National Semiconductor

LM2676
SIMPLE SWITCHER® High Efficiency 3A Step-Down Voltage Regulator

General Description

The LM2676 series of regulators are monolithic integrated circuits which provide all of the active functions for a step-down (buck) switching regulator capable of driving up to 3A loads with excellent line and load regulation characteristics. High efficiency (>90%) is obtained through the use of a low ON-resistance DMOS power switch. The series consists of fixed output voltages of 3.3V, 5V and 12V and an adjustable output version.

The SIMPLE SWITCHER concept provides for a complete design using a minimum number of external components. A high fixed frequency oscillator (260KHz) allows the use of physically smaller sized components. A family of standard inductors for use with the LM2676 are available from several manufacturers to greatly simplify the design process.

The LM2676 series also has built in thermal shutdown, current limiting and an ON/OFF control input that can power down the regulator to a low 50µA quiescent current standby condition. The output voltage is guaranteed to a ±2% tolerance. The clock frequency is controlled to within a ±11% tolerance.

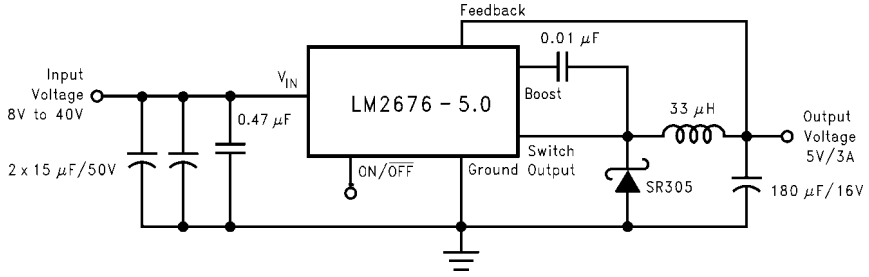
Features

- Efficiency up to 94%
- Simple and easy to design with (using off-the-shelf external components)
- 150 mΩ DMOS output switch
- 3.3V, 5V and 12V fixed output and adjustable (1.2V to 37V) versions
- 50µA standby current when switched OFF
- ±2%maximum output tolerance over full line and load conditions
- Wide input voltage range: 8V to 40V
- 260 KHz fixed frequency internal oscillator
- −40 to +125°C operating junction temperature range

Applications

- Simple to design, high efficiency (>90%) step-down switching regulators
- Efficient system pre-regulator for linear voltage regulators
- Battery chargers

Typical Application



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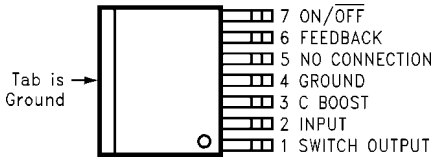
Connection Diagrams and Ordering Information

TO-263 Package
Top View



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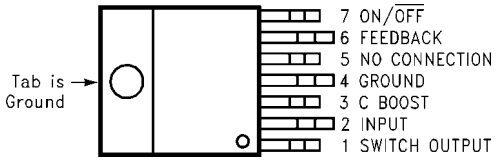
Order Number
LM2676S-3.3, LM2676S-5.0,
LM2676S-12 or LM2676S-ADJ
See NSC Package Number TS7B

TO-220 Package
Top View



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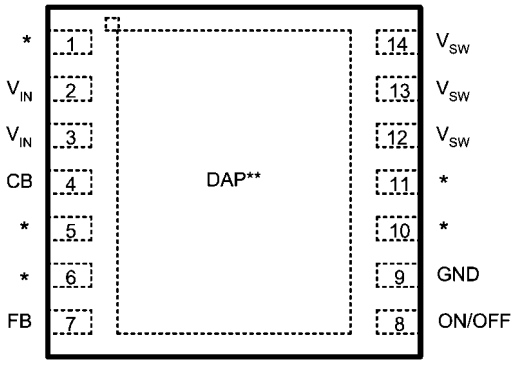
Order Number
LM2676T-3.3, LM2676T-5.0,
LM2676T-12 or LM2676T-ADJ
See NSC Package Number TA07B

