

# LM3677 Evaluation Board

National Semiconductor  
Application Note 1595  
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## 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 datasheet.

## 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 micro SMD-5 package. The fixed output voltage options

available in a micro SMD-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 LLP package with fixed voltage options 1.2V, 1.5V, 1.8V, and 1.82V.

## Operating Conditions

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

## Typical Application

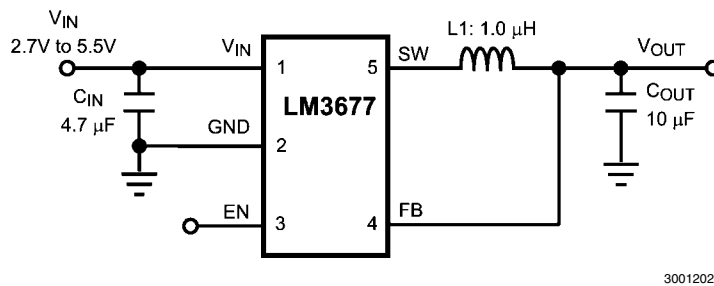


FIGURE 1. Fixed Output Voltage--Typical Application Circuit

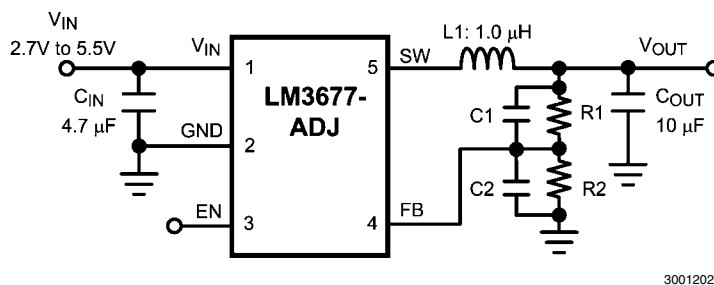


FIGURE 2. Adjustable Output Voltage—Typical Application Circuit

## 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 k $\Omega$  to keep the current drawn through this network well below 16  $\mu$ A quiescent current level (PFM mode) but large enough that it is not susceptible to noise. If  $R_2$  is 200 k $\Omega$ , and given the  $V_{FB}$  is 0.5V, then the current through the resistor feedback network will be 2.5  $\mu$ A. The output voltage of the adjustable parts ranges from 1.2V to 3.3V. The output voltage formula is:

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

$V_{OUT}$ : output voltage (V)

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

$R_1$ : feedback resistor from  $V_{OUT}$  to FB( $\Omega$ )

$R_2$ : feedback resistor from FB to GND ( $\Omega$ )

For the fixed output voltage parts the feedback resistors are internal and  $R_1$  is 0 $\Omega$ .

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  $C_2$ .

$$C_1 = \frac{1}{2 \times \pi \times R_1 \times 70 \text{ kHz}}$$

$$C_2 = \frac{1}{2 \times \pi \times R_2 \times 70 \text{ kHz}}$$

TABLE 1. LM3677-ADJ Configurations for Various  $V_{out}$  (Circuit of Figure 2)

$V_{OUT}$ (V)	$R_1$ (k $\Omega$ )	$R_2$ (k $\Omega$ )	$C_1$ (pF)	$C_2$ (pF)	L ( $\mu$ H)	$C_{IN}$ ( $\mu$ F)	$C_{OUT}$ ( $\mu$ F)
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

## Powering the LM3677 for Bench Measurements

When powering the LM3677 with a bench power supply, it is recommended to place a 100  $\mu$ F 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

