AN-1536 LM3676 Evaluation Board

1 Introduction

The LM3676 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 *LM3676 2-MHz 600-mA Step-Down DC-DC Converter With Mode Control* (SNVS426).

2 General Description

The LM3676 converts high input voltages to lower output voltages with high efficiency through an inductor based switching topology. The LM3676 has a mode-control pin that allows the user to select continuous Forced PWM mode over the complete load range or an intelligent Auto, PFM-PWM, mode that changes modes depending on the load. Setting the Mode pin low (<0.4V) places the LM3676 in Auto mode were hysteretic PFM extends the battery life through reduction of the quiescent current to 16µA (typ.) during light loads and system standby. When the Mode pin is high (>1.0V) the part offers superior efficiency under high load conditions (>100mA) and the lowest output noise performance during Forced PWM. The LM3676 is available in both fixed and adjustable output voltage options ranging from 1.0V to 3.3V in a 8-lead non-pullback WSON package (3mm × 3mm).

3 Operating Conditions

- V_{IN} range: 2.9V ≤ V_{IN} ≤ 5.5V
- 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

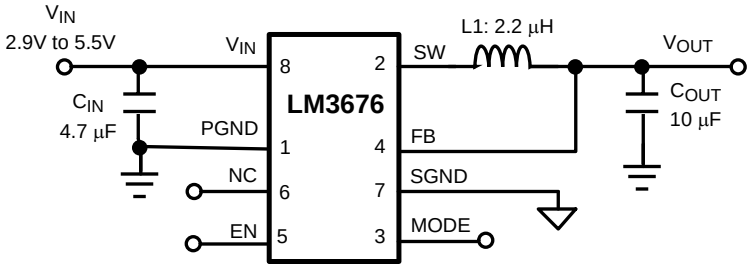

Figure 1. Typical Application Circuit: Fixed Voltage

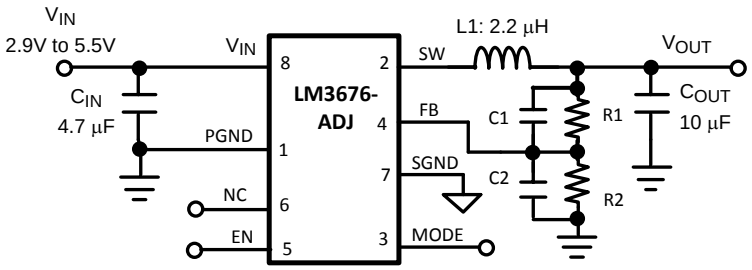

Figure 2. Typical Application Circuit: Adjustable Voltage

5 Output Voltage Selection for LM3676SD-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 200kΩ to keep the current drawn through this network small, 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. The output voltage formula is:

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

where:

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. The bypass capacitors C_1 and C_2 in parallel with the feedback resistors are chosen for stable operation. Following 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. LM3676-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)
1.0	200	200	18	None	2.2	4.7	10
1.1	191	158	18	None	2.2	4.7	10
1.2	280	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

6 Powering the LM3676 for Bench Measurement

When powering the LM3676 with a bench power supply, it is recommended to place a 100µF 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 specified operating voltage of 2.7V is reached. The enable pin should also never exceed the input voltage.

7 Connection Diagram and Package Mark Information

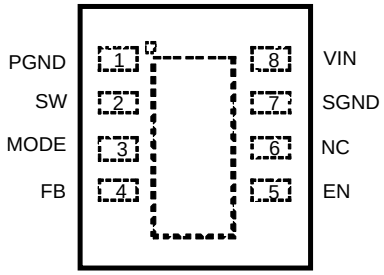

Figure 3. WSON, Top View

8 Pin Descriptions (8-lead Non-Pullback WSON Package)

Pin #	Name	Description
1	PGND	Power supply input.
2	SW	Switching node connection to the internal PFET switch and NFET synchronous rectifier.
3	MODE	Mode Control Pin: > 1.0V selects continous PWM mode ; < 0.4V selects Auto (PFM-PWM) mode. 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	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.
6	NC	Not Connected. Keep Pin floating
7	SGND	Signal Ground Pin.
8	VIN	Power Supply input. Connect to the input filter capacitor (Figure 1).

