FAST, FASTER, HIGH SPEED!
PHYSICAL PCB SAMPLE WE.SPEED!

WÜRTH ELEKTRONIK MORE THAN YOU EXPECT

SPEAKER INTRODUCTION

Andreas Dreher

Technical Project Management

- HDI-Design
- Signal Integrity & High Speed

Since 2003 at Würth Elektronik CBT

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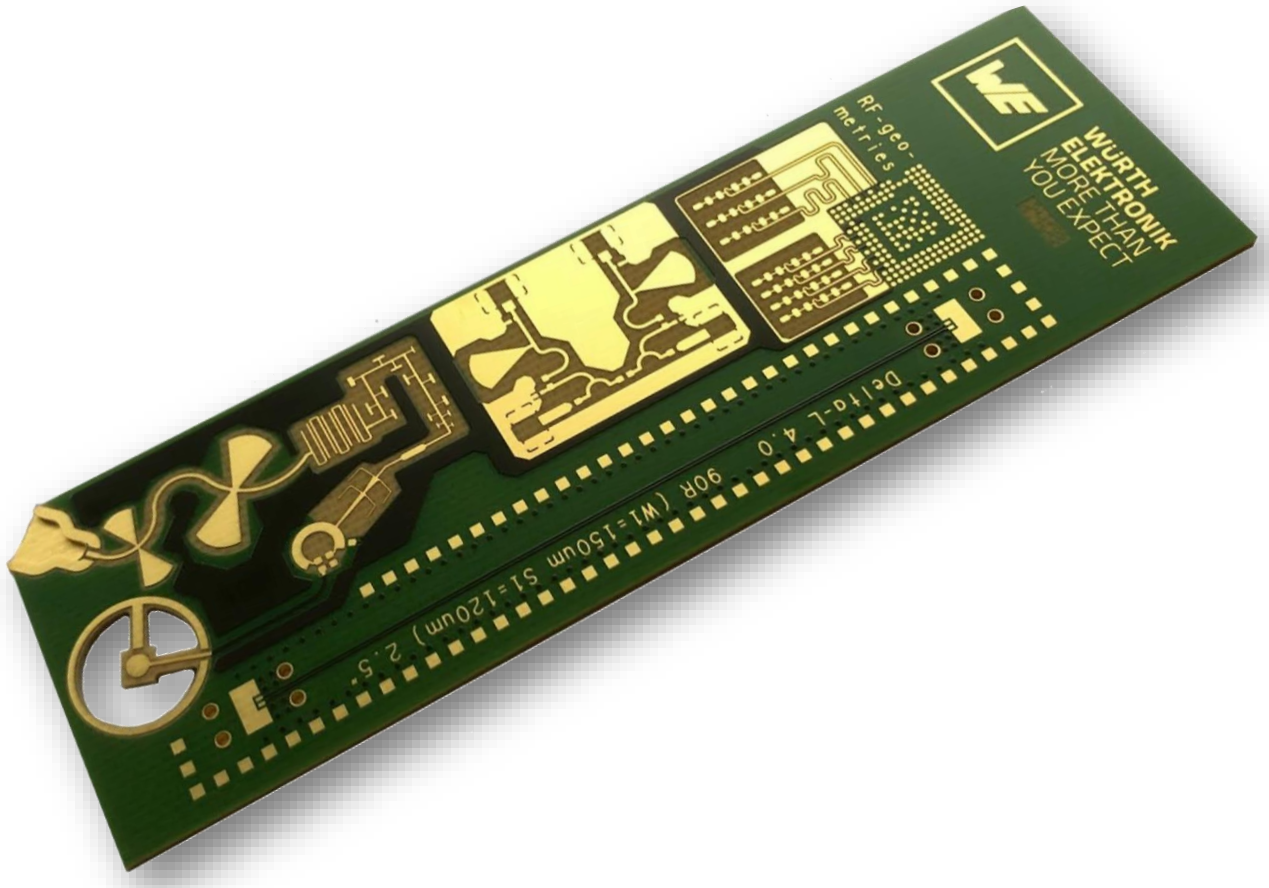
Andreas Dreher
Field Application Engineer
Technical Project Management

AGENDA

- Introduction to High Speed applications
- Features of the HIGH.speed physical PCB Sample
- What does High Speed means for PCB Manufacturing?
- How to measure material parameters?



