

# LTM4650A-1 Dual 25A or Single 50A µModule Regulator

## DESCRIPTION

Demonstration circuit 2268A-I is a high efficiency, high density, dual 8A, switch mode step-down power supply on a compact 1.5' × 1.2' PCB. It features the **LTM®4650A-1** µModule® regulator. The input voltage is from 4.5V to 16V. The output voltage is programmable from 0.6V to 5.3V. DC2268A-I can deliver up to 25A maximum in each channel. 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 resistor jumper (R1/R2) selects pulse-skipping mode for noise sensitive applications or Burst-Mode® in less noise sensitive applications. Two outputs can be connected in parallel for a single 50A 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. Remote output voltage sensing is available for improved output voltage regulation at the load point. An optional input inductor L1 reduces the EMI noise for noise sensitive applications. DC2268A can be easily inserted to an edge connector for testing and debugging. These features and the availability of the LTM4650A-1 in a compact 16mm × 16mm × 4.41mm LGA package make it ideal for use in many high-density point-of-load regulation applications. The LTM4650A-1 data sheet must be read in conjunction with this demo manual for working on or modifying the DC2268A-I.

**[Design files for this circuit board are available.](#)**

All registered trademarks and trademarks are the property of their respective owners.

## BOARD PHOTO

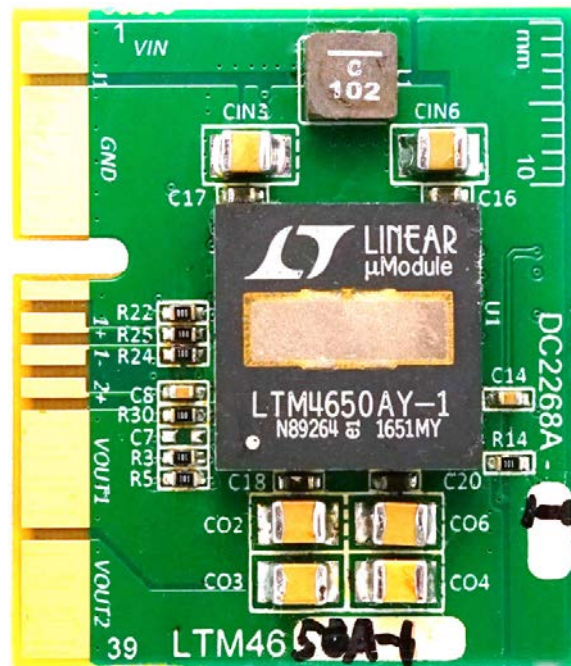


Figure 1. LTM4650A-1/DC2268A-I Demo Board

# DEMO MANUAL DC2268A-I

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

**Table 1.**

PARAMETER	CONDITIONS	VALUE
Input Voltage Range		4.5V ~ 16V
Output Voltage $V_{OUT1}$	$V_{IN} = 4.5\sim 16\text{V}$ , $I_{OUT1} = 0\text{A} \sim 25\text{A}$	$3.3\text{V} \pm 1.5\%$
Output Voltage $V_{OUT2}$	$V_{IN} = 4.5\sim 16\text{V}$ , $I_{OUT2} = 0\text{A} \sim 25\text{A}$	$1.5\text{V} \pm 1.5\%$
Per-Channel Maximum Continuous Output Current	De-rating is necessary for certain $V_{IN}$ , $V_{OUT}$ and thermal conditions	25A (per channel)
Default Operating Frequency		600kHz
External Clock Sync. Frequency Range		400kHz to 780kHz
Efficiency of Channel 1	$V_{IN} = 12\text{V}$ , $V_{OUT1} = 3.3\text{V}$ , $I_{OUT1} = 25\text{A}$ , $f_{SW} = 600\text{kHz}$	94.4%, see Figure 3
Efficiency of Channel 2	$V_{IN} = 12\text{V}$ , $V_{OUT2} = 1.5\text{V}$ , $I_{OUT2} = 25\text{A}$ , $f_{SW} = 600\text{kHz}$	90.0%, see Figure 4
Load Transient of Channel 1	$V_{IN} = 12\text{V}$ , $V_{OUT1} = 3.3\text{V}$ , $I_{STEP} = 12.5\text{A} \sim 18.75\text{A}$	$V_{OPP} = 157\text{mV}$ , see Figure 5
Load Transient of Channel 2	$V_{IN} = 12\text{V}$ , $V_{OUT2} = 1.5\text{V}$ , $I_{STEP} = 12.5\text{A} \sim 18.75\text{A}$	$V_{OPP} = 127\text{mV}$ , see Figure 6

