Different mmWave Automotive Radar Sensors have Different Antenna PCB Base Material Requirements

IWPC Webinar
2022, April 20

AGC Inc.

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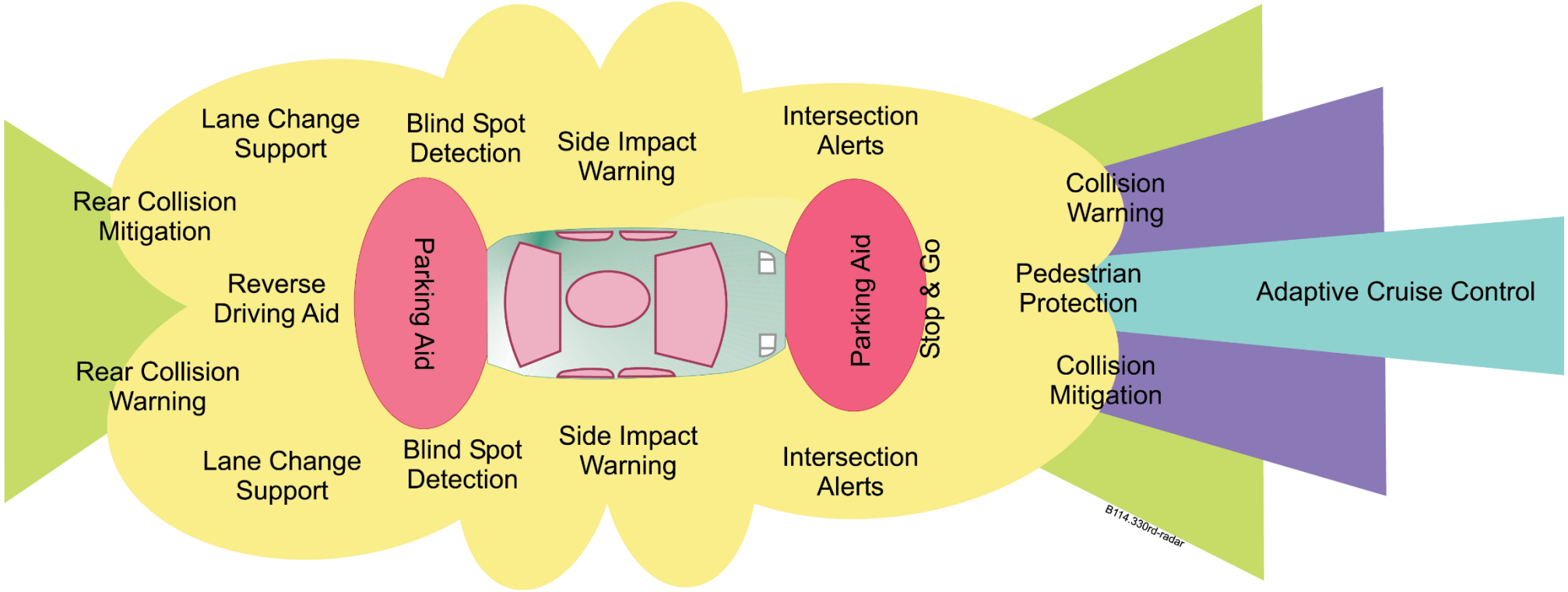
ADAS Applications

Advanced driver-assistance systems (ADAS) are electronic systems that assist drivers in driving and parking functions



(courtesy of PRISMARK)

60 GHz Cabin Sensor / Child Presence Detector CPD

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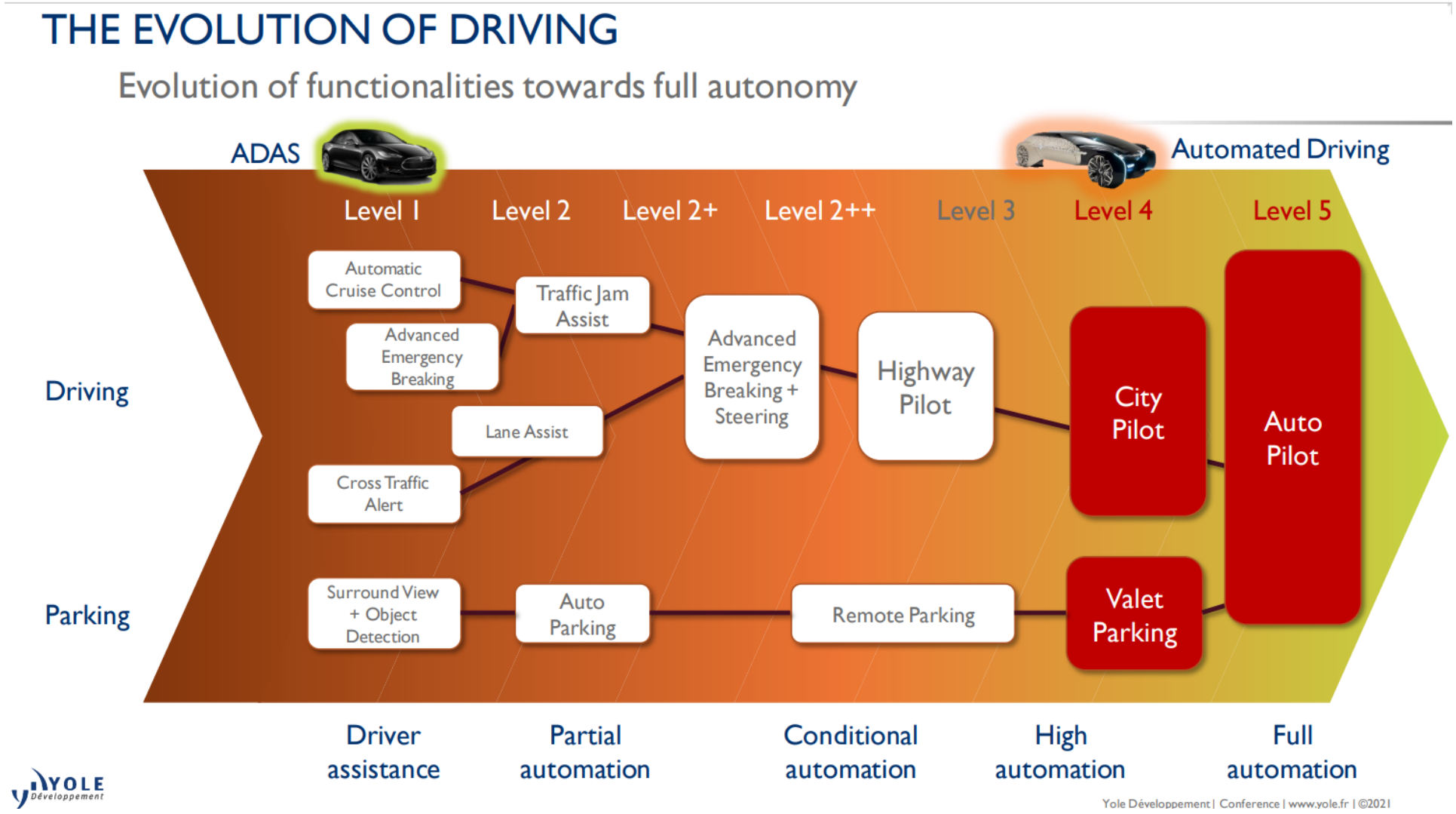
(courtesy of Nanjing Chuhang Technology Co., Ltd.)



(courtesy of YOLE)

THE EVOLUTION OF DRIVING

Similar number of sensors between ADAS and robotic vehicles

ADAS vehicles with highest level of autonomy are expected to embedded a similar number of sensors than robotic vehicles.