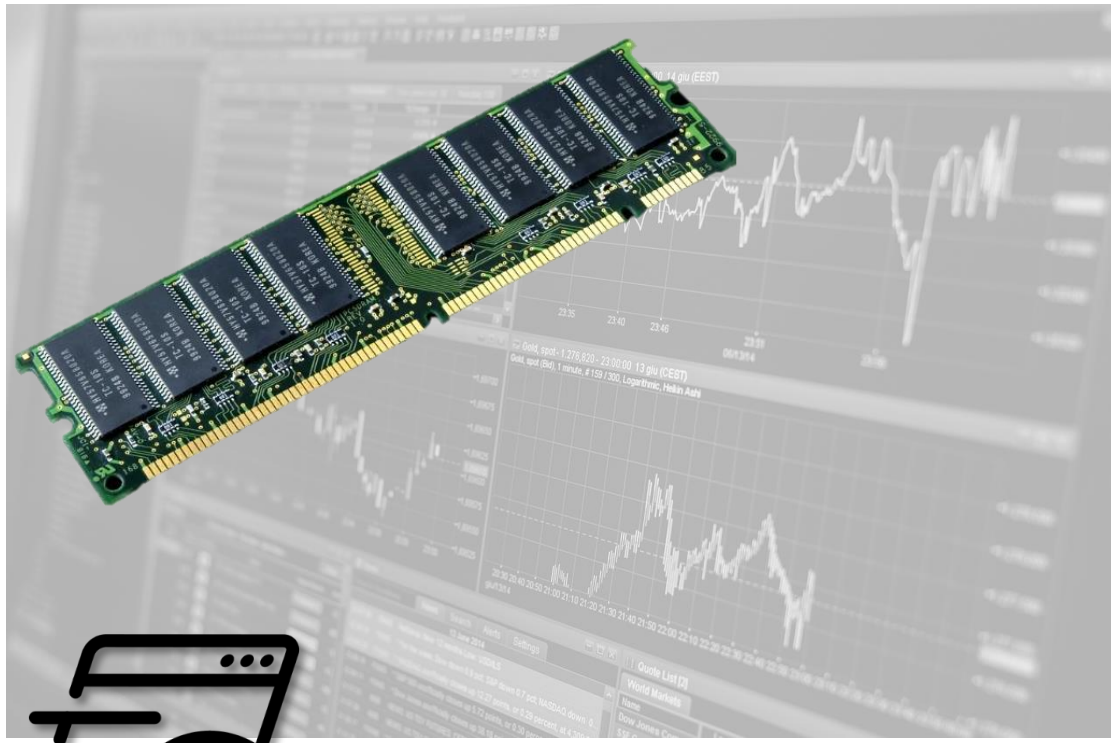
INTRODUCTION

Analog Applications

RF = Radio Frequency

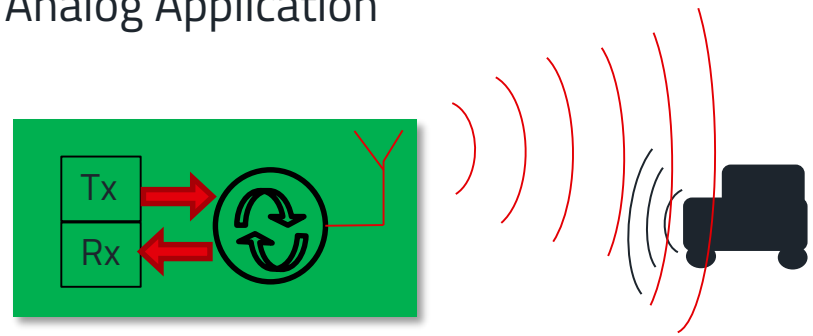
Digital Application

High Speed Data



INTRODUCTION

Analog Application

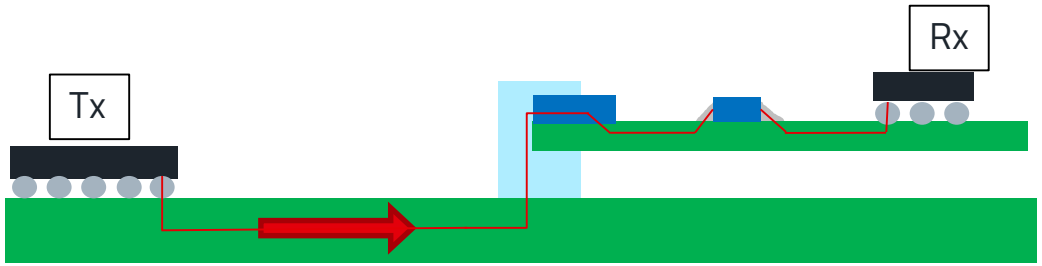


- Designed for one target Frequency
- Controlled Emission in Antenna Area

- Often low Layer count
- Hybrid material stackup possible

  - Bluetooth Module 2,4 GHz
  - Motion detection 6 GHz
  - Parking assistance 24 GHz
  - Radar +80 GHz

Digital Application



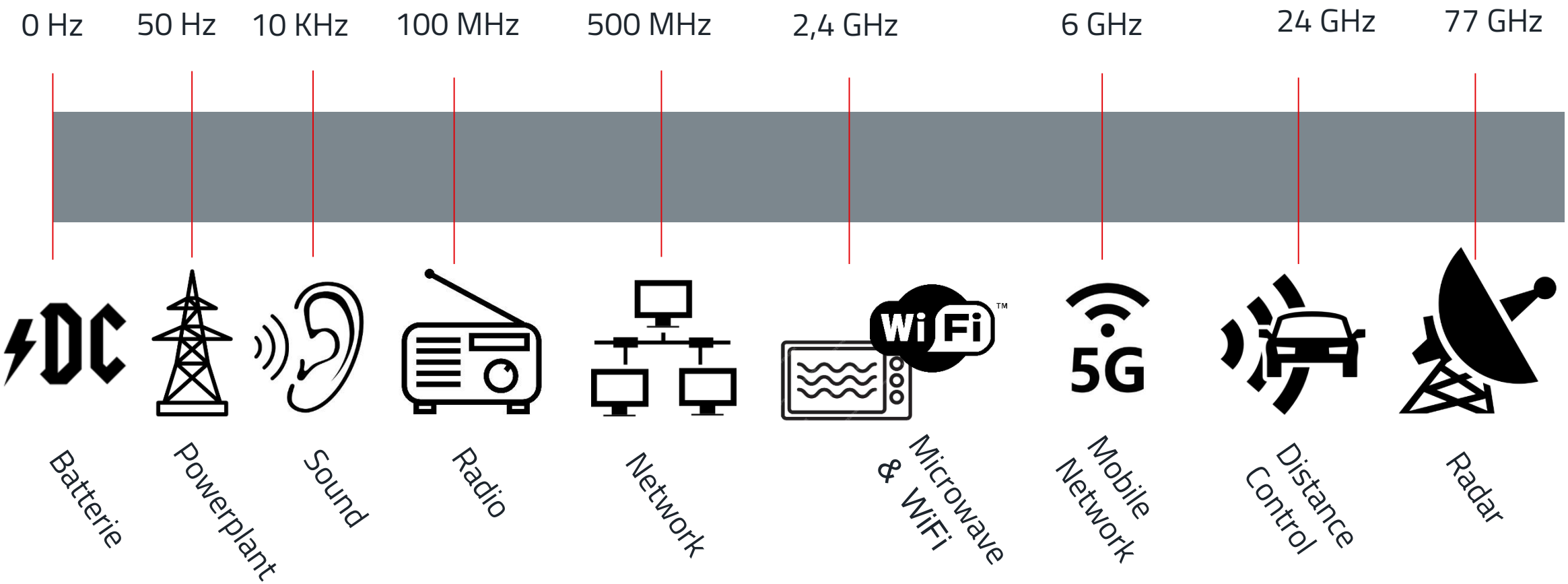
- Frequency mix, often broadband
- Good transfer of Signals

- Often complex HDI Stackups
- Digital signals with fast rise-times
  in the range of pico-seconds to nano-seconds

  - USB 3.x 2.5 – 5 GHz
  - Display Port 2.7 – 4.05 GHz
  - PCIe Gen3 4 GHz
  - PCIe Gen 5 16 GHz

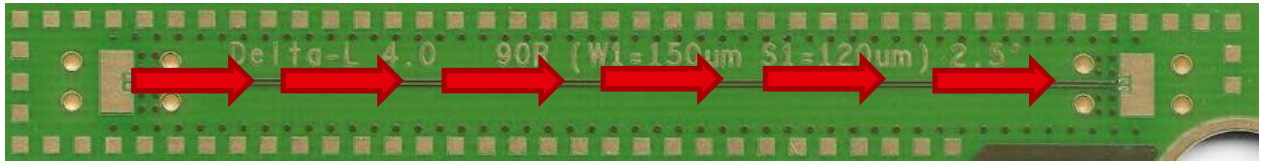
SURVEY

What maximum frequency do you use today ?

