Boost DC/DC Converter Synchronizes to any Frequency

by Gary Shockey

Power supplies that employ switching regulators often require tight control over the oscillator switching frequency, mainly in an effort to control high frequency noise that can interfere with sensitive circuitry. The LT1310 switching regulator can be synchronized to an external frequency, thus containing noise to well-defined frequency bands, which can be easily filtered.

The LT1310 combines a 1.5A Boost PWM DC/DC converter with an integrated phase-locked loop, which can be synchronized to any frequency between 10kHz and 4.5MHz. Figure 1 shows an application that converts 5V to 12V with an externally controlled switching frequency of 1.6MHz. To synchronize to an external input signal, the timing capacitor and PLL filter components must be chosen properly. This is a simple process and can be done using the graph in Figure 2.

In Figure 2, operating frequency is plotted versus timing capacitor (C_T) with the upper and lower lines corresponding to the minimum and maximum lock frequency given a specific C_T value. To choose the right timing capacitor, find the intersection of the desired operating frequency and the dashed line. Then move to the corresponding C_T value.

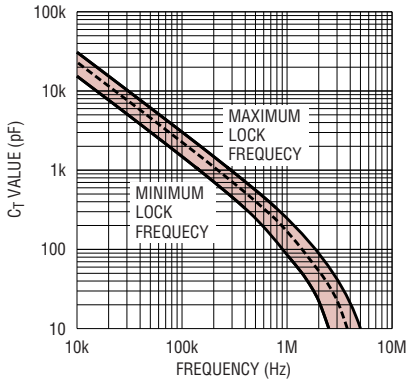
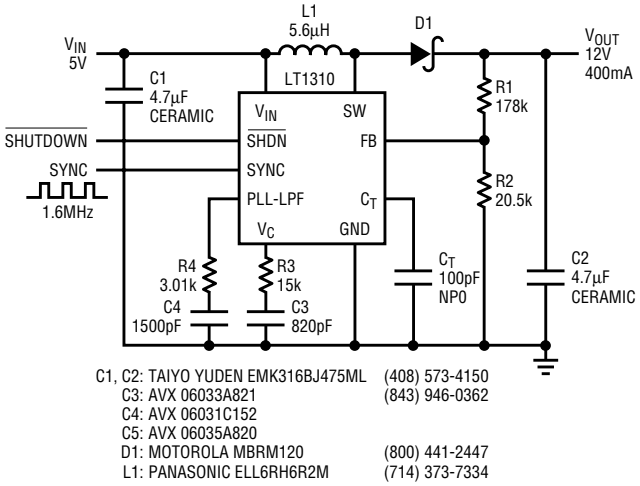


Figure 2. C_T vs operating frequency



C1, C2: TAIYO YUDEN EMK316BJ475ML (408) 573-4150
C3: AVX 06033A821 (843) 946-0362
C4: AVX 06031C152
C5: AVX 06035A820
D1: MOTOROLA MBRM120 (800) 441-2447
L1: PANASONIC ELL6RH6R2M (714) 373-7334

Figure 1. 5V to 12V converter synchronized at 1.6MHz

Alternately, use the following equations as a starting point:

for $f_{LOCK} \geq 2MHz$:

$$C_T = 0.75\left[\frac{250\times10^{-6}}{f_{LOCK}} - 40\times10^{-12}\right]$$

for $f_{LOCK} \leq 2MHz$:

$$C_T = 0.75\left[\frac{310\times10^{-6}}{f_{LOCK}} - 60\times10^{-12}\right]$$

Because the lock range for the PLL is nearly 2:1, the nearest standard value NP0 capacitor can be used. For the application shown in Figure 1, a 1.6MHz switching frequency corresponds to an 100pF timing capacitor. Figure 3 shows the input frequency being stepped from 1.2MHz to 1.9MHz with the PLL regaining lock in approximately 50µs. Since the switching frequency affects inductor ripple current, the inductor must also be scaled. Table 1 shows recommended component values for various switching frequencies.

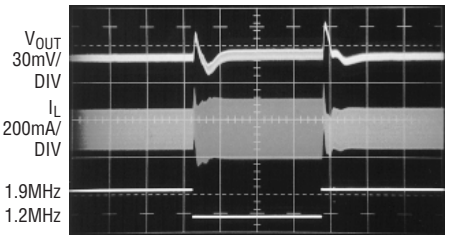


Figure 3. Phase-locked loop response

Table 1: Recommended component values for various switching frequencies (R4 = 3.01k)

Switching Frequency	C_T	C3	C4	R3	L1
600kHz	330pF	1500pF	2700pF	10k	10µH
1MHz	180pF	1000pF	2200pF	10k	6.2µH
1.6MHz	100pF	820pF	1500pF	15k	5.6µH
2MHz	68pF	820pF	1500pF	15k	4.7µH
2.5MHz	47pF	330pF	1500pF	20k	3.3µH
3MHz	33pF	330pF	1000pF	20k	2.7µH