LM2623 Cookbook

National Semiconductor
Application Note 1221
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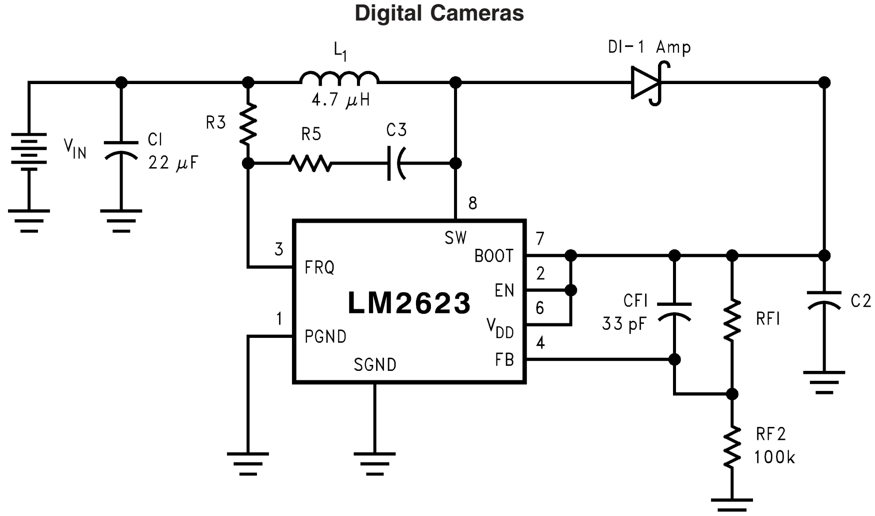
LM2623 General Purpose, Boost Converter Circuit

The next page shows the generic application circuit for LM2623 boost converters. The LM2623 boost converter circuits are very conventional, except for the ratio adaptive circuitry that is used to change the duty cycle. These components adjust the duty cycle to match it to the input/output voltage ratio requirements. R3 provides the drive current for the oscillator (frequency increases with lower resistance values). C3 and R5 provide the duty cycle adjustment. The default duty cycle when C3 and R5 are left out is about 17%. The value of C3 generally determines the total amount of charge transfer and resulting duty cycle adjustment. Smaller R3 values require larger C3 values (more charge transfer) to achieve the same duty cycle adjustment percentage. When more than 17% is necessary and it is not necessary to adjust the duty cycle dynamically (as the input to output voltage ratio changes), R5 can be omitted. Adding R5 allows the duty cycle to change as the input to output voltage ratio changes due to the battery discharging in portable applications. In applications where the fresh or fully charged battery voltage is close to the output voltage (2 cells generating 3.3V), the optimum duty cycle changes dramatically as the battery discharges. Use of the correct R5 in these situations will optimize the duty cycle for the voltage ratio and minimize the ripple due to overshoot caused by stored energy in the coil.

The table of values below the application circuit on the next page should produce good performance for the application requirements stated. Recommended inductor values are based on input voltage, load current and operating frequency. 4.7 µH works well in most LM2623 two cell applications. 6.8 µH works well in most LM2623 LiIon or three cell applications. RF1 and RF2 set the output voltage by dividing the output voltage for comparison to the reference at the pin 4 FB pin. CF1 couples the AC ripple from the output directly into the comparator at pin 4. When in regulation, this triggers the regulation limit each switching cycle. Triggering this limit allows the comparator to make the voltage comparison from the same direction (above the limit) each switching cycle. This minimizes the hysteretic component of ripple. A 68 µF or larger output capacitor is recommended to minimize ripple resulting from overshoot due to stored energy in the coil. The rectifier diode should be selected as a function of peak currents and efficiency requirements.

