DESIGN NOTES

DC-DC Converters for Portable Computers – Design Note 52

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Portable computers require simple and efficient converters for +5V power and display driving. A regulated 5V supply can be generated from two "AA" cells using the circuit shown in Figure 1. U1, an LT1073-5 micropower DC-DC converter, is arranged as a step-up, or "boost" converter. The 5V output, monitored by U1's SENSE pin, is internally divided down and compared to a 212mV reference voltage inside the device. U1's oscillator turns on when the output drops below 5V, cycling the switch on and off at a 19kHz rate. This action alternately causes current to build up in L1, then dump into C1 through D1, increasing the output voltage. When the output reaches 5V, the oscillator turns off. The gated oscillator provides the mechanism to keep the output at a constant 5V. R1 invokes the current limit feature of the LT1073, limiting peak switch current to 1A. U1 limits switch current by turning off the switch when the current reaches the programmed limit set by R1. Switch "on" time, therefore, decreases as V_{IN} is increased. Switch "off" time is not affected. This scheme keeps peak switch current constant over the entire input voltage range, allowing maximum energy transfer to occur at low battery voltage without exceeding L1's maximum current rating at high battery voltage.

The circuit delivers 5V at 150mA from an input range of 3.5V to 2.0V. Efficiency measures 80% at 3.0V, decreasing to 70% at 2.0V for load currents in the 15mA to 150mA range. Output ripple measures 170mVp-p and no-load quiescent current is just 135μA.

A −24V LCD bias generator is shown in Figure 2. In this circuit U1 is an LT1173 micropower DC-DC converter. The 3V input is converted to +24V by U1's switch, L1, D1, and C1. The switch pin (SW1) then drives a charge pump composed of C2, C3, D2, and D3 to generate –24V. Line regulation is less than 0.2% from 3.3V to 2.0V inputs. Load regulation, although it suffers somewhat since the −24V output is not directly regulated, measures 2% from a 1mA to 7mA load. The circuit will deliver 7mA from a 2.0V input at 73% efficiency.

If greater output power is required, Figure 2's circuit can be driven from a +5V source. R1 should be changed to

