

20V 20A Monolithic Buck Converter with Ultra-Low DCR Sensing

DESCRIPTION

Demonstration circuit 2341A is a high efficiency synchronous buck DC/DC converter with 4.5V to 20V input range. It can supply 20A maximum load current at 1.5V output. The demo board features the **LTC®7130** regulator. No external MOSFETs are required. It employs an LTC proprietary current sensing, current mode architecture, allowing the use of a very low DC resistance (DCR) power inductor to maximize efficiency in high current applications. Differential output voltage sensing along with a precision internal reference combine to offer accurate output regulation. The LTC7130 is housed in a 6.25mm × 7.5mm × 2.22mm 63-pin BGA package.

The light load operation mode of the converter is determined with the MODE/PLLIN pin. Use the JP2 jumper to select pulse-skipping mode (P.S.), Burst Mode® (BURST)

or forced continuous mode (CCM) operation. The converter can also be externally synchronized through the MODE/PLLIN pin (MODE/PLLIN terminal on the board; JP2: no jumper or BURST position). To shut down the converter, one simple way is to force the RUN pin below 1.1V (JP1: OFF). The power good output (PGOOD terminal) is low when the output voltage is outside of the ±10% regulation window.

The LTC7130 data sheet gives a complete description of the operation and application information. The data sheet must be read in conjunction with this demo manual.

Design files for this circuit board are available at <http://www.linear.com/demo/DC2341A>

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PERFORMANCE SUMMARY

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

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Input Voltage Range		4.5		20	V
Output Voltage	$V_{IN} = 4.5\text{V to } 20\text{V}$, $I_{OUT} = 0\text{A to } 20\text{A}$		1.5 ±2%		V
Maximum Output Current	$V_{IN} = 4.5\text{V to } 20\text{V}$, $V_{OUT} = 1.5\text{V}$		20		A
Typical Switching Frequency			530		kHz
Typical Efficiency	$V_{IN} = 12\text{V}$, $I_{OUT} = 20\text{A}$		89.2		%
Typical Output Voltage Ripple	$V_{IN} = 12\text{V}$, $I_{OUT} = 20\text{A}$		25		mV _{P-P}

QUICK START PROCEDURE

Demonstration circuit 2341A is easy to set up to evaluate the performance of the LTC7130. Refer to Figure 1 for the proper measurement equipment setup and follow the procedure below:

1. With power off, connect the input power supply to V_{IN} (4.5V to 20V) and GND (input return).
2. Connect the 1.5V output load between V_{OUT} and GND (Initial load: no load).
3. Connect the DVMs to the input and outputs.
4. Turn on the input power supply and check for the proper output voltages. V_{OUT} should be $1.5V \pm 2\%$.

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

NOTE: When measuring the output or input voltage ripple, 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.

