

Low Temperature Cofired Ceramic (LTCC)

Multi-layer high performance substrates



Core Competence

- High performance electronic packaging and substrate technology
- Ideally suited to RF and microwave products
- Low loss glass-ceramic dielectric
- High temperature, harsh environment suitability
- Hermetic
- Matched impedance routing
- Strip line and microstrip transmission lines
- Co-axial via structures
- Embedded and surface printed resistors
- Temperature coefficient of expansion matched to semiconductors

Typical LTCC RF/Microwave applications in Defence & Space Environments

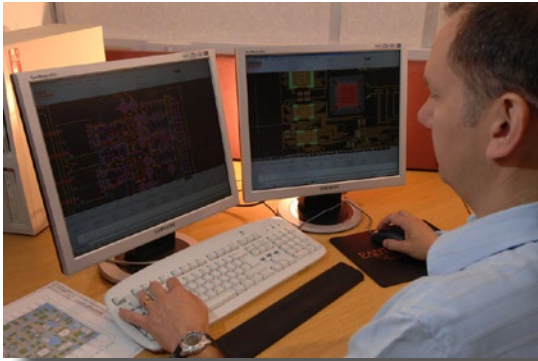
- Transmitters and Receivers
- Low Noise Amplifiers
- Voltage Control Oscillators
- Mixers
- Filters
- Power Splitters and Combiners
- Matching Networks
- Phased Array Radar
- Amplifiers
- Converters
- Power Drivers
- Power Amplifiers
- Sensors

Company Profile

RF2M Microelectronics Ltd is an autonomous UK division of API Technologies Corp, a leading international diversified designer and manufacturer of integrated microelectronic products, ranging from single chip to full system level solutions. It is primarily focused on serving global markets for defence, aerospace, space and energy applications. Services also include product design qualification, environmental, electrical testing and supply chain management.

OPTIMISED ELECTRONIC PACKAGING

RF2M offers a complete engineering, design, qualification and manufacturing service for modules and subsystems. Interconnect and assembly design is performed on advanced CAD/CAE workstations by experienced electronics engineers. Full electronic simulation is performed on analogue, digital, RF and Microwave and mixed mode circuits.



- Electromagnetic design and simulation
- Thermal simulation and design
- Analogue and digital simulation and design
- Thermal imaging analysis

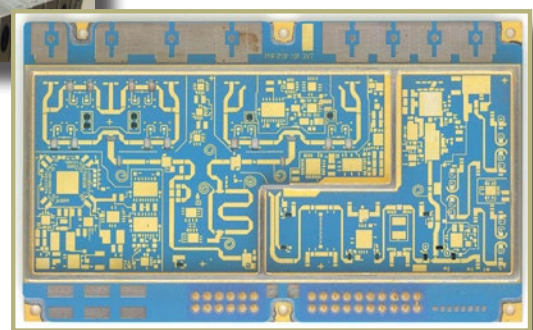
RF2M has demonstrated capability up to 60GHz and power management of tens of watts of power with LTCC based technology.

RF2M provides guidance on implementation into the appropriate substrate and component technology.

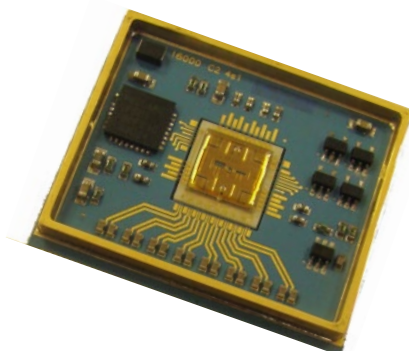
- Integrating passive elements where appropriate
- Optimum selection of bare die or packaged components
- Utilising cavities for active and passive devices
- Using thermal vias for power management
- Application of different tape materials and layer thicknesses
- Implementing distributed circuit elements (microstrips, striplines, stubs etc)
- Integrating pipes and channels for fluid management and sensing, and for wave guide applications.

SUITABILITY

- Harsh environments
- High mechanical stress
- Extreme temperatures
- Severe humidity



ADVANCED TECHNOLOGY SOLUTIONS



- Semiconductor dice and packaged components
- Wire bond or flip chip connections
- Epoxy or solder mounted components
- Hermetic seal or glob top
- Cavities/through holes
- Surface and embedded resistors
- Distributed and lumped element inductors and capacitors
- BGA/PGA/leaded/leadless module package

