MLCC, CLASS1, CLASS 2, BME, NME – ALL CLEAR? SURE THING

Frank Puhane
Leader Technical Engineering eiCap & eiRis – Capacitors and Resistors Division

WÜRTH ELEKTRONIK MORE THAN YOU EXPECT

AGENDA

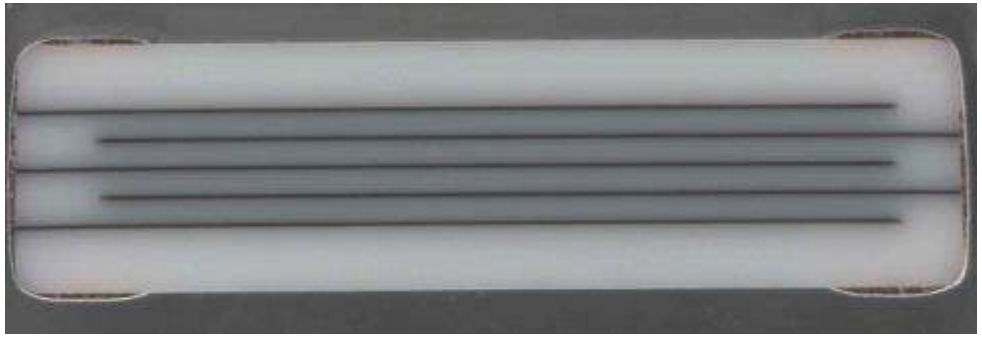
- Construction, production, specification of MLCCs
- What is NME and BME?
- Gong back in time
- Comparison of NME and BME
- Applications

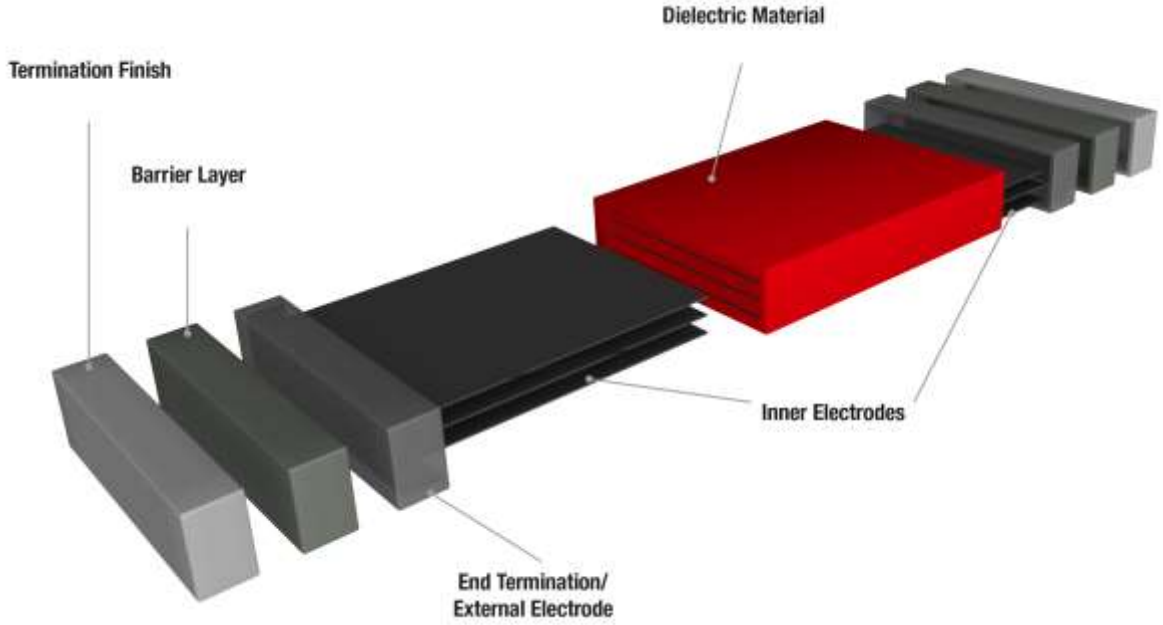
CONSTRUCTION, PRODUCTION, SPECIFICATION

MULTILAYER CERAMIC CHIP CAPACITOR – MLCC

Overview

- Most used capacitor in the world
- Distinction by the used dielectric material
- Monolithic ceramic body
- Multilayer construction process
  - Multilayer ceramic chip capacitors
  - MLCC



