

# Triple Step-Down Switching Regulator with 100% Duty Cycle Operation

## DESCRIPTION

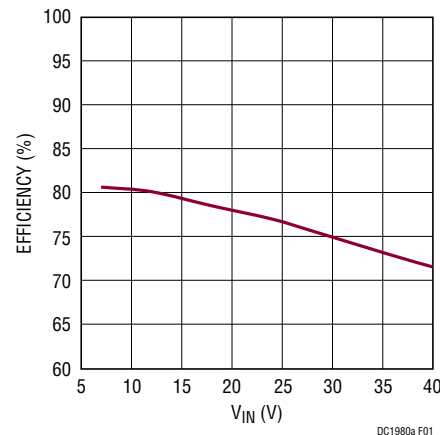
Demonstration circuit 1980A is a triple current mode PWM step-down DC/DC converter featuring the LT<sup>®</sup>3514. The demo circuit is designed for 5V, 3.3V and 1.8V outputs from a 5.4V to 36V input. The current capability of 5V and 1.8V outputs is 1A and the 3.3V output is capable of 2A output. Individual soft-start and current limit for each output as well as frequency synchronous function simplify the complex design of triple-output power converters.

Each converter is synchronized to either a common external clock input or a resistor programmable 250kHz to 2.2MHz internal oscillator. Programmable frequency allows optimization between efficiency and external component size. Each output can be independently disabled using its own RUN/SS pin.

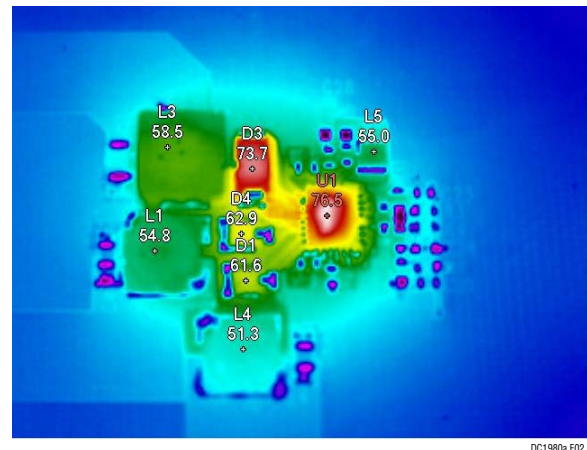
The LT3514 data sheet gives complete description of the device, operation and application information. The data sheet must be read in conjunction with this quick start guide for the demo circuit 1980A.

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

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



**Figure 1. System Efficiency at  $f = 1\text{MHz}$  with  $I_{\text{OUT}1} = I_{\text{OUT}4} = 1\text{A}$  and  $I_{\text{OUT}3} = 2\text{A}$**



**Figure 2. Thermal Image at  $V_{\text{IN}} = 12\text{V}$ ,  $f = 1\text{MHz}$  with  $I_{\text{OUT}1} = I_{\text{OUT}4} = 1\text{A}$  and  $I_{\text{OUT}3} = 2\text{A}$**

## PERFORMANCE SUMMARY

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

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
$V_{\text{IN}}$	Input Supply Range		5.4		36	V
$V_{\text{OUT}1}$	Output Voltage 1		4.85	5	5.15	V
$V_{\text{OUT}3}$	Output Voltage 3		3.2	3.3	3.4	V
$V_{\text{OUT}4}$	Output Voltage 4		1.746	1.8	1.854	V
Frequency	Switching Frequency	$V_{\text{IN}} = 12\text{V}$	0.9	1	1.1	MHz
$I_{\text{OUT}1}$	$V_{\text{OUT}1}$ Maximum Output Current	$V_{\text{IN}} = 5.4\text{V} \sim 36\text{V}$	1			A

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

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
$I_{OUT3}$	$V_{OUT3}$ Maximum Output Current	$V_{IN} = 5.4\text{V} \sim 36\text{V}$	2			A
$I_{OUT4}$	$V_{OUT4}$ Maximum Output Current	$V_{IN} = 5.4\text{V} \sim 36\text{V}$	1			A
$V_{OUT1(AC)}$	$V_{OUT1}$ Output Ripple	$V_{IN} = 5.4\text{V} \sim 36\text{V}$ , $I_{OUT1} = 1\text{A}$			25	mV
$V_{OUT3(AC)}$	$V_{OUT3}$ Output Ripple	$V_{IN} = 5.4\text{V} \sim 36\text{V}$ , $I_{OUT3} = 2\text{A}$			25	mV
$V_{OUT4(AC)}$	$V_{OUT4}$ Output Ripple	$V_{IN} = 5.4\text{V} \sim 36\text{V}$ , $I_{OUT4} = 1\text{A}$			25	mV

## QUICK START PROCEDURE

Demonstration circuit 1980A is easy to set up to evaluate the performance of the LT3514. Refer to Figure 3 for proper measurement equipment setup and follow the procedure below:

NOTE. When measuring the input or output voltage ripple, 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 VIN or VOUT and GND terminals. See Figure 4 for proper scope probe technique.

