LM3670 Evaluation Board

National Semiconductor
Application Note 1348
Netnarin Joy Taylor
October 9, 2008

Introduction

The LM3670 evaluation board is a working demonstration of a step down DC-DC converter. This application note contains information about the evaluation board. For further information on buck converter topology, device electrical characteristics, and component selection please refer to the datasheet.

General Description

The LM3670 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. LM3670 is available in both fixed output voltage options (1.2V, 1.5V, 1.6V, 1.8V, 1.875V, 2.5V, 3.3V) and adjustable voltage options range from 0.7V to 2.5V. The LM3670 is available in a SOT23-5 package.

Operating Conditions

- V_{IN} range: 2.5V ≤ V_{IN} ≤ 5.5V
- Recommended load current: 0 mA ≤ I_{OUT} ≤ 350 mA
- Ambient temperature (T_A) range: -40C to +85C
- Junction temperature (T_J) range: -40C to +125C

Typical Application

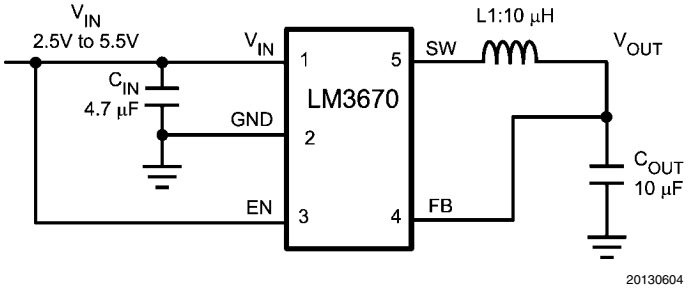

FIGURE 1. Fixed Output Voltage--Typical Application Circuit

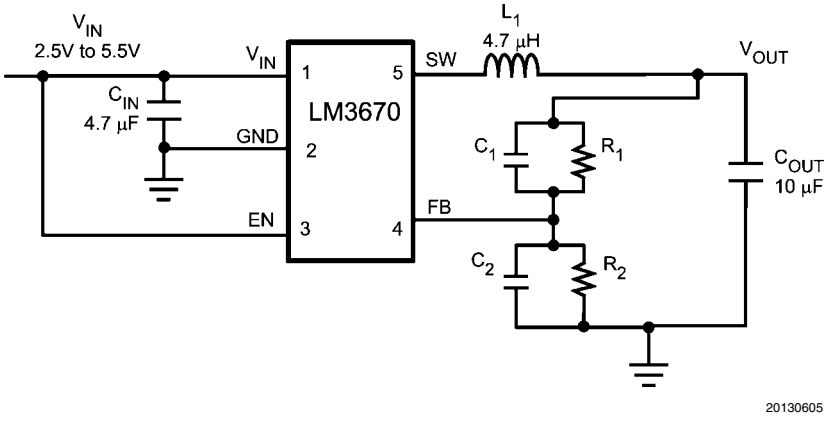

FIGURE 2. Adjustable Output Voltage—Typical Application Circuit

Output Voltage Selection for LM3670MF-ADJ

The output voltage of the adjustable parts can be programmed through the resistor network connected from V_{OUT} to V_{FB} to GND. The resistor from V_{FB} to GND (R_2) should be at least 100kΩ to keep the current sunk through this network well below 15µA quiescent current level (PFM mode with no switching) but large enough that it is not susceptible to noise. If R_2 is 200kΩ, and given the V_{FB} is 0.5V, then the current through the resistor feedback network will be 2.5µA (I_{FB} = 0.5V/R_2). The output voltage formula is:

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

V_{OUT}: output voltage (V)

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

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

R_2: feedback resistor from V_{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_4 and C_5 on Evaluation Board) in parallel with the feedback resistors are chosen for increased stability. Below are the formulas for $C_1$and C_2.