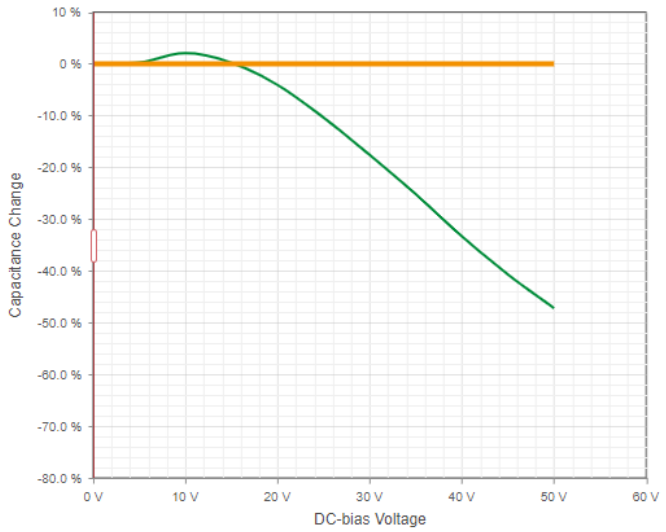


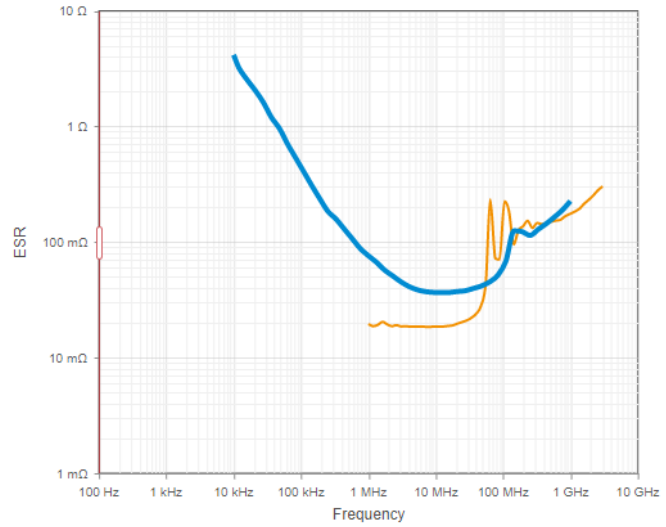
MULTILAYER CERAMIC CHIP CAPACITOR – MLCC

Difference class 1 and class 2

- Class 1 (e.g.: NP0 or C0G -> titanium oxide)
  - Smaller relative permittivity εr => lower capacitance
  - Depending on the type no temperature dependence (e.g. C0G / NP0)
  - Otherwise there are no derating
  - **They offer stable / precise C-values**
  - **For applications where fixed / stable capacitance value is needed**

