

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[®]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>

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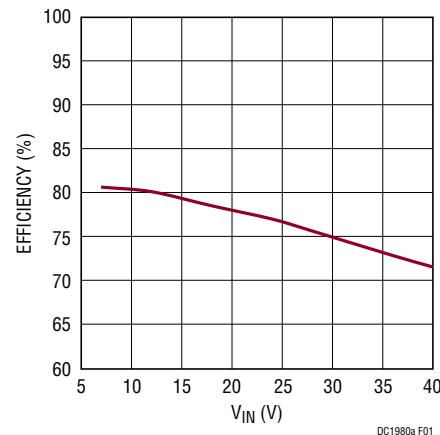


Figure 1. System Efficiency at $f = 1\text{MHz}$ with $I_{\text{OUT}1} = I_{\text{OUT}4} = 1\text{A}$ and $I_{\text{OUT}3} = 2\text{A}$

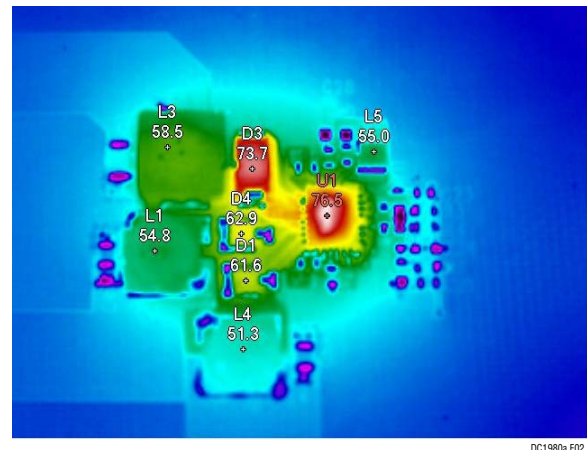


Figure 2. Thermal Image at $V_{\text{IN}} = 12\text{V}$, $f = 1\text{MHz}$ with $I_{\text{OUT}1} = I_{\text{OUT}4} = 1\text{A}$ and $I_{\text{OUT}3} = 2\text{A}$

PERFORMANCE SUMMARY

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

| SYMBOL | PARAMETER | CONDITIONS | MIN | TYP | MAX | UNITS |
|-------------------|--|---|-------|-----|-------|-------|
| V_{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

