

LT3081, LT8612, LT3092 24V 3A Constant Voltage, Constant Current Bench Supply

DESCRIPTION

DC2132A is a 24V 3A constant voltage, constant current bench supply. It regulates any output voltage from 0V to 24V and any output current from 0A to 3A. It runs from 10V to 40V input although the output voltage should remain 5V or more below the input voltage.

The LT[®]8612 step-down regulator is followed by two parallel LT[®]3081 linear regulators for a combination of low output ripple, high bandwidth and easy-to-adjust output voltage and current limits. The LT8612 is configured in pulse-skipping operation and its output voltage is regulated to roughly 1.7V above the output voltage of the LT3081. The LT3081 SET and I_{LIM} pins are connected to potentiometers that act as adjustable knobs on the PCB for voltage and current limit respectively.

The LT[®]3092 current source is used to deliver current to power the adjustable resistance of the voltage limit knob (potentiometer). That voltage directly sets the output voltage of the LT3081. The maximum output voltage can be set to three settings: 24V, 15V and 5.5V with the shunt position on JP1. The setting should be changed according to the choice of input voltage. A 36V, 24V, or 12V AC/DC converter can be used to power this supply (as well as any DC voltage between 10V and 40V.) If input voltage limits maximum output voltage, then it is recommended to adjust the maximum output voltage to get the full range of the adjustment knob for best resolution.

DC2132A operates to 0V and 0A. It is short-circuit proof. With very small output capacitance, the short-circuit spike is hundreds of times shorter in duration than commonly used and expensive laboratory bench power supplies. With the LT3081s in parallel on the output of this supply, small output capacitance makes this possible. Only 30μF is needed on the output of each LT3081. The LT3081 provides very low output ripple and short-circuit robustness.

An ON/OFF switch turns the converter and its components on and off. A green indicator LED tells if the circuit is on or not. Two TEMP turrets and an I_{MON} turret provide readouts of the LT3081 IC temperatures and the bench supply output current.

The LT3081, LT8612, and LT3092 data sheets give complete descriptions of the devices, operation and applications information. The data sheet must be read in conjunction with this demo manual for DC2132A. The LT3081ER is assembled in a 7-lead plastic DD (R) package with a thermally enhanced V_{OUT} tab and with $\theta_{JA} = 15^{\circ}\text{C/W}$. Proper board layout is essential for maximum thermal performance. See the the Layout Considerations section in the data sheet.

Design files for this circuit board are available at
<http://www.linear.com/demo/DC2132A>

LT, LT, LTC, LTM, Linear Technology and the Linear logo are registered trademarks of Linear Technology Corporation. All other trademarks are the property of their respective owners.

