LTM4650-1
Dual 25A or Single 50A µModule Regulator

DESCRIPTION

Demonstration circuit 2268A-H is a high efficiency, high density, dual 25A, switch mode step-down power supply on a compact 1.5-inch × 1.2-inch PCB. It features the LTM®4650-1 µModule® regulator. The input voltage is from 4.5V to 15V. The output voltage is programmable from 0.6V to 1.8V. DC2268A-H 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® operation 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 LTM4650-1 in a compact 16mm × 16mm × 5.01mm BGA package make it ideal for use in many high density point-of-load regulation applications. The LTM4650-1 data sheet must be read in conjunction with this demo manual for working on or modifying the DC2268A-H.

Design files for this circuit board are available at http://www.analog.com/DC2268A-H

BOARD PHOTO

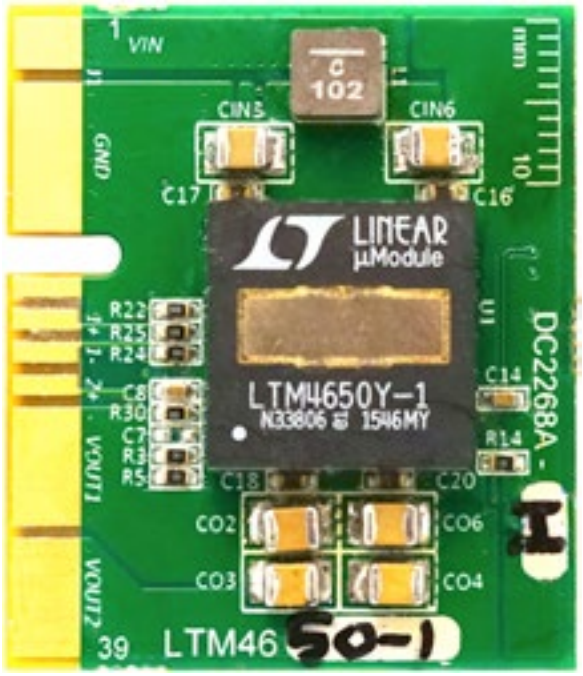


Figure 1. LTM4650-1/DC2268A-H Demo Board

PERFORMANCE SUMMARY

Specifications are at T_A = 25°C

PARAMETER	CONDITIONS/NOTES	VALUE
Input Voltage Range		4.5V ~ 15V
Output Voltage V_{OUT1}	V_{IN} = 4.5V ~15V, I_{OUT1} = 0A ~25A	1V ± 1.5%
Output Voltage V_{OUT2}	V_{IN} = 4.5V ~15V, I_{OUT2} = 0A ~25A	1.5V ± 1.5%
Per Channel Maximum Continuous Output Current	Derating is necessary for certain V_{IN}, V_{OUT} and thermal conditions	25A (per channel)
Default Operating Frequency		500kHz
External Clock Sync. Frequency Range		400kHz to 780kHz
Efficiency of Channel 1	V_{IN} = 12V, V_{OUT1} = 1.0V, I_{OUT1} = 25A, f_{SW} = 500kHz	86.3% (see Figure 3)
Efficiency of Channel 2	V_{IN} = 12V, V_{OUT2} = 1.5V, I_{OUT2} = 25A, f_{SW} = 500kHz	89.0% (see Figure 3)
Load Transient of Channel 1	V_{IN} = 12V, V_{OUT1} = 1V, I_{STEP} = 12.5A ~ 18.75A	V_{OPP} = 77mV (see Figure 4)
Load Transient of Channel 2	V_{IN} = 12V, V_{OUT2} = 1.5V, I_{STEP} = 12.5A ~ 18.75A	V_{OPP} = 84mV (see Figure 5)

QUICK START PROCEDURE

Demonstration circuit DC2268A-H is easy to set up to evaluate the performance of the LTM4650-1. 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 – 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 1.0V ± 1.5% (0.985V ~ 1.015V) and the output voltage in channel 2 should be 1.5V ± 1.5% (1.478V ~ 1.523V).
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) LTM4650-1 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) LTM4650-1 can be configured for a 2-phase single output at up to 20A on DC2268A-H. Install 0Ω resistors on R26, R27, R28, R29 and R32, and remove R14, R18 and R30. Output voltage is set by R7 based on equation V_{OUT} = 0.6V (1 + 60.4k/R7).

