

## LTM4630-1

# Dual 18A or Single 36A $\mu$ Module<sup>®</sup> Regulator with $\pm 0.8\%$ DC and 3% Transient Accuracy

## DESCRIPTION

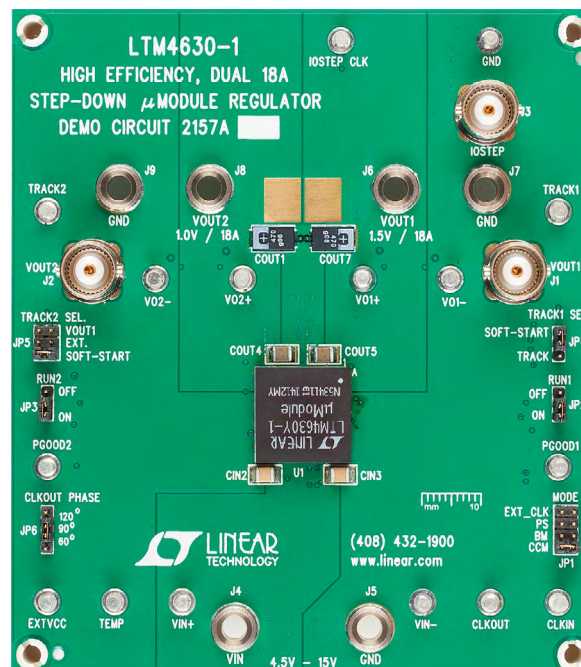
Demonstration circuit 2157A features the **LTM<sup>®</sup>4630EY-1**, the high efficiency, high density, dual 18A, switch mode step-down power module regulator with  $\pm 0.8\%$  total DC output accuracy. The input voltage is from 4.5V to 15V. The output voltage is programmable from 0.6V to 1.8V. DC2157A can deliver up to 18A maximum in each channel. With the help of external compensation,  $\pm 3\%$  transient accuracy can be achieved with 25% load step. As explained in the data sheet, output current derating is necessary for certain  $V_{IN}$ ,  $V_{OUT}$ , and thermal conditions. The board operates in continuous conduction mode in heavy load conditions. For high efficiency at low load currents, the MODE jumper (JP1) selects pulse-skipping mode for noise sensitive applications or Burst Mode<sup>®</sup> operation in less noise sensitive applications. Two outputs can be connected in parallel for a single 36A output solution with optional jumper resistors. The board allows the user to program

how its output ramps up and down through the TRACK/SS pin. The output can be set up to either coincidentally or ratiometrically track with another supply's output. Remote output voltage sensing is available for improved output voltage regulation at the load point. These features and the availability of the LTM4630-1 in a compact  $16\text{mm} \times 16\text{mm} \times 5.01\text{mm}$  BGA package make it ideal for use in many high density point-of-load regulation applications. The LTM4630-1 data sheet must be read in conjunction with this demo manual for working on or modifying the demo circuit DC2157A.