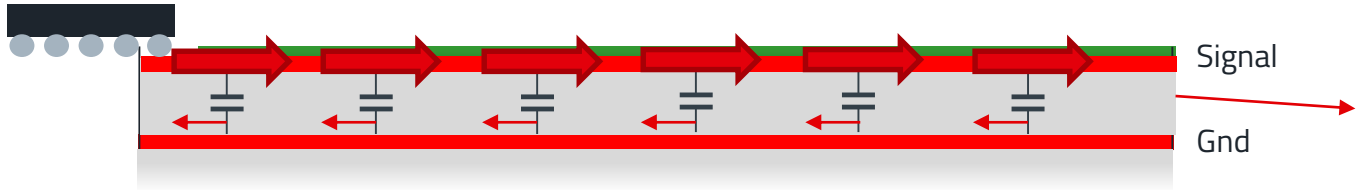


SIGNALPROPAGATION

Top View



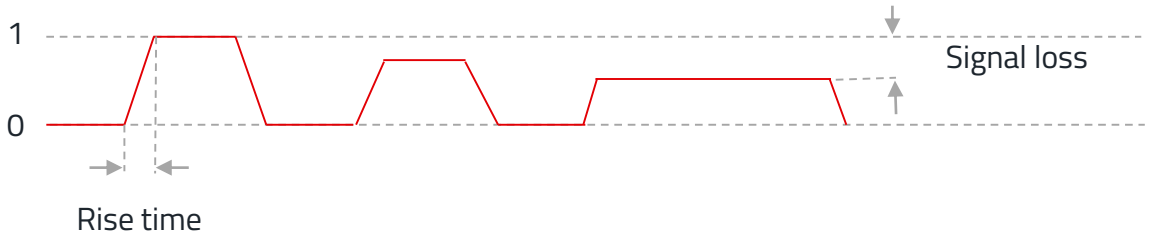
Cross section



~15cm/ps in FR4

Material Property

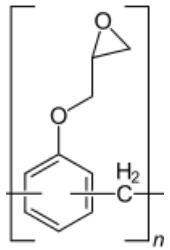
Signal



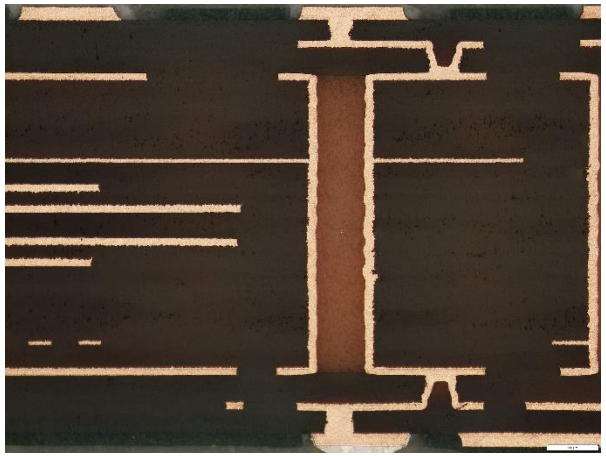
Rules of thumb: Test your design at > 3 GHz or < 10 ps rise time

MATERIAL COMPARISION

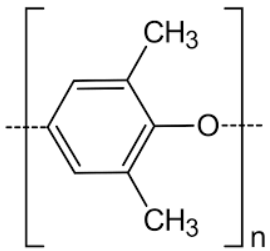
FR4 **Epoxy-Resin**



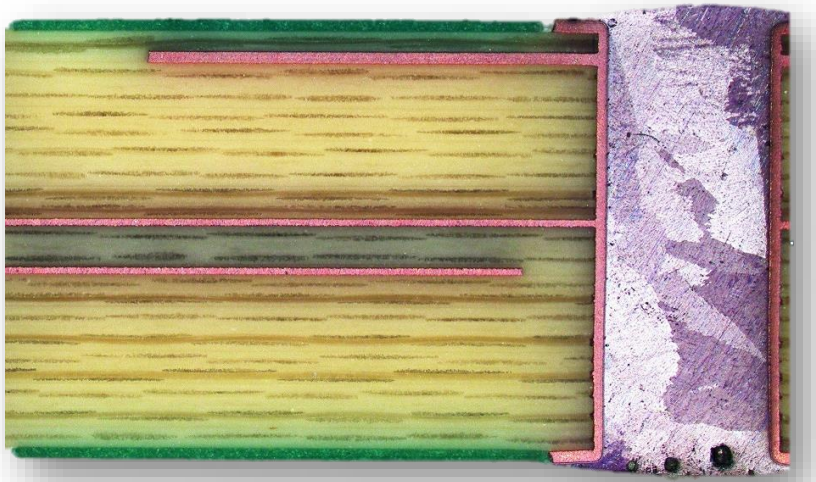
- Tg 130 – 180°C
- Dk 4.37 Df 0.022 at 1 GHz
- Without or with Fillers