   NOTE: Due to very small PCB size of the DC2268A board, the LTM4650-1 module can be quite hot at heavy load. Cooling air is required. See Figures 6 and 8.

Table 1. 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

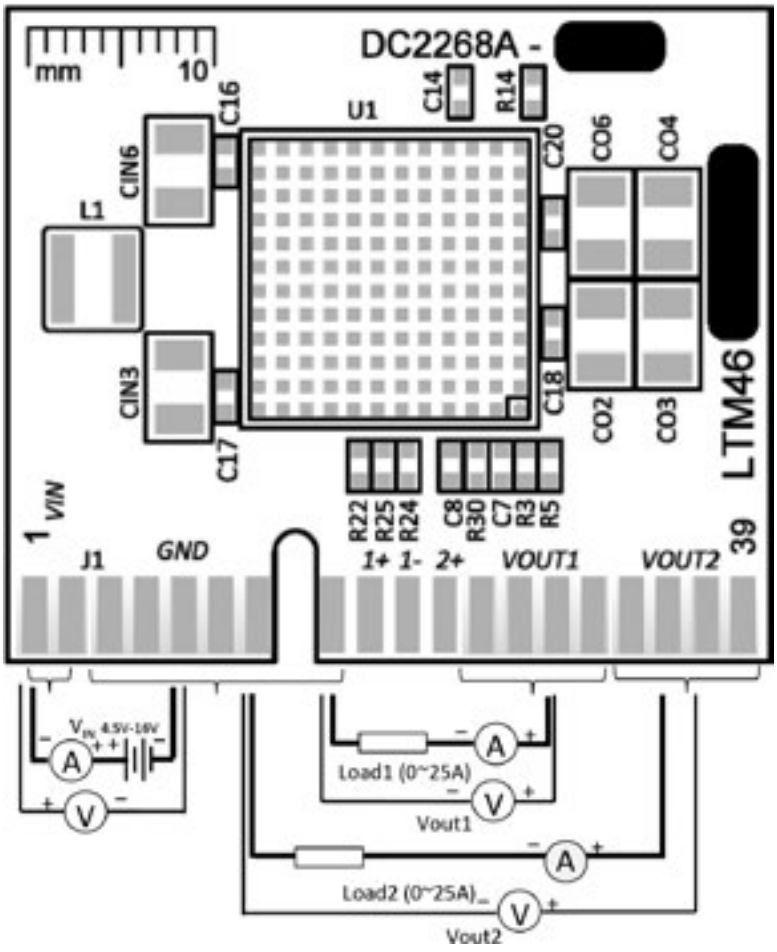


Figure 2. Test Setup of DC2268A-H

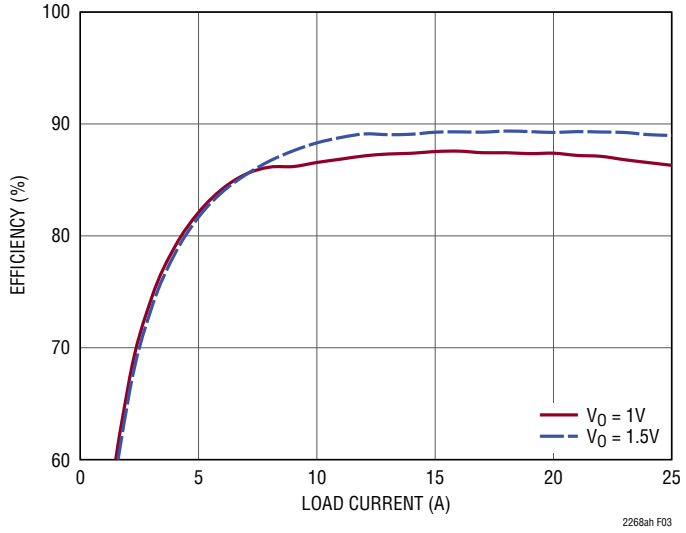


Figure 3. Measured Efficiency at V_{IN} = 12V, f_{SW} = 500kHz, (the Other Channel Is Off when Measuring One Channel's Efficiency)

