

## 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<sup>®</sup>8612** step-down regulator is followed by two parallel **LT<sup>®</sup>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<sub>LIM</sub> pins are connected to potentiometers that act as adjustable knobs on the PCB for voltage and current limit respectively.

The **LT<sup>®</sup>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<sub>MON</sub> 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<sub>OUT</sub> tab and with  $\theta_{JA} = 15^{\circ}\text{C}/\text{W}$ . 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>**

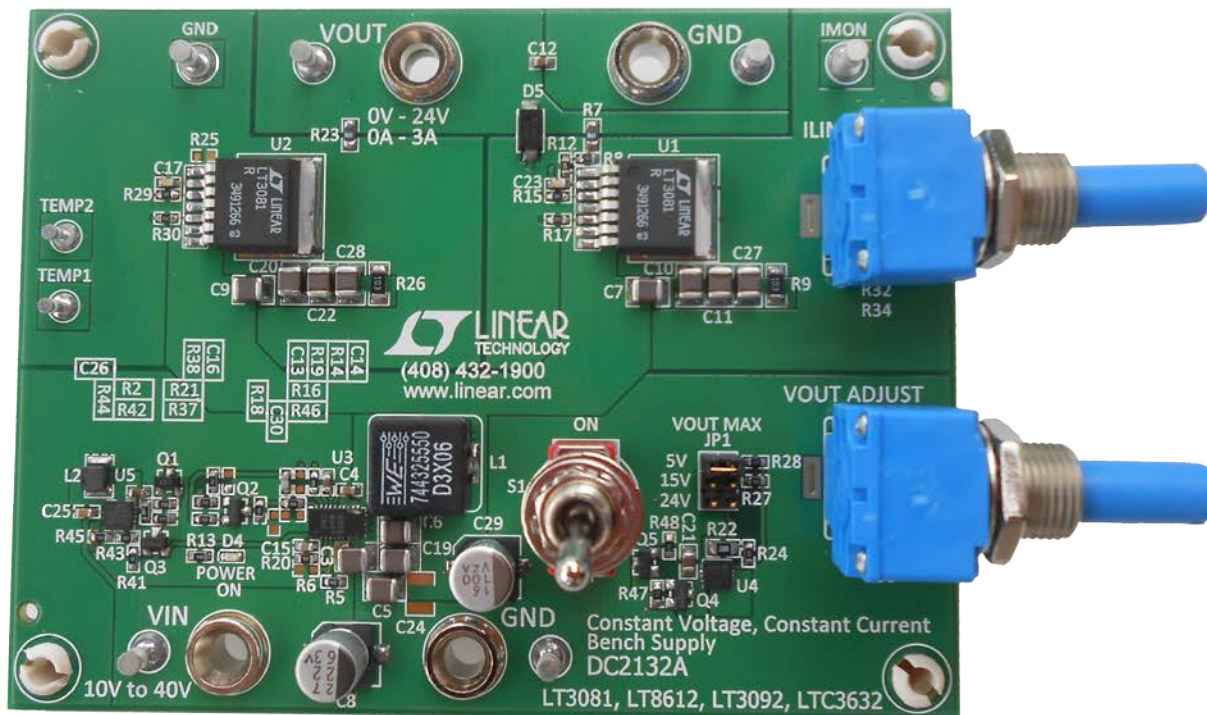
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# DEMO MANUAL DC2132A

## 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 <sub>p-p</sub>
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.

