

Micropower No-Opto Isolated Flyback Converter with 150V/2A Switch

DESCRIPTION

Demonstration circuit 2393A is a micropower no-opto isolated flyback converter featuring the LT[®]8304. This demo circuit outputs 5.0V, and maintains tight regulation with a load current from 20mA up to 4.2A and over an input voltage from 18V to 72V. The output current capability increases with the input voltage, as shown in the Performance Summary table.

The DC2393A needs less than 0.5% of its full output power as a minimum load to maintain good output voltage regulation. On the DC2393A, in order to avoid pre-loading, a 5.6V Zener diode is placed between its V_{OUT+} and V_{OUT-} to serve as a minimum load.

Transformer leakage inductance causes a voltage spike on the primary side after the power switch turns off. To limit this leakage inductance spike within MOSFET voltage rating of 150V, an RC snubber and a TVS clamp are installed to damp the ringing and clamp the MOSFET drain voltage to a safe level.

The Performance Summary table summarizes the performance of the demo board at room temperature. The demo circuit can be easily modified for different applications with some pre-designed transformers.

The LT8304 is a simple to use monolithic micropower isolated flyback converter. By sampling the isolated output voltage directly from the primary-side flyback waveform, the part requires no third winding or opto-isolator for regulation. The output voltage is programmed with two external resistors and a third optional temperature compensation resistor. By integrating the loop compensation and soft-start inside, the part reduces the number of external components. Boundary mode operation provides a small magnetic solution with excellent load regulation. Low ripple Burst Mode[®] operation maintains high efficiency at light load while minimizing the output voltage ripple. A 2A, 150V DMOS power switch is integrated along with all the high voltage circuitry and control logic into a thermally enhanced 8-lead SO package.

The LT8304 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 2393A

Design files for this circuit board are available at <http://www.linear.com/demo/DC2393A>

LT, LT, LTC, LTM, Linear Technology, the Linear logo and Burst Mode are registered trademarks of Linear Technology Corporation. All other trademarks are the property of their respective owners.

PERFORMANCE SUMMARY Specifications are at $T_A = 25^\circ\text{C}$

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Input Voltage		18	48	72	V
Output Voltage	$V_{IN} = 18V - 72V$ $I_{OUT} = 20mA - 2A$	4.75	5	5.25	V
Maximum Output Current	$V_{IN} = 18V$	2			A
	$V_{IN} = 24V$	2.4			A
	$V_{IN} = 48V$	3.5			A
	$V_{IN} = 72V$	4.2			A
Output Voltage Ripple (Peak-to-Peak)	$V_{IN} = 48V, I_{OUT} = 3.5A$			100	mV
Minimum Switching Frequency	$I_{OUT} = 0mA$		11		kHz
Efficiency	$V_{IN} = 24V, I_{OUT} = 2.4A$		83		%
	$V_{IN} = 48V, I_{OUT} = 3.5A$		84		%

QUICK START PROCEDURE

Demonstration circuit 2393A is easy to set up to evaluate the performance of the LT8304. 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} (E1) and GND (E2) terminals. Connect the load to the terminals V_{OUT+} (E3) and V_{OUT-} (E4) on the board.
2. Turn on the power at the input. Increase V_{IN} slowly to 18V.

Note: Make sure that the input voltage is always within spec. To operate the board with higher input/output voltage, input capacitor, output capacitor and output diode with higher voltage ratings are needed.

3. Check for the proper output voltages. The output should be regulated at 5.0V ($\pm 5\%$).

Note: The LT8304 requires very small minimum load to maintain good output voltage regulation. A Zener diode is placed on the output to clamp the voltage to 5.6V. This Zener can be replaced with a 249 Ω resistor at the trade off of lower efficiency.

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} (E1) and GND (E2), or V_{OUT+} (E3) and V_{OUT-} (E4) terminals. See Figure 2 for proper scope probe technique.

