

# LTC3622EMSE

## 17V, Dual 1A Synchronous Step-Down Regulator with Ultralow Quiescent Current

### DESCRIPTION

Demonstration circuit 2004A is a synchronous step-down regulator using the power-saving **LTC<sup>®</sup>3622EMSE** monolithic buck regulator in a 16-lead MSE package. The DC2004A operates from an input voltage range of 2.7V to 17V and provides dual 1A outputs with adjustable output voltage range from 1.2V to 5V. The LTC3622 IC quiescent current can be as low as 5 $\mu$ A in Burst Mode<sup>®</sup> operation with both channels enabled and less than 0.1 $\mu$ A in shut-down mode. The switching frequency is fixed to 1MHz or 2.25MHz with a  $\pm$ 50% synchronization range to an external clock. A user-selectable mode input is provided to allow the user to trade off ripple noise for light load efficiency.

Burst Mode operation provides the highest efficiency at light loads, while pulse-skipping mode provides the lowest ripple noise.

It is recommended to read the data sheet LTC3622 with this demo manual prior to working on or making any changes to DC2004A.

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

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

PARAMETER	CONDITIONS	VALUE
Default IC		LTC3622EMSE
Default Switching Frequency		1MHz
Default Operation Mode		Burst Mode Operation
Input Voltage Range		2.7V to 17V
Onboard User Selectable Output Voltages	V <sub>IN</sub> = 2.7V to 17V, I <sub>OUT1</sub> = I <sub>OUT2</sub> = 0A to 1A (V <sub>OUT</sub> ≤ V <sub>IN</sub> )	V <sub>OUT1</sub> : 1.2V, 1.8V, 2.5V V <sub>OUT2</sub> : 3.3V, 5.0V
Default Output Voltage		V <sub>OUT1</sub> = 2.5V V <sub>OUT2</sub> = 3.3V
Per Channel Maximum Continuous Output Current	V <sub>IN</sub> = 2.7V to 17V	I <sub>OUT1</sub> = I <sub>OUT2</sub> = 1A
Efficiency, V <sub>OUT1</sub>	V <sub>IN</sub> = 12V, V <sub>OUT1</sub> = 2.5V, I <sub>OUT1</sub> = 1A	85.7% (See Figure 3)
Efficiency, V <sub>OUT2</sub>	V <sub>IN</sub> = 12V, V <sub>OUT2</sub> = 3.3V, I <sub>OUT2</sub> = 1A	87.9% (See Figure 4)
Output Voltage Ripple, V <sub>OUT1</sub>	V <sub>IN</sub> = 12V, V <sub>OUT1</sub> = 2.5V, I <sub>OUT1</sub> = 1A	<4.7mV <sub>p-p</sub> (See Figure 5)
Output Voltage Ripple, V <sub>OUT2</sub>	V <sub>IN</sub> = 12V, V <sub>OUT2</sub> = 3.3V, I <sub>OUT2</sub> = 1A	<5.3mV <sub>p-p</sub> (See Figure 6)
Load Transient Response, V <sub>OUT1</sub>	V <sub>IN</sub> = 12V, V <sub>OUT1</sub> = 2.5V, I <sub>OUT1</sub> = 100mA to 1A	See Figure 7
Load Transient Response, V <sub>OUT2</sub>	V <sub>IN</sub> = 12V, V <sub>OUT2</sub> = 3.3V, I <sub>OUT2</sub> = 100mA to 1A	See Figure 8
Thermal Image	V <sub>IN</sub> = 12V, V <sub>OUT1</sub> = 2.5V, V <sub>OUT2</sub> = 3.3V, I <sub>OUT1</sub> = I <sub>OUT2</sub> = 1A, T <sub>A</sub> = 25°C	See Figure 9

## QUICK START PROCEDURE

Demonstration circuit 2004A is easy to set up to evaluate the performance of the LTC3622. Please refer to Figure 1 for proper measurement equipment setup and follow the procedure below:

- Place jumpers in the following positions:

