WEST COAST MAGNETICS

Product Design Guide:

Advanced RF Filtering Technology

WCM700 Series RF filters

HIGHLIGHTS

- **Compact, single component**
- **Multi-channel**
- **Narrow band pass from 1 MHz to 100 MHz**
- **Temperature stable**

CUSTOM SOLUTIONS

We consider all of your design objectives when providing a custom engineered solution. Use this Product Design Guide as an overview of the possibilities. Contact us for a custom solution that fits your specifications and application requirements.

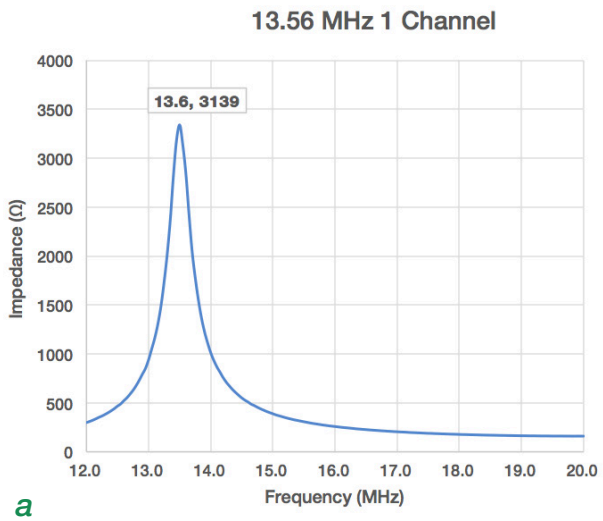
Summary

WCM's patent-pending RF filter coil technology provides a great improvement in RF filtering, by improving impedance characteristics, space efficiency, power handling, and temperature stability compared to LC parallel filters. Advancements include:

- Novel technique for making highly compact, narrow band, high impedance filters tunable for frequencies from 1 MHz to 50 MHz
- Supports high power applications
- Coils can be placed in series to permit independent filtering at multiple frequencies
- Technology enables multiple parallel independent filter channels into a single filter coil

Single-component design

WCM's technology, rather than combatting parasitic effects, takes advantage of them. The parasitic capacitance becomes the resonating capacitance for the turns of copper comprising the inductor. The designer is no longer concerned with sourcing the correct capacitor and inductor (specifying individual components). The designer can instead use a single WCM multi-channel filter (Figure 1) and be assured their parallel LC circuit will have high impedance, without any subcomponent tuning.



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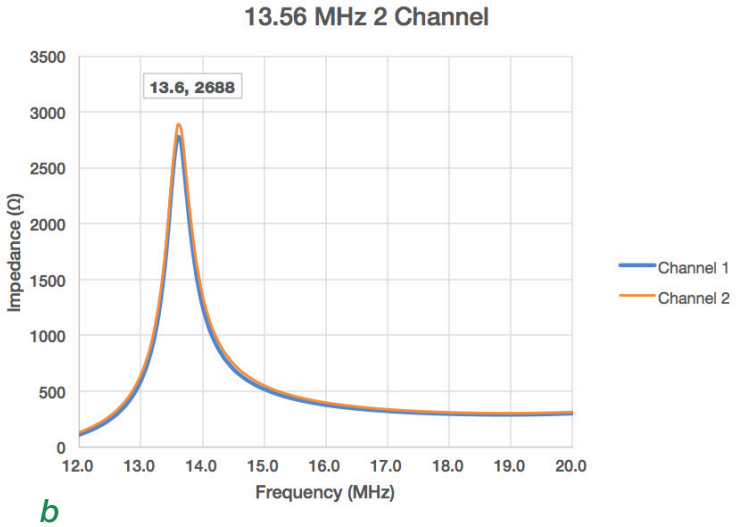

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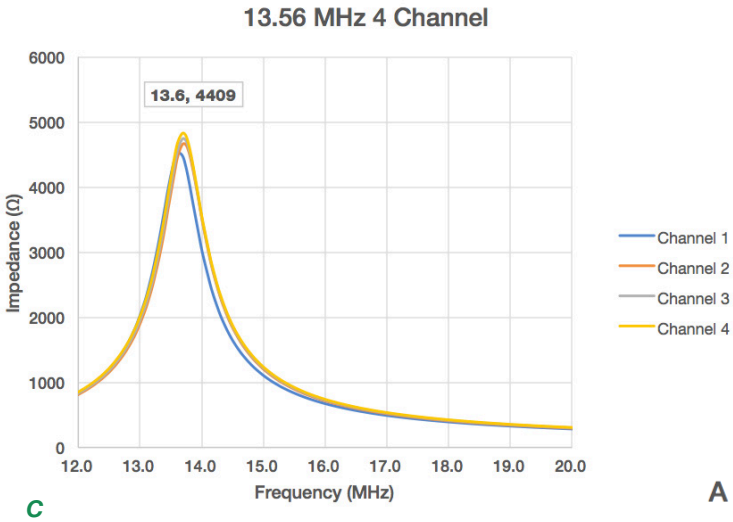

