Commercial passive parts for Space

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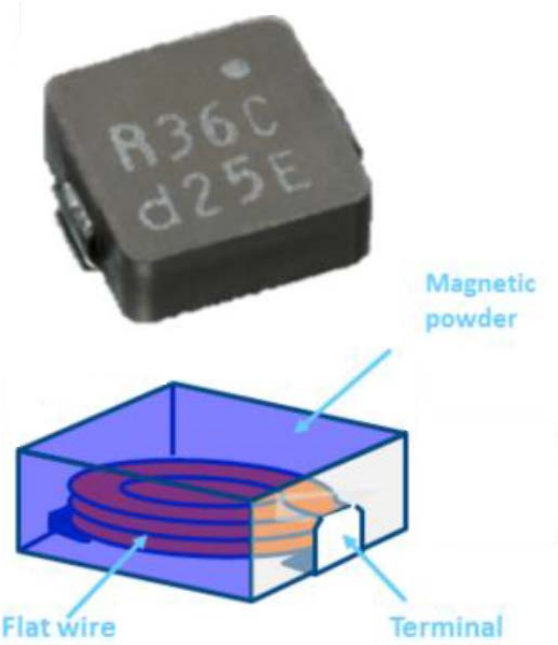
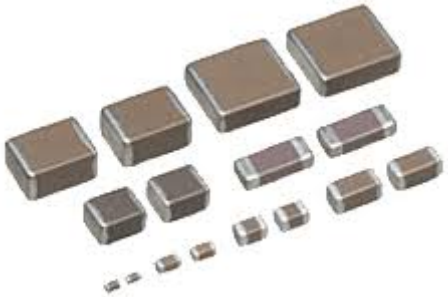
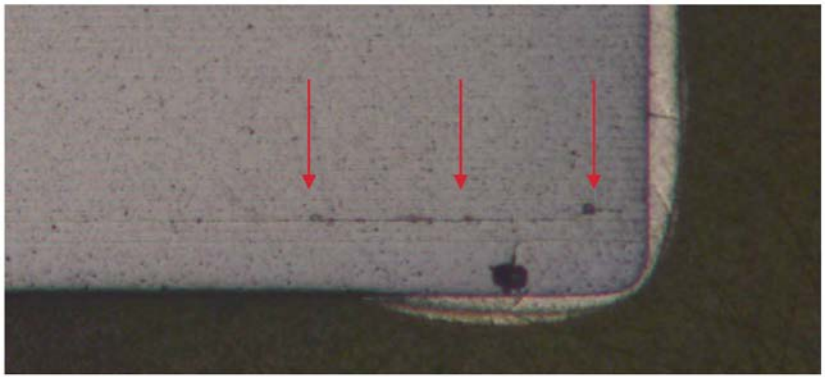


Fail-Safe Capacitors





Promising applications : Composite Inductors

Applications

- Filtering
- Voltage regulator modules & supplies
- IT systems (servers, laptop, HDTV…)
- DC/DC Converters

Benefits

- Low losses : iron losses are minimized
- Higher current, power & saturation in small packages
- Improved temperature stability
- …

