Symbol	Conditions	Ratings	Unit
Input voltage range	V_{IN}		15 to 28	V
Operating junction temperature range	$T_{j\text{ op}}$		-30 to +150	$^\circ\text{C}$

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

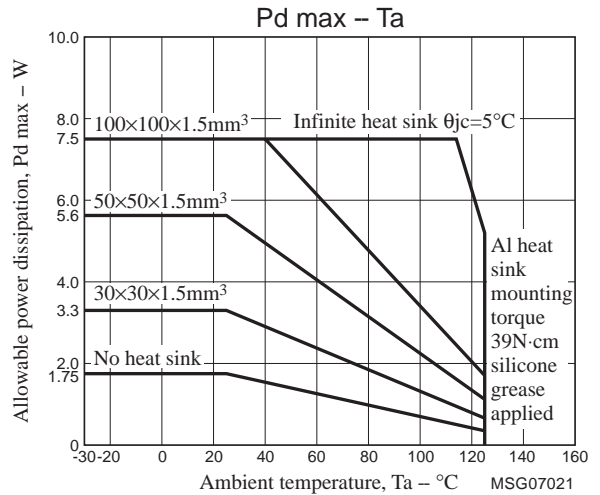
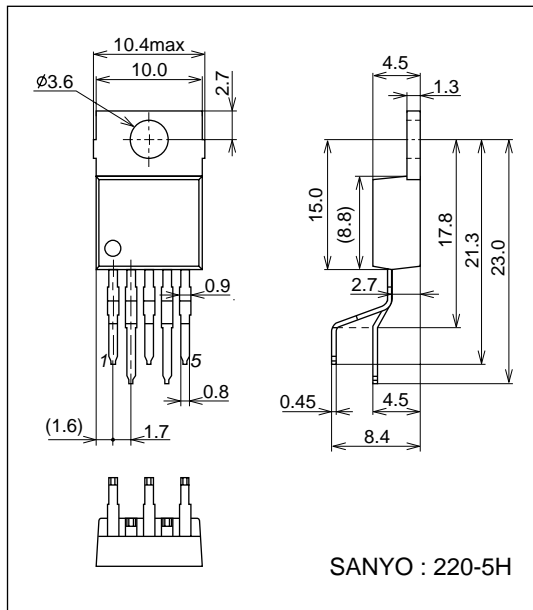
Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Output voltage	V_O	$V_{IN} = 24\text{V}, I_O = 1.0\text{A}$	11.5	12.0	12.5	V
Efficiency	η	$V_{IN} = 24\text{V}, I_O = 1.0\text{A}$		90		%
Switching frequency	f	$V_{IN} = 24\text{V}, I_O = 1.0\text{A}$	48	60	72	kHz
Line regulation	ΔV_{OLINE}	$V_{IN} = 18 \text{ to } 28\text{V}, I_O = 1.0\text{A}$		60	130	mV
Load regulation	ΔV_{OLOAD}	$V_{IN} = 24\text{V}, I_O = 0.5 \text{ to } 1.5\text{A}$		10	40	mV
Output voltage temperature coefficient	$\Delta V_O/\Delta T_a$			± 1.0		mV/ $^\circ\text{C}$
Ripple attenuation factor	RREJ	f = 100 to 120Hz		45		dB
Current limiter operating voltage	IS	$V_{IN} = 24\text{V}$	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