**Table 1. Jumper Selection**

JP1	JP2	JP3	JP4	JP5
RUN1	RUN2	MODE/SYNC	PHASE	ILIM
ON	ON	BURST	180°	1A

- Place VO1 SELECT jumper in 2.5V position (JP8) and VO2 SELECT jumper in 3.3V position (JP10).
- With power off, connect the input power supply at VIN1 and GND.
- Connect the Loads between VOUT1 and GND, VOUT2 and GND. Preset the loads to 0A.
- Connect the DMMs to the input and output to monitor the input voltage and output voltages.
- Turn on the power supply at the input. The RUN1 and RUN2 pin jumpers should be at ON position. Measure and make sure the input supply voltage is 12V. The output voltage VOUT1 should be  $2.5V \pm 1\%$ , and VOUT2 should be  $3.3V \pm 1\%$ .
- Once the input and output voltages are properly established adjust the loads within the operating range (0A to 1A max) and observe the output voltage regulations, output ripple voltages, switch node waveforms and other parameters. Refer to Figure 2 for proper input/output voltage ripple measurement.

- To select other output voltages, use the onboard user selectable output voltage jumpers. Shutting down LTC3622 by placing RUN1 and RUN2 pin jumpers to the OFF position or turn off the input power supply. Refer to the following tables (Table 2 and Table 3) for the output voltage selections and repeat steps 3 to 6.

**Table 2. VOUT1 Jumper Selection**

JP6	JP7	JP8	JP9
1.2V	1.8V	2.5V	*USER SELECT

**Table 3. VOUT2 Jumper Selection**

JP10	JP11	JP12
3.3V	5V	*USER SELECT

\*Note: If JP9 or JP12 is selected, R5 or R15 needs to be calculated and inserted to obtain the desired output voltage.

**Note 1:** To measure the input/output voltage ripple properly, do not use the long ground lead on the oscilloscope probe. See Figure 2 for the proper scope probe technique. Short, stiff leads need to be soldered to the (+) and (-) terminals of an output capacitor. The probe's ground ring needs to touch the (-) lead and the probe tip needs to touch the (+) lead.

**Note 2:** DC2004A can also be used to evaluate LTC3622EMSE-2 (2.25MHz) by simply changing U1 to LTC3622EMSE-2, L1 to 1.0μH (Coilcraft XFL4020-102ME) and L2 to 2.2μH (Coilcraft XFL4020-222ME).