QUICK START PROCEDURE

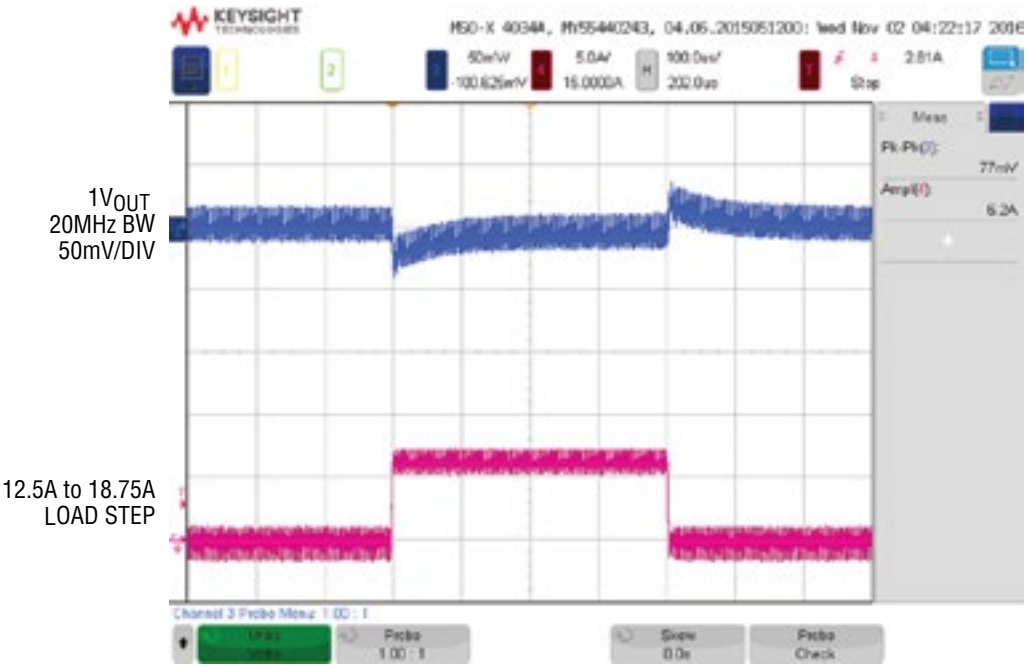


Figure 4. Measured Channel 1, 12.5A to 18.75A Load Transient (V_{IN} = 12V, V_{OUT1} = 1.0V)

