LTM4693 2.6V - 5.5V Input to 1.8V - 5V Output, Ultrathin 2A Buck-Boost µModule Regulator

DESCRIPTION

Demonstration circuit DC3016A is a buck-boost power supply featuring the LTM®4693, ultrathin, highly efficient, 2A buck-boost µModule® regulator. The LTM4693 regulates an output voltage above, below, or equal to the input voltage. This demonstration circuit is designed to have an input voltage from 2.6V to 5.5V with selectable 1.8V, 2.5V, 3.3V, and 5V output voltage up to 2A load. Derating may be necessary for specific V_{IN}, V_{OUT}, and thermal conditions.

This demo board includes a mode selector that allows the converter to run in CCM or Burst Mode® operation. Synchronization to an external clock is also possible. The switching frequency can be adjusted from 1MHz to 4MHz by a resistor. And the soft-start period is programmable by an external capacitor. The LTM4693 data sheet gives a complete description of these functions, operation, and application information. The data sheet must be read in conjunction with this quick start guide for demo circuit 3016A.

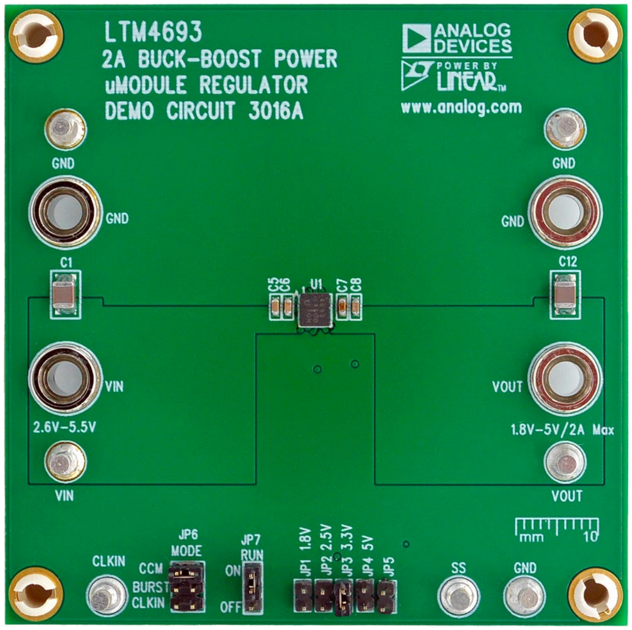
Design files for this circuit board are available.

PERFORMANCE SUMMARY **Specifications are at T_A = 25°C**

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
V_{IN}	Input Supply Range	Continuous Operation, Free Air	2.6		5.5	V
V_{OUT}	Output Voltage	Jumper Place: 1.8V Jumper Place: 2.5V Jumper Place: 3.3V Jumper Place: 5V	1.75 2.4 3.2 4.9	1.8 2.5 3.3 5	1.85 2.6 3.4 5.1	V V V V
I_{OUT}	Output Current	When $V_{IN} \geq V_{OUT}$ When $V_{IN} < V_{OUT}$			2 1	A A
f_{SW}	Switching Frequency			2200		kHz
P_{OUT}/P_{IN}	Efficiency See Figure 3 through Figure 6 for More Information	V_{IN} = 3.3V, V_{OUT} = 1.8V, I_{OUT} = 2A V_{IN} = 3.3V, V_{OUT} = 2.5V, I_{OUT} = 2A V_{IN} = 3.3V, V_{OUT} = 3.3V, I_{OUT} = 2A V_{IN} = 3.3V, V_{OUT} = 5V, I_{OUT} = 1A		86 90.5 92.4 92.3		% % % %

BOARD PHOTO

Top View



QUICK START PROCEDURE

Demonstration circuit 3016A is easy to set up to evaluate the performance of the LTM4693. Refer to Figure 1 for the proper measurement equipment setup and follow the procedure below:

NOTE: When measuring the 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 or directly across the relevant capacitor. See Figure 2 for the proper scope probe technique.

1. Place jumpers in the following positions:

   JP6(MODE) CCM

   JP7(RUN) ON

2. Set the output voltage by placing the respective jumper:

JP1	JP2	JP3	JP4
1.8V	2.5V	3.3V	5V

3. With power off, connect the input power supply to VIN and GND. With power off, connect loads from VOUT to GND.

4. Turn on the power at the input.

   NOTE: Make sure that the input voltage does not exceed 5.5V.

