

# LTM4623

## Tiny 2A DC/DC Inverting Buck-Boost µModule Regulator

### DESCRIPTION

Demonstration circuit 2721A-A features the [LTM®4623](#) µModule® regulator, a tiny high performance high efficiency step-down regulator configured as an inverting buck-boost regulator. The DC2721A-A has an operating input voltage range of 4V to 15V and is able to provide an output current of up to 2A. The output voltage can be programmed between -0.6V and -5.5V. The LTM4623 is a complete DC/DC point of load regulator in a thermally

enhanced 6.25mm × 6.25mm × 1.82mm LGA package requiring only a few input and output capacitors. The LTM4623 data sheet must be read in conjunction with this demo manual for working on or modifying demo circuit 2721A-A.

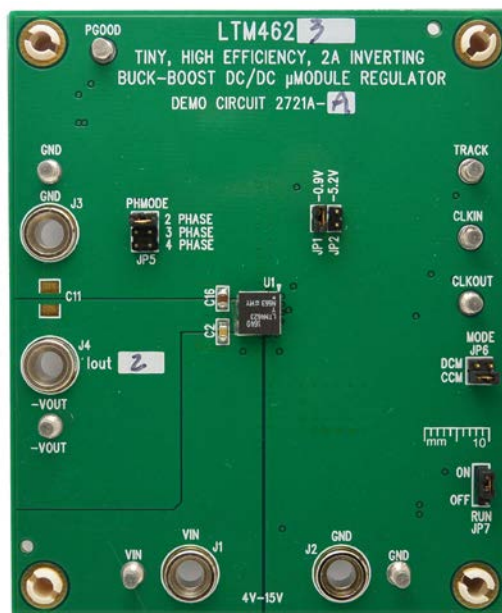
[Design files for this circuit board are available.](#)

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### PERFORMANCE SUMMARY Specifications are at T<sub>A</sub> = 25°C

PARAMETER	CONDITIONS/NOTES	VALUE
Input Voltage Range		4V to 15V
Output Voltage V <sub>OUT</sub>	Jumper Selectable	-0.9V <sub>DC</sub> , -5.2V <sub>DC</sub>
Maximum Continuous Output Current	Derating is Necessary for Certain Operating Conditions. See Data Sheet for Details	2A <sub>DC</sub>
Default Operating Frequency		1MHz
Efficiency	V <sub>IN</sub> = 12V, V <sub>OUT</sub> = -2.5V, I <sub>OUT</sub> = 2A	84% See Figure 2

### BOARD PHOTO



### QUICK START PROCEDURE

Demonstration circuit 2721A-A is an easy way to evaluate the performance of the LTM4623. Please refer to Figure 1 for test setup connections and follow the procedure below.

1. With power off, place the jumpers in the following positions for a typical  $-0.9V_{OUT}$  application:

JP7	JP5	JP1
RUN	MODE	$V_{OUT}$ Select
ON	CCM	-0.9V

2. Before connecting input supply, load and meters, pre-set the input voltage supply to be between 4V to 15V. Preset the load current to 0A.
3. With power off, connect the load, input voltage supply and meters as shown in Figure 1.
4. Turn on input power supply. The output voltage meter should display the selected output voltage  $\pm 2\%$ .
5. Once the proper output voltage is established, adjust the load current within the 0A to 2A range and observe the load regulation, efficiency, and other parameters. Output voltage ripple should be measured across C12 with a BNC cable terminated into  $50\Omega$  and an oscilloscope.
6. To observe increased light load efficiency place the mode pin jumper (JP5) in the DCM position.
7. Level shifting circuits are provided for PGOOD, CLKIN and RUN signals. The CLKIN turret E6 can be connected to a ground referenced clock with amplitude up to 3.3V for optional external clock synchronization. The PGOOD turret E8 provides a ground referenced 3.3V PGOOD signal.
8. Note that CLKOUT and TRACK signals are not level shifted, these signals are referenced to  $-V_{OUT}$ . If ground referenced CLKOUT output and TRACK input signals are desired, external level shifting circuits for these pins are necessary.