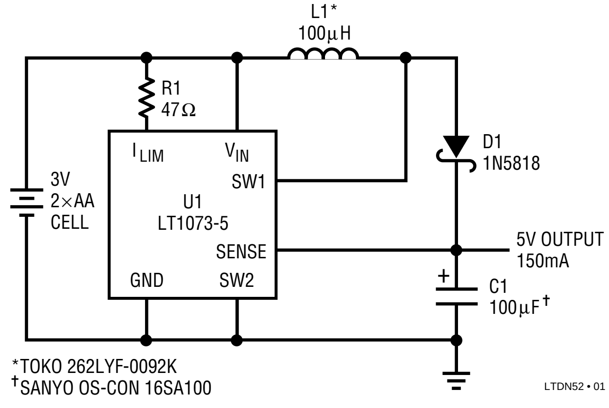


Figure 1. Two "AA" Cell to 5V Step-Up Converter Delivers 150mA

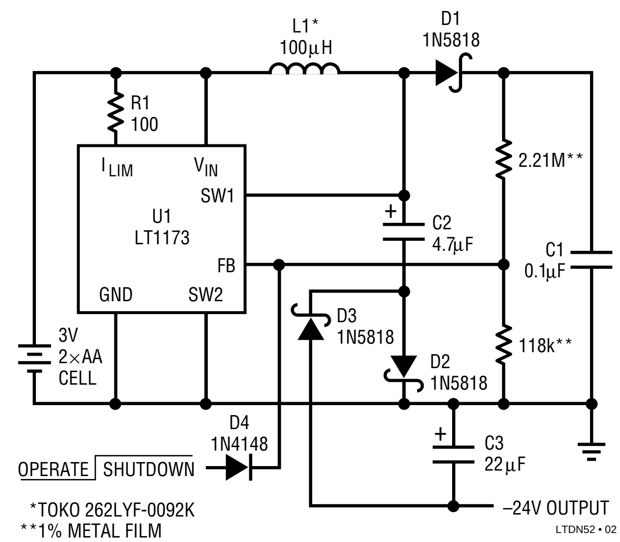


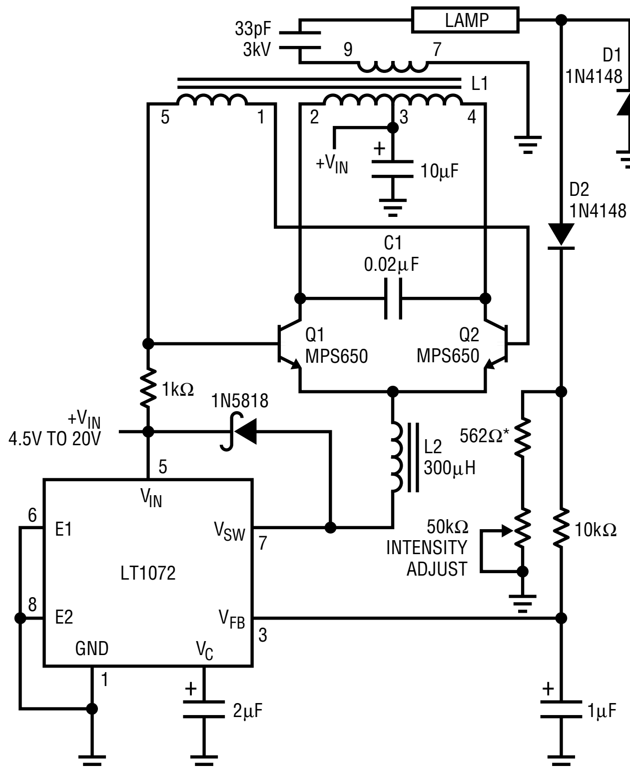
Figure 2. DC to DC Converter Generates –24V from 3V or 5V

47Ω and C3 to 47µF. With a 5V input, 40mA is available at 75% efficiency. Shutdown is accomplished by bringing the anode of D4 to a logic high, forcing the feedback pin of U1 to go above the internal reference voltage of 1.25V. Shutdown current is 110µA from the input source and 36µA from the shutdown signal.

Current generation portables require back lit LCD displays using cold cathode fluorescent lamps (CCFLs). Figure 3 provides 78% efficiency with full control over lamp brightness. 82% efficiency is possible if the LT1072 is driven from a low voltage (e.g. 3V-5V) source. Additional benefits include a 4.5V to 20V supply range and low radiated power due to sine wave based operation.

L1 and the transistors comprise a current driven Royer class converter which oscillates at a frequency primarily set by L1's characteristics and the 0.02µF capacitor. LT1072 driven L2 sets the magnitude of the Q1-Q2 tail current, and hence L1's drive level. The 1N5818 diode maintains current flow when the LT1072 is off.

The 0.02µF capacitor combines wth L1's characteristics to produce sine wave voltage drive at the Q1 and Q2 collectors. L1 furnishes voltage step-up, and about 1400Vp-p appears at its secondary. Current flows through the 33pF capacitor into the lamp. On negative waveform cycles the lamp's current is steered to ground via D1. Positive waveform cycles are directed, via D2, to the ground referred 562Ω-50k potentiometer chain. The positive half-sine appearing across these resistors represents 1/2 the lamp current. This signal is filtered by the 10k-1µF pair and presented to the LT1072's feedback pin. This connection closes a control loop which regulates lamp current. The 2µF capacitor at the LT1072's V_C pin provides stable loop compensation. The loop forces the LT1072 to switch-mode modulate L2's average current to whatever value is required to maintain a constant current in the lamp. The constant current's value, and hence lamp intensity, may be varied with the potentiometer. The constant current drive allows full 0-100% intensity control with no lamp dead zones or "pop-on" at low intensities. Additionally, lamp life is enhanced because current cannot increase as the lamp ages. Detailed information on this circuit appears in LTC Application Note 45, "Measurement and Control Circuit Collection."



C1 = MUST BE A LOW LOSS CAPACITOR.
METALIZED POLYCARB
WIMA FPK 2 (GERMAN) RECOMMENDED.
L1 = SUMIDA 6345-020 OR COILTRONIX CTX110092-1.
PIN NUMBERS SHOWN FOR COILTRONIX UNIT
L2 = COILTRONIX CTX300-4
* = 1% FILM RESISTOR
DO NOT SUBSTITUTE COMPONENTS

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Figure 3. Cold Cathode Fluorescent Lamp Power Supply

For literature on our DC-DC Converters, call **(800) 637-5545**. For applications help, call (408) 432-1900, Ext. 456

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