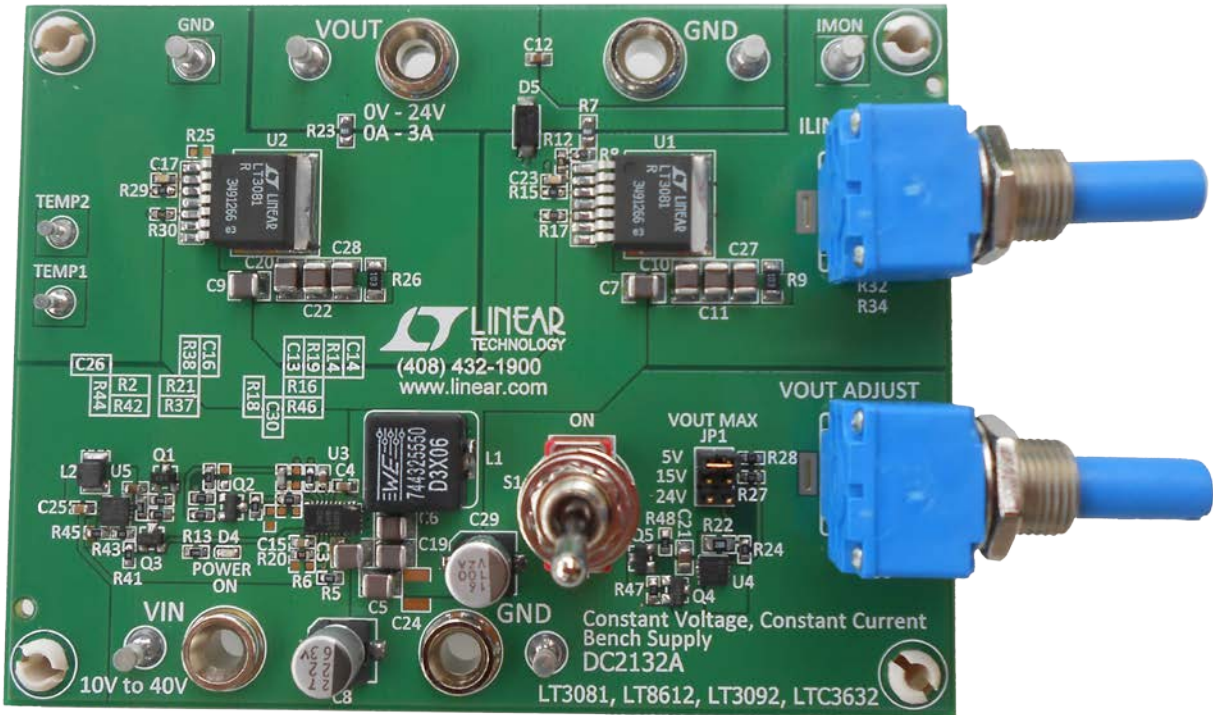
DEMO MANUAL DC2132A

PERFORMANCE SUMMARY

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

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
V_{IN} Input Voltage Range		10		40	V
LT8612 Switching Frequency	$R_{20} = 60.4\text{k}$		700		kHz
V_{OUT} Range (Set by V_{LIMIT})	$V_{IN} = 36\text{V}$, JP1 Set to 24V	0		25	V
I_{OUT} Range (Set by I_{LIMIT})		0		3.1	A
Quiescent Current	$V_{IN} = 36\text{V}$, $V_{OUT} = 24\text{V}$, No Load		31		mA
Typical Efficiency with 3A Output	$V_{IN} = 36\text{V}$, $V_{OUT} = 24\text{V}$		90		%
	$V_{IN} = 12\text{V}$, $V_{OUT} = 5\text{V}$		71		%
	$V_{IN} = 12\text{V}$, $V_{OUT} = 3.3\text{V}$		62		%
LT3081 Input-to-Output Voltage Drop	$R_{37} = 1.00\text{k}$, $R_{21} = R_{38} = 100\text{k}$, $R_{18} = 4.99\text{k}$		1.7		V
V_{OUT} AC Ripple	$V_{IN} = 36\text{V}$, $V_{OUT} = 24\text{V}$, $I_{OUT} = 3.0\text{A}$		~10		mV _{p-p}
Minimum Load		0			mA

BOARD PHOTO



QUICK START PROCEDURE

DC2132A is easy to set up to evaluate the performance of the LT3081 and LT8612. Follow the procedure below:

1. Set the ON/OFF switch to OFF to disable switching.
2. With power off, connect the input power supply to the V_{IN} and GND terminals. Make sure that the V_{IN} DC input voltage will not exceed 40V. Be careful for hot plug transients above 40V.
3. The DC2132A bench supply is robust and can be turned on with or without a load. If the load is too big, DC2132A will limit its output. If there is a short-circuit on the output, DC2132A will run through the short safely and will limit its current to its I_{LIMIT} setting.
4. Observe the output voltage and current as well as the temperature of the ICs.