## QUICK START PROCEDURE

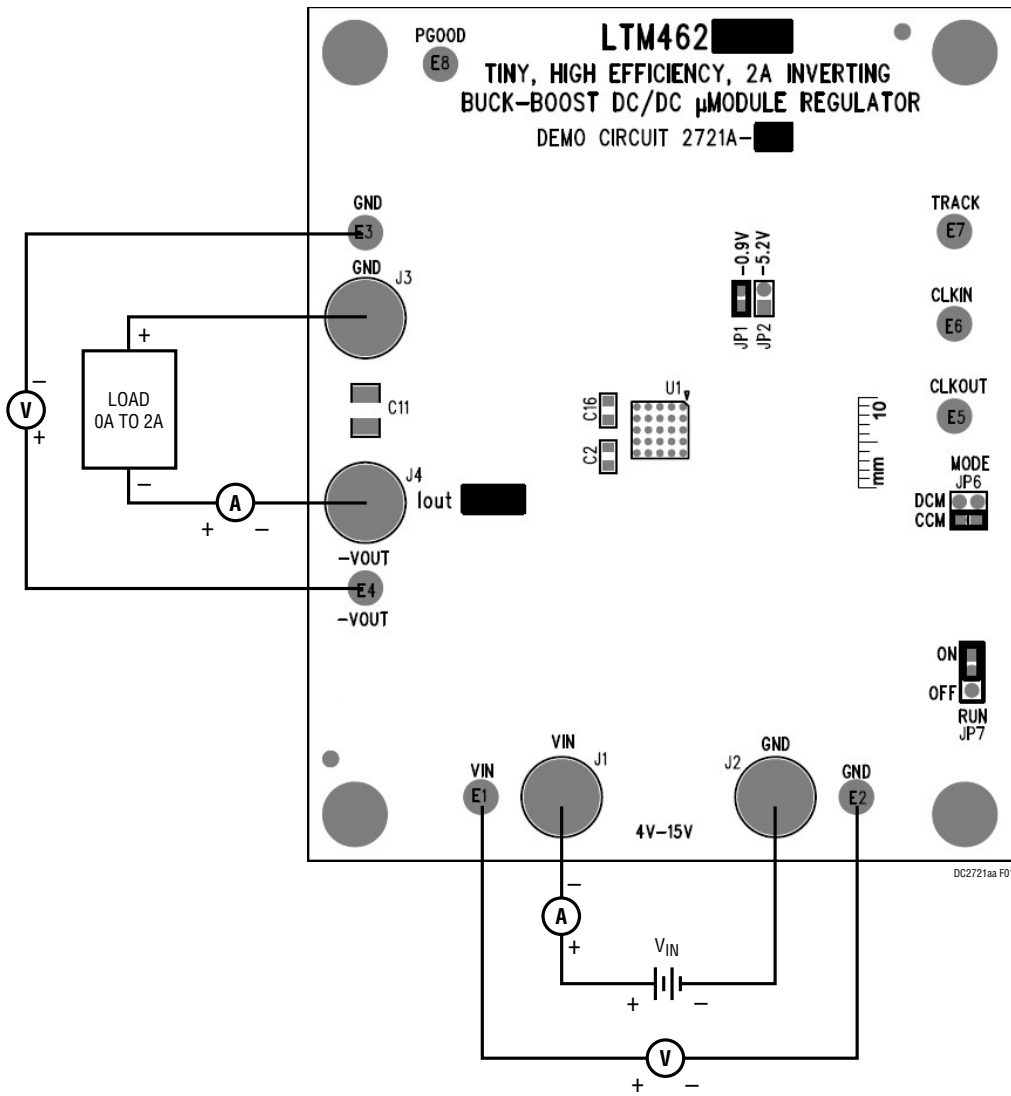


Figure 1. Test Setup

### QUICK START PROCEDURE

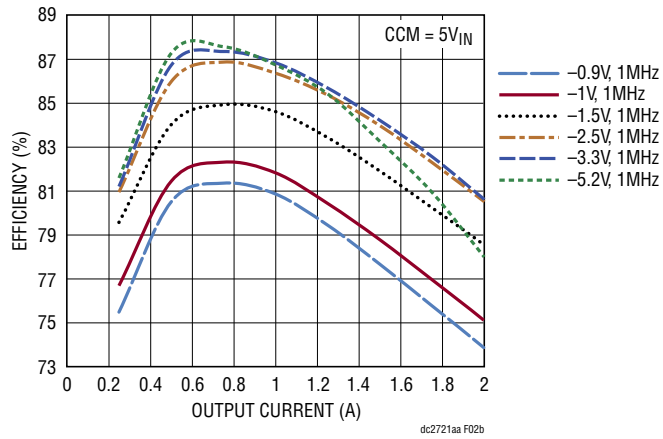
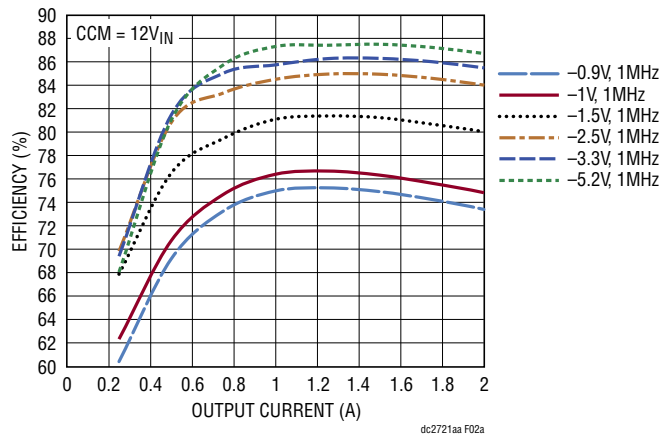
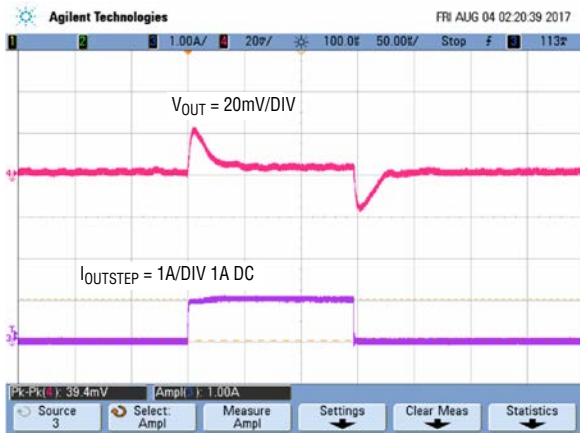


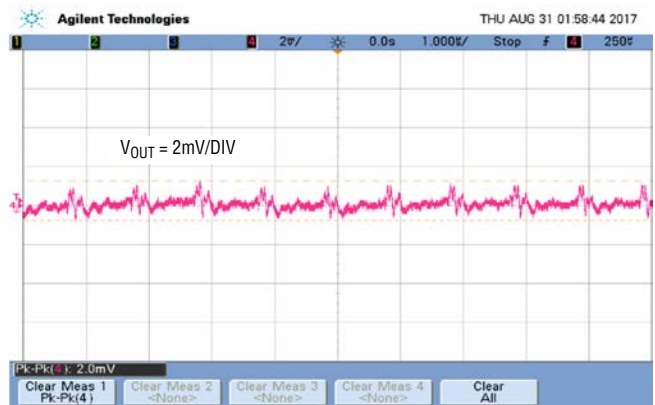
