LT8309
No-Opto Flyback Converter with Synchronous Rectifier

DESCRIPTION

Demonstration circuit 1961A features the LT®8309, a secondary synchronous driver in an isolated, no opto-coupler, flyback converter. It regulates a 12V, 5A output from a 36V to 72V input source.

Output regulation is handled on the primary side by the LT3748, a boundary conduction mode flyback controller which senses output voltage directly from the primary, resulting in a simple flyback schematic with no opto-coupler.

The LT8309 synchronous rectifier driver replicates the behavior of a diode by sensing the synchronous MOSFET drain-to-source voltage to determine its turn on period. By replacing the diode with a N-channel MOSFET, applications are no longer restricted by the heat constraints of the rectifier diode.

On the DC1961A, the LT8309 is biased from the rectified drain voltage node of secondary side synchronous MOSFET, not directly connecting to output voltage. This configuration allows the synchronous MOSFET to remain conducting at all times, even when output is shorted to ground, so as to provide a very robust short circuit performance.

The Performance Summary table summarizes the performance of the demo board at room temperature. For thermally critical applications, proper amount of air flow can help to reduce power components' temperature rise, therefore greatly improving circuit reliability.

The LT8309 data sheet gives a complete description of the part, operation and application information. The data sheet must be read in conjunction with this quick start guide for demo circuit 1961A.

Design files for this circuit board are available at http://www.linear.com/demo

PERFORMANCE SUMMARY

Specifications are at T_A = 25°C

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Input Voltage		36	48	72	V
Output Voltage	V_{IN} = 36V to 72V, I_{OUT} = 0.15A to 5A	11.4	12	12.6	V
Maximum Output Current		5			A
Output Voltage Ripple (Peak to Peak)	V_{IN} = 36V to 72V, I_{OUT} = 5A (20MHz BW)		150		mV
Boundary Mode Switching Frequency	V_{IN} = 48V, I_{OUT} = 5A		133		kHz
Minimum Switching Frequency	I_{OUT} = 0mA		42		kHz
Efficiency	V_{IN} = 36V, I_{OUT} = 5A		91		%
	V_{IN} = 48V, I_{OUT} = 5A		91.5		%
	V_{IN} = 72V, I_{OUT} = 5A		91.5		%

QUICK START PROCEDURE

Demonstration circuit 1961A is easy to set up to evaluate the performance of the LT8309. Refer to Figure 1 for proper measurement equipment setup and follow the procedure below:

1. With power off, connect the input power supply to the board through V_{IN} and GND terminals. Connect the load to the terminals V_{OUT}^+ and V_{OUT}^- on the board.
2. Turn on the power at the input.

NOTE: Make sure that the input voltage does not exceed 72V. To operate the board with higher input/output voltage, input capacitor, output capacitor and MOSFETs with higher voltage ratings are needed.

3. Check for the proper output voltages. The output should be regulated at 12V (±5%).

NOTE: The LT3748 requires a minimum load to maintain good output voltage regulation. On the DC1961A, in order to avoid pre-loading, a Zener diode is placed between its V_{OUT}^+ and V_{OUT}^- to serve as a minimum load.

4. Once the proper output voltage is established, adjust the input voltage and load current within the operating range and observe the output voltage regulation, ripple voltage, efficiency and other parameters.

NOTE: When measuring the input or output voltage ripples, care must be taken to avoid a long ground lead on the oscilloscope probe. Measure the input or output voltage ripple by touching the probe tip directly across the V_{IN} and GND, or V_{OUT}^+ and V_{OUT}^- terminals. See Figure 2 for proper scope probe technique.