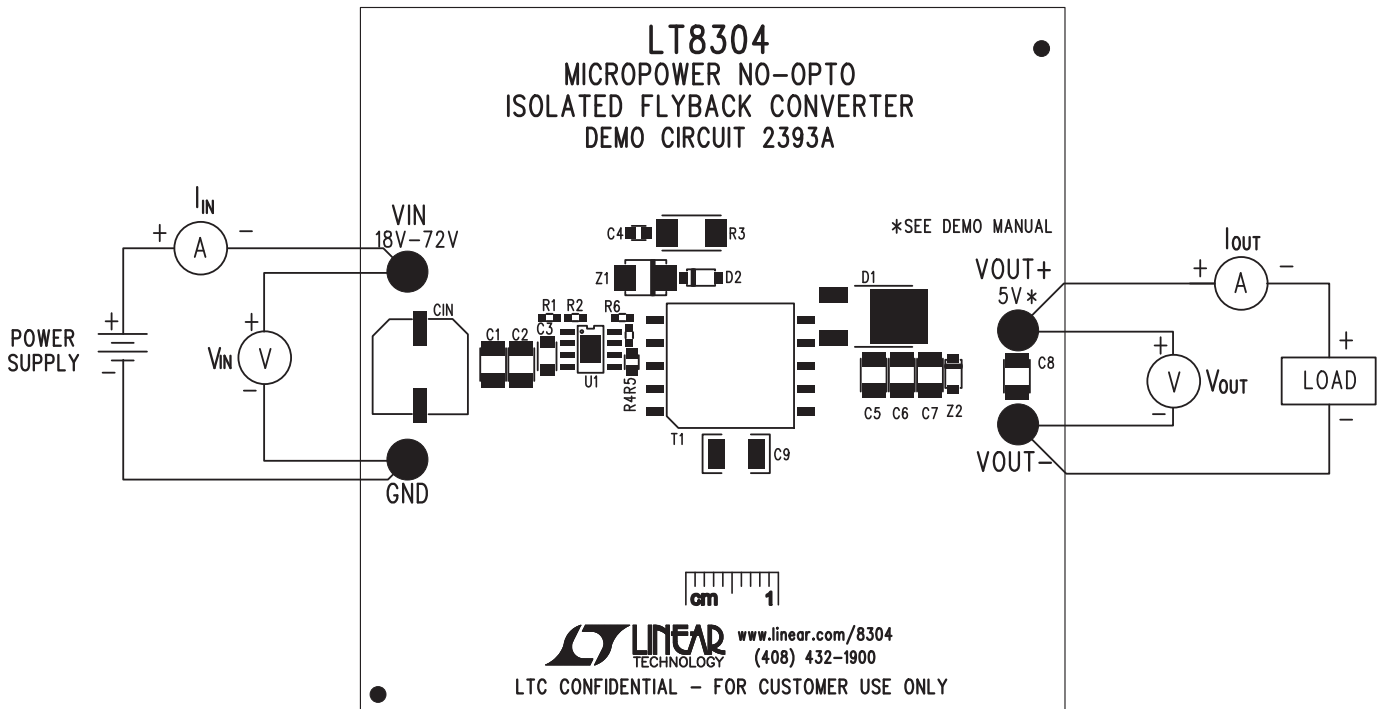


Figure 1. Proper Measurement Equipment Setup

QUICK START PROCEDURE

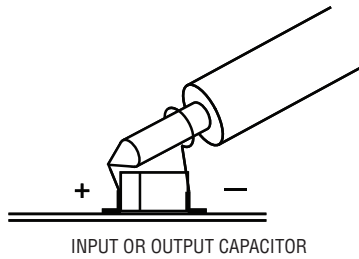