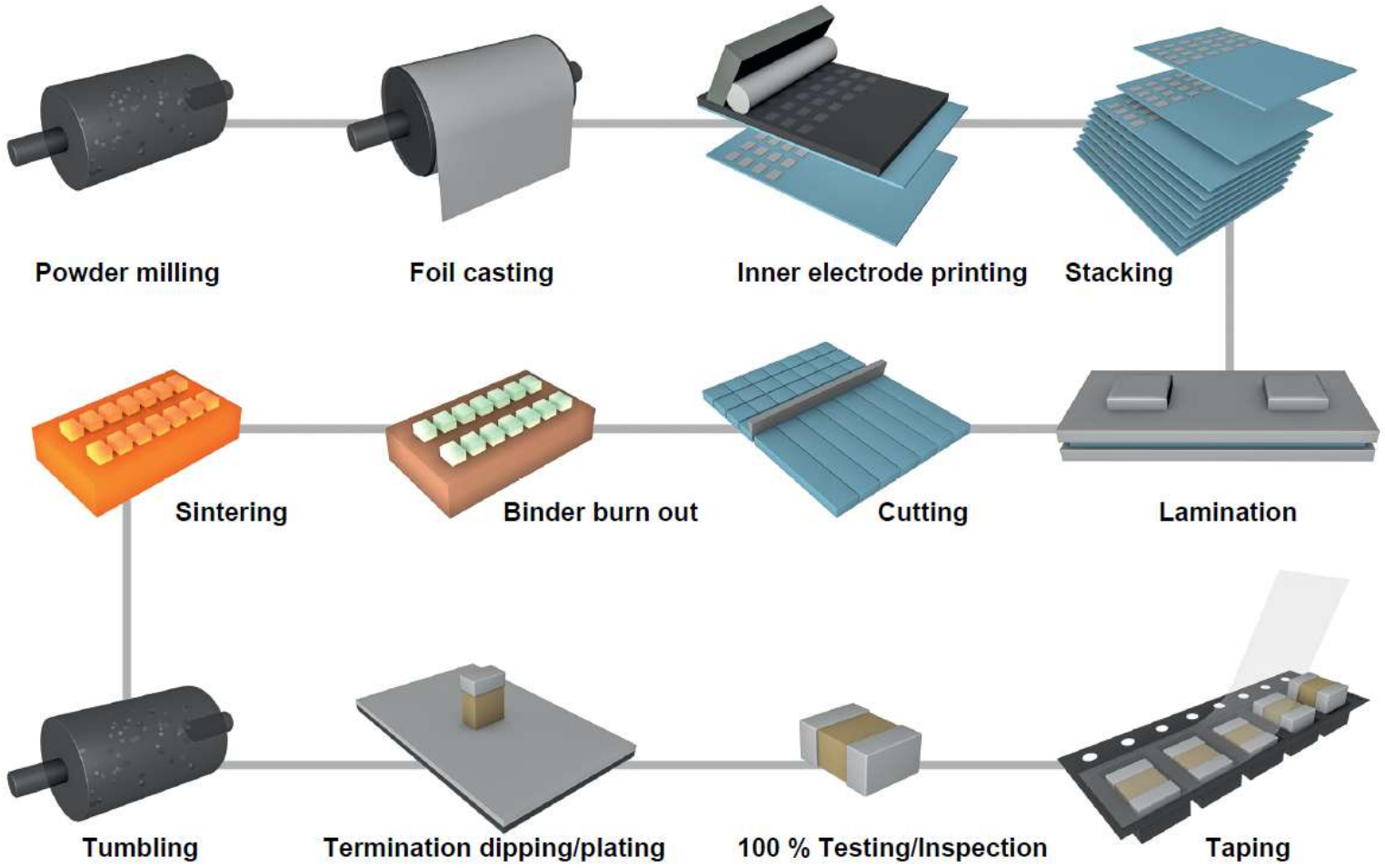
- Class 2 (e.g.: X7R, X5R, Y5V -> barium titanate)
  - Higher relative permittivity εr => higher capacitance
  - Non-linear temperature dependence (manufacturer specific due to material mix / design)
  - DC bias and aging behavior
  - **The capacitance value in the DB is not explicitly available in the application**
  - **Manufacturer's data must be checked in order to estimate the resulting capacitance**





