AN-1395 LM3671 Evaluation Board

1 Introduction

The LM3671 evaluation board is a working demonstration of a step down DC-DC converter. This document contains information about the evaluation board. For further information on buck converter topology, device electrical characteristics, and component selection, see the device-specific data sheet.

2 General Description

The LM3671 converts high input voltages to lower output voltages with high efficiency through an inductor-based switching topology. Automatic intelligent switching between PWM low-noise and PFM low-current mode offers improved system control. LM3671 is available in both fixed output voltage options and adjustable voltage options range from 1.1 V to 3.3 V in SOT23-5, DSBGA-5 package or 6-pin USON packages. The fixed output voltage options available in a SOT 23-5 package are 1.2 V, 1.25 V, 1.375 V, 1.5 V, 1.6 V, 1.8 V, 1.875 V, 2.5 V, 2.8 V, and 3.3 V. The fixed output voltage options available in the DSBGA-5 package are 1.2 V, 1.5 V, 1.8 V, 1.875 V, 2.5 V, 2.8 V, and 3.3 V. The fixed output voltage options available in the 6-pin USON package are 1.2 V, 1.3 V, 1.6 V and 1.8 V.

3 Operating Conditions

- Recommended input voltage range:
  - V_{IN} = 2.7 V to 4.5 V for 1.1 V ≤ V_{OUT} < 1.5 V
  - V_{IN} = 2.7 V to 5.5 V for 1.5 V ≤ V_{OUT} < 1.8 V
  - V_{IN} = (V_{OUT}+ $V_{DROPOUT}$) to 5.5 V for 1.8 V ≤ V_{OUT} ≤ 3.3 V
  - where $V_{DROPOUT}$ = I_{LOAD}* ($R_{DSON,\ PFET}$ + $R_{INDUCTOR}$)
- Recommended load current: 0 mA ≤ I_{OUT} ≤ 600 mA
- Ambient temperature (T_A) range: -30C to +85C
- Junction temperature (T_J) range: -30C to +125C

4 Typical Application

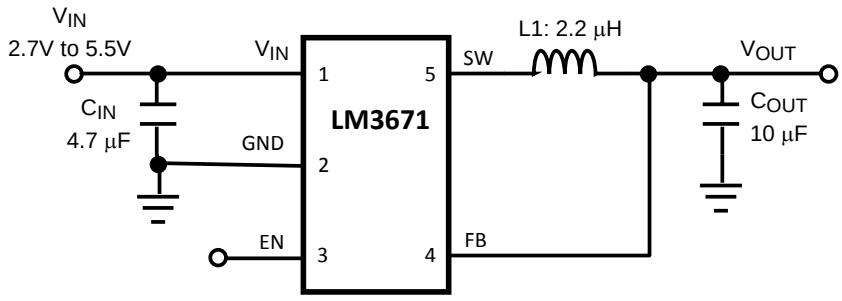


Figure 1. Fixed Output Voltage — Typical Application Circuit

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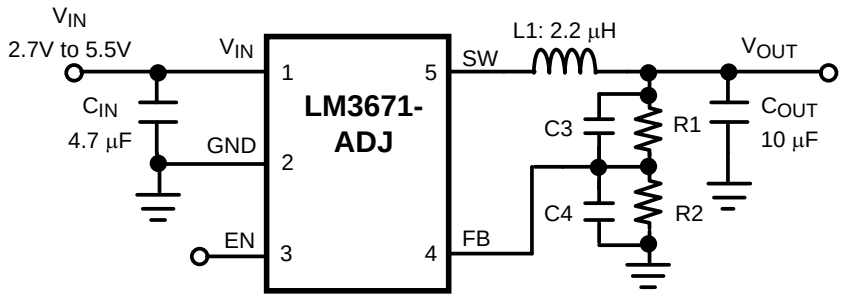