Figure 2. Proper Scope Probe Placement for Measuring Input or Output Ripple

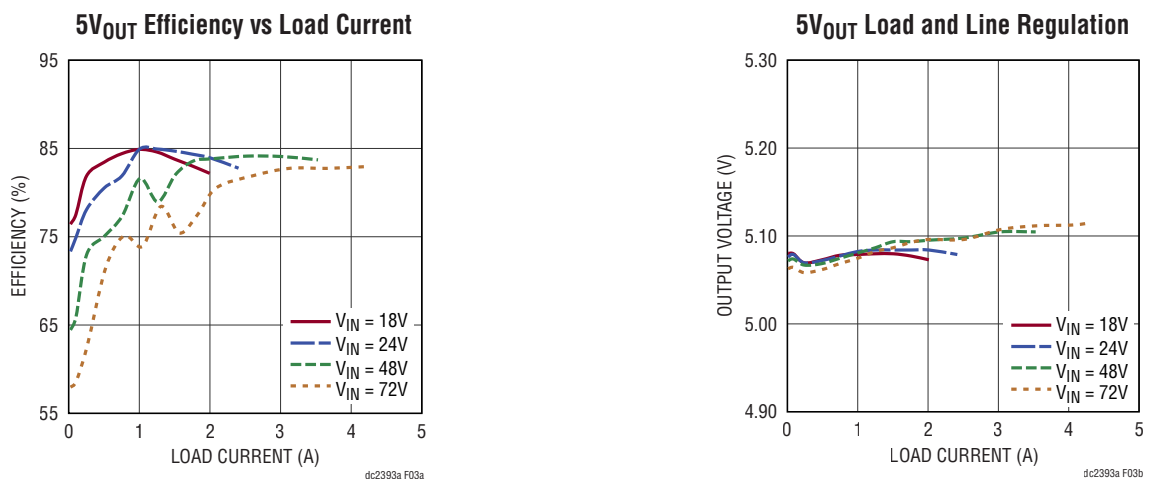


Figure 3. Typical Efficiency and Regulation Curves