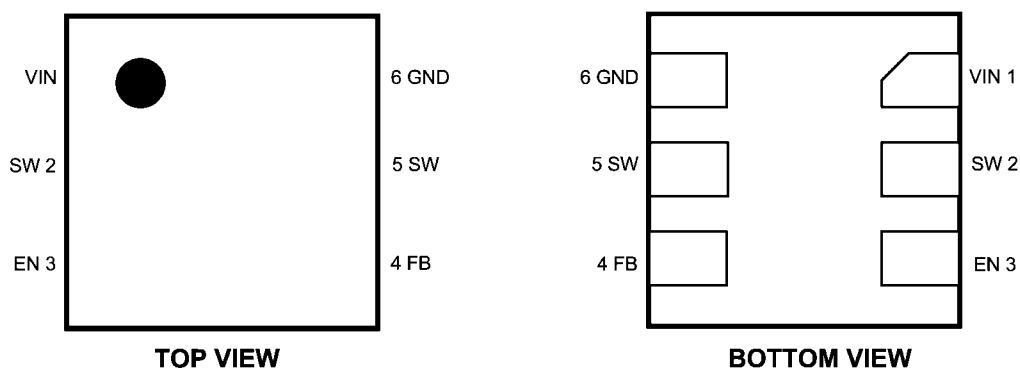
supply and long power cables. The combination of the power supply and inductance within the power cables produce a large voltage spike that may damage the device. In addition, consideration must given to the enable pin of the device. The enable should never be taken high, until minimum guaranteed operating voltage of 2.7V is reached. The enable pin should also never exceed the input voltage.

## Connection Diagrams and Package Mark Information



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FIGURE 3. 5-bump micro SMD Package



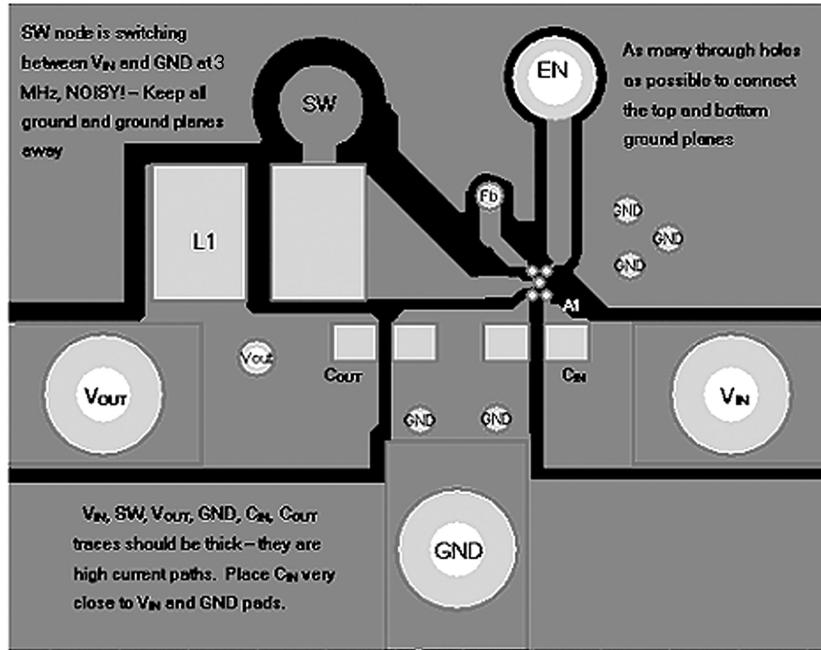
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FIGURE 4. 6-pin LLP Package

## Pin Descriptions

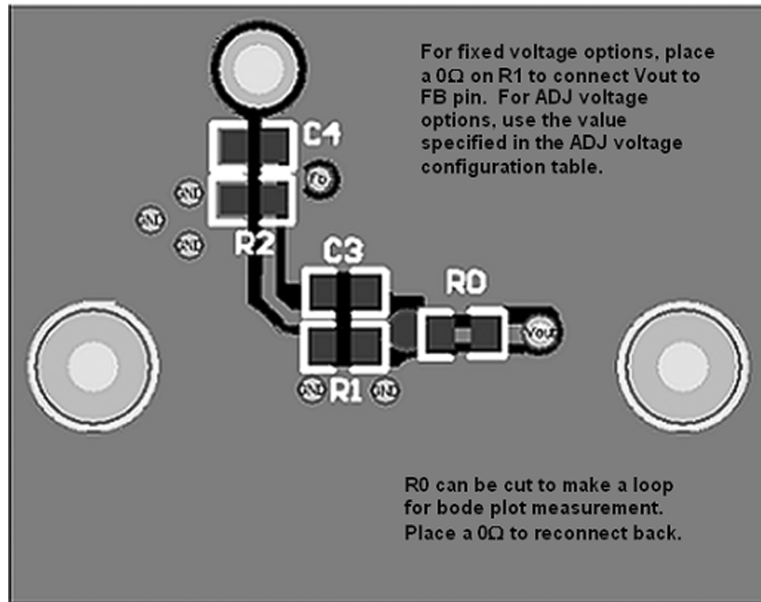
Pin#	Name	Description
A1	1	$V_{IN}$ Power supply input. Connect to the input filter capacitor.
A3	6	GND Ground pin.
C1	3	EN Enable pin. The device is in shutdown mode when voltage to this pin is < 0.4V and enabled when > 1.0V. Do not leave this pin floating.
C3	4	FB Feedback analog input. Connect to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