Figure 2. Adjustable Output Voltage — Typical Application Circuit

5 Output Voltage Selection for LM3671MF-ADJ

The output voltage of the adjustable parts can be programmed through the resistor network connected from V_{OUT} to FB to GND. The resistor from FB to GND (R_2) should be 200 kΩ to keep the current drawn through this network well below 16 µA quiescent current level (PFM mode), but large enough that it is not susceptible to noise. If R_2 is 200 kΩ, given the V_{FB} is 0.5 V, then the current through the resistor feedback network will be 2.5 µA. The output voltage of the adjustable parts ranges from 1.1 V to 3.3 V. The output voltage formula is:

$$V_{OUT} = V_{FB} \left(\frac{R_1}{R_2} + 1 \right) \quad (1)$$

V_{OUT}: output voltage (V)

V_{FB}: feedback voltage (0.5 V typical)

R_1: feedback resistor from V_{OUT} to FB (Ω)

R_2: feedback resistor from FB to GND (Ω)

For the fixed output voltage parts the feedback resistors are internal and R_1 is 0Ω.

The bypass capacitors $C_1$and C_2 (labeled C_3 and C_4 on evaluation board) in parallel with the feedback resistors are chosen for increased stability. Below are the formulas for $C_1$and C_2.

$$C_1 = \frac{1}{2 \times \pi \times R_1 \times 45\ kHz} \quad (2)$$

$$C_2 = \frac{1}{2 \times \pi \times R_2 \times 45\ kHz} \quad (3)$$

Table 1. LM3671-ADJ Configurations for Various V_{out} (Circuit of Figure 2)

V_{OUT} (V)	R_1 (kΩ)	R_2 (kΩ)	C_1 (pF)	C_2 (pF)	L (µH)	C_{IN} (µF)	C_{OUT} (µF)
1.1	240	200	15	none	2.2	4.7	10
1.2	280	200	12	none	2.2	4.7	10
1.3	320	200	12	none	2.2	4.7	10
1.5	357	178	10	none	2.2	4.7	10
1.6	442	200	8.2	none	2.2	4.7	10
1.7	432	178	8.2	none	2.2	4.7	10
1.8	464	178	8.2	none	2.2	4.7	10
1.875	523	191	6.8	none	2.2	4.7	10
2.5	402	100	8.2	none	2.2	4.7	10
2.8	464	100	8.2	33	2.2	4.7	10
3.3	562	100	6.8	33	2.2	4.7	10

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6 Powering the LM3671 for Bench Measurements

When powering the LM3671 with a bench power supply, it is recommended to place a 100 µF tantalum capacitor across the V_{IN} and GND supply terminals of the bench power supply. This capacitor will reduce the input spike caused by the power supply and long power cables. The combination of the power supply and inductance within the power cables produce a large voltage spike that may damage the device. In addition, consideration must also be looked at the enable pin of the device. The enable should never be taken high, until minimum guaranteed operating voltage of 2.7 V is reached. The enable pin should also never exceed the input voltage.

7 Connection Diagram and Package Mark Information

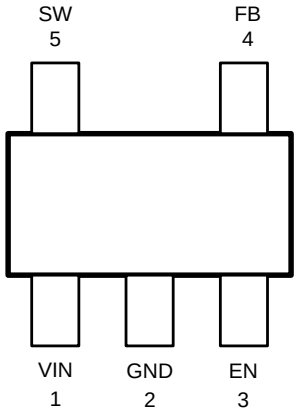


Figure 3. SOT23–5, Top View

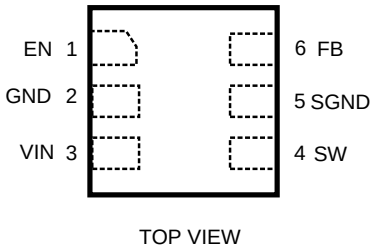


Figure 4. 6–Pin USON, Top View

Table 2. Pin Descriptions (SOT23-5)

Pin No	Name	Description
1	V_{IN}	Power supply input. Connect to the input filter capacitor
2	GND	Ground pin
3	EN	Enable input. The device is in shutdown mode when voltage to this pin is < 0.4 V and enabled when > 1.0 V. Do not leave this pin floating.
4	FB	Feedback analog input. Connect directly to the output filter capacitor for fixed voltage versions. For adjustable version external resistor dividers are required (Figure 2). The internal resistor dividers are disabled for the adjustable version.
5	SW	Switching node connection to the internal PFET switch and NFET synchronous rectifier.

