Ordering number : ENA2191

LA5774MC

Monolithic Linear IC

ON Semiconductor®

http://onsemi.com

Separately-excited Step-down **Switching Regulator (Variable Type)**

Overview

The LA5774MC is a Separately-excited step-down switching regulator (variable type).

Function

- High efficiency.
- Time-base generator (160kHz) incorporated.
- Current limiter incorporated.
- Thermal shutdown circuit incorporated.
- Soft start circuit incorporated.

Specifications

Absolute Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum Input voltage	V_{IN} max		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 substrate.*	3.9	W
VOS pin application reverse voltage	VVOS		-0.2 to +7	V
Operating temperature	Topr		-30 to +125	°C
Storage temperature	Tstg		-40 to +150	°C

* Specified substrate : 76.1×114.3×1.6mm^3 : Copper foil ratio 60% FR4

Caution 1) Absolute maximum ratings represent the value which cannot be exceeded for any length of time.

Caution 2) Even when the device is used within the range of absolute maximum ratings, as a result of continuous usage under high temperature, high current, high voltage, or drastic temperature change, the reliability of the IC may be degraded. Please contact us for the further details.

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

ORDERING INFORMATION

See detailed ordering and shipping information on page 5 of this data sheet.

Electrical Characteristics at Ta = 25°C, V_O = 3.3V

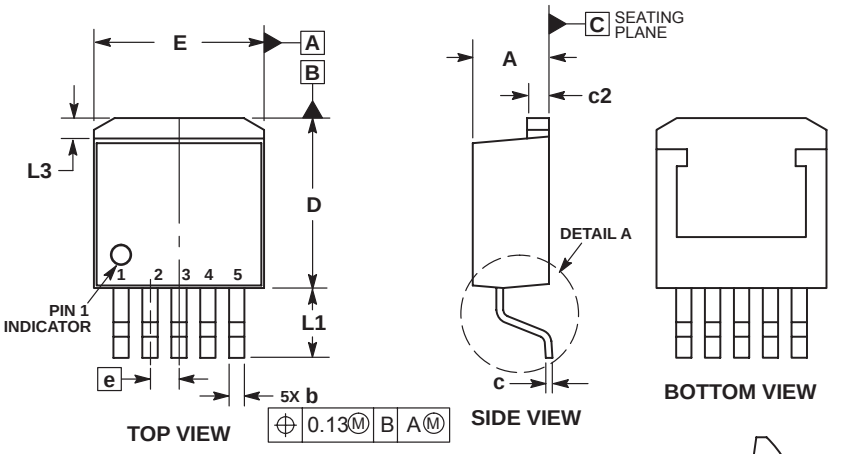
Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Reference voltage	V_{OS}		1.235	1.26	1.285	V
Efficiency	η			78		%
Switching frequency	fosc		128	160	192	kHz
Line regulation	ΔV_OLINE	V_{IN} = 8 to 20V		40	100	mV
Load regulation	ΔV_OLOAD	I_O = 0.5 to 1.5A		10	30	mV
Output voltage temperature 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		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

D²PAK5 / SMP5J

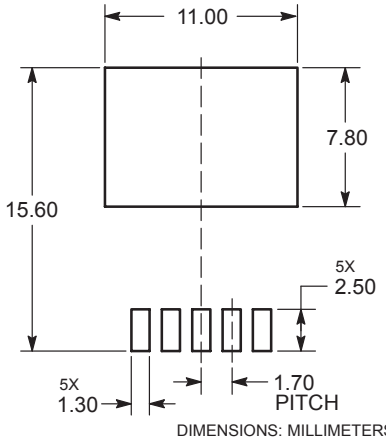
CASE 418AS
ISSUE O



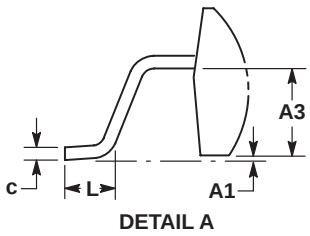
NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.15 MILLIMETERS PER SIDE.
4. DIMENSIONS D AND E ARE DETERMINED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.
5. DATUMS A AND B ARE DETERMINED AT DATUM PLANE C.