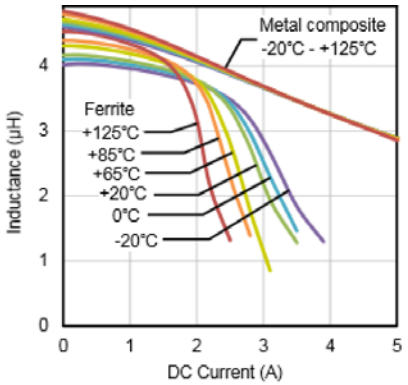


Figure 5. Temperature Characteristics

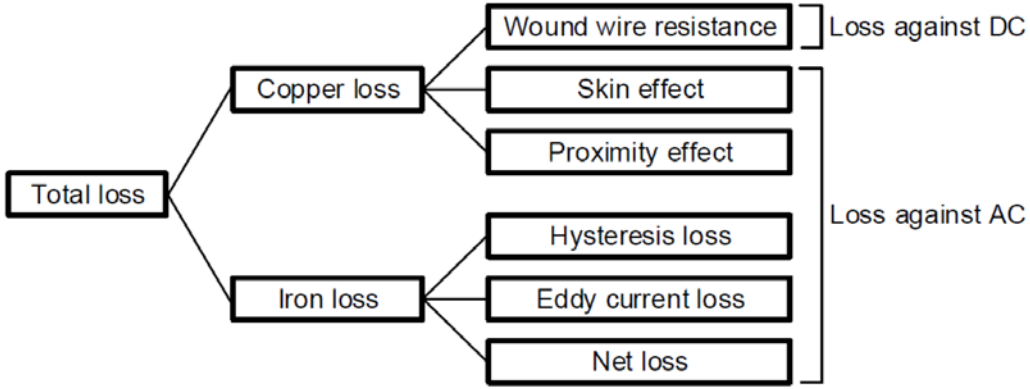
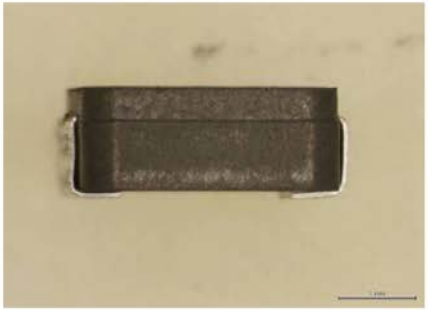


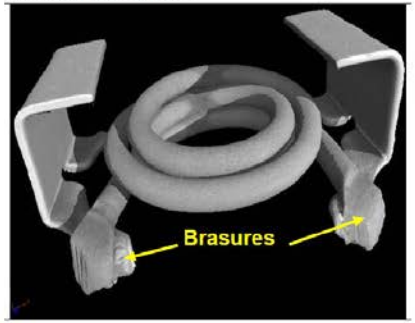
Figure 10. Inductor Loss

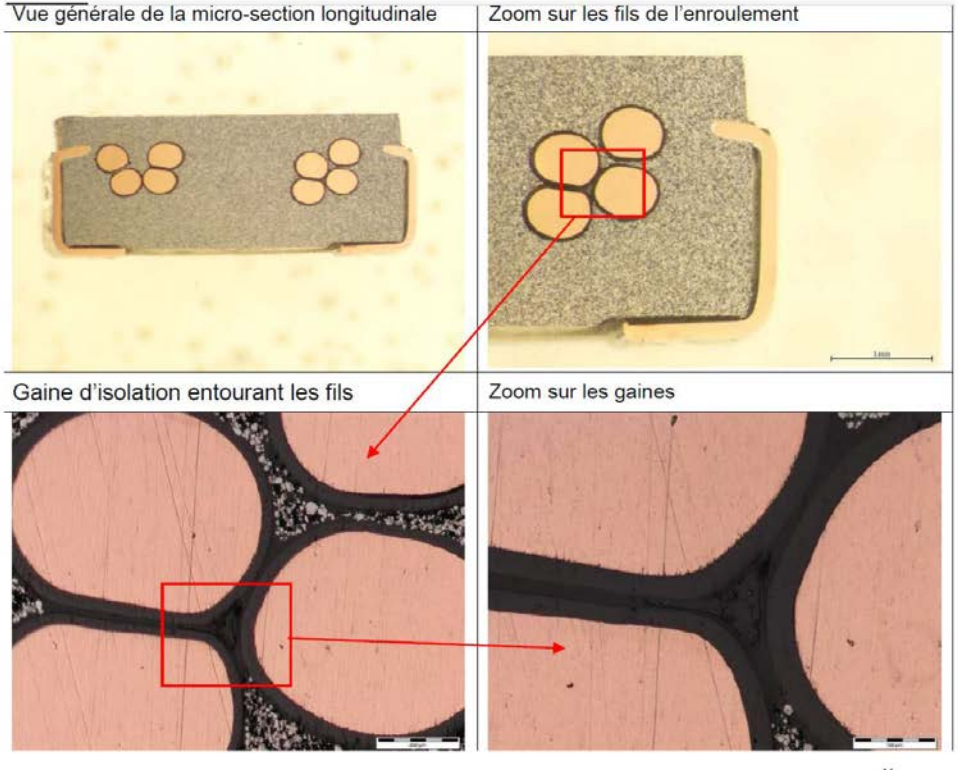
Promising applications : Composite Inductors

Construction analysis : no defect noted



Les brasures ne présentent pas de lacune et sont correctement maitrisées





Promising applications : AEC-Q-200 (extract)

Note: A letter or "●" indicates that performance of that stress test should be considered for the appropriate process change