1. Place JP1 to JP4 on ON position.
2. With power off, connect the input power supply to VIN and GND.

3. Turn on the power at the input.

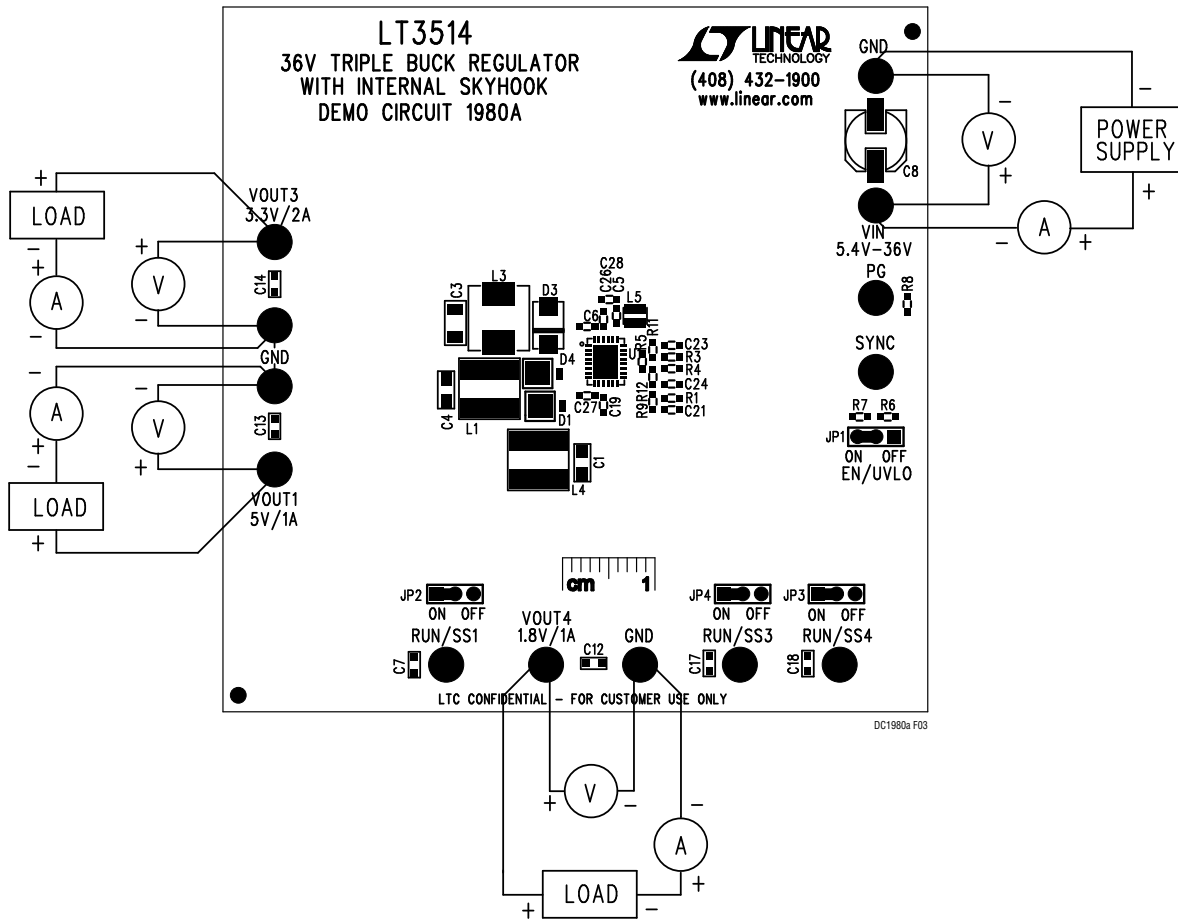
NOTE. Make sure that the input voltage does not exceed 36V

4. Check for the proper output voltages.

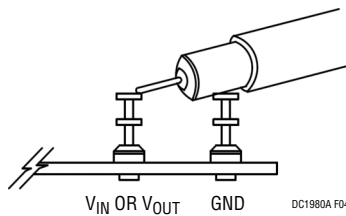
NOTE. If there is no output, temporarily disconnect the load to make sure that the load is not set too high.