## QUICK START PROCEDURE

DC2268A-I is easy to set up to evaluate the performance of the LTM4650A-1. It can be easily inserted to an edge connector (SAMTEC MEC2-20-01-L-DV--TR) for testing and debugging. Please refer to Figure 2 for proper measurement setup and follow the procedure below:

1. Pull up the RUN1(J1 Pin 22) and RUN2(J1 Pin 24) between 1.4V to 5V or leave them floating.
2. With power off, connect the input power supply, load and meters as shown in Figure 2. 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  $3.3\text{V} \pm 1.5\%$  ( $3.25\text{V} \sim 3.35\text{V}$ ) and the output voltage in channel 2 should be  $1.5\text{V} \pm 1.5\%$  ( $1.478\text{V} \sim 1.523\text{V}$ ),

NOTE: Due to very small PCB size of the DC2268A board, the LTM43650A-1 module can be quite hot at heavy load. Cooling air is required. See Figures 7 and 8

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  $C_{O3}$  and  $C_{O4}$ .
5. (Optional) LTM4650A-1 can be synchronized to an external clock signal. Remove R2 and apply a clock signal (0V~5V, square wave) to MODE-PLLIN pin.
6. (Optional) LTM4650A-1 can be configured for a 2-phase single output at up to 36A on DC2268A-I. Install 0Ω resistors on R26, R27, R28, R29, R32, and remove R14, R18 R30. Output voltage is set by R7 based on equation  $V_{OUT} = 0.6\text{V} (1 + 60.4\text{k}/\text{R7})$ .

**Table 2. DC2268A Demo Circuit**

DEMO BOARD NUMBER	μModule REGULATOR ON THE BOARD	OUTPUT CURRENT
DC2268A-A	LTM4620	13A,13A
DC2268A-B	LTM4620A	13A,13A
DC2268A-C	LTM4628	8A, 8A
DC2268A-D	LTM4630	18A,18A
DC2268A-E	LTM4630-1	18A,18A
DC2268A-F	LTM4630A	18A, 18A
DC2268A-G	LTM4631	10A, 10A
DC2268A-H	LTM4650-1	25A, 25A
DC2268A-I	LTM4650A-1	25A, 25A