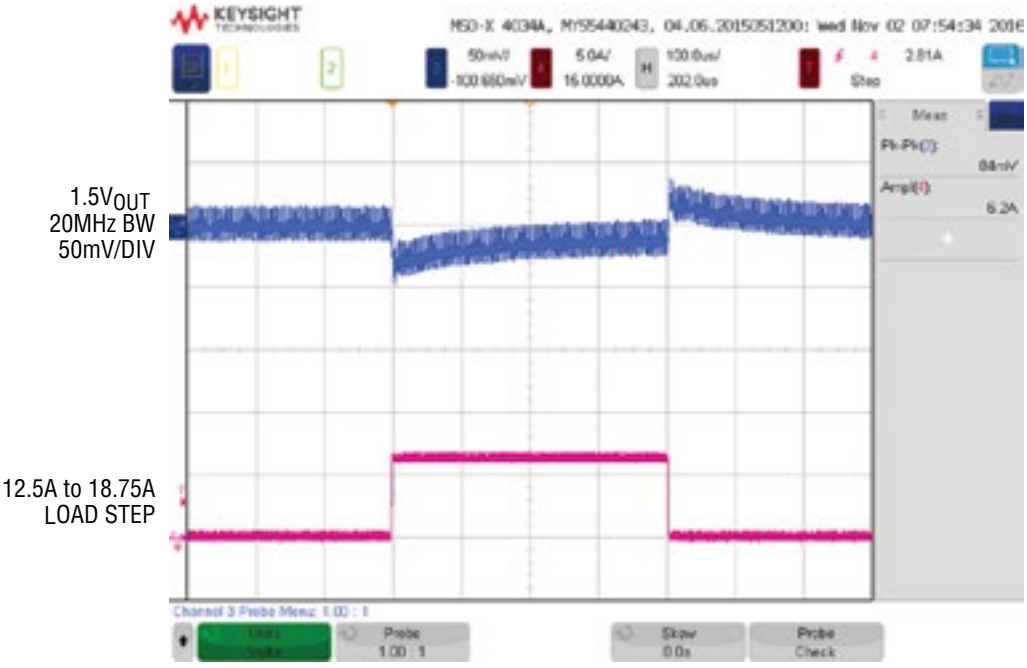


Figure 5. Measured Channel 2 12.5A to 18.75A Load Transient (V_{IN} = 12V, V_{OUT2} = 1.5V)

QUICK START PROCEDURE

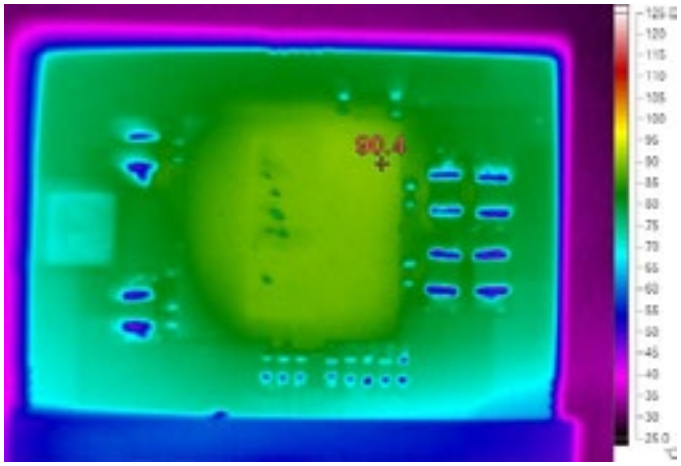


Figure 6. Thermal Performance at V_{IN} = 12V, V_{OUT1} = 1.0V/12A, V_{OUT2} = 1.5V/12A, f_{SW} = 500kHz, T_A = 23°C, No Forced Airflow

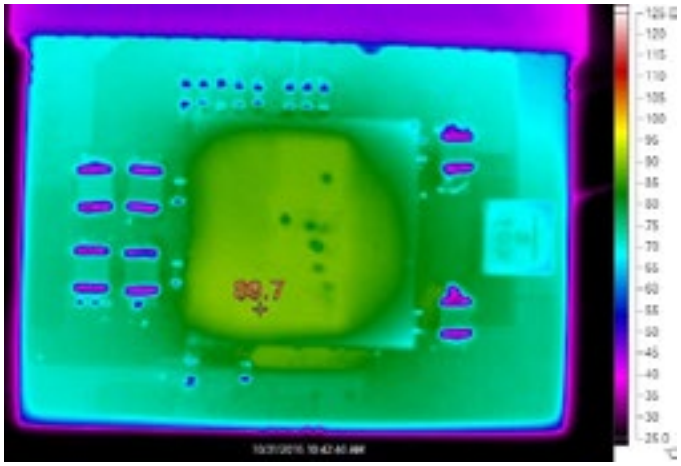


Figure 7. Thermal Performance at V_{IN} = 12V, V_{OUT1} = 1.0V/21A, V_{OUT2} = 1.5V/21A, f_{SW} = 500kHz, T_A = 23°C, 400LFM Airflow