5. Check for the proper output voltages.

   When JP1 is selected, V_{OUT} = 1.75V to 1.85V

   When JP2 is selected, V_{OUT} = 2.4V to 2.6V

   When JP3 is selected, V_{OUT} = 3.2V to 3.4V

   When JP4 is selected, V_{OUT} = 4.9V to 5.1V

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

6. Once the proper output voltages are established, adjust the loads within the operating ranges, and observe the output voltage regulation, ripple voltage, efficiency, and other parameters.

7. To adjust the switching frequency, turn off the power supply, and modify R1 and R7.

QUICK START PROCEDURE

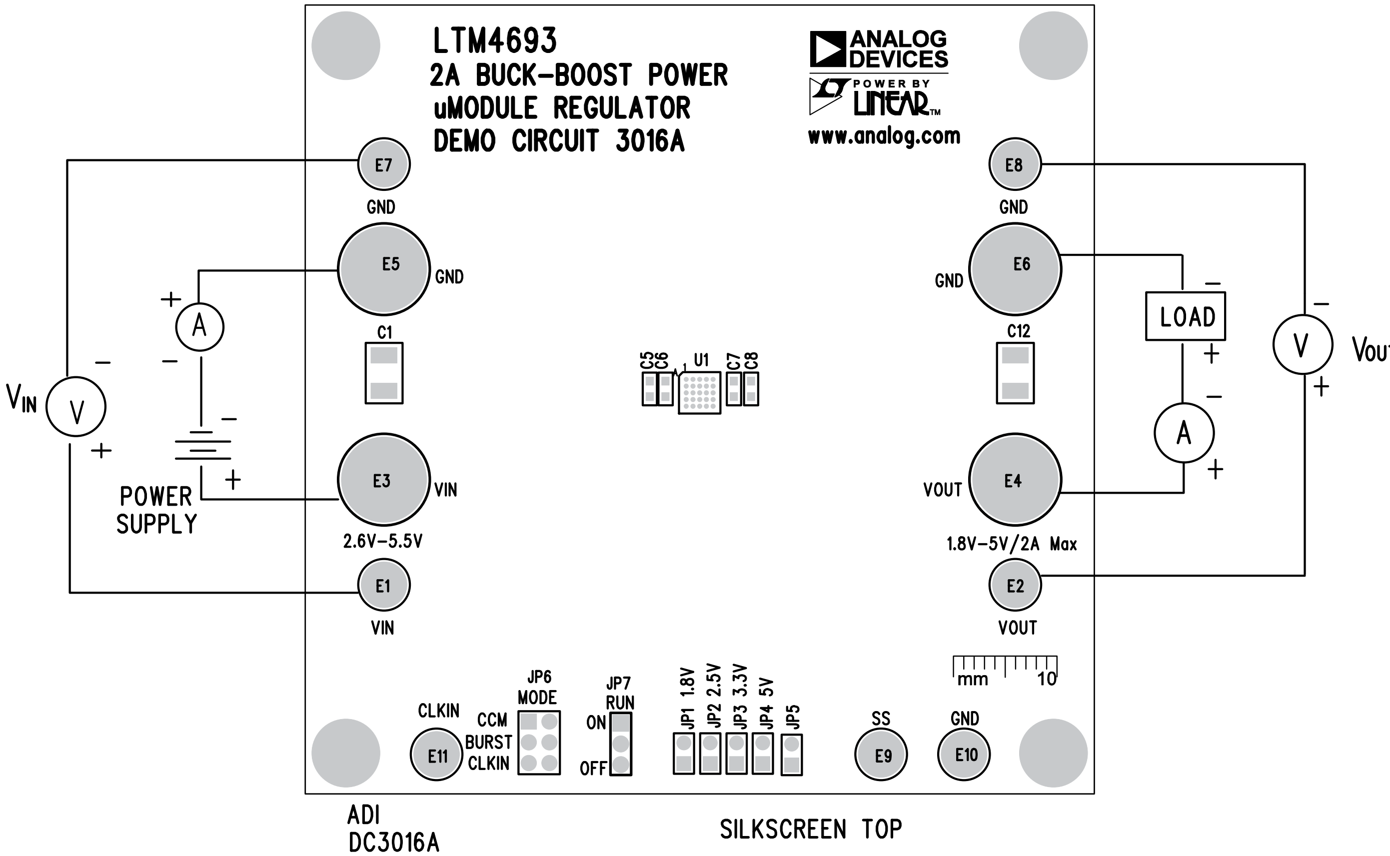


Figure 1. Test Setup Drawing for DC3016A

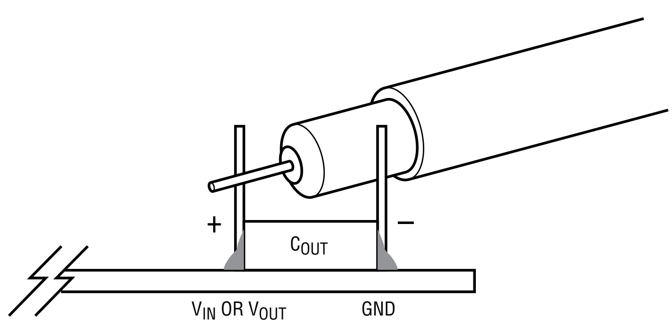


Figure 2. Proper Measurement Equipment Setup

QUICK START PROCEDURE

Mode Selection and Frequency Synchronization

The Demonstration circuit 3016A's Mode selector allows the converter to run in CCM operation, Burst Mode, or synchronize to an external clock source by changing the position of JP6. For synchronizing to an external clock source, apply the external clock from CLKIN turret to GND. Refer to the data sheet for more details.