Level 3	Level 4	Level 5
Conditional automation	**High automation**	**Full automation**
• In defined use cases, the driver can transfer the driving task to the system. • Side activities can be permitted. • The driver has to take over within a specified time (level 3) or when he wants to leave the domain (level 4).		
Ultrasonic x8 **Radar LRR x2** **Radar MRR x4** **ADAS camera x3** **Viewing camera x4** **LiDAR x1** **Dead reckoning x1**	**Ultrasonic x10** **Radar LRR x2** **Radar MRR x4** **Radar SRR x2** **ADAS camera x7** **Viewing camera x6** **LiDAR x5** **Dead reckoning x1**	**Ultrasonic x10** **Radar LRR x2** **Radar MRR x4** **Radar SRR x4** **ADAS camera x9** **LiDAR x5** **Dead reckoning x2**
Computing power ~250TOPS	**Computing power ~500 TOPS?**	**Computing power ~1,000 TOPS?**
22 sensors	**36 sensors**	**34 sensors**

- Highest levels of autonomy will require much more sensors than what can be expected of level 2 or level 3 of autonomy.
- The number of sensors for highest levels of autonomy is expected to be similar to the number of sensors used in robotic vehicles.

Note: Dead reckoning sensors are not taken into account in the total.

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(courtesy of YOLE)

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The Case for PTFE Laminates

Stable DK and DF from -50 to +150 °C

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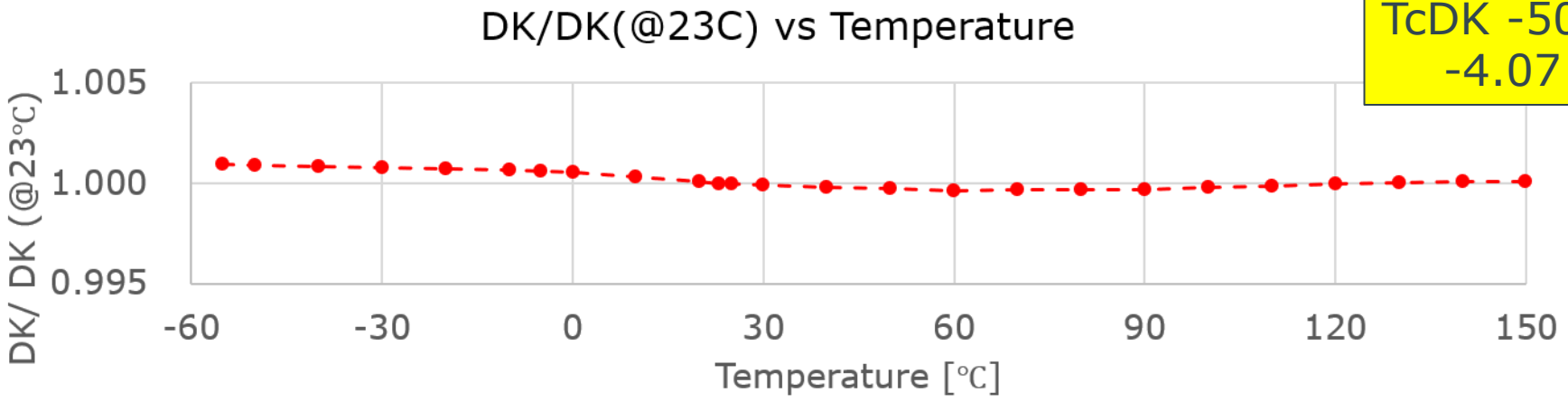
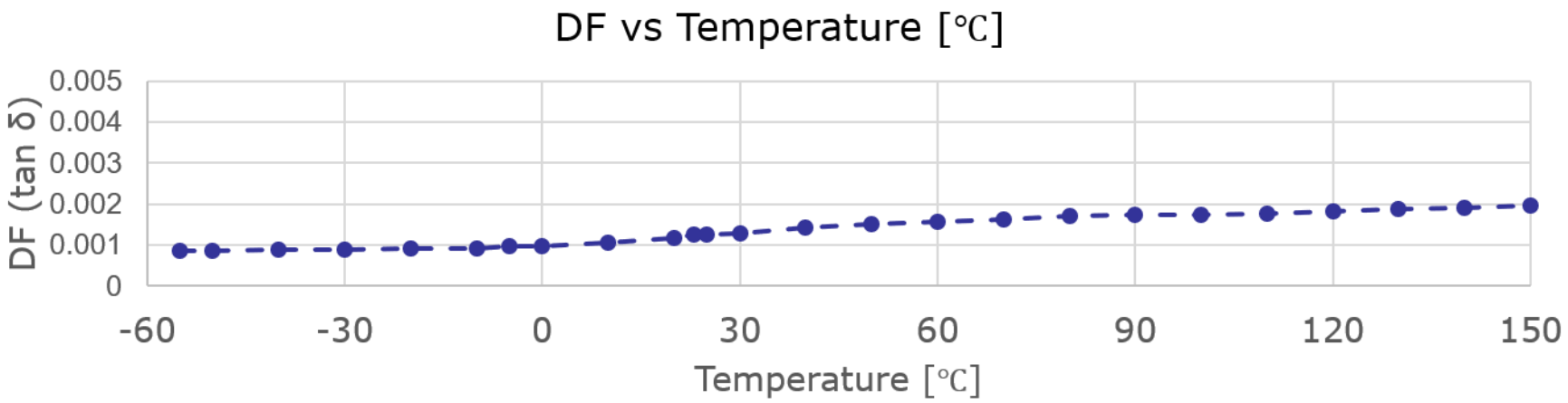
TcDK -50 to +150 °C
-4.07 ppm/°C





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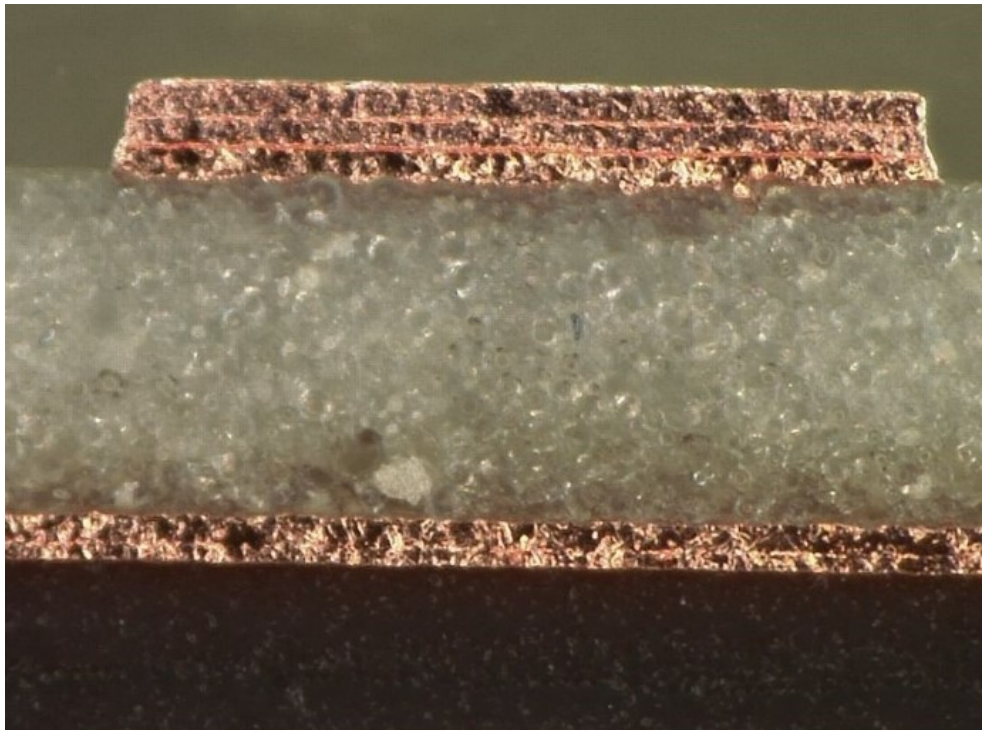
NF-30 is a Ceramic Filled Non-Reinforced PTFE Laminate