**Design files for this circuit board are available at**  
<http://www.linear.com/demo/DC2157A>

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## BOARD PHOTO



dc2157afc

# DEMO MANUAL DC2157A

## PERFORMANCE SUMMARY

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

| PARAMETER                                     | CONDITIONS                                                                                                | VALUE                                     |
|-----------------------------------------------|-----------------------------------------------------------------------------------------------------------|-------------------------------------------|
| Input Voltage Range                           |                                                                                                           | 4.5V ~ 15V                                |
| Output Voltage $V_{OUT1}$ (LTM4630-1A)        | $V_{IN} = 4.5\text{V} \sim 15\text{V}$ , $I_{OUT1} = 0\text{A} \sim 18\text{A}$ , JP1: CCM                | $1.5\text{V} \pm 0.8\%$ (1.488V ~ 1.512V) |
| Output Voltage $V_{OUT2}$ (LTM4630-1A)        | $V_{IN} = 4.5\text{V} \sim 15\text{V}$ , $I_{OUT2} = 0\text{A} \sim 18\text{A}$ , JP1: CCM                | $1.0\text{V} \pm 0.8\%$ (0.992V ~ 1.008V) |
| Per Channel Maximum Continuous Output Current | Derating Is Necessary for Certain $V_{IN}$ , $V_{OUT}$ and Thermal Conditions, See Data Sheet for Details | 18A                                       |
| Default Operating Frequency                   |                                                                                                           | 500kHz                                    |
| Resistor Programmable Frequency Range         |                                                                                                           | 250kHz to 780kHz                          |
| External Clock Sync. Frequency Range          |                                                                                                           | 400kHz to 780kHz                          |
| Efficiency of Channel 1                       | $V_{IN} = 5\text{V}$ , $V_{OUT1} = 1.5\text{V}$ , $I_{OUT1} = 18\text{A}$ , $f_{SW} = 500\text{kHz}$      | 89.7% See Figure 2                        |
| Efficiency of Channel 2                       | $V_{IN} = 5\text{V}$ , $V_{OUT2} = 1.0\text{V}$ , $I_{OUT2} = 18\text{A}$ , $f_{SW} = 500\text{kHz}$      | 86.2% See Figure 3                        |
| Load Transient of Channel 1                   | $V_{IN} = 12\text{V}$ , $V_{OUT1} = 1.5\text{V}$ , $I_{STEP} = 0\text{A} \sim 4.5\text{A}$                | See Figure 4                              |
| Load Transient of Channel 2                   | $V_{IN} = 12\text{V}$ , $V_{OUT2} = 1.0\text{V}$ , $I_{STEP} = 0\text{A} \sim 4.5\text{A}$                | See Figure 5                              |

## QUICK START PROCEDURE

Demonstration circuit DC2157A is easy to set up to evaluate the performance of the LTM4630-1. Please refer to Figure 1 for proper measurement setup and follow the procedure below:

1. Place jumpers in the following positions for a typical application:

| JP1  | JP2  | JP3  | JP4         | JP5         | JP6          |
|------|------|------|-------------|-------------|--------------|
| MODE | RUN1 | RUN2 | TRACK1 SEL. | TRACK2 SEL. | CLKOUT PHASE |
| CCM  | ON   | ON   | SOFT-START  | SOFT-START  | 90°          |

2. With power off, connect the input power supply, load and meters as shown in Figure 1. Preset the load to 0A and  $V_{IN}$  supply to 12V.
3. Turn on the power supply at the input. The output voltage in channel 1 should be  $1.5\text{V} \pm 0.8\%$  (1.488V ~ 1.512V) and the output voltage in channel 2 should be  $1.0\text{V} \pm 0.8\%$  (0.992V ~ 1.008V).
4. Once the proper output voltage is established, adjust the load within the operating range and observe the output voltage regulation, output voltage ripple, efficiency and other parameters. Output ripple should be measured at J1 and J2 with BNC cables. 50 $\Omega$  termination should be set on the oscilloscope or BNC cables.

5. (Optional) For optional load transient test, apply an adjustable pulse signal between IOSTEP CLK and GND test point. Pulse amplitude (3V ~ 3.5V) sets the load step current amplitude. The output transient current can be monitored at the BNC connector J3 (15mV/A). The pulse signal should have very small duty cycle (<10%) to limit the thermal stress on the transient load circuit. Switch the jumper resistors R34 or R35 (on the backside of boards) to apply load transient on channel 1 or channel 2 correspondingly.
6. (Optional) LTM4630-1 can be synchronized to an external clock signal. Place the JP1 jumper on EXT\_CLK and apply a clock signal (0~5V, square wave) on the CLKIN test point.
7. (Optional) The outputs of LTM4630-1 can track another supply. The jumpers JP4 and JP5 allow choosing soft-start or output tracking. If tracking external voltage is selected, the corresponding test points, TRACK1 and TRACK2, need to be connected to a valid voltage signal.
8. (Optional) LTM4630-1 can be configured for a 2-phase single output at up to 36A on DC2157A. Install 0 $\Omega$  resistors on R14, R17, R28, R39 and remove R7, R19. Output voltage is set by R25 based on equation:

