

AN-1471 LM3489 Demonstration Board

1 Introduction

The LM3489 is a high efficiency PFET switching regulator controller that can be used to quickly and easily develop a small, cost effective, switching buck regulator for a wide range of applications. The hysteretic control architecture provides for simple design without any control loop stability concerns using a wide variety of external components. The PFET architecture also allows for low component count as well as ultra-low dropout, and 100% duty cycle operation. Another benefit is high efficiency operation at light loads without an increase in output ripple. A dedicated Enable Pin (enabled if left unconnected) provides a shutdown mode drawing only 7 μ A.

The current limit protection can be implemented by measuring the voltage across the PFET's $R_{DS(ON)}$, thus, eliminating the need for a sense resistor. The cycle-by-cycle current limit can be adjusted with a single resistor, ensuring safe operation over a range of output currents.

This LM3489 demonstration board provides a 3.3 V output with 500 mA nominal load capability (maximum 1A) from a wide input voltage range of 7 V to 28 V. The reference design is optimized for overall conversion efficiency. This document contains the demo board schematic, PCB layout, Bill of Materials (BOM) and typical operating waveforms are provided for reference.

2 Evaluation Board Schematic

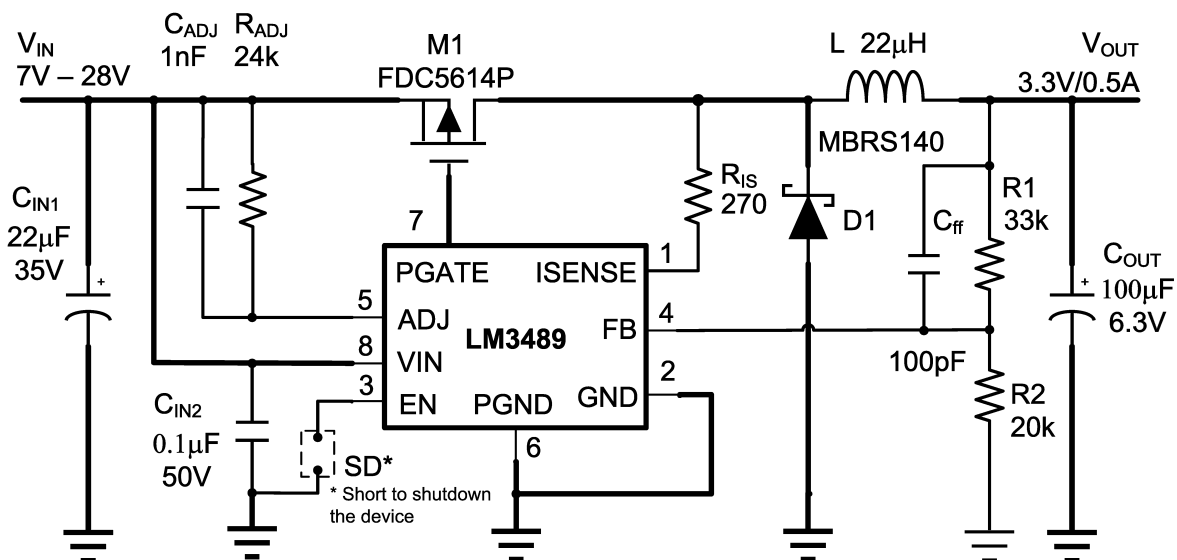
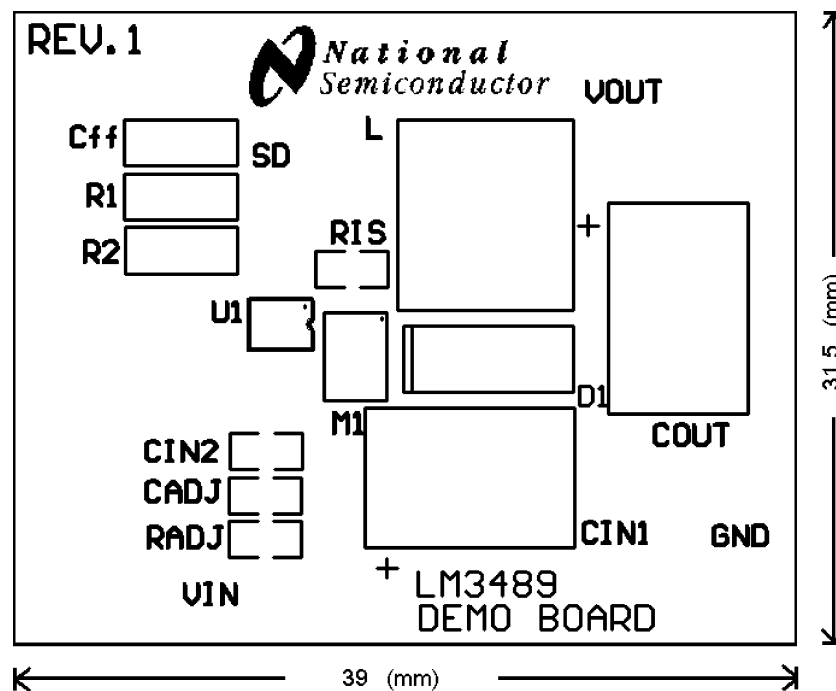