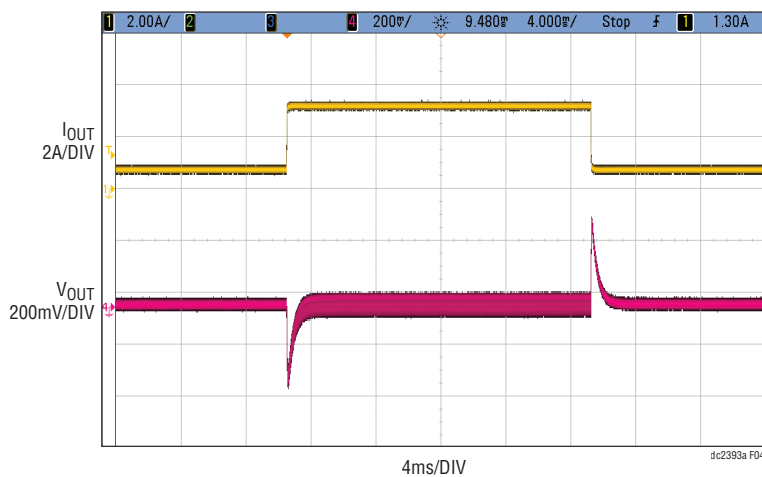


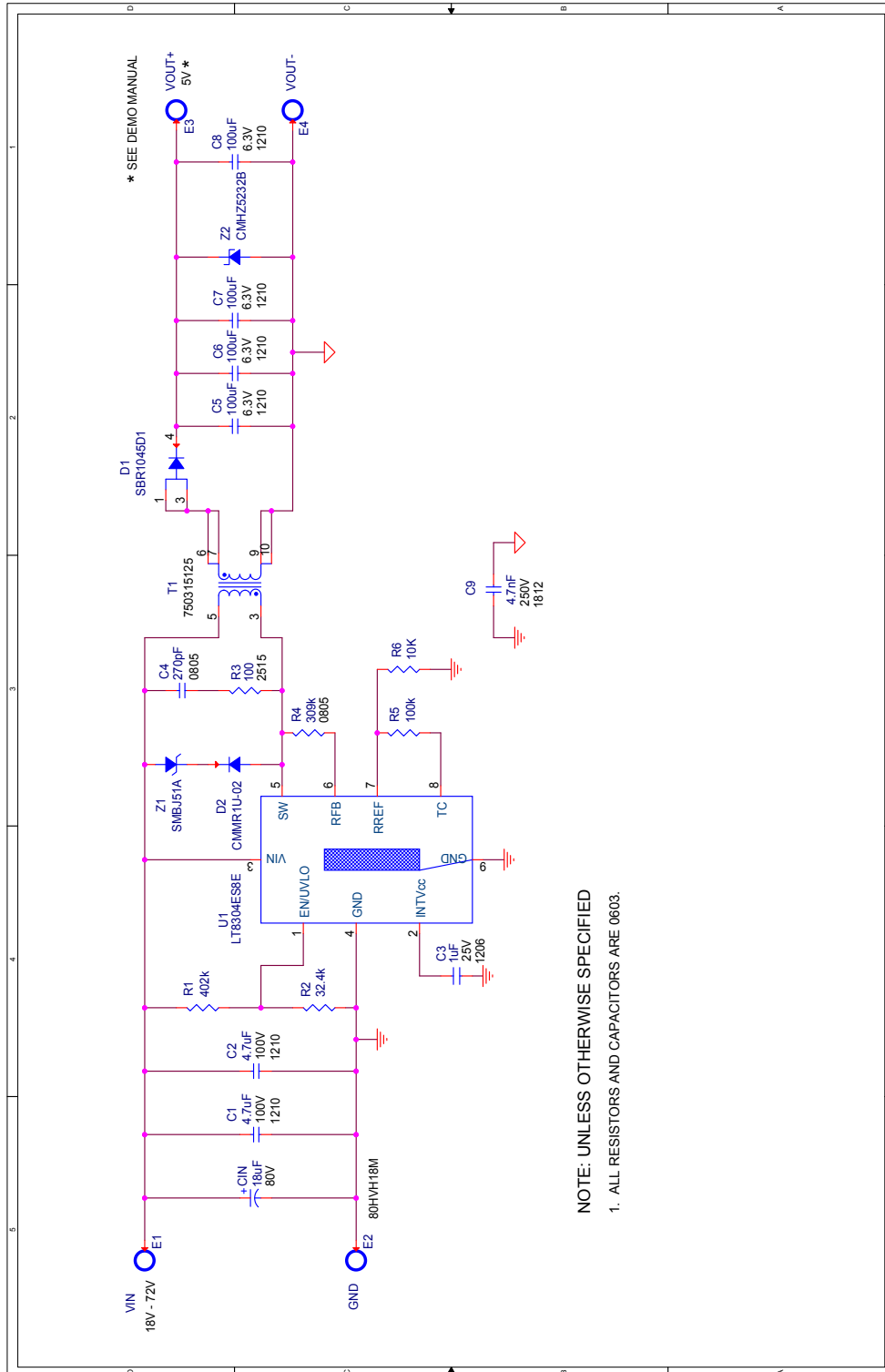
Figure 4. Load Transient Responses ($V_{IN} = 48V$, Load Transient Between 1A and 3.5A)