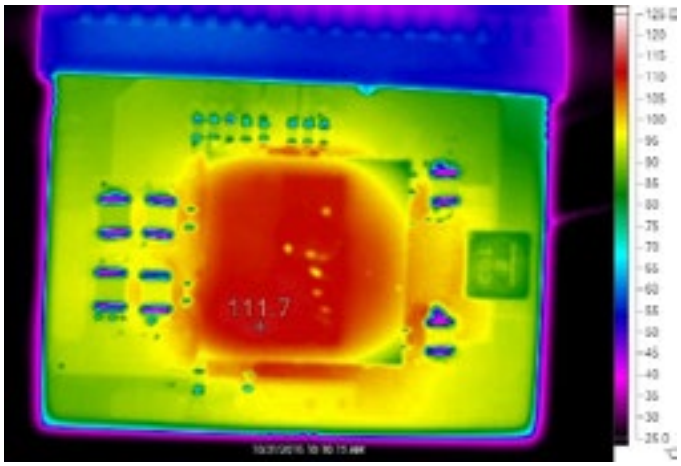
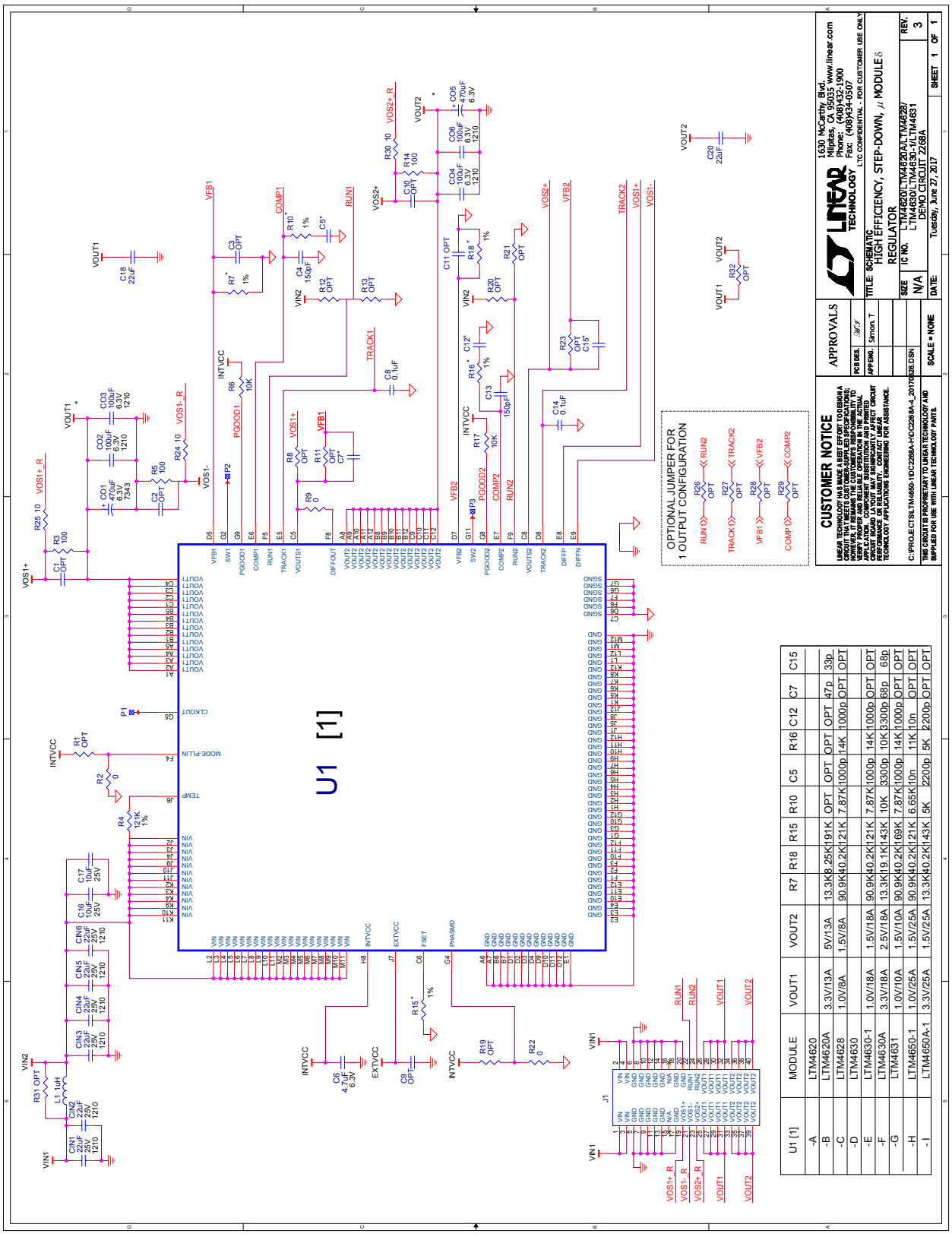


Figure 8. Thermal Performance at V_{IN} = 12V, V_{OUT1} = 1.0V/25A, V_{OUT2} = 1.5V/25A, f_{SW} = 500kHz, T_A = 23°C, 400LFM Airflow