LM2623 Boost Converter Circuit
Typical Applications
Digital Cameras



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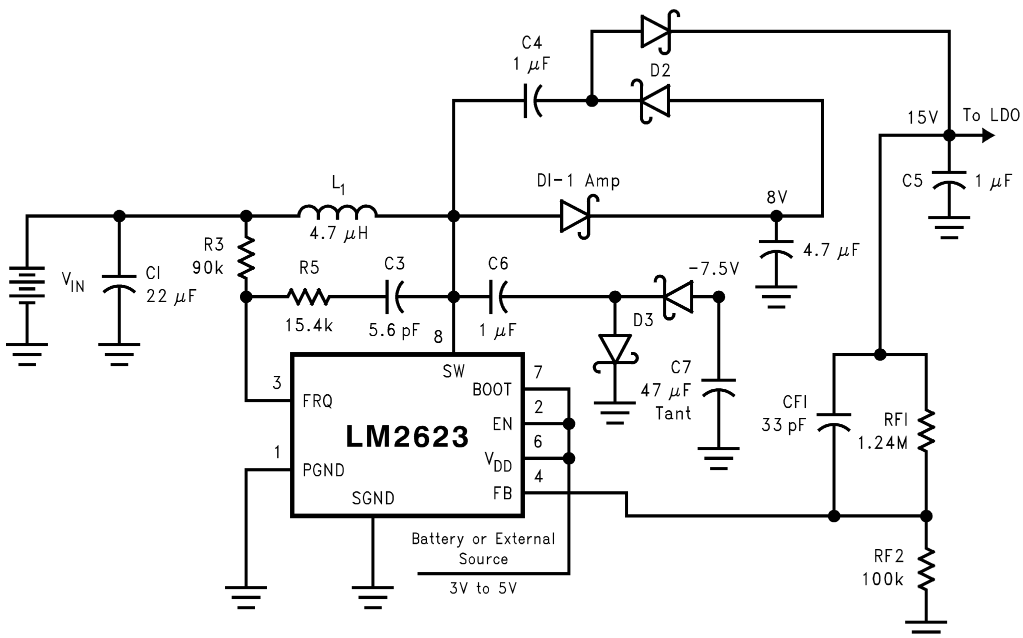
V_{IN}	Load Type	V_{OUT}	RFI	R3	R5	C3	C2
2 Cells	Analog/Digital	3.6V	182k	90k	35k	3.3 pF	100 µF Tant + 4.7 µF Cer
2 Cells	Motor Drive	5V	300k	90k	22k	4.7 pF	68 µF Tant
3 Cells or Li I	Motor Drive	5V	300k	150k	35k	4.7 pF	68 µF Tant

Dual Output Supply for CCD/LCD from 2 Cell Input

This supply begins with a general purpose, 8V, boost converter circuit. Conventional, plus and minus doubler circuits are then added to generate a regulated 16V and a tracking, negative supply (nominally −7.5V). Since the −7.5V supply tracks but is not regulated, a large capacitor (47 µF) is required to keep the voltage close to a regulated value. The 16V supply is regulated, so a smaller capacitor value (1 µF) can be used. Dual SOT-23 diode packages are recommended to minimize component count in the doubler circuits. Losses in the primary 8V stage are reflected in both the 16V and −7.5V outputs, so a one amp schottky and 4.7 µF capacitor are recommended here. The V_{DD} supply on the IC can run off the 8V output or be supplied externally from a minimum 3V source.

The circuit as shown will put out about 800 mW. Conversion efficiency of the 8V primary stage is typically over 80% for nominal loads. Efficiency of the final output stages will be in the low to mid 70s for nominal loads. In typical applications, the 16V usually goes through an LDO to satisfy the very low ripple requirements of the CCD. The −7.5V supply may also need to be followed by a linear regulator or filter to be used for CCDs.

LM2623 Dual Output Converter Circuit
Typical Applications
Digital Cameras CCD/LCD Supply