Figure 2. Measured Supply Efficiency at 12V<sub>IN</sub> and 5V<sub>IN</sub>

## QUICK START PROCEDURE



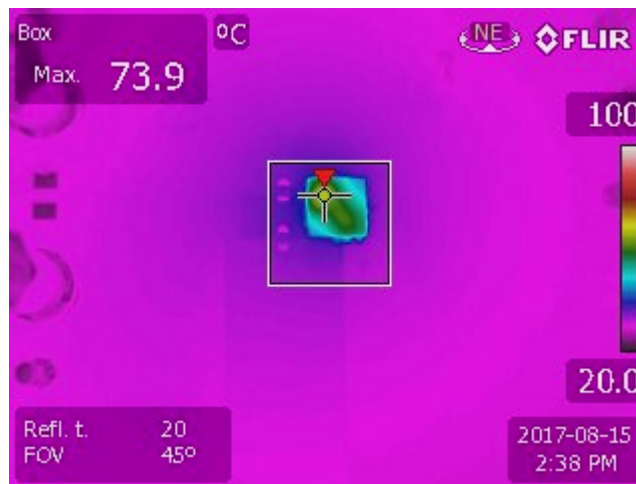
$V_{IN}$ (V)	$V_{OUT}$ (V)	$C_{OUT}$
12	-0.9	$1 \times 100\mu\text{F}/6.3\text{V} +$ $1 \times 22\mu\text{F}/6.3\text{V} +$ $1 \times 47\mu\text{F}/6.3\text{V}$