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Table 3. Pin Descriptions (6–pin USON)

Pin No	Name	Description
1	EN	Enable pin. The device is in shutdown mode when voltage to this pin is < 0.4 V and enabled when > 1.0 V. Do not leave this pin floating.
2	PGND	Ground pin
3	V_{IN}	Power supply input. Connect to the input filter capacitor.
4	SW	Switching node connection to the internal PFET switch and NFET synchronous rectifier.
5	SGND	Signal ground (feedback ground).
6	FB	Feedback analog input. Connect directly to the output filter capacitor for fixed voltage versions. For adjustable version external resistor dividers are required (Figure 2). The internal resistor dividers are disabled for the adjustable version.



Figure 5. 5-bump DSBGA Package

Table 4. Pin Descriptions (5-bump DSBGA)

Pin No	Name	Description
A1	V_{IN}	Power supply input. Connect to the input filter capacitor
A3	GND	Ground pin
C1	EN	Enable pin. The device is in shutdown mode when voltage to this pin is <0.4 V and enabled when >1.0 V. Do not leave this pin floating.
C3	FB	Feedback analog input. Connect to the output filter capacitor for fixed voltage versions. For adjustable version external resistor dividers are required (Figure 2). The internal resistor dividers are disabled for the adjustable version.
B2	SW	Switching node connection to the internal PFET switch and NFET synchronous rectifier. Connect to an inductor with a saturation current rating that exceeds the 750 mA max. Switch Peak Current Limit Specification.

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8 Evaluation Board Layout

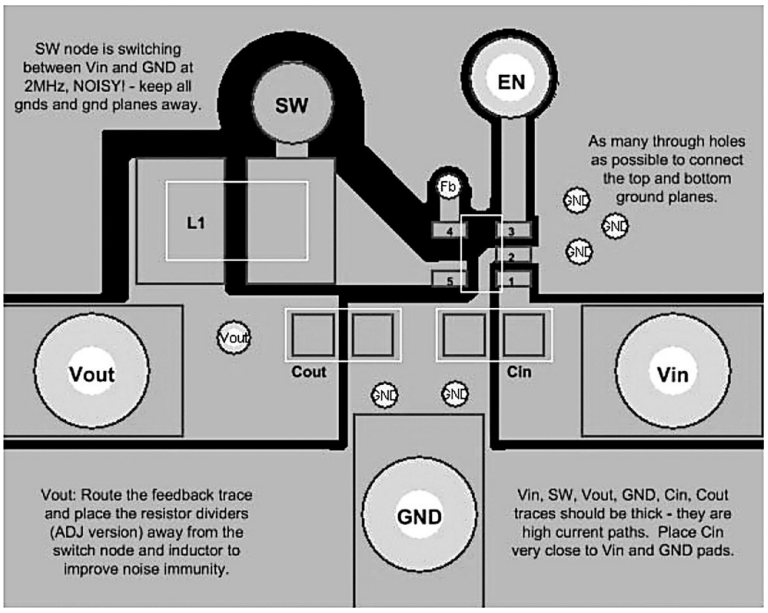


Figure 6. Top Layer (SOT23-5)