$$C_1 = \frac{1}{2 * \pi * R_1 * 10\ kHz}$$

$$C_2 = \frac{1}{2 * \pi * R_2 * 10\ kHz}$$

TABLE 1. Adjustable LM3670 Configurations for Various V_{OUT}

V_{OUT} (V)	R_1(kΩ)	R_2(kΩ)	C_1(pF)	C_2(pF)	L (µH)	C_{IN} (µF)	C_{OUT} (µF)
0.7	80.6	200	200	150	4.7	4.7	10
0.8	120	200	130	none	4.7	4.7	10
0.9	160	200	100	none	4.7	4.7	10
1.0	200	200	82	none	4.7	4.7	10
1.1	240	200	68	none	4.7	4.7	10
1.2	280	200	56	none	4.7	4.7	10
1.24	300	200	56	none	4.7	4.7	10
1.24	221	150	75	120	4.7	4.7	10
1.5	402	200	39	none	10	4.7	10
1.6	442	200	39	none	10	4.7	10
1.7	487	200	33	none	10	4.7	10
1.875	549	200	30	none	10	4.7	14.7 (10 || 4.7)
2.5	806	200	22	82	10	4.7	22

Powering the LM3670 for Bench Measurements

When powering the LM3670 with a bench power supply, it is recommended to place a 100µF 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 2.7V is reached. The enable pin should also never exceed the input voltage.

Connection Diagram and Package Mark Information

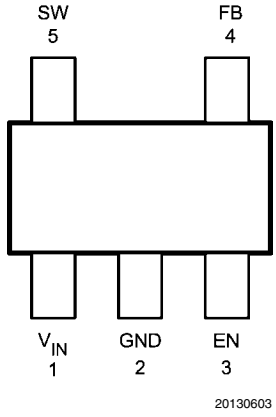

FIGURE 3. SOT23–5 Package-Top View

Pin Descriptions

Pin #	Name	Description
1	V_{IN}	Power supply input. Connect to the input filter capacitor
2	GND	Ground pin
3	EN	Enable input
4	FB	Feedback analog input. Connect to the output filter capacitor
5	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.