Rail Tracking

Demonstration circuit 3016A is configured for an on-board soft-start circuit. The soft-start ramp rate can be adjusted by changing the value of C14. Refer to the data sheet for more details.

Bode Plot Measurement

Demonstration circuit 3016A provides the auxiliary circuits for bode plot measurement. R6 as the bottom resistor of voltage divider needs to be changed for different output voltage. The default value of R6 is for $5V_{OUT}$. R10 and R12 are one tenth of the top resistor and bottom resistor of voltage divider. And C18 should be 10 times as feed-forward capacitor C13. The perturbation signal should be injected between R9 and GND, then measure the bode plot at the symmetrical points (between the middle point of R6 and R9, and the middle point of R10 and R12).

TYPICAL TEST RESULTS

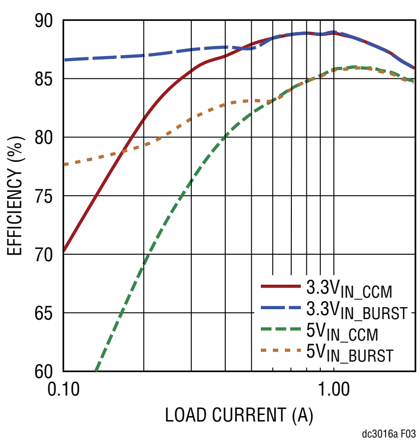


Figure 3. Measured Efficiency (V_{OUT} = 1.8V, f_{SW} = 2.2MHz)

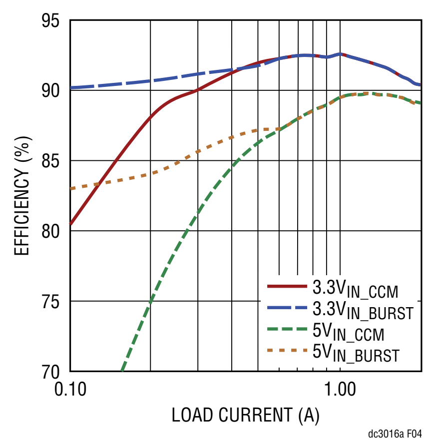


Figure 4. Measured Efficiency (V_{OUT} = 2.5V, f_{SW} = 2.2MHz)

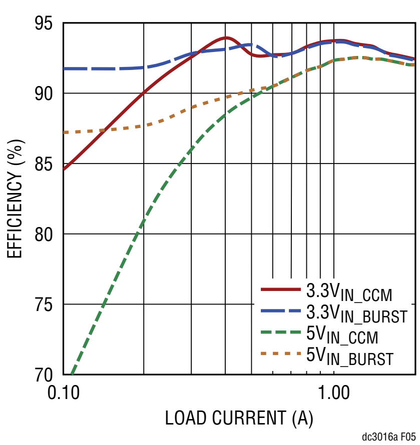


Figure 5. Measured Efficiency (V_{OUT} = 3.3V, f_{SW} = 2.2MHz)