**QUICK START PROCEDURE**

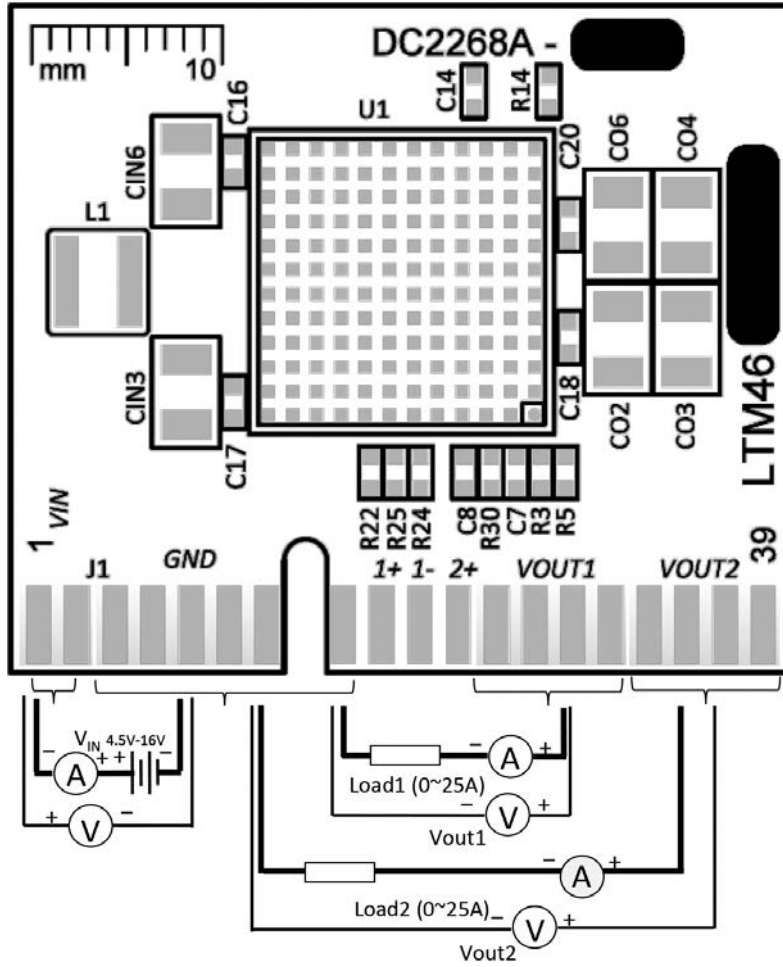


Figure 2. Test Setup of DC2268A-I

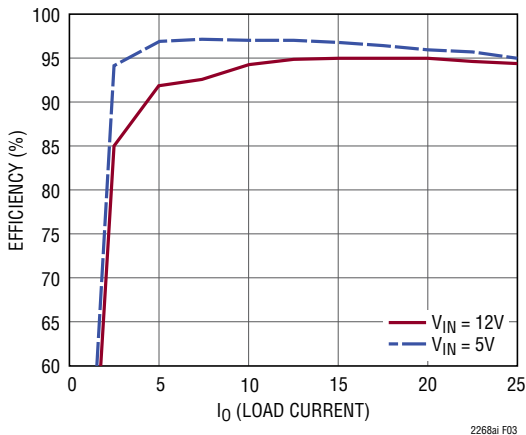


Figure 3. Measured Efficiency on Channel 1 ( $V_{OUT1} = 3.3V$ ,  $f_{sw} = 600kHz$ , Channel 2 Disabled)

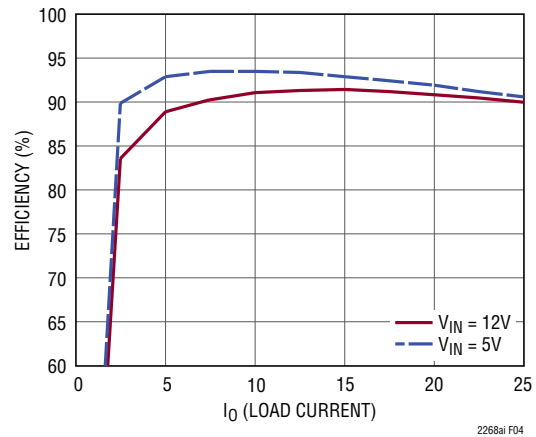


Figure 4. Measured Efficiency on Channel 2 ( $V_{OUT2} = 1.5V$ ,  $f_{sw} = 600kHz$ , Channel 1 Disabled)

## QUICK START PROCEDURE

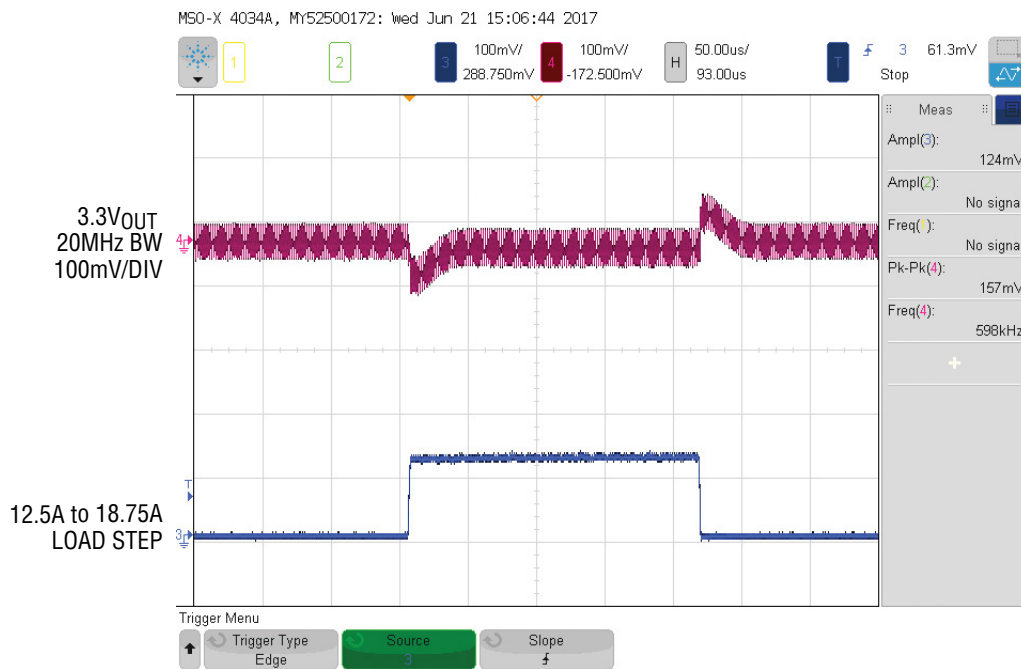


Figure 5. Measured Channel 1 12.5A to 18.75A Load Transient ( $V_{IN} = 12V$ ,  $V_{OUT1} = 3.3V$ )