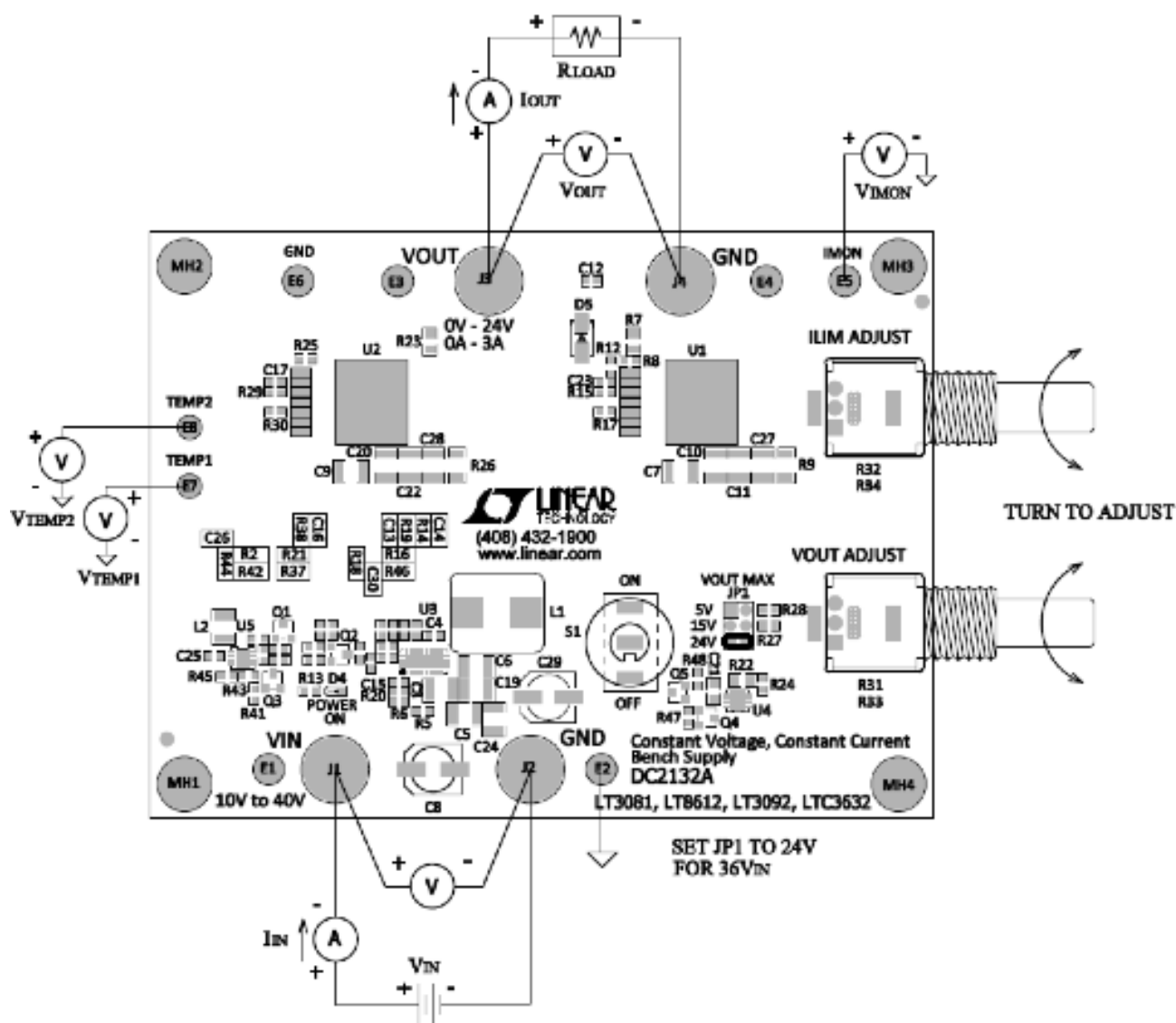


Figure 1. Test Procedure Setup Drawing for DC2132A

## QUICK START PROCEDURE

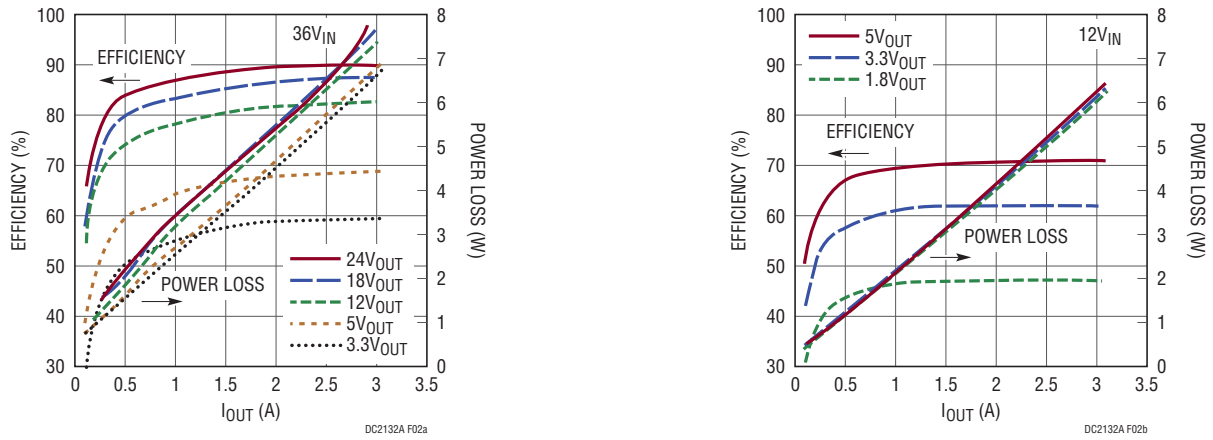


Figure 2. DC2132A Efficiency and