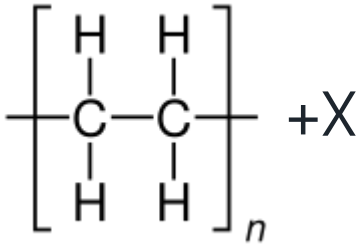
Megtron 6 PPE-Resin



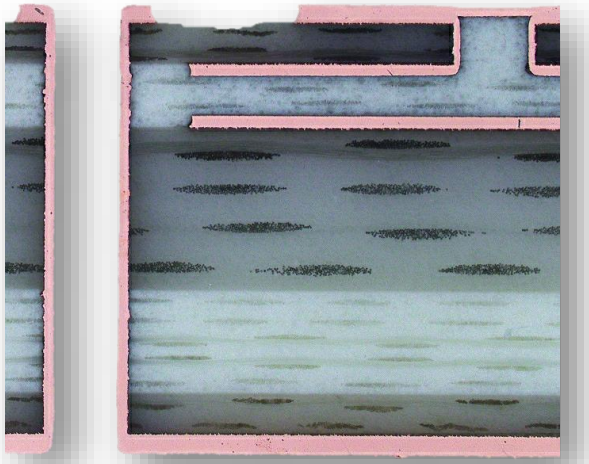
- Tg 185°C
- Dk 3.61 Df 0,0040 at 10 GHz
- With Fillers



Rogers **Hydrocabon-Resin**



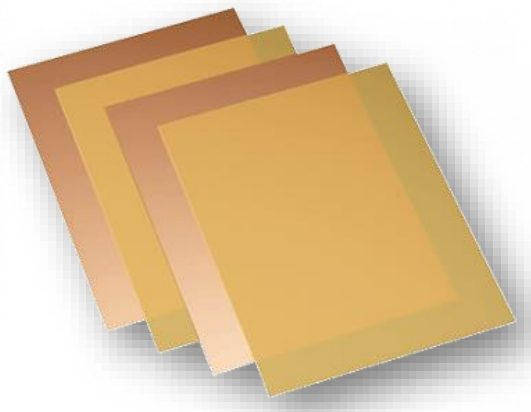
- Tg > 280°C
- Dk 3.48 Df 0.0037 at 10 GHz
- With ceramic Fillers



