LT3091EDE

–36V, 1.5A Negative Linear Regulator with Programmable Current Limit

DESCRIPTION

Demonstration circuit DC2276A is a 1.5A low dropout negative linear regulator featuring the LT®3091. This device is designed for applications requiring negative output voltage, high current without a heat sink, output adjustability to zero and low dropout voltage.

The LT3091 features fast transient response, high PSRR and output noise as low as $18\mu V_{RMS}$. The LT3091 generates a wide output voltage range (0V to –32V) while maintaining unity gain operation. This yields virtually constant bandwidth, load regulation, PSRR and noise, independent of the programmed output voltage.

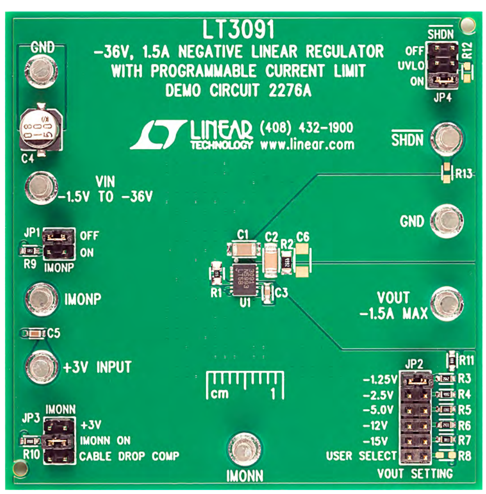
The LT3091 supplies 1.5A at a typical dropout voltage of 300mV. Operating quiescent current is nominally 1.2mA and drops to <<1µA in shutdown. A single resistor adjusts the LT3091's precision programmable current limit. The LT3091's positive or negative current monitor either sources a current (0.25mA/A) or sinks a current (0.5mA/A) proportional to output current.

Built-in protection includes reverse output protection, internal current limit with foldback and thermal shutdown with hysteresis.

DC2276A uses the LT3091EDE which is a 14-lead (4mm x 3mm) plastic DFN package with an exposed pad on the bottom side of the IC for better thermal performance. These features make DC2276A an ideal circuit for surface-mount power supplies, rugged industrial power supplies, low output voltage supplies and as a post regulator for switching supplies.

Design files for this circuit board are available at http://www.linear.com/demo/DC2276A

BOARD PHOTO



PERFORMANCE SUMMARY Specifications are at T_A = 25°C

CONDITIONS	I_{OUT}	V_{IN} (V) MIN*	V_{IN} (V) TYP	V_{IN} (V) MAX	V_{OUT} (V) MIN	V_{OUT} (V) TYP	V_{OUT} (V) MAX
Shunt at –1.25V for JP1	–10mA	–36.0		–1.55	–1.30	–1.25	–1.20
	–1.5A	–2.75		–1.55	–1.30	–1.25	–1.20
Shunt at –2.5V for JP1	–10mA	–36.0		–2.80	–2.6	–2.5	–2.4
	–1.5A	–4.0		–2.80	–2.6	–2.5	–2.4
Shunt at –5.0V for JP1	–10mA	–36.0		–5.30	–5.2	–5.0	–4.8
	–1.5A	–6.50		–5.30	–5.2	–5.0	–4.8
Shunt at –12V for JP1	–10mA	–36.0		–12.3	–12.5	–12.0	–11.5
	–1.5A	–13.5		–12.3	–12.5	–12.0	–11.5
Shunt at –15V for JP1	–10mA	–36.0		–15.3	–15.6	–15.0	–14.4
	–1.5A	–16.5		–15.3	–15.6	–15.0	–14.4

* The minimum input voltage for –1.5A load current is set by the 50°C temperature rise of LT3091 on the demo circuit without forced-air cooling. Lower input voltage can be reached if larger copper area or forced-air cooling is applied. The output current is also limited by the differential voltage of input and output voltage, please refer the data sheet for details.

QUICK START PROCEDURE

DC2276A is easy to set up to evaluate the performance of the LT3091. Refer to Figure 1 for proper measurement equipment setup and follow the procedure below:

NOTE: When measuring the input or output voltage ripple, care must be taken to avoid a long ground lead on the oscilloscope probe. Measure the input or output voltage ripple by touching the probe tip directly across the terminals of the input or output capacitors. See Figure 2 for proper scope probe technique.

1. Use JP2 to set the desired output voltage.
2. Put JP4 on ON position.
3. With power off, connect the input power supply to V_{IN} and GND.
4. Turn on the power at the V_{IN}.

   NOTE: Make sure that the V_{IN} voltage does not exceed –36V.