	MILLIMETERS	
DIM	MIN	MAX
A	4.20	4.80
A1	0.00	0.30
A3	2.40	3.00
b	0.75	1.05
c	0.25	0.55
c2	1.10	1.50
D	9.50	10.30
E	9.80	10.20
e	1.70 BSC	
L	1.20	1.80
L1	3.80	4.40
L3	1.00	1.40

RECOMMENDED SOLDERING FOOTPRINT*



DIMENSIONS: MILLIMETERS



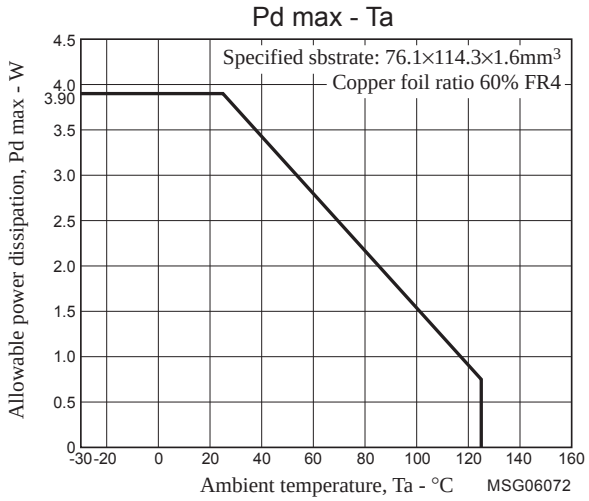
DETAIL A

*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

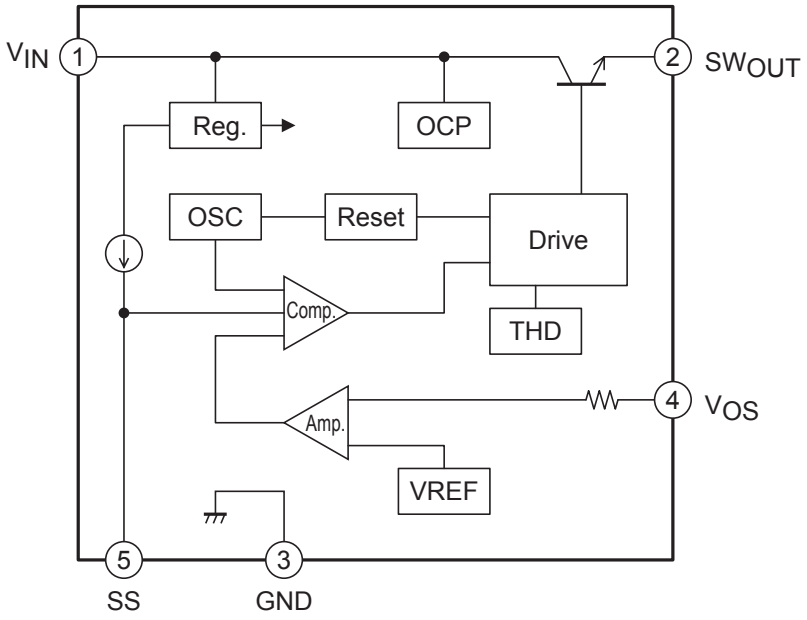
Pin Assignment

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

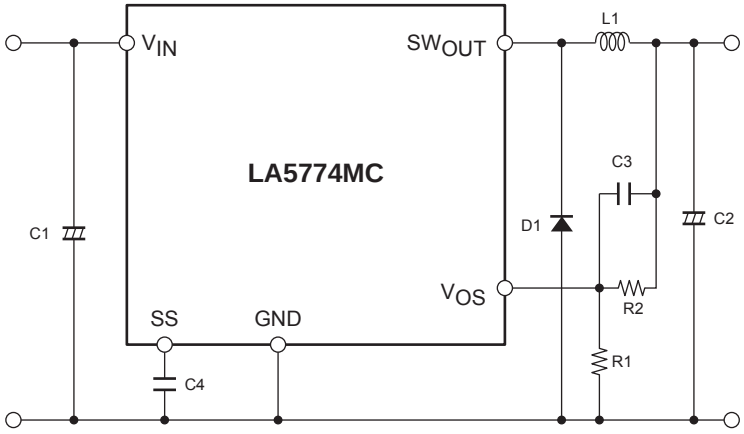
Allowable power dissipation derating curve



Block Diagram



Application Circuit Example



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 1.26V (typ).
   The equation to set the output voltage is as follows:

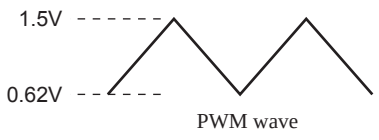
$$V_O = \left(1 + \frac{R2}{R1}\right) \times 1.26V(typ)$$

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

2. 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 voltage is 0.62V (typ), the start delay time can be calculated as follows:
   ex. For setting at 1μF

$$Td = \frac{C \times V}{i} = \frac{1\mu F \times 0.62}{22\mu A} = 28.2\ ms$$

3. 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} = 15 V to V_{IN} = 3.3V is to be made, for example, the PWM-ON duty has the value as shown below.