Power Loss at Different Voltage and Current

**QUICK START PROCEDURE**

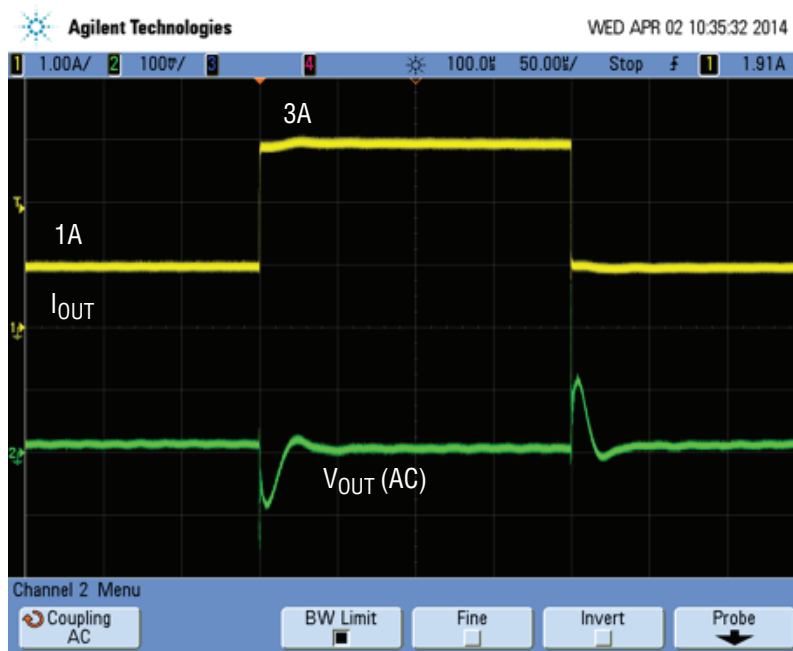


Figure 3. DC2132A 1A to 3A Transient Response 36V<sub>IN</sub>, 24V<sub>OUT</sub>