9 Evaluation Board Layout

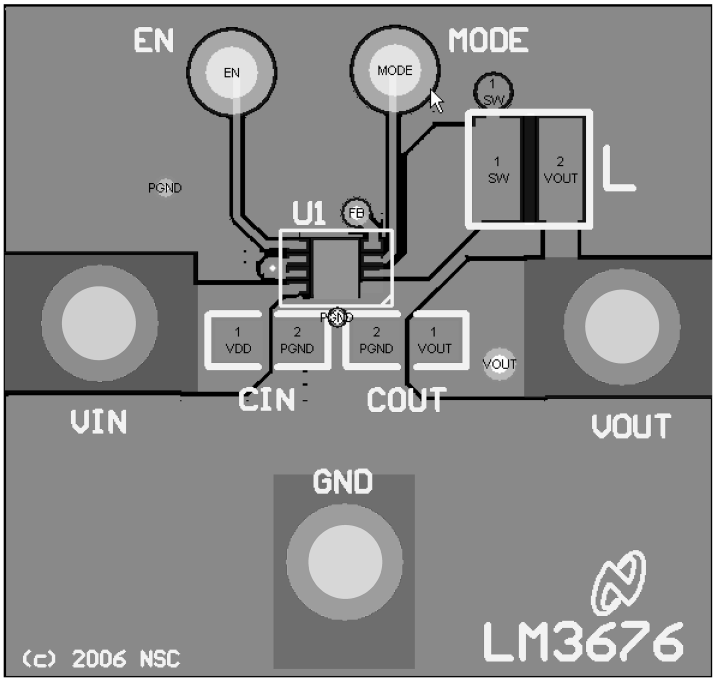

Figure 4. Top Layer (WSON-8 pin)

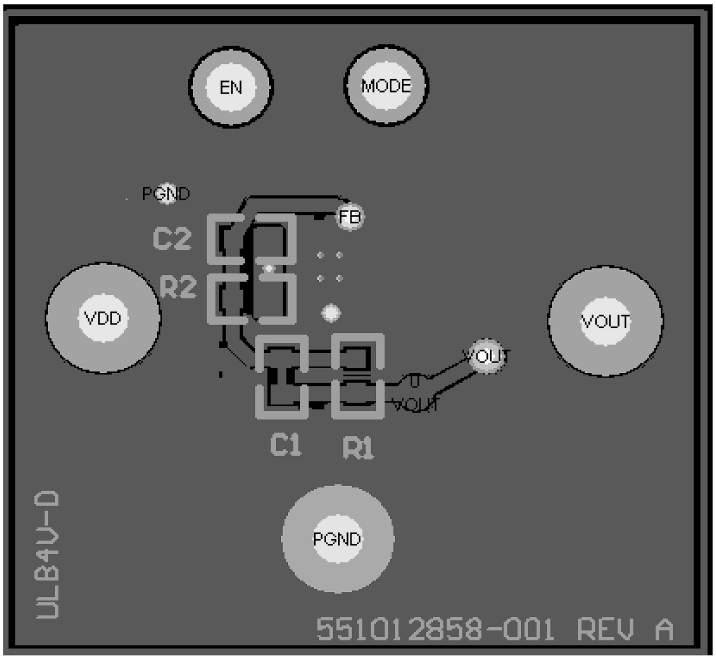

Figure 5. Bottom Layer (WSON-8 pin)

10 Bill of Materials for Common Configurations

Part	Manufacture	Manufacture #	Description
LM3676 - 3.3V Adjustable	Texas Instruments		
C1 (input C)	TDK	C2012XR0J475K	4.7µF, 6.3V, 0805, 10%
C2 (output C)	TDK	C2012X5R0J106K	10µF, 6.3V, 0805, 10%
L1 (inductor)	Coilcraft	DO3314-222MX	2.2µH inductor, 1.6A sat
R1 (V_{OUT} to V_{FB})	Vishay	CRCW06035623F	562kΩ, 0603, 1%
R2 (V_{FB} to GND)	Vishay	CRCW06031003F	100kΩ, 0603, 1%
C3 (V_{OUT} to V_{FB})	Vishay	VJ0603A6R8KXAA	6.8pF, 0603, 10%
C4 (V_{FB} to GND)	Vishay	VJ0603A330KXAA	33pF , 0603, 10%
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)
Post for EN	Turrent	1573-2	Upright post from eval board
Post for V_{IN}	Turrent	1502-2	Upright post from eval board
Post for V_{OUT}	Turrent	1502-2	Upright post from eval board
Post for GND	Turrent	1502-2	Upright post from eval board

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