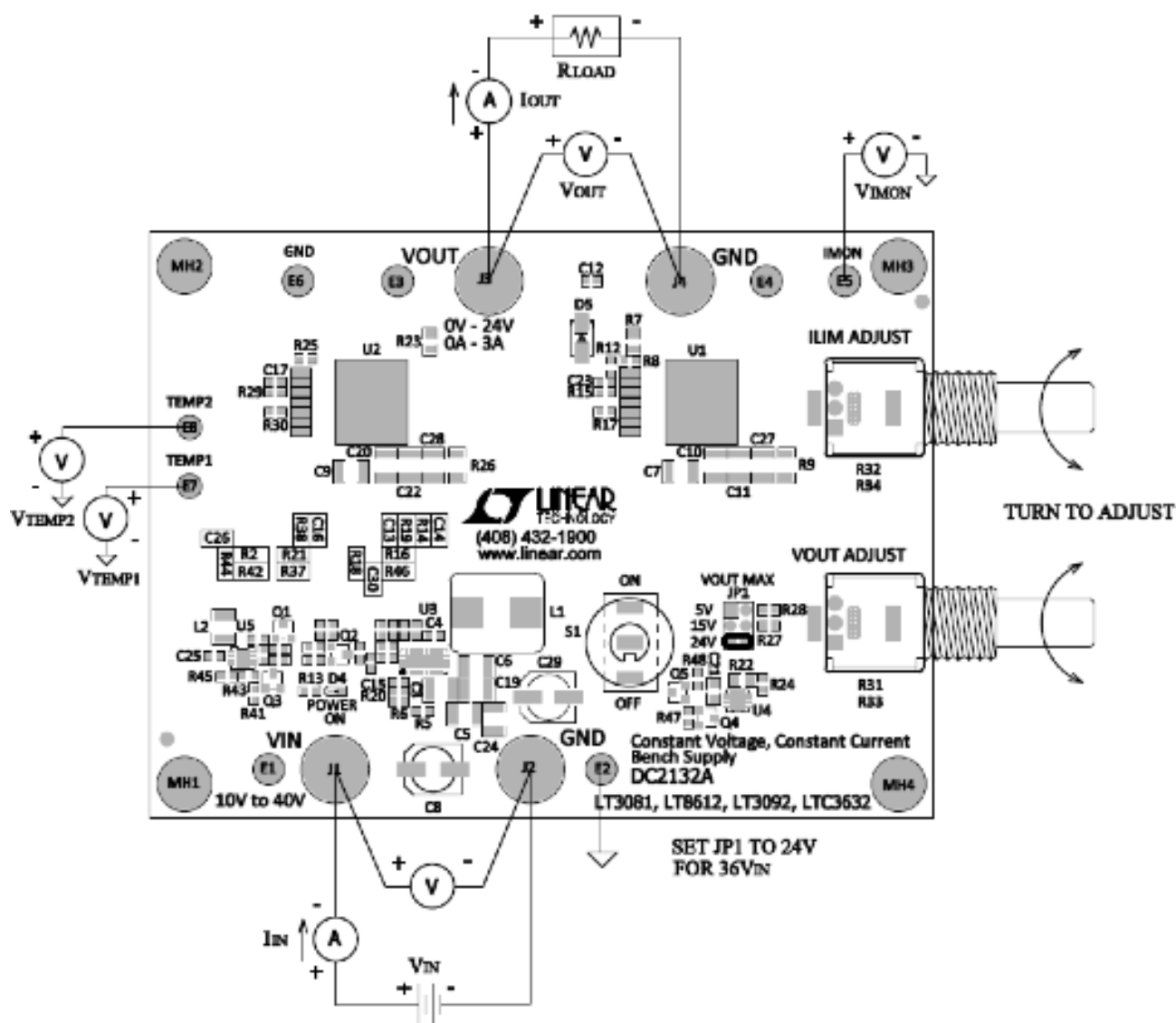


Figure 1. Test Procedure Setup Drawing for DC2132A

QUICK START PROCEDURE

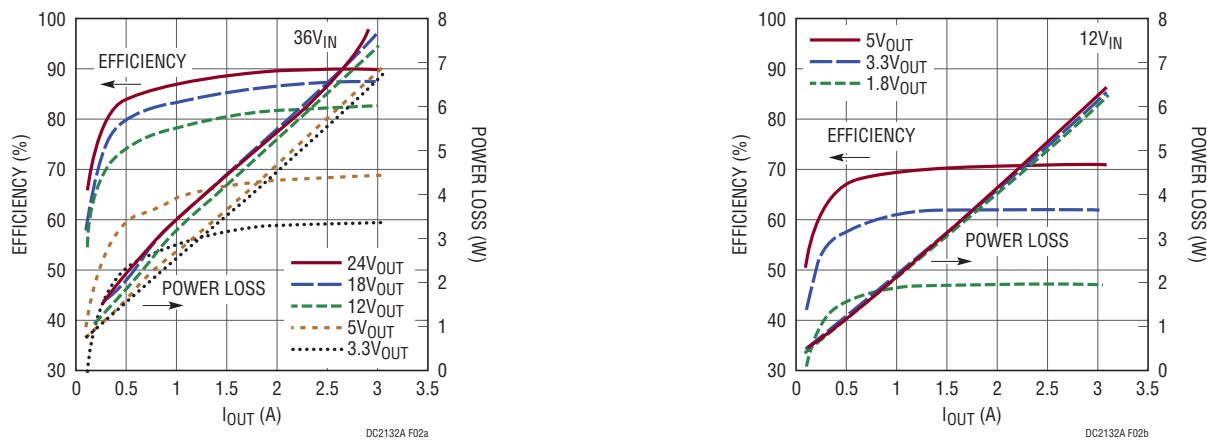