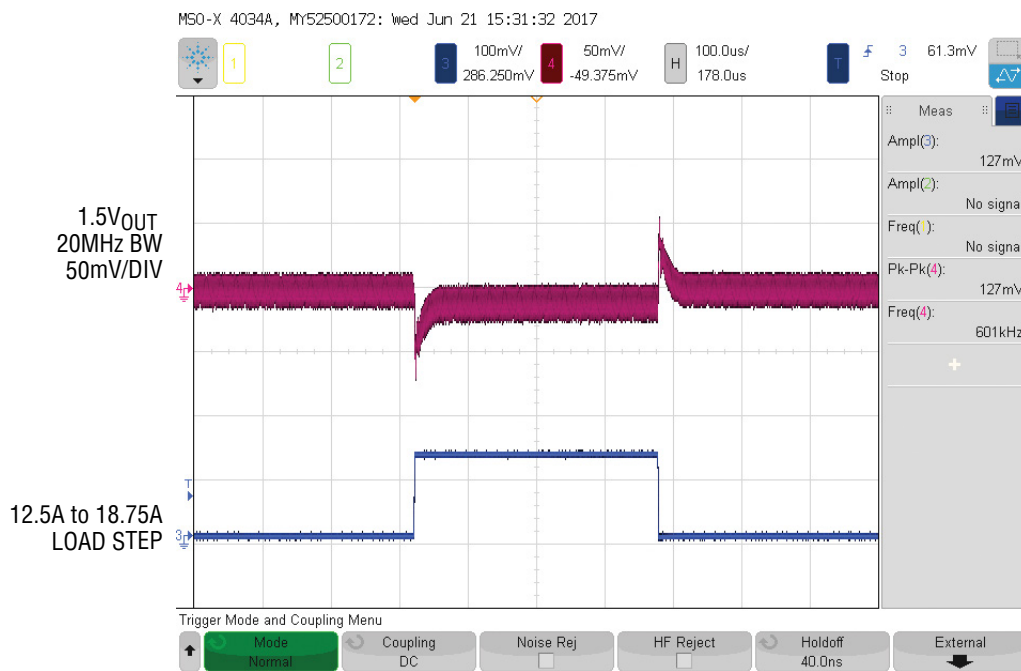
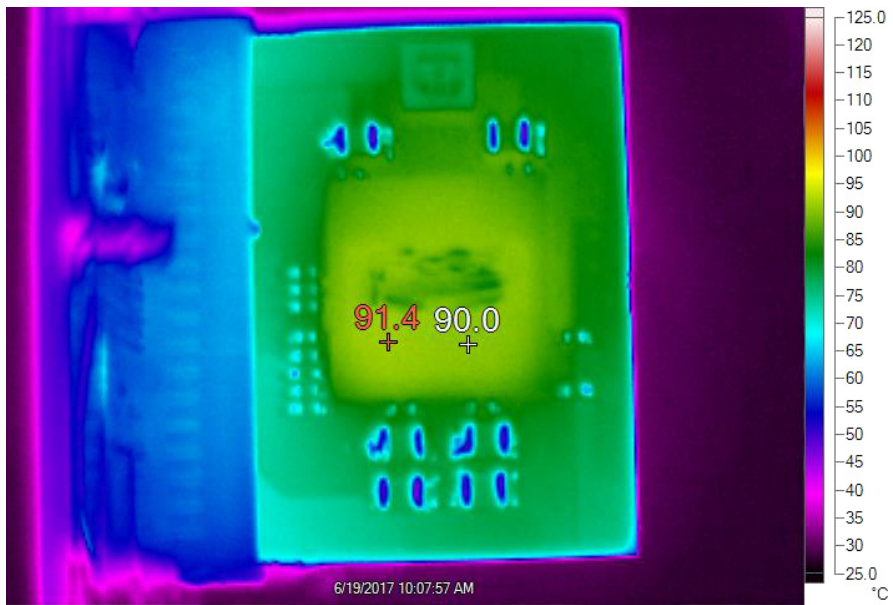
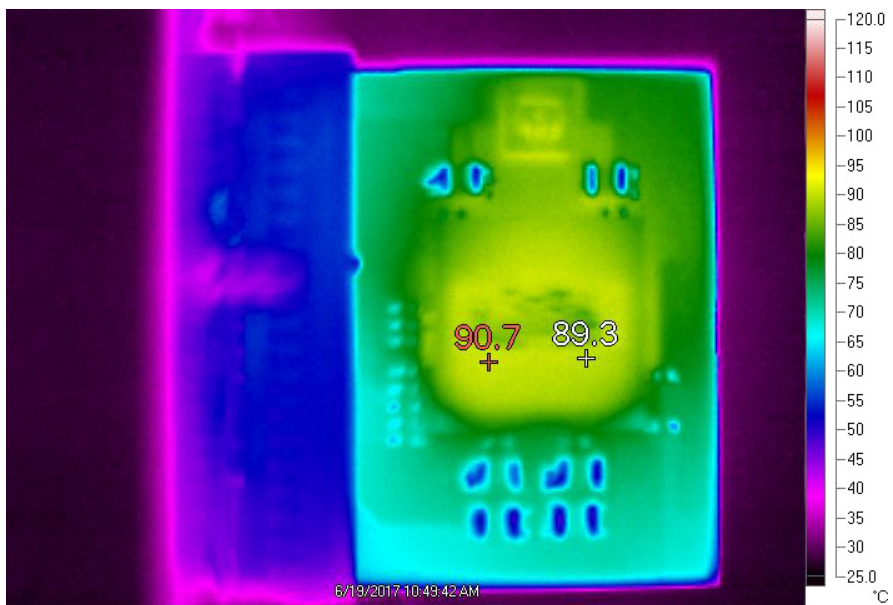


