LM3489 Demonstration Board

National Semiconductor
Application Note 1471
TK Man
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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 µA.

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

Evaluation Board Schematic

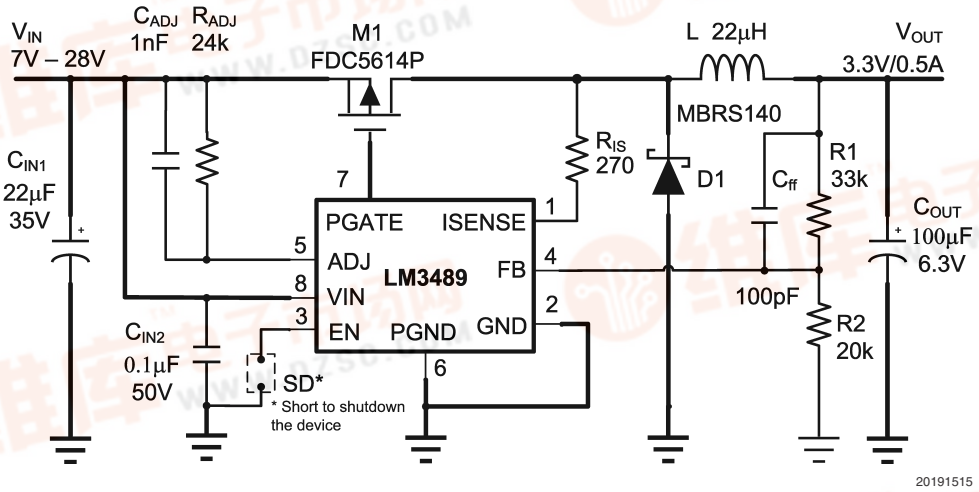

FIGURE 1. LM3489 Evaluation Board Schematic

Bill of Materials

Label	Description	Manufacturer
CIN1	Tantalum Capacitor 22µF 35V EEJL1VD226R	Panasonic
	Tantalum Capacitor 22µF 35V 293D226X0035E	Vishay
CIN2	0603 Ceramic Chip Capacitor 0.1µF 50V ECJ1VB1H104K	Panasonic
COUT	Low ESR Capacitor, POSCAP 100µF 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 22µH LQH66SN220M03L	Murata
M1	P-channel MOSFET 60V FDC5614P	Fairchild
R1	0805 Chip Resistor 33kΩ CRCW08053302F	Vishay

Bill of Materials (Continued)

Label	Description	Manufacturer
	0805 Chip Resistor 33kΩ ERJ3GEYF333	Panasonic
R2	0805 Chip Resistor 20kΩ CRCW08052002F	Vishay
	0805 Chip Resistor 20kΩ ERJ3GEYF203	Panasonic
RADJ	0603 Chip Resistor 24kΩ CRCW08052402F	Vishay
	0603 Chip Resistor 24kΩ ERJ3GEYF243	Panasonic
RIS	0603 Chip Resistor 270Ω CRCW08052700F	Vishay
	0603 Chip Resistor 270Ω ERJ3GEYF271	Panasonic
U1	Buck Controller With ENABLE PIN LM3489MM	National Semiconductor

