# Introduction

This application note describes the recommended filtering technique for oscillators in surface mounted device (SMD) packages from IDT. This includes both ceramic and plastic packages which have one power pin that supplies the analog, core and output stages of the device. Since separate filtering can not be added to each stage, careful consideration must be taken to filter noise from entering into the device.

Figure 1. Simplified Circuit
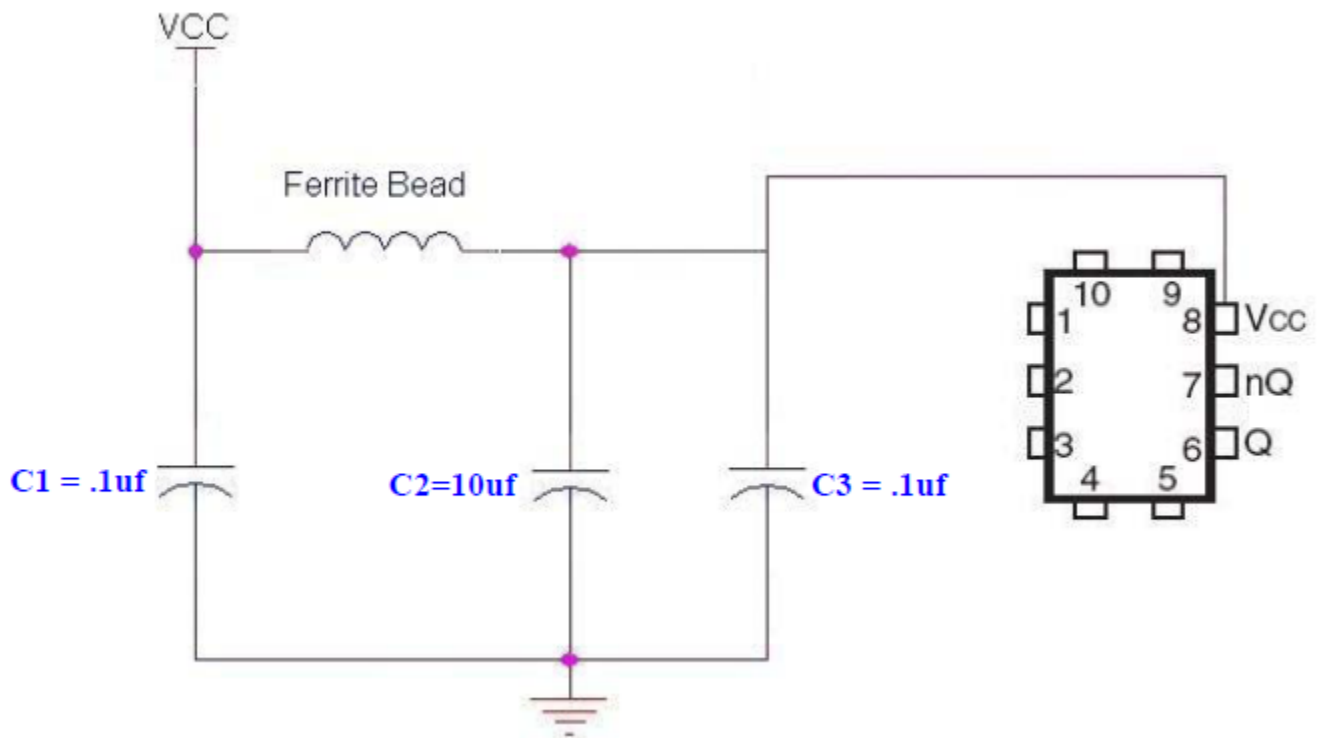
Procedure

The filter configuration in Figure 1 is commonly used for SMD oscillator devices. It consists of a ferrite bead and 3 capacitors. The combination of the capacitors, parasitic resistance from the printed circuit board, and the resistive component of the ferrite bead will behave as a low pass filter and help suppress high frequency noise. The selection criteria for the capacitor values (C1, C2 and C3) was based on performance, values readily available and cost. Other values can be used to improve the rejection level of the low pass filter with an increase in cost and supplier lead times.

The filter was simulated with three different Murata ferrite beads. Refer to Table 1. The primary difference between them is the impedance at 100MHz, rated current and DC resistance. The conditions for the simulation were taken using nominal voltage and temperature on Cadence Spectre.