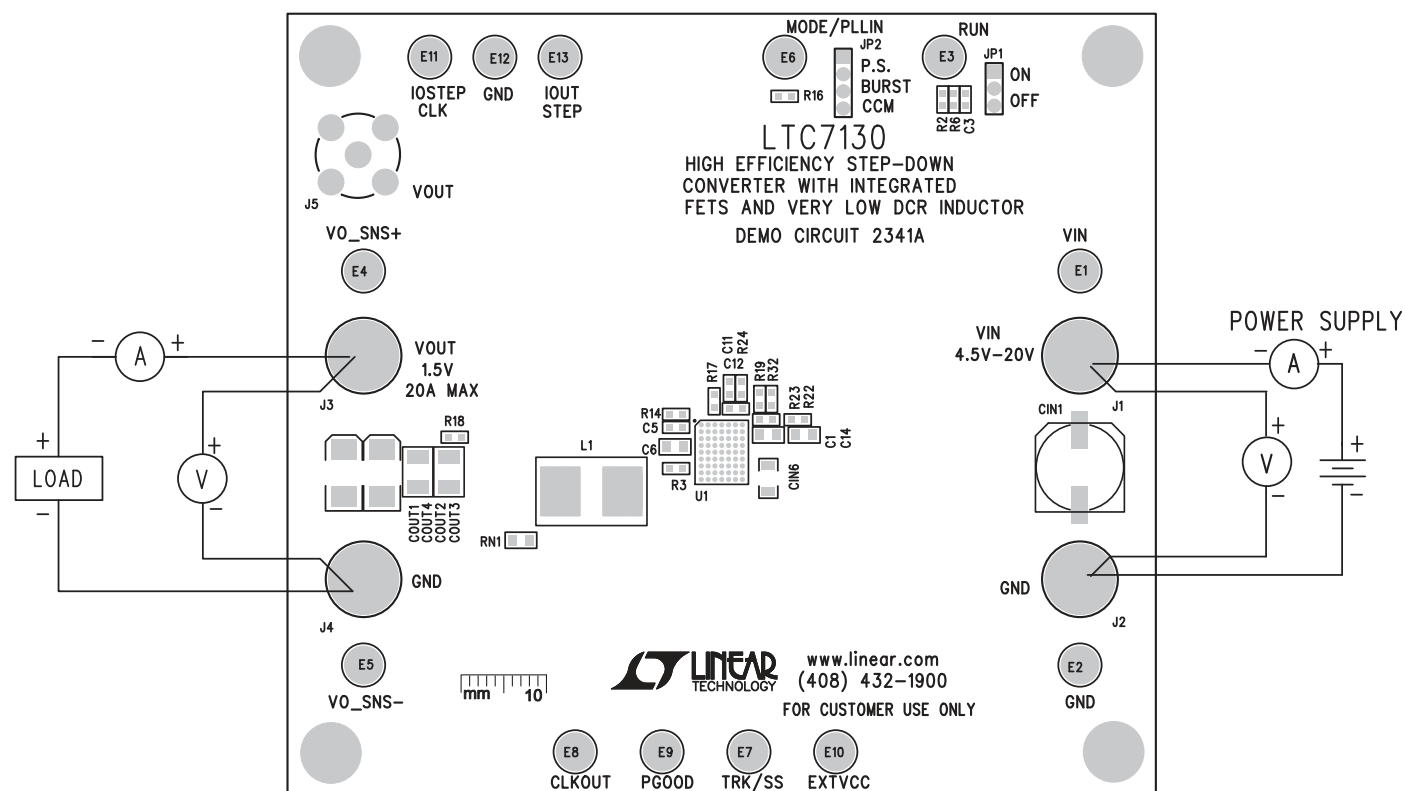


Figure 1. Proper Measurement Equipment Setup

QUICK START PROCEDURE

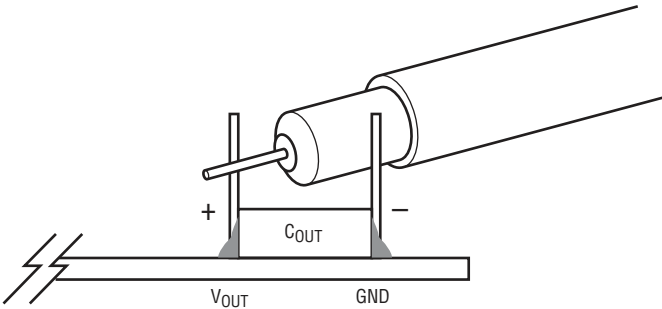


Figure 2. Measuring Output Voltage Ripple

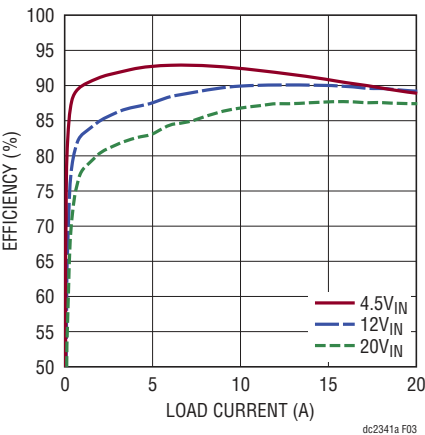


Figure 3. Efficiency vs Load Current ($V_0 = 1.5V$, Burst Mode)

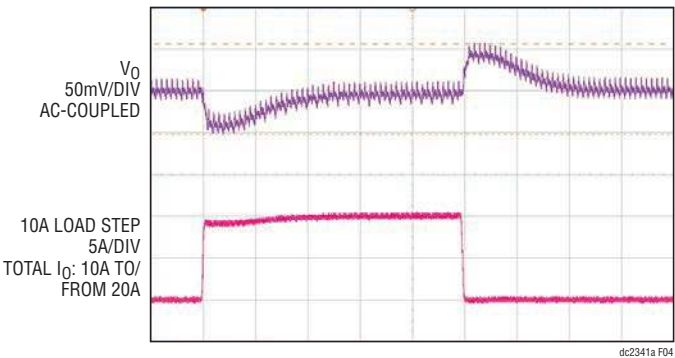


Figure 4. Load Step Transient Test ($V_{IN} = 12V$)

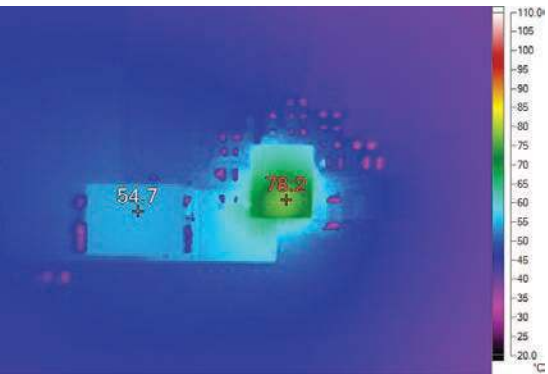


Figure 5. Thermal Picture ($V_{IN} = 12V$, $I_0 = 20A$. 21°C Ambient, No Forced Airflow)