Stable DK/DK and DF up to 110 GHz

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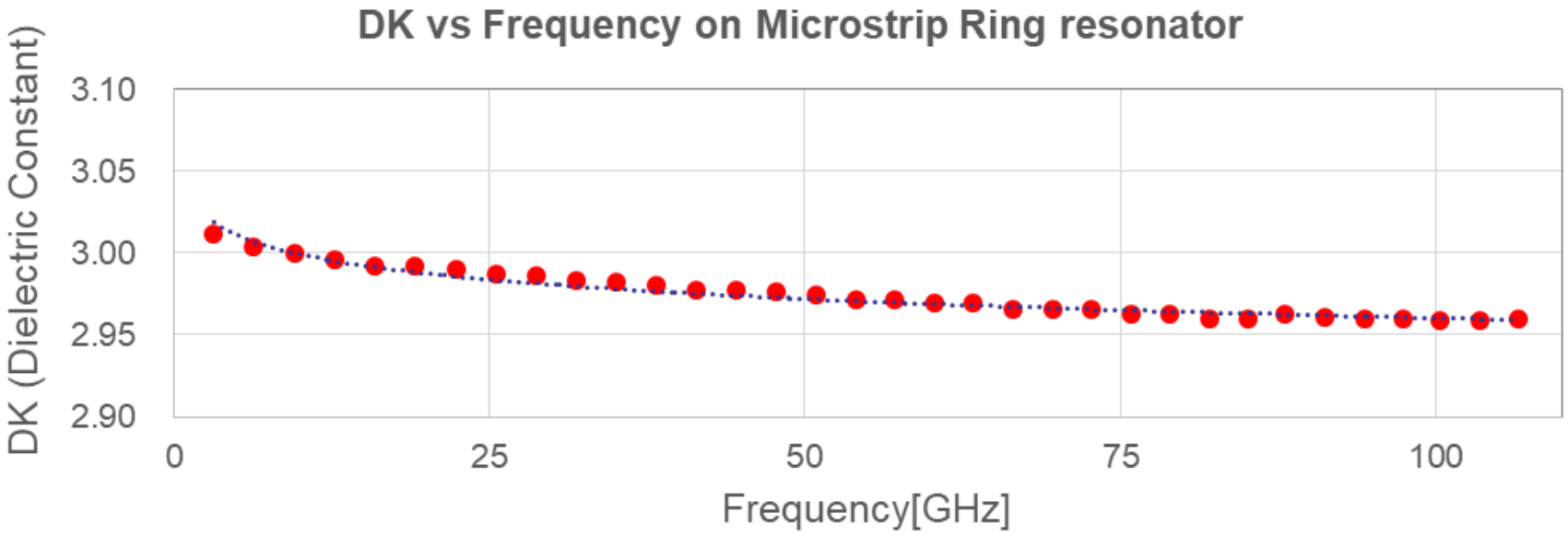