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	6	CIN1, CIN2, CIN3, CIN4, CIN5, CIN6	CAP, 1210 22µF 10% 25V X5R	AVX 12103D226KAT2A
2	2	CO1, CO5	CAP, 7343 470µF 20% 6.3V POSCAP	PANASONIC 6TPF470MAH
3	4	CO2, CO3, CO4, CO6	CAP, 1210 100µF 10% 6.3V X5R	AVX 12106D107KAT2A
4	1	C6	CAP, 0603 4.7µF 20% 6.3V X5R	AVX 06036D475MAT2A
5	2	C8, C14	CAP, 0603 0.1µF 10% 25V X7R	AVX 06033C104KAT2A
6	2	C5, C12	CAP, 0603 10nF 5% 16V C0G	AVX 0603YC103JAT2A
7	2	C16, C17	CAP, 0603 10µF 20% 25V X5R	TDK C1608X5R1E106M080AC
8	2	C18, C20	CAP, 0603 22µF 20% 6.3V X5R	TDK C1608X5R0J226M080AC
9	1	L1	IND, 1.0µH	COILCCRAFT XAL5030-102MEC
10	2	R2, R22	RES, 0603 0Ω JUMPER	VISHAY CRCW06030000Z0EA
11	3	R3, R5, R14	RES, 0603 100Ω 5% 0.1W	VISHAY CRCW0603100RJNEA
12	1	R4	RES, 0603 121k 1% 0.1W	VISHAY CRCW0603121KFKEA
13	2	R6, R17	RES, 0603 10k 5% 0.1W	VISHAY CRCW060310K0JNEA
14	1	R7	RES, 0603 13.3k 1% 0.1W	VISHAY CRCW060313K3FKEA
15	1	R9	RES, 0603 0Ω	VISHAY CRCW06030000Z0EA
16	1	R10	RES, 0603 6.65k 1% 0.1W	VISHAY CRCW0606K65FKEA
17	1	R16	RES, 0603 11k 1% 0.1W	VISHAY CRCW060011K0FKEA
18	1	R15	RES, 0603 121k 1% 0.1W	VISHAY CRCW0603121KFKEA
19	1	R18	RES, 0603 40.2k 1% 0.1W	VISHAY CRCW060340K2FKEA
20	3	R24, R25, R30	RES, 0603 10Ω 5% 0.1W	VISHAY CRCW060310R0JNEA
21	1	U1	IC, VOLTAGE REGULATOR LGA	LINEAR TECH. LTM4650EY-1B#PBF
Additional Demo Board Circuit Components				
1	0	C1, C2, C3, C4, C7, C9, C10, C11, C13, C15	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
Hardware				
1	1	J1	CONN., CARD EDGE 1.6mm	SAMTEC MEC2-20-01-L-DV-TR

SCHEMATIC DIAGRAM



U1 [1]	MODULE	VOUT1	VOUT2	R7	R18	R15	R10	C5	R16	C12	C7	C15
-A	LTM4620											
-B	LTM4620A	3.3V/13A	5V/13A	13.3KΒ.25K	191K	OPT	OPT	OPT	OPT	OPT	47p	33p
-C	LTM4628	1.0V/8A	1.5V/8A	90.9K	40.2K	121K	7.87K	1000p	14K	1000p	OPT	OPT
-D	LTM4630											
-E	LTM4630-1	1.0V/18A	1.5V/18A	90.9K	40.2K	121K	7.87K	1000p	14K	1000p	OPT	OPT
-F	LTM4630A	3.3V/18A	2.5V/18A	13.3K	19.1K	143K	10K	3300p	10K	3300p	68p	68p
-G	LTM4631	1.0V/10A	1.5V/10A	90.9K	40.2K	169K	7.87K	1000p	14K	1000p	OPT	OPT
-H	LTM4650-1	1.0V/25A	1.5V/25A	90.9K	40.2K	121K	6.65K	10n	11K	10n	OPT	OPT
-I	LTM4650A-1	3.3V/25A	1.5V/25A	13.3K	40.2K	143K	5K	2200p	5K	2200p	OPT	OPT

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.

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