

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 30 μ F 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 $\theta_{JA} = 15^{\circ}\text{C}/\text{W}$. 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>

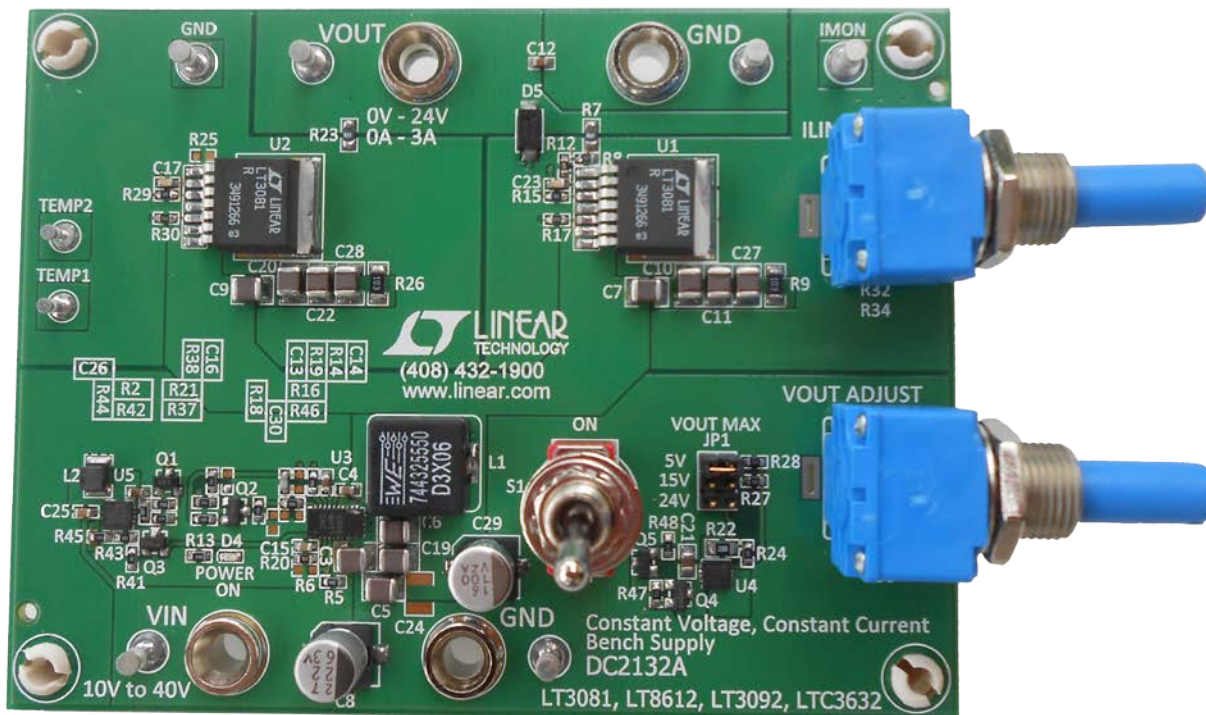
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DEMO MANUAL DC2132A

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 _{p-p} |
| Minimum Load | | 0 | | | mA |

BOARD PHOTO



dc2132af

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.