$$V_{OUT} = 0.6\text{V}(1 + 60.4\text{k}/\text{R25})$$

# QUICK START PROCEDURE

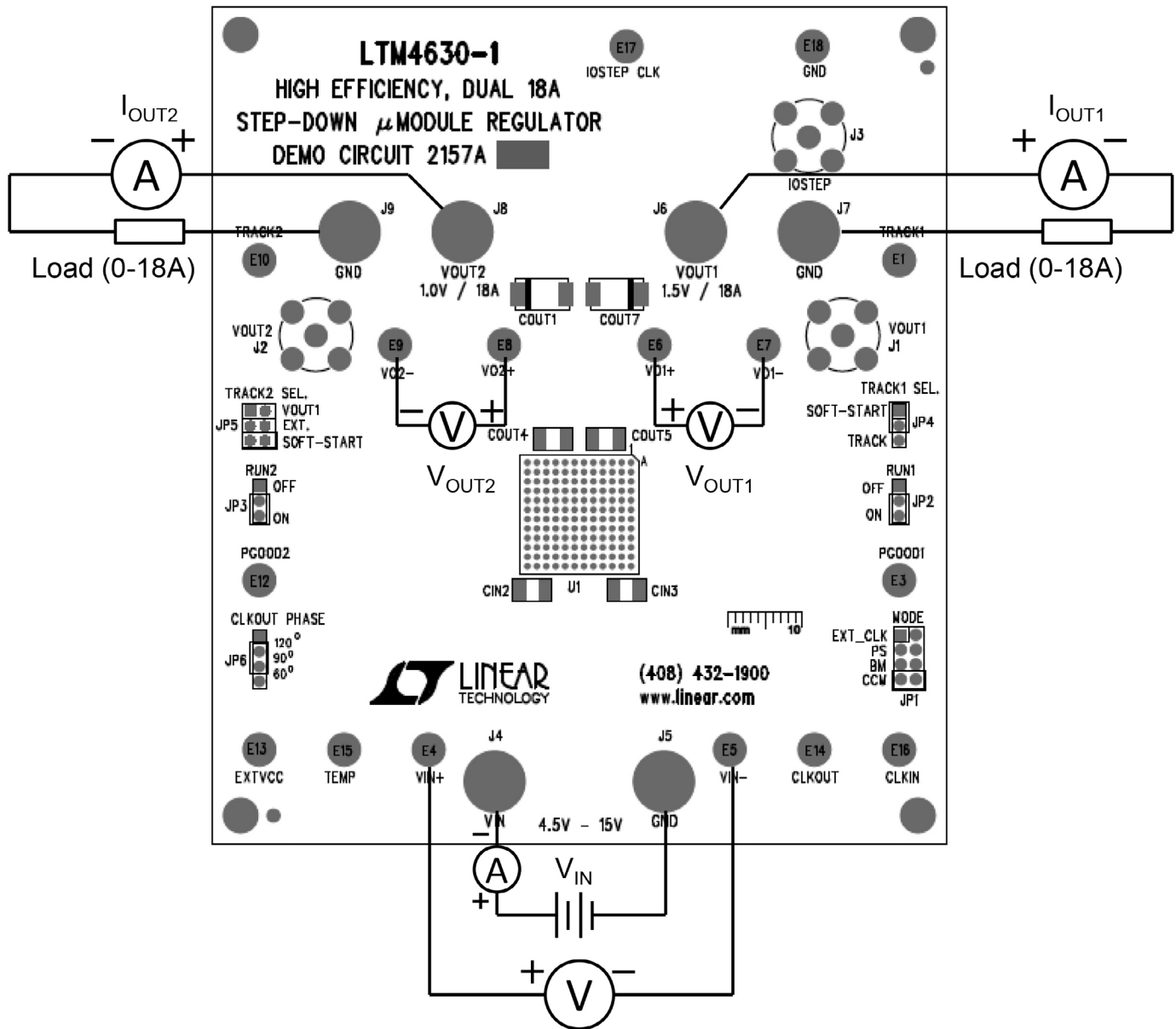


Figure 1. Test Setup of DC2157A

QUICK START PROCEDURE

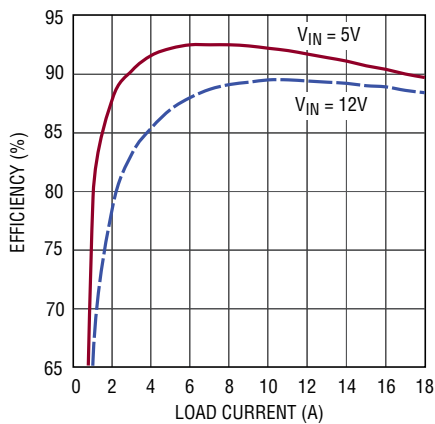


Figure 2. Measured Efficiency on Channel 1  
( $V_{OUT1} = 1.5V$ ,  $f_{SW} = 500kHz$ , Channel 2 Disabled)

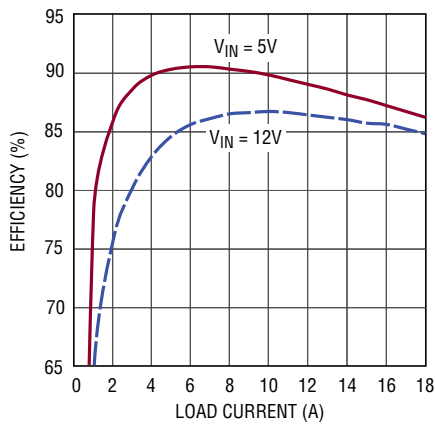