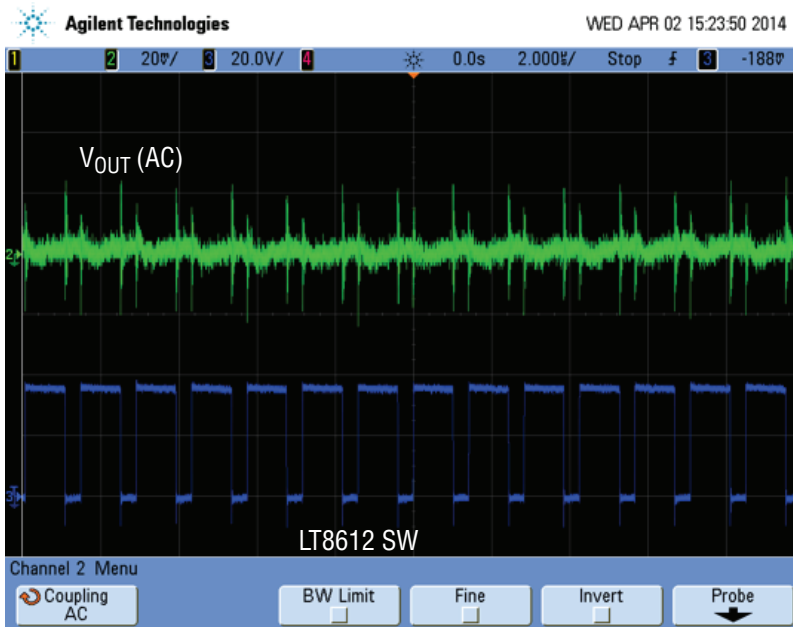


Figure 4. DC2132A Output Voltage Ripple

## QUICK START PROCEDURE

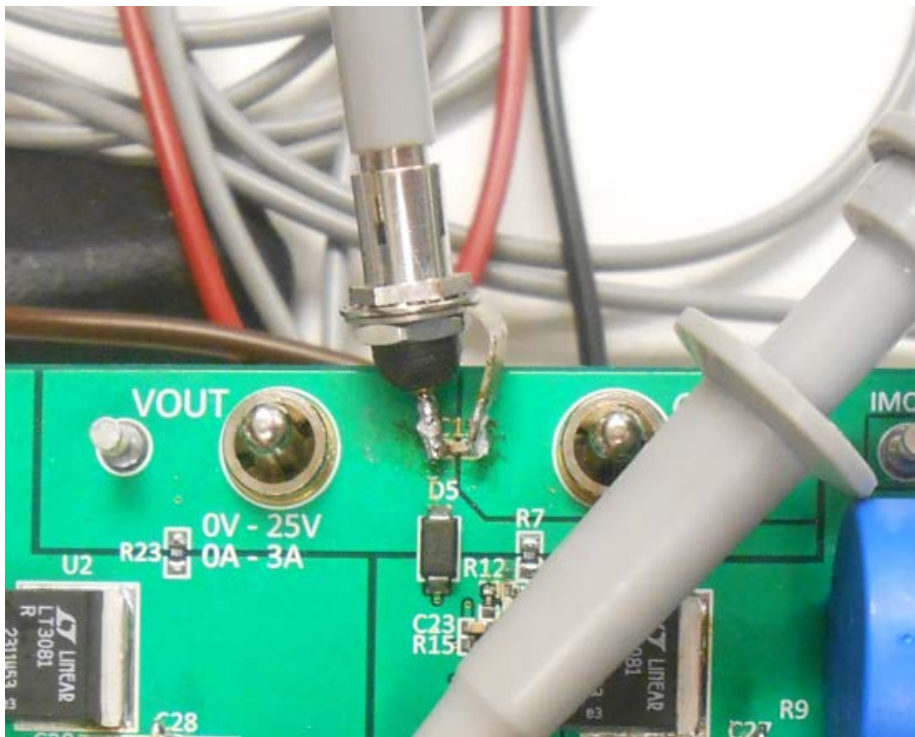
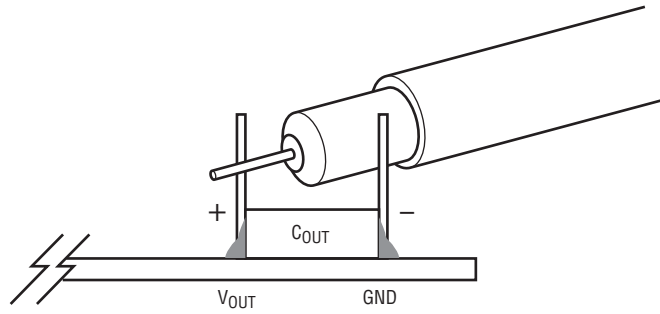


Figure 5. DC2132A Output Voltage Ripple Measurement Method



## PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
<b>Required Circuit Components</b>				
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 CRCW0603549KFKEA
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

