Syfer Technology Limited
Old Stoke Road
Arminghall, Norwich, Norfolk
NR14 8SQ England

Tel: +44 (0)1603 723310
Fax +44 (0)1603 723301
Email: sales@syfer.co.uk
Web: www.syfer.com

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Integrated filters deliver superior performance

Integrated passives for high frequency designs provide superior performance at lower cost. Dr John Yelland explains how the combination of LTCC technology and advanced, innovative component design delivers significant advantages.

In our communications-dominated electronics world, with the focus on 'connected' and wireless portable devices, high frequency design and integration have become critical factors. The integration of digital, analogue and mixed signal circuits continues apace, with RF and microwave circuitry more often included. Notably, however, the integration of associated passive RF and microwave components has progressed far more slowly. These components, principally inductors and capacitors, which form such a small part of a circuit diagram, can now occupy most of the physical space on a printed circuit board implementation. Clearly, increased integration of microwave components, such as filters, baluns and couplers, promises significant advantages.

UK-based manufacturer, Syfer Technology has introduced a range of surface-mount low-pass, band-pass, high-pass and band-stop filters for frequencies up to 6 GHz. These integrated passive devices combine several discrete devices in a single package, thereby offering considerable savings in cost and board space. Importantly, however, the superior design of these integrated devices, delivers significant performance advantages too. Syfer combines its well-proven low temperature co-fired ceramic (LTCC) technology with established manufacturing expertise and an advanced microwave component design capability to produce complex passive RF and microwave components as single chip devices.

Advanced manufacture

LTCC products are based on a glass-ceramic composite. A device comprises several 'green' layers each down to 50µm thick, upon which the required circuits are printed. After printing the layers are stacked then fired in a single process. A firing temperature below 900□C allows silver conductor material to be used, offering the best possible electrical conductivity and thus the highest Q. Once sintered, the material forms a highly reliable, structurally and electrically stable component. The combination of a high Q and the high thermal conductivity of the composite material ensures that the size reduction benefit is not offset by an undesirable reduction in power handling capability.

Contact is made between layers using conducting vias; this allows the creation of inductors. Thus it is possible to produce capacitive, inductive and stripline elements with ground planes and stripline inter-connects. The manufacturing process is a three-dimensional development of the standard process for ceramic capacitors, and retains all of its advantages: low cost, high reliability and good temperature performance.

Innovative design
But the design process is, of course, far more complex, and requires skills not normally found within the ceramic SMD industry. Syfer has the in-house skills and experience to design a wide range of filters cost-effectively for both general and customer-specific applications. Close liaison between in-house design and fabrication allows the company to offer an efficient turnkey service from design, through prototyping, to volume manufacture.

A key advantage to the OEM is that with these integrated passives, board design is greatly simplified. When designing an RF filter using discrete components, the chip capacitors and printed or chip inductors are interconnected by printed tracks on a circuit board. These tracks are microstrip transmission lines, and must be designed for the correct impedance with the microstrip phase length, loss and dispersion all taken into account. The discontinuities between the microstrip lines and the discrete components, the dimensional and electrical tolerances of the PCB, and component placement tolerances, must all be included in the analysis. With integrated filters, the electrical and mechanical tolerances associated with the PCB and with the placement of discrete components, no longer directly affect filter characteristics.

Enhanced performance
Integrated filters deliver enhanced performance in several respects. The interconnections between circuit elements are physically smaller and thus electrically less significant. They are also in stripline, not microstrip, thus less dispersive, less lossy and more easily analysed and synthesised. The discontinuities within the filter are less severe, and component proximity effects can be accounted for in dedicated 3D analysis software. The finite difference time domain method of simulation used in Syfer's advanced 3D modelling package provides the most accurate of designs in the shortest development time and with the minimum number of design iterations.

Cost Reduction
Implementing many circuit elements within a single package obviously much reduces assembly time, component cost, and circuit dimensions. Less obvious advantages are the technical design and cost benefits of reliably reproducible performance. The reduced effort involved in in-house design and development of a discrete element filter, also reduces cost and improves time to market. Specifying an integrated SMD filter effectively subcontracts all this design work to the filter supplier, where its cost is amortised across multiple designs and high volume manufacture.

Conclusion
Syfer's low temperature co-fired ceramic technology, combined with proven SMD manufacturing techniques and specialist design skills deliver integrated filter components for high frequency applications to give the competitive advantages of low cost, high performance and reduced time to market.