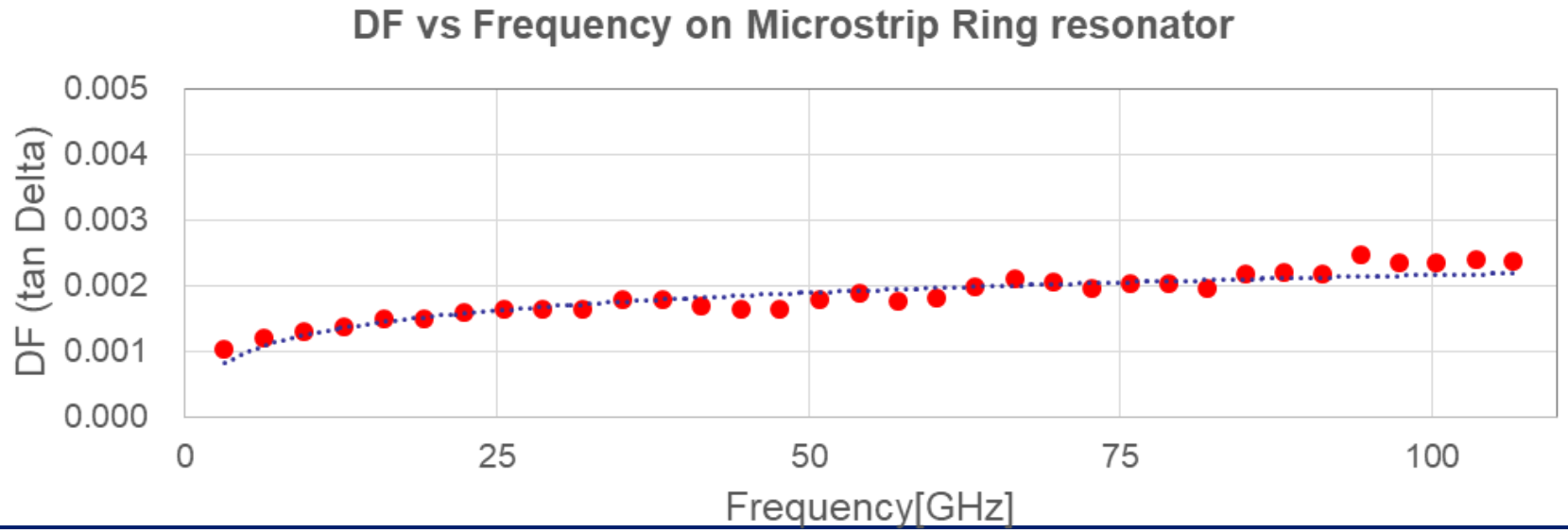

Copper Foil is also of Importance

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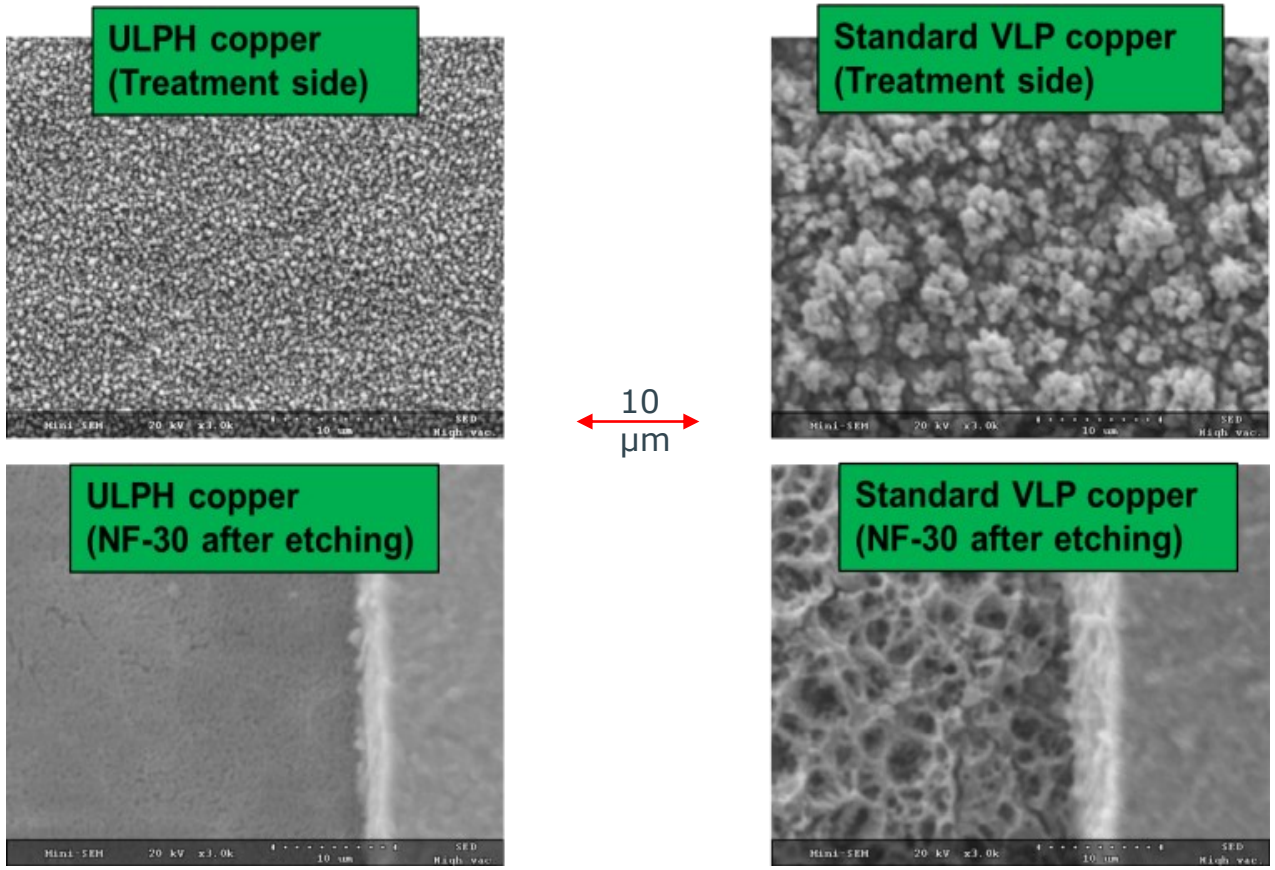
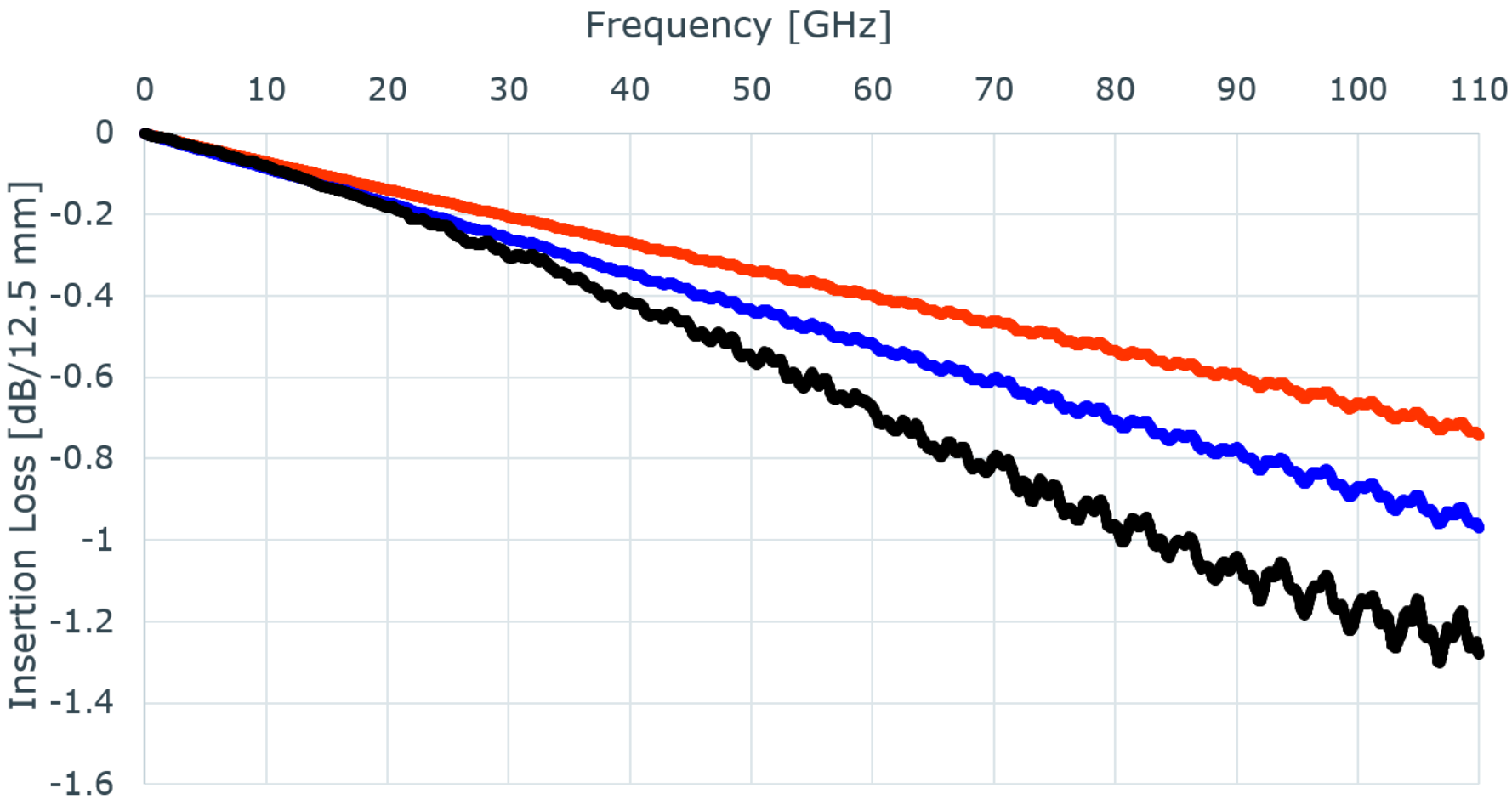
ULPH copper foil vs. VLPH copper foil



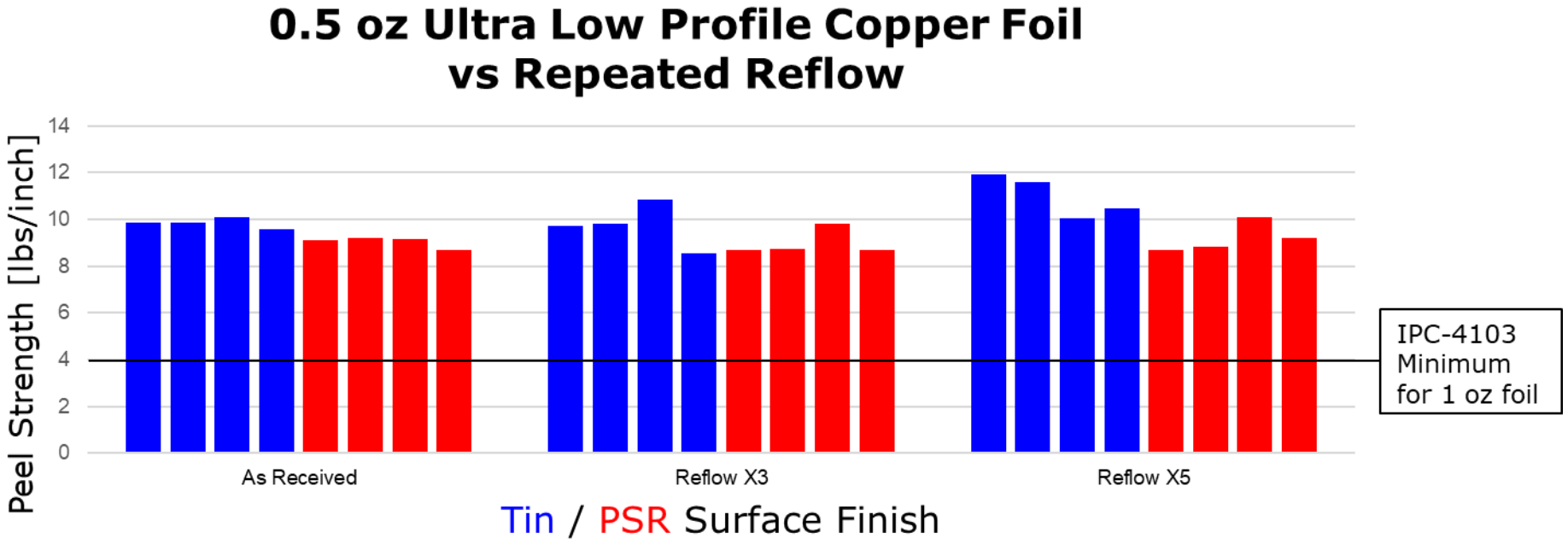
(courtesy of Circuit Foil Luxembourg Sàrl)