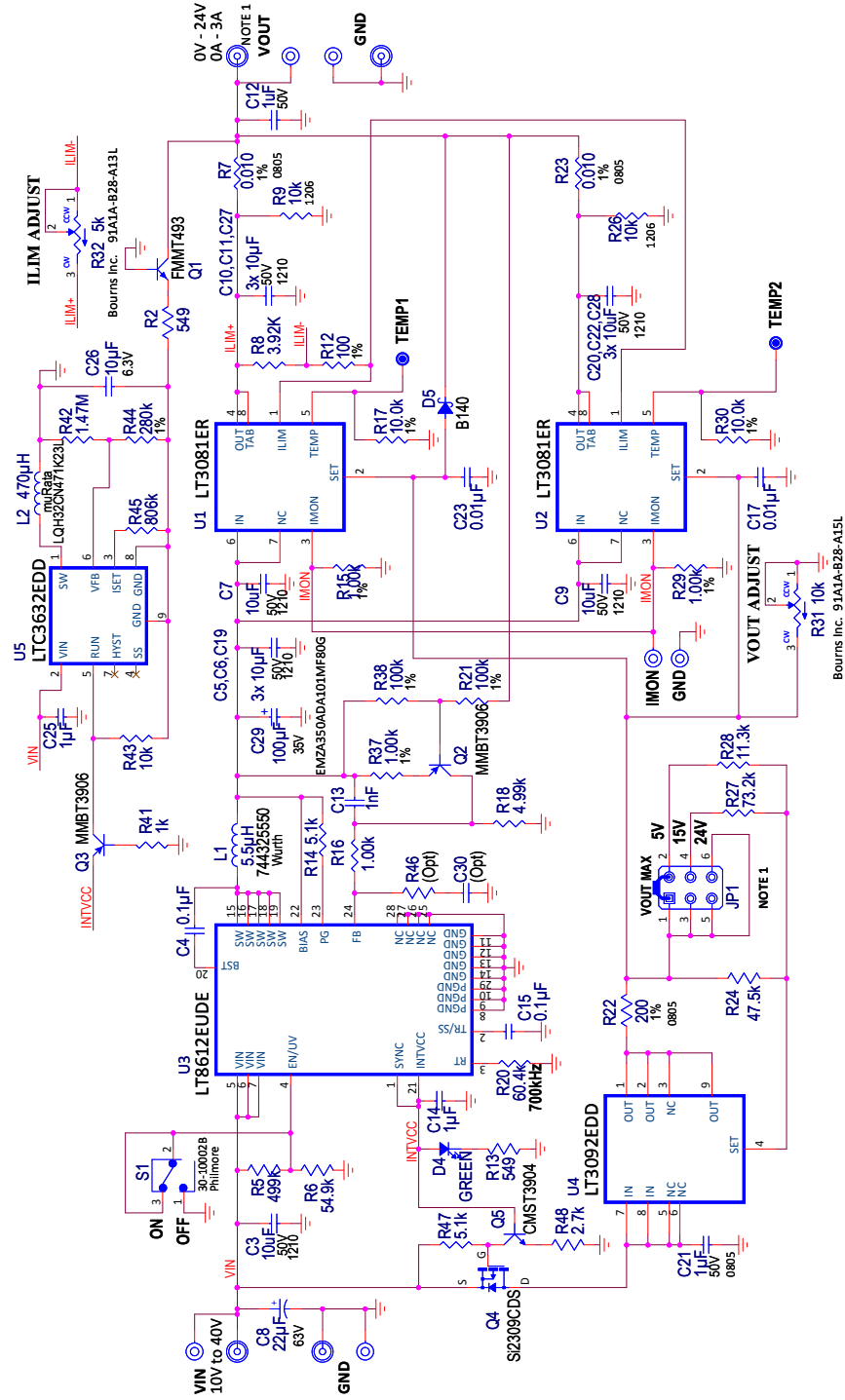
1	1	C8	CAP, ALUM 22 $\mu$ F 63V 25%	SUN ELECT. IND. 63CE22BS
2	0	C16, C30	OPTIONAL 0603	
3	0	C24	OPTIONAL 1210	
4	1	D4	LED, GRN	OSRAM OPTO SEMI. LG L29K-G2J1-24-Z
5	0	R6, R19, R25, R46	OPTIONAL 0603	
6	1	R13	RES., CHIP 549 $\Omega$ 0.10W 1% 0603	VISHAY CRCW0603549RFKEA
7	1	R16	RES./JUMPER, CHIP 0 $\Omega$ 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



**SCHEMATIC DIAGRAM**



Bourns Inc. 91A1A-B28-A15L

# DEMO MANUAL DC2132A

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