MULTILAYER CERAMIC CHIP CAPACITOR – MLCC

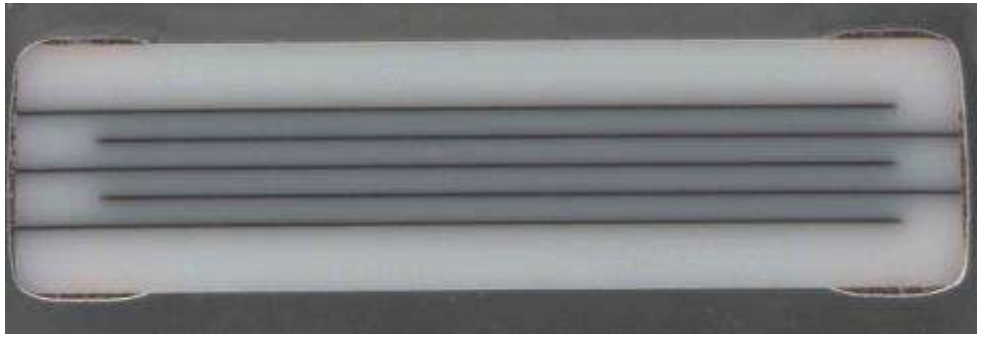
Production process

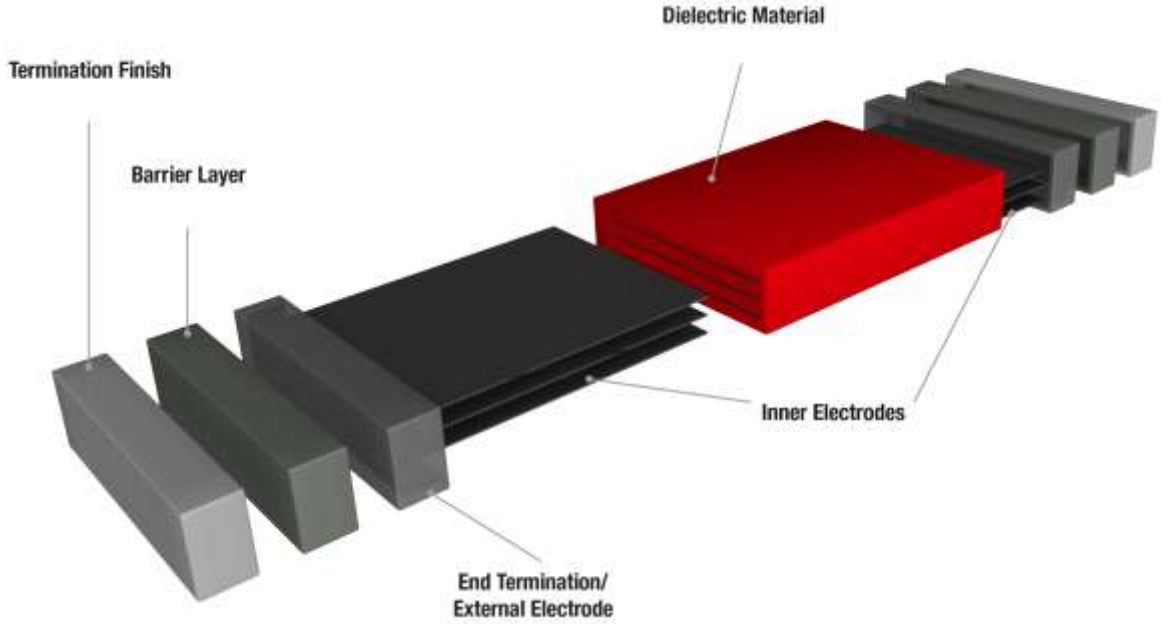


MULTILAYER CERAMIC CHIP CAPACITOR – MLCC

What is NME and BME?

- NME
  - Noble Metal Electrodes
  - As silver or palladium
- BME
  - Base Metal Electrodes
  - As copper or nickel





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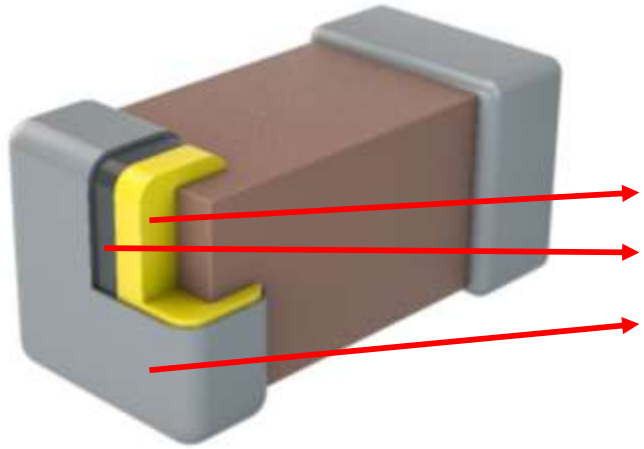
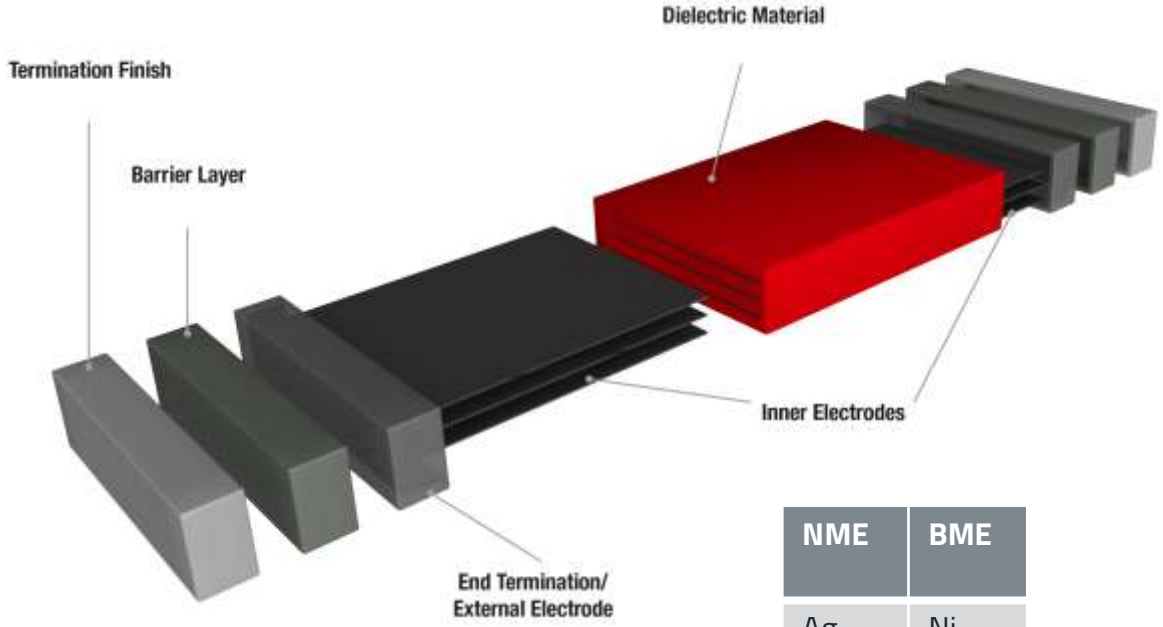