# Evaluation Board Layout



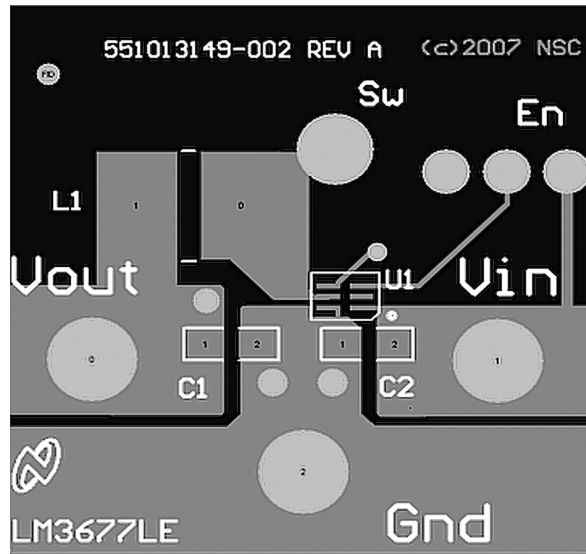
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FIGURE 5. Top Layer (5-bump micro SMD)



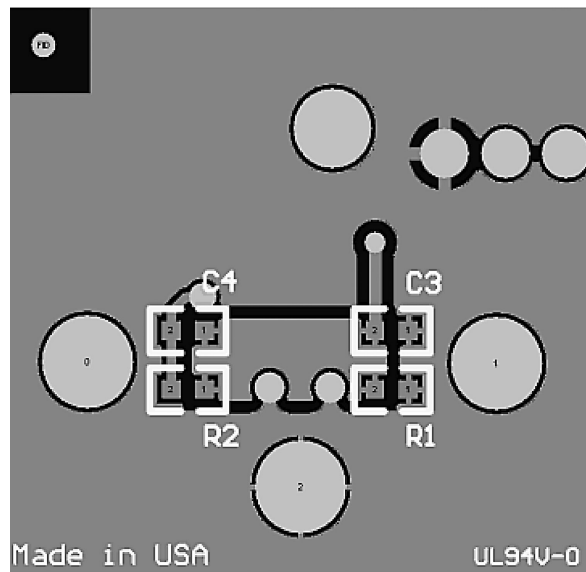
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FIGURE 6. Bottom Layer (5-bump micro SMD)



30012008

FIGURE 7. Top Layer (6-pin LLP)



30012009

FIGURE 8. Bottom Layer (6-pin LLP)

## BOM For Common Configurations

	Manufacture	Manufacture #	Description
<b>LM3677TL - 1.8V FIXED</b>			
C1 (input C)	TDK	C1608X5R0J475K	4.7 $\mu$ F, 6.3V, 0603, 10%
C2 (output C)	TDK	C1608X5R0J106K	10 $\mu$ F, 6.3V, 0603, 10%
L1 (inductor)	FDK	MIPSA2520D 1R0	1.0 $\mu$ H chip inductor
R1 ( $V_{OUT}$ to $V_{FB}$ )	Vishay	CRCW06030R00F	0 $\Omega$ , 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
<b>LM3677LE - 1.8V FIXED</b>			
C1 (input C)	TDK	C1608X5R0J475K	4.7 $\mu$ F, 6.3V, 0603, 10%
C2 (output C)	TDK	C1608X5R0J106K	10 $\mu$ F, 6.3V, 0603, 10%
L1 (inductor)	FDK	MIPSA2520D 1R0	1.0 $\mu$ H chip inductor
R1 ( $V_{FB}$ to GND)	None		
R2 ( $V_{OUT}$ to $V_{FB}$ )	Vishay	CRCW06030R00F	0 $\Omega$ , 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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