Figure 2. DC2132A Efficiency and Power Loss at Different Voltage and Current

QUICK START PROCEDURE

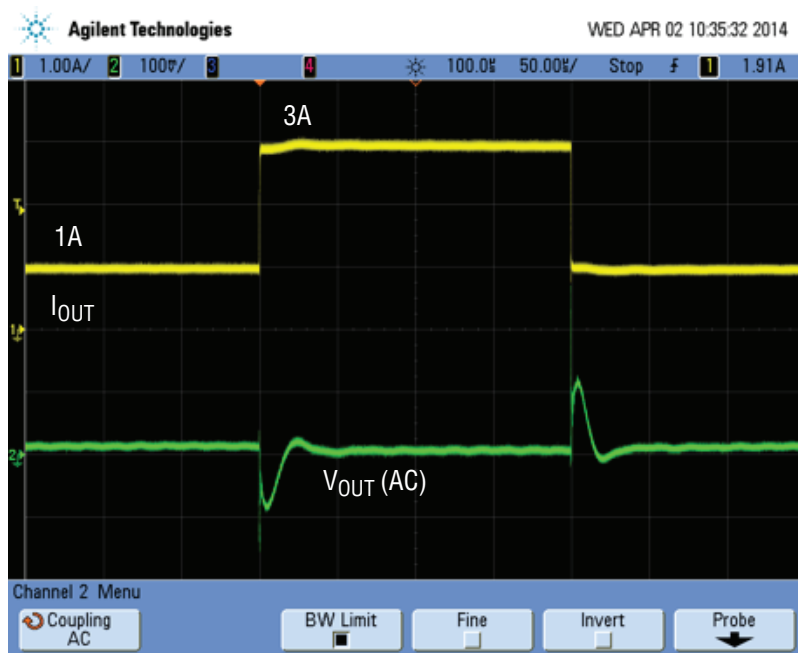


Figure 3. DC2132A 1A to 3A Transient Response 36V_{IN}, 24V_{OUT}