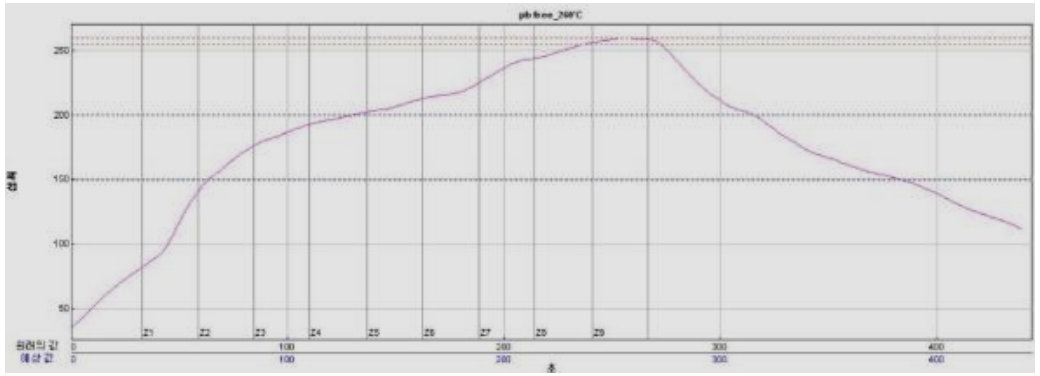
Copper Foil Influence on Insertion Loss



Ultra Low Profile copper foil; Reverse Treatment copper foil; VLP copper foil

Copper Foil Mechanical Reliability





NF-30 Electrical Stability

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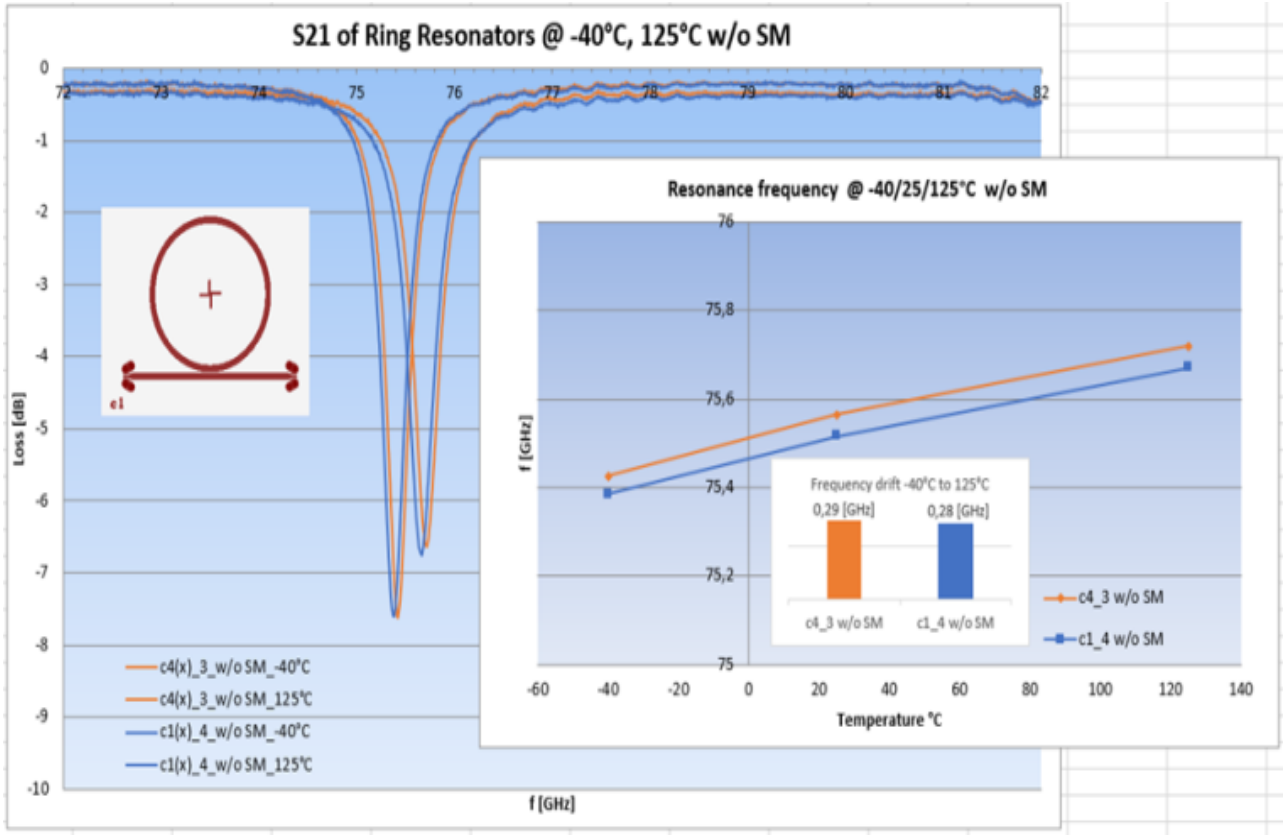
Insertion Loss S21 of ring resonators

show a quite small frequency drift over temperature



(courtesy of Robert Bosch GmbH)

NF-30 Easy Conversion to PCBs

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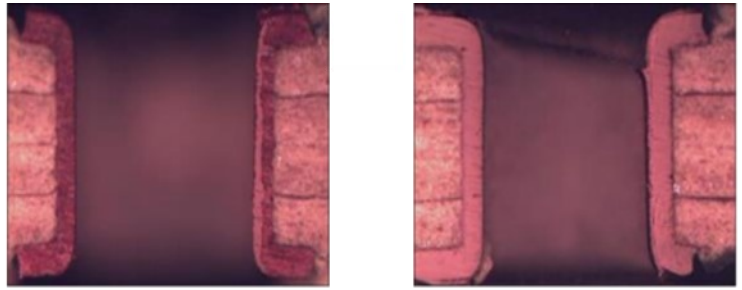
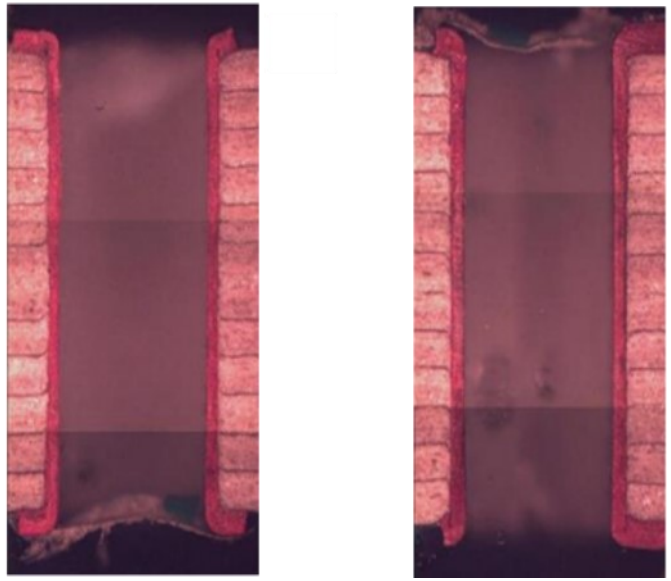
Plated vias in 20 and 60 mil NF-30