Figure 6. Measured Channel 12.5A to 18.75A Load Transient ( $V_{IN} = 12V$ ,  $V_{OUT2} = 1.5V$ )

**QUICK START PROCEDURE**



**Figure 7. Thermal Performance at  $V_{IN} = 12V$ ,  $V_{OUT1} = 3.3V/11A$ ,  $V_{OUT2} = 1.5V/11A$ ,  $f_{sw} = 600kHz$ ,  $T_A = 23^\circ C$ , No Forced Airflow**



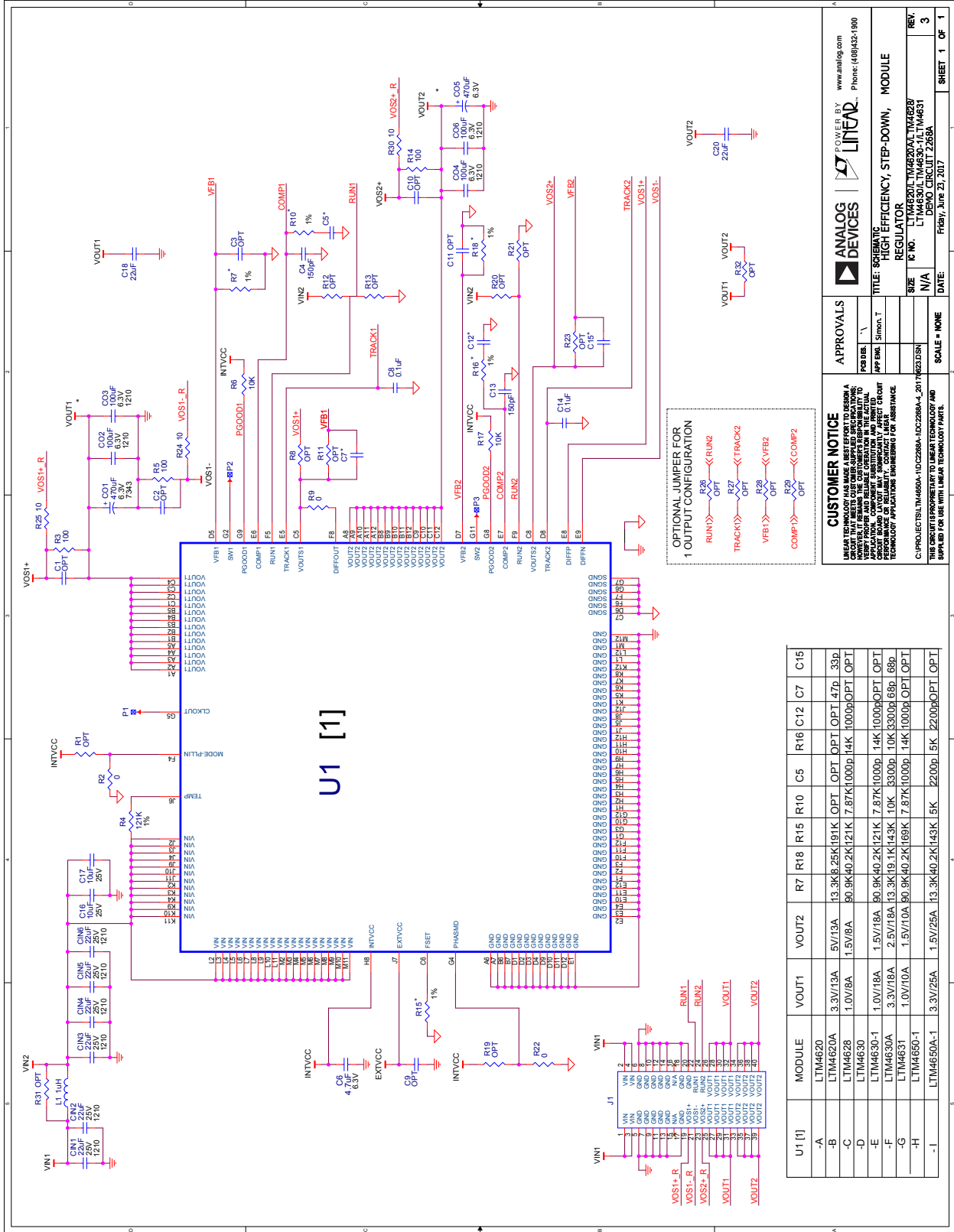
**Figure 8. Thermal Performance at  $V_{IN} = 12V$ ,  $V_{OUT1} = 3.3V/19A$ ,  $V_{OUT2} = 1.5V/19A$ ,  $f_{sw} = 600kHz$ ,  $T_A = 23^\circ C$ , 400LFM Airflow**

# DEMO MANUAL DC2268A-I

## PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
<b>Required Circuit Components</b>				
1	6	CIN1, CIN2, CIN3, CIN4, CIN5, CIN6	CAP, 1210 22 $\mu$ F 10% 25V X5R	AVX 12103D226KAT2A
2	2	C01, C05	CAP, 7343 470 $\mu$ F 20% 6.3V POSCAP	PANASONIC 6TPF470MAH
3	4	C02, C03, C04, C06	CAP, 1210 100 $\mu$ F 10% 6.3V X5R	AVX 12106D107KAT2A
4	1	C6	CAP, 0603 4.7 $\mu$ F 20% 6.3V X5R	AVX 06036D475MAT2A
5	2	C7, C15	CAP, 0603 68pF 5% 50V COG / NPO	AVX 06035A680JAT2A
6	2	C8, C14	CAP, 0603 0.1 $\mu$ F 10% 25V X7R	AVX 06033C104KAT2A
7	2	C5, C12	CAP, 0603 2200pF 5% 16V COG	AVX 0603YC222JAT2A
8	2	C16, C17	CAP, 0603 10 $\mu$ F 20% 25V X5R	TDK C1608X5R1E106M080AC