Test # From Table 5	3	4	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
MATERIAL																			
Bobbin material	●	●		●	●	●				●			●				●		
Core material		●			●	●				●			●			B	●		
Insulation material	●	●		●	●	●			●			●	●	a		B	●		
Lead material					●	●		●			●	●			●			●	●
Mold material	●	●	●	●	●	●			●	●			●			B	●		
Solder material		●				●		●		●	●		●		●			●	●
Wire/foil material			●	●	●	●								●		B		●	●
PROCESS																			
Insulation strip			●			●			●			●							
Lead prep/plating		●				●		●			●	●	●		●			●	●
Terminal Attach		●	●			●		●		●	●	a	●		●				
Marking						●			●										
Molding	●	●		●	●	●	●		●	●			●			B	●		
Soldering		●				●		●			●		●		●			●	●
Winding - Insulation				●	●				●			●		a		B			
Winding - Wire			●		●	●										B			
DESIGN																			
Bobbin		●				●	●			●			●	●		B			
Core		●				●	●			●	●		●			B			
Insulation system				●	●	●	●		●			●		a		B	●		
Lead						●	●	●			●	●		●	●			●	●
Mold		●	●			●	●		●	●			●			B			
Wire/foil		●				●	●						●			B		●	●
MISCELLANEOUS																			
Mfg. Site Transfer	●	●	●		●			●				●	●			B			●
Material Suppliers		●	●			●	●	●					●			B			
Process Control Change						●	●												

a = Multilayer only

B = comparative data (unchanged vs. Changed) required

3. High Temperature Exposure (Storage)
4. Temperature Cycling

6. Moisture Resistance
7. Biased Humidity
8. Operational Life
9 External Visual
10. Physical Dimension
11. Terminal Strength (Leaded)

12. Resistance to Solvents
13. Mechanical Shock
14. Vibration
15. Resistance to Soldering Heat
16. Thermal Shock
17. Electrostatic Discharge (ESD)
18. Solderability
19. Electrical Characterization
20. Flammability
21. Board Flex
22. Terminal Strength (SMD)

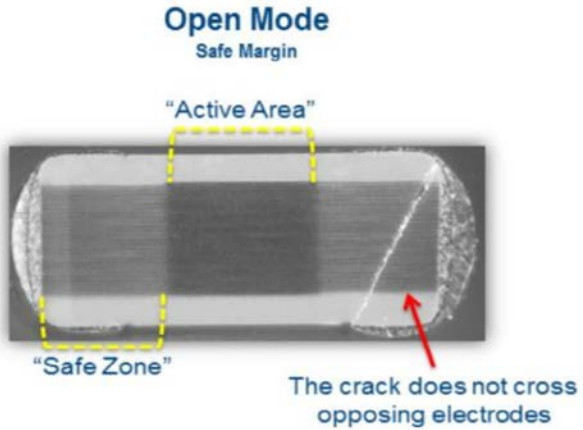
Promising applications : Fail-Safe Capacitors

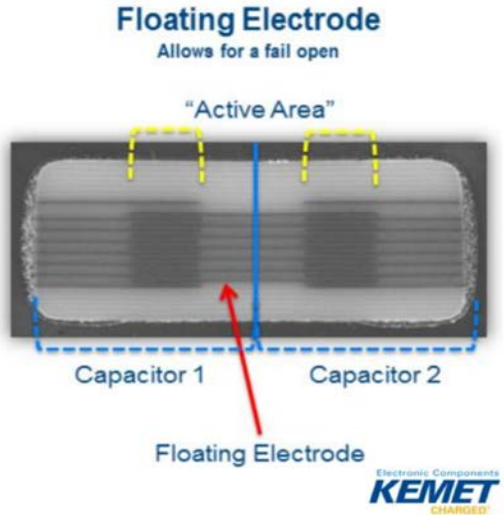
Applications

- **Filtering & decoupling**
- **Automotive : Flex crack mitigation**
- **Space : manual soldering**
- **Increase of reliability**

Benefits

- **No short circuit :**
  - only change in capacitor values
- **Risk reducing measures**
- **Smaller packages**
- **But : limited ranges**





Promising applications : AEC-Q-200 (extract)

Note: A letter or "●" indicates that performance of that stress test should be considered (**not necessarily required**) for the appropriate process change