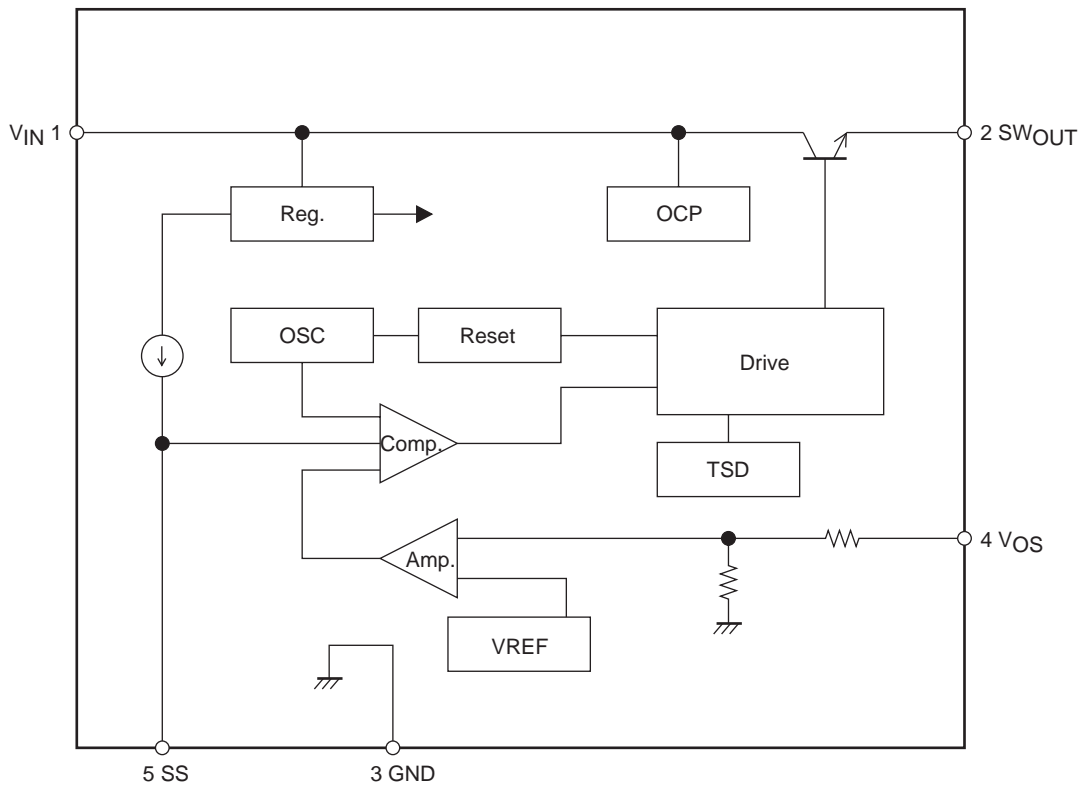


Pin Assignment

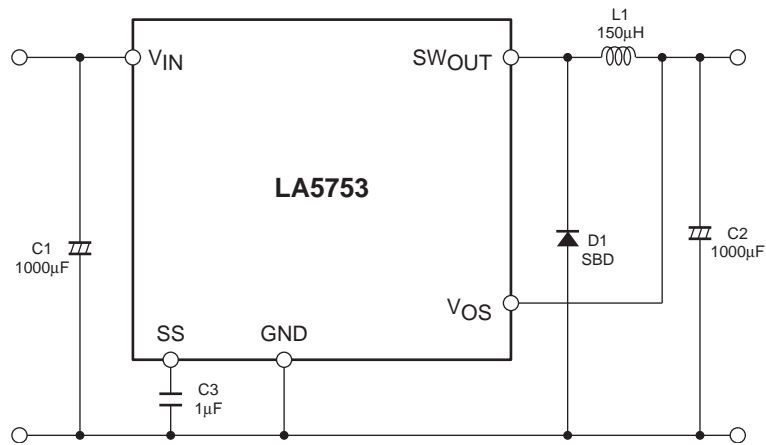
(1) V_{IN} (2) SW_{OUT} (3) GND (4) V_{OS} (5) SS

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Block Diagram



Application Circuit Example



Notes: $C3$ 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

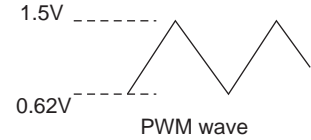
The SS pin has the internally-connected 22μA (typ) constant-current supply. When the voltage of SS pin exceeds the threshold voltage, the regulator starts operation. As the threshold is 0.62V(typ), the start delay time can be calculated as follows:

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 $V_{IN} = 24V$ to 12V output to be made, for example, the PWM-ON duty has the value as shown below.



$$PWMduty = \frac{V_{OUT} + VF}{V_{IN} - V_{sat} + VF} = 53\%$$

(Note that calculation is made with $V_{sat} = 1V$ and $VF = 0.2V$)

The output voltage of error amplifier, which is 12V, is the value with PWM = 53%, as calculated in the above equation, so that this voltage is determined as follows:

$$V_{er} = (\Delta VPWM) \times PWMduty + VPWML = 0.88V \times 0.53 + 0.62V = 1.09V$$

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

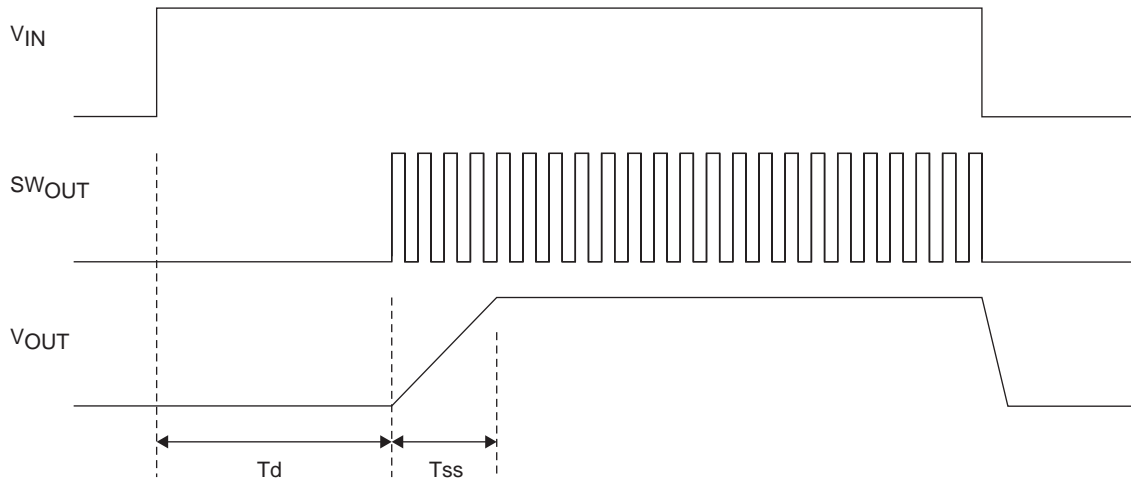
SS pin and error amplifier output voltages are designed to prefer the lower voltages, so that V_{OUT} will reach the designed regulation voltage in timing when the SS pin voltage exceeds the error amplifier output. Therefore, the soft start time is calculated as follows:

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

For the set conditions of $C = 1\mu F$ and $PWMduty = 53\%$:

$$T_{ss} = \frac{1\mu \times 0.88V \times 0.53}{22\mu A} = 21.2 \text{ msec}$$

Timing Chart



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