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Boost converter generates three analog rails

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The standard boost converter in **Figure 1** uses not only IC_1, C_1, L_1, D_1, and C_2 to generate a main 5V output, but also additional small, low-cost components to provide two auxiliary supply rails of 10 and –5V. These auxiliary outputs are useful for analog circuitry in small handheld instruments, which often require supply voltages greater than the signal range. Input voltages of 0.8 to 5.5V, which is equivalent to voltages from a battery pack of one to three cells, sustain the main regulated output of 5V±2%. With an input of 1.8V from two flat cells, for instance, and with the other rails unloaded, the circuit can produce 25 mA with 80 to 90% efficiency.

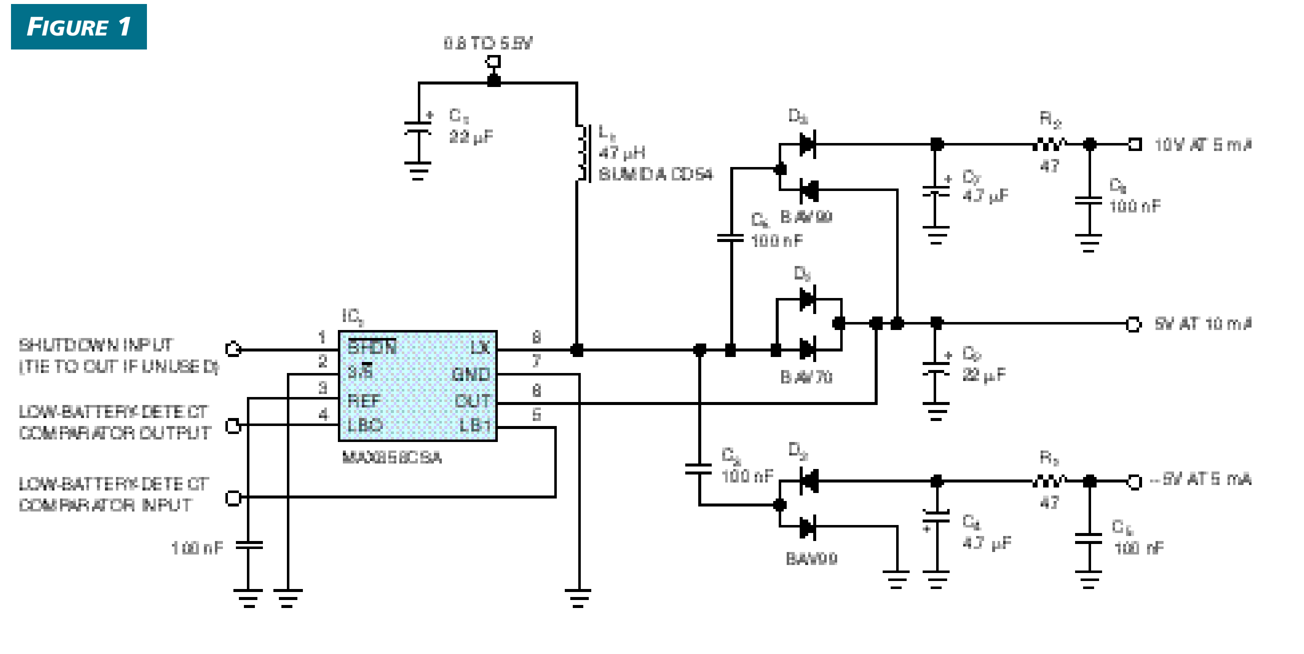
The converter's LX switching node drives low-cost, discrete charge pumps via "flying capacitors" C_3 and C_6 to create the –5V and 10V outputs. The LX node switches between 0V and a level-one diode drop above the 5V rail, so the charge pumps' drive voltage is reasonably well-regulated. Moreover, the drop across D_1 roughly compensates for diode drops in the two charge-pump outputs. IC_1's internal control scheme also assists in regulating the auxiliary outputs. This IC's current-limited, minimum-off-time, pulse-frequency modulation constantly adapts its switching frequency to the net load current; the frequency increases when the load increases, producing a greater transfer of energy via the flying capacitors. The result is a type of pseudoregulation for the charge-pump outputs.

These analog supply rails can drive precision op amps, such as the MAX400 and OP-07, whose input common-mode-rejection and output-range specifications are 2 to 3V within the supply rails. Thus, the rails are good enough if the –5V output is less than –3V and the 10V output is more than 8V. Accordingly, the component choices in **Figure 1**, such as the lossy RC output filters and silicon signal diodes in place of Schottky diodes, provide for minimal cost and ripple rather than maximum regulation. The 4.7-μF capacitors, C_4 and C_7, can be high-ESR, commodity, multilayer-ceramic types with 16V ratings, a 1206 case, and a Y5V dielectric, such as the 1206YG475ZAT2A from AVX Corp (www.avxcorp.com).

