National Semiconductor

LM2671
SIMPLE SWITCHER® Power Converter High Efficiency 500mA Step-Down Voltage Regulator with Features

LM2671 SIMPLE SWITCHER Power Converter High Efficiency 500mA Step-Down Voltage Regulator with Features

General Description

The LM2671 series of regulators are monolithic integrated circuits built with a LMDMOS process. These regulators provide all the active functions for a step-down (buck) switching regulator, capable of driving a 500mA load current with excellent line and load regulation. These devices are available in fixed output voltages of 3.3V, 5.0V, 12V, and an adjustable output version.

Requiring a minimum number of external components, these regulators are simple to use and include patented internal frequency compensation (Patent Nos. 5,382,918 and 5,514,947), fixed frequency oscillator, external shutdown, soft-start, and frequency synchronization.

The LM2671 series operates at a switching frequency of 260 kHz, thus allowing smaller sized filter components than what would be needed with lower frequency switching regulators. Because of its very high efficiency (>90%), the copper traces on the printed circuit board are the only heat sinking needed.

A family of standard inductors for use with the LM2671 are available from several different manufacturers. This feature greatly simplifies the design of switch-mode power supplies using these advanced ICs. Also included in the datasheet are selector guides for diodes and capacitors designed to work in switch-mode power supplies.

Other features include a guaranteed ±1.5% tolerance on output voltage within specified input voltages and output load conditions, and ±10% on the oscillator frequency. External shutdown is included, featuring typically 50 µA stand-by current. The output switch includes current limiting, as well as thermal shutdown for full protection under fault conditions.

To simplify the LM2671 buck regulator design procedure, there exists computer design software, ***LM267X Made Simple*** (version 6.0).

Features

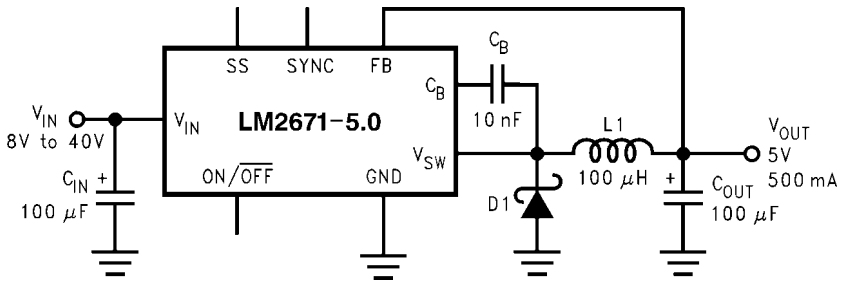
- Efficiency up to 96%
- Available in SO-8, 8-pin DIP and LLP packages
- Computer Design Software ***LM267X Made Simple*** (version 6.0)
- Simple and easy to design with
- Requires only 5 external components
- Uses readily available standard inductors
- 3.3V, 5.0V, 12V, and adjustable output versions
- Adjustable version output voltage range: 1.21V to 37V
- ±1.5% max output voltage tolerance over line and load conditions
- Guaranteed 500mA output load current
- 0.25Ω DMOS Output Switch
- Wide input voltage range: 8V to 40V
- 260 kHz fixed frequency internal oscillator
- TTL shutdown capability, low power standby mode
- Soft-start and frequency synchronization
- Thermal shutdown and current limit protection

Applications

- Simple High Efficiency (>90%) Step-Down (Buck) Regulator
- Efficient Pre-Regulator for Linear Regulators

Typical Application

(Fixed Output Voltage Versions)



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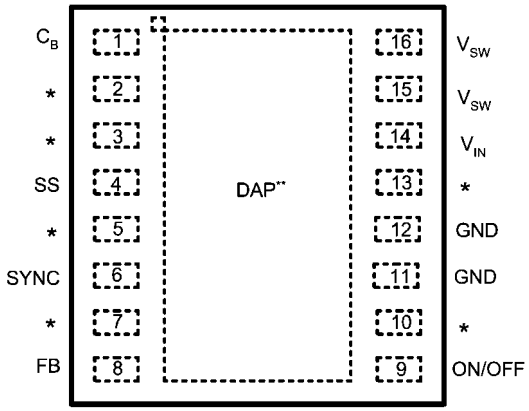
Connection Diagrams