NME	BME
AG	Cu
Ni	Ni
Sn	Sn



NME	BME
Ag	Ni
Pd	Cu

HISTORY

MULTILAYER CERAMIC CHIP CAPACITOR – MLCC

Going back in time

- Why noble metal was used?
  - Sintering temperature
  - Good electrical performance

- Where it was used?
  - For the electrodes
  - For the termination contact

- Why we changed it?
  - Price per pieces was high
  - Price increase at the end of 90s for noble metal

MULTILAYER CERAMIC CHIP CAPACITOR – MLCC

Going back in time

- What changed when using BME?
  - Different ceramic material
  - Atmosphere at the sintering
- Where we use it?
  - Inner and external electrodes
- The development of BME technology played an important role in expanding the application area

Table I. Physical properties and price ratio of various electrodes.

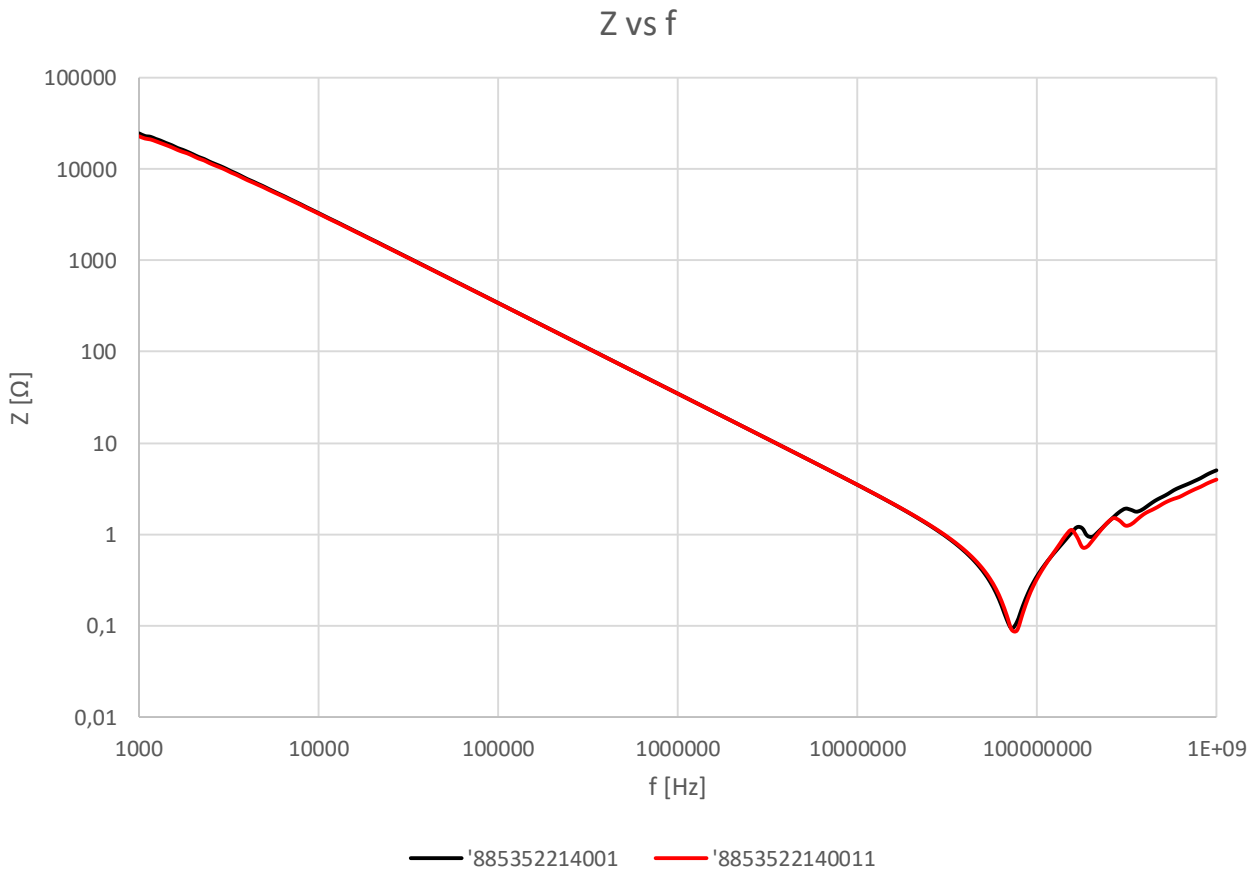
Metals	Melting point (°C)	Resistivity (mΩ)	Firing atmosphere	Price ratio
Ag	961	1.62	Air	3
Cu	1080	1.72	Reducing	1
Ni	1453	6.9	Reducing	1
Pd	1552	10.4	Air	80