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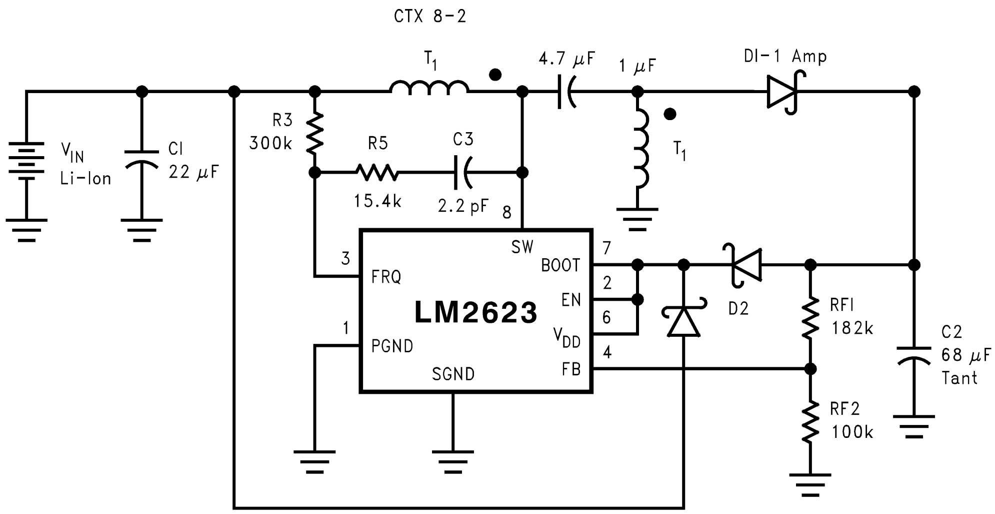
Transformer Coupled, (SEPIC) Converter for LI-ION or 3 Cell Input

Transformer coupled solutions are commonly used in cases where multiple output voltages are required. The application shown below uses a single output winding to obtain 3.3V. Because of the inherent stability of the on/off control system in the LM2623, the control portion of the circuit does not need to change when multiple output windings are added. The circuit shown is a generic example for generating any number of outputs from a single Lithium-Ion cell, as long as the 3.3V output is used for regulation. Efficiencies of 75% to 80% can be obtained for generation of 3.3V with this circuit configuration.

LM2623 Sepic Circuit
Typical Applications
Digital Cameras



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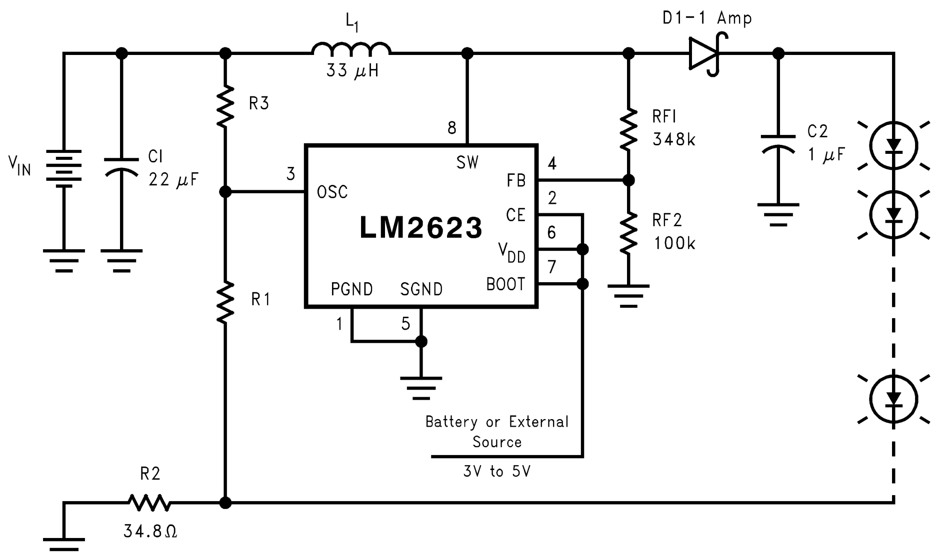
White Led Driver Application Circuits

Optimal drive circuits for LEDs require reasonable current regulation and very high efficiency. Since the human eye cannot detect small variations in light intensity, particularly when adjacent LEDs are driven with the same current, tight regulation tolerances used for processor voltage sources are not necessary. Most power supply ICs use 1.2V bandgap references and these are typically used to sense current for current source applications. The application circuit shown on the next page uses about .6V drop in series with LEDs to sense current. This reduces the losses in a 2 LED circuit by about 9%. The LED current will usually be held within 10% for input voltage, temperature, LED voltage and IC process variations combined. Typical regulation is much closer than that.

