AN-1595 LM3677 Evaluation Board

1 Introduction

The LM3677 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 data sheet.

2 General Description

The LM3677 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. LM3677 is available in both fixed output voltage options and adjustable voltage options range from 1.2V to 3.3V in a DSBGA-5 package. The fixed output voltage options available in a DSBGA-5 package are 1.2V, 1.3V, 1.5V, 1.6V, 1.8V, 2.5V, 2.8V, and 3.3V. The LM3677 is also available in a 6–pin USON package with fixed voltage options 1.2V, 1.5V, 1.8V, and 1.82V.

3 Operating Conditions

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

4 Typical Application

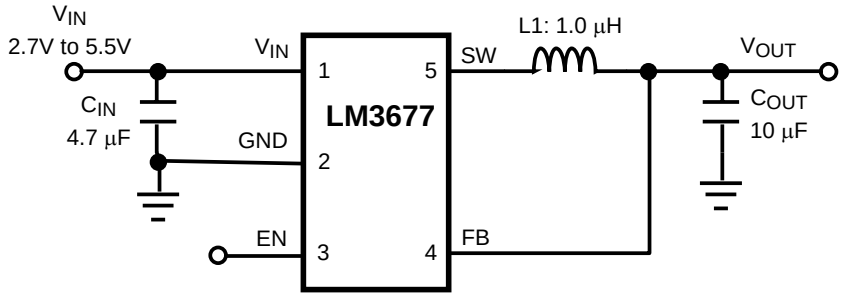

Figure 1. Fixed Output Voltage--Typical Application Circuit

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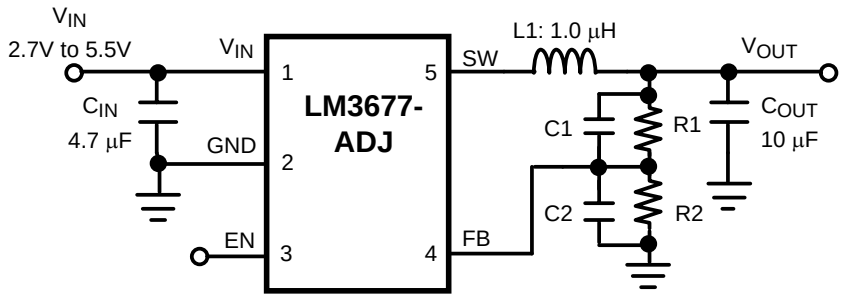

Figure 2. Adjustable Output Voltage—Typical Application Circuit

5 Output Voltage Selection for LM3677TL-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, and given the V_{FB} is 0.5V, then the current through the resistor feedback network will be 2.5 µA. The output voltage of the adjustable parts ranges from 1.2V to 3.3V. 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 (0.5V 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.

$$C_1 = \frac{1}{2 \times \pi \times R_1 \times 70\ kHz} \quad (2)$$

(3)

$$C_2 = \frac{1}{2 \times \pi \times R_2 \times 70\ kHz} \quad (4)$$

Table 1. LM3677-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)
1.2	280	200	8.2	none	1.0	4.7	10
1.3	320	200	8.2	none	1.0	4.7	10
1.5	357	178	6.8	none	1.0	4.7	10
1.6	442	200	5.6	none	1.0	4.7	10
1.8	464	178	5.6	none	1.0	4.7	10
2.5	402	100	6.0	none	1.0	4.7	10
2.8	464	100	5.6	24	1.0	4.7	10
3.3	562	100	5.6	24	1.0	4.7	10

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6 Powering the LM3677 for Bench Measurements

When powering the LM3677 with a bench power supply, it is recommended to place a 100 µF tantalum capacitor across the VIN 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 given to the enable pin of the device. The enable should never be taken high, until minimum ensured operating voltage of 2.7V is reached. The enable pin should also never exceed the input voltage.