MATERIAL COMPARISION

Impact of new Materials

Raw Material

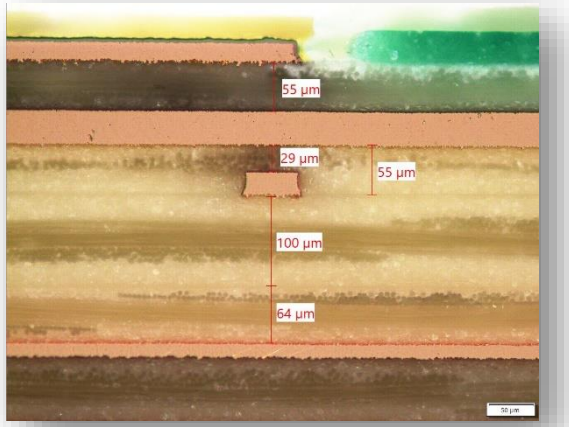


Price increase
4x - 20x
to Tg150 Material

Wet Processes

More aggressive
chemistry necessary

Multilayer Pressing

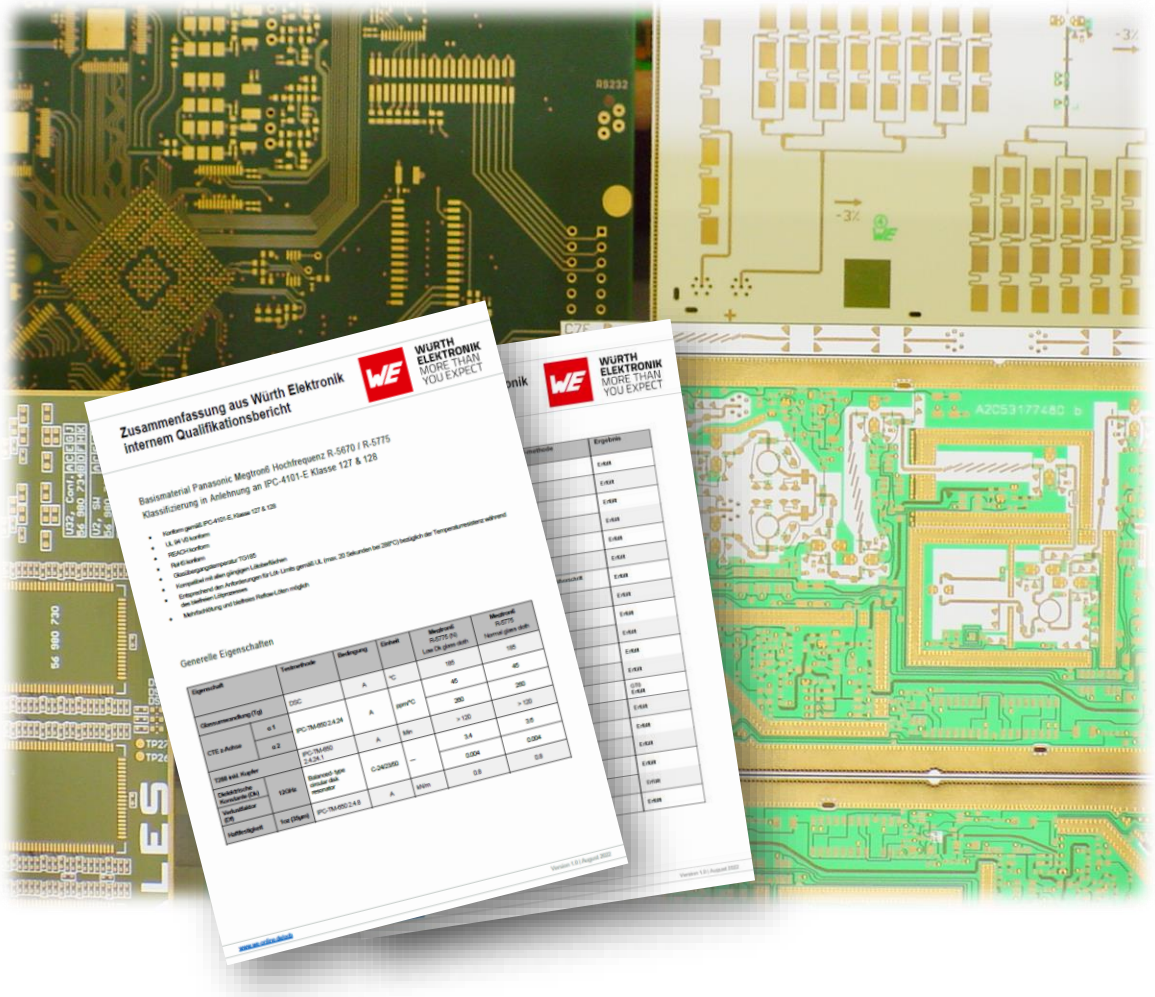


Higher temperature
and
more time necessary

Drill Parameters

Higher wear out
of drill bits

QUALIFIED MATERIALS



For analog and digital High Speed applications

Panasonic

MEGTRON6

Dk 3.61

Dissipation factor 0.0040 at 10 GHz

UL LISTED

For special applications

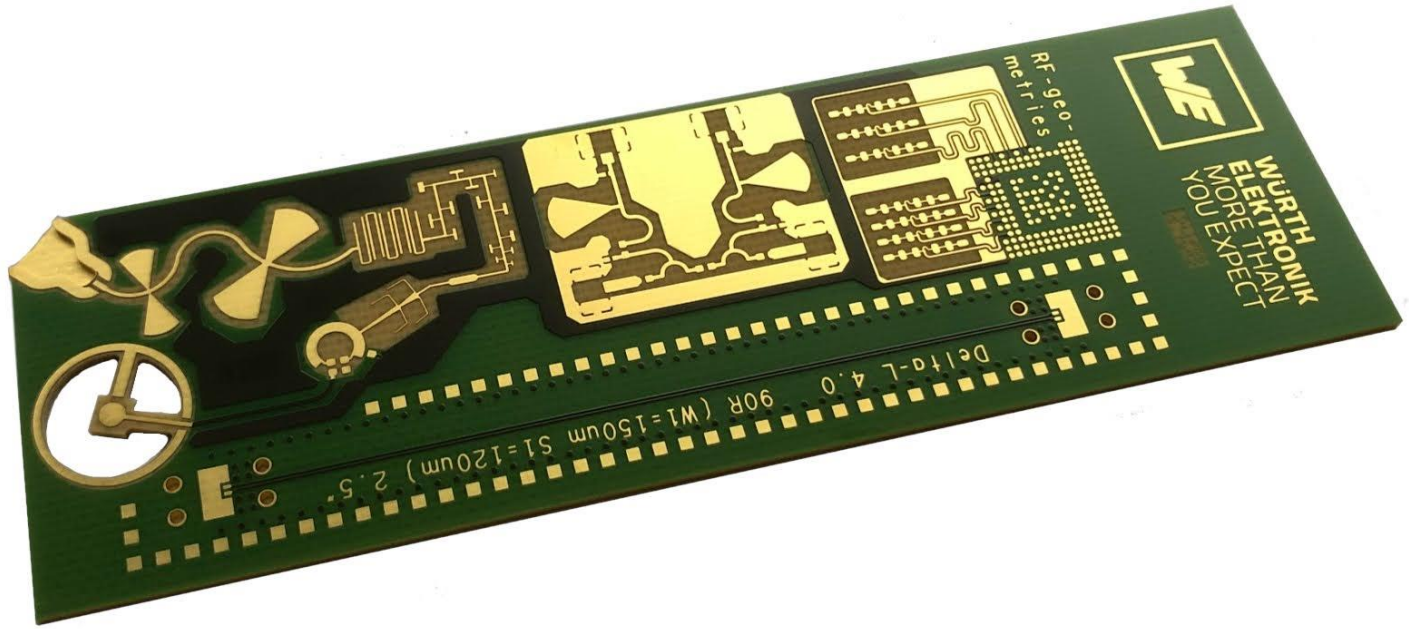
ROGERS CORPORATION

4000-Family

Dk of 3.48

Dissipation factor of 0.0037 @10 GHz

HIGH.SPEED PHYSICAL PCB SAMPLE



Get your personal sample **NOW**

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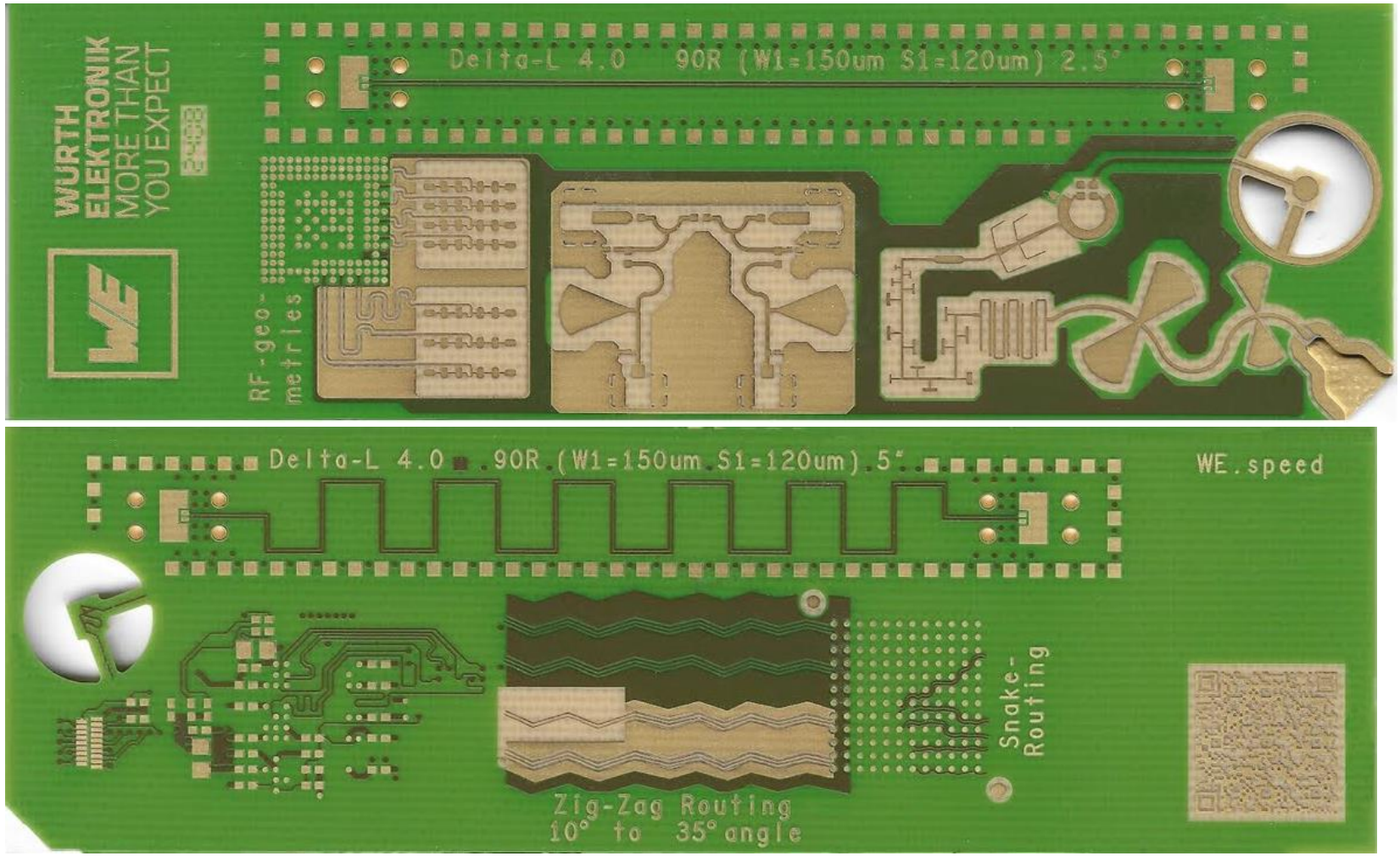
HIGH.SPEED PHYSICAL PCB SAMPLE

