# LTC3536
# 1A, Low Noise, Wide $V_{IN}$ Buck-Boost DC/DC Converter

## DESCRIPTION

Demonstration circuit 1797A is a combined step-up and step-down DC/DC converter using the LTC®3536 monolithic synchronous buck-boost regulator. The DC1797A has wide input voltage range of 1.8V to 5.5V, and is capable of delivering up to 1A of output current. The output voltage of the DC1797A can be set as low as 1.8V and can go as high as 5.5V. The DC1797A supports two operational modes: fixed-frequency pulse-width modulation (PWM) and Burst Mode® operation. Fixed-frequency mode of operation maximizes the output current, reduces output voltage ripple, and yields a low noise switching spectrum. Burst Mode operation employs a variable frequency switching algorithm that minimizes the no-load input quiescent current and improves efficiency at light loads.

The DC1797A consumes less than 28µA of quiescent current during Burst Mode operation, and during shutdown, it consumes less than 1µA. The DC1797A has a standard operating frequency of 1MHz, but can be adjusted to frequencies as high as 2MHz. If Pin 1 (RT) is tied to $V_{IN}$, the default switching frequency is 1.2MHz. Because of the high switching frequency of the DC1797A, small, low profile surface mount components are used in the circuit. These features, plus the LTC3536 availability in a small 10-lead DFN package, make the DC1797A a perfect match for battery-powered, hand-held applications.

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



## PERFORMANCE SUMMARY

| PARAMETER | CONDITIONS | VALUE |
|---|---|---|
| Minimum Input Voltage | | 1.8V |
| Maximum Input Voltage | | 5.5V |
| Output Voltage $V_{OUT}$ Regulation | $V_{IN}$ = 1.8V to 5.5V | 3.3V ±2% |
| Maximum Continuous Output Current | Fixed Frequency Mode | 1A |
| Preset Operating Frequency | R6 = 100kΩ | 1MHz |
| External Clock Sync. Frequency Range | | 300kHz to 2MHz |
| Efficiency | $V_{IN}$ = 5V, $V_{OUT}$ = 3.3V, $I_{OUT}$ = 0.2A | 95% |
| Typical Output Ripple $V_{OUT}$ | $V_{IN}$ = 5V, $I_{OUT}$ = 1A (20MHz Bandwidth) | < 15m$V_{P-P}$ |
| Burst Mode Operation | $V_{IN}$ = 5V, $V_{OUT}$ = 3.3V<br>$V_{IN}$ = 2.5V, $V_{OUT}$ = 3.3V | < 0.15A<br>< 0.1A |

## QUICK START PROCEDURE

Demonstration circuit 1797A is easy to set up to evaluate the performance of the LTC3536. For proper measurement equipment configuration, set up the circuit according to the diagram in Figure 1. Before proceeding to test, insert shunts into JP1 fixed frequency and JP2 off positions, which connects the RUN pin to ground (GND), and thus, shutdown the circuit.

**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 $V_{IN}$ or $V_{OUT}$ and GND terminals. See Figure 2 for proper scope probe technique.

1. With the DC1797 set up according to the proper measurement and equipment in Figure 1, apply 5V at $V_{IN}$. Measure $V_{OUT}$; it should read 0V. If desired, one can measure the shutdown supply current at this point. The supply current will be approximately 3µA, or less, in shutdown.
2. Turn on the circuit by inserting the shunt in header JP2 into the ON position. The output voltage should be regulating. Measure $V_{OUT}$ — it should measure 3.3V ±% (Do not apply more than the rated maximum voltage of 5.5V to the board or the part may be damaged).
3. Vary the converter load, which should not exceed 1A at $V_{IN}$ 5.0V.
4. Vary the input voltage from 1.8V to 5.5V, the available output current depends on the input voltage, see the LTC3536 data sheet for details.
5. Set output current to zero and move jumper JP2 into Burst Mode position and measure $V_{OUT}$ — it should register 3.3V ±1%.
6. Vary the input voltage from 1.8V to 5.5V, the available output current depends on the input voltage. Load in Burst Mode operation should no exceed 0.15A at $V_{IN}$ 5.0V and 0.1A at 2.5V, see the LTC3536 data sheet for details.