Figure 1. LM3489 Evaluation Board Schematic

Table 1. Bill of Materials (BOM)

Label	Description	Manufacturer
CIN1	Tantalum Capacitor 22 μ F 35V EEJL1VD226R	Panasonic
	Tantalum Capacitor 22 μ F 35V 293D226X0035E	Vishay
CIN2	0603 Ceramic Chip Capacitor 0.1 μ F 50V ECJ1VB1H104K	Panasonic
COUT	Low ESR Capacitor, POSCAP 100 μ F 6.3V 6TPC100M	Sanyo
CADJ	0603 Ceramic Chip 1nF 50V ECJ1VB1H102K	Panasonic
	0603 Ceramic Chip 1nF 50V VJ0805A102KXAA	Vishay
Cff	0805 Ceramic Chip 100pF 50V ECJ1VC1H101J	Panasonic
	0805 Ceramic Chip 100pF 50V VJ0805A101KXAA	Vishay
D1	Schottky Diode 1A 40V MBRS140T3	ON Semiconductor
	Schottky Diode 1A 40V CMSH1-40	Central Semi
L	Inductor 22 μ H LQH66SN220M03L	Murata
M1	P-channel MOSFET 60V FDC5614P	Fairchild
R1	0805 Chip Resistor 33k Ω CRCW08053302F	Vishay
	0805 Chip Resistor 33k Ω ERJ3GEYF333	Panasonic
R2	0805 Chip Resistor 20k Ω CRCW08052002F	Vishay
	0805 Chip Resistor 20k Ω ERJ3GEYF203	Panasonic
RADJ	0603 Chip Resistor 24k Ω CRCW08052402F	Vishay
	0603 Chip Resistor 24k Ω ERJ3GEYF243	Panasonic
RIS	0603 Chip Resistor 270 Ω CRCW08052700F	Vishay
	0603 Chip Resistor 270 Ω ERJ3GEYF271	Panasonic
U1	Buck Controller With ENABLE PIN LM3489	Texas Instruments