Figure 3. Measured Efficiency on Channel 2  
( $V_{OUT2} = 1.0V$ ,  $f_{SW} = 500kHz$ , Channel 1 Disabled)

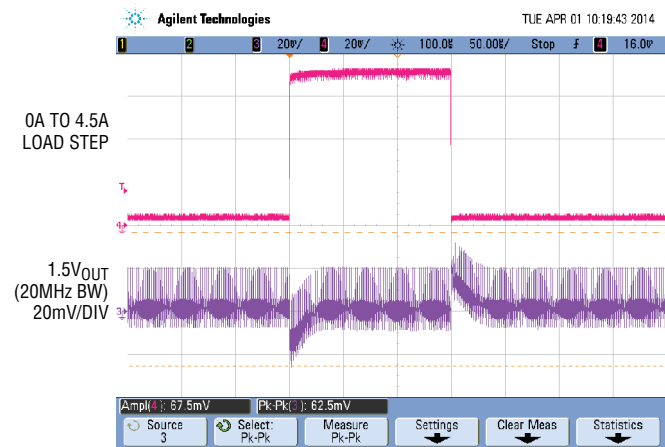


Figure 4. Measured Channel 1 0A to 4.5A Load Transient  
( $V_{IN} = 12V$ ,  $V_{OUT1} = 1.5V$ )

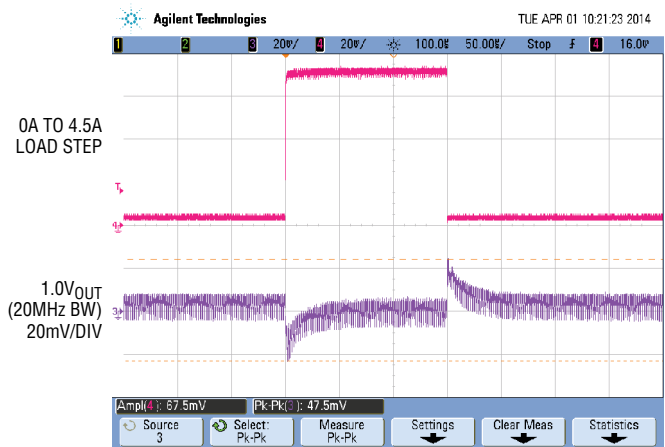


Figure 5. Measured Channel 2 0A to 4.5A Load Transient  
( $V_{IN} = 12V$ ,  $V_{OUT2} = 1.0V$ )