5. Once the proper output voltages are established, adjust the load within the operating range and observe the output voltage regulation, ripple voltage, efficiency and other parameters.

**QUICK START PROCEDURE**



**Figure 3. DC1980A Proper Equipment Setup**



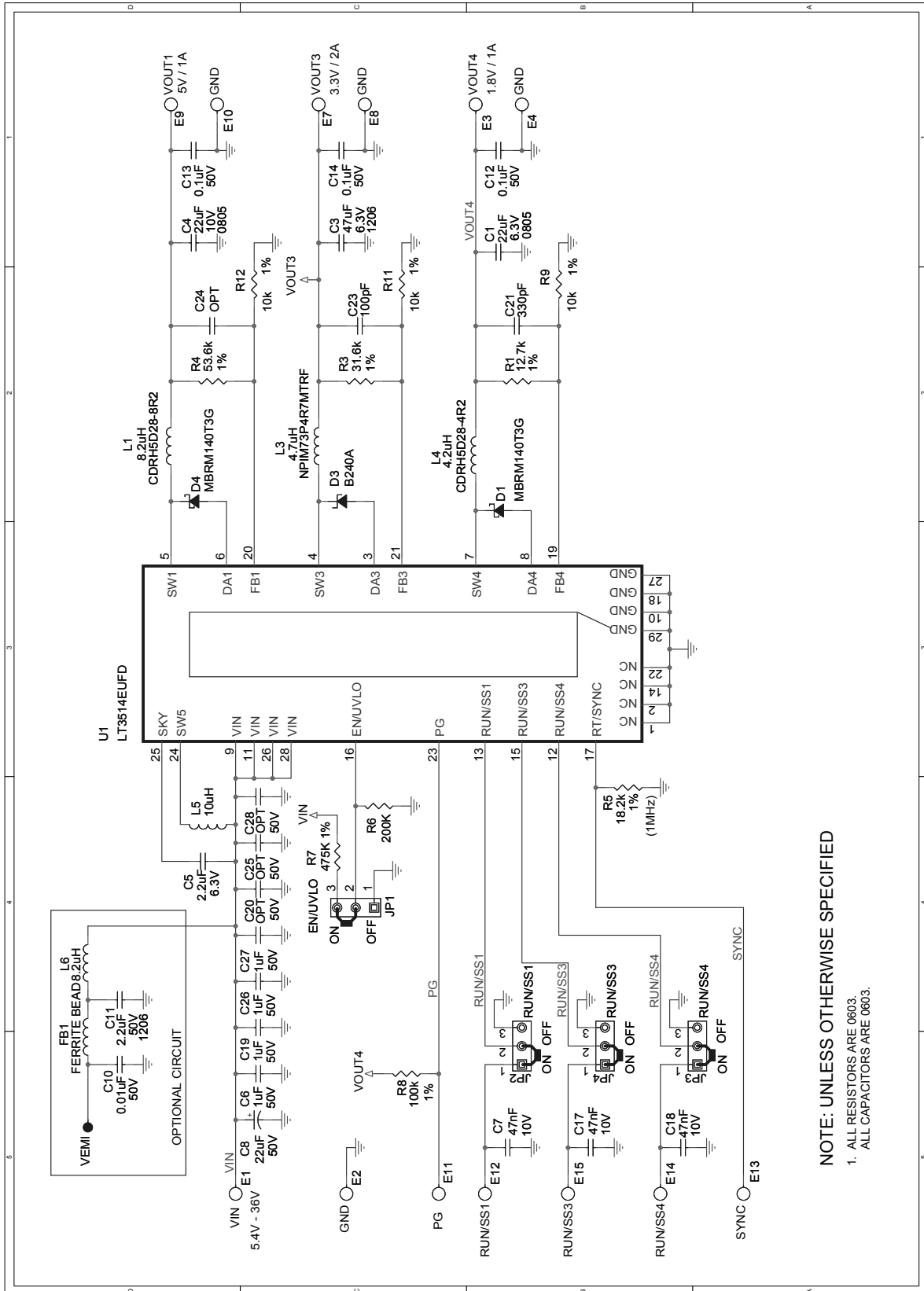
**Figure 4. Measuring Input or Output Ripple**