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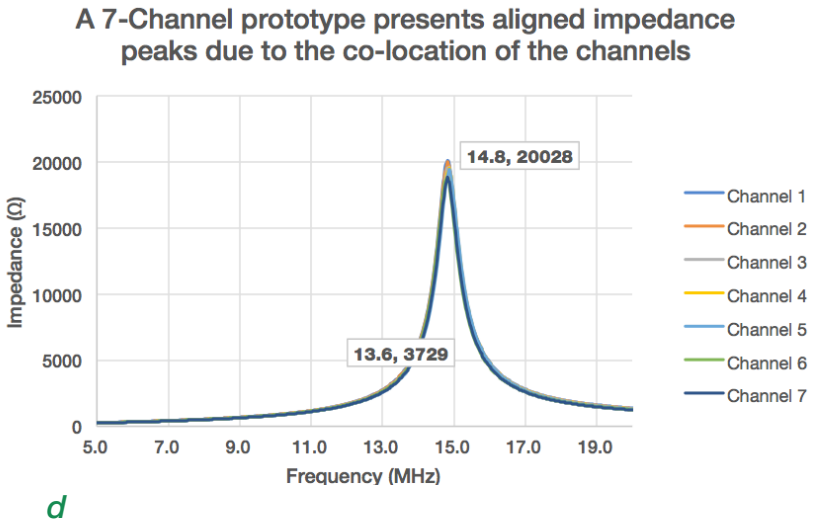

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Figure 1) Multi-Channel RF filters.

RF filter channels tuned to the same frequency demonstrate aligned, high impedance peaks in each channel in a single device. a) Single channel; b) 2-channel; c) 4-channel; d) 7-channel

Advanced compact copper foil technology

WCM's new technology is much more space efficient compared to a parallel LC filter. As mentioned, parallel LC filters are not co-located, which requires more space allocated to the filter. WCM's filter places multiple channels in nearly identical locations (Figure 2), conserving space in constrained systems.

The copper foil used in WCM's filter efficiently uses space compared to round magnet wire, which is subject to the skin effect at radio frequencies. The skin effect forces current to flow on the outside of the wire, which wastes cross-section of round magnet wire. WCM's filter uses foil to have the current fill a larger proportion of the copper cross-section, and utilize copper area more efficiently.

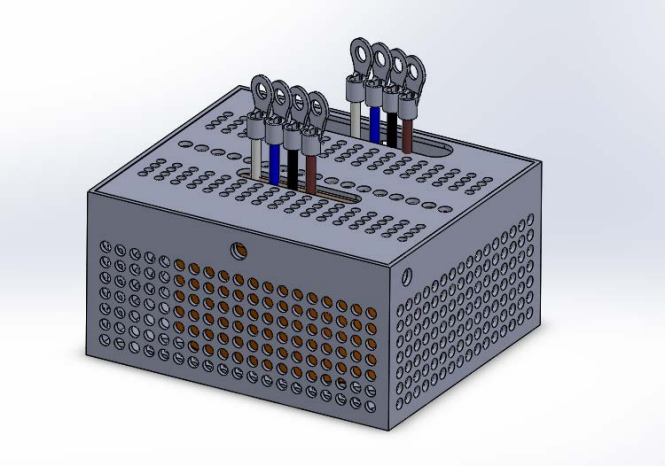

Figure 2) 4-channel RF filter design.

Independent channels are separated by thin yet resilient insulation, allowing for channels to operate simultaneously. Overall dimensions are 3.5" x 2.9" x 2.1"

Continuously tunable

The nature of the device allows the frequency to be continuously tuned and set in the range of 2 to 50 MHz (Figure 3) with expansion into the range of 1-100 MHz in the future. The designer can specify the desired frequency, and WCM can create a unit with high impedance at that frequency. The unit can have its impedance maximum nearly at, or exactly at, the target frequency. This technology can easily accommodate multiple channels. Previous LC filters required separate inductors and capacitors for each channel; these channels are not necessarily aligned due to the non-co-location of the parts relative to other components. Because each channel of the WCM filter is on a common core, the alignment of the channels is much improved.