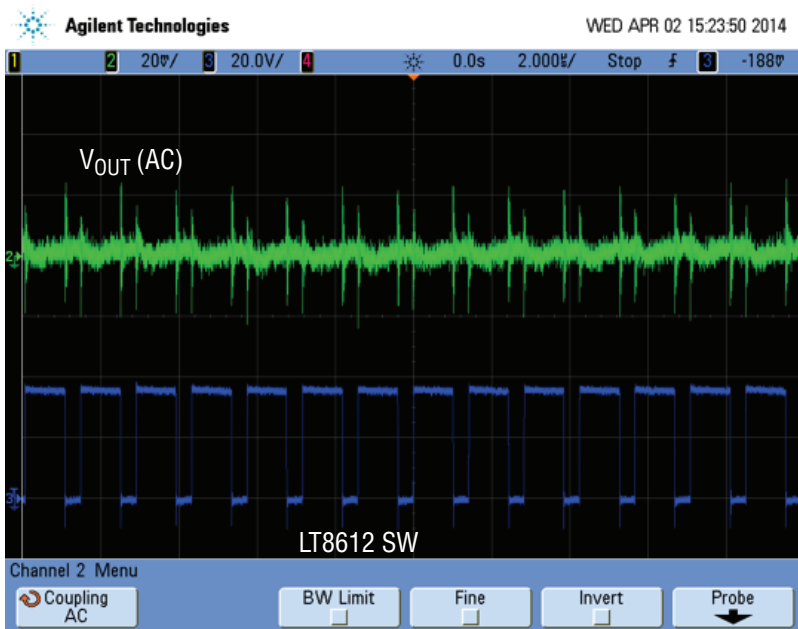


Figure 4. DC2132A Output Voltage Ripple

QUICK START PROCEDURE

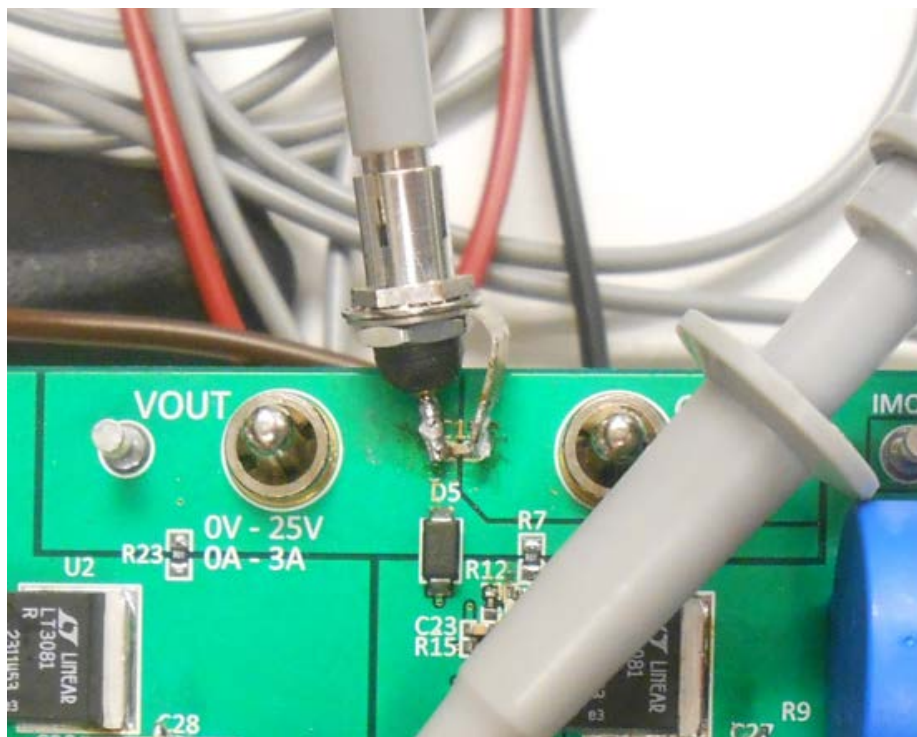
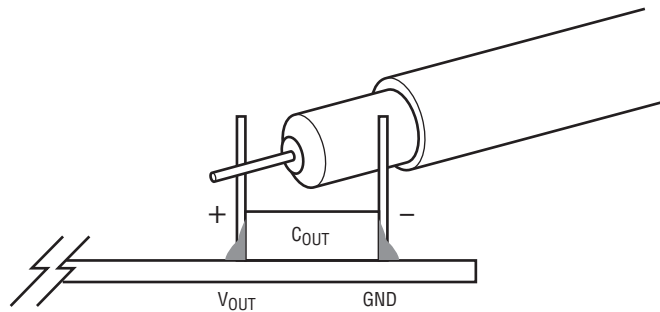