# DEMO MANUAL DC1980A

## PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
<b>Required Circuit Components</b>				
1	1	C1	CAP, X5R, 22 $\mu$ F, 6.3V, 10% 0805	TDK, C2012X5R0J226K
2	1	C3	CAP, X5R, 47 $\mu$ F, 6.3V, 10% 1206	MURATA, GRM31CR60J476KE19L
3	1	C4	CAP, X5R, 22 $\mu$ F, 10V, 10% 0805	TDK, C2012X5R1A226K
4	1	C5	CAP, X5R, 2.2 $\mu$ F, 6.3V, 10% 0603	TDK, C1608X5R0J225K
5	4	C6, C19, C26, C27	CAP, X5R, 1 $\mu$ F, 50V, 10% 0603	TDK, C1608X5R1H105K
6	3	C7, C17, C18	CAP, X7R, 47nF, 10V, 10% 0603	AVX, 0603ZC473KAT2A
7	1	C21	CAP, NP0, 330pF, 50V, 5% 0603	AVX 06035A331JAT2A
8	1	C23	CAP, NP0, 100pF, 50V, 5% 0603	AVX 06035A101JAT
9	2	D1, D4	DIODE, SCHOTTKY BARRIER RECTIFIER	ON SEMI, MBRM140T3G
10	1	D3	SCHOTTKY RECTIFIER, SMA	VISHAY, B240A-M3
11	1	L1	IND, 8.2 $\mu$ H	SUMIDA, CDRH5D28NP-8R2NC
12	1	L3	IND, 4.7 $\mu$ H	NIC, NPIM73P4R7MTRF
13	1	L4	IND, 4.2 $\mu$ H	SUMIDA, CDRH5D28NP-4R2NC
14	1	L5	IND, 10 $\mu$ H	COILCRAFT, XPL2010-103MLB
15	1	R1	RES, CHIP, 12.7k, 1% 1/16W, 0603	VISHAY, CRCW060312K7FKED
16	1	R3	RES, CHIP, 31.6k, 1% 1/16W, 0603	VISHAY, CRCW060331K6FKED
17	1	R4	RES, CHIP, 53.6k, 1%, 1/16W, 0603	VISHAY, CRCW060353K6FKED
18	1	R5	RES, CHIP, 18.2k, 1% 1/16W, 0603	VISHAY, CRCW060318K2FKED
19	1	R6	RES, CHIP, 200k, 5% 1/16W, 0603	VISHAY, CRCW0603200KJNED
20	1	R7	RES, CHIP, 475k, 1% 1/16W, 0603	VISHAY, CRCW0603475KFKED
21	1	R8	RES, CHIP, 100k, 1% 1/16W, 0603	VISHAY, CRCW0603100KFKED
22	3	R9, R11, R12	RES, CHIP, 10k, 1% 1/16W, 0603	VISHAY, CRCW060310K0FKED
23	1	U1	IC, 36V TRIPLE BUCK REGULATOR	LINEAR TECHNOLOGY, LT3514EUFDPB
<b>Additional Demo Board Circuit Components</b>				
1	1	C8	CAP, ALUM, 22 $\mu$ F, 50V, 20%	SUN ELECT, 50CE22BS
2	0	C10 (OPT)	CAP, X7R, 0.01 $\mu$ F, 50V, 10% 0603	TDK, C1608X7R1H103K OPTION
3	0	C11 (OPT)	CAP, X7R, 2.2 $\mu$ F, 50V, 10% 1206	MURATA, GCM31CR71H225KA55L
4	3	C12 TO C14	CAP, X7R, 0.1 $\mu$ F, 50V, 10% 0603	MURATA, GRM188R71H104KA93D
5	0	C20, C25, C28 (OPT)	CAP, X7R, 0.1 $\mu$ F, 50V, 10% 0603	MURATA, GRM188R71H104KA93D
6	0	C24 (OPT)	CAP, 0603	
7	0	FB1 (OPT)	FERRITE BEAD, OPTION	OPTION
8	0	L6 (OPT)	IND, 8.2 $\mu$ H OPTION	VISHAY, IHLP-2525CZ-01 OPTION
<b>Hardware: For Demo Board Only</b>				
1	15	E1 TO E15	TURRET	MILL MAX, 2501-2-00-80-00-00-07-0
2	4	JP1 TO JP4	HEADER, 3PIN, 2mm	SAMTEC, TMM-103-02-L-S
3	4	xJP1 TO xJP4	SHUNT, 2mm	SAMTEC, 2SN-BK-G

**SCHEMATIC DIAGRAM**



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

# DEMO MANUAL DC1980A

---

## 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