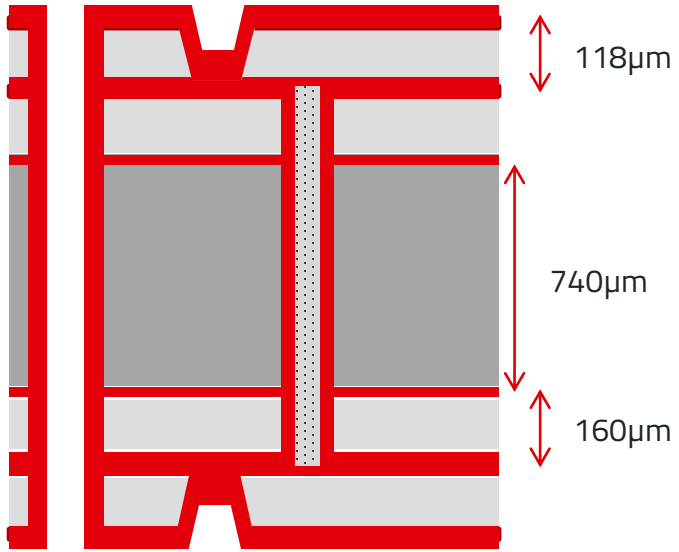
Overview

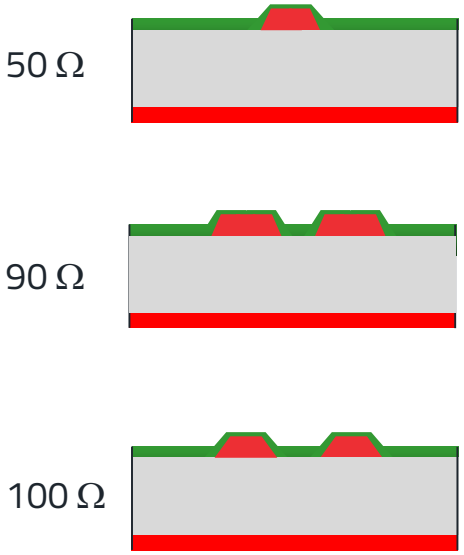


HIGH.SPEED PHYSICAL PCB SAMPLE

Stackup

1+4b+1





	Line Width	Line Space
Single Ended Coated Microstrip	208 µm	
Differential Pair Edge Coupled Coated Microstrip	150 µm	120 µm
Differential Pair Edge Coupled Coated Microstrip	123 µm	138 µm

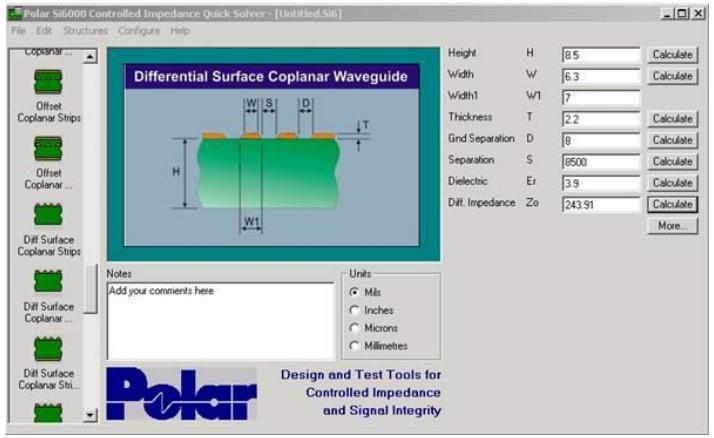
Base material: Panasonic Megtron 6

SUPPORT: If you need an Impedance controlled Stack up feel free to contact us hdi@we-online.com