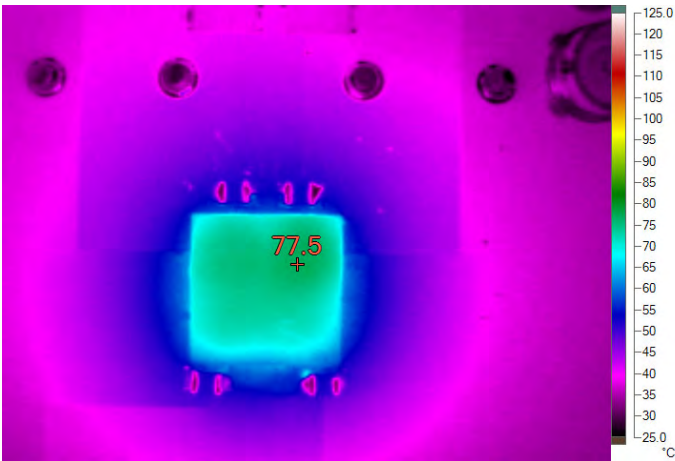


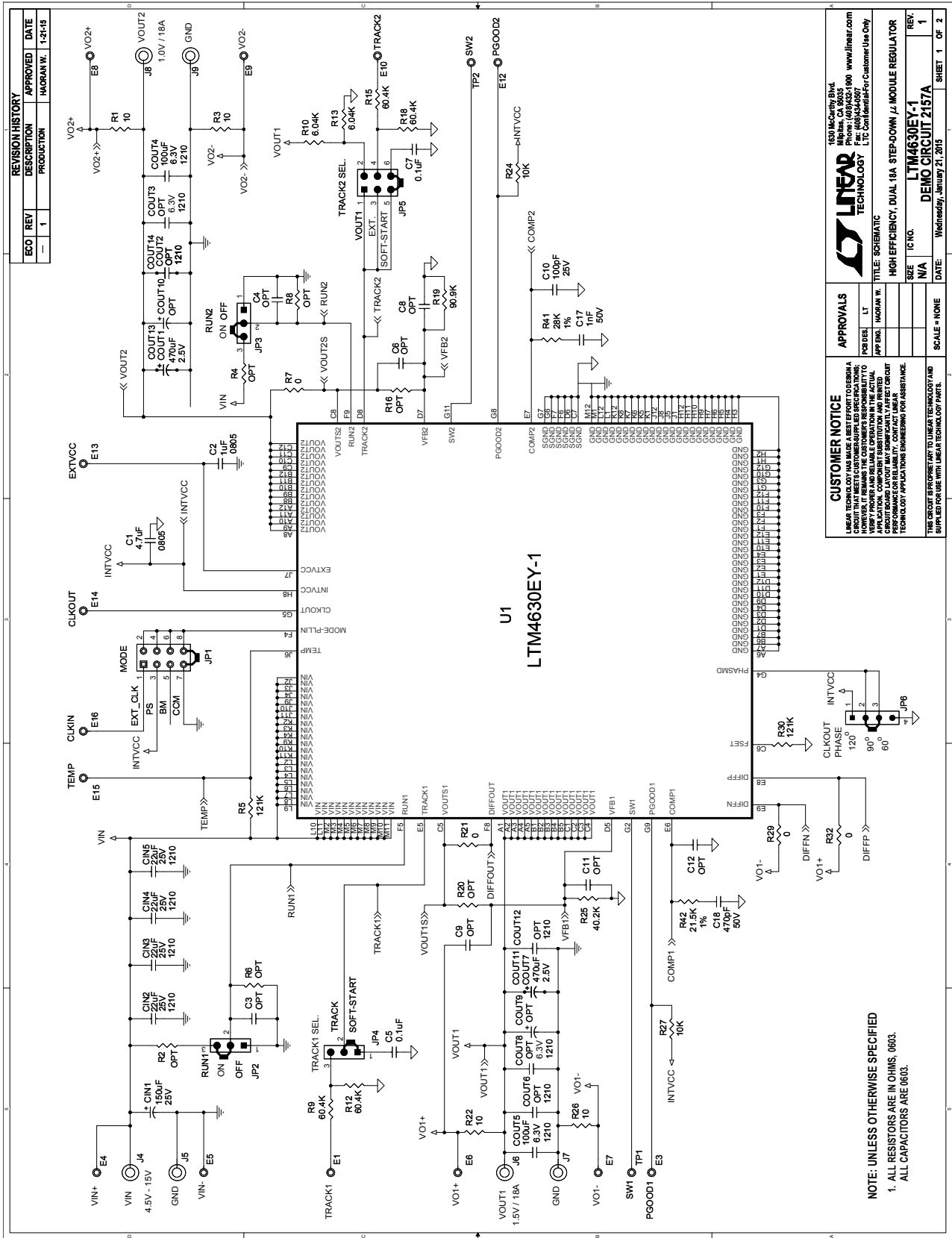
Figure 6. Thermal Capture at  $12V_{IN}$ ,  $1.5V_{OUT1}$  at 18A and  $1V_{OUT2}$  at 18A ( $T_A = 25^{\circ}C$ , 200LFM Airflow and No Heat Sink)