3 Demonstration Board PCB Layout


Figure 2. LM3489 Demonstration Board PCB Top Overlay

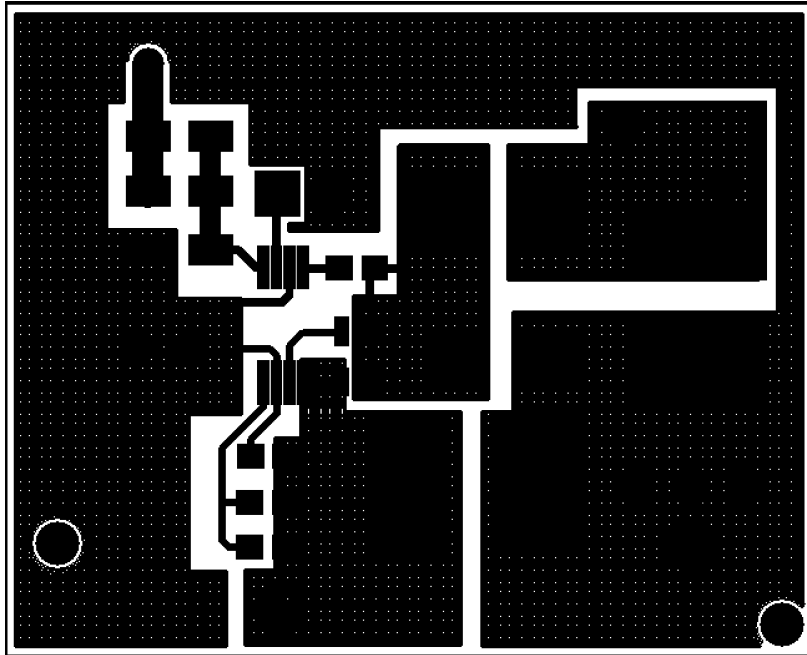


Figure 3. LM3489 Demonstration Board PCB Top Layer Layout

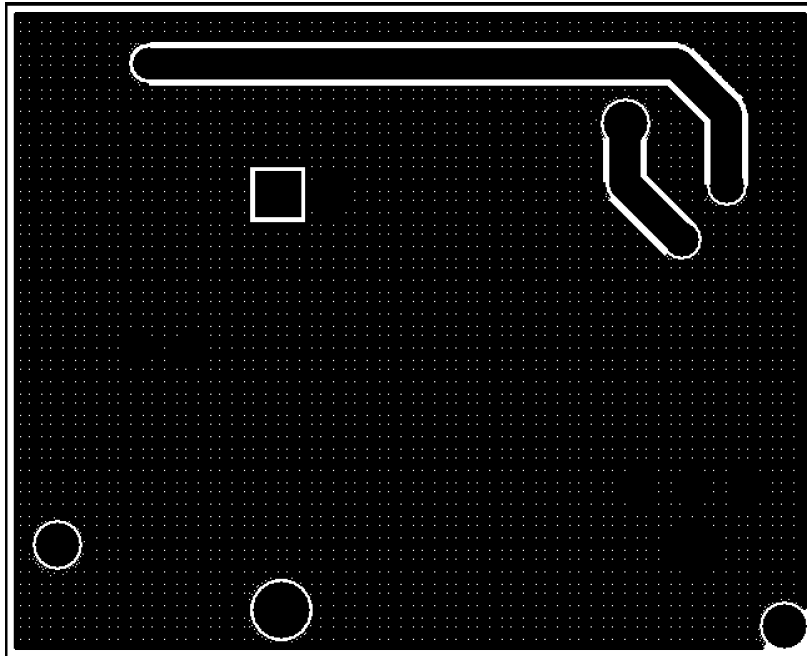


Figure 4. LM3489 Demonstration Board PCB Bottom Layer Layout

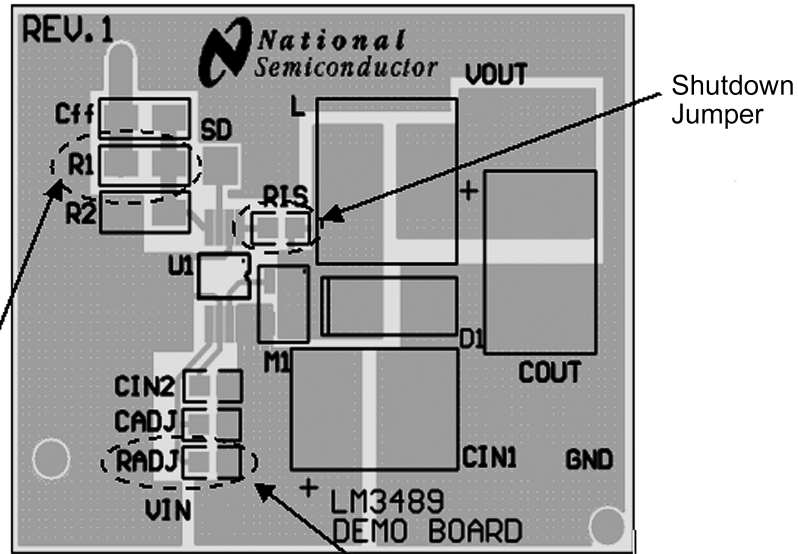
4 Demonstration Board Quick Setup Procedures