PWM wave

$$PWMduty = \frac{V_{OUT} + VF}{V_{IN} - Vsat + VF} = 25\ \%$$

   (Note that calculation is made with Vsat = 1V and VF = 0.2V)

   The output voltage of error amplifier, which is 3.3 V, is the value with PWM = 25%, as calculated in the above equation, so that this voltage is determined as follows:

$$\boldsymbol{Ver = (\Delta VPWM) \times PWMduty + VPWML = 0.88V \times 0.25 + 0.62V = 0.84V}$$

   (ΔVPWM is the PWM amplitude value or 0.88V(typ) while VPWML is the lower limit voltage of PWM waveform or 0.62V(typ))

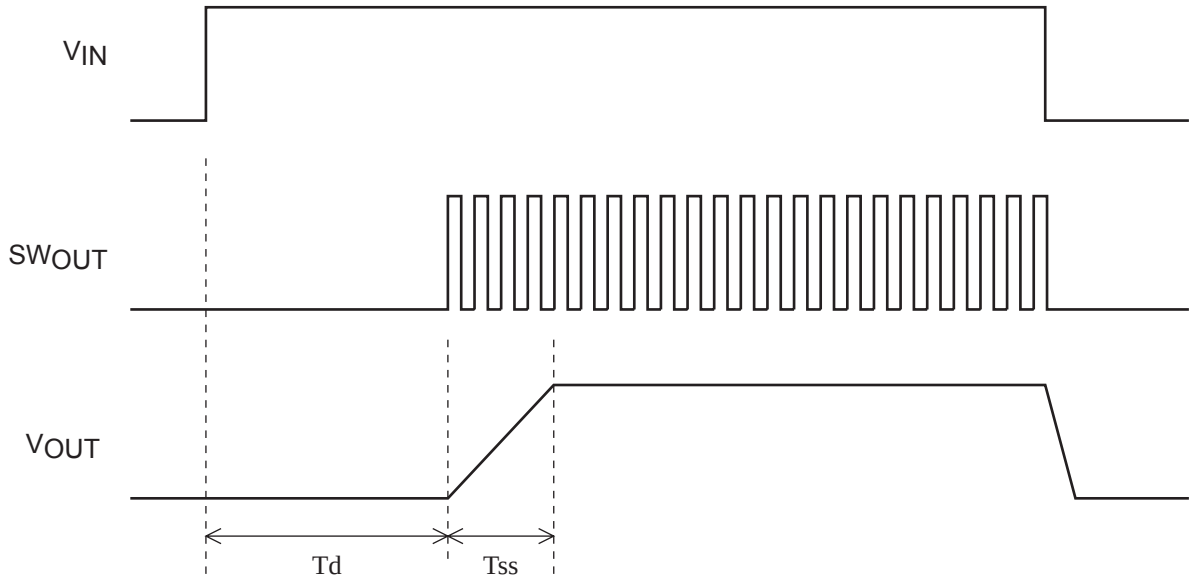
SS pin and error amplifier output voltages are designed to prefer the lower voltages, so that V_{OUT} will reach the designed regulation voltage in timing when the SS pin voltage exceeds the error amplifier output.
Therefore, the soft start time is calculated as follows:

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

For the set conditions of C = 1μF and PWMduty = 25%:

$$Tss = \frac{1\mu F \times 0.88V \times 0.25}{22\mu A} = 10ms$$

Timing Chart



ORDERING INFORMATION

Device	Package	Shipping (Qty / Packing)
LA5774MC-BE	SMP5J (Pb-Free / Halogen Free)	1000 / Tape & Reel
LA5774MC-E	SMP5J (Pb-Free / Halogen Free)	50 / Fan-Fold