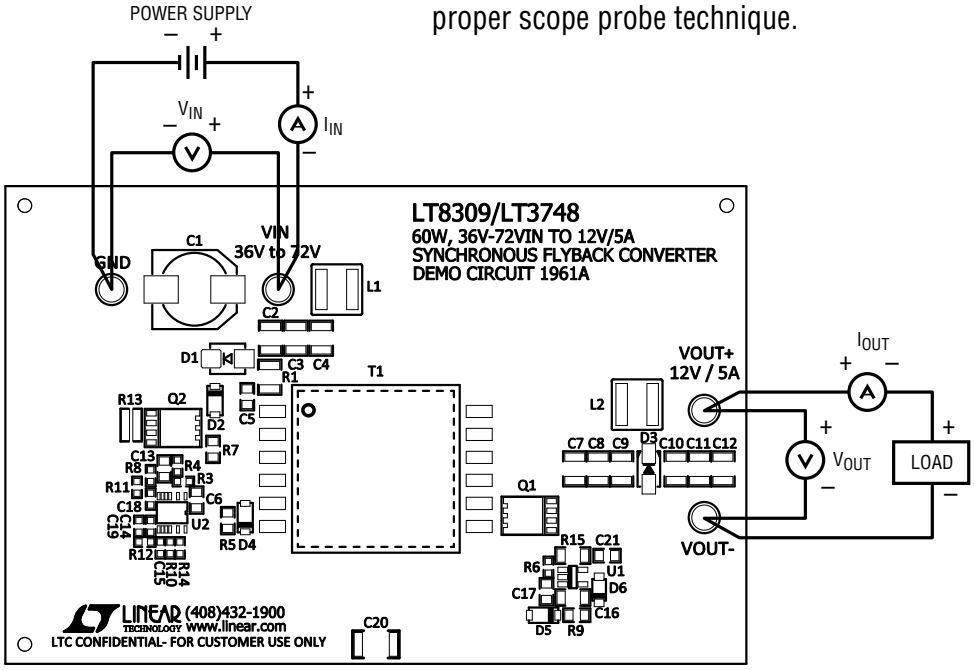


Figure 1. Proper Measurement Equipment Setup

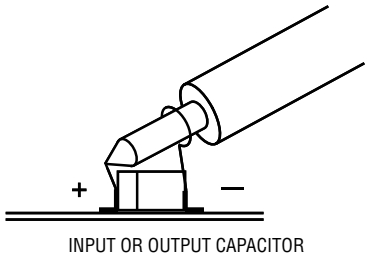


Figure 2. Proper Scope Probe Placement for Measuring Input/Output Ripple

PERFORMANCE

Efficiency Curve

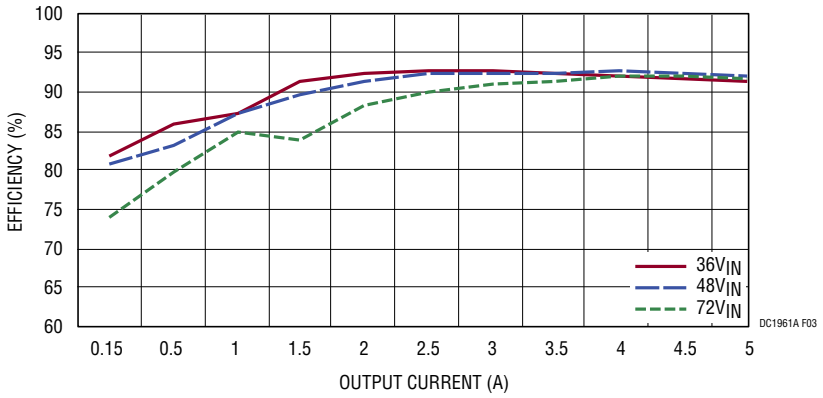


Figure 3. Typical Efficiency Curve

Output Load and Line Regulation

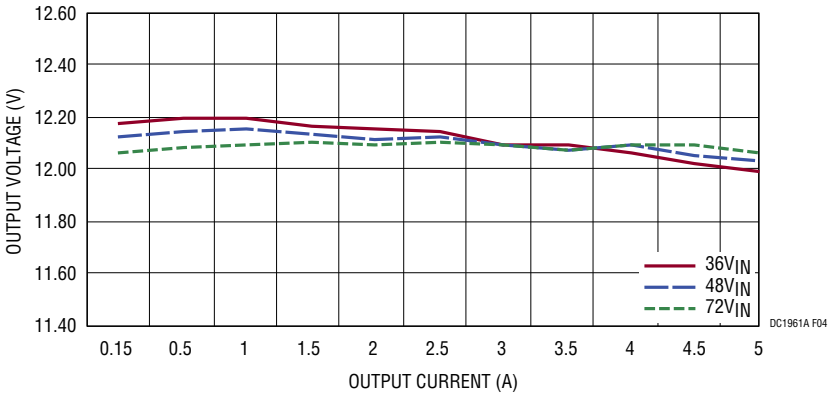


Figure 4. Typical Regulation Curve