Evaluation Board Layout

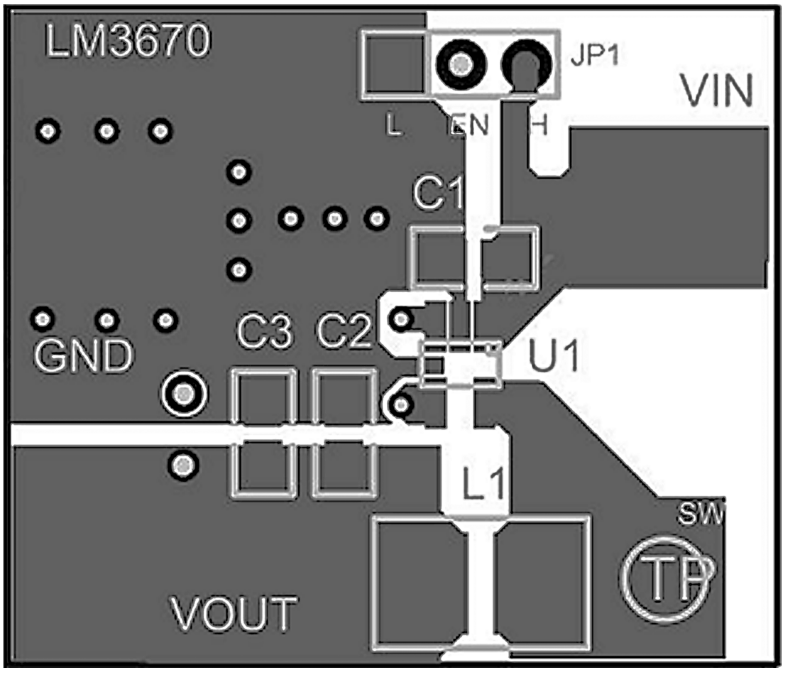

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FIGURE 4. Top Layer

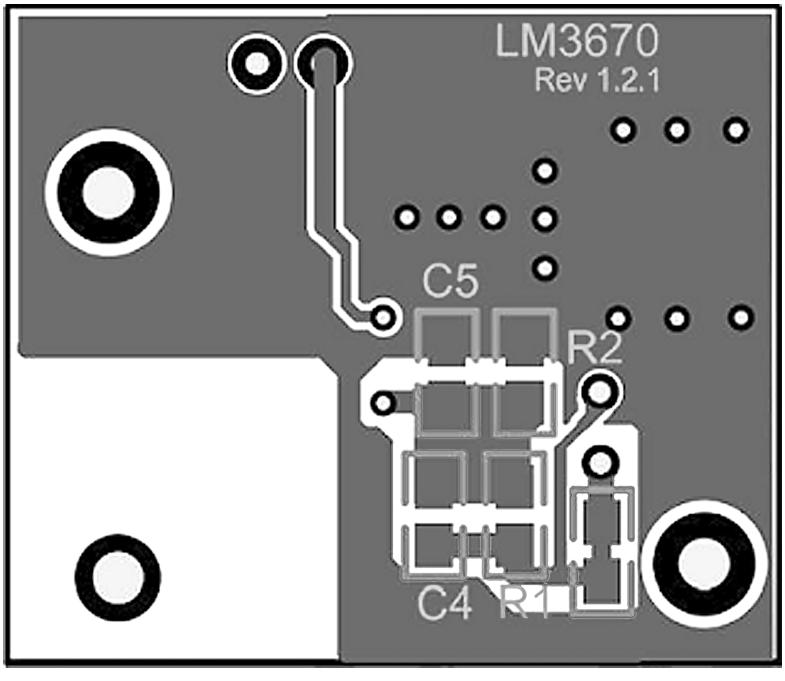

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FIGURE 5. Bottom Layer

BOM For Common Configurations

	Manufacture	Manufacture #	Description
LM3670 - 1.8V & 3.3V FIXED			
C1 (input C)	Taiyo Yuden	LMK316BJ475ML	4.7µF,10V,20%,1206
C3 (output C)	TDK	3216X5R0J106M	10µF,6.3V,20%,1206
C2 (aux output C)			
L1 (inductor)	Coilcraft	DO1608C-103	10µH inductor, 1.1A sat
R1 (V_{OUT} to V_{FB})	Vishay	CRCW08050R00F	0Ω, 0805
C4 (V_{OUT} to V_{FB})			
R2 (V_{FB} to GND)			
C5 (V_{FB} to GND)			
LM3670 - 1.2V ADJUSTABLE			
C1 (input C)	Taiyo Yuden	LMK316BJ475ML	4.7 µF,10V,20%,1206
C3 (output C)	TDK	3216X5R0J106M	10 µF,6.3V,20%,1206
C2 (aux output C)			
L1 (inductor)	Coilcraft	DO1608C-472	4.7 µH inductor, 1.5A sat
R1 (V_{OUT} to V_{FB})	Vishay	CRCW08052803F	280 kΩ, 0805, 1%
C4 (V_{OUT} to V_{FB})	Vishay	VJ0805Y560KXXA	56 pF, 0805, 10%
R2 (V_{FB} to GND)	Vishay	CRCW08052003F	200 kΩ, 0805, 1%
C5 (V_{FB} to GND)			
LM3670 - 1.5V ADJUSTABLE			
C1 (input C)	Taiyo Yuden	LMK316BJ475ML	4.7 µF,10V,20%,1206
C3 (output C)	TDK	3216X5R0J106M	10 µF,6.3V,20%,1206
C2 (aux output C)			
L1 (inductor)	Coilcraft	DO1608C-103	10 µH inductor, 1.1A sat
R1 (V_{OUT} to V_{FB})	Vishay	CRCW08054023F	402 kΩ, 0805, 1%
C4 (V_{OUT} to V_{FB})	Vishay	VJ0805A390KXAA	39 pF, 0805, 10%
R2 (V_{FB} to GND)	Vishay	CRCW08052003F	200 kΩ, 0805, 1%
C5 (V_{FB} to GND)			
LM3670 - 2.5V ADJUSTABLE			
C1 (input C)	Taiyo Yuden	LMK316BJ475ML	4.7 µF,10V,20%,0805
C3 (output C)	Taiyo Yuden	JMK316BJ226ML	22 µF,6.3V,20%, 1206
C2 (aux output C)			
L1 (inductor)	Coilcraft	DO1608C-103	10 µH inductor, 1.1A sat
R1 (V_{OUT} to V_{FB})	Vishay	CRCW08058063F	806 kΩ, 0805, 1%
C4 (V_{OUT} to V_{FB})	Vishay	VJ0805A220KXAA	22 pF, 0805, 10%
R2 (V_{FB} to GND)	Vishay	CRCW08052003F	200 kΩ, 0805, 1%
C5 (V_{FB} to GND)	Vishay	VJ0805A820KXAA	82 pF, 0805, 10%
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)

Notes

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