## PARTS LIST

| ITEM                                            | QTY | REFERENCE                                                             | PART DESCRIPTION                   | MANUFACTURER/PART NUMBER          |
|-------------------------------------------------|-----|-----------------------------------------------------------------------|------------------------------------|-----------------------------------|
| <b>Required Circuit Components</b>              |     |                                                                       |                                    |                                   |
| 1                                               | 1   | CIN1                                                                  | CAP., 150µF, 25V, Aluminum Electr. | SUN ELECT., 25CE150AX             |
| 2                                               | 4   | CIN2, CIN3, CIN4, CIN5                                                | CAP., X5R, 22µF, 25V, 10%, 1210    | MURATA, GRM32ER61E226KE15L        |
| 3                                               | 4   | COUT1, COUT7, COUT11, COUT13                                          | CAP., 470µF, 2.5V, POSCAP, F8-D3L  | SANYO, 2R5TPF470M6L               |
| 4                                               | 2   | COUT4, COUT5                                                          | CAP., X5R, 100µF, 6.3V, 20% 1210   | AVX, 12106D107MAT2A               |
| 5                                               | 1   | U1                                                                    | I.C., 16X16X5.01-BGA               | LINEAR TECH., LTM4630EY-1A#PBF    |
| <b>Additional Demo Board Circuit Components</b> |     |                                                                       |                                    |                                   |
| 6                                               | 0   | COUT2, COUT3, COUT6, COUT8, COUT9, COUT10, COUT12, COUT14             | OPT, 1210                          | OPT                               |
| 7                                               | 1   | C1                                                                    | CAP., X5R, 4.7µF, 25V, 10%, 0805   | AVX, 08053D475KAT2A               |
| 8                                               | 1   | C2                                                                    | CAP., X7R, 1µF, 25V, 10%, 0805     | AVX, 08053C105KAT2A               |
| 9                                               | 2   | C5, C7                                                                | CAP., X5R, 0.1µF, 25V, 10%, 0603   | AVX, 06033D104KAT2A               |
| 10                                              | 0   | C3, C4, C6, C8, C9, C11, C12                                          | OPT, 0603                          | OPT                               |
| 11                                              | 1   | C10                                                                   | CAP., X7R, 100pF, 25V, 10%, 0603   | AVX, 06033C101KAT2A               |
| 12                                              | 4   | C13, C14, C15, C16                                                    | CAP., X7R, 1µF, 10V, 10%, 0603     | AVX, 06033C105KAT2A               |
| 13                                              | 1   | C18                                                                   | CAP., X7R, 470pF, 25V, 10%, 0603   | AVX, 06033C471KAT4A               |
| 14                                              | 1   | C17                                                                   | CAP., X7R, 1nF, 25V, 10%, 0603     | AVX, 06033C102JAT2A               |
| 15                                              | 1   | Q1                                                                    | XSTR, MOSFET                       | VISHAY, SUD50N04-8M8P-4GE3        |
| 16                                              | 4   | R1, R3, R22, R26                                                      | RES., CHIP, 10Ω, 1%, 0603          | VISHAY, CRCW060310R0FKEA          |
| 17                                              | 0   | R2, R4, R6, R8, R11, R14, R16, R17, R20, R23, R28, R31, R33, R39, R40 | OPT, 0603                          | OPT                               |
| 18                                              | 3   | R24, R27, R36                                                         | RES., CHIP, 10k, 1%, 0603          | VISHAY, CRCW060310K0FKEA          |