Figure 5. DC2132A Output Voltage Ripple Measurement Method

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	12	C3, C5, C6, C7, C9, C10, C11, C19, C20, C22, C27, C28	CAP., X5R 10µF 50V 20% 1210	TAIYO YUDEN UMK325BJ106MM-T
2	1	C4	CAP., X5R 0.1µF 50V 10% 0603	TDK C1608X5R1H104K
3	1	C12	CAP., X5R 1µF 50V 10% 0603	TDK C1608X5R1H105K
4	1	C13	CAP., NPO 1nF 25V 5% 0603	AVX 06033A102JAT2A
5	1	C14	CAP., X5R 1µF 25V 10% 0603	TDK C1608X5R1E105K
6	1	C15	CAP., X7R 0.1µF 25V 10% 0603	AVX 06033C104KAT2A
7	2	C17, C23	CAP., X7R 0.01µF 100V 10% 0603	AVX 06031C103KAT2A
8	1	C21	CAP., X7R 1µF 50V 10% 0805	MURATA GRM21BR71H105KA12L
9	1	C25	CAP., X7R 1µF 16V 10% 0603	MURATA GCM188R71C105KA64L
10	1	C26	CAP., X5R 10µF 6.3V 20% 0603	TDK C1608X5R0J106M
11	1	C29	CAP., ALUM. ELECT. 100µF 35V ±20% F80	NIPPON CHEMI-CON EMZA350ADA101MF80G
12	1	D5	SCHOTTKY DIODE, 1A/40V SMA	DIODES/ZETEX B140-13-F
13	1	L1	INDUCTOR, 5.5µH	WÜRTH ELEKTRONIK 744325550
14	1	L2	INDUCTOR, 470µH ±10% 1210	MURATA LQH32CN471K23L
15	1	Q1	TRANSISTOR, NPN SOT-23	DIODES/ZETEX FMMT493TA
16	2	Q2, Q3	TRANSISTOR, PNP SOT-23	DIODES/ZETEX MMBT3906-7-F
17	1	Q4	MOSFET, SINGLE P-CHANNEL 60V SOT-23	VISHAY SI2309CDS-T1-GE3
18	1	Q5	TRANSISTOR, NPN SOT-23	CENTRAL SEMI. CORP. CMST3904TR
19	1	R2	RES., CHIP 549Ω 0.10W 1% 0603	VISHAY CRCW0603549RFKEA
20	1	R5	RES., CHIP 499k 0.10W 1% 0603	VISHAY CRCW0603499KFKEA
21	1	R6	RES., CHIP 54.9k 0.10W 1% 0603	VISHAY CRCW060354K9FKEA
22	2	R7, R23	RES., 0.010Ω 0.125W 1% 0805	VISHAY WSL0805R0100FEA
23	1	R8	RES., CHIP 3.92k 0.10W 1% 0603	VISHAY CRCW06033K92FKEA
24	2	R9, R26	RES., CHIP 10k 0.25W 5% 1206	VISHAY CRCW120610K0JNED
25	1	R12	RES., CHIP 100Ω 0.10W 1% 0603	VISHAY CRCW0603100RFKEA
26	2	R14, R18	RES., CHIP 4.99k 0.10W 1% 0603	VISHAY CRCW06034K99FKEA
27	3	R15, R29, R37	RES., CHIP 1.00k 0.10W 1% 0603	VISHAY CRCW06031K00FKEA
28	2	R17, R30	RES., CHIP 10.0k 0.10W 1% 0603	VISHAY CRCW060310K0FKEA
29	1	R20	RES., CHIP 60.4k 0.10W 1% 0603	VISHAY CRCW060360K4FKEA
30	2	R21, R38	RES., CHIP 100k 0.10W 1% 0603	VISHAY CRCW0603100KFKEA
31	1	R22	RES., CHIP 200Ω 0.125W 1% 0805	VISHAY CRCW0805200RFKEA
32	1	R24	RES., CHIP 47.5k 0.10W 1% 0603	VISHAY CRCW060347K5FKEA
33	1	R27	RES., CHIP 73.2k 0.10W 1% 0603	VISHAY CRCW060373K2FKEA
34	1	R28	RES., CHIP 11.3k 0.10W 1% 0603	VISHAY CRCW060311K3FKEA
35	1	R31	POT. 1 TURN 10k ±10%	BOURNS 91A1A-B28-A15L
36	1	R32	POT. 1 TURN 5k ±10%	BOURNS 91A1A-B28-A13L
37	1	R41	RES., CHIP 1k 0.10W 5% 0603	VISHAY CRCW06031K00JNEA
38	1	R42	RES., CHIP 1.47M 0.10W 1% 0603	VISHAY CRCW06031M47FKEA
39	1	R43	RES., CHIP 10k 0.10W 5% 0603	VISHAY CRCW060310K0JNEA
40	1	R44	RES., CHIP 280k 0.10W 1% 0603	VISHAY CRCW0603280KFKEA

