

Dual Charge-Pump Voltage Converter

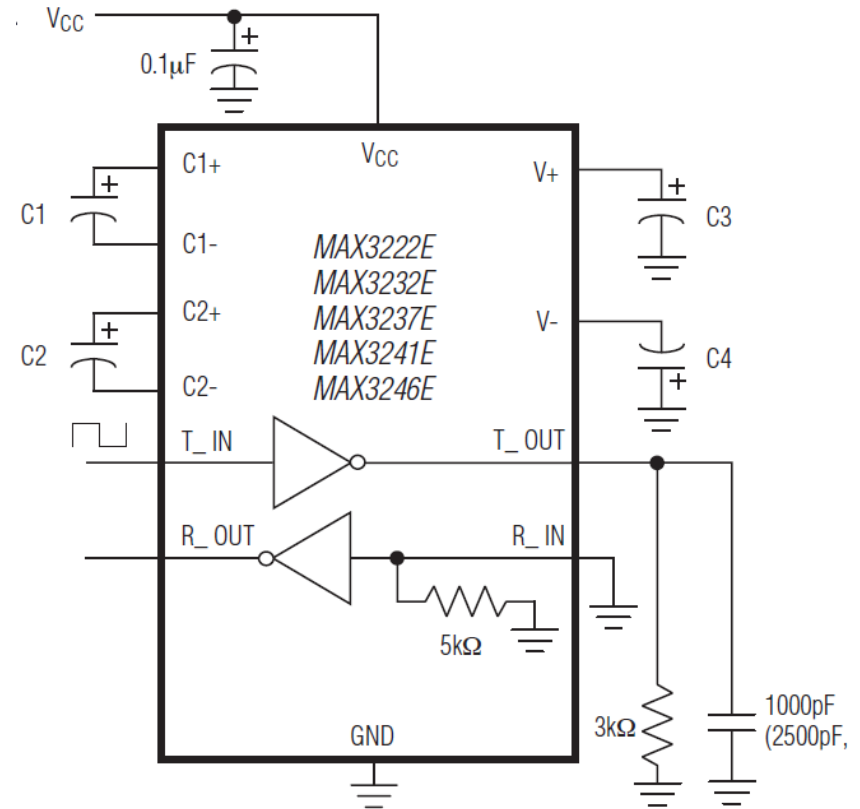
The MAX3222E/MAX3232E/MAX3237E/MAX3241E/MAX3246E's internal power supply consists of a regulated dual charge pump that provides output voltages of +5.5V (doubling charge pump) and -5.5V (inverting charge pump) over the +3.0V to +5.5V VCC range. The charge pump operates in discontinuous mode; if the output voltages are less than 5.5V, the charge pump is enabled, and if the output voltages exceed 5.5V, the charge pump is disabled. Each charge pump requires a flying capacitor (C1, C2) and a reservoir capacitor (C3, C4) to generate the V+ and V- supplies (Figure 1).

Table 2. Required Minimum Capacitor Values

VCC (V)	C1 (μ F)	C2, C3, C4 (μ F)
MAX3222E/MAX3232E/MAX3241E		
3.0 to 3.6	0.1	0.1
4.5 to 5.5	0.047	0.33
3.0 to 5.5	0.1	0.47

Capacitor Selection

The capacitor type used for C1–C4 is not critical for proper operation; polarized or nonpolarized capacitors can be used. The charge pump requires 0.1 μ F capacitors for 3.3V operation. For other supply voltages, see Table 2 for required capacitor values. Do not use values smaller than those listed in Table 2. Increasing the capacitor values (e.g., by a factor of 2) reduces ripple on the transmitter outputs and slightly reduces power consumption. C2, C3, and C4 can be increased without changing C1's value. **However, do not increase C1 without also increasing the values of C2, C3, C4, and CBYPASS to maintain the proper ratios (C1 to the other capacitors).**