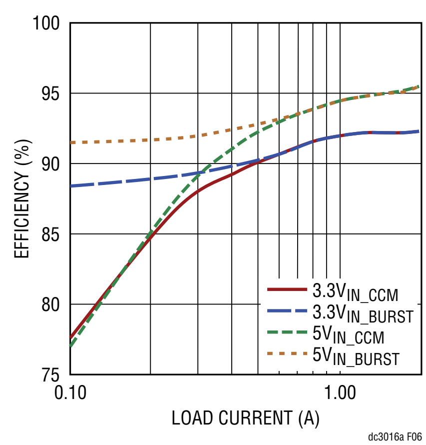
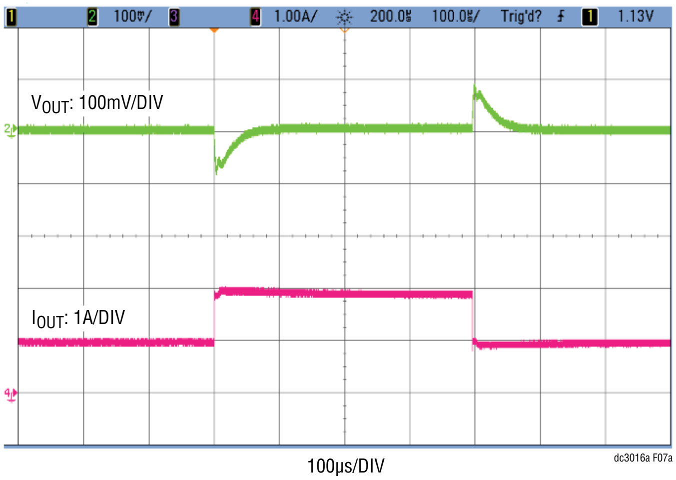
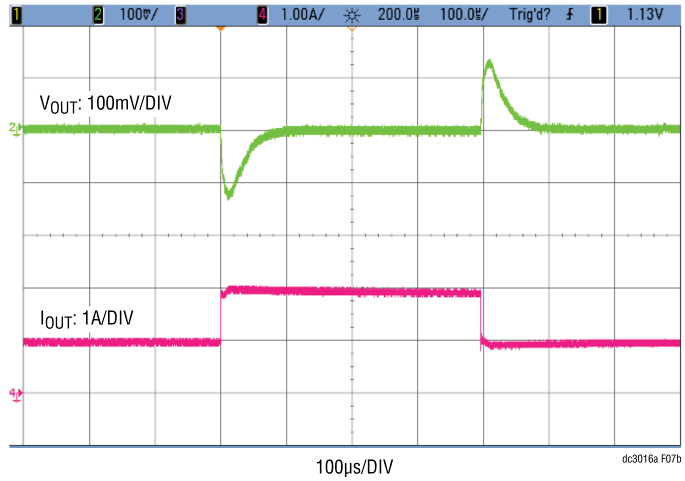


Figure 6. Measured Efficiency (V_{OUT} = 5V, f_{SW} = 2.2MHz)

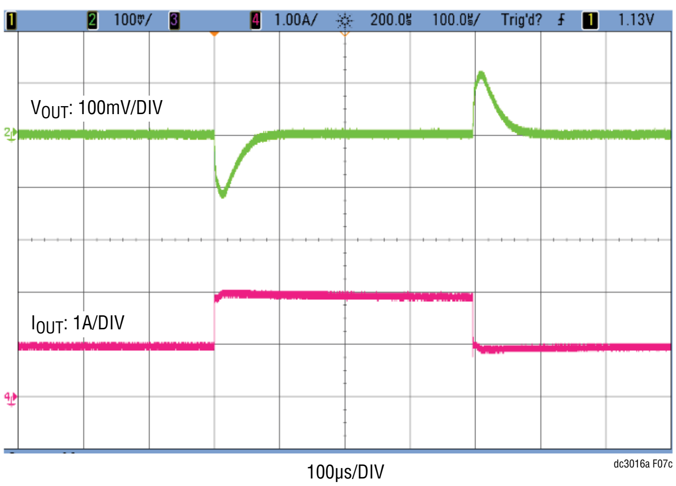
TYPICAL TEST RESULTS



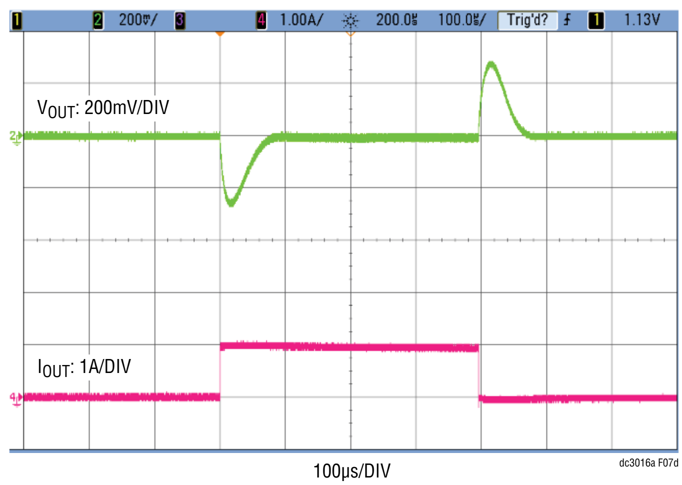
(7a) V_{IN} = 3.3V, V_{OUT} = 1.8V, 1A-2A-1A Load Transient