The output ripple varies with the supply voltage and output load. Operating with an input voltage of 1.8V, the circuit produces ripple amplitudes over the load of 2 to 10 mV p-p for the 10V rail and 15 to 30 mV p-p for the –5V rail. By increasing C_5 and C_8 to 2.2 μF, you can reduce these ripple levels to 1 and 5 mV, respectively.

With no load on the auxiliary rails, the 5V output's maximum available load current rises with input supply voltage (**Figure 2a**). You can increase this available output power by replacing D_1 with a lower loss Schottky diode. At an input of 1.8V, the output power available for the three rails (loaded with 10 mA at 5V, 5 mA at 10V, and 5 mA at –5V) is somewhat less than 125 mA; with a 5-mA load, the 10V and –5V outputs are approximately 9.75 and –3.7V, respectively (**Figure 2b**). A 2.7V input based on three flat cells yields

FIGURE 1



Adding external charge pumps to this 5V boost converter produces auxiliary analog rails of 10 and –5V.

around 275 mW.

The MAX858 operates with peak inductor currents of 125 mA. If you need more current, you can replace this IC with related parts that have 500 mA and 1A ratings. Note that these changes require different passive components; the inductor and main output diode ratings must match the inductor's peak current. The charge pumps can remain the same if their output currents don't change much.

You can also retain the cheap, common, commodity dual diodes D_1, D_2, and D_3, but detail specifications vary, so look carefully at data sheets for the part you actually use. For example, the BAV70's dc forward current, I_F, and peak forward surge current, I_{FSM} for 1 µsec, differ among manufacturers. For the Motorola (www.motorola.com) part, I_F=200 mA, and I_{FSM}=500 mA. For National Semiconductor (www.national.com), I_F=600 mA, and I_{FSM}=2A. For Philips (www.philips.com), I_F=125 mA, and I_{FSM}=4A, and for Vishay-Siliconix (www.siliconix.com), I_F=250 mA, and I_{FSM}=4.5A. This caution is advisable in all second-source considerations. (DI #2200) EDN

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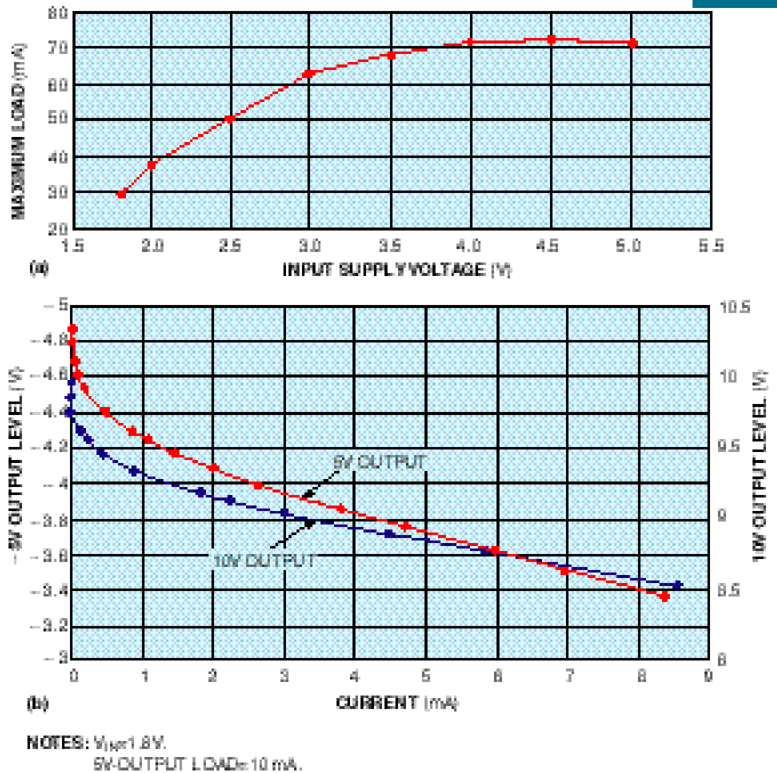
FIGURE 2



With auxiliary rails unloaded, the 5V output's maximum available load current rises with input supply voltage (a). The auxiliary-output voltage levels depend on the load current (b).