IMPEDANCE REQUIERMENTS

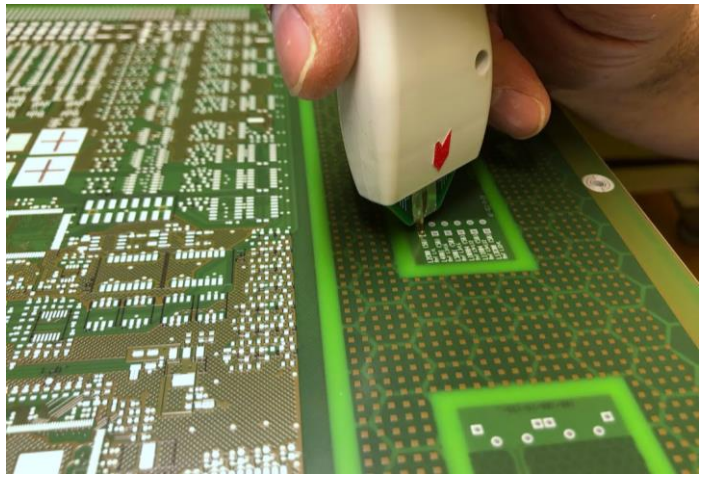
Defined by Component choice

- Impedance Calculation



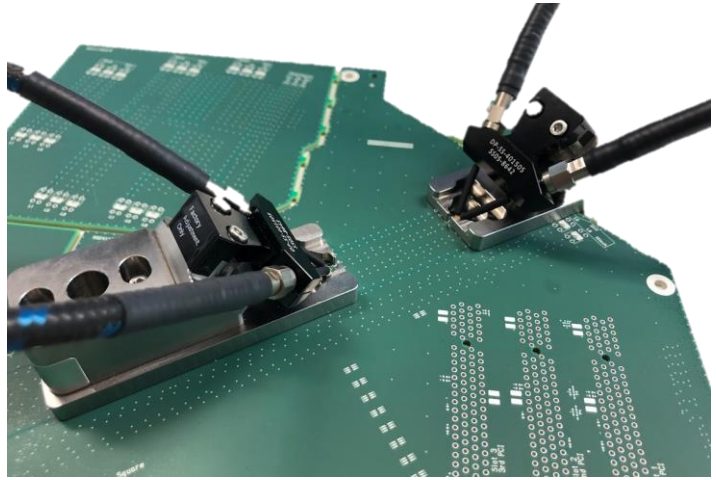
- Material Selection
- Design Rules
- Process Tolerance

- Impedance Measurement



- Process Control

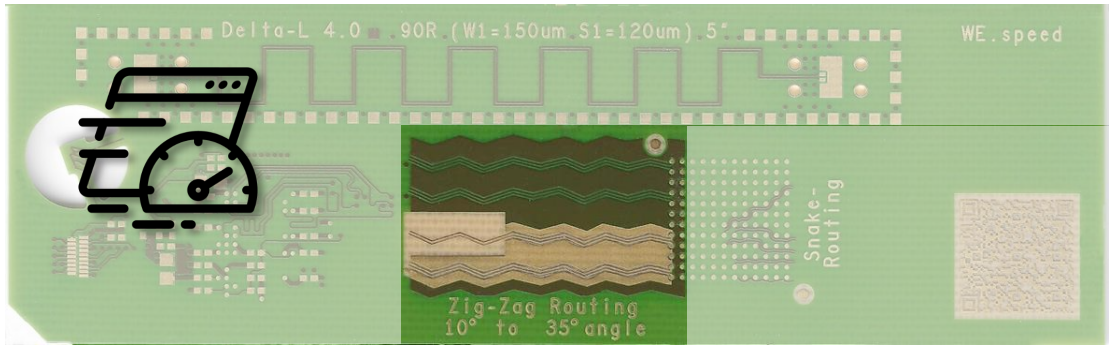
- HIGHSPEED Measurement „Atlas“



- Helping customer with
  - Material Choice
  - Design Rules
- Reseach & Development