7 Connection Diagrams and Package Mark Information

Figure 3. 5-bump DSBGA Package

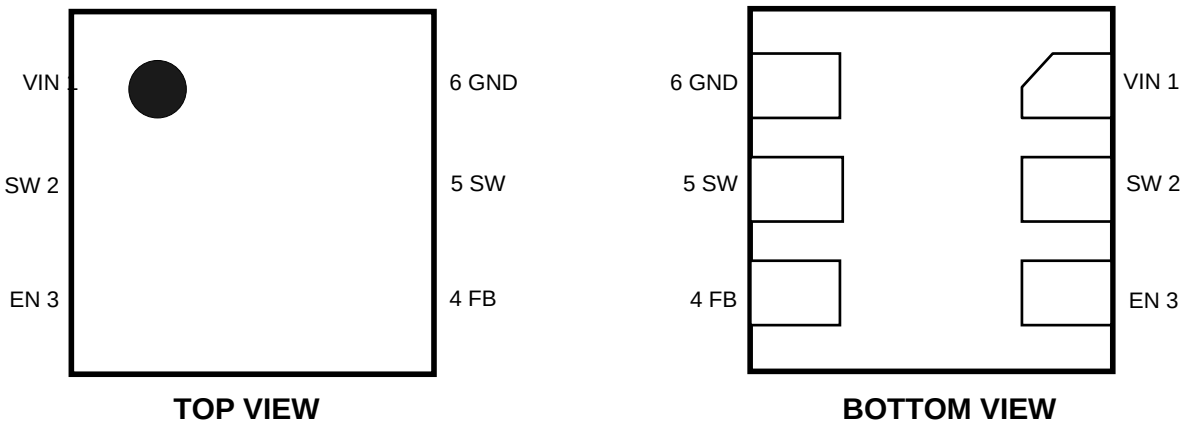

Figure 4. 6–pin USON Package

8 Pin Descriptions

Pin#		Name	Description
A1	1	V_{IN}	Power supply input. Connect to the input filter capacitor.
A3	6	GND	Ground pin.
C1	3	EN	Enable pin. The device is in shutdown mode when voltage to this pin is < 0.4V and enabled when > 1.0V. Do not leave this pin floating.
C3	4	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	2,5	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.

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9 Evaluation Board Layout

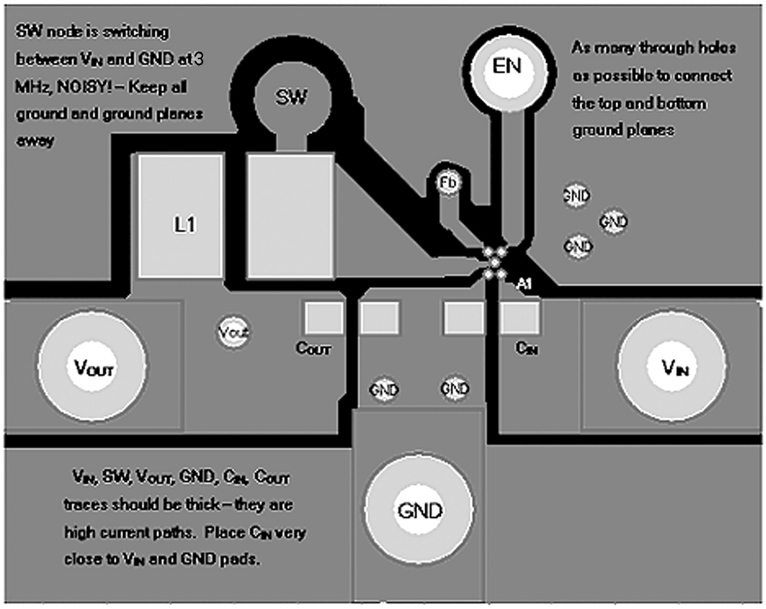

Figure 5. Top Layer (5-bump DSBGA)