9	2	C18, C20	CAP, 0603 22 $\mu$ F 20% 6.3V X5R	TDK C1608X5R0J226M080AC
10	1	L1	IND, 1.0 $\mu$ H	COILCRAFT XAL5030-102MEC
11	2	R2, R22	RES, 0603 0 $\Omega$ JUMPER	VISHAY CRCW06030000Z0EA
12	3	R3, R5, R14	RES, 0603 100 $\Omega$ 5% 0.1W	VISHAY CRCW0603100RJNEA
13	1	R4	RES, 0603 121k 1% 0.1W	VISHAY CRCW0603121KFKEA
14	2	R6, R17	RES, 0603 10k 5% 0.1W	VISHAY CRCW060310K0JNEA
15	1	R7	RES, 0603 13.3k 1% 0.1W	VISHAY CRCW060313K3FKEA
16	1	R9	RES, 0603 0 $\Omega$	VISHAY CRCW06030000Z0EA
17	2	R10, R16	RES, 0603 5k 1% 0.1W	VISHAY CRCW0605K00FKEA
18	1	R15	RES, 0603 143k 1% 0.1W	VISHAY CRCW0603143KFKEA
19	1	R18	RES, 0603 40.2k 1% 0.1W	VISHAY CRCW060340K2FKEA
20	3	R24, R25, R30	RES, 0603 10 $\Omega$ 5% 0.1W	VISHAY CRCW060310R0JNEA
21	1	U1	IC, VOLTAGE REGULATOR LGA	ANALOG DEVICES, LTM4650AEV-1#PBF
<b>Additional Demo Board Circuit Components</b>				
1	0	C1, C2, C3, C4, C9, C10, C11, C13	CAP, 0603 OPTION	OPTION
2	0	R1, R8, R11, R12, R13, R19, R20, R21, R23, R26, R27, R28, R29	RES, 0603 OPTION	OPTION
3	0	R31, R32	RES, 2512 OPTION	OPTION
<b>Hardware: For Demo Board Only</b>				
1	1	J1	CONN., CARD EDGE 1.6mm	SAMTEC MEC2-20-01-L-DV--TR

