

# 15V, 200mA Synchronous Buck-Boost DC/DC Converter with 1.3 $\mu$ A Quiescent Current

## DESCRIPTION

Demonstration Circuit 1922A features the LTC<sup>®</sup>3129, a high efficiency 200mA buck-boost DC/DC converter with a wide  $V_{IN}$  and  $V_{OUT}$  range.

The DC1922A demo board has two user selectable operating modes: Burst Mode<sup>®</sup> Operation and Fixed Frequency PWM (JP3). There is also an accurate programmable RUN pin which is used to ENABLE the converter (JP1). The LTC3129 also incorporates a maximum power point control function which can be enabled (JP2) for applications where the input source is a solar cell or is high impedance, such as intrinsically safe applications or high  $Z_{OUT}$  thermal electric generators (TEGs).

The DC1922A operates with a 2.42V to 15V input voltage range, and has been designed with the output voltage set to 5.0V. Once the converter is started the LTC3129 can operate with  $V_{IN}$  as low as 1.92V provided  $V_{CC}$  is back-fed. The demo board has optional provisions to back-feed  $V_{CC}$  (D1) in order to increase efficiency in some 5V

output applications, or to allow operation with  $V_{IN}$  down to 1.92V. Consult the data sheet for more information on these options.

The DC1922A demo board also incorporates a connector (J1) which can be used to connect to a Dust Networks Mote demo board.

Figure 1 shows typical demo board efficiency and Figure 2 shows typical step response.

The LTC3129 data sheet has detailed information about the operation, specification, and applications of the part. The data sheet should be read in conjunction with this quick start guide.

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

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## PERFORMANCE SUMMARY

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

| PARAMETER              | VALUE                         |
|------------------------|-------------------------------|
| Input Voltage Range    | 2.42V to 15V                  |
| $V_{OUT}$              | 5.0V                          |
| $I_{OUT}$ (See Note 1) | 200mA, for $V_{IN} > V_{OUT}$ |
| Efficiency             | See Figure 1                  |

NOTE 1: The demo board output current is a function of  $V_{IN}$ . Please refer to the data sheet for more information.

DESCRIPTION

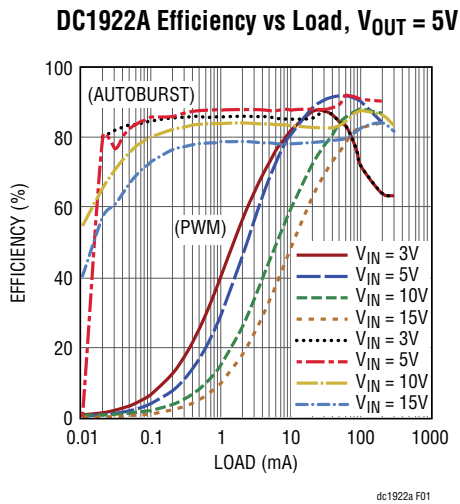


Figure 1. DC1922A Efficiency in AUTOBURST MODE



Figure 2. DC1922A Step Response

## QUICK START PROCEDURE

Using short twisted pair leads for any power connections and with all loads and power supplies off, refer to Figure 3 for the proper measurement and equipment setup. The power supply (PS1) should not be connected to the circuit until told to do so in the procedure below.

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  $V_{IN}$  or  $V_{OUT}$  and GND terminals (see Figure 4), or by using an oscilloscope probe tip jack.

1. Jumper, PS1 and LOAD settings to start:

PS1 = OFF

JP1 (RUN) = ON

JP2 (MPPC) = OFF

JP3 (PWM) = BURST MODE OPERATION

JP4 (DUST PWR) = NC

2. With power OFF connect the power supply (PS1) as shown in Figure 3. If accurate current measurements are desired (for efficiency calculations for example) then connect an ammeter (AM1) in series with the supply as shown. The ammeter is not required however.
3. Connect a 50mA load to  $V_{OUT}$  as shown in Figure 3 ( $100\Omega$  for  $V_{OUT} = 5V$ ). Connect an ammeter (AM2) if accurate current measurement or monitoring is desired.
4. Turn on PS1 and slowly increase voltage until the voltage at  $V_{IN}$  is 4.0V.
5. Verify  $V_{OUT}$  is ~5.0V.
6.  $V_{IN}$  can now be varied between 2.42V and 15.0V.  $V_{OUT}$  should remain in regulation.

