AN-1891 LM22679 Evaluation Board

1 Introduction

The LM22679 evaluation board is designed to demonstrate the capabilities of the LM22679 switching regulator. The LM22679 evaluation board schematic shown in Figure 1 is configured to provide an output voltage of 3.3V up to 5A load current with an input voltage range of 4.5V to 42V. Due to the low $R_{DS(ON)}$ of the integrated N-channel MOSFET and maximum duty-cycle limitations, the minimum input voltage of 4.5V will only provide a 3.3V output voltage for load currents up to 500 mA. At 5.5V input voltage 3A of output current is possible while maintaining 3.3V of output voltage. For load currents higher than 3A, an input voltage of 6.5V or higher is required. The typical operating frequency is 500 kHz. The evaluation board is designed to operate at ambient temperatures up to 30°C.

The performance of the evaluation board is as follows:

- Input Range: 4.5V to 42V
- Output Voltage: 3.3V
- Output Current Range: 0A to 5A
- Frequency of Operation: 500 kHz
- Board Size: 2.25 × 2 inches (57 mm × 50.5 mm)
- Package: TO-263 THIN

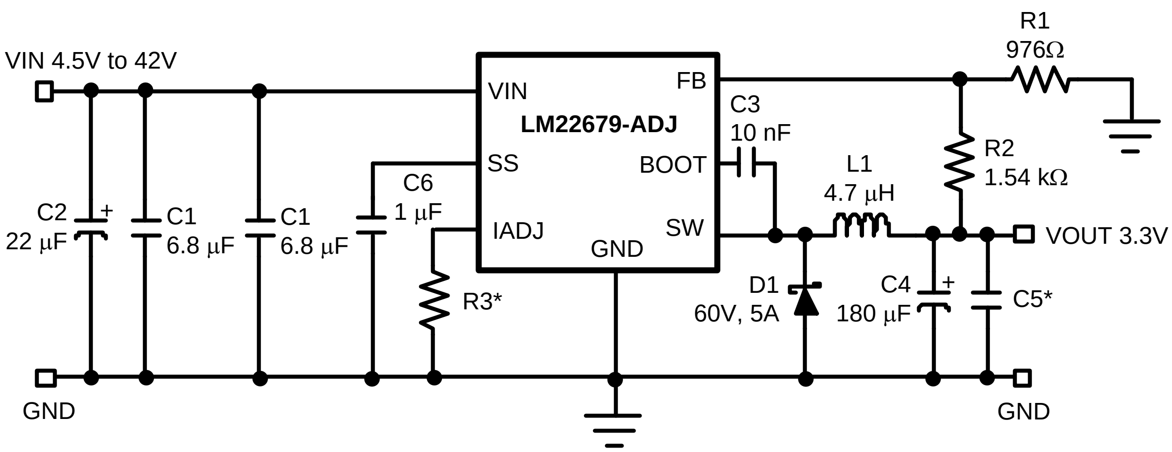
At low input voltages between 4.5V and 6V, a minimum load of approximately 5 mA may be required to reach a regulated 3.3V output voltage. For more details, see *LM22679/LM22679Q 42V, 5A SIMPLE SWITCHER Step-Down Voltage Regulator with Features* (SNVS581).

To aid in the design and evaluation of DC/DC buck converter solutions based on the LM22679 switching regulator, the evaluation board can be re-configured for different output voltages.

The evaluation board is designed to highlight applications with a small solution size. This implies that there will be a tradeoff with the area of heat dissipation available. If this evaluation board is operated continuously at a full 5A load, it will get hot. For higher output voltages than the pre-adjusted 3.3V, the total output power as well as the total power conversion losses will increase. It is recommended to use a fan or other source of air flow when evaluating the board at full 5A load or at output voltages greater than 3.3V. Typical evaluation board performance and characteristics curves are shown in Section 7. The PCB layout is shown in Section 8.

Test points are provided to enable easy connection and monitoring of critical signals. When performing over load or short circuit tests, refer to the current limit section of the LM22679 datasheet (SNVS581) to determine if the circuit is in safe operating mode.

For more information about device function and electrical characteristics, refer to the LM22679 datasheet (SNVS581).



*component not populated on LM22679EVAL evaluation board

Figure 1. Evaluation Board Schematic

2 Evaluation Board Setup

Before applying power to the LM22679 evaluation board, all external connections should be verified. The external power supply must be turned off and connected with proper polarity to the VIN and GND posts. A load resistor or electronic load should be connected between the VOUT and GND posts as desired. Both the VIN and VOUT connections should use the closest GND posts respective to VIN or VOUT. The output voltage can be monitored with a multi-meter or oscilloscope at the VOUT post.

Once all connections to the evaluation board have been verified, input power can be applied. A load resistor or electronic load does not require connection during startup. The output voltage will ramp up when an input voltage is applied. Make sure that the external power supply (input voltage power source) is capable of providing enough current so that the adjusted output voltage can be obtained. Keep in mind that the startup current will be greater than the steady state current.