Demonstration Board PCB Layout

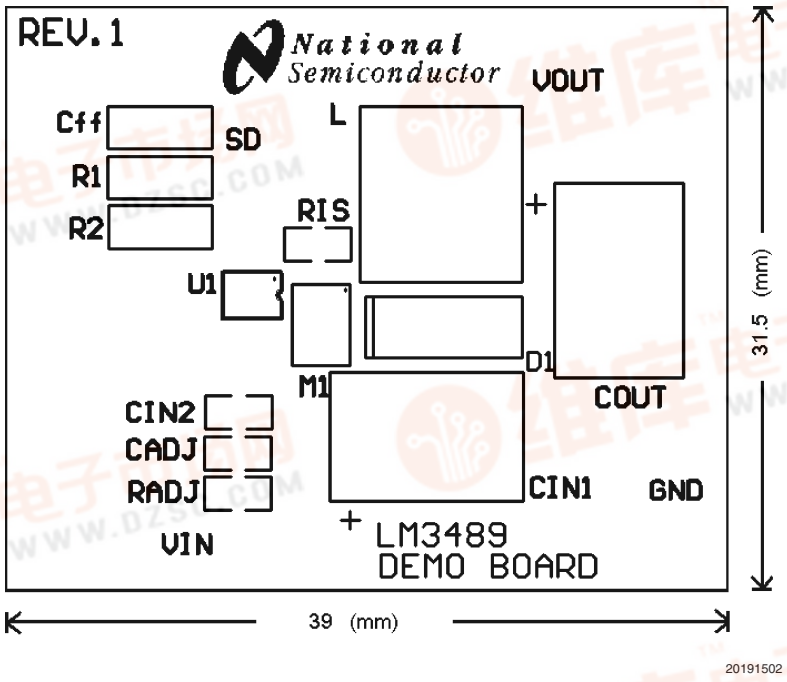

FIGURE 2. LM3489 Demonstration Board PCB Top Overlay

Demonstration Board PCB Layout (Continued)

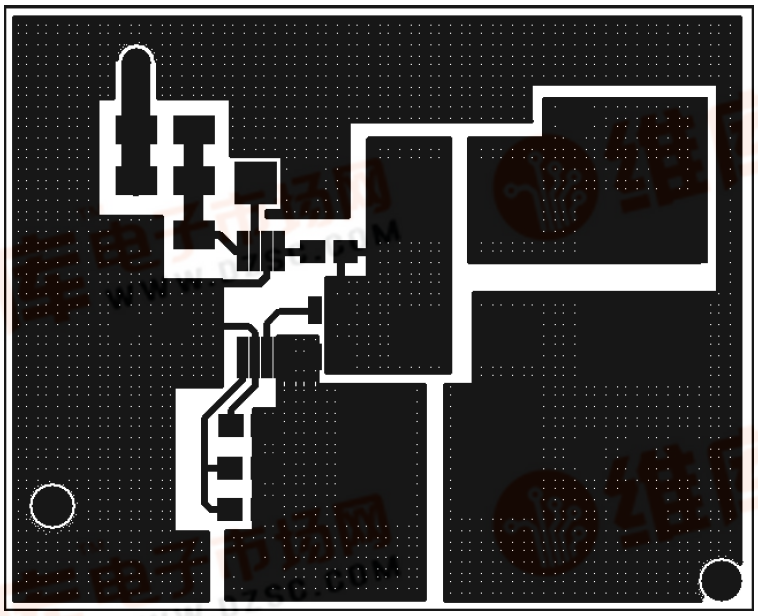

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FIGURE 3. LM3489 Demonstration Board PCB Top Layer Layout

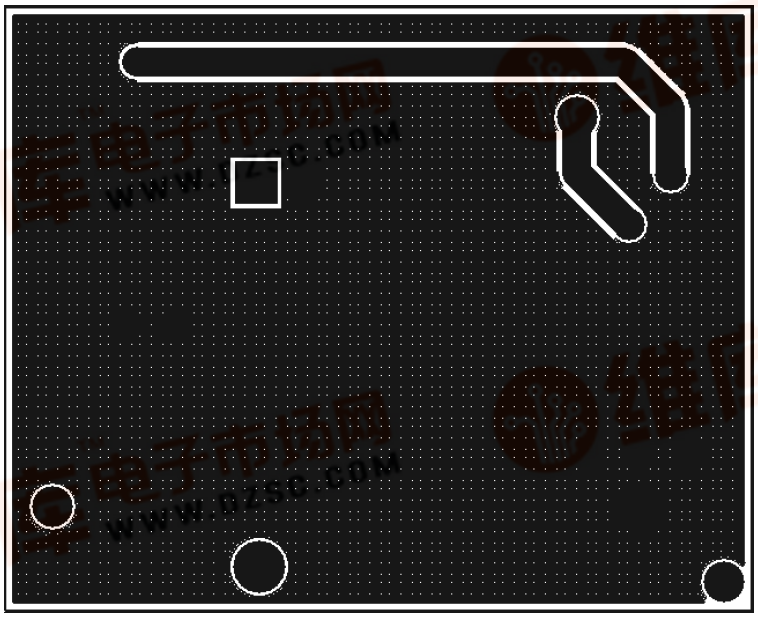

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FIGURE 4. LM3489 Demonstration Board PCB Bottom Layer Layout