PERFORMANCE

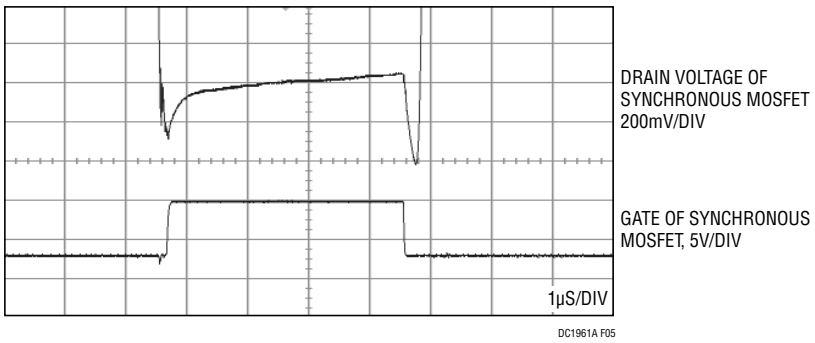


Figure 5. Synchronous MOSFET Drain and Gate Voltage (V_{IN} = 48V, I_{OUT} = 5A)

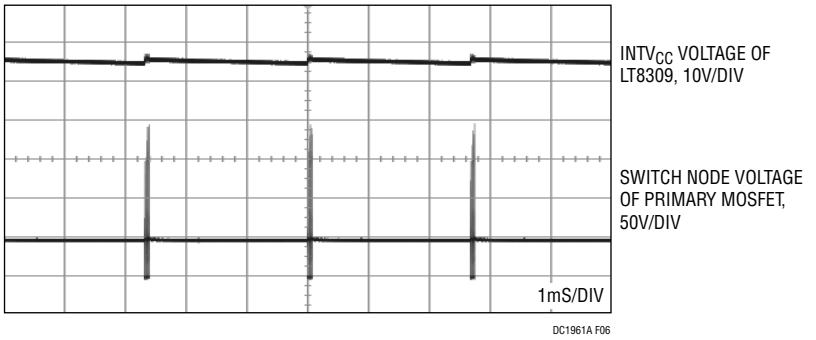


Figure 6. Output Short Circuit Waveforms (V_{IN} = 48V)

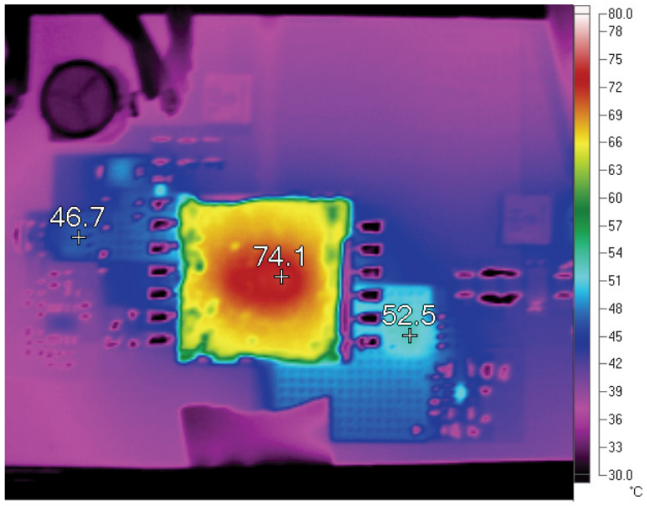


Figure 7. Thermal Picture, 48V_{IN} and 5A_{OUT} (T_A = 25°C, Air Flow 200LFM)
Synchronous MOSFET, 52.5°C; Primary MOSFET, 46.7°C; Transformer, 74.1°C