7. Load current ( $I_{OUT}$ ) can also be varied. The maximum  $I_{OUT}$  is a function of  $V_{IN}$  and the current limit. Consult the data sheet for more information on  $I_{OUT}$  vs  $V_{IN}$ . In general for  $V_{IN} > V_{OUT}$   $I_{OUT}$  can be increased to 200mA. For  $V_{IN} < V_{OUT}$   $I_{OUT}$  capability will be reduced.
8. For operation in fixed frequency (PWM) mode move Jumper JP3 to FIXED FREQ. See the data sheet for more information on Burst Mode operation.
9. NOTE: If  $V_{OUT}$  drops out of regulation, check to be sure that  $V_{IN}$  is not below the minimum value for regulation (see data sheet).

### For USE with a Solar Cells/MPPC:

10. With power OFF move jumper MPPC (JP2) to ON.
11. If using a power supply as the source, place a minimum of  $10\Omega$ , 10W resistor in series with the input to simulate the source resistance. If using a solar cell (s) or high impedance source, no additional resistance should be needed.
12. Set resistor R9 to a value which will set the MPPC pin to the desired voltage. See the data sheet section "Programming the MPPC Voltage" for more information.
13. With no load and the MPPC voltage set, increase the source voltage above the MPPC set point.  $V_{OUT}$  should be in regulation. As the load is increased  $V_{IN}$  will drop until it reaches the MPPC set voltage. As the load is increased further,  $V_{OUT}$  will drop out of regulation, but  $V_{IN}$  will be regulated to the set point voltage. This is to prevent the input source from collapsing and to allow the maximum power to be extracted from the source.
14. Consult the data sheet for more information on maximum power point control (MPPC) operation.

## QUICK START PROCEDURE

### For USE with a DUST Networks MOTE demo board:

15. Connector J1 is designed to interface with a Dust Networks Mote demo board. Consult the Dust documentation for optimal  $V_{OUT}$  regulation setting. In general the Dust Networks Mote will operate with  $V_{OUT}$  set to 3.3V. However, care should be taken to not overvoltage the Mote. Newer Motes may require a different  $V_{OUT}$ . The DC1922A demo board can be configured for different  $V_{OUT}$  voltages by simply changing R2.
16. The DC1922A demo board can be configured for  $V_{OUT} = 3.3V$  by changing resistor R2 to 1.1M for  $R1 = 2M$ .
17. Once the output voltage has been set to the proper voltage and with the power supply OFF connect DC1922A to the Dust Networks Mote demo board using J1. See Figure 5 and 6 for the proper connections and orientation. Move jumper JP4 to  $V_{OUT}$ .
18. Once the boards have been connected, turn on PS1 and increase the voltage to approximately 3V.  $V_{OUT}$  should now be in regulation.  $V_{IN}$  can now be varied over the operating range and  $V_{OUT}$  should remain in regulation.

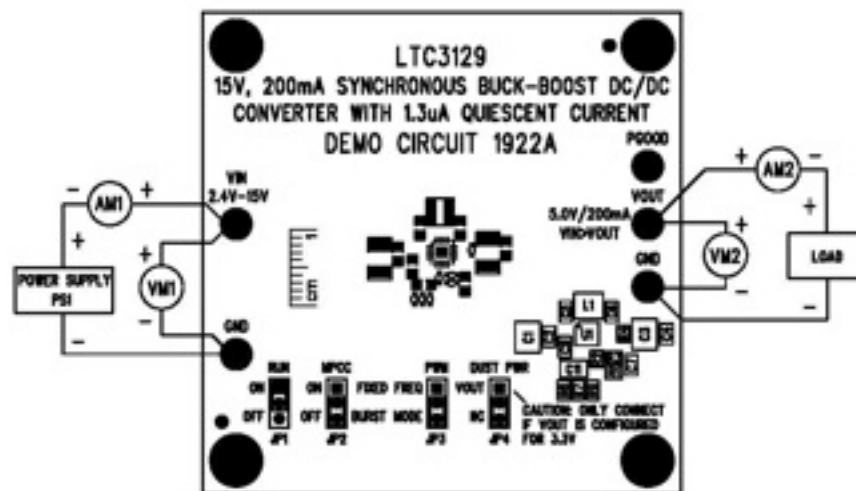


Figure 3. Proper Measurement Equipment Setup

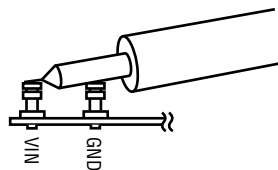


Figure 4. Measuring Input or Output Ripple

## QUICK START PROCEDURE



Figure 5. DC1922A Connected to DC9003 Dust Mote (Top View)