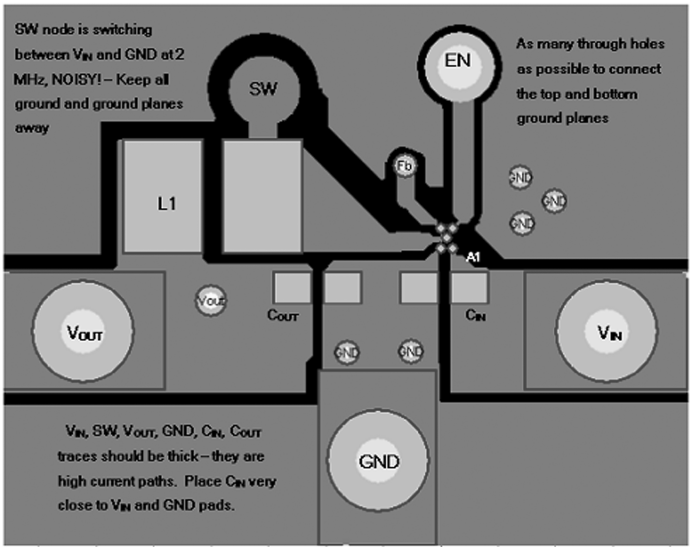


Figure 7. Top Layer (5-bump DSBGA)

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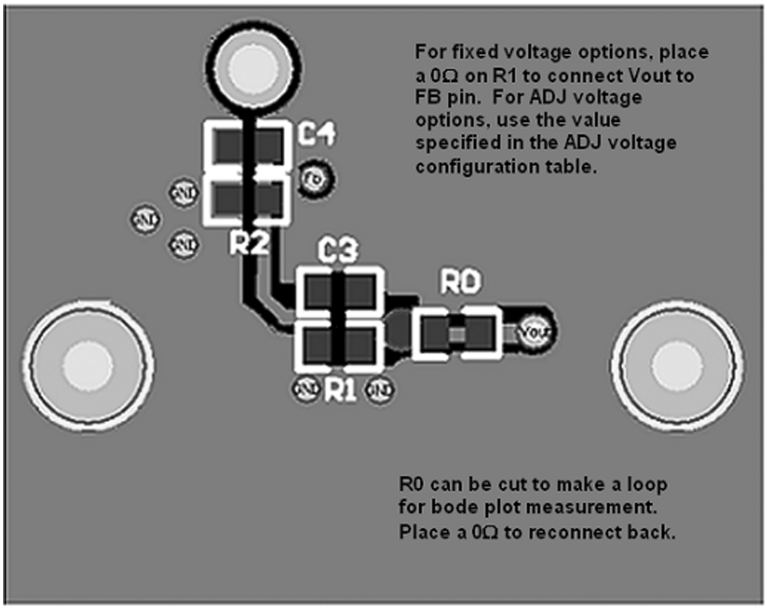


Figure 8. Bottom Layer (SOT23-5 and 5-bump DSBGA)

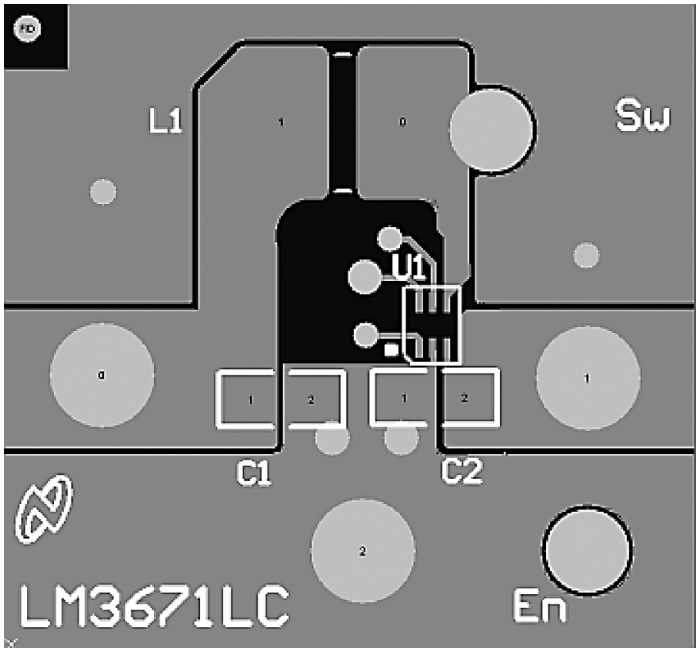


Figure 9. Top Layer (6–pin USON)

