



# DESIGN NOTES

## SOT-23 DC/DC Converters Generate Up to $\pm 35\text{V}$ Outputs and Consume Only $20\mu\text{A}$ of Quiescent Current – Design Note 223

Bryan Legates

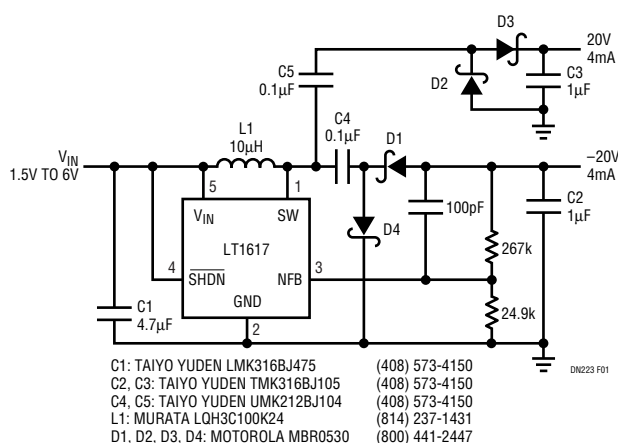
Today's portable devices need small power supply solutions that operate with a minimum of supply current. To meet these needs, Linear Technology introduces the LT<sup>®</sup>1615, LT1615-1, LT1617 and LT1617-1 micropower SOT-23 DC/DC converters. With an input voltage range as low as 1V and an output voltage range as high as  $\pm 35\text{V}$ , these devices provide considerable power supply design flexibility.

The LT1615 and LT1615-1 are designed to regulate positive output voltages, whereas the LT1617 and LT1617-1 are designed to directly regulate negative output voltages without the need for feedback level-shifting circuitry. The LT1615 and LT1617 have a 350mA current limit and a minimum input voltage of 1.2V, whereas the LT1615-1 and LT1617-1 have a lower, 100mA current limit and a minimum input voltage of 1V. All four converters use tiny, low profile inductors and capacitors to minimize the overall system footprint and cost. With a quiescent current of only  $20\mu\text{A}$  and a shutdown current of  $0.5\mu\text{A}$ , these devices squeeze the most life out of any battery-powered application.

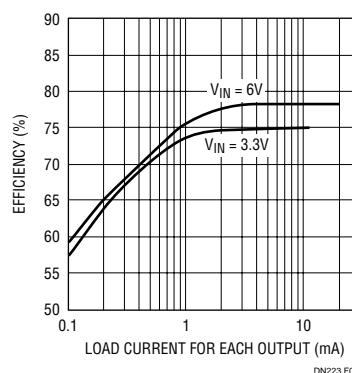
### $\pm 20\text{V}$ Dual-Output Converter with Output Disconnect

Today, most portable devices use a liquid crystal display (LCD). Different manufacturers require substantially different bias voltages for their LCDs. Typically, a single 9V to 25V supply is needed (either positive or negative), but some LCDs require both a positive and negative supply. Figure 1 shows a  $\pm 20\text{V}$  dual-output converter ideally suited for LCD bias applications needing both supplies. Both outputs are developed using charge pumps, so both are disconnected from the input when the LT1617 is turned off. Because the supplies are generated in the same manner, this circuit features excellent cross regulation: for a  $5\times$  difference in output currents, the positive and negative output voltages differ less than 1%; for a  $10\times$  difference, they differ less than 2%. A similar circuit can be implemented using the LT1615 if the regulation of the positive output is more important. As shown in Figure 2, efficiency reaches 78% with a fresh 4-cell alkaline battery.

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**Figure 1.  $\pm 20\text{V}$  Dual Output Converter with Output Disconnect**



**Figure 2.  $\pm 20\text{V}$  Dual Output Converter Efficiency**

## 24V Boost Converter

Figure 3 shows a circuit ideal for LCD applications needing only a positive bias voltage. This 24V boost converter delivers 10mA from a nearly discharged single Li-Ion cell. An input voltage as low as 1.5V can be used with this converter, but the output current capability reduces to 5mA. Converter efficiency is shown in Figure 4.