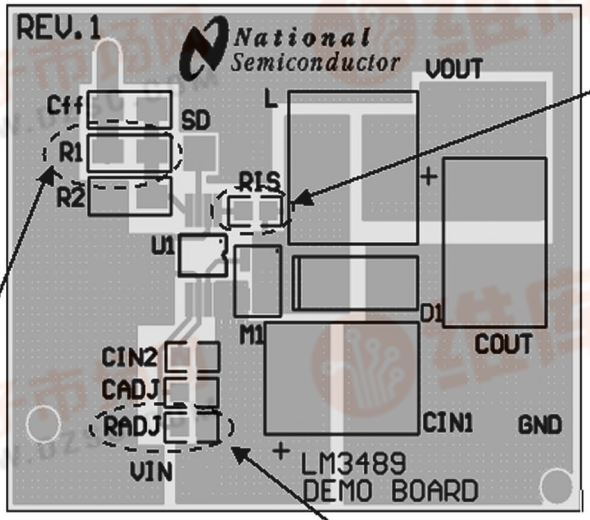
Demonstration Board Quick Setup Procedures

Step	Description	Notes
1	Connect power supply to VIN terminals	V_{IN} range 7V to 28V
2	Connect load to the VOUT terminals	I_{OUT} range 0A to 500mA
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	3.3V ±100 mV
5	Apply 500mA load and check V_{OUT} again	3.3V ±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	

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	$V_{OUT(Ripple)}$	20MHz Bandwidth limit	-	-	40	mV_{P-P}
Output Voltage Regulation	ΔV_{OUT}	All V_{IN} and IOUT conditions	1.5		1.5	%
Efficiency		V_{IN} = 7V V_{IN} = 28V (I_{OUT} = 100mA to 500mA)	88 73		90 80	%
Output Short Current Limit	I_{LIM-SC}			1.4		A

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 :

$$R_{ADJ} = \frac{R_{DSON(M1)} \times I_{IND\_PEAK}}{3 \times 10^{-6}}\ \Omega$$

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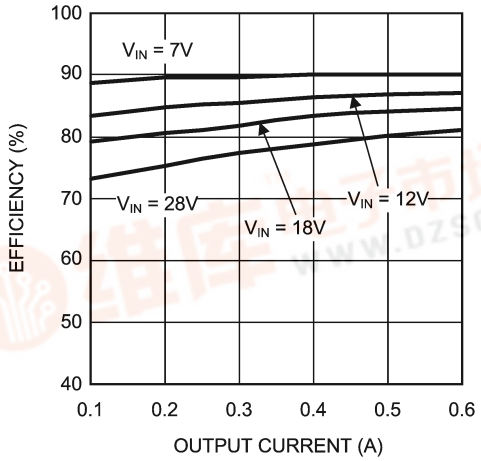
Typical Performance and Waveforms

All curves taken at V_{IN} = 12V with the demonstration board for LM3478/79, 25°C unless otherwise specified.