3 Soft-Start

The capacitor C6 sets the amount of soft-start. A 1 µF soft-start capacitor is used for slow start-up. See the LM22679 datasheet (SNVS581) for details about the soft-start function.

4 Current Limit Adjust

Current limit can be reduced from the nominal LM22679 peak current limit by using a resistor R3. See the LM22679 datasheet (SNVS581) for information about the current limit adjust function. R3 is not populated on the evaluation board. This sets the current limit to the nominal current limit as specified in the LM22679 datasheet.

5 Component Selection

Before changing the default components refer to *LM22679/LM22679Q 42V, 5A SIMPLE SWITCHER Step-Down Voltage Regulator with Features* (SNVS581) for information regarding component selection. The WEBENCH® designer online circuit simulation tool is also available on the TI website.

The output voltage is adjustable with resistors R1 and R2 shown in Figure 1. Any changes to these evaluation board feedback resistors may require changes to the inductor and output capacitor values. It is especially important to change the output capacitor, C4, if the output voltages are adjusted higher than 5V. The Schottky diode, D1, has a voltage rating of 60V to allow for a 42V maximum input voltage. If the input voltage is below 38V, a 40V Schottky diode may be used with a lower forward voltage to improve efficiency. For improved heat dissipation, a Schottky diode in a D2PAK package may be selected for higher efficiency. The input capacitor, C2, is not always required. This capacitor is placed on the evaluation board to make the application robust and minimize input voltage ringing if power is suddenly applied. Capacitor C2 also helps stabilize the transfer function of the converter loop. Input capacitors C1 and C7 provide the high di/dt portion of the switch current. Both capacitors are selected with appropriate values intended only for the evaluation of the LM22679. For production designs, the impedance of the power source as well as the ripple current rating of the selected input capacitors need to be taken into consideration and modified accordingly. See the LM22679 datasheet (SNVS581) for more information.

Output capacitor C5 is not populated but space is provided to add a second output capacitor. This second output capacitor may be used to further reduce output voltage ripple.

6 Bill of Materials

Table 1. LM22679EVAL Bill of Materials

Ref #	Value	Supplier	Part Number
C1, C7	6.8 µF 50V ceramic	TDK	C4532X7R1H685M
C2	22 µF 63V electrolytic	Panasonic	EEEFK1J220XP
C3	10 nF 50V ceramic	TDK	C1608X7R1H103K
C4	180 µF 6.3V 12mohm Polymer Aluminum	Panasonic	EEFUE0J181R
C5	Not populated	-	
C6	1 µF 10V ceramic	TDK	C1608Y5V1A105Z
D1	60V 5A CMSH5-60	Central Semiconductor	CMSH5-60
L1	4.7 µH 8.5A WE-PD XL	Wurth	74477004
		Coilcraft	MSS1278-472MLD
R1	976Ω 1%	-	CRCW0603976RFKEA
R2	1.54 kΩ 1%	-	CRCW06031K54FKEA
R3	Not populated	-	
U1		Texas Instruments	LM22679

7 Performance Characteristics

Unless otherwise specified, V_{IN} = 12V, T_A = 25°C.

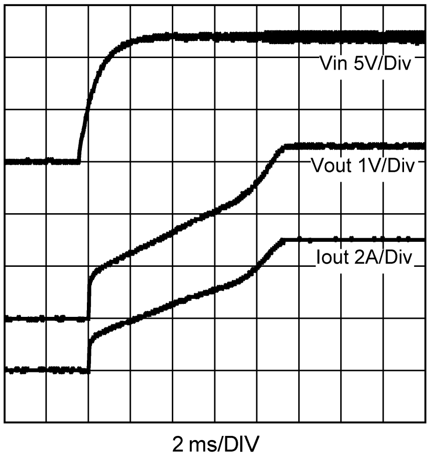


Figure 2. Start-Up Waveforms (Load Resistor = 0.66Ω)