Step	Description	Notes
1	Connect power supply to VIN terminals	V _{IN} range 7 V to 28V
2	Connect load to the VOUT terminals	I _{OUT} range 0A to 500 mA
3	SD jumper should left open for normal operation -Short this jumper to shutdown	
4	Set V _{IN} = 12V, with no load applied, check V _{OUT} with voltmeter	3.3 V ±100 mV
5	Apply 500 mA load and check V _{OUT} again	3.3 V ±100 mV
6	Short output terminals and check short circuit current with an ammeter	Nominal 1.4A
7	Short SD jumper to check for shutdown function	

5 Demonstration Board Performance Characteristic

Description	Symbol	Condition	Min	Typical	Max	Unit
Input Voltage	V _{IN}		7	12	28	V
Output Voltage	V _{OUT}		3.2	3.3	3.4	V
Output Current	I _{OUT}		0	0.5	1	A
Output Voltage Ripple	V _{OUT(Ripple)}	20 MHz Bandwidth limit	-	-	40	mV _{P-P}
Output Voltage Regulation	ΔV _{OUT}	All V _{IN} and I _{OUT} conditions	1.5		1.5	%
Efficiency		V _{IN} = 7 V V _{IN} = 28 V (I _{OUT} = 100 mA to 500 mA)	88 73		90 80	%
Output Short Current Limit	I _{LIM-SC}			1.4		A

6 Output Voltage and Current Limit Setting



Output Voltage setting

Find the value of R1 by :

Assume R2 = 20kΩ

$$R1 = \left(\frac{V_{OUT}}{1.239} - 1 \right) \times 20k\Omega$$

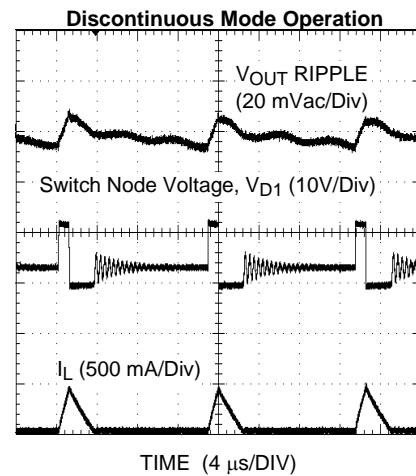
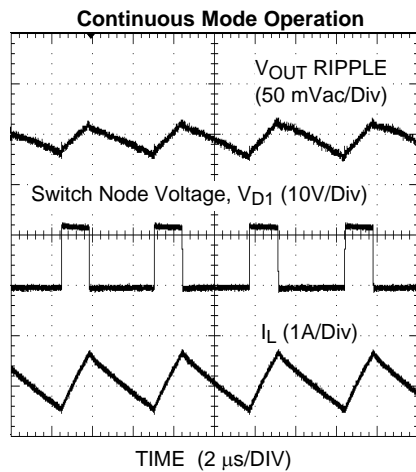
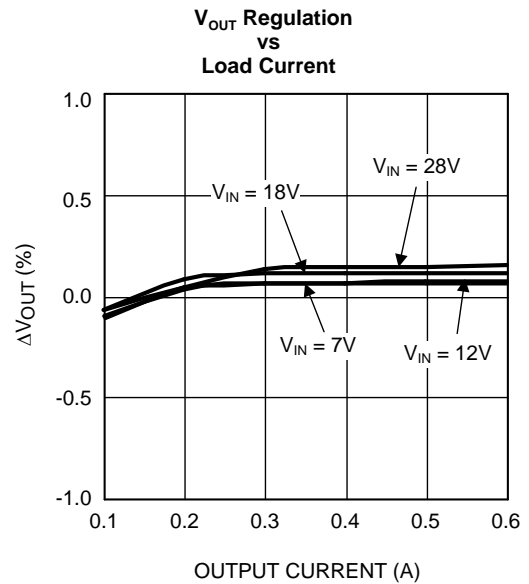
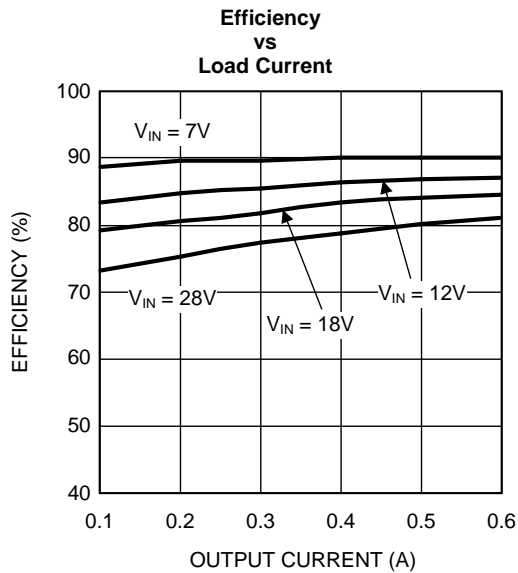
Current Limit setting