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PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	1	CIN1	CAP, ALUM ELEC180μF 20% 25V	PANASONIC., 25SVPF180M
2	2	CIN4, CIN5	CAP, 1210 22μF 20% 25V X5R	AVX, 12103D226MAT2A
3	1	CIN6	CAP, 1206 10μF 20% 25V X5R	AVX, 12063D106MAT2A
4	2	COUT1, COUT4	CAP, 7343 330μF 20% 2.5V POSCAP	PANASONIC, 2R5TPE330M9
5	4	COUT2, COUT3, C15, C16	CAP, 1210 100μF 20% 6.3V X5R	AVX, 12106D107MAT2A
6	2	C1, C17	CAP, 0805 1μF 10% 25V X5R	AVX, 08053D105KAT2A
7	2	C2, C5, C7	CAP, 0603 220nF 10% 25V X5R	MURATA GRM188R71E224KA88D
8	1	C10	CAP, 0603 0.1μF 10% 10V X5R	AVX, 0603ZD104KAT2A
9	1	C11	CAP, 2.2nF X7R 50V 5% 0603	AVX, 06035C222JAT2A
10	1	C12	CAP, 0603 120pF 10% 25V NPO	AVX, 06033A121KAT2A
11	2	C6, C14	CAP, 0805 4.7μF 20% 10V X5R	AVX, 0805ZD475MAT2A
12	1	D1	DOIDE, SCHOTTKY 30V SOD-323	CENTRAL SEMI., CMDSH-3 TR
13	1	L1	IND, 0.25μH	WURTH ELEKTRONIK, 744308025
14	1	Q1	MOSFET, N-CH D-S 40V TO252	VISHAY, SUD50N04-8M8P-4GE3
15	1	R1	RES, 2.2Ω 1/10W 5% 0603	VISHAY, CRCW06032R20JNEA
16	4	R8, R16, R17, R20	RES, 0Ω JUMPER 1/10W 0603	VISHAY, CRCW06030000Z0EA
17	2	R19, R30	RES, 10k 1/10W 5% 0603	VISHAY, CRCW060310K0JNEA
18	1	R28	SENSE RES, 2512 0.01Ω 1% 1W	VISHAY, WSL2512R0100FEA
19	1	R10	RES 0603 100k 1% 1/10W	VISHAY, CRCW0603100KFKEA
20	1	R13	RES 0603 1k 1% 1/10W	VISHAY, CRCW06031K00FKEA
21	1	R4	RES, 0603 619Ω 1% 1/10W	VISHAY, CRCW0603619RFKEA
22	2	R9, R12	RES, 0603 10Ω 5% 1/10W	VISHAY, CRCW060310R0JNEA
23	1	R24	RES, 0603 6.04k 1% 1/10W	VISHAY, CRCW06036K04FKEA
24	2	R3	RES, 0603 2.7Ω 1% 1/10W	VISHAY, CRCW06032R7FKEA
25	1	R23	RES, 0603 124k 1% 1/10W	VISHAY, CRCW0603124KFKEA
26	1	R11	RES, 0603 3.01k 1% 1/10W	VISHAY, CRCW06033K01FKEA
27	1	R5	RES, 0603 3.09k 1% 1/10W	VISHAY, CRCW06033K09FKEA
28	1	R32	RES, 0603 6.65k 1% 1/10W	VISHAY, CRCW06036K65FKEA
29	1	U1	IC, LTC7130EY#PBF	LINEAR TECH., LTC7130EY#PBF
Additional Demo Board Circuit Components				
30	0	COUT5, COUT6 OPT	CAP, 7343 OPTION	
31	0	CIN2, CIN3, (OPT)	CAP, OPTION	
32	0	C3, C4, C8, C9, C13, (OPT)	CAP, 0603 OPTION	
33	0	RN1, R2, R6, R7, R14, R15, R18, R22, R25, R27, R29	RES, 0603 OPTION	
Hardware: For Demo Board Only				
34	13	E1-E13	TESTPOINT, TURRET, 0.094" PbF	MILL-MAX, 2501-2-00-80-00-00-07-0
35	1	JP2	HEADER, 4 PIN 0.079" SINGLE ROW	SULLINS, NRPN041PAEN-RC
36	1	JP1	HEADER, 3 PIN 0.079" SINGLE ROW	SULLINS, NRPN031PAEN-RC
37	4	J1-J4	JACK, BANANA	KEYSTONE 575-4
38	1	J5	CONN, BNC, 5 PINS	CONNEX, 112404
39	4	MH1, MH2, MH3, MH4	STAND-OFF, NYLON 0.50" tall	KEYSTONE, 8833
40	2	JP1, JP2	SHUNT, 0.079" CENTER	SAMTEC, 2SN-BK-G

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

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