DEMO MANUAL DC2393A

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	1	C1N	CAP., ALUM 18 μ F 80V	SUN ELECTRONIC INDUSTRIES CORPORATION, 80HVH18M
2	2	C1, C2	CAP., 4.7 μ F, X7S, 100V, 10% 1210	TDK, C3225X7S2A475K200AB
3	1	C3	CAP., 1 μ F, X7R, 25V, 10% 1206	MURATA, GRM31MR71E105KA01L
4	1	C4	CAP., 270pF, C0G, 50V, 5% 0805	MURATA, GRM2165C1H271JA01D
5	4	C5, C6, C7, C8	CAP., 100 μ F, X5R, 6.3V, 20% 1210	MURATA, GRM32ER60J107ME20L
6	1	C9	CAP., 4.7nF, X7R, 250V, 10% 1812	MURATA, GA343DR7GD472KW01L
7	1	D1	DIODE, SBR1045D1, DPAK	DIODES INC., SBR1045D1-13
8	1	Z2	DIODE, CMHZ5232B, SOD-123	CENTRAL SEMI., CMHZ5232B
9	1	Z1	DIODE, SMBJ51A, SMB	DIODES INC., SMBJ51A-13-F
10	1	D2	DIODE, CMMR1U-02, SOD-123F	CENTRAL SEMI., CMMR1U-02
11	1	R1	RES., 402k, 1/10W, 1% 0603	VISHAY, CRCW0603402KFKEA
12	1	R2	RES., 32.4k, 1/10W, 1% 0603	VISHAY, CRCW0603324KFKEA
13	1	R3	RES., 100 Ω , 1W, 1% 2515	VISHAY, WSC2515100R0FEA
14	1	R4	RES., 309k, 1/8W, 1% 0805	VISHAY, CRCW0805309KFKEA
15	1	R5	RES., 100k, 1/10W, 1% 0603	VISHAY, CRCW0603100KFKEA
16	1	R6	RES., 10k, 1/10W, 1% 0603	VISHAY, CRCW060310K0FKEA
17	1	T1	TRANSFORMER, 750315125	WURTH ELEKTRONIK, 750315125
18	1	U1	IC LT8304 S08E	LINEAR TECH., LT8304ES8E#PBF
Hardware: For Demo Board Only				
1	4	E1 – E4	TESTPOINT, TURRET, .094" PBF	MILL-MAX, 2501-2-00-80-00-00-07-0

SCHEMATIC DIAGRAM



NOTE: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTORS AND CAPACITORS ARE 0603.

DEMO MANUAL DC2393A

DEMONSTRATION BOARD IMPORTANT NOTICE

Linear Technology Corporation (LTC) provides the enclosed product(s) under the following **AS IS** conditions:

This demonstration board (DEMO BOARD) kit being sold or provided by Linear Technology is intended for use for **ENGINEERING DEVELOPMENT OR EVALUATION PURPOSES ONLY** and is not provided by LTC for commercial use. As such, the DEMO BOARD herein may not be complete in terms of required design-, marketing-, and/or manufacturing-related protective considerations, including but not limited to product safety measures typically found in finished commercial goods. As a prototype, this product does not fall within the scope of the European Union directive on electromagnetic compatibility and therefore may or may not meet the technical requirements of the directive, or other regulations.

If this evaluation kit does not meet the specifications recited in the DEMO BOARD manual the kit may be returned within 30 days from the date of delivery for a full refund. **THE FOREGOING WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY THE SELLER TO BUYER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. EXCEPT TO THE EXTENT OF THIS INDEMNITY, NEITHER PARTY SHALL BE LIABLE TO THE OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.**

The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user releases LTC from all claims arising from the handling or use of the goods. Due to the open construction of the product, it is the user's responsibility to take any and all appropriate precautions with regard to electrostatic discharge. Also be aware that the products herein may not be regulatory compliant or agency certified (FCC, UL, CE, etc.).

No License is granted under any patent right or other intellectual property whatsoever. **LTC assumes no liability for applications assistance, customer product design, software performance, or infringement of patents or any other intellectual property rights of any kind.**

LTC currently services a variety of customers for products around the world, and therefore this transaction **is not exclusive**.

Please read the DEMO BOARD manual prior to handling the product. Persons handling this product must have electronics training and observe good laboratory practice standards. **Common sense is encouraged.**

This notice contains important safety information about temperatures and voltages. For further safety concerns, please contact a LTC application engineer.

Mailing Address:

Linear Technology
1630 McCarthy Blvd.
Milpitas, CA 95035

Copyright © 2004, Linear Technology Corporation