Figure 6. DC1922A Connected to DC9003 Dust Mote (Bottom View)

# DEMO MANUAL DC1922A

## PARTS LIST

| ITEM                                            | QTY | REFERENCE              | PART DESCRIPTION                                                                         | MANUFACTURER/PART NUMBER        |
|-------------------------------------------------|-----|------------------------|------------------------------------------------------------------------------------------|---------------------------------|
| <b>Required Circuit Components</b>              |     |                        |                                                                                          |                                 |
| 1                                               | 1   | C1                     | CAP CER 22 $\mu$ F, 25V, X5R, 20%, 1210                                                  | TDK, C3225X5R1E226M             |
| 2                                               | 2   | C2, C4                 | CAP CER 1.0 $\mu$ F, 25V, X5R, 20%, 0603                                                 | TDK, C1608X5R1E105M             |
| 3                                               | 1   | C3                     | CAP CER 22 $\mu$ F, 10V, X5R, 20%, 1210                                                  | TDK, C3225X5R1A226M             |
| 4                                               | 2   | C5,C6                  | CAP CER 22000pF, 50V, X7R, 10%, 0603                                                     | TDK, C1608X7R1H223K             |
| 5                                               | 1   | C7                     | CAP CER 33pF, 50V, 5%, NP0 0603                                                          | TDK, C1608C0G1H330J             |
| 6                                               | 1   | C9                     | CAP CER 2.2 $\mu$ F, 10V, X7R, 20%, 0603                                                 | TDK, C1608X7R1A225M             |
| 7                                               | 1   | C10                    | CAP CER 10pF, 50V, NP0, $\pm$ 0.25pF 0603                                                | TDK, C1608C0G1H100C             |
| 8                                               | 1   | L1                     | INDUCTOR, 10 $\mu$ H                                                                     | COILCRAFT, EPL3015-103          |
| 9                                               | 1   | Q1                     | N-CHANNEL MOSFET, 20V, SOT23                                                             | DIODES/ZETEX, ZXMN2F30FHTA      |
| 10                                              | 4   | R1, R4, R5, R6         | RES,CHIP, 2.0M, 1/16W, 1%, 0402                                                          | VISHAY, CRCW04022M00FKED        |
| 11                                              | 1   | R2                     | RES, CHIP, 619k, 1/16W,1%, 0402                                                          | VISHAY, CRCW0402619KFKED        |
| 12                                              | 1   | R3                     | RES, CHIP, 2.21k, 1/16W, 1%, 0402                                                        | VISHAY, CRCW04022K21FKED        |
| 13                                              | 1   | U1                     | 15V, 200mA SYNCHRONOUS BUCK - BOOST DC / DC CONVERTER WITH 1.3 $\mu$ A QUIESCENT CURRENT | LINEAR TECHNOLOGY, LTC3129EUD   |
| <b>Additional Demo Board Circuit Components</b> |     |                        |                                                                                          |                                 |
| 1                                               | 0   | C8                     | CAP TANT 68 $\mu$ F, 20V, 10%, SMD 7343 (OPT)                                            | OPT                             |
| 2                                               | 0   | C11                    | CAP CER 6.3V, 0603 (OPT)                                                                 | OPT                             |
| 3                                               | 0   | D1                     | DIODE SCHOTTKY (OPT)                                                                     | OPT                             |
| 4                                               | 0   | R7, R8, R9             | RES 1/10W, 1%, 0402 SMD (OPT)                                                            | OPT                             |
| <b>Hardware: For Demo Board Only</b>            |     |                        |                                                                                          |                                 |
| 1                                               | 5   | E1, E2, E3, E4, E5     | TESTPOINT, TURRET 0.094"                                                                 | MILLMAX 2501-2-00-80-00-00-07-0 |
| 2                                               | 1   | J1                     | HEADER, 2 $\times$ 6, 12-PIN, SMT HORIZONTAL SOCKET W/KEY, 0.100"                        | SAMTEC, SMH-106-02-L-D-05       |
| 3                                               | 4   | JP1, JP2, JP3, JP4     | JMP, 0.079 SINGLE ROW HEADER, 3 PIN                                                      | SAMTEC, TMM-103-02-L-S          |
| 4                                               | 4   | XJP1, XJP2, XJP3, XJP4 | SHUNT, .079" CENTER                                                                      | SAMTEC, 2SN-BK-G                |
| 5                                               | 4   | (STAND-OFFS)           | STAND-OFF, NYLON 0.625" Tall                                                             | KEYSTONE, 8834(SNAP ON)         |





# DEMO MANUAL DC1922A

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