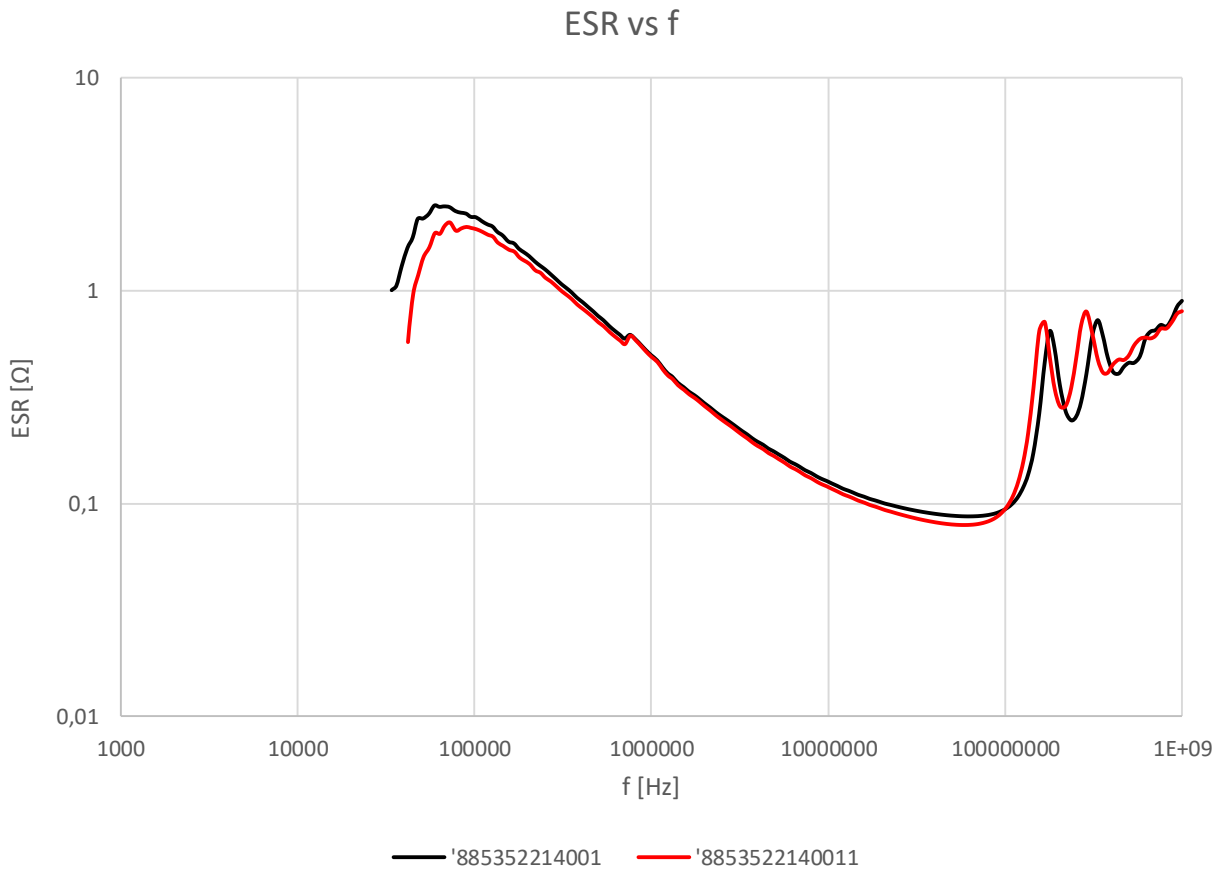
COMPARISON NME AND BME

Comparison NME and BME

WCAP-CSSA

- Interference suppression capacitor with X2 or Y2/X1 specification

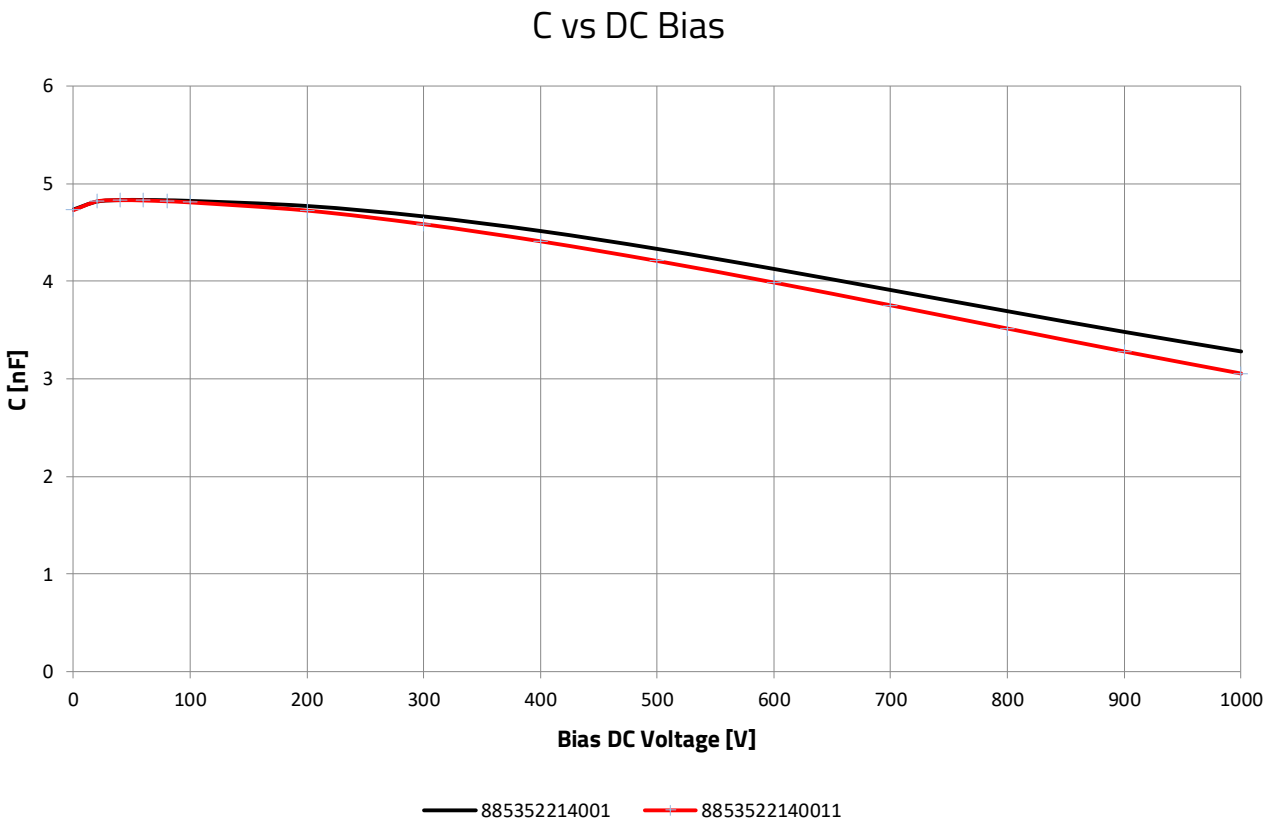