Test # From Table 2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	21	22	23
MATERIAL																				
Binder Material		●	●									●		●						
Dielectric Change	●	●	●		●	●			●	●	●	●		●	●		B	C		●
Electrode Attach	●	●				●							C	●			B	C	●	
Electrode Material	●	●	●		●	●			●	●		●		●	●		B			
Encapsulation		●		●	●		●	●		●										
Lead Material		●	●			●	●		●			●	●			●	B			
PROCESS																				
Dicing	●	●		●	●		●	●		●	●						B			C
Electrode Apply	C				C								C	C	C		BC	C		
Firing Profile		●	●			●								●	●		B			C
Lamination/Press Technique			●		●								●	●			B	●		C
Powder Particle Size		●			●								●		●		B	●		
Screening/Printing						C					C				C		BC			C
Termination Process	●	●	●	●	●	●	●	●	●	●	●	●	●			●	B	●	●	
DESIGN																				
Electrode Thickness	●	●	●			●		●			●	●		●	●		B			
Layer Thickness	●	●	●		●	●		●	●		●			●	●		B			C
Lead Diameter		●		●	●	●	●	●	●			●								
Number of Layers		C	C		C	C		C			C			C	C		BC			C
Termination Area	●			●			●	●				●						●	●	
Terminal Interface	●	●	●	●	●	●			●		●	●	●				B	●	●	
MISCELLANEOUS																				
Mfg. Site Transfer	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	B	●	●	C
Material Suppliers	●	●	●	●	●	●			●	●	●	●	●	●	●	●	B	●	●	C
New/Modified Mfg. Equipment		●		●	●	●		●	a			●			●	●	B			C

a = termination equipment only **B = comparative data (unchanged vs. Changed) required** C = Ceramics only **D = Tantalums only**

3. High Temperature Exposure (Storage)
4. Temperature Cycling
5. Destructive Physical Analysis
6. Moisture Resistance
7. Biased Humidity
8. Operational Life
9 External Visual
10. Physical Dimension
11. Terminal Strength (Leaded)
12. Resistance to Solvents
13. Mechanical Shock
14. Vibration
15. Resistance to Soldering Heat
16. Thermal Shock
17. Electrostatic Discharge (ESD)
18. Solderability
19. Electrical Characterization
21. Board Flex
22. Terminal Strength (SMD)
23. Beam Load Test

COMET: The use of Automotive components for Space applications

Communities of Experts aims to:

- **Enrich the expertise and contribute to innovation by:**
  - Sharing knowledge, know-how and feedback;
  - Encouraging inter-disciplinary collaboration between networks;
  - Developing innovative ideas.
- **Promote exchanges and cooperation between space field & other domain**

A workshop was organized in Toulouse in May 2018 :

- Automotive components manufacturers
- How to use automotive parts in the space sector
- Space industry perspective

COMET: The use of Automotive components for Space applications

Automotive components manufacturers

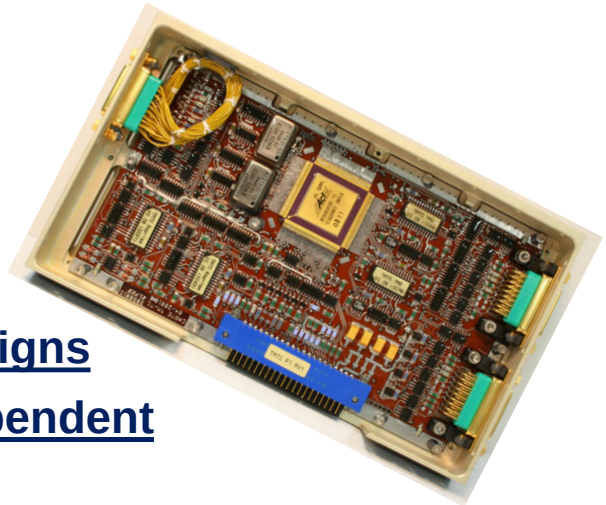
Manufacturer	Components available
Kemet	Tantalum & Ceramic Capacitors
Coilcraft	Automotive magnetics
Susumu	Thin Film Resistor Technology
Vishay	AEC-Q200 Resistors
Vishay	AEC-Q101 Semiconductors
Microchip	Solutions for Space from Automotive

- ✓ A wide range of products available
- x Hard to access to PPAP (and qualification data)
- x Space is a “niche market” : manufacturers insist to sell their space products

COMET: The use of Automotive components for Space applications

How can we use them?

- **Very important effort at selection level**
  - What is a good COTS?
- **Transpose Automotive methods to Space sector**
  - Tin-free soldering
  - Design rules & Prohibited practice
  - Mass procurement



How do we test them?

- **Testing at board level** → **Appropriate designs**
- **Representative Radiation tests** → **Lot dependent**

COTS Initiative

CNES Team aims to:

- **Gather data on COTS**
- **Promote exchanges and cooperation in space industry**

Ongoing actions :

- **Tests on COTS**
  - 100s of references already tested and shared inside our Multi-partenariat
- **New passive families being tested**
  - MEMS, Crystals, Thermostat…

Thank you !