Top View



*No Connections

**Connect to Pin 9 on PCB

10091441

LLP-14
See NS package Number SRC14A

Ordering Information for LLP Package

Output Voltage	Order Information	Package Marking	Supplied As
12	LM2676SD-12	S0003LB	250 Units on Tape and Reel
12	LM2676SDX-12	S0003LB	2500 Units on Tape and Reel
3.3	LM2676SD-3.3	S0003NB	250 Units on Tape and Reel
3.3	LM2676SDX-3.3	S0003NB	2500 Units on Tape and Reel
5.0	LM2676SD-5.0	S0003PB	250 Units on Tape and Reel
5.0	LM2676SDX-5.0	S0003PB	2500 Units on Tape and Reel
ADJ	LM2676SD-ADJ	S0003RB	250 Units on Tape and Reel
ADJ	LM2676SDX-ADJ	S0003RB	2500 Units on Tape and Reel

Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/ Distributors for availability and specifications.

Input Supply Voltage	45V
ON/OFF Pin Voltage	−0.1V to 6V
Switch Voltage to Ground (Note 12)	−1V to V_{IN}
Boost Pin Voltage	V_{SW} + 8V
Feedback Pin Voltage	−0.3V to 14V
Power Dissipation	Internally Limited
ESD (Note 2)	2 kV
Storage Temperature Range	−65°C to 150°C
Soldering Temperature	
Wave	4 sec, 260°C
Infrared	10 sec, 240°C
Vapor Phase	75 sec, 219°C

Operating Ratings

Supply Voltage	8V to 40V
Junction Temperature Range (T_J)	−40°C to 125°C

Electrical Characteristics

Limits appearing in **bold type face** apply over the entire junction temperature range of operation, −40°C to 125°C. Specifications appearing in normal type apply for $T_A = T_J = 25°C$.

LM2676-3.3

Symbol	Parameter	Conditions	Typical (Note 3)	Min (Note 4)	Max (Note 4)	Units
V_{OUT}	Output Voltage	V_{IN} = 8V to 40V, 100mA ≤ I_{OUT} ≤ 3A	3.3	3.234/**3.201**	3.366/**3.399**	V
η	Efficiency	V_{IN} = 12V, I_{LOAD} = 3A	86			%

LM2676-5.0

Symbol	Parameter	Conditions	Typical (Note 3)	Min (Note 4)	Max (Note 4)	Units
V_{OUT}	Output Voltage	V_{IN} = 8V to 40V, 100mA ≤ I_{OUT} ≤ 3A	5.0	4.900/**4.850**	5.100/**5.150**	V
η	Efficiency	V_{IN} = 12V, I_{LOAD} = 3A	88			%

LM2676-12

Symbol	Parameter	Conditions	Typical (Note 3)	Min (Note 4)	Max (Note 4)	Units
V_{OUT}	Output Voltage	V_{IN} = 15V to 40V, 100mA ≤ I_{OUT} ≤ 3A	12	11.76/**11.64**	12.24/**12.36**	V
η	Efficiency	V_{IN} = 24V, I_{LOAD} = 3A	94			%

LM2676-ADJ

Symbol	Parameter	Conditions	Typ (Note 3)	Min (Note 4)	Max (Note 4)	Units
V_{FB}	Feedback Voltage	V_{IN} = 8V to 40V, 100mA ≤ I_{OUT} ≤ 3A V_{OUT} Programmed for 5V	1.21	1.186/**1.174**	1.234/**1.246**	V
η	Efficiency	V_{IN} = 12V, I_{LOAD} = 3A	88			%

All Output Voltage Versions Electrical Characteristics

Limits appearing in **bold type face** apply over the entire junction temperature range of operation, –40°C to 125°C.

Specifications appearing in normal type apply for $T_A = T_J = 25°C$. Unless otherwise specified V_{IN}=12V for the 3.3V, 5V and Adjustable versions and V_{IN}=24V for the 12V version.