**QUICK START PROCEDURE**

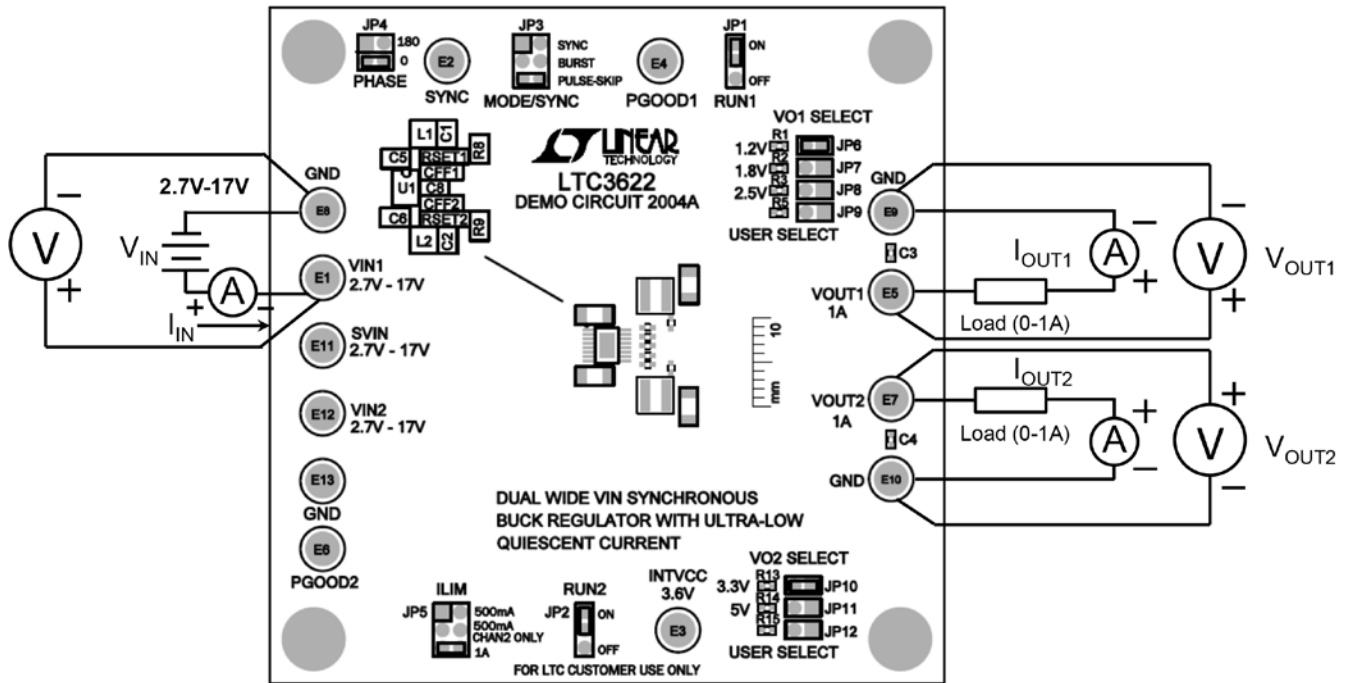


Figure 1. Proper Equipment Measurement Setup

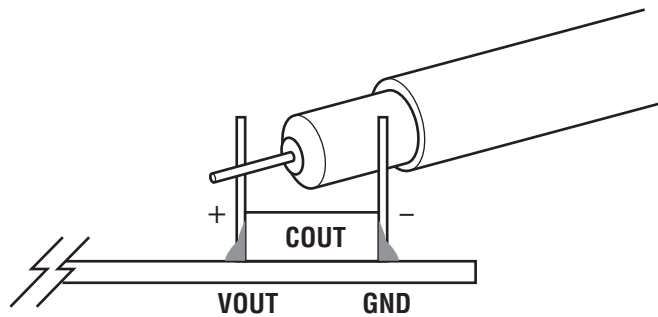


Figure 2. Scope Probe Placements for Measuring Input or Output Ripple

## QUICK START PROCEDURE

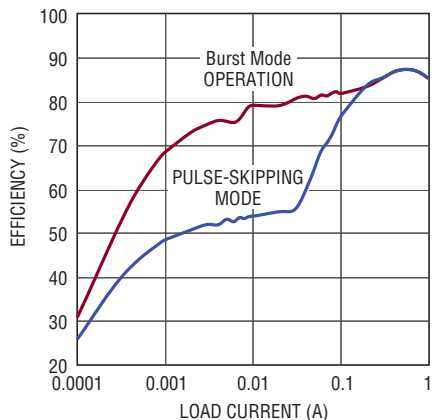


Figure 3.  $V_{OUT1}$  Measured Efficiency at  $V_{IN} = 12V$ ,  $V_{OUT1} = 2.5V$ ,  $L1 = 3.3\mu H$ ,  $f_{SW} = 1MHz$  (with  $V_{OUT2}$  OFF)

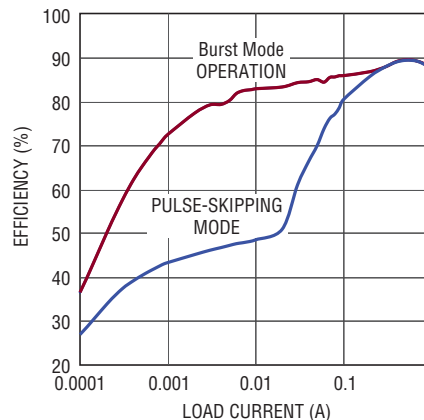


Figure 4.  $V_{OUT2}$  Measured Efficiency at  $V_{IN} = 12V$ ,  $V_{OUT2} = 3.3V$ ,  $L1 = 4.7\mu H$ ,  $f_{SW} = 1MHz$  (with  $V_{OUT1}$  OFF)

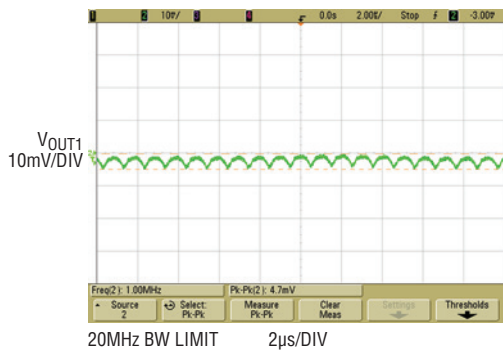


Figure 5.  $V_{OUT1}$  Measured Output Voltage Ripple at  $V_{IN} = 12V$ ,  $V_{OUT1} = 2.5V$ ,  $I_{OUT1} = 1A$ ,  $f_{SW} = 1MHz$