viewed from x and y direction

NF-30 20mil



NF-30 60mil



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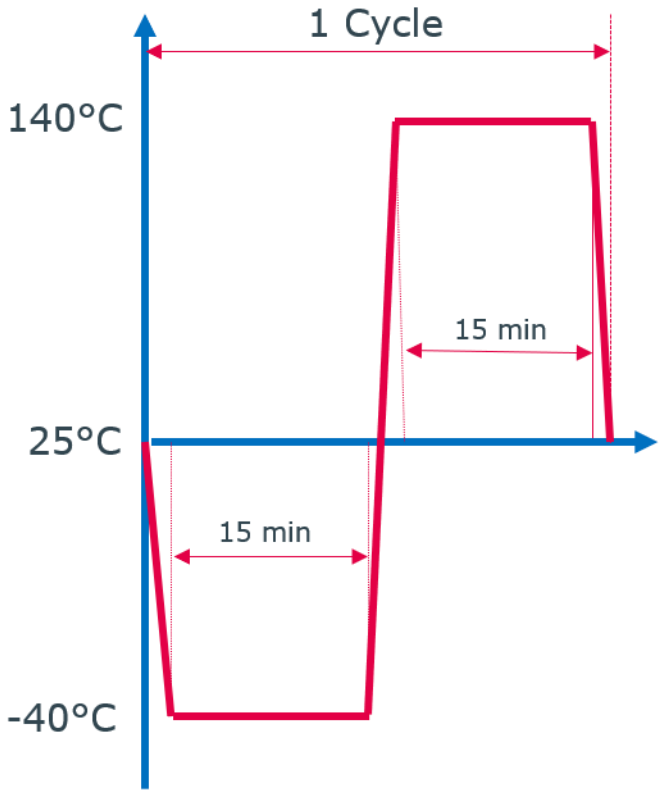
Thermal Cycling Test Condition

1,000 cycles
from -40°C (15 min) to + 140°C (15 min)



NF-30 Thermal Reliability in Multilayer PCB

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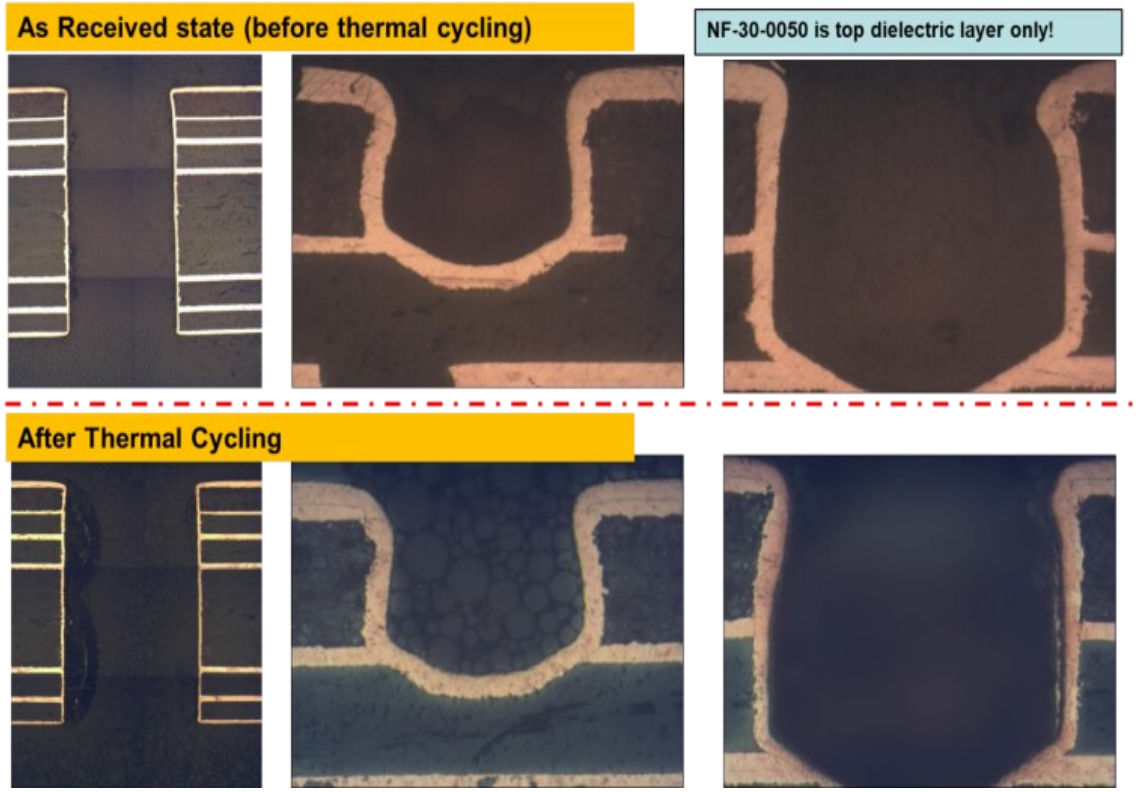
NF-30 hybrid multilayer before and after thermal cycling

1,000 cycles from -40°C to + 140°C



NF-30 Thermal Reliability in Multilayer PCB

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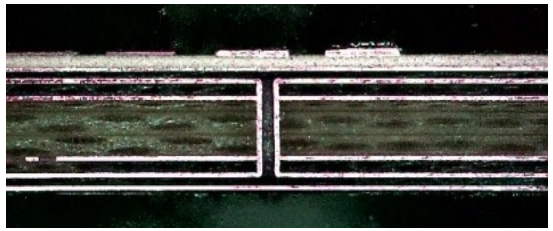
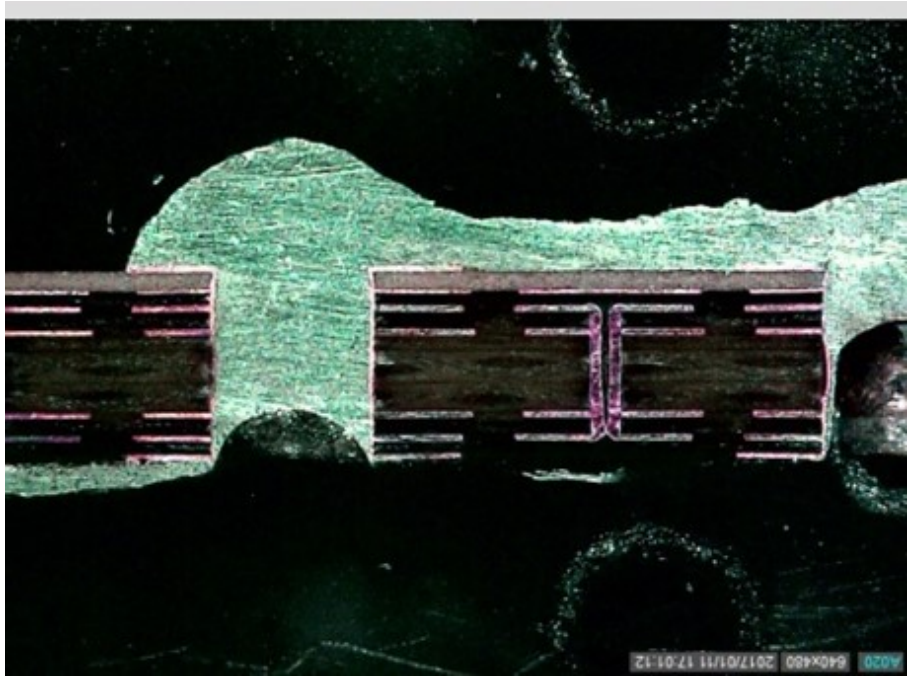
NF-30 hybrid multilayer after 50x solder float (10 s at 288 °C)





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The Case for Thermoset Resin Laminates