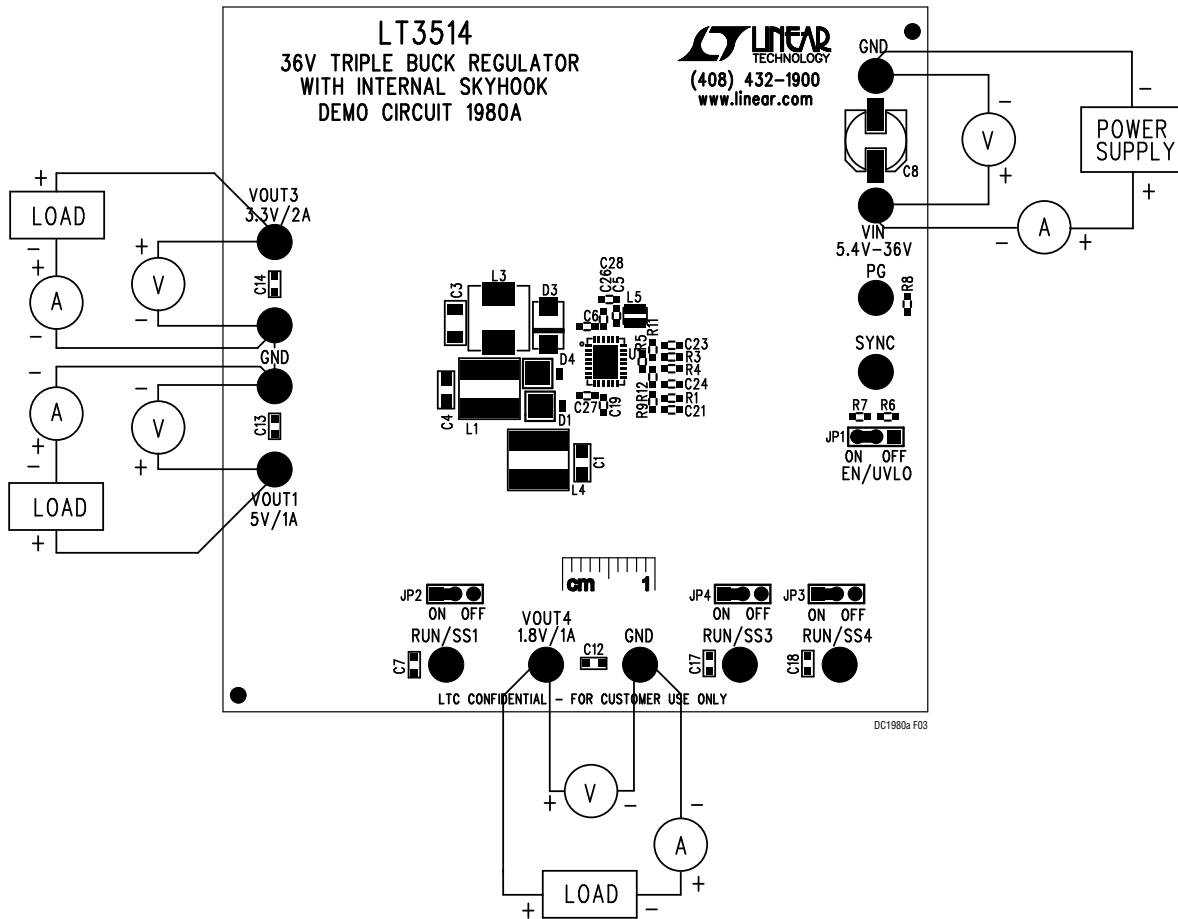


Figure 3. DC1980A Proper Equipment Setup

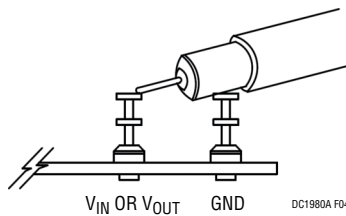


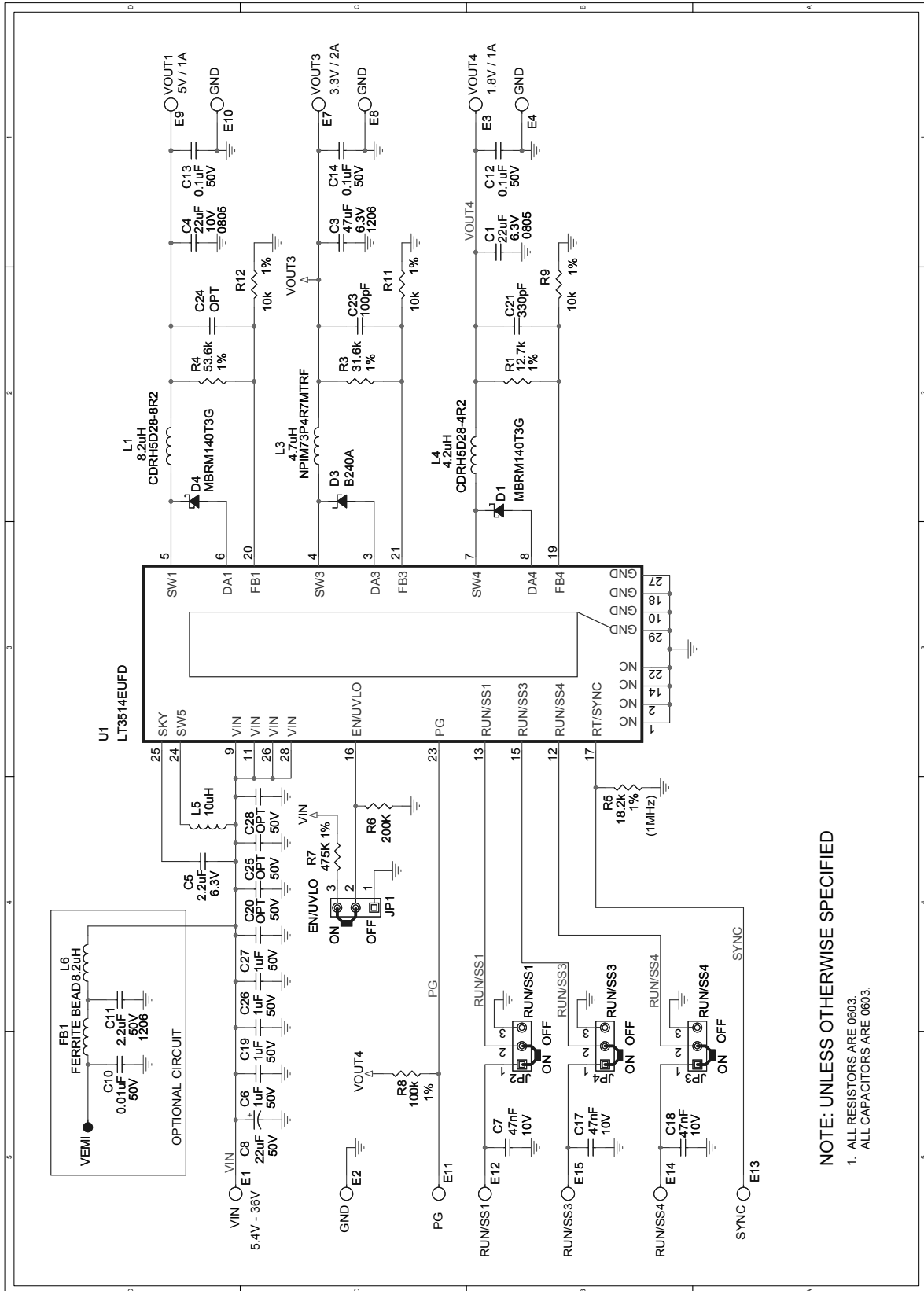
Figure 4. Measuring Input or Output Ripple