(7b) V_{IN} = 3.3V, V_{OUT} = 3.3V, 1A-2A-1A Load Transient



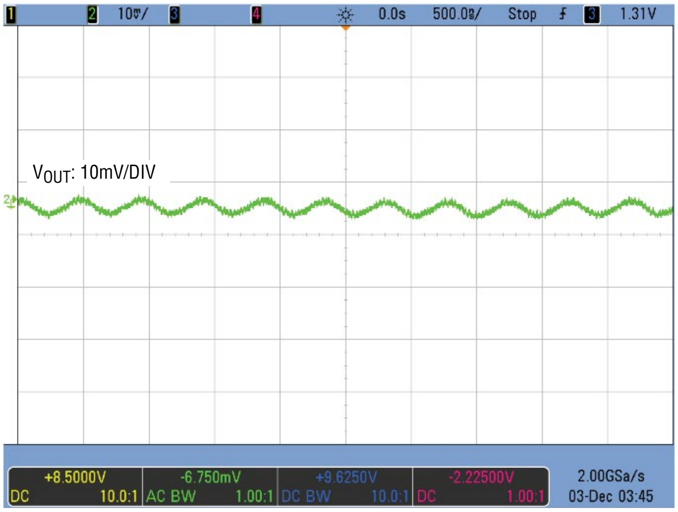
(7c) V_{IN} = 5V, V_{OUT} = 3.3V, 1A-2A-1A Load Transient



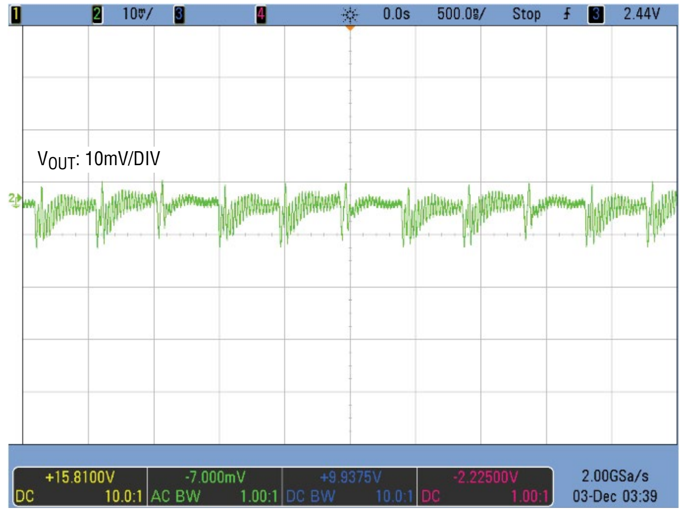
(7d) V_{IN} = 3.3V, V_{OUT} = 5V, 0A-1A-0A Load Transient