SCHEMATIC DIAGRAM



**ANALOG DEVICES** | POWER BY **LINEAR** | www.analog.com | Phone: (418)432-1900

**APPROVALS**

POBIB: \

APP EML: Simon.T

**CUSTOMER NOTICE**

LINEAR TESTS MEET OUR OWN SPECIFIED PERFORMANCE. CUSTOMERS MUST VERIFY PROPER AND RELIABLE OPERATION IN THE ACTUAL LOAD AND ENVIRONMENT. THE ACTUAL PERFORMANCE OF THE PRODUCT MAY VARY FROM THE SPECIFIED PERFORMANCE OF THE PRODUCT DUE TO MANUFACTURING TOLERANCES.

CIPROJECTS/LTM4620A-1DC2268A-1\_2017REG3.DSN

DATE: 1/16/17

SCALE: NONE

REV: 3

SHEET 1 OF 1



## ESD Caution

**ESD (electrostatic discharge) sensitive device.** Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

## Legal Terms and Conditions

By using the evaluation board discussed herein (together with any tools, components documentation or support materials, the "Evaluation Board"), you are agreeing to be bound by the terms and conditions set forth below ("Agreement") unless you have purchased the Evaluation Board, in which case the Analog Devices Standard Terms and Conditions of Sale shall govern. Do not use the Evaluation Board until you have read and agreed to the Agreement. Your use of the Evaluation Board shall signify your acceptance of the Agreement. This Agreement is made by and between you ("Customer") and Analog Devices, Inc. ("ADI"), with its principal place of business at One Technology Way, Norwood, MA 02062, USA. Subject to the terms and conditions of the Agreement, ADI hereby grants to Customer a free, limited, personal, temporary, non-exclusive, non-sublicensable, non-transferable license to use the Evaluation Board FOR EVALUATION PURPOSES ONLY. Customer understands and agrees that the Evaluation Board is provided for the sole and exclusive purpose referenced above, and agrees not to use the Evaluation Board for any other purpose. Furthermore, the license granted is expressly made subject to the following additional limitations: Customer shall not (i) rent, lease, display, sell, transfer, assign, sublicense, or distribute the Evaluation Board; and (ii) permit any Third Party to access the Evaluation Board. As used herein, the term "Third Party" includes any entity other than ADI, Customer, their employees, affiliates and in-house consultants. The Evaluation Board is NOT sold to Customer; all rights not expressly granted herein, including ownership of the Evaluation Board, are reserved by ADI. CONFIDENTIALITY. This Agreement and the Evaluation Board shall all be considered the confidential and proprietary information of ADI. Customer may not disclose or transfer any portion of the Evaluation Board to any other party for any reason. Upon discontinuation of use of the Evaluation Board or termination of this Agreement, Customer agrees to promptly return the Evaluation Board to ADI. ADDITIONAL RESTRICTIONS. Customer may not disassemble, decompile or reverse engineer chips on the Evaluation Board. Customer shall inform ADI of any occurred damages or any modifications or alterations it makes to the Evaluation Board, including but not limited to soldering or any other activity that affects the material content of the Evaluation Board. Modifications to the Evaluation Board must comply with applicable law, including but not limited to the RoHS Directive. TERMINATION. ADI may terminate this Agreement at any time upon giving written notice to Customer. Customer agrees to return to ADI the Evaluation Board at that time. LIMITATION OF LIABILITY. THE EVALUATION BOARD PROVIDED HEREUNDER IS PROVIDED "AS IS" AND ADI MAKES NO WARRANTIES OR REPRESENTATIONS OF ANY KIND WITH RESPECT TO IT. ADI SPECIFICALLY DISCLAIMS ANY REPRESENTATIONS, ENDORSEMENTS, GUARANTEES, OR WARRANTIES, EXPRESS OR IMPLIED, RELATED TO THE EVALUATION BOARD INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTY OF MERCHANTABILITY, TITLE, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS. IN NO EVENT WILL ADI AND ITS LICENSORS BE LIABLE FOR ANY INCIDENTAL, SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES RESULTING FROM CUSTOMER'S POSSESSION OR USE OF THE EVALUATION BOARD, INCLUDING BUT NOT LIMITED TO LOST PROFITS, DELAY COSTS, LABOR COSTS OR LOSS OF GOODWILL. ADI'S TOTAL LIABILITY FROM ANY AND ALL CAUSES SHALL BE LIMITED TO THE AMOUNT OF ONE HUNDRED US DOLLARS (\$100.00). EXPORT. Customer agrees that it will not directly or indirectly export the Evaluation Board to another country, and that it will comply with all applicable United States federal laws and regulations relating to exports. GOVERNING LAW. This Agreement shall be governed by and construed in accordance with the substantive laws of the Commonwealth of Massachusetts (excluding conflict of law rules). Any legal action regarding this Agreement will be heard in the state or federal courts having jurisdiction in Suffolk County, Massachusetts, and Customer hereby submits to the personal jurisdiction and venue of such courts. The United Nations Convention on Contracts for the International Sale of Goods shall not apply to this Agreement and is expressly disclaimed.