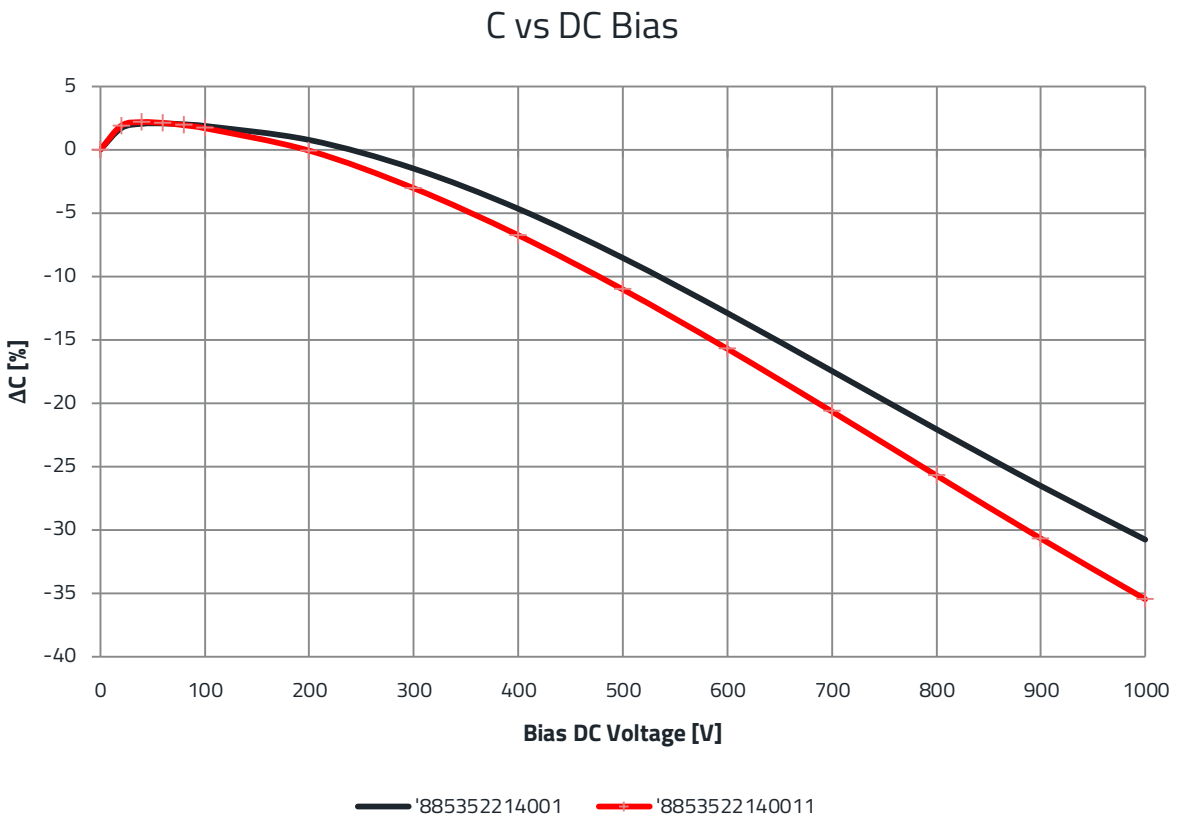


Comparison NME and BME

WCAP-CSSA

- Interference suppression capacitor with X2 or Y2 specification

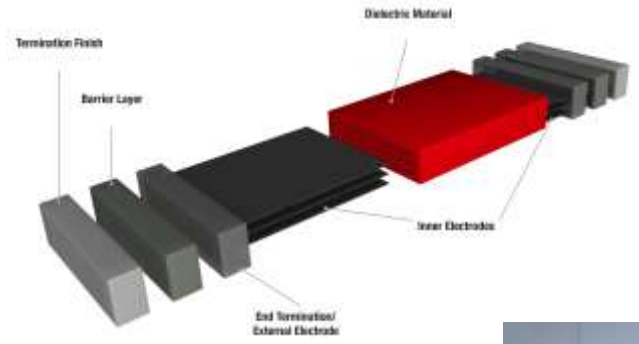


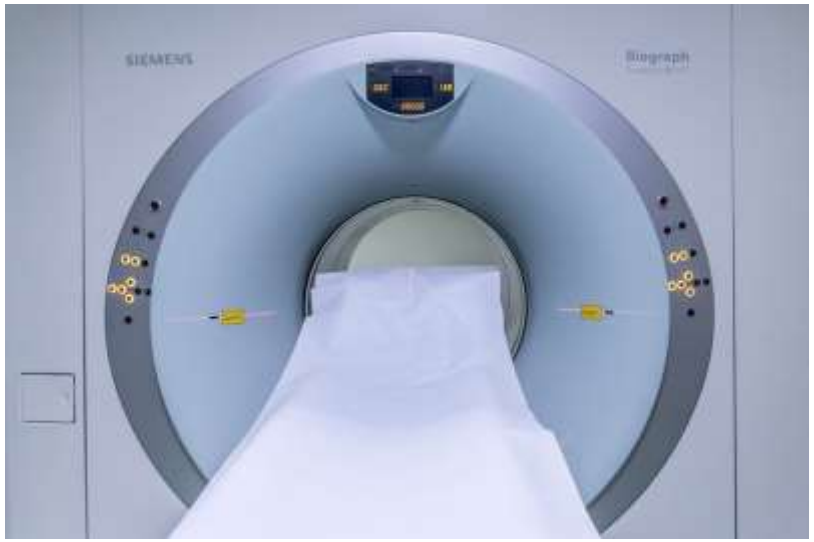


APPLICATIONS

Application

- Why we need non-magnetic products?
  - Static magnetic field
  - Radio frequencies
  - Electromagnetic wave
  - Interferences inside a design
  - Different vendor offer such parts





QUESTIONS