Figure 7. Transient Response Waveform

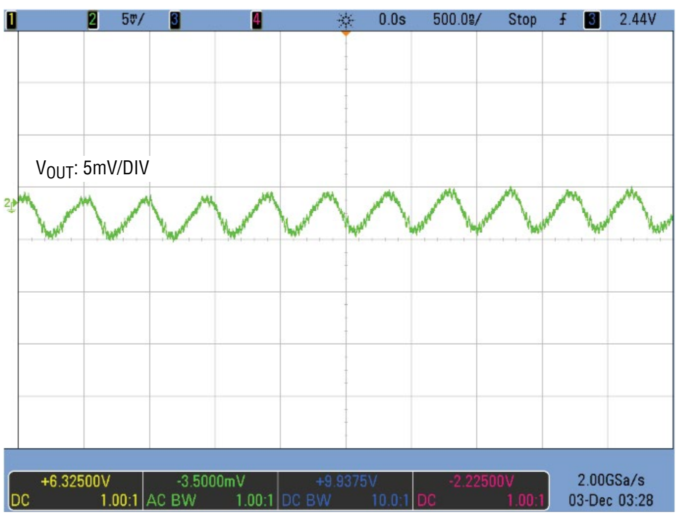
TYPICAL TEST RESULTS



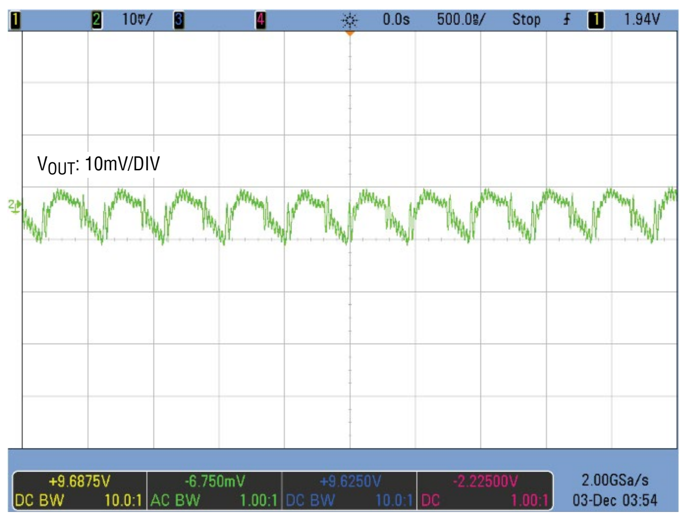
(8a) Output Voltage Ripple (V_{IN} = 3.3V, V_{OUT} = 1.8V, I_{OUT} = 2A)



(8b) Output Voltage Ripple (V_{IN} = 3.3V, V_{OUT} = 3.3V, I_{OUT} = 2A)



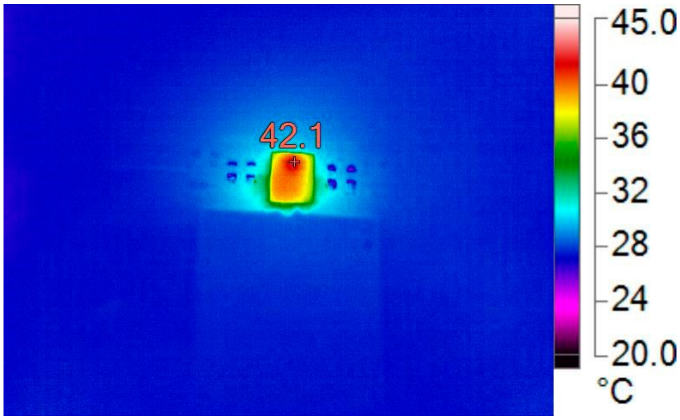
(8c) Output Voltage Ripple (V_{IN} = 5V, V_{OUT} = 3.3V, I_{OUT} = 2A)



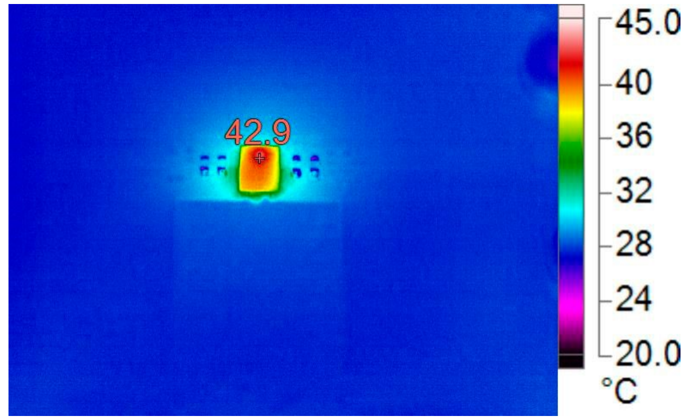
(8d) Output Voltage Ripple (V_{IN} = 3.3V, V_{OUT} = 5V, I_{OUT} = 1A)

Figure 8. Measured Output Voltage Ripple (20MHz BW, CCM)