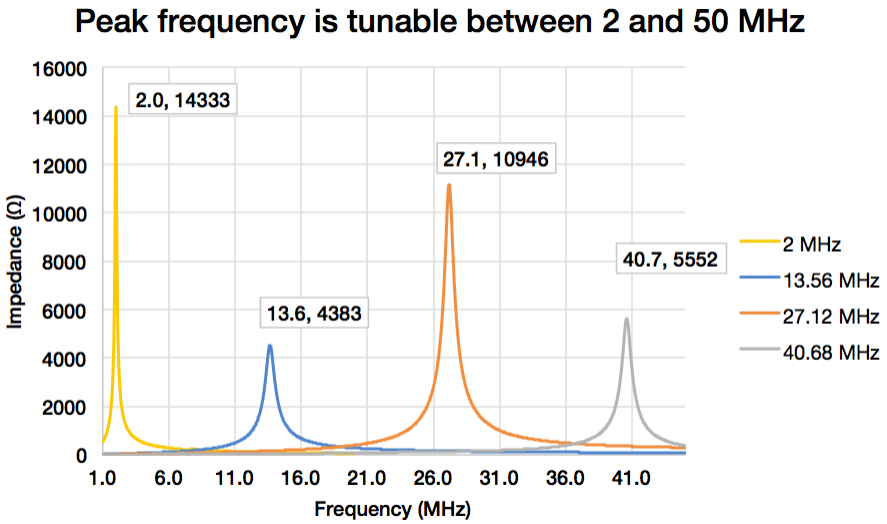

Figure 3) Single channel in an RF filter turned to different frequencies.

Impedance curves for prototype foil wound RF filter tuned to a) 2 MHz; b) 13.6 MHz; c) 27.1 mHz; d) 40.7 MHz

Temperature stable

WCM's technology also improves power handling when the reduction in cross-section from the skin effect. The usage of the entire cross-section of copper of WCM's foil allows for more current to flow in the component than other filters with less resistive heating. If the application uses very high current where heating is inevitable, the materials of construction can handle the heating, with 200° C temperature rating. WCM's technology does not utilize a ferrite core, which can have a dramatic change in magnetic properties and loss with temperature. WCM's technology is relatively stable with temperature (Figure 4); the resistance of the copper varies with temperature causing a slight change in impedance (but a very minimal change compared to a parallel LC filter using an inductor with a ferrite core).

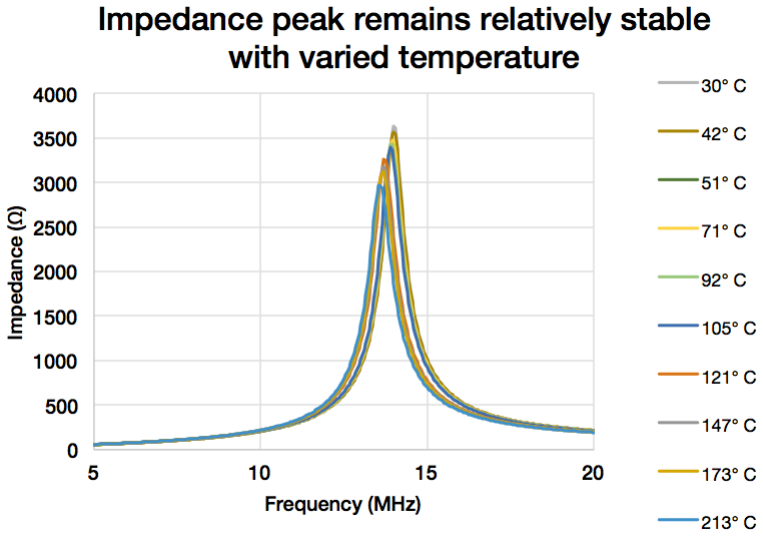

Figure 4) Effect of temperature on RF filter impedance peak.

Impedance of a foil wound RF Filter tuned to 13.6mHZ tested at various temperatures

CONTACT US WITH YOUR REQUIREMENTS

We have built prototypes and implemented designs in several frequency ranges. The table below is provided as guidance to design engineers. RF filter prototype ranges include:

- Channels: 1-7
- RF frequency: 2-50 MHz, 1-100 MHz in development
- Impedance: > 10 KΩ at resonant frequency
- DCR: <100 mΩ for 2 MHz, <15 mΩ for frequencies greater than 13 MHz at 25°C each channel
- L: 5 µH to 300 µH nom. at 25°C each channel
- C: 10-25 pF nom. each channel
- Channel to channel isolation up to 3 kV AC
- All materials Class H 155°C rates unless otherwise requested
- Prototype Dimensions: 4-channel ~ 3" x 1.5" x 1.5"; 7-channel ~4" x 3.25" x 1.5"

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