Symbol	Parameter	Conditions	Typ	Min	Max	Units
DEVICE PARAMETERS						
I_Q	Quiescent Current	$V_{FEEDBACK}$ = 8V For 3.3V, 5.0V, and ADJ Versions $V_{FEEDBACK}$ = 15V For 12V Versions	4.2		6	mA
I_{STBY}	Standby Quiescent Current	ON/OFF Pin = 0V	50		100/**150**	µA
I_{CL}	Current Limit		4.5	3.8/**3.6**	5.25/**5.4**	A
I_L	Output Leakage Current	V_{IN} = 40V, ON/OFF Pin = 0V V_{SWITCH} = 0V V_{SWITCH} = –1V	 16		 200 15	µA mA
$R_{DS(ON)}$	Switch On-Resistance	I_{SWITCH} = 3A	0.15		0.17/**0.29**	Ω
f_O	Oscillator Frequency	Measured at Switch Pin	260	**225**	**280**	kHz
D	Duty Cycle	Maximum Duty Cycle Minimum Duty Cycle	91 0			% %
I_{BIAS}	Feedback Bias Current	$V_{FEEDBACK}$ = 1.3V ADJ Version Only	85			nA
$V_{ON/OFF}$	ON/OFF Threshold Voltage		1.4	**0.8**	**2.0**	V
$I_{ON/OFF}$	ON/OFF Input Current	ON/OFF Input = 0V	20		**45**	µA
θ_{JA}	Thermal Resistance	T Package, Junction to Ambient (Note 5)	65			°C/W
θ_{JA}		T Package, Junction to Ambient (Note 6)	45			
θ_{JC}		T Package, Junction to Case	2			
θ_{JA}		S Package, Junction to Ambient (Note 7)	56			
θ_{JA}		S Package, Junction to Ambient (Note 8)	35			
θ_{JA}		S Package, Junction to Ambient (Note 9)	26			
θ_{JC}		S Package, Junction to Case	2			++
θ_{JA}		SD Package, Junction to Ambient (Note 10)	55			°C/W
θ_{JA}		SD Package, Junction to Ambient (Note 11)	29			

Note 1: Absolute Maximum Ratings are limits beyond which damage to the device may occur. Operating Ratings indicate conditions under which of the device is guaranteed. Operating Ratings do not imply guaranteed performance limits. For guaranteed performance limits and associated test condition, see the electrical Characteristics tables.

Note 2: ESD was applied using the human-body model, a 100pF capacitor discharged through a 1.5 kΩ resistor into each pin.

Note 3: Typical values are determined with $T_A = T_J = 25°C$ and represent the most likely norm.

Note 4: All limits are guaranteed at room temperature (standard type face) and at **temperature extremes (bold type face)**. All room temperature limits are 100% tested during production with $T_A = T_J = 25°C$. All limits at temperature extremes are guaranteed via correlation using standard standard Quality Control (SQC) methods. All limits are used to calculate Average Outgoing Quality Level (AOQL).

Note 5: Junction to ambient thermal resistance (no external heat sink) for the 7 lead TO-220 package mounted vertically, with ½ inch leads in a socket, or on a PC board with minimum copper area.

Note 6: Junction to ambient thermal resistance (no external heat sink) for the 7 lead TO-220 package mounted vertically, with ½ inch leads soldered to a PC board containing approximately 4 square inches of (1 oz.) copper area surrounding the leads.

Note 7: Junction to ambient thermal resistance for the 7 lead TO-263 mounted horizontally against a PC board area of 0.136 square inches (the same size as the TO-263 package) of 1 oz. (0.0014 in. thick) copper.

Note 8: Junction to ambient thermal resistance for the 7 lead TO-263 mounted horizontally against a PC board area of 0.4896 square inches (3.6 times the area of the TO-263 package) of 1 oz. (0.0014 in. thick) copper.