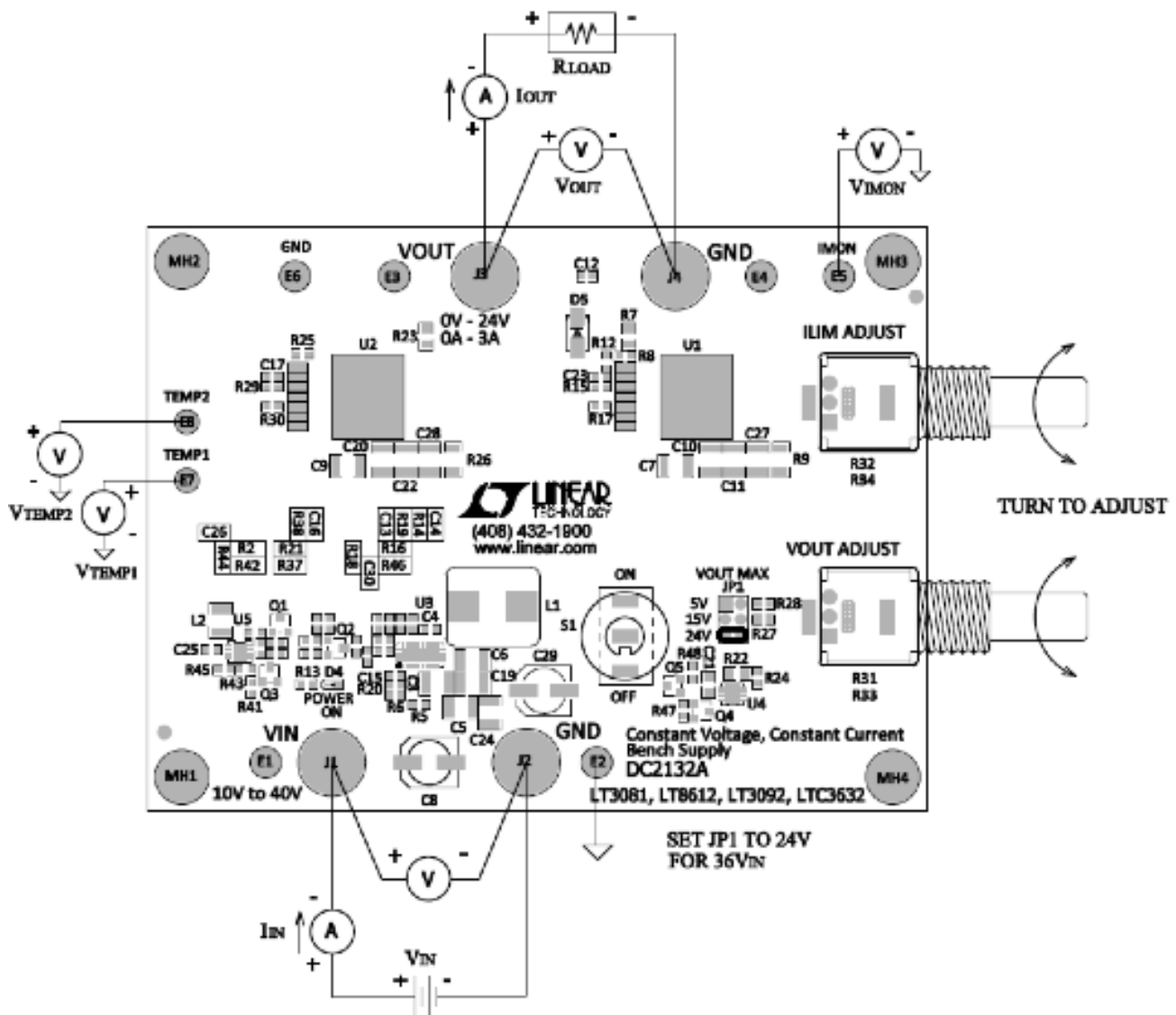


Figure 1. Test Procedure Setup Drawing for DC2132A

QUICK START PROCEDURE

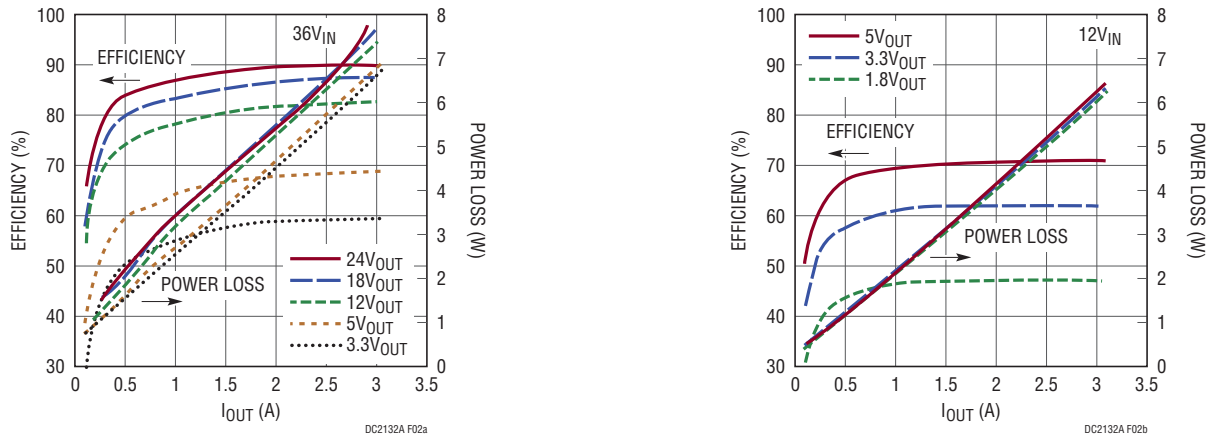


Figure 2. DC2132A Efficiency and Power Loss at Different Voltage and Current