16-Lead LLP Surface Mount Package
Top View



* No Connections
**Connect to Pins 11, 12 on PCB

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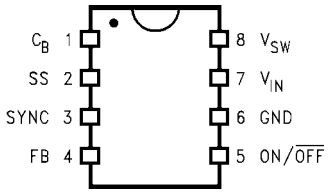
LLP Package
See NSC Package Drawing Number LDA16A

8-Lead Package
Top View



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SO-8/DIP Package
See NSC Package Drawing Number MO8A/N08E

TABLE 1. Package Marking and Ordering Information

Output Voltage	Order Information	Package Marking	Supplied as:
16 Lead LLP			
12	LM2671LD-12	S0005B	1000 Units on Tape and Reel
12	LM2671LDX-12	S0005B	4500 Units on Tape and Reel
3.3	LM2671LD-3.3	S0006B	1000 Units on Tape and Reel
3.3	LM2671LDX-3.3	S0006B	4500 Units on Tape and Reel
5.0	LM2671LD-5.0	S0007B	1000 Units on Tape and Reel
5.0	LM2671LDX-5.0	S0007B	4500 Units on Tape and Reel
ADJ	LM2671LD-ADJ	S0008B	1000 Units on Tape and Reel
ADJ	LM2671LDX-ADJ	S0008B	4500 Units on Tape and Reel
SO-8			
12	LM2671M-12	2671M-12	Shipped in Anti-Static Rails
12	LM2671MX-12	2671M-12	2500 Units on Tape and Reel
3.3	LM2671M-3.3	2671M-3.3	Shipped in Anti-Static Rails
3.3	LM2671MX-3.3	2671M-3.3	2500 Units on Tape and Reel
5.0	LM2671M-5.0	2671M-5.0	Shipped in Anti-Static Rails
5.0	LM2671MX-5.0	2671M-5.0	2500 Units on Tape and Reel
ADJ	LM2671M-ADJ	2671M-ADJ	Shipped in Anti-Static Rails
ADJ	LM2671MX-ADJ	2671M-ADJ	2500 Units on Tape and Reel
DIP			
12	LM2671N-12	LM2671N-12	Shipped in Anti-Static Rails
3.3	LM2671N-3.3	LM2671N-3.3	Shipped in Anti-Static Rails
5.0	LM2671N-5.0	LM2671N-5.0	Shipped in Anti-Static Rails
ADJ	LM2671N-ADJ	LM2671N-ADJ	Shipped in Anti-Static Rail

Absolute Maximum Ratings (Note 1)

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

Supply Voltage	45V
ON/$\overline{OFF}$ Pin Voltage	$-0.1V \le V_{SH} \le 6V$
Switch Voltage to Ground	−1V
Boost Pin Voltage	$V_{SW} + 8V$
Feedback Pin Voltage	$-0.3V \le V_{FB} \le 14V$
ESD Susceptibility	
Human Body Model (Note 2)	2 kV
Power Dissipation	Internally Limited

Storage Temperature Range	−65°C to +150°C
Lead Temperature	
M Package	
Vapor Phase (60s)	+215°C
Infrared (15s)	+220°C
N Package (Soldering, 10s)	+260°C
LLP Package (See AN-1187)	
Maximum Junction Temperature	+150°C

Operating Ratings

Supply Voltage	6.5V to 40V
Temperature Range	$-40°C \le T_J \le +125°C$

Electrical Characteristics

LM2671-3.3

Specifications with standard type face are for T_J = 25°C, and those in **bold type face** apply over **full Operating Temperature Range.**

Symbol	Parameter	Conditions	Typical (Note 4)	Min (Note 5)	Max (Note 5)	Units
SYSTEM PARAMETERS Test Circuit *Figure 2* (Note 3)						
V_{OUT}	Output Voltage	V_{IN} = 8V to 40V, I_{LOAD} = 20 mA to 500 mA	3.3	3.251/**3.201**	3.350/**3.399**	V
V_{OUT}	Output Voltage	V_{IN} = 6.5V to 40V, I_{LOAD} = 20 mA to 250 mA	3.3	3.251/**3.201**	3.350/**3.399**	V
η	Efficiency	V_{IN} = 12V, I_{LOAD} = 500 mA	86			%