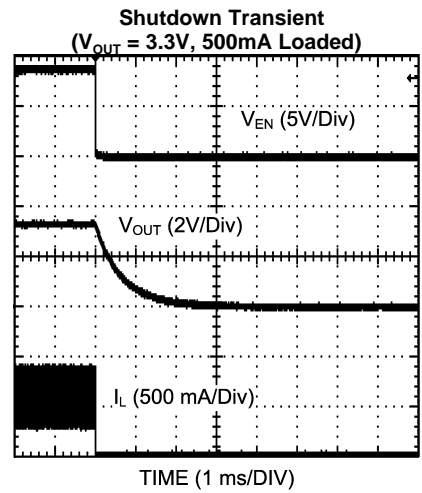
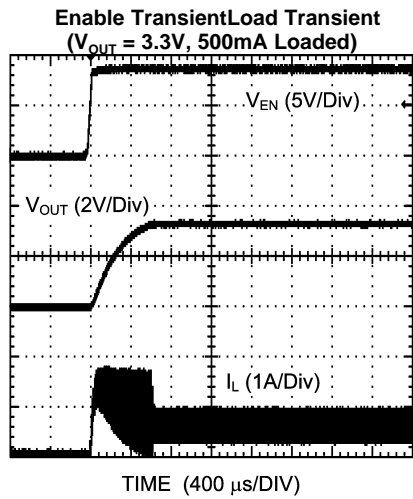
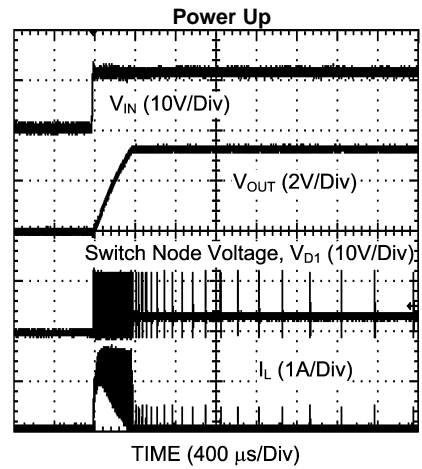
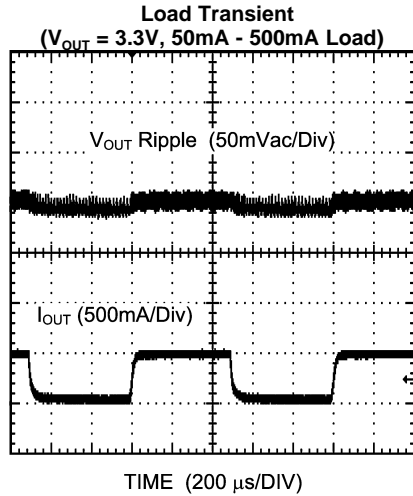
Find the value of R_{ADJ} by :

$$R_{ADJ} = \frac{R_{DS(on),M1} \times I_{IND_PEAK}}{3 \times 10^{-6}} \Omega$$

7 Typical Performance and Waveforms

All curves taken at $V_{IN} = 12\text{ V}$ with the demonstration board for $V_{OUT} = 3.3\text{ V}$. $T_J = 25^\circ\text{C}$, unless otherwise specified.





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CAUTION

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

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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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<https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-delivered-in-japan.html>

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