DEMO MANUAL DC2132A

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
41	1	R45	RES., CHIP 806k 0.10W 1% 0603	VISHAY CRCW0603806KFKEA
42	1	R47	RES., CHIP 5.1k 0.10W 5% 0603	VISHAY CRCW06035K10JNEA
43	1	R48	RES., CHIP 2.7k 0.10W 5% 0603	VISHAY CRCW06032K70JNEA
44	2	U1, U2	I.C., LINEAR REGULATOR DD-R (07) (1462-REV F)	LINEAR TECH. CORP. LT3081ER#PBF
45	1	U3	I.C., REGULATOR QFN (28) (UDE) 3mm × 6mm	LINEAR TECH. CORP. LT8612EUDE#PBF
46	1	U4	I.C., DC/DC CONVERTER DFN (08) (DD) 3mm × 3mm	LINEAR TECH. CORP. LT3092EDD#PBF
47	1	U5	I.C., STEP-DOWN CONVERTER DFN (08) (DD) 3mm × 3mm	LINEAR TECH. CORP. LTC3632EDD#PBF

Optional Circuit Components

1	1	C8	CAP, ALUM 22 μ F 63V 25%	SUN ELECT. IND. 63CE22BS
2	0	C16, C30	OPTIONAL 0603	
3	0	C24	OPTIONAL 1210	
4	1	D4	LED, GRN	OSRAM OPTO SEMI. LG L29K-G2J1-24-Z
5	0	R6, R19, R25, R46	OPTIONAL 0603	
6	1	R13	RES., CHIP 549 Ω 0.10W 1% 0603	VISHAY CRCW0603549RFKEA
7	1	R16	RES./JUMPER, CHIP 0 Ω 0.25W 0603	VISHAY CRCW06030000Z0EA
8	0	R33	OPTIONAL POT. 10 TURNS 10k	BOURNS 3950S-1-103L
9	0	R34	OPTIONAL POT. 10 TURNS 5k	BOURNS 3950S-1-502L

Hardware

1	6	E1, E2, E3, E4, E5, E6	TURRET, TESTPOINT	MILL-MAX 2501-2-00-80-00-00-07-0
2	2	E7, E8	TURRET, TESTPOINT	MILL-MAX 2308-2-00-80-00-00-07-0
3	1	JP1	HEADERS, DBL. ROW 2 × 3 2mm CTRS.	SAMTEC TMM-103-02-L-D
4	4	J1, J2, J3, J4	CONNECTOR, BANANA JACK	KEystone 575-4
5	1	S1	SWITCH TOGGLE, SPDT	PHILMORE, 30-10002B
6	1	XJP1	SHUNT, 2mm CTRS.	SAMTEC 2SN-BK-G



DEMO MANUAL DC2132A

DEMONSTRATION BOARD IMPORTANT NOTICE

Linear Technology Corporation (LTC) provides the enclosed product(s) under the following **AS IS** conditions:

This demonstration board (DEMO BOARD) kit being sold or provided by Linear Technology is intended for use for **ENGINEERING DEVELOPMENT OR EVALUATION PURPOSES ONLY** and is not provided by LTC for commercial use. As such, the DEMO BOARD herein may not be complete in terms of required design-, marketing-, and/or manufacturing-related protective considerations, including but not limited to product safety measures typically found in finished commercial goods. As a prototype, this product does not fall within the scope of the European Union directive on electromagnetic compatibility and therefore may or may not meet the technical requirements of the directive, or other regulations.

If this evaluation kit does not meet the specifications recited in the DEMO BOARD manual the kit may be returned within 30 days from the date of delivery for a full refund. THE FOREGOING WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY THE SELLER TO BUYER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. EXCEPT TO THE EXTENT OF THIS INDEMNITY, NEITHER PARTY SHALL BE LIABLE TO THE OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user releases LTC from all claims arising from the handling or use of the goods. Due to the open construction of the product, it is the user's responsibility to take any and all appropriate precautions with regard to electrostatic discharge. Also be aware that the products herein may not be regulatory compliant or agency certified (FCC, UL, CE, etc.).

No License is granted under any patent right or other intellectual property whatsoever. **LTC assumes no liability for applications assistance, customer product design, software performance, or infringement of patents or any other intellectual property rights of any kind.**

LTC currently services a variety of customers for products around the world, and therefore this transaction **is not exclusive**.

Please read the DEMO BOARD manual prior to handling the product. Persons handling this product must have electronics training and observe good laboratory practice standards. **Common sense is encouraged.**

This notice contains important safety information about temperatures and voltages. For further safety concerns, please contact a LTC application engineer.

Mailing Address:

Linear Technology
1630 McCarthy Blvd.
Milpitas, CA 95035

Copyright © 2004, Linear Technology Corporation

dc2132af