Figure 3. Measured Load Transient Response (1A to 2A Load Step)



$V_{IN}$ (V)	$V_{OUT}$ (V)	$I_{OUT}$ (A)	$C_{OUT}$
12	-0.9	2	$1 \times 100\mu\text{F}/6.3\text{V} +$ $1 \times 22\mu\text{F}/6.3\text{V} +$ $1 \times 47\mu\text{F}/6.3\text{V}$

Figure 4. Measured  $V_{OUT}$  Ripple



$V_{IN}$ (V)	$V_{OUT}$ (V)	$I_{LOAD}$ (A)	$f_{SW}$ (MHz)	$T_{AMBIENT}$ (C)	FORCED AIRFLOW (LFM)
12	-5.2	2	1	25	0

Figure 5. Measured Case Temperature

# DEMO MANUAL

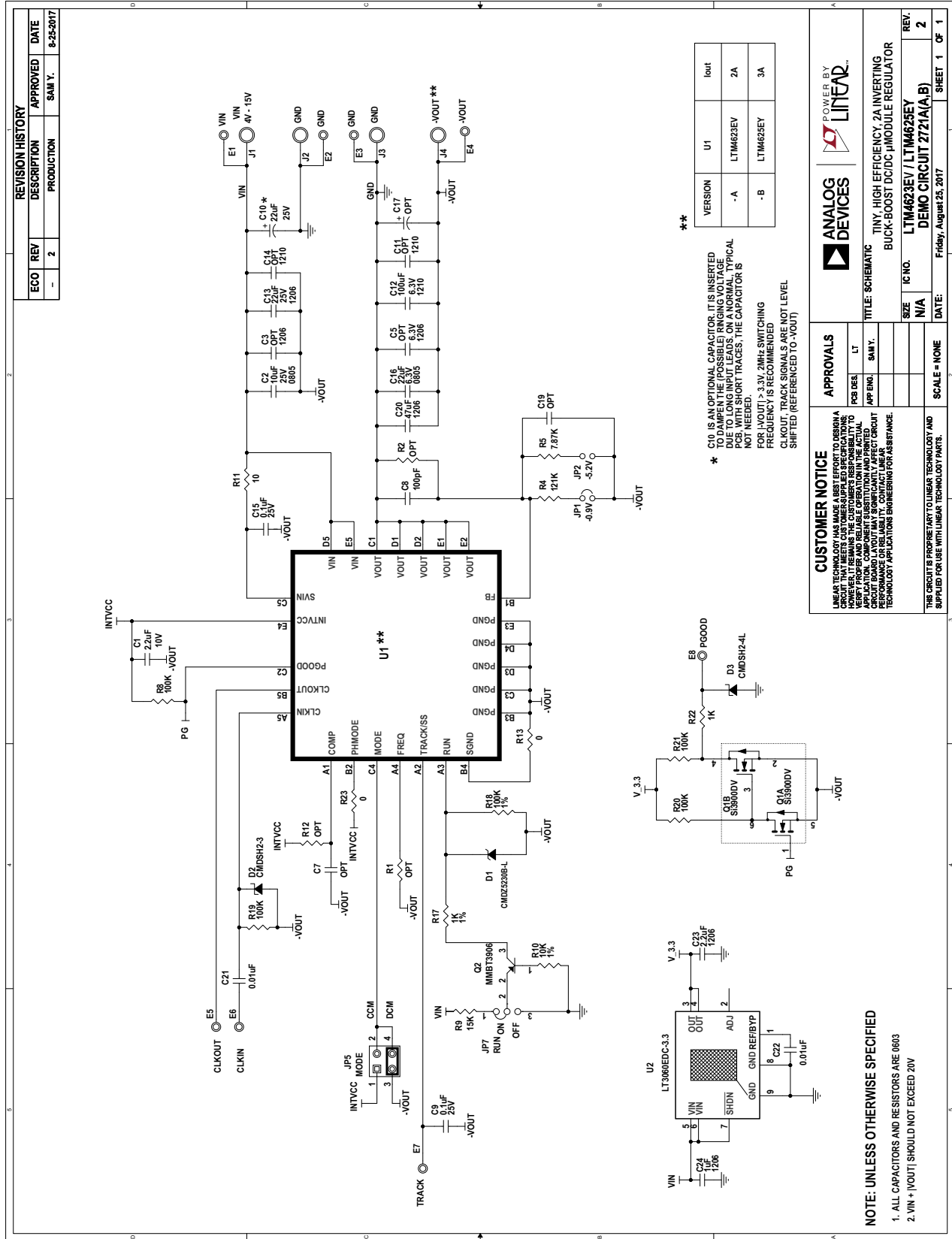
## DC2721A-A

### PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
<b>Required Circuit Components</b>				
1	1	C1	CAP., 2.2uF, X5R, 10V, 10%, 0603	MURATA, GRM188R61A225KE34D
2	1	C2	CAP., 10uF, X5R, 25V, 10%, 0805	AVX, 08053D106KAT2A
3	1	C12	CAP., 100uF, X5R, 6.3V, 20%,1210	MURATA, GRM32ER60J107ME20L
4	1	C16	CAP., 22uF, X5R, 6.3V, 20%, 0805	TDK, C2012X5R0J226M125AC
5	1	C20	CAP., 47uF, X5R, 6.3V, 20%,1206	TDK, C3216X5R0J476M160AC
6	1	R4	RES., 121k, 1/10W, 1%, 0603	VISHAY, CRCW0603121KFKEA
7	1	U1	I.C., STEP-DOWN $\mu$ MODULE REGULATOR, LGA-25	ANALOG DEVICES, LTM4623EV#PBF
<b>Additional Demo Board Circuit Components</b>				
1	0	C3,C5 (OPT)	CAP., OPTION, 1206	OPT
2	0	C7,C19 (OPT)	CAP., OPTION, 0603	OPT
3	1	C8	CAP., 100pF, X7R, 50V, 10%, 0603	AVX, 06035C101KAT2A
4	2	C9,C15	CAP., 0.1uF, X5R, 25V, 10%, 0603	AVX, 06033D104KAT2A
5	1	C10	CAP., 22uF, TANT. POLY., 25V, 20%, 7343	PANSONIC, 25TQC22MV
6	0	C11,C14 (OPT)	CAP., OPTION, 1210	OPT
7	1	C13	CAP., 22uF, X5R, 16V, 10%, 1206	MURATA, GRM31CR61C226ME15L
7	1	C23	CAP., 2.2uF, X5R, 10V, 10%,1206	AVX, 1206ZD225KAT2A