## X-ON Electronics

Largest Supplier of Electrical and Electronic Components

*Click to view similar products for [Power Management IC Development Tools](#) category:*

*Click to view products by [Analog Devices](#) manufacturer:*

Other Similar products are found below :

[EVAL-ADM1168LQEBZ](#) [EVB-EP5348UI](#) [MIC23451-AAAYFL EV](#) [MIC5281YMME EV](#) [DA9063-EVAL](#) [ADP122-3.3-EVALZ](#) [ADP130-0.8-EVALZ](#) [ADP130-1.2-EVALZ](#) [ADP130-1.5-EVALZ](#) [ADP130-1.8-EVALZ](#) [ADP1714-3.3-EVALZ](#) [ADP1716-2.5-EVALZ](#) [ADP1740-1.5-EVALZ](#) [ADP1752-1.5-EVALZ](#) [ADP1828LC-EVALZ](#) [ADP1870-0.3-EVALZ](#) [ADP1871-0.6-EVALZ](#) [ADP1873-0.6-EVALZ](#) [ADP1874-0.3-EVALZ](#) [ADP1882-1.0-EVALZ](#) [ADP199CB-EVALZ](#) [ADP2102-1.25-EVALZ](#) [ADP2102-1.875EVALZ](#) [ADP2102-1.8-EVALZ](#) [ADP2102-2-EVALZ](#) [ADP2102-3-EVALZ](#) [ADP2102-4-EVALZ](#) [ADP2106-1.8-EVALZ](#) [ADP2147CB-110EVALZ](#) [AS3606-DB](#) [BQ24010EVM](#) [BQ24075TEVM](#) [BQ24155EVM](#) [BQ24157EVM-697](#) [BQ24160EVM-742](#) [BQ24296MEVM-655](#) [BQ25010EVM](#) [BQ3055EVM](#) [NCV891330PD50GEVB](#) [ISLUSBI2CKIT1Z](#) [LM2744EVAL](#) [LM2854EVAL](#) [LM3658SD-AEV/NOPB](#) [LM3658SDEV/NOPB](#) [LM3691TL-1.8EV/NOPB](#) [LM4510SDEV/NOPB](#) [LM5033SD-EVAL](#) [LP38512TS-1.8EV](#) [EVAL-ADM1186-1MBZ](#) [EVAL-ADM1186-2MBZ](#)