5. Check for the proper output voltages:

   NOTE: If there is no output, temporarily dis-connect the load to make sure that the load is not set too high or is shorted.

6. Once the proper output voltages are established, adjust the loads within the operating range and observe the output voltage regulation, efficiency and other parameters.

   NOTE: Make sure that the power dissipation is limited below the thermal limit.

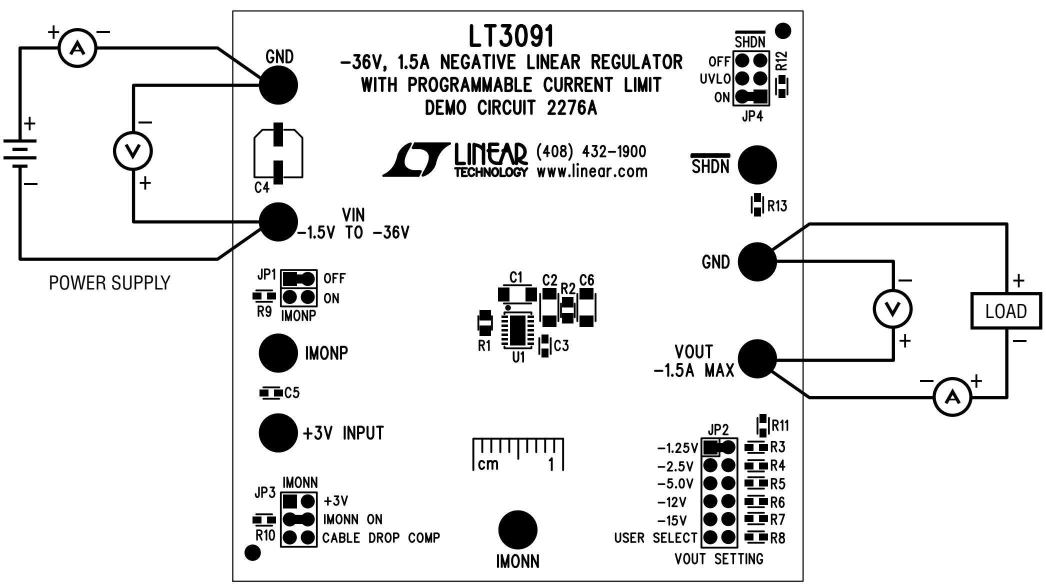


Figure 1. Test Procedure Setup for DC2276A

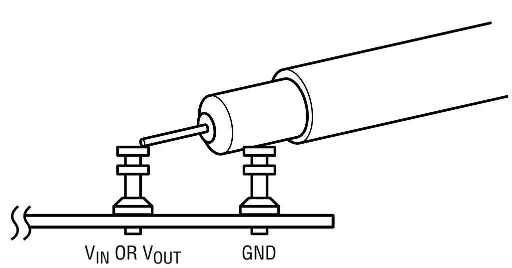


Figure 2. Measuring Input or Output Ripple

POSITIVE OR NEGATIVE CURRENT MONITOR AND CABLE DROP COMPENSATION CONFIGURATION

There are both positive and negative current monitors on the LT3091. The configurations for these two monitors are different. Please check following table for proper configuration.

When the positive current monitor is in use, JP1 needs to be configured on ON position and JP3 needs to be configured on +3V position. Meantime, a +3V external power supply needs to be connected to +3V INPUT turret.

When the negative current monitor is in use, JP1 needs to be configured on OFF position and JP3 needs to be configured on IMONN ON position. There is no external power supply needed.

Demo Circuit 2276A also can be configured to evaluate the cable drop compensation on the LT3091. Note that cable drop compensation is only using negative current monitor configuration. JP1, JP3 and R11 shall be configured. JP1 needs to be configured on OFF position. JP3 needs to be configured on CABLE DROP COMP position. R11 needs be replaced by a calculated value which has the following relationship with the total output cable impedance (RCBL) below. R11 and RCBL are both in Ω: R11 = RCBL • 2 k.

	JP1 (IMONP)	JP3 (IMONN)	R11(Ω)
Positive Current Monitor	ON	+3V	0
Negative Current Monitor	OFF	IMONN ON	0
Cable Drop Compensation	OFF	CABLE DROP COMP	RCBL(Ω) • 2 k

THERMAL IMAGE

An example thermal image shows the temperature distribution on the PC board. The test is done in still air at room temperature with 2.25W power dissipation in the LT3091 IC. This gives an IC case-to-ambient thermal resistance of θ_{CA} = 22°C/W on the demo circuit. The IC, at its highest point, reaches 75°C, at –2.75V_{IN}, –1.25V_{OUT} and 1.5A load current.