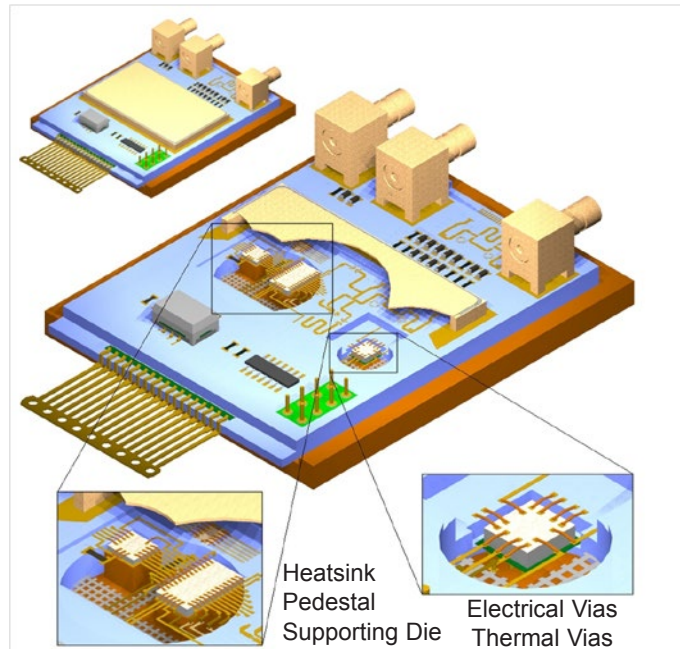
TECHNICAL BACKGROUND

Low Temperature Co-fired Ceramic (LTCC) is a substrate technology providing reliable, high density electrical interconnection and supporting active and passive components. It has similarities with the more conventional multi-layer Printed Circuit Board in its configuration but this ceramic technology is highly suited to radio and microwave frequencies and for harsh operating environments where high temperatures and high mechanical stresses are prevalent.

Irregular shaped substrates and 3D structures can be readily accommodated with LTCC and thus, open cavities and hermetic package structures can be realised for active semiconductor component mounting and wire bonding along with passive electronic components.

The technology is able to integrate thick film planar resistors on the top surface of the substrate or, where lower tolerance resistors are acceptable, embedded within the multi-layer structure.

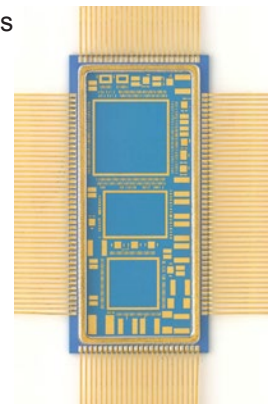
Unlike thick film/multi-layer technology, where screen printing is an additive process building multi-layer interconnect which is interleaved with dielectric layers, the LTCC process is based on pre-cast thin layers of glass-ceramic dielectric which are individually screen printed with conductor patterns and then stacked, laminated and co-fired to establish a robust homogeneous multi-layer structure.



WHY USE LTCC?

LTCC is best suited for applications that can take advantage of one or more of the following:

- Good electrical performance
- Dimensional and electrical stability under temperature, moisture and mechanical stress
- High density, through embedded passives and bare semiconductor die
- 3D capability, cavities, channels
- Effective thermal management with metal loaded vias
- Hermeticity
- Matched TCE with semiconductors (Thermal Coefficient of Expansion)
- Multiple assembly and packaging solutions



CERAMIC VS ORGANIC PCB

LTCC advantages over printed circuit boards

- Higher operating temperature up to 350°C
- Lower expansion coefficient
- Good thermal properties
- Superior high frequency performance
- Higher integration density: Embedded passives and higher layer count possible
- Higher reliability: eliminates interconnections by integrating passives
- Lower system cost: reduces test, insertion, assembly
- Smaller package size due to integration
- Cost effective for dense package due to parallel processing of layers
- Hermetic packages possible

LTCC VS THICK FILM

LTCC advantages over Thick Film

- Cavities and high number of layers
- Higher breakdown voltages between layers
- Mixed metals easier to control – hermetic encapsulation of low cost silver interconnect
- Surface topology smoother
- Well defined dielectric thicknesses and therefore suitable for microwave signal transmission
- Cavities allow:
 - Localised hermetic sealing
 - Reduced thickness under die (Reduced thermal paths)
 - Short, profiled wirebonds



LTCC VS HTCC

LTCC advantages over HTCC

- Lower resistance metalization i.e., Au & Ag Vs W & Mo
- Higher number of layers
- Lower tooling costs
- Shorter prototype cycles
- More embedded passive option i.e., alternate dielectrics
- Higher flexibility of post print metal and dielectric options
- Lower dielectric constant ceramic tapes available
- Higher level of part complexity and flexibility

CAPABILITY SUMMARY

Substrates and Tapes	Range of LTCC dielectric tape and conductor/resistor materials from leading suppliers/manufacturers – DuPont, Ferro and Hereaus.
Specialist Substrates Tapes	Range of dielectric materials providing low cost high performance and low loss characteristics
Conductors	Silver, Gold, Platinum, Palladium Silver and Platinum Silver. Track width: Standard = 200-250µm High Density = 100 - 150µm Track Separation: Standard = 200 -250µm High Density = 100 - 125 µm
Resistors	Infinite range of values with sheet resistivities from 10 Ohms - 100K Ohms on the surface or embedded in the structure. Resistors: Tolerance: +/-1% (on surface) Tolerance: +/-15% of type (Embedded)
Vias	Vias can be stacked, staggered, buried, or blind. Hermeticity is achieve with a dielectric barrier. Dielectric vias: Standard = 150-250µm High density = 100-150µm Via Pitch: Standard = 3x - 4x via size High density - 2.5x via size
Cavities	Enable embedding active components into the substrate surface and minimisation of module height and enable short and controlled impedance wirebonds.

DESIGN & MANUFACTURING SERVICES

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