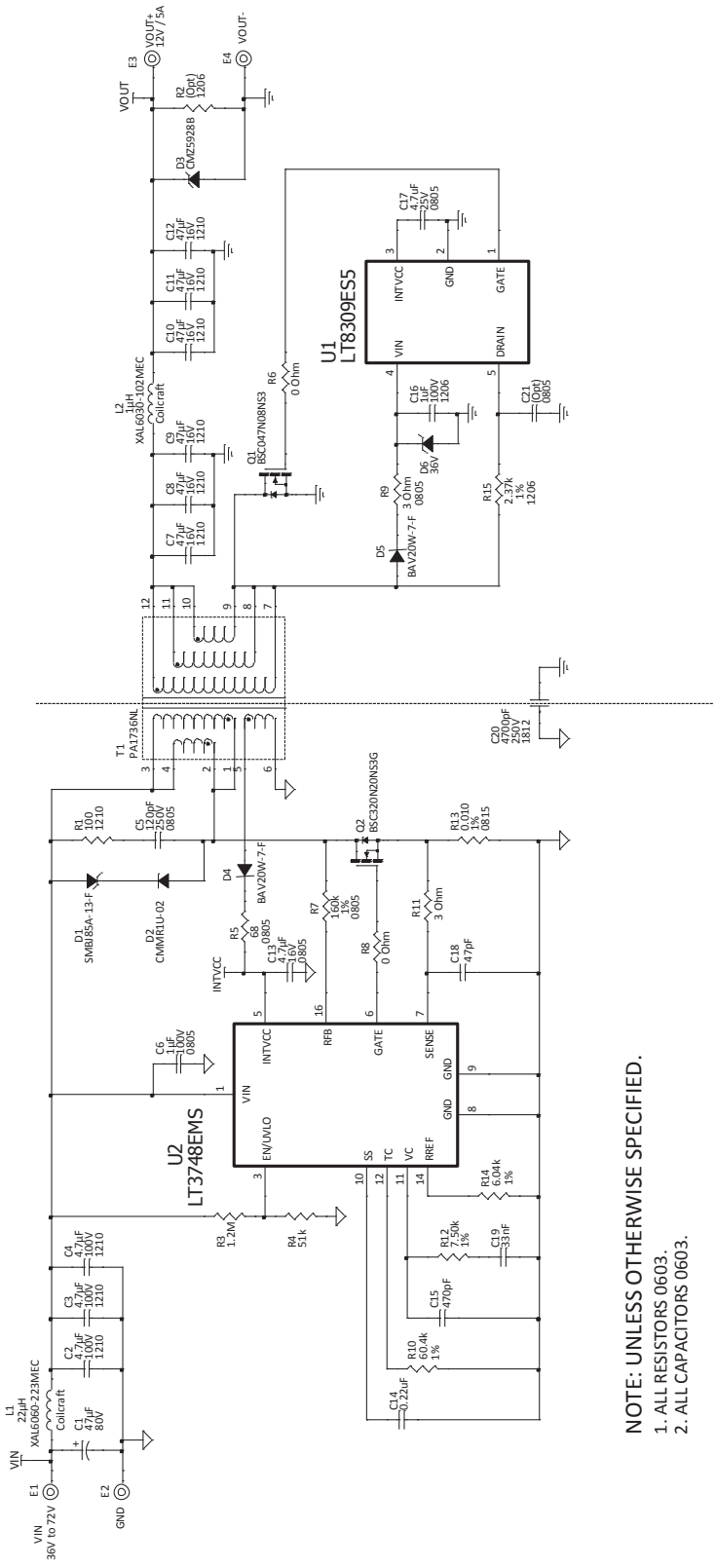
PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	1	C1	CAP., ALUM, 47µF, 80V, 20%, SMD	Nippon Chemi-Con, EMZA800ADA470MJA0G
2	3	C2, C3, C4	Cap., X7S, 4.7µF, 100V, 20%, 1210	TDK, C3225X7S2A475MT
3	1	C5	Cap., U2J, 120pF, 250V, 5%, 0805	Murata, GRM21A7U2E121JW31D
4	1	C6	Cap., X7S, 1µF, 100V, 10%, 0805	TDK, C2012X7S2A105K
5	6	C7-C12	Cap., X5R, 47µF, 16V, 10%, 1210	Murata, GRM32ER61C476KE15L
6	1	C13	Cap., X5R, 4.7µF, 16V, 20%, 0805	TDK, C2012X5R1C475M
7	1	C14	Cap., X7R, 0.22µF, 25V, 10%, 0603	TDK, C1608X7R1E224K
8	1	C15	Cap., NPO, 470pF, 25V, 5%, 0603	AVX, 06033A471JAT2A
9	1	C16	Cap., X7R, 1µF, 100V, 20%, 1206	TDK, C3216X7R2A105M
10	1	C17	Cap., X5R, 4.7µF, 25V, 10%, 0805	TDK, C2012X5R1E475K
11	1	C18	Cap., NPO, 47pF, 25V, 5%, 0603	AVX, 06033A470JAT2A
12	1	C19	Cap., X7R, 0.033µF, 25V, 10%, 0603	AVX, 06033C333KAT2A
13	1	C20	Cap., X7R, 4700pF, 250V, 10%, 1812	Murata, GA343DR7GD472KW01L
14	1	D1	Diode, TVS UNI-DIR 85V, 600W, SMB	Diodes Inc., SMBJ85A-13-F
15	1	D2	Diode, 1A/200V, SOD-123	Central Semi., CMMR1U-02 TR
16	1	D3	Diode Zener, 13V SMA	Central Semi., CMZ5928B TR
17	2	D4, D5	DIODE, SWITCHING 150V, 0.2A, SOD123	Diodes Inc., BAV20W-7-F
18	1	D6	Zener Diode, 36V, SOD-123	Central Semi., CMHZ5258B TR
19	1	L1	Inductor, 22µH, XAL6060	Coilcraft, XAL6060-223MEC
20	1	L2	Inductor, 1µH, XAL6030	Coilcraft, XAL6030-102MEB
21	1	Q1	MOSFET, N-CH, 80V, 100A, TDSON-8	Infineon, BSC047N08NS3 G
22	1	Q2	MOSFET, N-CH, 200V, 36A, TDSON-8	Infineon, BSC320N20NS3 G