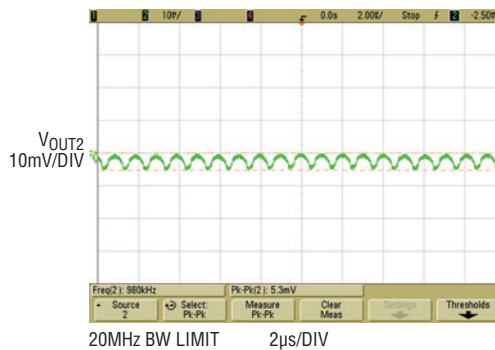
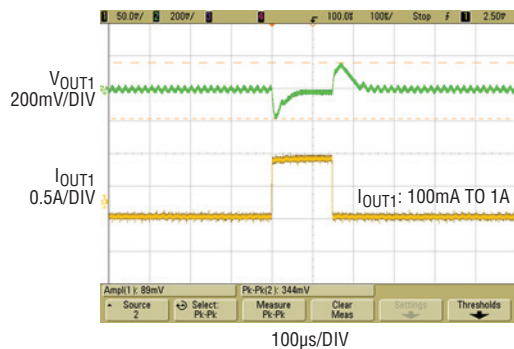
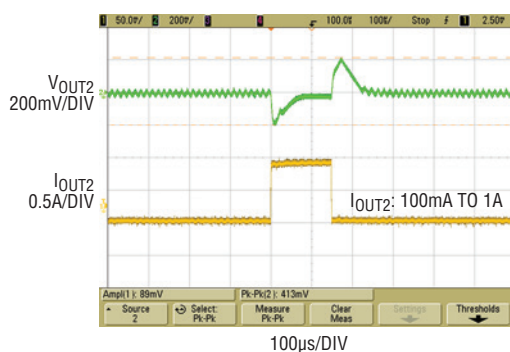


Figure 6.  $V_{OUT2}$  Measured Output Voltage Ripple at  $V_{IN} = 12V$ ,  $V_{OUT2} = 3.3V$ ,  $I_{OUT2} = 1A$ ,  $f_{SW} = 1MHz$

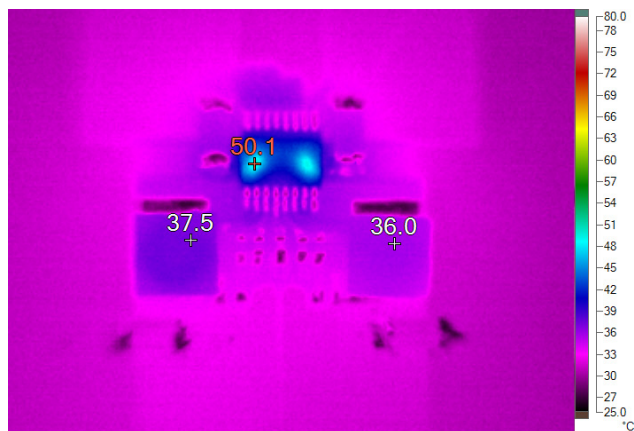
**QUICK START PROCEDURE**



**Figure 7. Load Transient Response at  $V_{IN} = 12V$ ,  $V_{OUT1} = 2.5V$ ,  $I_{OUT1} = 100mA$  to  $1A$ ,  $f_{SW} = 1MHz$ , Burst Mode Operation**



**Figure 8. Load Transient Response at  $V_{IN} = 12V$ ,  $V_{OUT2} = 3.3V$ ,  $I_{OUT2} = 100mA$  to  $1A$ ,  $f_{SW} = 1MHz$ , Burst Mode Operation**