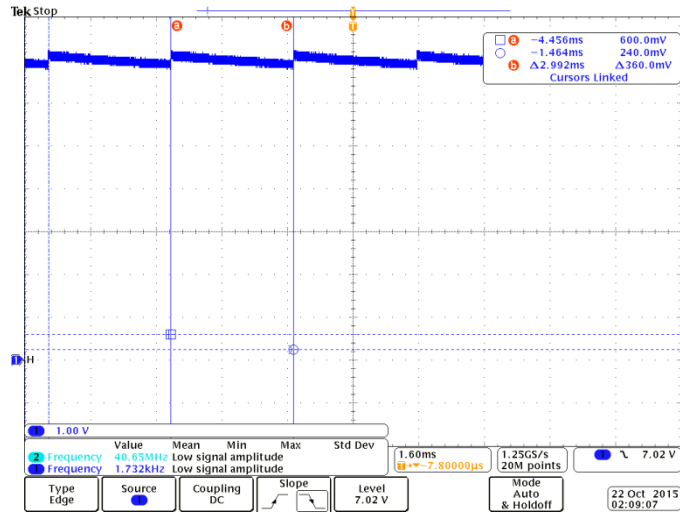


Power-Supply Decoupling

In most circumstances, a 0.1 μ F VCC bypass capacitor is adequate. In applications sensitive to power-supply noise, use a capacitor of the same value as charge-pump capacitor C1. Connect bypass capacitors as close to the IC as possible.

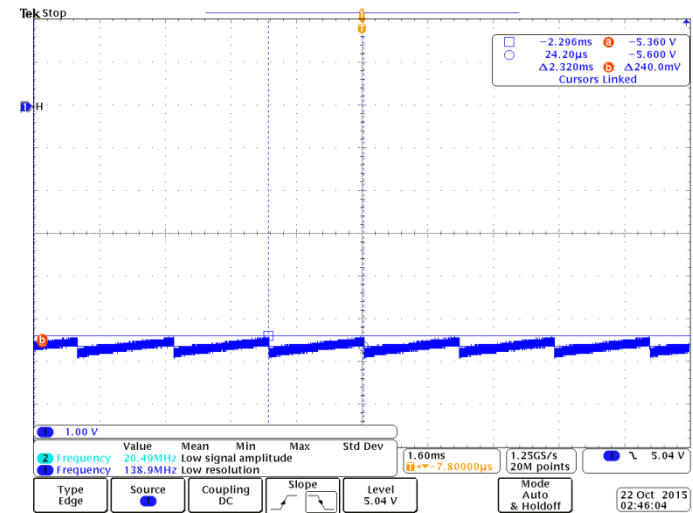
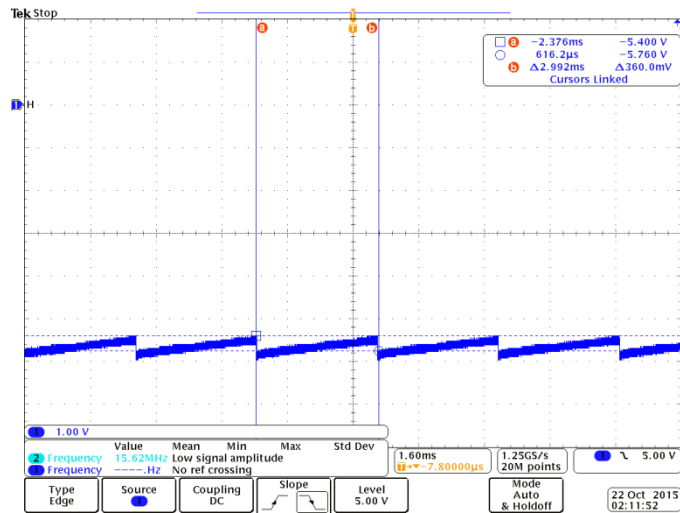
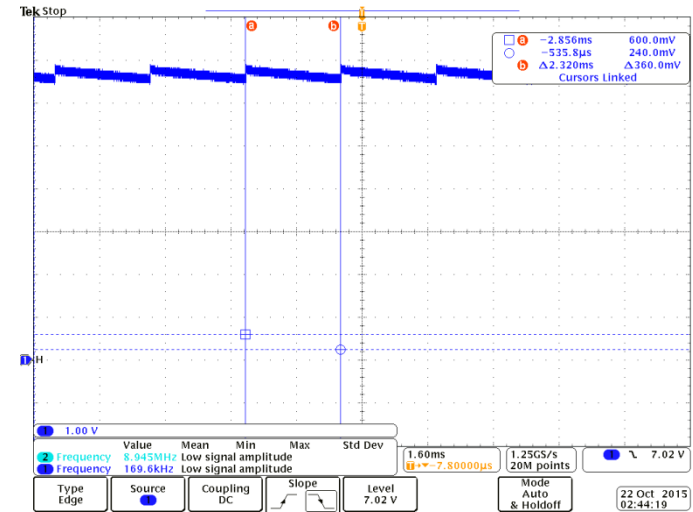
V+