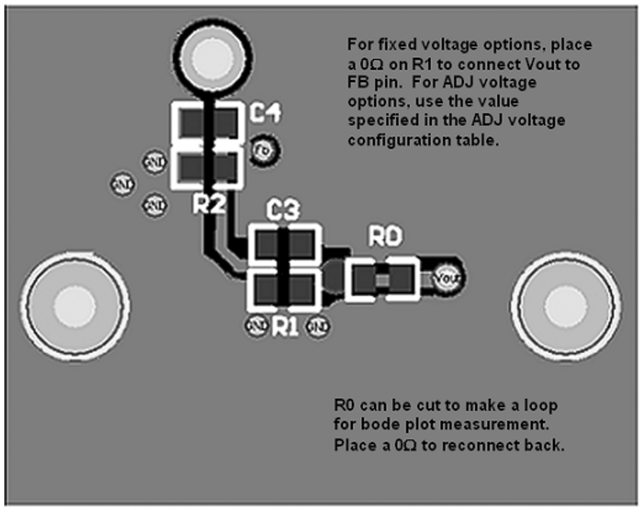

Figure 6. Bottom Layer (5-bump DSBGA)

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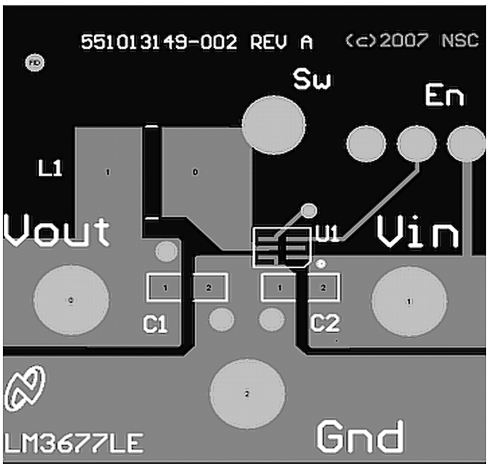

Figure 7. Top Layer (6–pin USON)

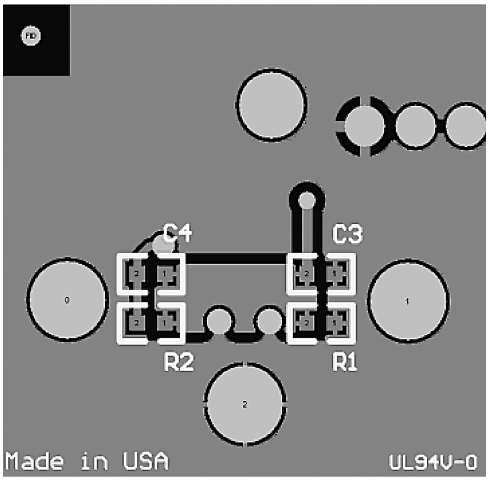

Figure 8. Bottom Layer (6–pin USON)

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10 BOM For Common Configurations

	Manufacture	Manufacture #	Description
LM3677 - 1.8V FIXED			
C1 (input C)	TDK	C1608X5R0J475K	4.7 µF, 6.3V, 0603, 10%
C2 (output C)	TDK	C1608X5R0J106K	10 µF, 6.3V, 0603, 10%
L1 (inductor)	FDK	MIPSA2520D 1R0	1.0 µH chip inductor
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		
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)

	Manufacture	Manufacture #	Description
LM3677 - 1.8V FIXED			
C1 (input C)	TDK	C1608X5R0J475K	4.7 µF, 6.3V, 0603, 10%
C2 (output C)	TDK	C1608X5R0J106K	10 µF, 6.3V, 0603, 10%
L1 (inductor)	FDK	MIPSA2520D 1R0	1.0 µH chip inductor
R1 (V_{FB} to GND)	None		
R2 (V_{OUT} to V_{FB})	Vishay	CRCW06030R00F	0Ω, 0603, 1%
C3 (V_{FB} to GND)	None		
C4 (V_{OUT} to V_{FB})	None		
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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3.2.1 *For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210*

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