LM2671-5.0

Symbol	Parameter	Conditions	Typical (Note 4)	Min (Note 5)	Max (Note 5)	Units
SYSTEM PARAMETERS Test Circuit *Figure 2* (Note 3)						
V_{OUT}	Output Voltage	V_{IN} = 8V to 40V, I_{LOAD} = 20 mA to 500 mA	5.0	4.925/**4.850**	5.075/**5.150**	V
V_{OUT}	Output Voltage	V_{IN} = 6.5V to 40V, I_{LOAD} = 20 mA to 250 mA	5.0	4.925/**4.850**	5.075/**5.150**	V
η	Efficiency	V_{IN} = 12V, I_{LOAD} = 500 mA	90			%

LM2671-12

Symbol	Parameter	Conditions	Typical (Note 4)	Min (Note 5)	Max (Note 5)	Units
SYSTEM PARAMETERS Test Circuit *Figure 2* (Note 3)						
V_{OUT}	Output Voltage	V_{IN} = 15V to 40V, I_{LOAD} = 20 mA to 500 mA	12	11.82/**11.64**	12.18/**12.36**	V
η	Efficiency	V_{IN} = 24V, I_{LOAD} = 500 mA	94			%

LM2671-ADJ

Symbol	Parameter	Conditions	Typ (Note 4)	Min (Note 5)	Max (Note 5)	Units
SYSTEM PARAMETERS Test Circuit *Figure 3* (Note 3)						
V_{FB}	Feedback Voltage	V_{IN} = 8V to 40V, I_{LOAD} = 20 mA to 500 mA V_{OUT} Programmed for 5V (see Circuit of *Figure 3*)	1.210	1.192/**1.174**	1.228/**1.246**	V

Symbol	Parameter	Conditions	Typ (Note 4)	Min (Note 5)	Max (Note 5)	Units
V_{FB}	Feedback Voltage	V_{IN} = 6.5V to 40V, I_{LOAD} = 20 mA to 250 mA V_{OUT} Programmed for 5V (see Circuit of *Figure 3*)	1.210	1.192/**1.174**	1.228/**1.246**	V
η	Efficiency	V_{IN} = 12V, I_{LOAD} = 500 mA	90			%

All Output Voltage Versions

Specifications with standard type face are for T_J = 25°C, and those in **bold type face** apply over **full Operating Temperature Range**. Unless otherwise specified, V_{IN} = 12V for the 3.3V, 5V, and Adjustable versions and V_{IN} = 24V for the 12V version, and I_{LOAD} = 100 mA.

Symbol	Parameters	Conditions	Typ	Min	Max	Units
DEVICE PARAMETERS						
I_Q	Quiescent Current	$V_{FEEDBACK}$ = 8V For 3.3V, 5.0V, and ADJ Versions	2.5		3.6	mA
		$V_{FEEDBACK}$ = 15V For 12V Versions	2.5			mA
I_{STBY}	Standby Quiescent Current	ON/$\overline{OFF}$ Pin = 0V	50		100/**150**	µA
I_{CL}	Current Limit		0.8	0.62/**0.575**	1.2/**1.25**	A
I_L	Output Leakage Current	V_{IN} = 40V, ON/$\overline{OFF}$ Pin = 0V V_{SWITCH} = 0V	1		25	µA
		V_{SWITCH} = −1V, ON/$\overline{OFF}$ Pin = 0V	6		15	mA
$R_{DS(ON)}$	Switch On-Resistance	I_{SWITCH} = 500 mA	0.25		0.40/**0.60**	Ω
f_O	Oscillator Frequency	Measured at Switch Pin	260	**225**	**275**	kHz
D	Maximum Duty Cycle		95			%
	Minimum Duty Cycle		0			%
I_{BIAS}	Feedback Bias Current	$V_{FEEDBACK}$ = 1.3V ADJ Version Only	85			nA
$V_{S/D}$	ON/$\overline{OFF}$ Pin Voltage Thesholds		1.4	**0.8**	**2.0**	V
$I_{S/D}$	ON/$\overline{OFF}$ Pin Current	ON/$\overline{OFF}$ Pin = 0V	20	**7**	**37**	µA
F_{SYNC}	Synchronization Frequency	V_{SYNC} = 3.5V, 50% duty cycle	400			kHz
V_{SYNC}	Synchronization Threshold Voltage		1.4			V
V_{SS}	Soft-Start Voltage		0.63	**0.53**	**0.73**	V
I_{SS}	Soft-Start Current		4.5	**1.5**	**6.9**	µA
θ_{JA}	Thermal Resistance	N Package, Junction to Ambient (Note 6) M Package, Junction to Ambient (Note 6)	95 105			°C/W

Note 1: Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but device parameter specifications may not be guaranteed under these conditions. For guaranteed specifications and test conditions, see the Electrical Characteristics.