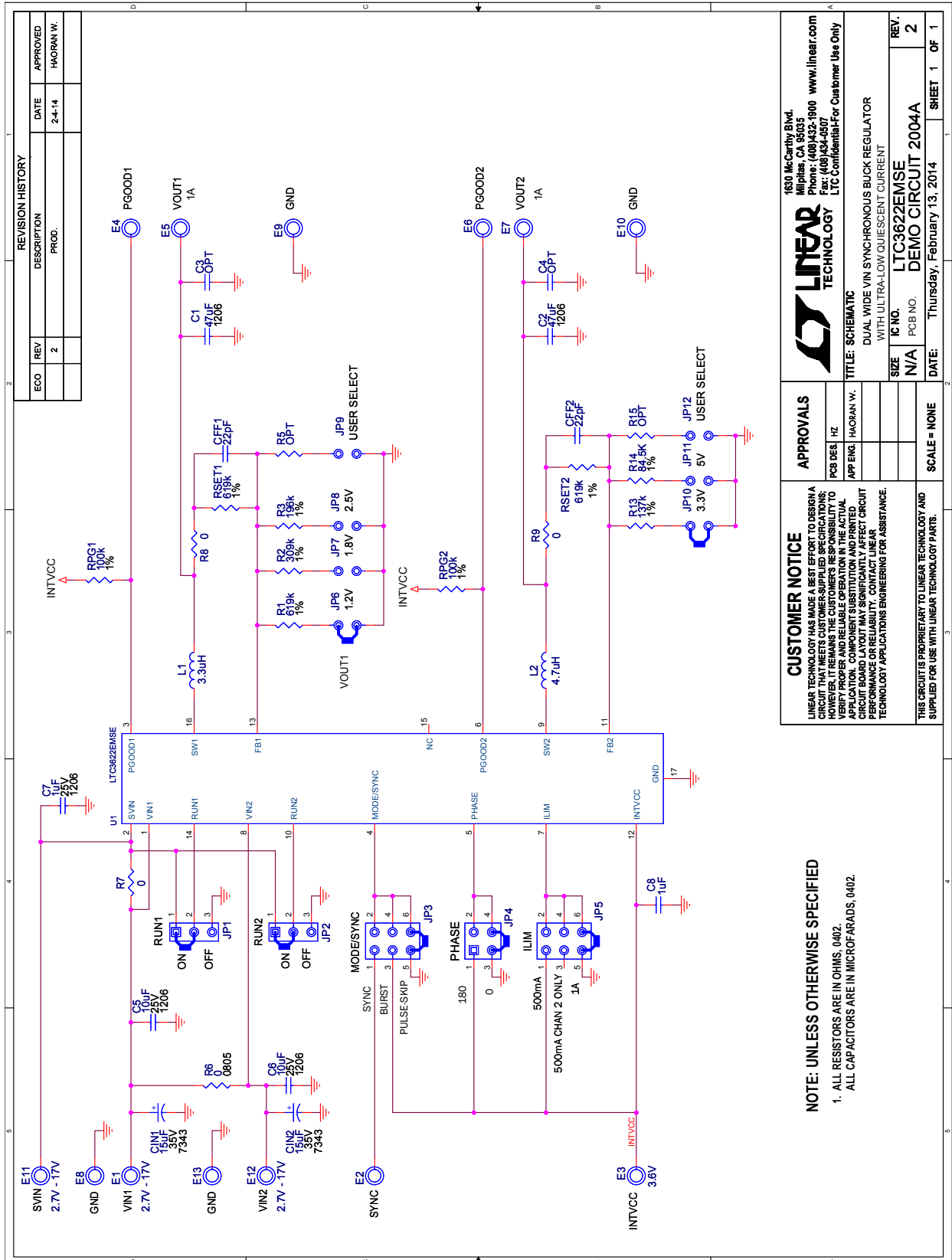
**Figure 9. Thermal Performance at  $V_{IN} = 12V$ ,  $V_{OUT1} = 2.5V$ ,  $I_{OUT1} = 1A$ ,  $V_{OUT2} = 3.3V$ ,  $I_{OUT2} = 1A$ ,  $f_{SW} = 1MHz$ , No Airflow,  $T_A = 25^\circ C$**