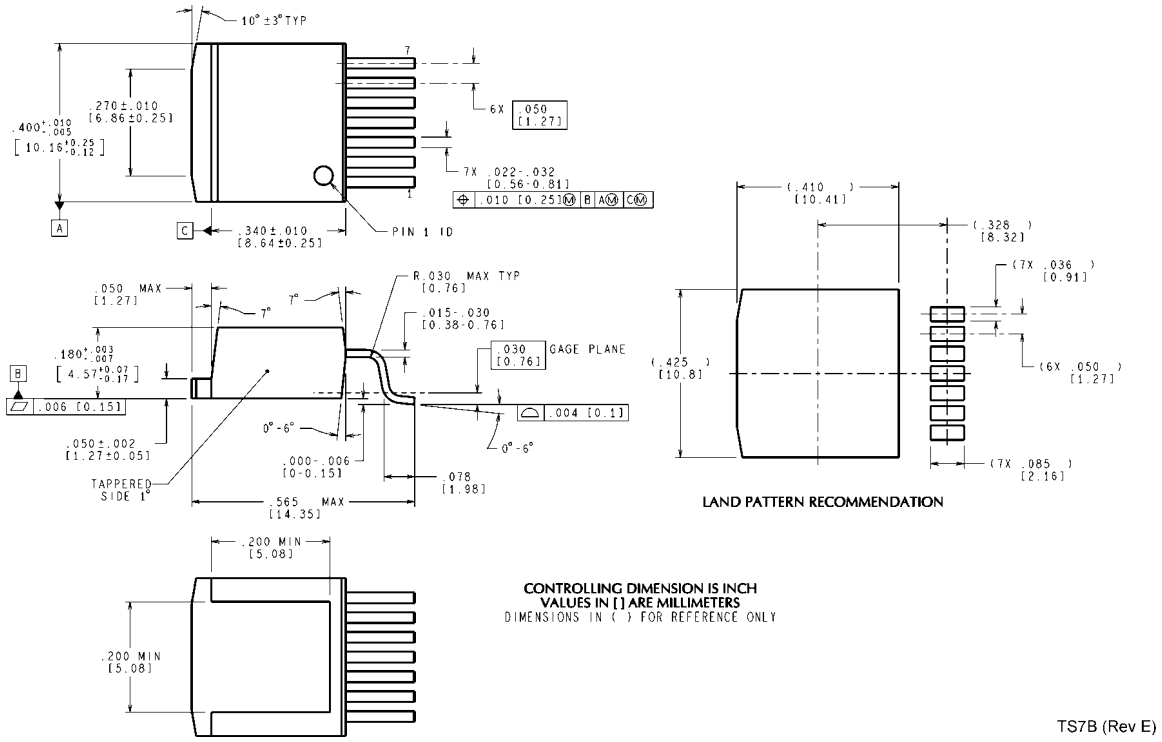
Note 9: Junction to ambient thermal resistance for the 7 lead TO-263 mounted horizontally against a PC board copper area of 1.0064 square inches (7.4 times the area of the TO-263 package) of 1 oz. (0.0014 in. thick) copper. Additional copper area will reduce thermal resistance further. See the thermal model in Switchers Made Simple® software.

Note 10: Junction to ambient thermal resistance for the 14-lead LLP mounted on a PC board copper area equal to the die attach paddle.

Note 11: Junction to ambient thermal resistance for the 14-lead LLP mounted on a PC board copper area using 12 vias to a second layer of copper equal to die attach paddle. Additional copper area will reduce thermal resistance further. For layout recommendations, refer to Application Note AN-1187.

Note 12: The absolute maximum specification of the 'Switch Voltage to Ground' applies to DC voltage. An extended negative voltage limit of -8V applies to a pulse of up to 20 ns, -6V of 60 ns and -3V of up to 100 ns.

Physical Dimensions inches (millimeters) unless otherwise noted



TS7B (Rev E)

TO-263 Surface Mount Power Package
Order Number LM2676S-3.3, LM2676S-5.0,
LM2676S-12 or LM2676S-ADJ
NS Package Number TS7B