7	1	C24	CAP., 1uF, X7R, 25V, 10%,1206	AVX, 12063C105KAT2A
8	0	C17 (OPT)	CAP., OPTION, 7343	OPT
9	2	C21,C22	CAP., 0.01uF, X7R, 16V, 10%, 0603	AVX, 0603YC103KAT2A
10	1	D1	DIODE, ZENER, SOD323	CENTRAL SEMI., CMDZ5230B-L
11	1	D2	DIODE, SCHOTTKY, SOD323	CENTRAL SEMI., CMDSH2-3
12	1	D3	DIODE, SCHOTTKY, SOD323	CENTRAL SEMI., CMDSH2-4L
13	1	Q1	XSTR., MOSFET, N-CHAN., 20V, TSOP-6	VISHAY, SI3900DV-T1-GE3
14	1	Q2	XSTR., PNP 40V 0.2A SOT-23	ON SEMI., MMBT3906LT1G
15	0	R1,R2,R12 (OPT)	CAP., OPTION, 0603	OPT
16	1	R5	RES., 7.87k, 1/10W, 1%, 0603	VISHAY, CRCW06037K87FKEA
17	5	R8,R18,R19,R20,R21	RES., 100k, 1/10W, 1%, 0603	VISHAY, CRCW0603100KFKEA
18	1	R9	RES., 15k, 1/10W, 1%, 0603	VISHAY, CRCW060315KFOKEA
19	1	R10	RES., 10k, 1/10W, 1%, 0603	VISHAY, CRCW060310KOFKEA
20	1	R11	RES., 10 OHMS, 1/10W, 1%, 0603	VISHAY, CRCW060310R0FKEA
21	2	R13,R23	RES., 0 OHM, 1/10W, 0603	VISHAY, CRCW06030000Z0EA
22	2	R17,R22	RES., 1k, 1/10W, 1%, 0603	VISHAY, CRCW06031K0FKEA
23	1	U2	IC, REG LDO 3.3V 0.1A DFN8	ANALOG DEVICES, LT3060EDC-3.3#TRPBF
<b>Hardware: For Demo Board Only</b>				
1	8	E1,E2,E3,E4,E5,E6,E7,E8	TEST POINT, TURRET, 0.094", MTG. HOLE	MILL MAX 2501-2-00-80-00-00-07-0
2	2	JP1,JP2	CONN., HEADER, 1X2, 2mm	WURTH ELEKTRONIK, 62000211121
3	1	JP5	CONN., HEADER, 2X2, 2mm	WURTH ELEKTRONIK, 62000421121
4	1	JP7	CONN., HEADER, 1X3, 2mm	WURTH ELEKTRONIK, 62000311121
5	4	XJP1,XJP5,XJP6,XJP7	CONN., SHUNT, FEMALE, 2 POS, 2mm	WURTH ELEKTRONIK, 60800213421
6	4	J1,J2,J3,J4	CONN., BANANA JACK, FEMALE, THT, NON-INSULATED, SWAGE, 0.218"	KEYSTONE, 575-4
7	4	MH1,MH2,MH3,MH4	STANDOFF, NYLON, SNAP-ON , 0.375"	KEYSTONE, 8832

