Low Cost, Low Noise VCO Biasing Circuit for Cable/TV tuners

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Phase-locked loops (PLL) are used in a variety of applications, most notably in Cable and TV tuners. In these, the PLL synchronizes an output signal (typically generated by a Voltage Controlled Oscillator, VCO) with a reference or input signal in frequency as well as in phase. The VCO used in these PLLs requires a biasing circuit. Depending on the VCO used, this biasing circuit is required to provide an output voltage between 24 and 32 Volts from an input voltage of typically 5V, 9V or 12V. Figure 1 shows the circuit diagram of a low cost VCO biasing circuit. This circuit converts a 5V input to an output of 27V, in order to bias the VCO.

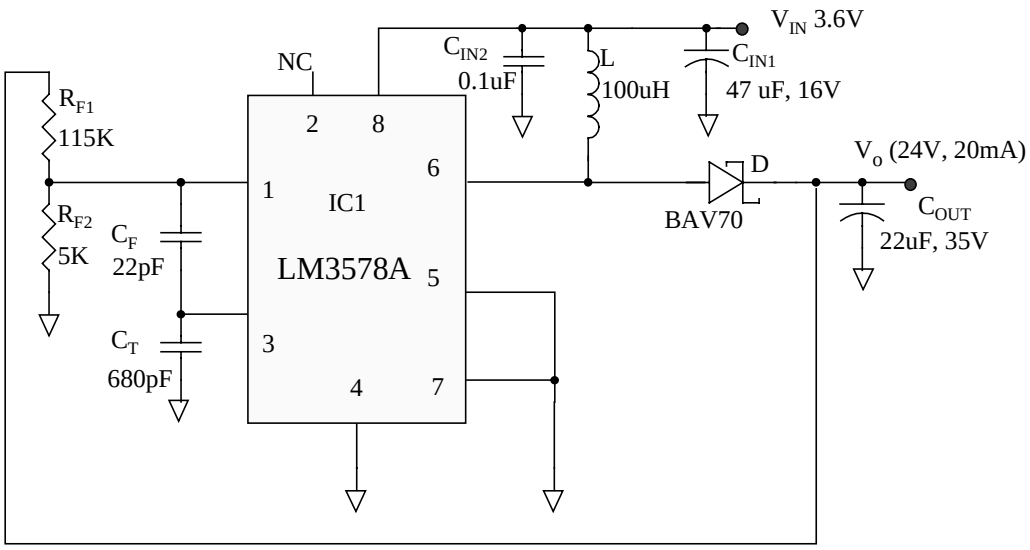


Figure 1

Converter Specifications:
Input Voltage, V_{IN} = 5V
Output Voltage V_{OUT} = 27V
Load Current I_L = 10mA (max.)
Switching Frequency, fs = 100kHz.

Since the load current requirements are very low, this converter is chosen to operate in discontinuous conduction mode. The output voltage is maintained at 27V by the feedback network consisting of the resistors, R_{f1} and R_{f2}. Pins 1 and 2 are set to 1V internally. The output voltage level can be adjusted to the desired value by changing the feedback resistors, R_{F1} and R_{F2}, using the equation-

$$V_{out} = 1 + \frac{R_{f1}}{R_{f2}}$$

The switching frequency is set by using the timing capacitor C_T. Choosing a value of 680pF for C_T sets the switching frequency at 100kHz. Capacitor C_F (typically between 10-25 pF), together with the feedback resistors (R_{F1} and R_{F2}), is used for compensation. For more details on the choice of the above components, please refer to the data sheet for LM3578A.

The same circuit will work for 9V or 12V input, with a slight modification. A higher voltage input capacitor will be required. Also, a higher value inductor should be used. Since the current requirements are so low, it is possible to use inexpensive inductor and capacitors in the application. The capacitor C_{IN2} is enough to suppress the switching noise. An inexpensive input filter can be used to further suppress the noise. The noise is dependent on the ESR of the input and output capacitors. Hence, low-ESR capacitors should be used in this application. This circuit offers advantages of low cost and low noise (figure 2)over other commonly used circuits, such as switched capacitors.

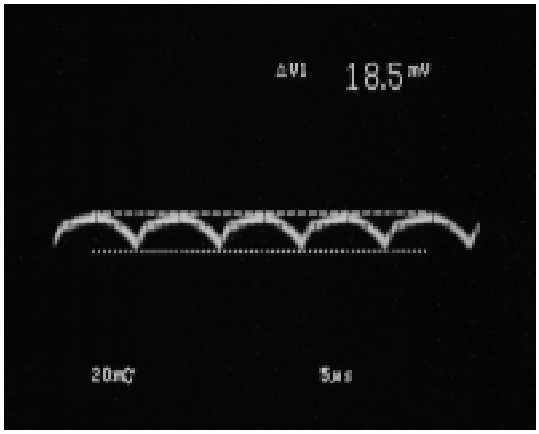


Figure 2(a) Input voltage Ripple (18.5mVp-p)

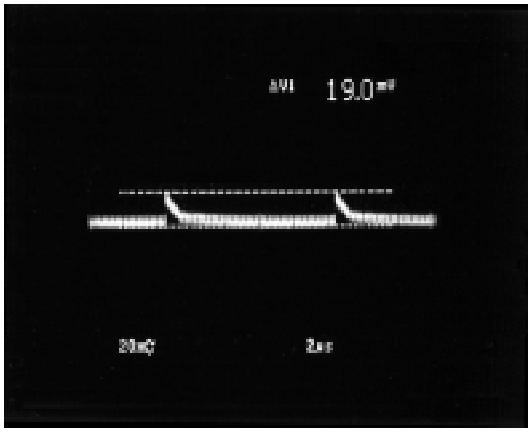
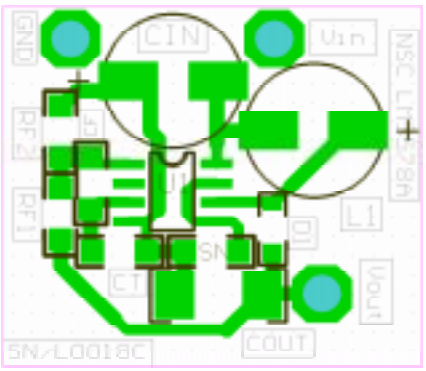


Figure 2(b) Output voltage ripple (19.0mV p-p)



Typical Layout (Scale- 2:1)

Parts List:

Designator	*Value*	*Description*	*Manufacturer*	*Part No.*
IC1	-	Switching Regulator	National Semiconductor	LM3578AM
D	40V, 250mA	Output diode	Fairchild	BAV70
L*	100µH, 0.1A	Boost Inductor	Coilcraft	DT1608-104
C_{IN1}	47µF, 16V	Input Capacitor, surface mount tantalum	Sprague	595C4760016D2W
C_{IN2}	0.1µF, 50V	Input capacitor- Required for suppressing noise	Novacap	1206N104H250N
C_{OUT}*	22µF, 35V	Output Capacitor, surface mount tantalum	AVX	TPSE226M035R0300
R_{F1}	115KΩ	Feedback resistor	Panasonic	ERJ-8GCYJ134M
R_{F2}	5K	Feedback Resistor	Panasonic	ERJ-8GCYJ512M
C_F	22pF	Feedback Capacitor	Novacap	1206N220H250N
C_T	680pF	Timing Capacitor, Sets the switching frequency	Novacap	1206B681J250N

* Any inductor with the given rating can be used for this application. Any 22uF,35V low esr capacitor can be used for C_{OUT}.