DEMO MANUAL DC1980A

PARTS LIST

| ITEM | QTY | REFERENCE | PART DESCRIPTION | MANUFACTURER/PART NUMBER |
|---|-----|---------------------|---------------------------------------|-----------------------------------|
| Required Circuit Components | | | | |
| 1 | 1 | C1 | CAP, X5R, 22 μ F, 6.3V, 10% 0805 | TDK, C2012X5R0J226K |
| 2 | 1 | C3 | CAP, X5R, 47 μ F, 6.3V, 10% 1206 | MURATA, GRM31CR60J476KE19L |
| 3 | 1 | C4 | CAP, X5R, 22 μ F, 10V, 10% 0805 | TDK, C2012X5R1A226K |
| 4 | 1 | C5 | CAP, X5R, 2.2 μ F, 6.3V, 10% 0603 | TDK, C1608X5R0J225K |
| 5 | 4 | C6, C19, C26, C27 | CAP, X5R, 1 μ 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 μ H | SUMIDA, CDRH5D28NP-8R2NC |
| 12 | 1 | L3 | IND, 4.7 μ H | NIC, NPIM73P4R7MTRF |
| 13 | 1 | L4 | IND, 4.2 μ H | SUMIDA, CDRH5D28NP-4R2NC |
| 14 | 1 | L5 | IND, 10 μ 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 |
| Additional Demo Board Circuit Components | | | | |
| 1 | 1 | C8 | CAP, ALUM, 22 μ F, 50V, 20% | SUN ELECT, 50CE22BS |
| 2 | 0 | C10 (OPT) | CAP, X7R, 0.01 μ F, 50V, 10% 0603 | TDK, C1608X7R1H103K OPTION |
| 3 | 0 | C11 (OPT) | CAP, X7R, 2.2 μ F, 50V, 10% 1206 | MURATA, GCM31CR71H225KA55L |
| 4 | 3 | C12 TO C14 | CAP, X7R, 0.1 μ F, 50V, 10% 0603 | MURATA, GRM188R71H104KA93D |
| 5 | 0 | C20, C25, C28 (OPT) | CAP, X7R, 0.1 μ 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 μ H OPTION | VISHAY, IHLP-2525CZ-01 OPTION |
| Hardware: For Demo Board Only | | | | |
| 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

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