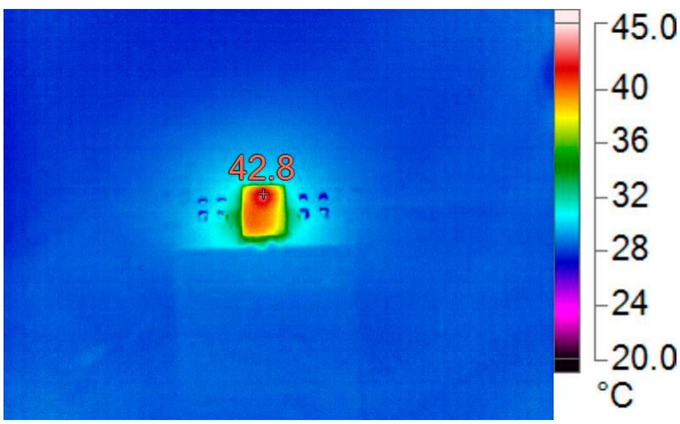
TYPICAL TEST RESULTS



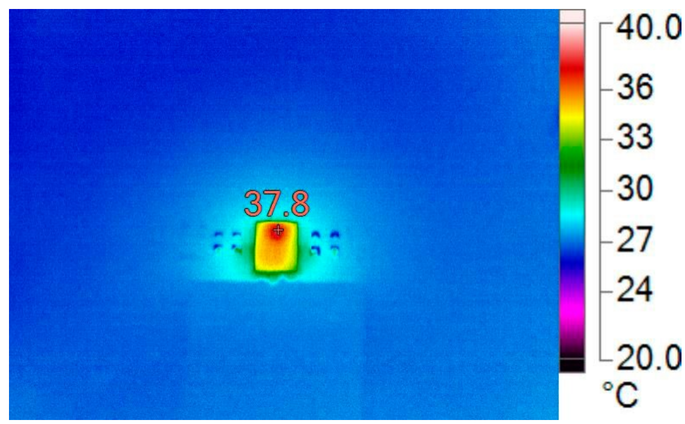
(9a) V_{IN} = 3.3V, V_{OUT} = 1.8V, I_{OUT} = 2A



(9b) V_{IN} = 3.3V, V_{OUT} = 3.3V, I_{OUT} = 2A



(9c) V_{IN} = 5V, V_{OUT} = 3.3V, I_{OUT} = 2A



(9d) V_{IN} = 3.3V, V_{OUT} = 5V, I_{OUT} = 1A

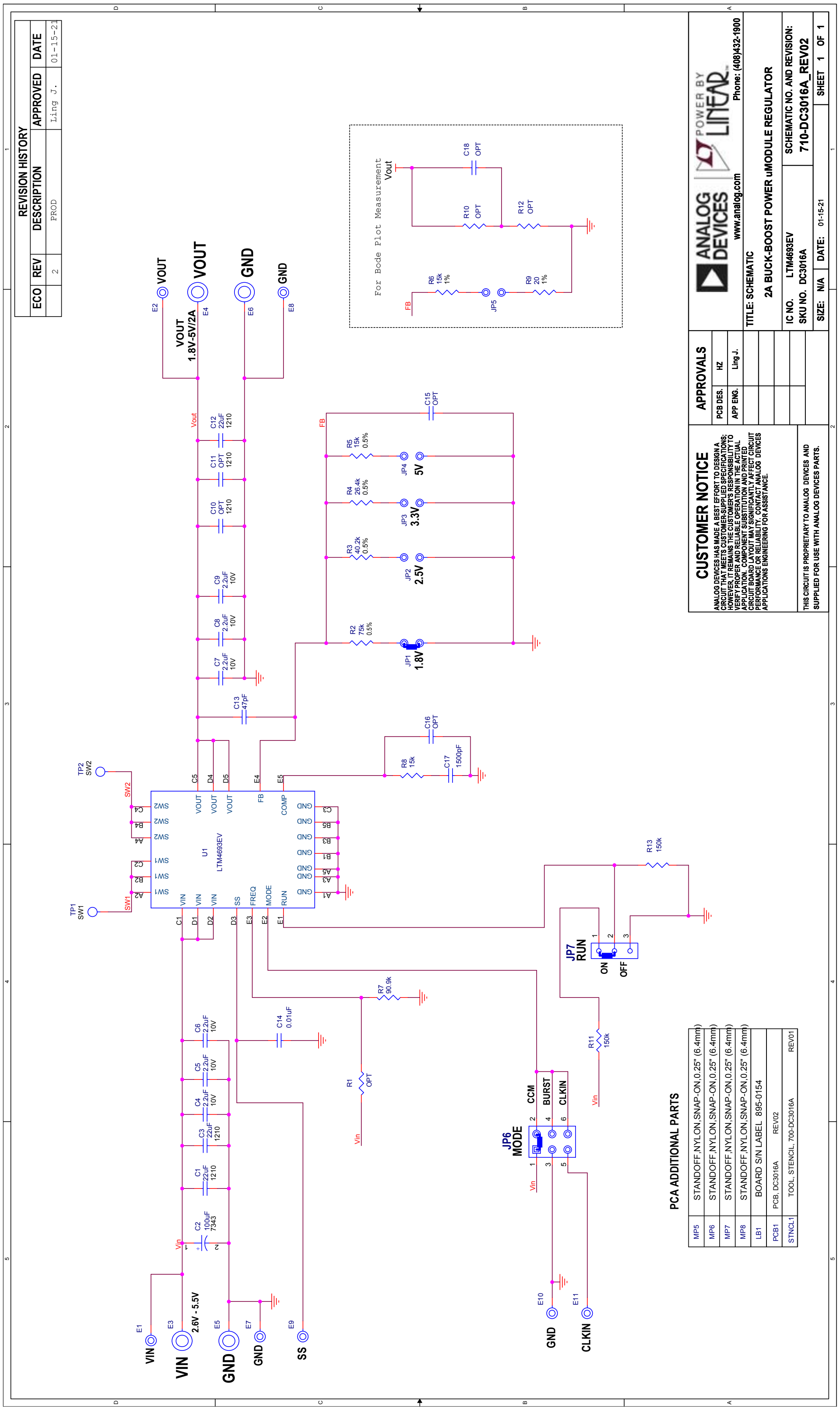
AIRFLOW	HEATSINK	AMBIENT (°C)
Natural Convection	None	25

