Advanced Technology for Automotive Applications

Design, Manufacture & Test
C-MAC MicroTechnology is a leader in the manufacture and test of complex, high-reliability electronics for automotive environments.

C-MAC MicroTechnology provides design solutions incorporating hybrid technology on thick film ceramic, LTCC and PCBA. Each technology has its own merits for key applications in the automotive sector which demands safe operation in extreme environmental conditions.

Our design and manufacturing solutions are in a wide range of applications including:

» Turbo charger controllers
» Mass air flow and pressure sensors
» Exhaust gas recirculation valve controllers
» Alternators - voltage regulation
» Electronic parking brake (EPB) sensors
» High intensity discharge (HID) headlamp controls
» Electronic control units (ECUs); ignition, fuel injection, transmission
» Electronic power steering (EPS)
» Integrated starter alternators and stop-start technology ECUs
» Electronic stability control ESC (ESP/ABS)
» High power motor drive controls (brushless)
» LED headlamp controllers - thick film or insulated metal substrate
» Advanced driver assistance systems (ADAS) and anti-collision systems
» Other automotive sensors - MEMs technology; acceleration, YAW-rate, inclination
» Hybrid electric vehicle (HEV) applications:
  » Traction control, oil pump and other motor drive controls

C-MAC’s thick film technology ideally suits applications which are modular, require high circuit density, operating temperature and power dissipation, as well as low costs for high volume manufacture.

In order to support continued expansion into the automotive sector, C-MAC has achieved ISO TS16949 registration. This is part of our commitment to continuous improvement, a policy that extends throughout C-MAC MicroTechnology.
A service providing total customer satisfaction

» C-MAC will support the complete product life cycle from prototypes, engineering models to full volume production

» C-MAC will help you design modules and solutions to fulfill your requirements. We have a wide choice of substrates and can overcome a range of layout constraints.

» Quality and service are key objectives for our organisation

» Flexible production, ship-to-line and just-in-time are standard

Reliable technology for competitive interconnections:

» Thick film and LTCC technology are exceptionally tolerant in the most severe environmental operating conditions

» Products are designed to customer specifications, providing the best possible solution for extremely precise and demanding electronic circuits

» A high degree of miniaturisation and package density is achievable

» C-MAC employs the latest manufacturing techniques and processes to provide our customers with on-time products at a competitive price.

As a commitment to quality, manufacturing processes are assessed and operated under Statistical Process Control (SPC). This is complemented by techniques such as design and process Failure Mode and Effect Analysis (FMEA), and product simulation.
Manufacturing Processes

Our modern manufacturing concepts are supported by automated state-of-the-art equipment, in an ESD-protected clean room production environment. Processes are optimised using statistical process control (SPC) and data evaluation.

Thick Film Printing

» Fully automated screen printing of thick film and LTCC circuits, using state-of-the-art equipment in class 10000 clean room environments
» Metallised through-holes and multilayer structures for integrated functionality
» Laser trimming of passive resistors and active adjustment of assembled circuits in addition to substrate laser scribing

Chip and Wire Bonding

» Fully automated die bonding, ball and wedge wire bonding on state-of-the-art equipment covering wire sizes from 25 micron gold up to 500 micron aluminium
» Encapsulation techniques with epoxy or silicone glob top on ceramic

Component Assembly

» In-line component assembly including solder paste screen printing, reflow soldering and vacuum soldering.
» Surface mount component placement with high-speed vision alignment machines on ceramic substrate sizes up to 8” x 6” with either single or doubled-sided component mounting
» Component styles and sizes from 0201 passives to large BGAs. Placement rate is dependent on design but up to 40,000 placements per hour can be achieved
» Reflow soldering using convection techniques in a nitrogen atmosphere
» Leadframe assemblies using reel-to-reel strip wave soldering equipment
» All soldering processes can either use a no-clean flux system or conventional RMA flux followed by solvent cleaning.

Electrical Test

» Fully functional electrical testing is standard practice

[Graph of Solderjoint X-Bar Chart]
Technology

Substrates
Al₂O₃ (96%) 4” x 4”, 5” x 6”, 8” x 6”
LTCC (Low Temperature Co-fired Ceramic)
Thickness .010”, .015”, .020”, .025”, .030”, .040”, .100”
AlN (Aluminium nitride)
FR4 and other organic substrates

Screen-Printing
Conventional Printing
- track width: standard: 150μm-250μm
  75μm for high density prints
- number of conductor layers: 4 max
  (on each side) (LTCC can achieve 70+ conductive layers)
- conductor materials: Ag, AgPt, AgPd, AgPtPd, Au, Cu

Diffusion Patterning
- 5 layers max
- 200μm vias

Photo-Imaged
- Au, AgPt, Ag track width: 50μm

Etched
- Au, Ag track width: 50μm

Metalized through holes

Castellations

Resistors
- 500μm square min (trimmed)
- 300μm square min (untrimmed)
- low ohm high power serpentine design

Laser Trimming
Passive Absolute +/- 0.10%
Ratio +/- 0.05%

Assembly
Low/high volume SMD single or double-sided
Chip and wire bonding (Au and Al)
Lead-frame attach SIL, DIL
- Pitch 50, 75, 100 mills
- Snap-in
Chip on board

Power modules (Thick Ag or Cu, DBC or AlN)

Flip chip

Complete module assembly

Test
Automatic test systems
Full temperature test
Thermal shock
Temperature cycling
Burn-in
Humidity (e.g. 25°C/85% rh)

Encapsulation
Conformal coating
Glob-top
Silicone gel

Cleaning
Solvent based
No clean when applicable
# Thick Film / LTCC / PCB Benefits Comparison

<table>
<thead>
<tr>
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<th>Thick Film</th>
<th>LTCC</th>
<th>PCB (FR4)</th>
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<td>c. RF &amp; Microwave</td>
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<td>Track resistivity</td>
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## Manufacturing Sites

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