

## 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                | $V_{IN} = 4.5\text{V to } 20\text{V}$ , $I_{OUT} = 0\text{A to } 20\text{A}$ |     | $1.5 \pm 2\%$ |     | 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 <sub>P-P</sub> |

## 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.

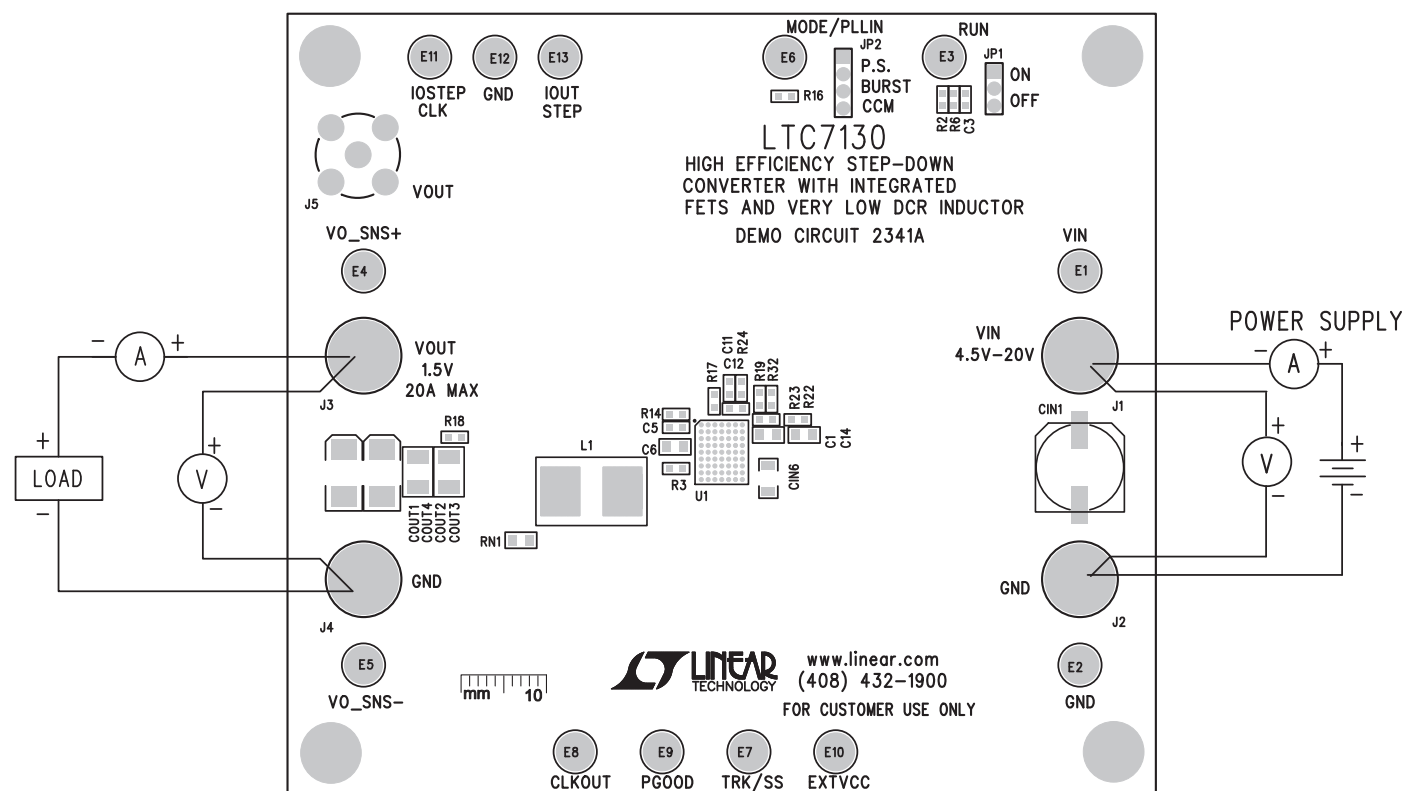


Figure 1. Proper Measurement Equipment Setup

## QUICK START PROCEDURE

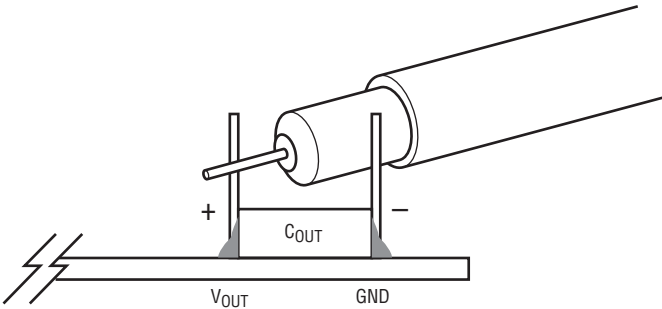


Figure 2. Measuring Output Voltage Ripple

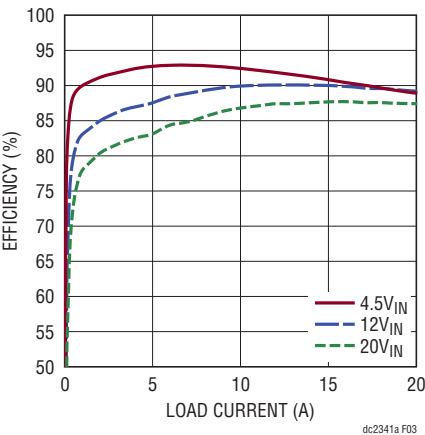


Figure 3. Efficiency vs Load Current ( $V_0 = 1.5V$ , Burst Mode)

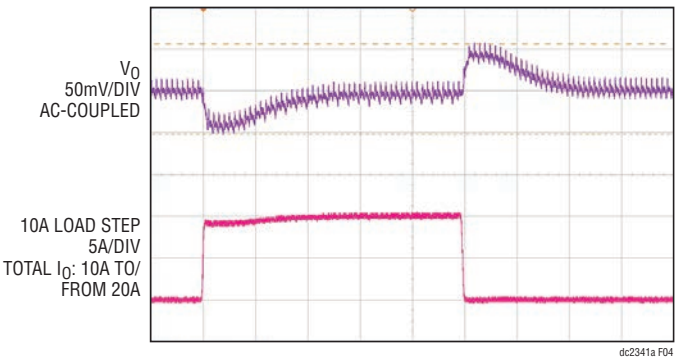


Figure 4. Load Step Transient Test ( $V_{IN} = 12V$ )

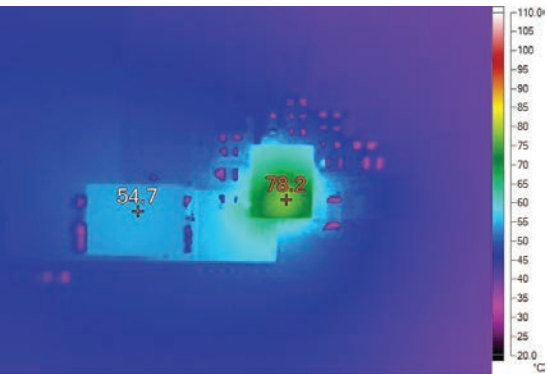


Figure 5. Thermal Picture ( $V_{IN} = 12V$ ,  $I_O = 20A$ . 21°C Ambient, No Forced Airflow)

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## PARTS LIST

| ITEM                                            | QTY | REFERENCE                                          | PART DESCRIPTION                | MANUFACTURER/PART NUMBER          |
|-------------------------------------------------|-----|----------------------------------------------------|---------------------------------|-----------------------------------|
| <b>Required Circuit Components</b>              |     |                                                    |                                 |                                   |
| 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       |
| <b>Additional Demo Board Circuit Components</b> |     |                                                    |                                 |                                   |
| 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                |                                   |
| <b>Hardware: For Demo Board Only</b>            |     |                                                    |                                 |                                   |
| 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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