MW4000M Stable DK and DF up to 110 GHz

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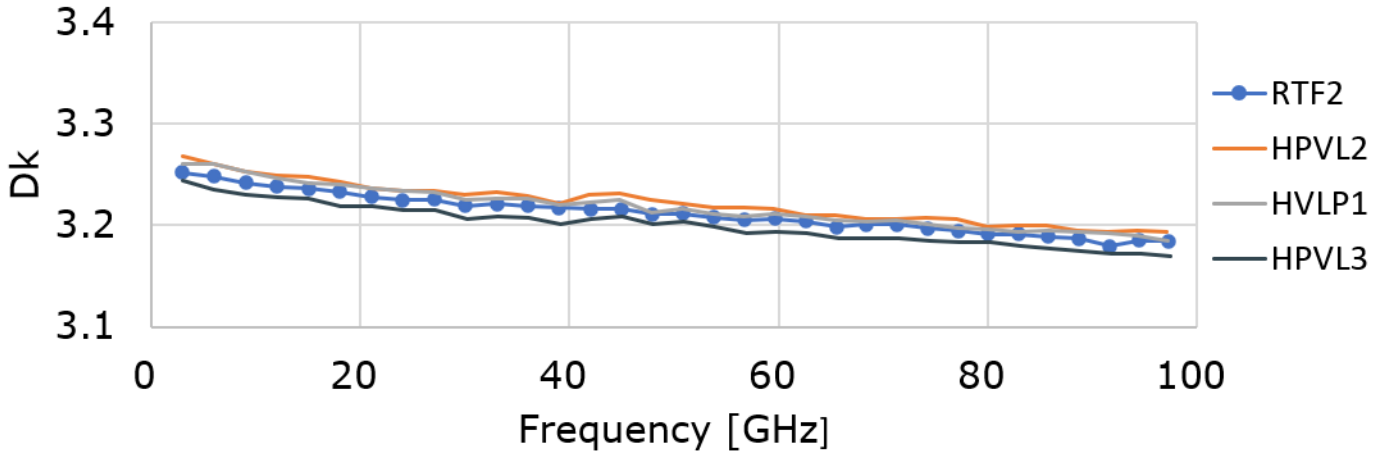

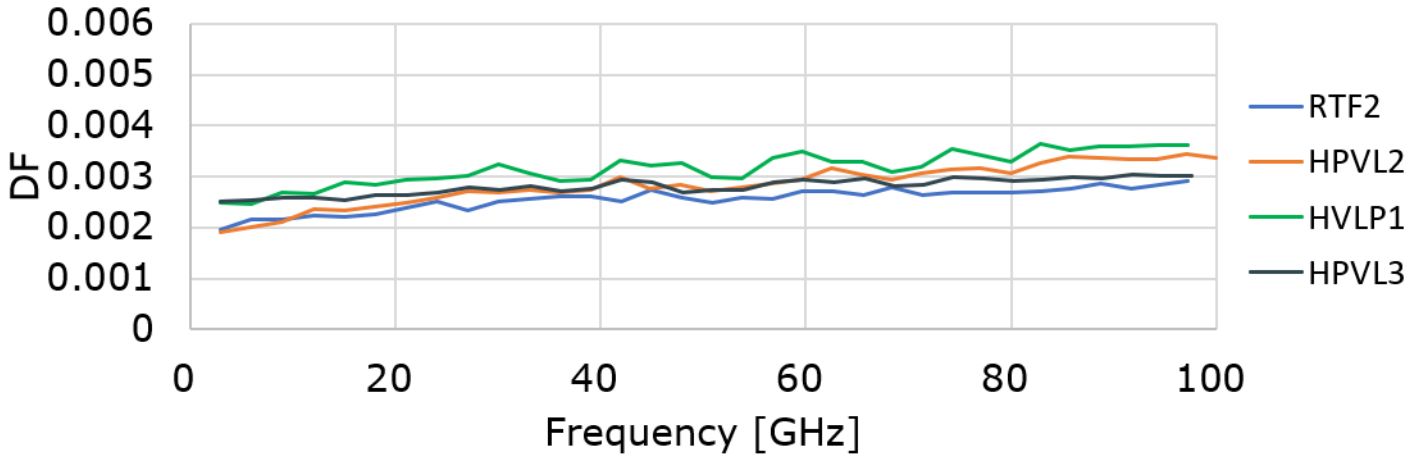

Copper Foil Influence on Insertion Loss

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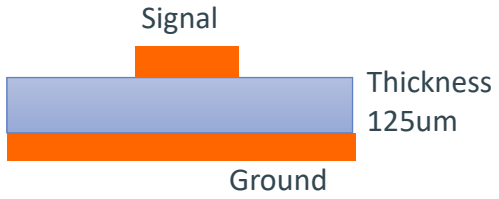
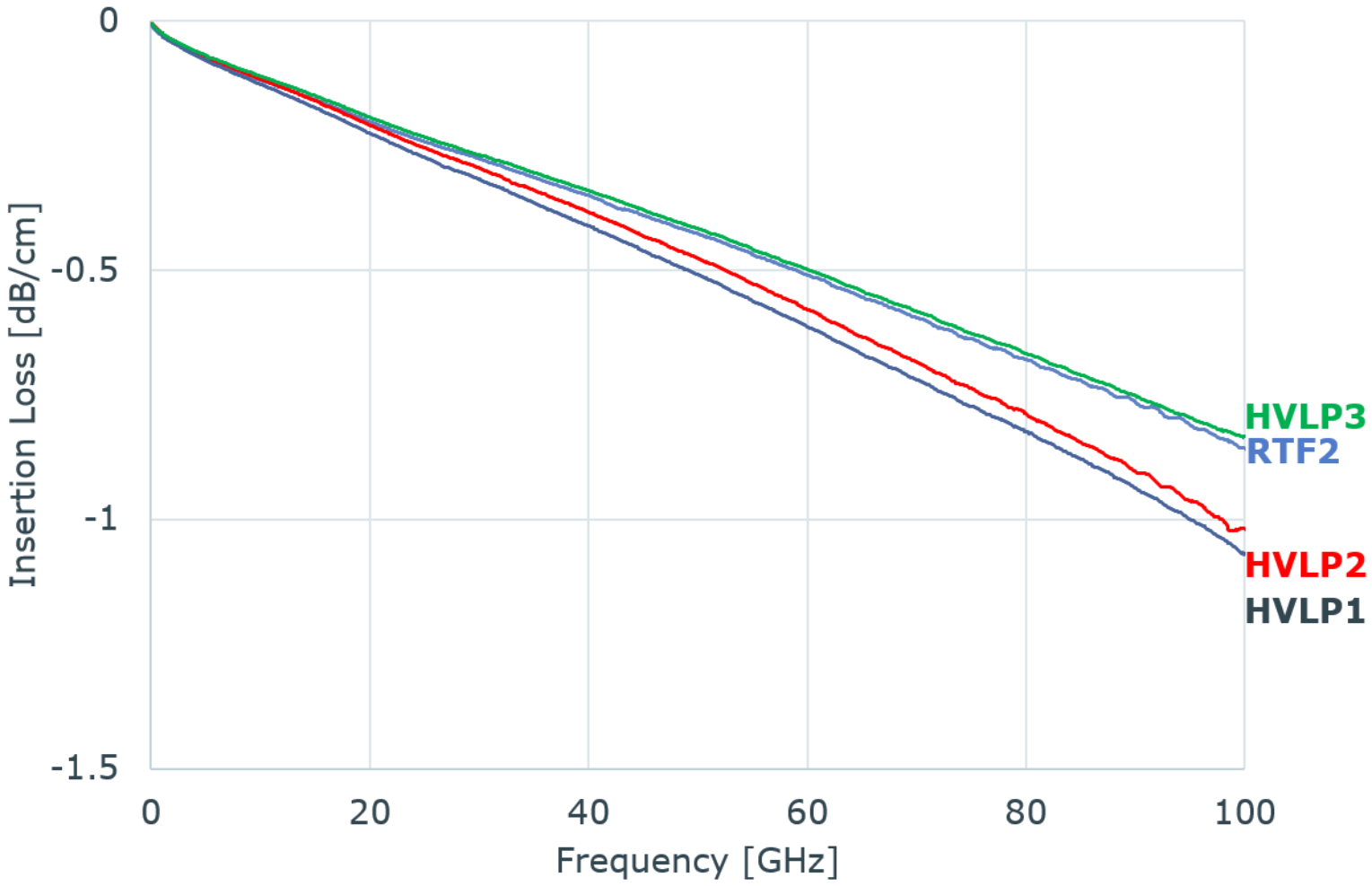
Microstripline method