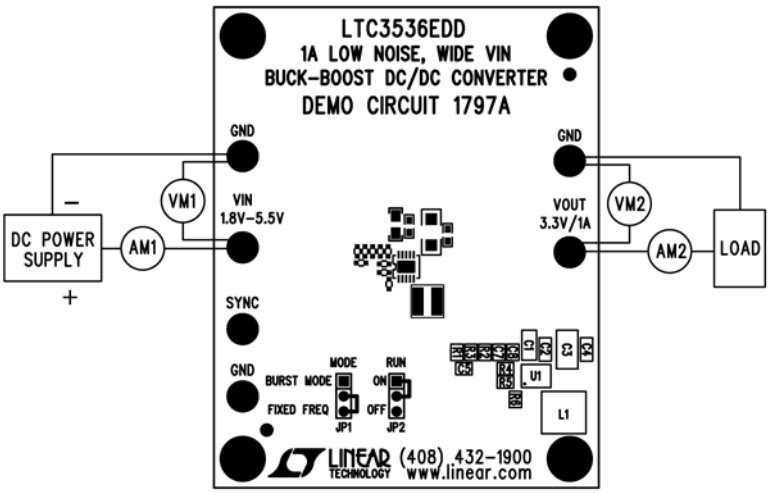



**Figure 1. Proper Measurement Equipment Setup**

## QUICK START PROCEDURE

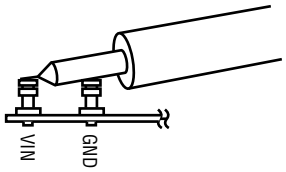



**Figure 2. Measuring Input or Output Ripple**

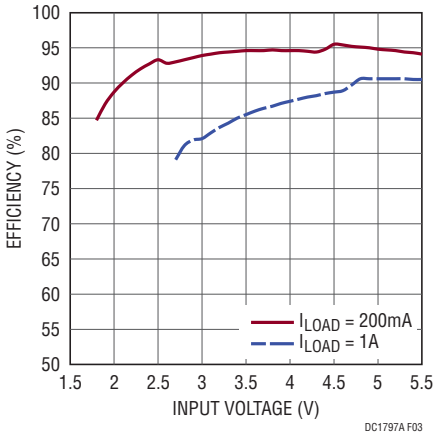



**Figure 3. Efficiency vs Input Voltage**

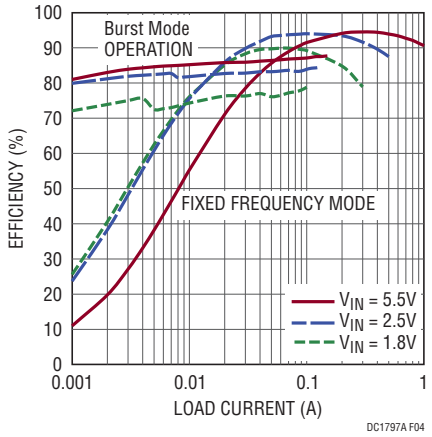



**Figure 4. Efficiency vs Input Voltage for Fixed Frequency and Burst Mode Operation**

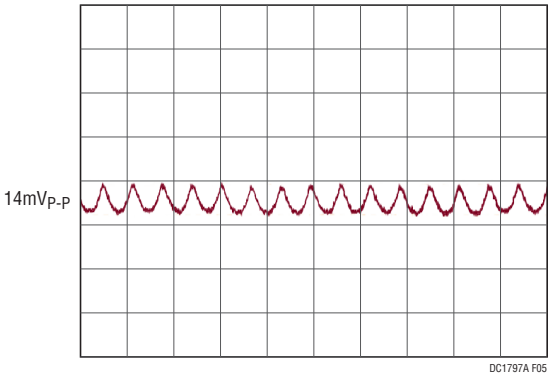
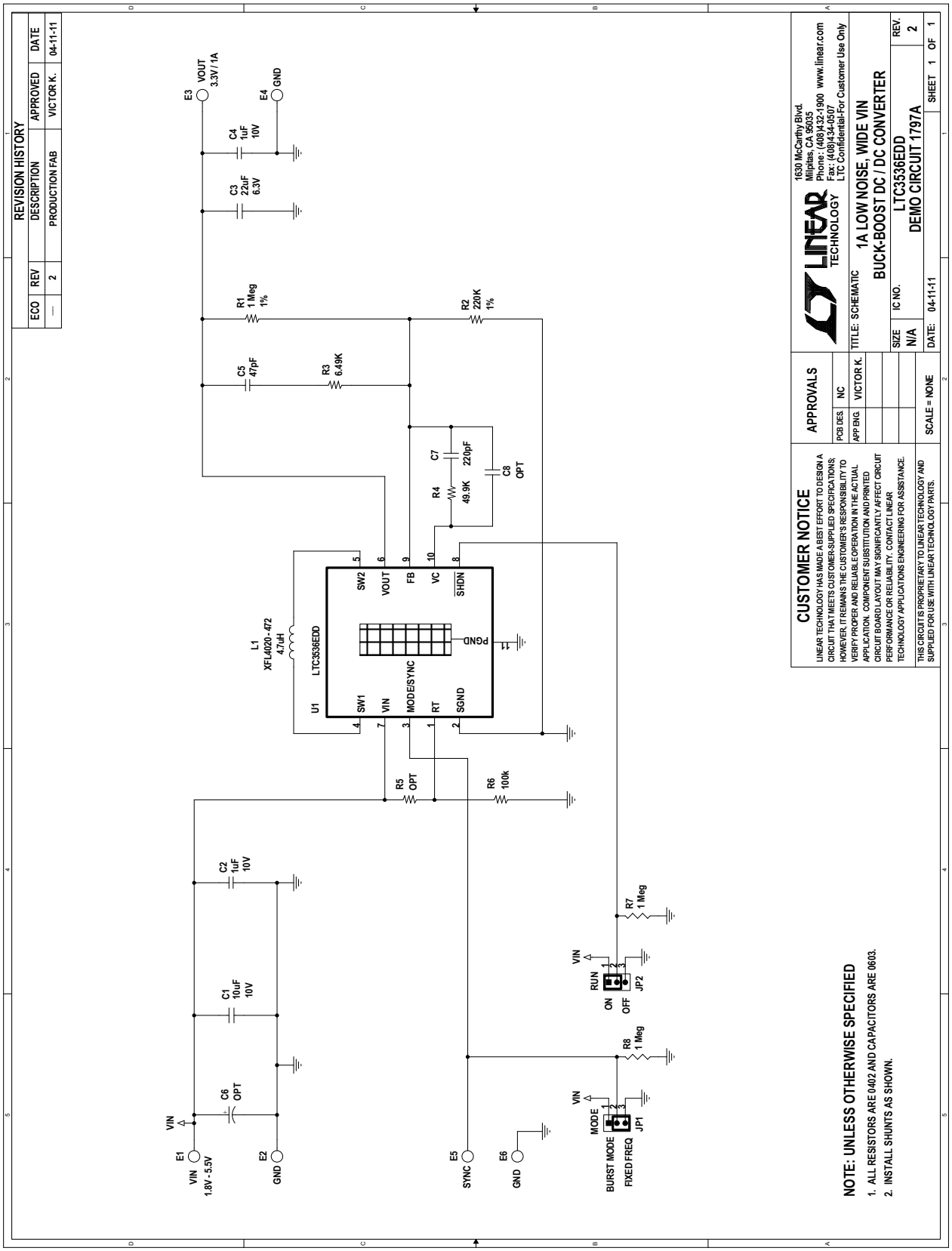