Note 2: The human body model is a 100 pF capacitor discharged through a 1.5 kΩ resistor into each pin.

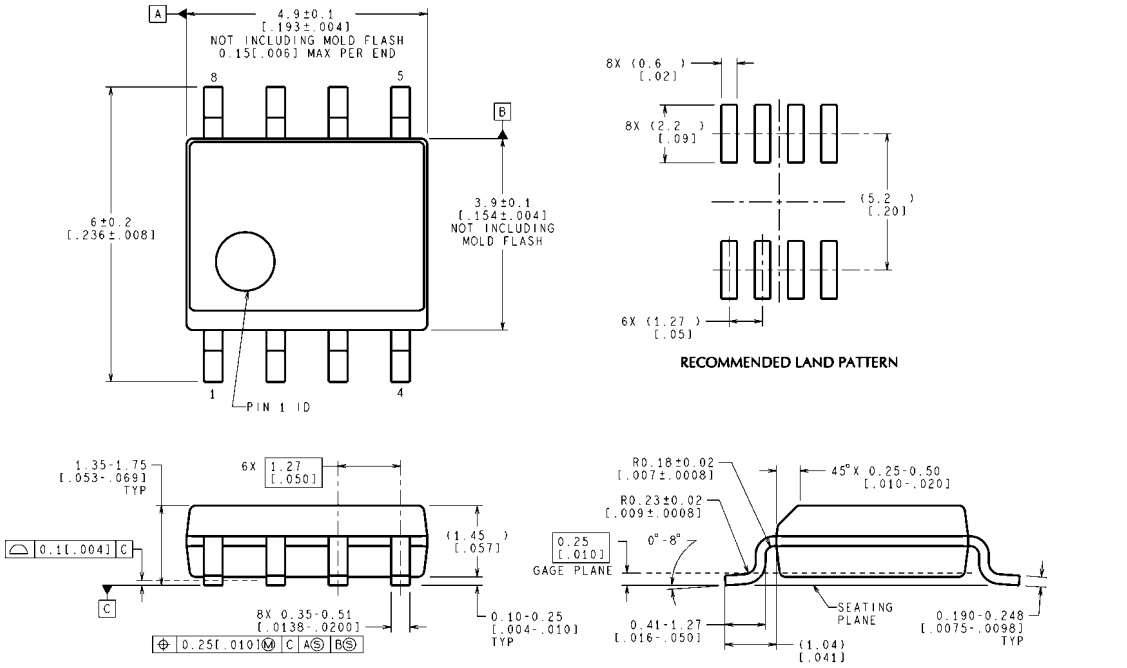
Note 3: External components such as the catch diode, inductor, input and output capacitors, and voltage programming resistors can affect switching regulator performance. When the LM2671 is used as shown in *Figure 2* and *Figure 3* test circuits, system performance will be as specified by the system parameters section of the Electrical Characteristics.

Note 4: Typical numbers are at 25°C and represent the most likely norm.

Note 5: All limits guaranteed at room temperature (standard type face) and at **temperature extremes (bold type face)**. All room temperature limits are 100% production tested. All limits at **temperature extremes** are guaranteed via correlation using standard Statistical Quality Control (SQC) methods. All limits are used to calculate Average Outgoing Quality Level (AOQL).

Note 6: Junction to ambient thermal resistance with approximately 1 square inch of printed circuit board copper surrounding the leads. Additional copper area will lower thermal resistance further. See Application Information section in the application note accompanying this datasheet and the thermal model in ***LM267X Made Simple*** version 6.0 software. The value θ_{J-A} for the LLP (LD) package is specifically dependent on PCB trace area, trace material, and the number of layers and thermal vias. For improved thermal resistance and power dissipation for the LLP package, refer to Application Note AN-1187.

Physical Dimensions inches (millimeters) unless otherwise noted



CONTROLLING DIMENSION IS MILLIMETER
VALUES IN [ ] ARE INCHES
DIMENSIONS IN ( ) FOR REFERENCE ONLY

M08A (Rev L)

8-Lead (0.150″ Wide) Molded Small Outline Package, JEDEC
Order Number LM2671M-3.3, LM2671M-5.0,
LM2671M-12 or LM2671M-ADJ
NS Package Number M08A