| 19                                              | 4   | R7, R21, R29, R32                                                     | RES., CHIP, 0Ω, 1%, 0603           | VISHAY, CRCW06030000Z0EA          |
| 20                                              | 4   | R9, R12, R15, R18                                                     | RES., CHIP, 60.4k, 1%, 0603        | VISHAY, CRCW060360K4FKEA          |
| 21                                              | 2   | R10, R13                                                              | RES., CHIP, 6.04k, 1%, 0603        | VISHAY, CRCW06036K04FKEA          |
| 22                                              | 1   | R19                                                                   | RES., CHIP, 90.9k, 1%, 0603        | VISHAY, CRCW060390K9FKEA          |
| 23                                              | 1   | R25                                                                   | RES., CHIP, 40.2k, 1%, 0603        | VISHAY, CRCW060340K2FKEA          |
| 24                                              | 2   | R5, R30                                                               | RES., CHIP, 121k, 1%, 0603         | VISHAY, CRCW0603121KFKEA          |
| 25                                              | 1   | R34                                                                   | RES., CHIP, 0Ω, 0.5W, 2010         | VISHAY, CRCW20100000Z0EF          |
| 26                                              | 0   | R35                                                                   | OPT, 2010                          | OPT                               |
| 27                                              | 1   | R37                                                                   | RES., CHIP, 0.015Ω, 1W, 2512       | VISHAY, WSL2512R0150FEA           |
| 28                                              | 0   | R38                                                                   | OPT 2512                           | OPT                               |
| 29                                              | 1   | R42                                                                   | RES., CHIP, 21.5k, 1%, 0603        | VISHAY, CRCW060321K5FKEA          |
| 30                                              | 1   | R41                                                                   | RES., CHIP, 28k, 1%, 0603          | VISHAY, CRCW060328K0FKEA          |
| <b>Hardware-For Demo Board Only</b>             |     |                                                                       |                                    |                                   |
| 31                                              | 16  | E1, E3-E10, E12-E18                                                   | TESTPOINT, TURRET, .094"           | MILL-MAX, 2501-2-00-80-00-00-07-0 |
| 32                                              | 3   | J1, J2, J3                                                            | CONN,BNC,5 PINS                    | CONNEX 112404                     |
| 33                                              | 6   | J4-J9                                                                 | JACK BANANA                        | KEYSTONE, 575-4                   |
| 34                                              | 1   | JP1                                                                   | HEADER 4 PIN 0.079 DOUBLE ROW      | SULLINS, NRPN042PAEN-RC           |
| 35                                              | 1   | JP6                                                                   | HEADER 4 PIN 0.079 SINGLE ROW      | SULLINS, NRPN041PAEN-RC           |
| 36                                              | 3   | JP2, JP3, JP4                                                         | HEADER 3 PIN 0.079 SINGLE ROW      | SULLINS, NRPN031PAEN-RC           |
| 37                                              | 1   | JP5                                                                   | HEADER 3 PIN 0.079 DOUBLE ROW      | SULLINS, NRPN032PAEN-RC           |
| 38                                              | 6   | XJP1-XJP6                                                             | SHUNT, 0.079" CENTER               | SAMTEC, 2SN-BK-G                  |
| 39                                              | 4   | (STAND-OFF)                                                           | STAND-OFF, NYLON 0.50"             | KEYSTONE, 8833(SNAP ON)           |