Original 1 μ F C1 and Vcc capacitors



V-

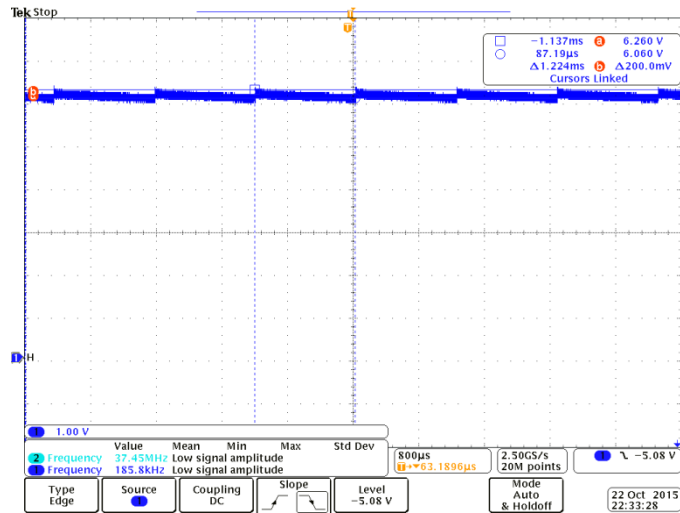
0.15 μ F C1 and Vcc capacitors



V+

0.047 μ F C1 capacitor

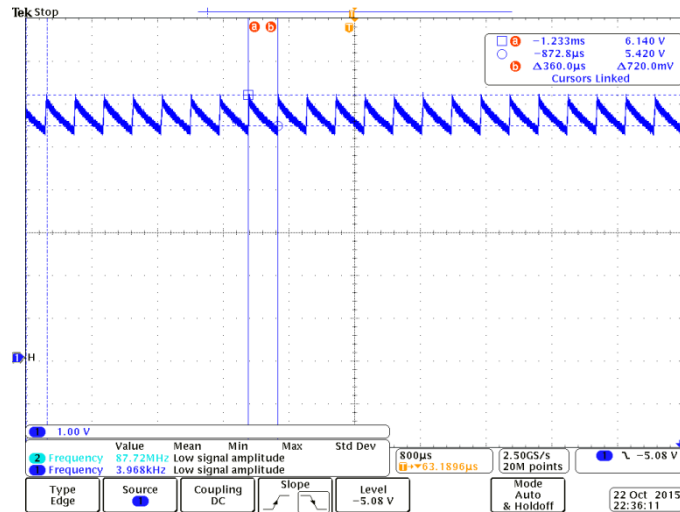
No load during measurement



V+

0.047 μ F C1

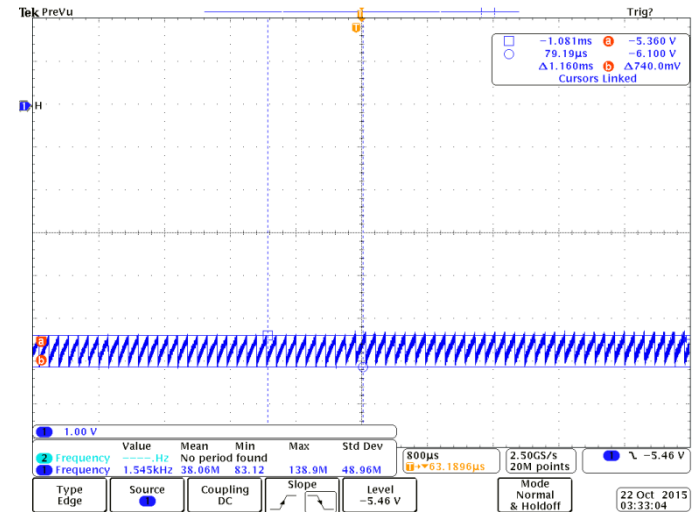
Added 3k Ω load during measurement

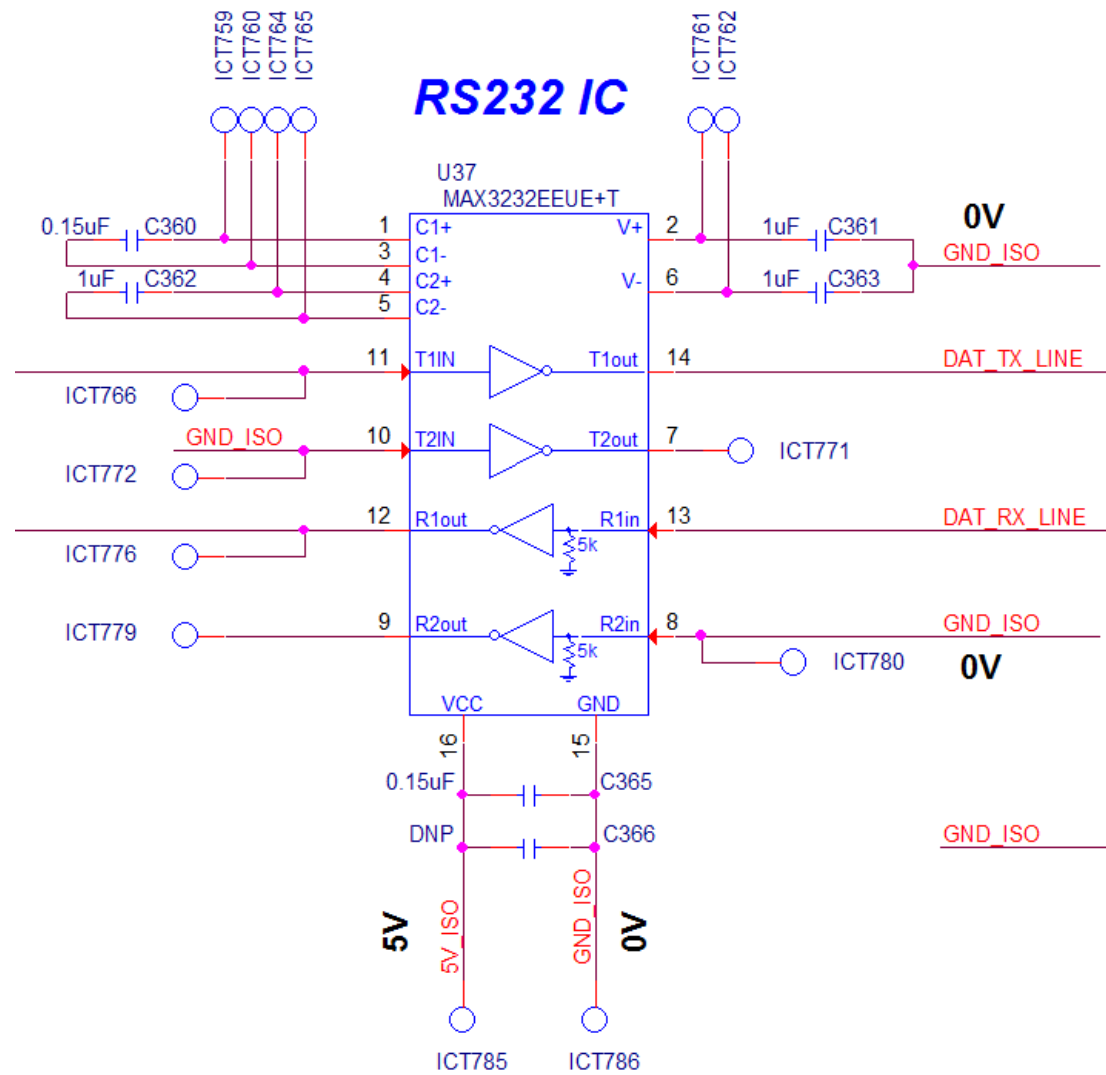


V-

0.15 μ F C1 and Vcc capacitors

Added 3k Ω load during measurement





Oct 22, 2015 2:22 PM



Ron Michallick

Guru 62415 points

TI Employee

Jim.

Keeping the ratio is good thinking. However, this 7:1 C1 ratio can still give a large V+ voltage increase in just one cycle of boost. With your larger storage capacitors, a bigger ratio can be used. Try cutting the C1 value in half.

The charge pump runs as needed to keep about 5.6V on both V+ and V-
VCC charges C1. (to Vcc)
VCC + C1 charges V+ (about VCC + 0.6V)
V+ charges C2
C2 charges V-

Regards,
Ronald Michallick
Linear Applications

Oct 22, 2015 2:34 PM



Jim Wiemeyer

Prodigy 30 points

Community Member



In reply to Ron Michallick:

Okay, I will perhaps try a C1 value around 0.1 μ F to 0.047 μ F. The datasheet guidelines seem a bit loose, based upon your recommendations. I would expect ripple to resemble the fractional ratio of capacitances times about 5.5V

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Oct 22, 2015 3:14 PM



Ron Michallick

Guru 62415 points

TI Employee

In reply to Jim Wiemeyer:

Jim,

You are very close. 7:1 caps could get a boost increase of $VCC / (7 + 1)$. This is 688mV for VCC=5.5V
It is normal for fairly large ripple using the recommend capacitors.

Regards,
Ronald Michallick
Linear Applications