Efficiency vs Load Current



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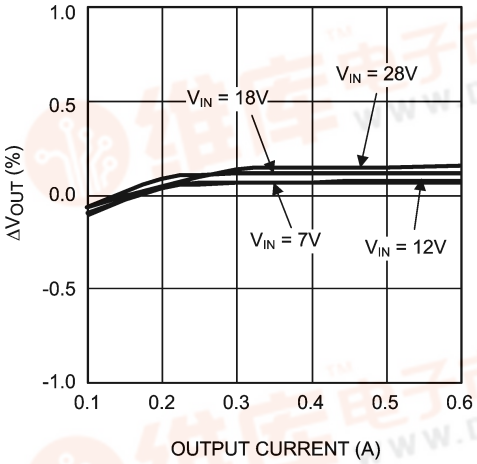
V_{OUT} Regulation vs Load Current



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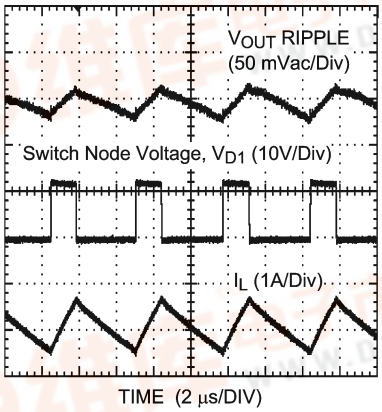
Continuous Mode Operation



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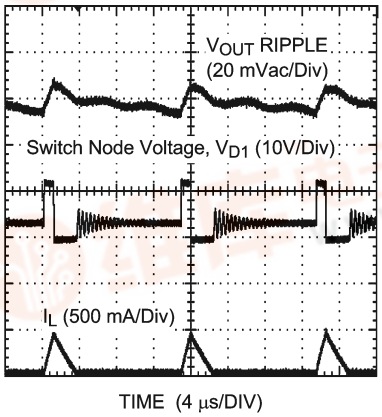
Discontinuous Mode Operation



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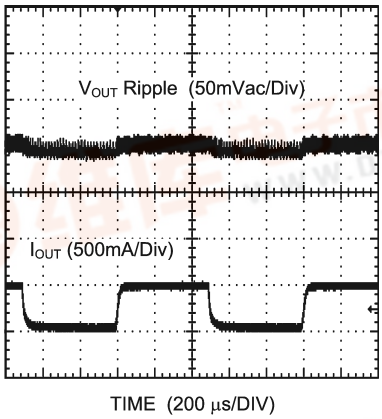
Load Transient
(V_{OUT} = 3.3V, 50mA - 500mA Load)



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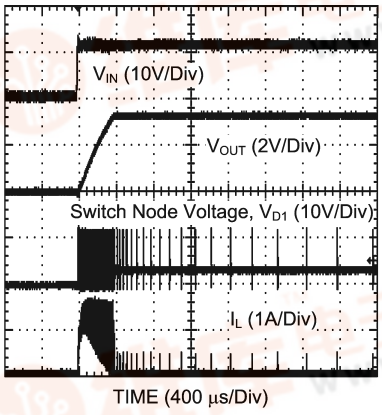
Power Up



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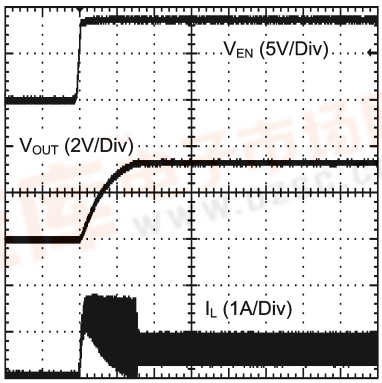
Typical Performance and Waveforms

All curves taken at V_{IN} = 12V with the demonstration board for V_{OUT} = 3.3V, T_A = 25˚C, unless otherwise specified. (Continued)

Enable TransientLoad Transient (V_{OUT} = 3.3V, 500mA Loaded)



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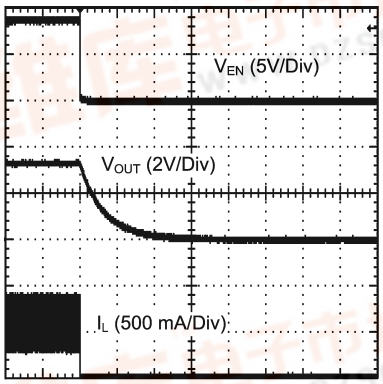
Shutdown Transient (V_{OUT} = 3.3V, 500mA Loaded)



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