QUICK START PROCEDURE

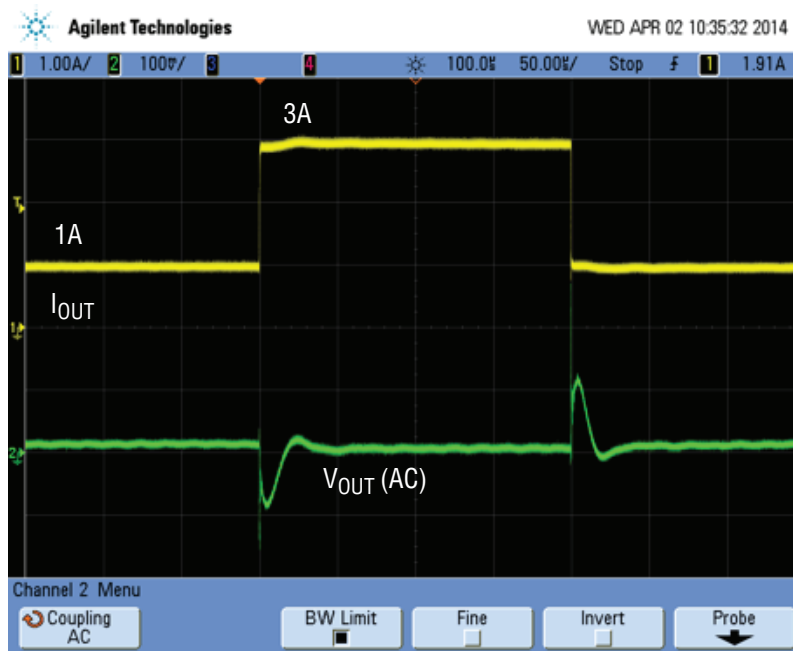


Figure 3. DC2132A 1A to 3A Transient Response 36V_{IN}, 24V_{OUT}

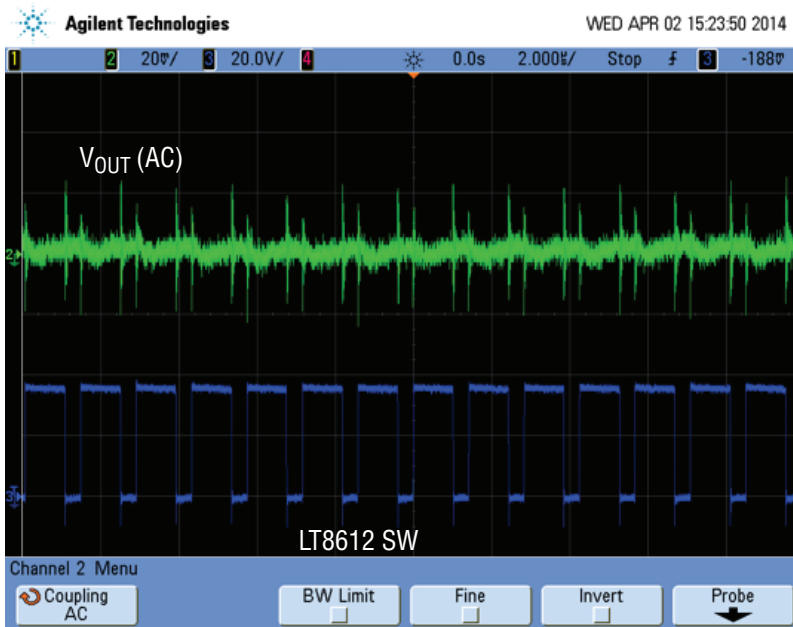


Figure 4. DC2132A Output Voltage Ripple

QUICK START PROCEDURE