# DEMO MANUAL DC2004A

## PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
<b>Required Circuit Components</b>				
1	2	CFF1, CFF2	CAP, 0402 22pF 5% 50V NPO	AVX 04025A220JAT2A
2	2	CIN1, CIN2	CAP, 7343 22µF 20% 35V TANT	AVX TPSY226M035R0200
3	2	C1, C2	CAP, 1206 47µF 20% 16V X5R	TDK C3216X5R1C476M160AB
4	2	C5, C6	CAP, 1206 10µF 20% 25V X5R	TDK C3216X5R1E106M
5	1	C7	CAP, 1206 1.0µF 20% 10V X5R	TDK C3216X5R1A105M
6	1	C8	CAP, 0402 1.0µF 20% 10V X5R	TDK C1005X5R1A105M
7	1	L1	IND, 3.3µH 20%	COILCRAFT XFL4020-332MEC
8	1	L2	IND, 4.7µH 20%	COILCRAFT XFL4020-472MEC
9	2	RPG1, RPG2	RES, 0402 100k 1% 1/16W	VISHAY CRCW0402100KFKED
10	3	RSET1, R1, RSET2	RES, 0402 619k 1% 1/16W	VISHAY CRCW0402619KFKED
11	1	R2	RES, 0402 309k 1% 1/16W	VISHAY CRCW0402309KFKED
12	1	R3	RES, 0402 196k 1% 1/16W	VISHAY CRCW0402196KFKED
13	1	R13	RES, 0402 137k 1% 1/16W	VISHAY CRCW0402137KFKED
14	1	R6	RES, 0805 0Ω JUMPER	VISHAY CRCW08050000Z0EA
15	1	R7	RES, 0603 0Ω JUMPER	VISHAY CRCW06030000Z0EA
16	2	R8, R9	RES, 0402 0Ω 1%	VISHAY, CRCW04020000Z0ED
17	1	R14	RES, 0402 84.5k 1% 1/16W	VISHAY CRCW040284K5FKED
18	1	U1	IC, DUAL SYNCHRONOUS STEP-DOWN CONVERTER	LINEAR TECH LTC3622EMSE
<b>Additional Demo Board Circuit Components</b>				
1	0	C3, C4	CAP, 0402 OPTION	OPTION
2	0	R5, R15	RES, 0402 OPTION	OPTION
<b>Hardware</b>				
1	13	E1, E2, E3, E4, E5, E6, E7, E8, E9, E10, E11, E12, E13	TURRET	MILL-MAX 2501-2-00-80-00-00-07-0
2	2	JP1, JP2	HEADER, 3PIN, 2mm	SULLINS NRPN031PAEN-RC
3	2	JP3, JP5	HEADER, 3PIN, DBL ROW 2mm	SULLINS NRPN032PAEN-RC
4	1	JP4	HEADER, 2mm DBL ROW (2X2) 4PIN	SULLINS, NRPN022PAEN-RC
5	7	JP6, JP7, JP8, JP9, JP10, JP11, JP12	HEADER, 2PIN, 2mm	SULLINS NRPN021PAEN-RC
6	7	XJP1, XJP2, XJP3, XJP4, XJP5, XJP6, XJP10	SHUNT, 2mm	SAMTEC 2SN-BK-G
7	4	MH1, MH2, MH3, MH4	STANDOFF, SNAP ON	KEYSTONE_8831

SCHEMATIC DIAGRAM



REVISION HISTORY		
ECO	REV	DESCRIPTION
	2	
		DATE
		APPROVED
		HAORAN W.

		1630 McCarthy Blvd. Milpitas, CA 95035 Phone: (408) 432-1600 www.linear.com Fax: (408) 634-4507 LTC Confidential For Customer Use Only	
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<b>APPROVALS</b> PCB DES: HZ APP ENG: HAORAN W.		SIZE: N/A IC NO.: LTC3622EMSE PCB NO.: DEMO CIRCUIT 2004A	REV.: 2 SHEET 1 OF 1
THIS CIRCUIT IS PROPRIETARY TO LINEAR TECHNOLOGY AND SUPPLIED FOR USE WITH LINEAR TECHNOLOGY PARTS.		DATE: Thursday, February 13, 2014	

**NOTE: UNLESS OTHERWISE SPECIFIED**  
 1. ALL RESISTORS ARE IN OHMS, 0402.  
 ALL CAPACITORS ARE IN MICROFARADS, 0402.

# DEMO MANUAL DC2004A

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