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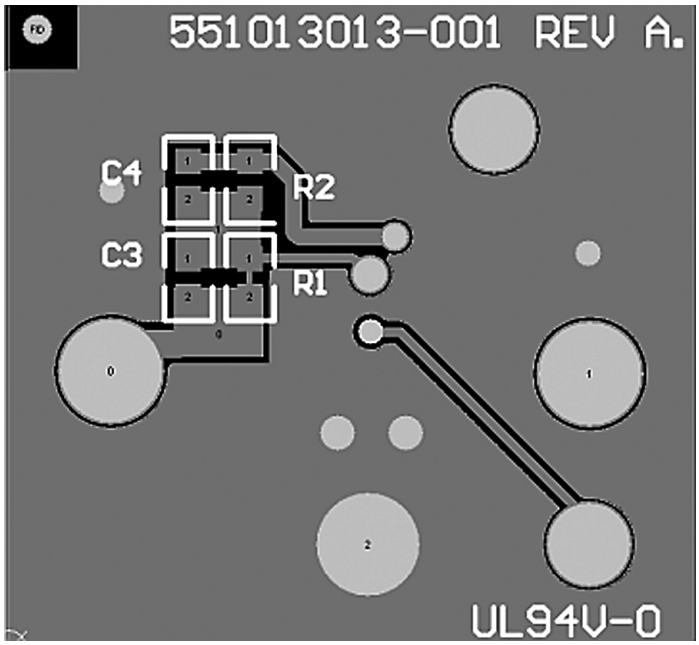


Figure 10. Bottom Layer (6–pin USON)

Table 5. Bill of Materials (BOM) For Common Configurations

	Manufacture	Manufacture No	Description
LM3671MF/TL-1.5 FIXED, LM3671LC-1.6 FIXED			
C2 (input C)	TDK	C2012X5R0J475K	4.7 µF, 6.3 V, 0805, 10%
C1 (output C)	TDK	C2012X5R0J106K	10 µF, 6.3 V, 0805, 10%
L1 (inductor)	Coilcraft	DO3314-222MX	2.2 µH inductor, 1.6A sat
R1 (V_{OUT} to V_{FB})	Vishay	CRCW06030R00F	0Ω, 0603, 1%
R2 (V_{FB} to GND)	None		
C3 (V_{OUT} to V_{FB})	None		
C4 (V_{FB} to GND)	None		
LM3671MF/TL - 1.8 V ADJUSTABLE			
CIN (input C)	TDK	C2012X5R0J475K	4.7 µF, 6.3 V, 0805, 10%
COUT (output C)	TDK	C2012X5R0J106K	10 µF, 6.3 V, 0805, 10%
L1 (inductor)	Coilcraft	DO3314-222MX	2.2 µH inductor, 1.6A sat
R1 (V_{OUT} to V_{FB})	Vishay	CRCW06034643F	464 kΩ, 0603, 1%
R2 (V_{FB} to GND)	Vishay	CRCW06031783F	178 kΩ, 0603, 1%
C3 (V_{OUT} to V_{FB})	Vishay	VJ0603A8R2KXAA	8.2 pF, 0603, 10%
C4 (V_{FB} to GND)	None		
COMMON TO ALL			
V_{IN} banana jack - red	Johnson Components	108-0902-001	connector, insulated banana jack (red)
V_{OUT} banana jack - yellow	Johnson Components	108-0907-001	connector, insulated banana jack (yellow)
GND banana jack - black	Johnson Components	108-0903-001	connector, insulated banana jack (black)

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- *Reorient or relocate the receiving antenna.*
- *Increase the separation between the equipment and receiver.*
- *Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.*
- *Consult the dealer or an experienced radio/TV technician for help.*

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