Rev.A

## SCHEMATIC DIAGRAM



REVISION HISTORY			
ECO	REV	DESCRIPTION	DATE
-	2	PRODUCTION	8-25-2017

VERSION	U1	Iout
-A	LTM4623EV	2A
-B	LTM4625EV	3A

\*\* C10 IS AN OPTIONAL CAPACITOR. IT IS INSERTED AT THE BOARD LEVEL TO IMPROVE THE REGULATOR'S LOAD REGULATION. DUE TO LONG INPUT LEADS, ON A NORMAL TYPICAL PCB, WITH SHORT TRACES, THE CAPACITOR IS NOT NEEDED.  
FOR I<sub>OUT</sub> > 3.3V, 2MHz SWITCHING FREQUENCY IS RECOMMENDED  
CLKOUT, TRACK SIGNALS ARE NOT LEVEL SHIFTED (REFERRED TO -VOUT)

**CUSTOMER NOTICE**  
LINEAR TECHNOLOGY HAS MADE A BEST EFFORT TO DESIGN A CIRCUIT THAT MEETS CUSTOMER-SUPPLIED SPECIFICATIONS. HOWEVER, CUSTOMERS SHOULD VERIFY PROPER AND RELIABLE OPERATION IN THE ACTUAL APPLICATION. LINEAR TECHNOLOGY DOES NOT WARRANT ANY EFFECT ON CIRCUIT PERFORMANCE OR RELIABILITY. CONTACT LINEAR TECHNOLOGY APPLICATIONS ENGINEERING FOR ASSISTANCE.

**APPROVALS**

DESIGN	LT
APP ENGR	SAM Y.

SCALE = NONE

DATE: Friday, August 25, 2017

SHEET 1 OF 1

ANALOG DEVICES  
POWER BY  
LINFAR™

TITLE: SCHEMATIC  
BUCK-BOOST DC/DC MODULE REGULATOR  
REV. 2  
LTM4623EV / LTM4625EV  
DEMO CIRCUIT 2721(A,B)

**NOTE: UNLESS OTHERWISE SPECIFIED**  
1. ALL CAPACITORS AND RESISTORS ARE 0603  
2. VIN + |VOUT| SHOULD NOT EXCEED 20V

# DEMO MANUAL

## DC2721A-A

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### 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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Rev.A