**Figure 5. Output Noise, $V_{IN}$ = 4.5V, $I_{OUT}$ = 1A**

## PARTS LIST

| ITEM | QTY | REFERENCE | PART DESCRIPTION | MANUFACTURER, PART NUMBER |
|---|---|---|---|---|
| **Required Circuit Components** | | | | |
| 1 | 1 | C1 | Capacitor Ceramic 10µF 10V X5R 10% 0805 | Murata, GRM21BR61A106KE19L |
| 2 | 2 | C2, C4 | Capacitor Ceramic 1.0µF 10V X7R 20% 0603 | AVX, 06036C105MAT2A |
| 3 | 1 | C3 | Capacitor Ceramic 22µF 6.3V X5R 10% 1206 | AVX, 12066D226KAT2A |
| 4 | 1 | C5 | Capacitor Ceramic 47PF 50V C0G 5% 0402 | TDK, C1005C0G1H470J |
| 5 | 1 | C7 | Capacitor Ceramic 220PF 50V C0G 5% 0402 | Murata, GRM1555C1H221JA01D |
| 6 | 1 | L1 | Inductor, 4.7µH | Coilcraft XFL4020-472MEC |
| 7 | 3 | R1, R7, R8 | Resistor 1.00MΩ 1/16W 1% 0402 SMD | Vishay, CRCW04021M00FK |
| 8 | 1 | R2 | Resistor 220kΩ 1/16W 1% 0402 SMD | Vishay, CRCW0402220KFKED |
| 9 | 1 | R3 | Resistor 6.49kΩ 1/16W 1% 0402 SMD | Vishay, CRCW04026K49FKED |
| 10 | 1 | R4 | Resistor 49.9kΩ 1/16W 1% 0402 SMD | Vishay, CRCW040249K9FKED |
| 11 | 1 | R6 | Resistor 100kΩ 1/16W 1% 0402 SMD | Vishay, CRCW0402100KFKED |
| 12 | 1 | U1 | Buck-Boost Converter | Linear Technology, LTC3536EDD |
| **Additional Demo Board Circuit Components** | | | | |
| 1 | 0 | C6 | Capacitor, POSCAP 47µF 10V | Sanyo, 10TPB47MC, Optional |
| 2 | 0 | C8 | Capacitor C0G 0402 | Optional |
| 3 | 0 | R5 | Resistor, 0402 | Optional |
| **Hardware** | | | | |
| 1 | 4 | MH1–MH4 | Stand-Off, Nylon (Snap On), 0.375" Tall | Keystone, 8832 |
| 2 | 6 | E1, E2, E3, E4, E5, E6 | Turret, 0.09 Diameter | Mill-Max, 2501-2-00-80-00-00-07-0 |
| 3 | 2 | JP2, JP1 | Headers, 3 Pins, 2mm CTRs | Samtec, TMM-103-02-L-S |
| 4 | 2 | XJP1, XJP2 | Shunt, 2mm CTRs | Samtec, 2SN-BK-G |
| 5 | 1 | FAB, Printed Circuit Board | Demo Circuit 1797A-2 | |

## SCHEMATIC DIAGRAM



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