- 5mil (125 μm) thickness calculated by the two-length micro strip line (8”/2”)





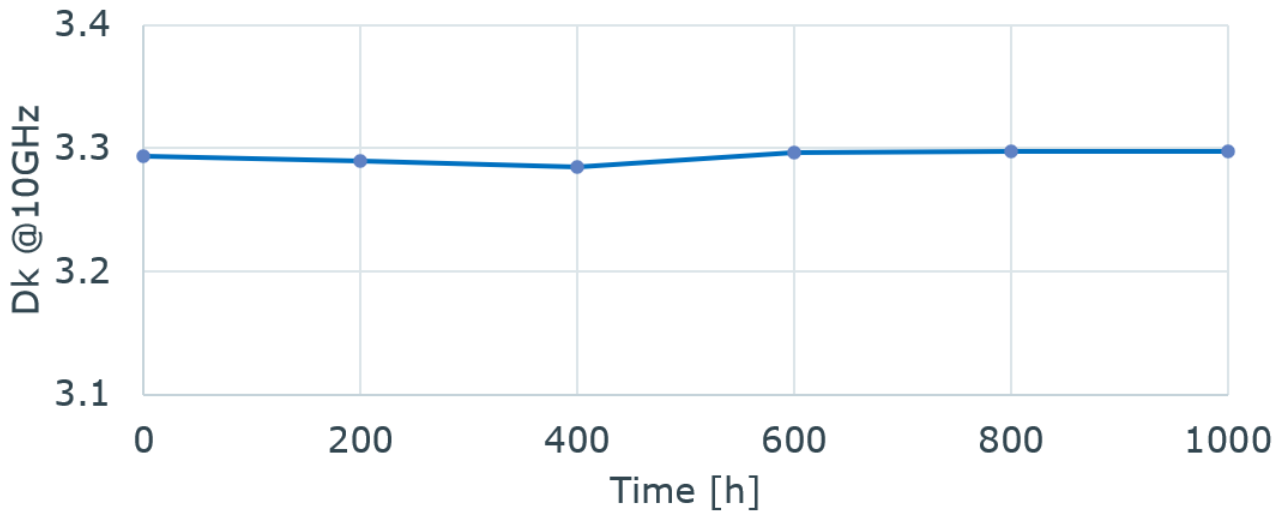
HVLP: different grades **RTF2**: Reverse Treatment copper foil

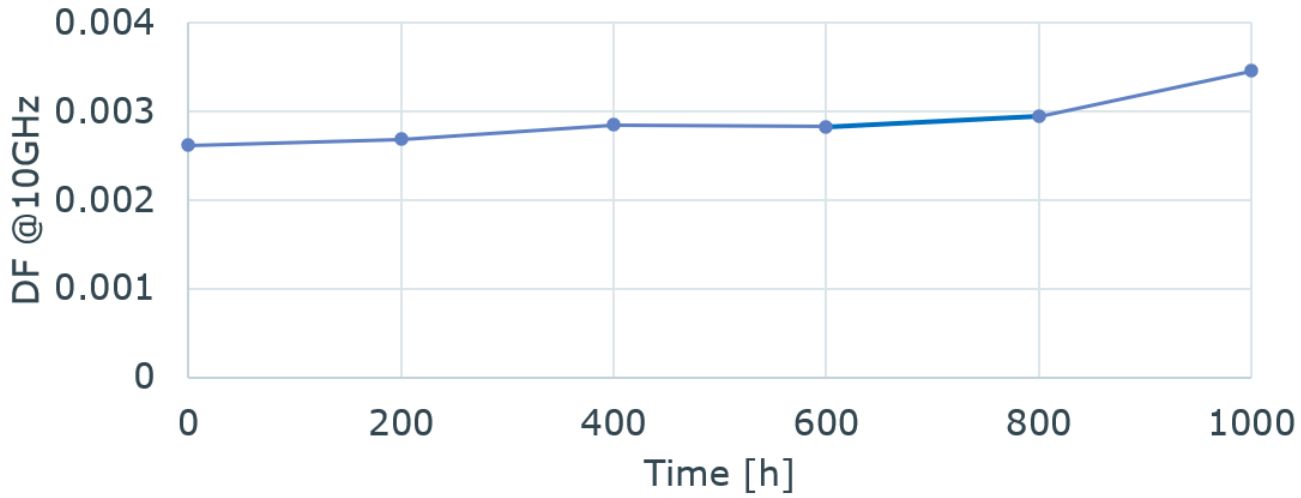
MW4000M Aging Resistance

Stable dielectric performance even in a high temperature and high humidity environment

Split Post Dielectric Resonator (SPDR) method

- 5mil (125 μm) thickness
- at 125°C
- Frequency: 10GHz





MW4000M Thermal Reliability in Multilayer PCB

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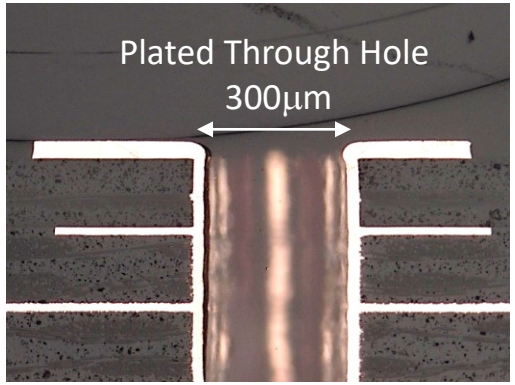
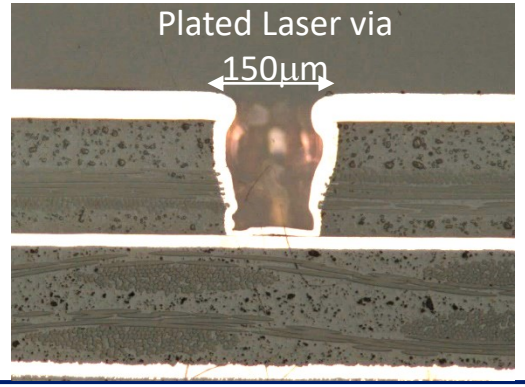
MW4000M hybrid multilayer before and after thermal cycling

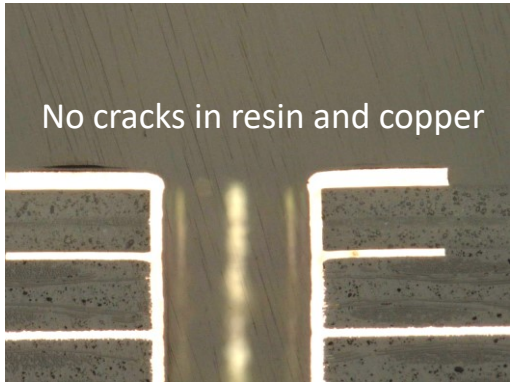
1,000 cycles from -40°C to + 140°C

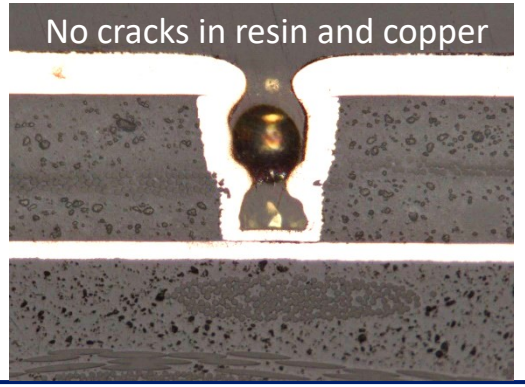
After Pre-condition





After 500 cycles





Suitable Substrate Materials for Radar Antenna PCBs

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You now have valuable substrate information, allowing you to choose the most suitable substrate for your design(s), irrespective of the actual frequency

You can contact me at any time

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RF Business Unit