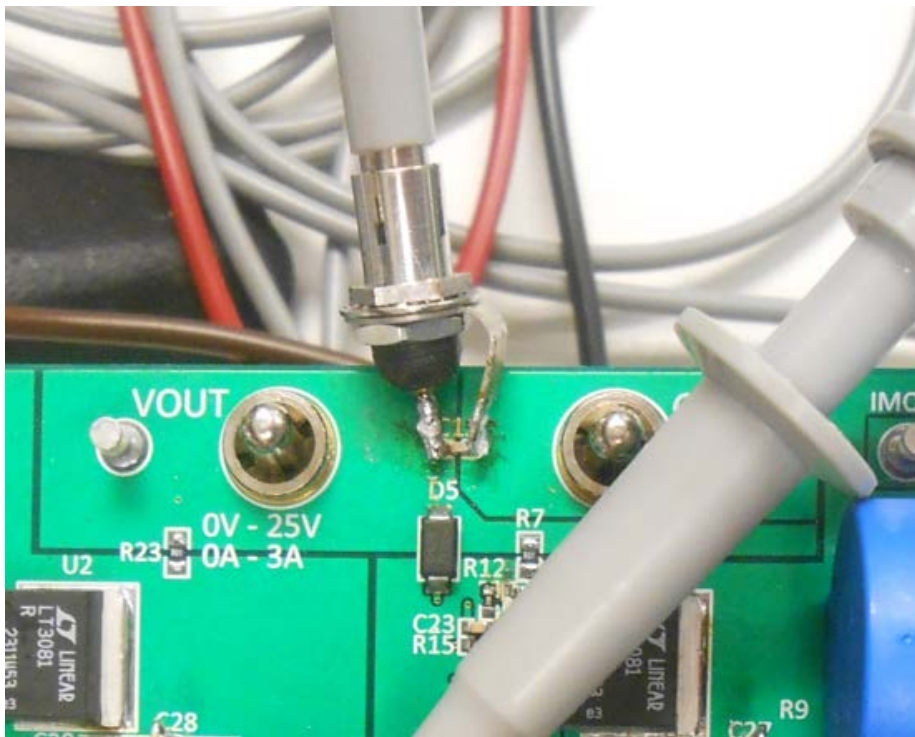
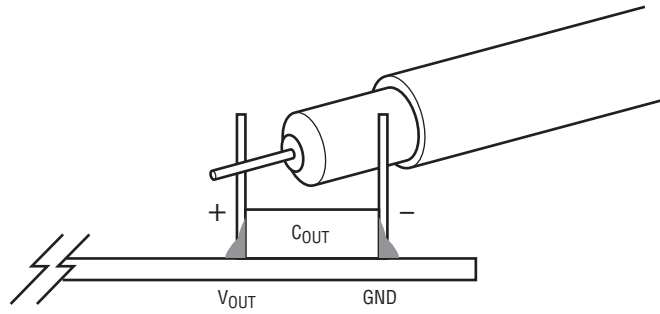


Figure 5. DC2132A Output Voltage Ripple Measurement Method

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 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 |