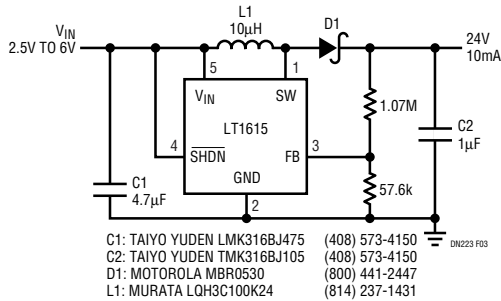


Figure 3. 24V Boost Converter

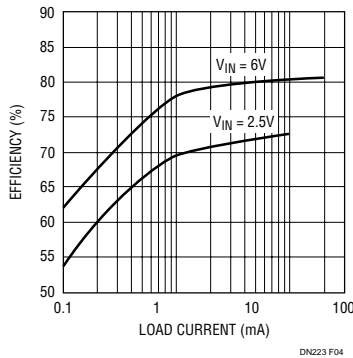


Figure 4. 24V Boost Converter Efficiency

## 1V to 35V Boost Converter

The circuit in Figure 5 shows the impressive input and output voltage range of the LT1615-1. As shown, the circuit will work from one to four alkaline cells or a single cell Li-Ion battery. The maximum input voltage for this circuit is limited by the 6.3V voltage rating on the input capacitor, C1. The LT1615-1 can operate with an input voltage as high as 15V. The output current is limited by the 1V minimum input (this converter can provide 2mA with a 3V input). If a larger output current is needed, but operation from a 1V input is not required, use an LT1615 in place of the LT1615-1 to obtain a 3× increase in maximum output current.

### Data Sheet Download

<http://www.linear-tech.com/go/dnLT1615>  
<http://www.linear-tech.com/go/dnLT1617>

## 1-Cell to 3V Boost Converter

A 1-cell alkaline to 3V boost converter using the LT1615-1 is shown in Figure 6. Capable of providing 15mA of output current, this converter occupies a board area less than 1/4" by 5/16" (less than 0.078 inches<sup>2</sup>). See Figure 7 for converter efficiency, which reaches 75% with a fresh 1-cell alkaline battery.

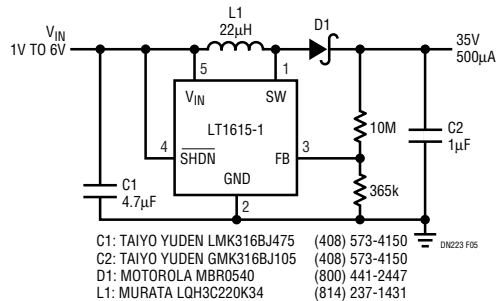


Figure 5. 1V to 35V Boost Converter

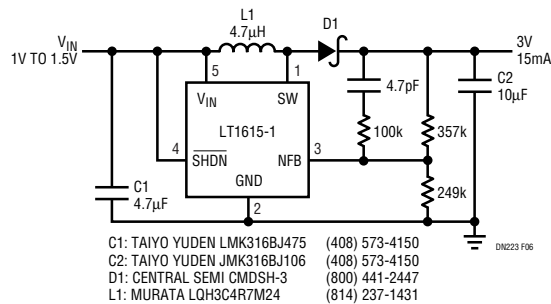


Figure 6. 1-Cell Alkaline to 3V Boost Converter

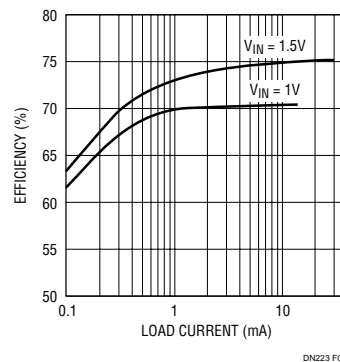


Figure 7. 1-Cell to 3V Boost Converter Efficiency

For literature on our DC/DC Converters, call **1-800-4-LINEAR**. For applications help, call (408) 432-1900, Ext. 2593