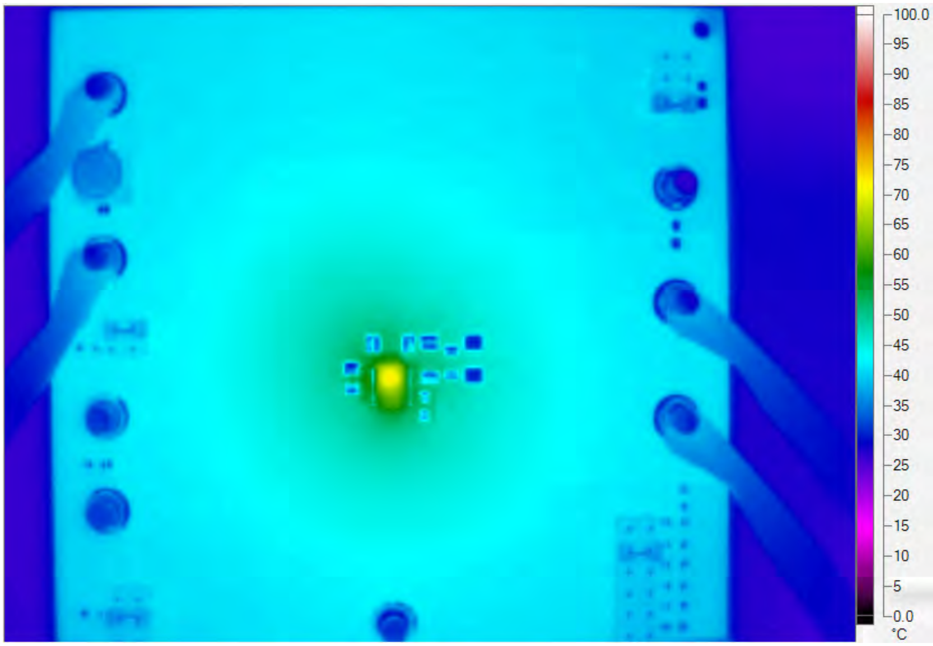
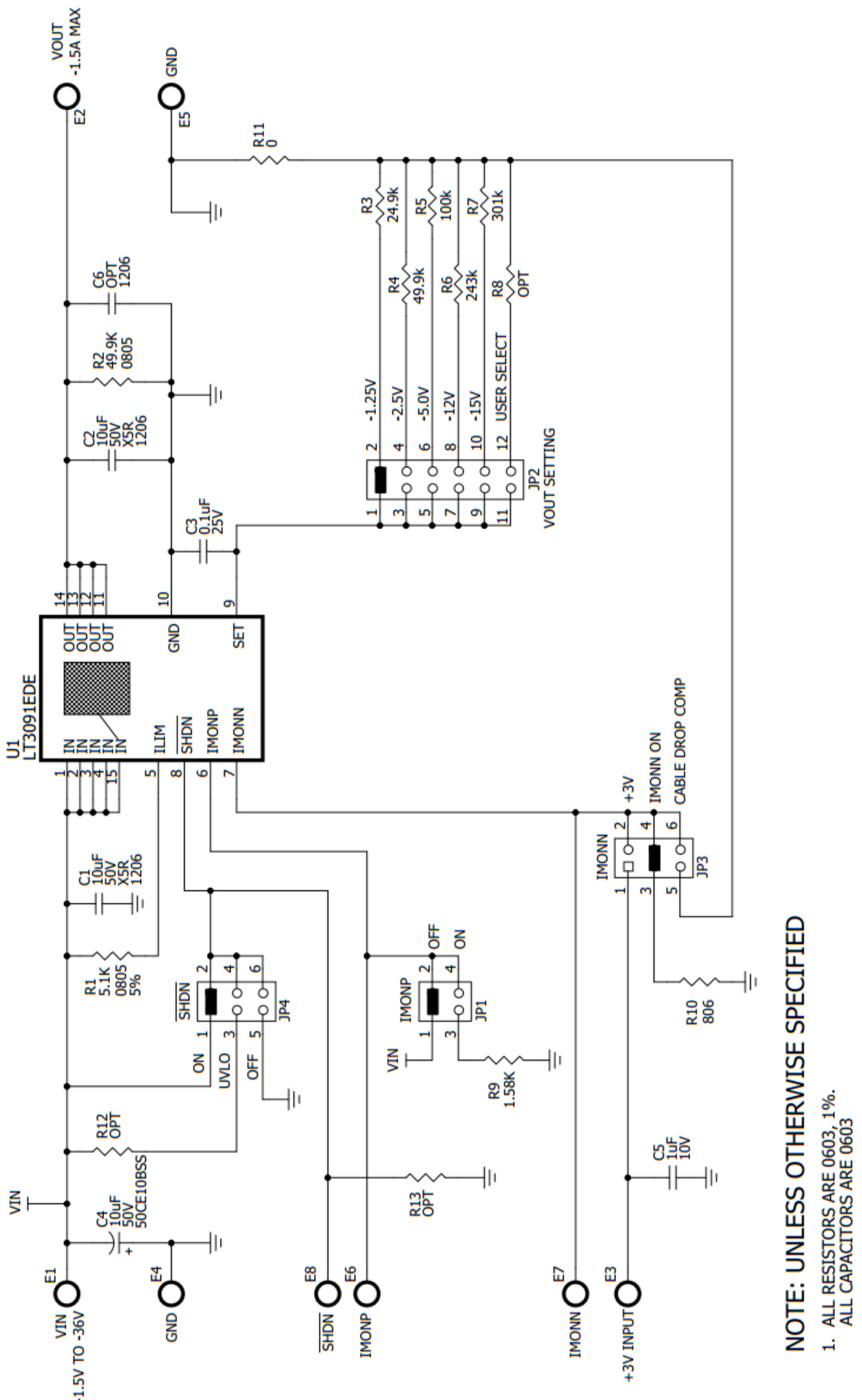