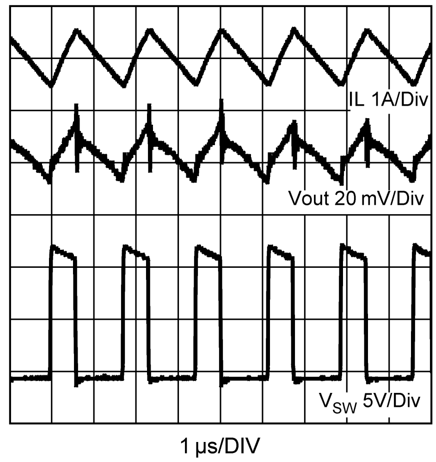


Figure 3. Operation at 5A

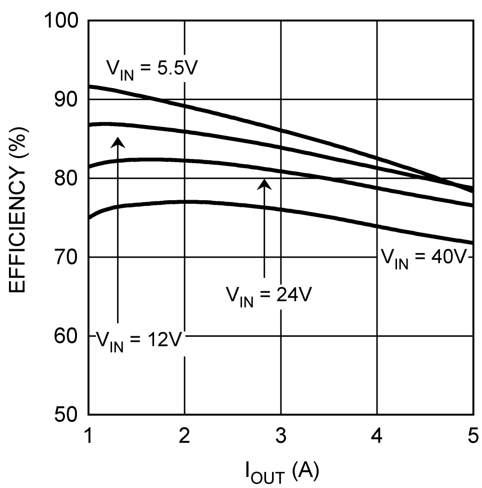


Figure 4. Efficiency vs I_{OUT}

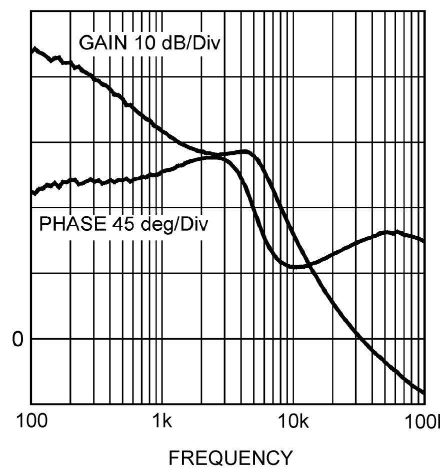


Figure 5. Overall Loop Gain and Phase (I_{OUT} = 5A)

8 PCB Layout Diagram

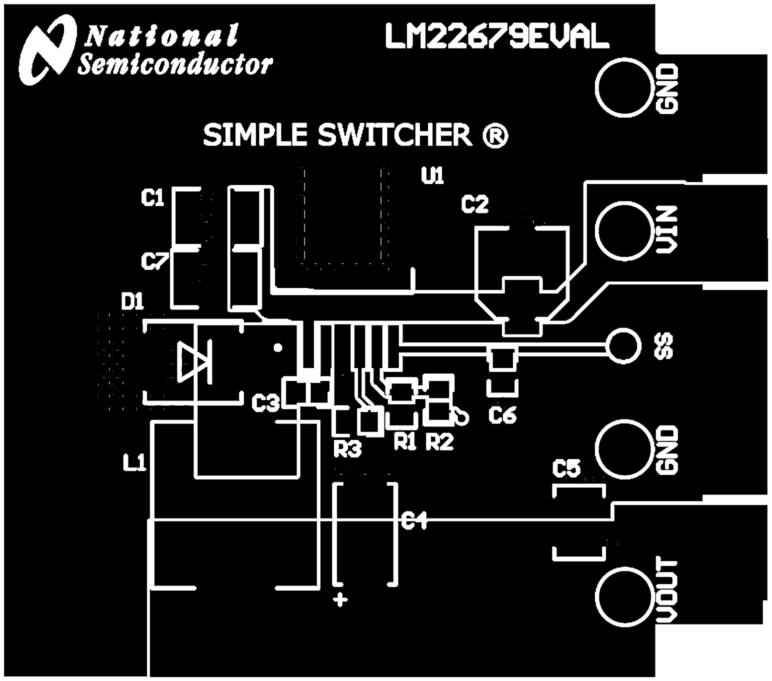


Figure 6. Top Layer

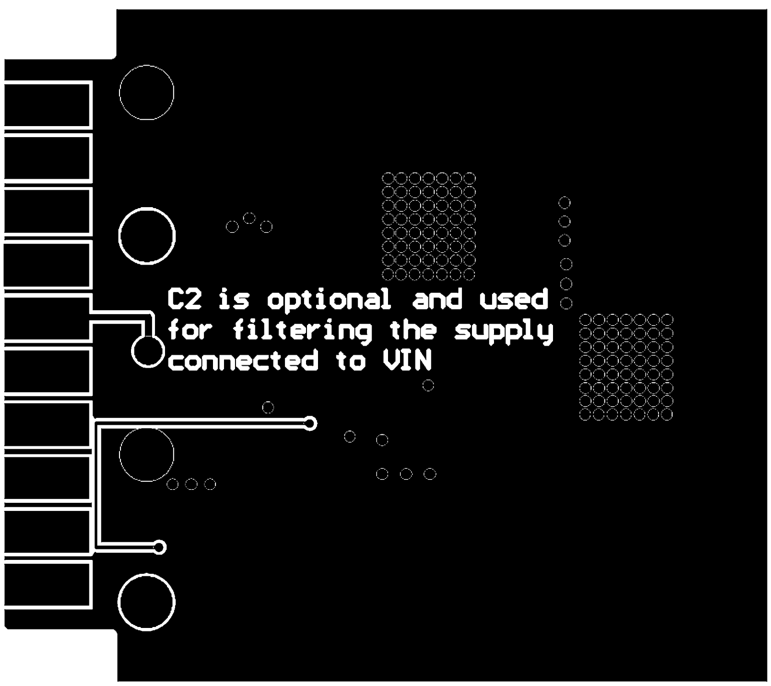


Figure 7. Bottom Layer