The application circuit shown below is a balanced circuit that draws essentially constant power from the battery. Constant power with a constant voltage load results in constant current drive. The oscillator is supplied current through R3. R1 shunts current away from the oscillator pin through the current sense resistor, R2. The circuit is balanced when the voltage across R2 is approximately .6V. The balance is such that input voltage changes are offset by decreases in oscillator “on time”. This results in constant power being drawn from the battery. Small current fluctuations change the voltage across R2 and increase or decrease the oscillator drive to compensate. This maintains the balance. The IC’s change in frequency with temperature is very well matched to the change in LED voltage with temperature. This also helps to maintain the balance. The output pulse on the switch pin is voltage divided through RF1 and RF2 and triggers the regulation limit each time the switch pin swings positive. When the coil discharges its energy, the output voltage reduces and falls below the regulation limit. This turns the oscillator back on again and the supply goes through another switching cycle. Discharging the coil energy each cycle makes the off time vary in proportion to the on time. The power drawn from the battery is then linear with increases or decreases in on time (rather than varying as the “on time” squared). The circuit needs to be balanced with nominal parts in a given application. Once balanced, it should keep the current constant within 10% for voltage, temperature and part variations. Conversion efficiencies (neglecting the sensing resistor drop) will approach 90%. Over 80% of the input power is actually converted into power driving the LEDs for most input voltage and output loading conditions.

LM2623 White LED Driver Circuit



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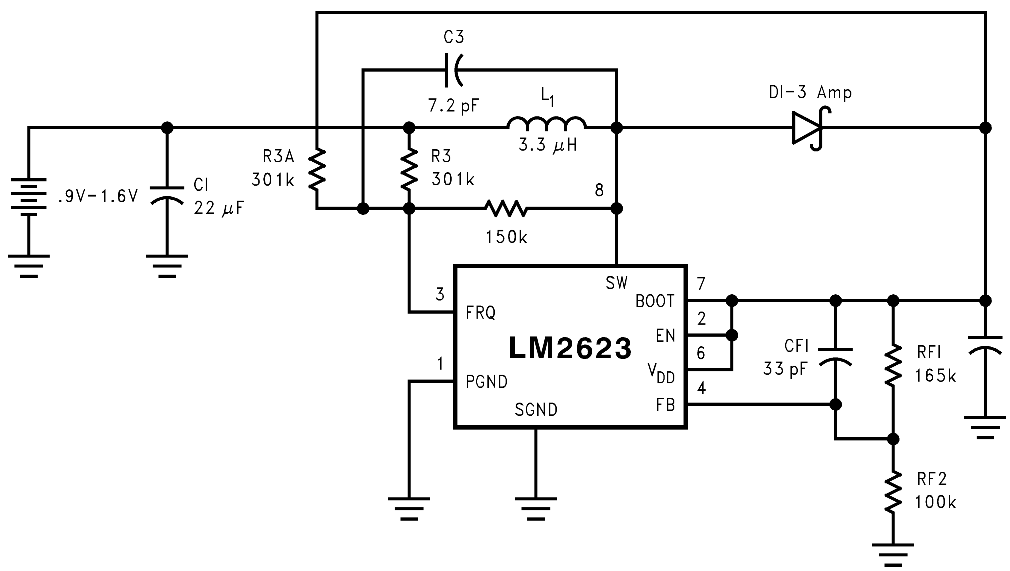
I_{OUT}	LED	V_{IN}	R1	R3	RF1
20 mA	2	3 Cell or LiI	900k	1M	348k
17	3	3 Cell or LiI	1.2M	1.2M	348k
18	2	2 Cells	845k	845k	348k
17.5	3	2 Cells	1.38M	1.33M	348k

Note: For small changes in I_{OUT}, adjust R2 accordingly.

Boost Converter for Single Cell Systems

The LM2623 has a guaranteed start-up voltage of 1.1V @ 25˚C. The start-up voltage is below the open circuit cell potential of NiCad and NiMH over the entire operating range (0 to 85˚C). This allows it to be used for single cell boost converters in rechargeable systems (NiCad and NiMH). Both the V_{DD} supply and the oscillator drive for the IC need to be "boot-strapped" from the output after the supply starts up to insure proper operation. Use of a 3 amp rectifier is recommended to minimize the voltage drop from input to output during start-up to a few millivolts. The addition of R3A drives the oscillator from the output voltage after the supply has started up. Using both R3 and R3A is necessary to allow the duty cycle to vary as the input voltage varies. Efficiencies of 75% to 80% are achievable for conversion from a single cell to 3.3V with the circuit shown.

LM2623 1 Cell Converter Circuit
Typical Applications
Pager or Digital Cameras



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