Figure 3. Temperature Rise at 2.25W Dissipation (V_{IN} = –2.75V, V_{OUT} = –1.25V, I_{OUT} = –1.5A)

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	2	C1,C2	CAP., X5R, 10µF, 50V, 10%, 1206	MURATA, GRM31CR61H106KA12L
2	1	C3	CAP., X7R, 0.1µF, 25V, 10%, 0603	MURATA, GRM188R71E104KA01D
3	1	C4	CAP., ALUM, 10µF, 50V, 20%	SUN ELECT, 50CE10BSS
4	1	C5	CAP., X7R, 1µF, 10V, 10%, 0603	MURATA, GRM188R71A105KA61D
5	1	R1	RES., CHIP, 5.1k, 1/10W, 5%, 0603	VISHAY, CRCW06035K10JNEA
6	1	R2	RES., CHIP, 49.9k, 1/8W, 1%, 0805	VISHAY, CRCW080549K9FKEA
7	1	R3	RES., CHIP, 24.9k, 1/10W, 1%, 0603	VISHAY, CRCW060324K9FKEA
8	1	R4	RES., CHIP, 49.9k, 1/10W, 1%, 0603	VISHAY, CRCW060349K9FKEA
9	1	R5	RES., CHIP, 100k, 1/10W, 1%, 0603	VISHAY, CRCW0603100KFKEA
10	1	R6	RES., CHIP, 243k, 1/10W, 1%, 0603	VISHAY, CRCW0603243KFKEA
11	1	R7	RES., CHIP, 301k, 1/10W, 1%, 0603	VISHAY, CRCW0603301KFKEA
12	1	R9	RES., CHIP, 1.58k, 1/10W, 1%, 0603	VISHAY, CRCW06031K58FKEA
13	1	R10	RES., CHIP, 806, 1/10W, 1%, 0603	VISHAY, CRCW0603806RFKEA
14	1	R11	RES., CHIP, 0, 1/10W, 0603	VISHAY, CRCW06030000Z0EA
15	1	U1	I.C., REGULATOR, DFN14	LINEAR TECH, LT3091EDE#PBF
Additional Demo Board Circuit Components				
16	0	C5 (OPT)	CAP., OPTION, 1206	
17	0	R8, R12, R13 (OPT)	RES., OPTION, 0603	
Hardware: For Demo Board Only				
18	8	E1-E8	TESTPOINT, TURRET, .094" PBF	MILL-MAX, 2501-2-00-80-00-00-07-0
19	1	JP1	HEADER 2x2 PIN 0.079 DOUBLE ROW	WURTH ELEKTRONIK, 62000421121
20	1	JP2	HEADER 6x2 PIN 0.079 DOUBLE ROW	SAMTEC, TMM-106-02-L-D
21	2	JP3-JP4	HEADER 3x2 PIN 0.079 DOUBLE ROW	WURTH ELEKTRONIK, 62000621121
22	4	XJP1-XJP4	SHUNT, 0.079" CENTER	WURTH ELEKTRONIK, 60800213421

SCHEMATIC DIAGRAM



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LT 0915 • PRINTED IN USA