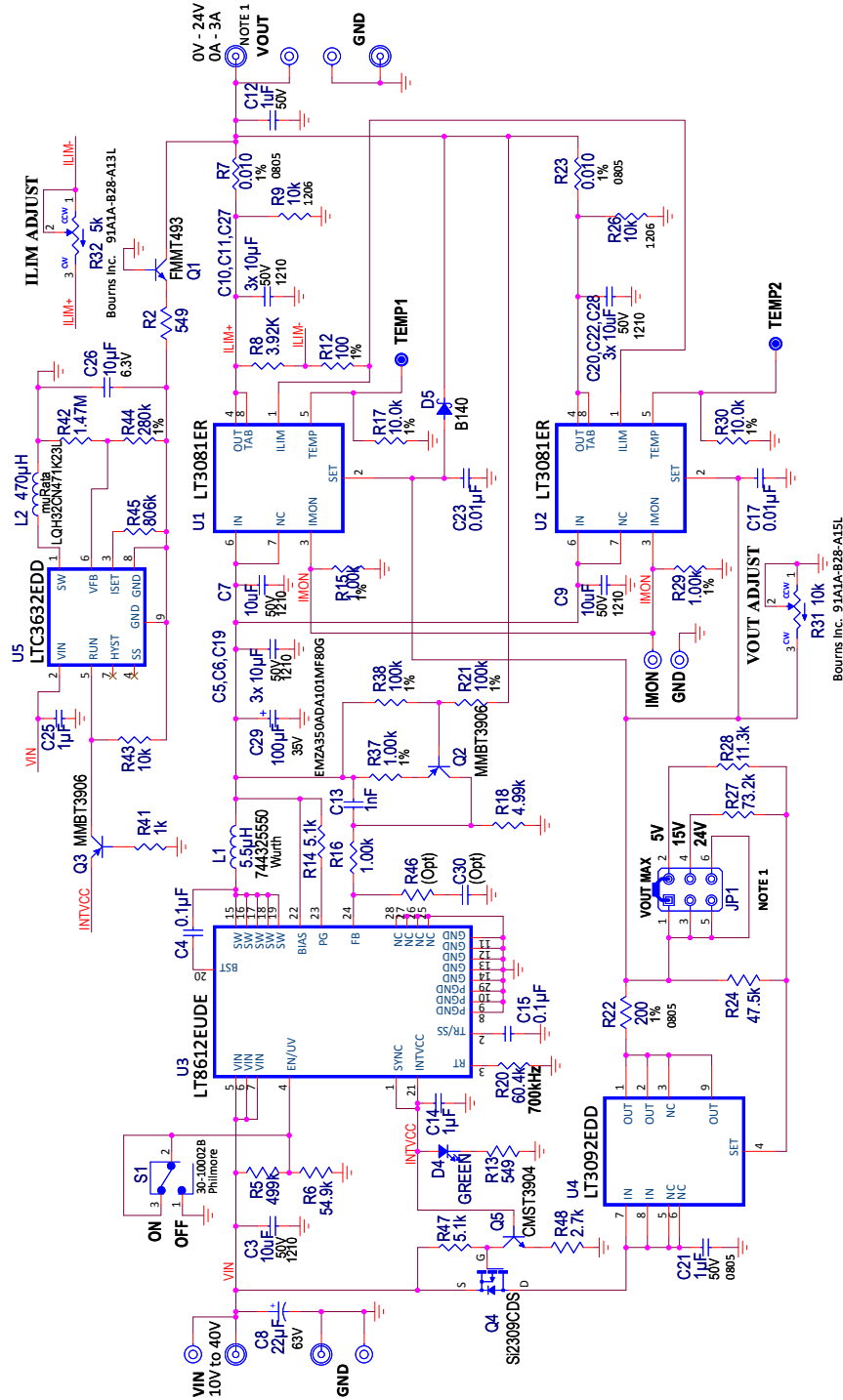
Optional Circuit Components

| | | | | |
|---|---|-------------------|---|------------------------------------|
| 1 | 1 | C8 | CAP, ALUM 22 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 |

SCHEMATIC DIAGRAM



Bourns Inc. 91A1A-B28-A15L

DEMO MANUAL DC2132A

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