23	1	R1	Res., Chip 100, 0.50W, 5%, 1210	Vishay, CRCW1210100RJNEA
24	1	R3	Res., Chip 1.2M, 0.1W, 5%, 0603	Vishay, CRCW06031M20JNEA
25	1	R4	Res., Chip 51k 0.1W 5% 0603	Vishay, CRCW060351K0JNEA
26	1	R5	Res., Chip 68, 1/8W, 5%, 0805	Vishay, CRCW080568R0JNEA
27	2	R6, R8	Res/Jumper, Chip 0Ω, 0.25W, 5A, 0603	Vishay, CRCW06030000Z0EA
28	1	R7	Res., Chip 160k, 1/8W, 1%, 0805	Vishay, CRCW0805160KFKEA
29	1	R9	Res., Chip 3Ω, 1/8W, 5%, 0805	Vishay, CRCW08053R00JNEA
30	1	R10	Res., Chip 60.4k, 0.1W, 1%, 0603	Vishay, CRCW060360K4FKEA
31	1	R11	Res., Chip 3, 1/10W, 5%, 0603	Vishay, CRCW06033R00JNEA
32	1	R12	Res., Chip 7.50k, 0.1W, 1%, 0603	Vishay, CRCW06037K50FKEA
33	1	R13	Sense Res., RL Vert. 0.010, 1W, 1%, 0815	SUSUMU, RL3720WT-R010-F
34	1	R14	Res., Chip 6.04k, 0.1W, 1%, 0603	Vishay, CRCW06036K04FKEA
35	1	R15	Res., Chip 2.37k, 0.25W, 1%, 1206	Vishay, CRCW12062K37FKEA
36	1	T1	Transformer, ±5%, 20.5µH, EFD20 Platform	Pulse Engrng., PA1736NLT
37	1	U1	I.C., Rectifier Driver, TSOT23-S5	Linear Tech. Corp. LT8309ES5#PBF
38	1	U2	I.C., No-Opto Flyback Converter	Linear Tech. Corp. LT3748EMS#PBF
39	1		FAB, PRINTED CIRCUIT BOARD Rev 2	DEMO CIRCUIT #1961A

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Additional Demo Board Circuit Components				
1	0	C21	Cap., 0805	
2	0	R2	Res., 1206	
Hardware: For Demo Board Only				
1	4	E1, E2, E3, E4	Turret, Testpoint	Mill Max, 2501-2-00-80-00-00-07-0

SCHEMATIC DIAGRAM



NOTE: UNLESS OTHERWISE SPECIFIED.
1. ALL RESISTORS 0603.
2. ALL CAPACITORS 0603.

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