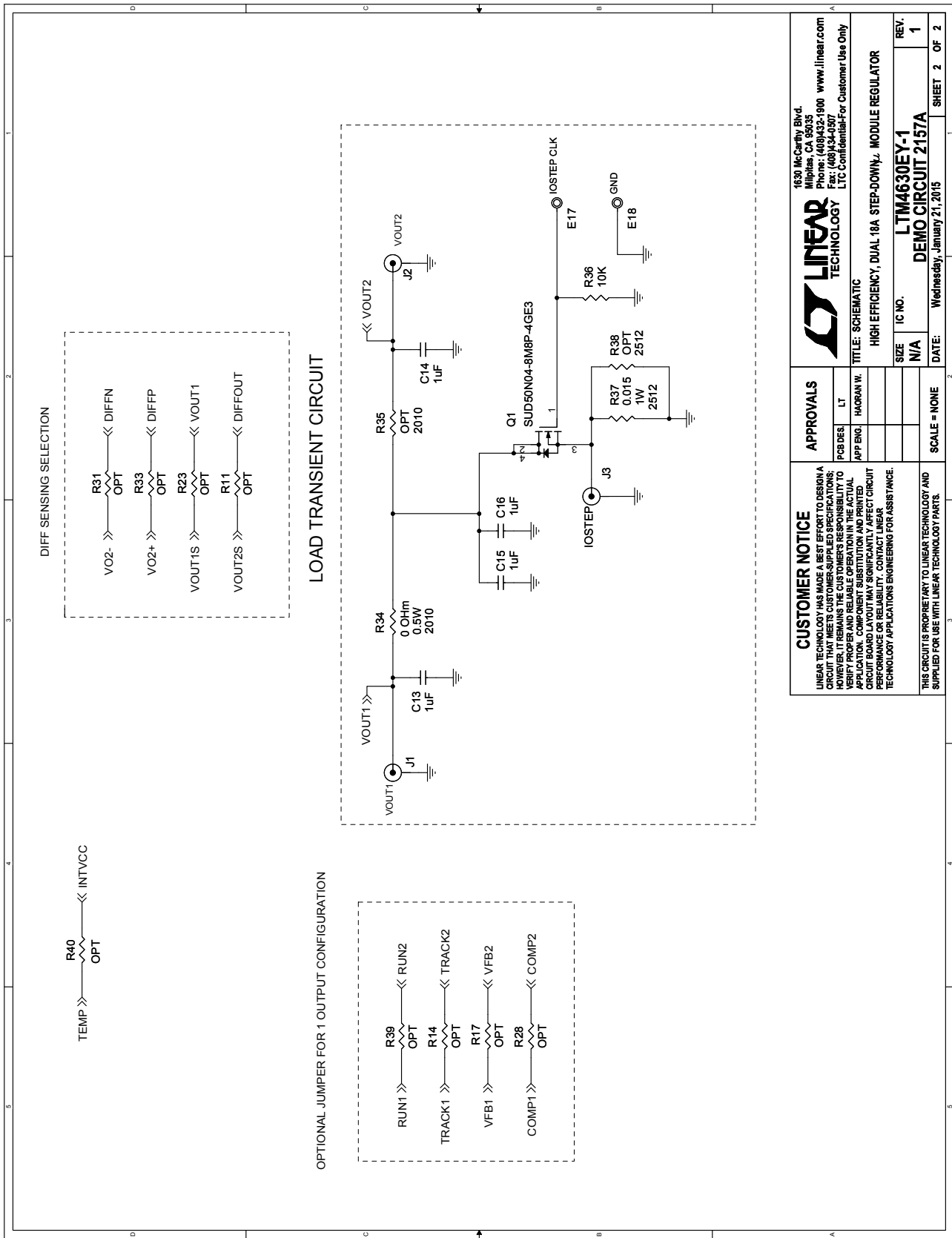
# DEMO MANUAL DC2157A

## SCHEMATIC DIAGRAM



dc2157afc

## SCHEMATIC DIAGRAM





# DEMO MANUAL DC2157A

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