Table 1:   Murata Ferrite Bead Datasheet Parameters

Part Number	Impedance (at 100MHz/20°C)	Rated Current	DC Resistance	Operating Temperature Range
BLM18BB121SN1	120Ω ±25%	500mA	0.30Ω max	-55 to +125°C
BLM18BB151SN1	150Ω ±25%	450mA	0.37Ω max	-55 to +125°C
BLM18BB221SN1	220Ω ±25%	450mA	0.45Ω max	-55 to +125°C

In order to properly simulate a low pass filter, a small signal equivalent circuit must be generated. Refer to Figure 2. In addition, the parasitic resistance from the filter printed circuit board traces must be calculated and simulated. This has a first order effect on the attenuation of the filter.
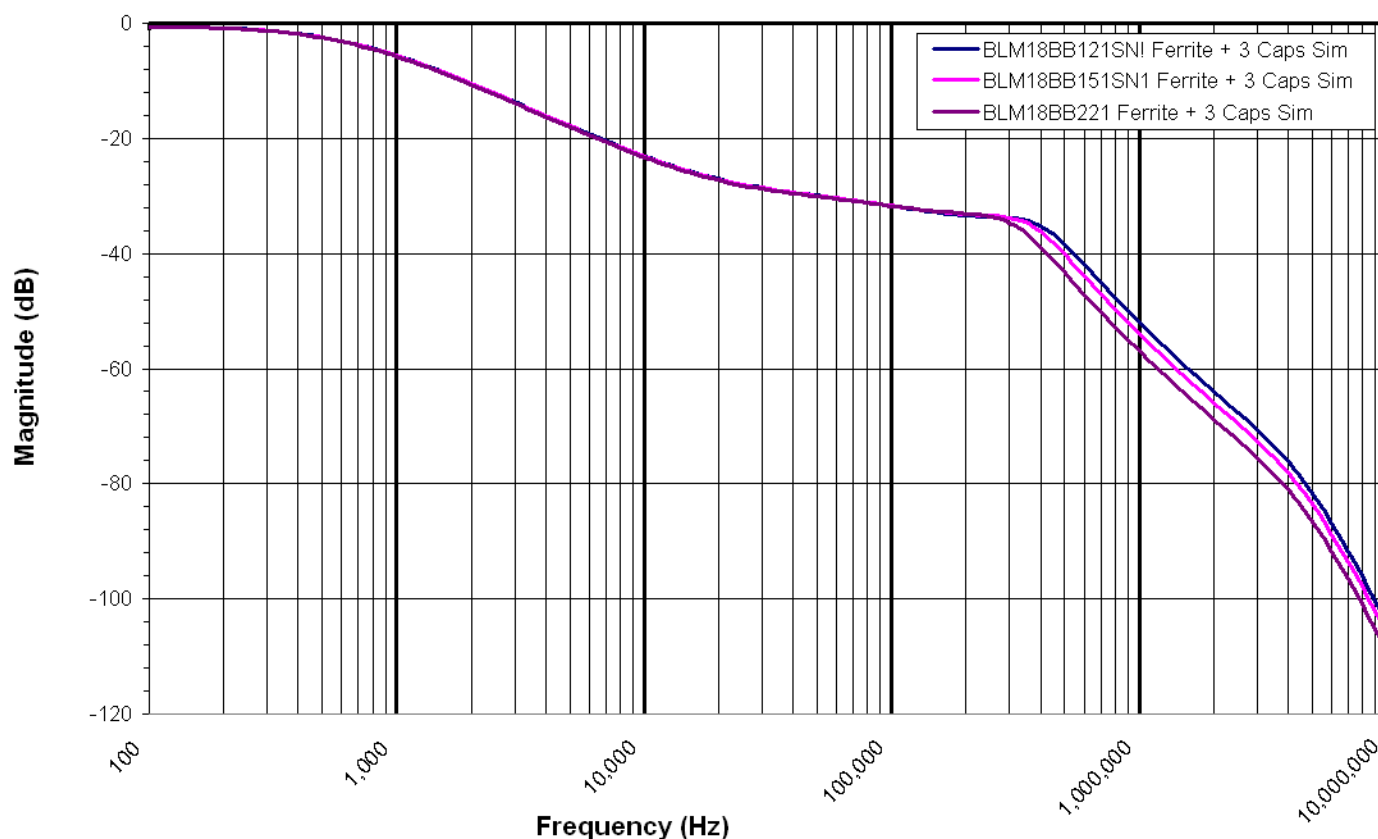
Figure 2.   Simulation Circuit – Small Signal Equivalent Circuit
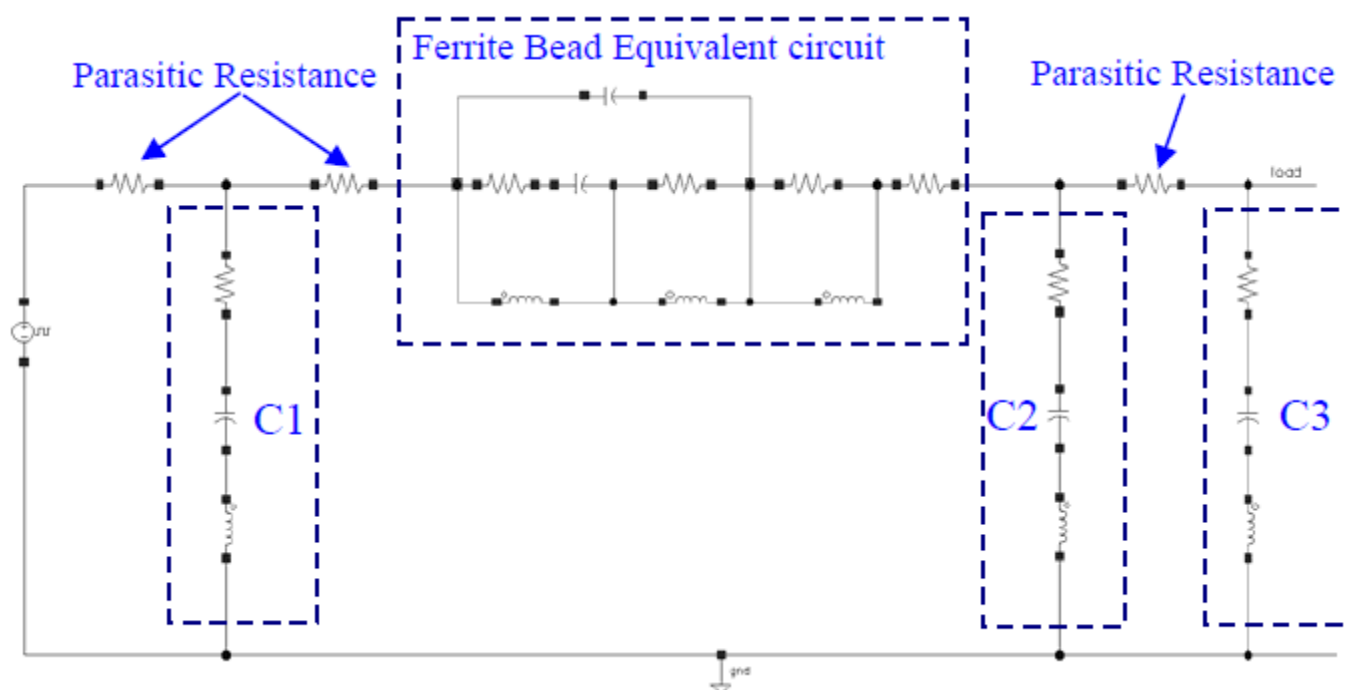
Results

Figure 3 shows the simulation results for the three ferrite beads. They track to approximately 300kHz, after that, the BLM18BB221 has better filtering performance than the other two. This is due to the higher impedance.

Figure 3. Loop Filter Simulation Results

Conclusion

A good number of switch-mode power supplies have transient frequencies ranging between 100kHz and 600kHz. Note that at 100kHz, the filter has approximately 30dB of attenuation. Though the simulations are using ideal conditions, Figure 3 shows the general trend of the filter. The filter recommendations are a general guideline to be used for reducing external noise from coupling into the device. The filter performance is designed for a broadband of power supply noise. If the frequency noise component is known and is out of the filter range, it is recommended that additional filtering be added and the component values adjusted. In order to achieve the best possible filtering, the placement of the components should be on the same layer as the device and be as close to the power pin as possible. If considering using a ferrite bead or inductors other than what is recommended, take special precaution. The combination of a capacitor, inductor and random noise can cause unwanted oscillations. In addition to localized filtering, bulk capacitance should be added in the general area of the device.

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