Figure 9. Thermal Images

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	3	C1, C3, C12	CAP., 22µF, X5R, 25V, 20%, 1210	AVX, 12103D226MAT2A
2	1	C2	CAP., 100µF, TANT. POSCAP, 20V, 20%, 7343, 55mΩ, TQC, NO SUBS. ALLOWED	PANASONIC, 20TQC100MYF
3	6	C4-C9	CAP., 2.2µF, X7R, 10V, 10%, 0603	MURATA, GRM188R71A225KE15D
4	1	C13	CAP., 47pF, X7R, 50V, 10%, 0603	AVX, 06035C470KAT2A
5	1	C14	CAP., 0.01µF, X7R, 50V, 10%, 0603	AVX, 06035C103KAT2A
6	1	C17	CAP., 1500pF, X7R, 50V, 10%, 0603	AVX, 06035C152KAT2A
7	1	R2	RES., 75k, 0.5%, 1/5W, 0603	PANASONIC, ERJ-PB3D7502V
8	1	R3	RES., 40.2k, 0.5%, 1/16W, 0603, METAL THIN FILM	SUSUMU, RR0816P-4022-D-59C
9	1	R4	RES., 26.4k, 0.5%, 1/10W, 0603, THIN FILM	YAGEO, RT0603DRE0726K4L
10	1	R5	RES., 15k, 0.5%, 1/10W, 0603	VISHAY, CRCW060326K4FKEA
11	1	R6	RES., 15k, 1%, 1/10W, 0603	NIC, NRC06F1502TRF
12	1	R7	RES., 90.9k, 1%, 1/10W, 0603, AEC-Q200	VISHAY, CRCW060390K9FKEA
13	1	R8	RES., 15k, 5%, 1/10W, 0603	YAGEO, RC0603JR-0715KL
14	1	R9	RES., 20Ω, 1%, 1/10W, 0603	YAGEO, RC0603FR-0720RL
15	1	R11	RES., 150k, 1%, 1/10W, 0603	PANASONIC, ERJ3EKF1503V
16	1	R13	RES., 150k, 5%, 1/10W, 0603, AEC-Q200	PANASONIC, ERJ3GEYJ154V
17	2	TP1, TP2	TESTPOINT, PCB COPPER FEATURE	N/A, N/A
18	1	U1	IC, BUCK BOOST POWER µMODULE, 25-PIN LGA	ANALOG DEVICES, LTM4693EV#PBF
Additional Demo Board Circuit Components				
1	0	C10, C11	CAP., OPTION, 1210	
2	0	C15, C16, C18	CAP., OPTION, 0603	
3	0	R1, R10, R12	RES., OPTION, 0603	
Hardware: For Demo Board Only				
1	7	E1, E2, E7-E11	TEST POINT, TURRET, 0.094" MTG. HOLE, PCB 0.062" THK	MILL-MAX, 2501-2-00-80-00-00-07-0
2	4	E3-E6	CONN., BANANA JACK, FEMALE, THT, NON-INSULATED, SWAGE, 0.218”	KEYSTONE, 575-4
3	5	JP1-JP5	CONN., HDR, MALE, 1x2, 2mm, VERT, ST, THT	SULLINS CONNECTOR SOLUTIONS, NRPN021PAEN-RC
4	1	JP6	CONN., HDR, MALE, 2x3, 2mm, VERT, ST, THT	SULLINS CONNECTOR SOLUTIONS, NRPN032PAEN-RC
5	1	JP7	CONN., HDR, MALE, 1x3, 2mm, VERT, ST, THT, NO SUBS. ALLOWED	SAMTEC, TMM-103-02-L-S
6	4	MP5-MP8	STANDOFF, NYLON, SNAP-ON, 0.25" (6.4mm)	KEYSTONE, 8831
7	3	XJP1-XJP3	CONN., SHUNT, FEMALE, 2-POS, 2mm	SAMTEC, 2SN-BK-G

SCHEMATIC DIAGRAM



Rev. 0

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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