HIGH.SPEED PHYSICAL PCB SAMPLE

Zig-Zag Routing

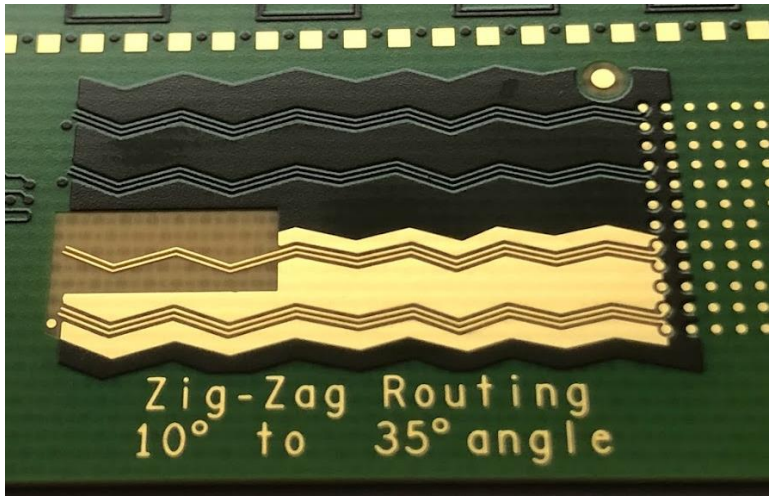


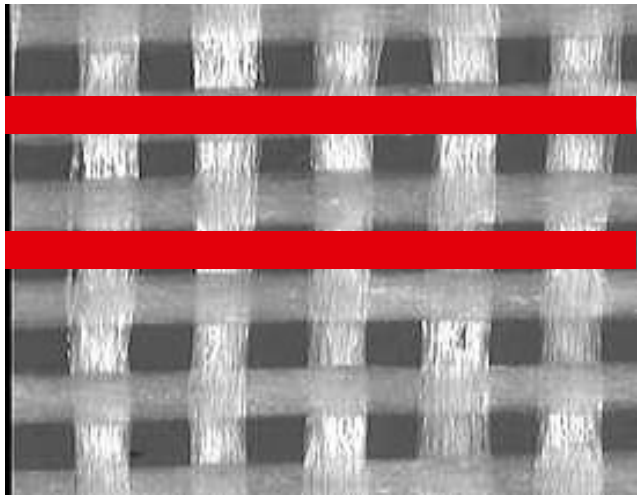
- Minimize Fiber-Weave Effect

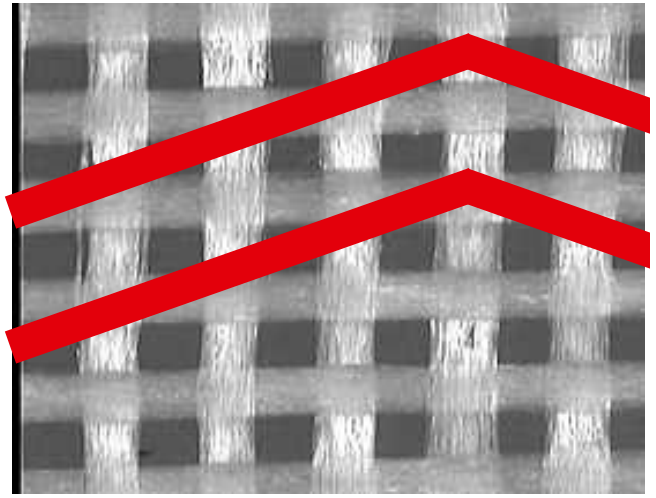
  Dk / E_R Glas ~6.0

  Dk / E_R Fr4-Resin ~3.5

- Used in Customer application **WEdesign** Team 20-22-GHz

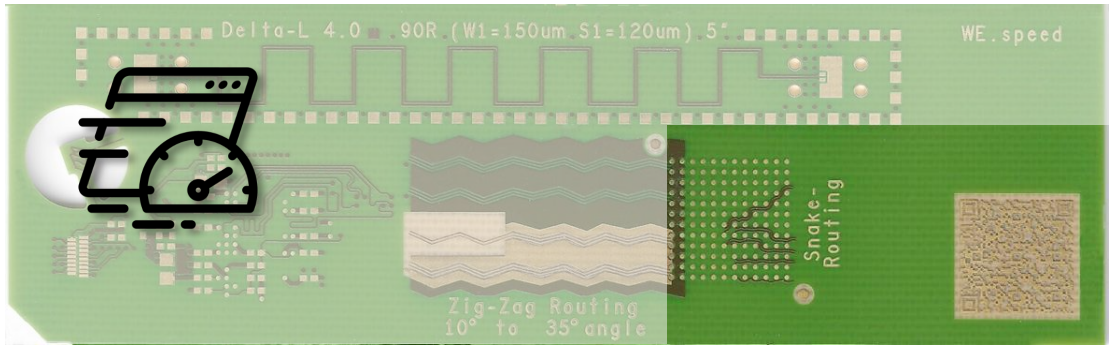






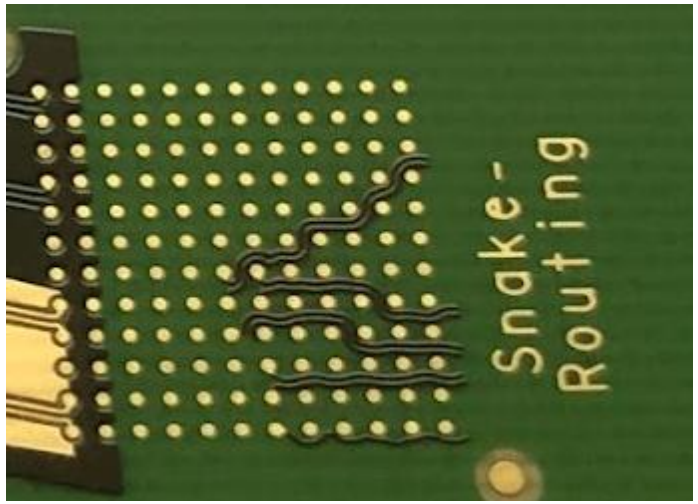
HIGH.SPEED PHYSICAL PCB SAMPLE

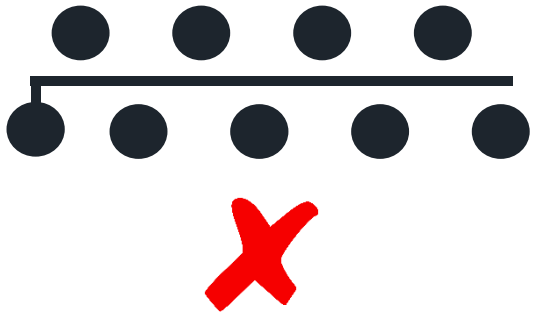
Snake-Routing

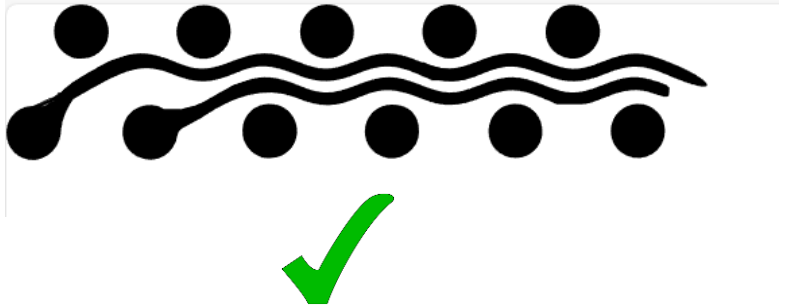


Snake-Routing

- Beneficial for differential Pairs
- Avoiding of sharp edges and corners to minimize reflections
- Improving spacing at staggered / diagonal Grids

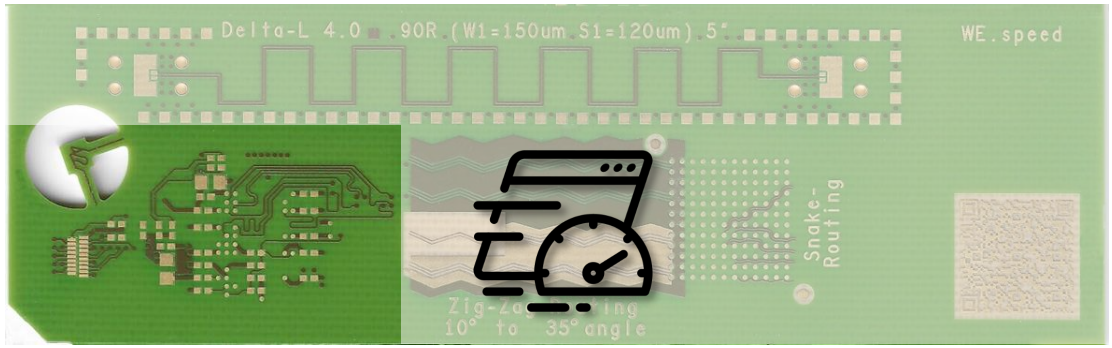






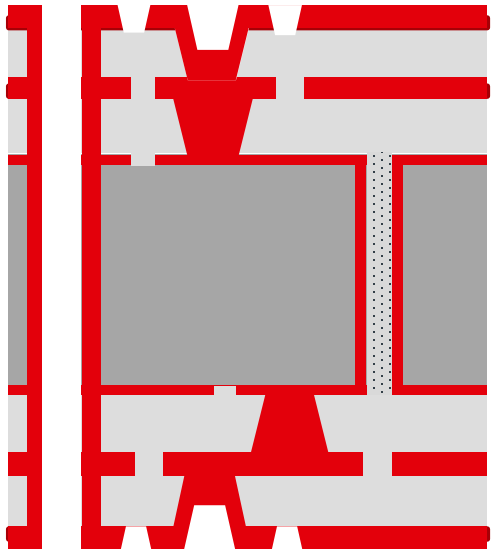
HIGH.SPEED PHYSICAL PCB SAMPLE

HDI-Design

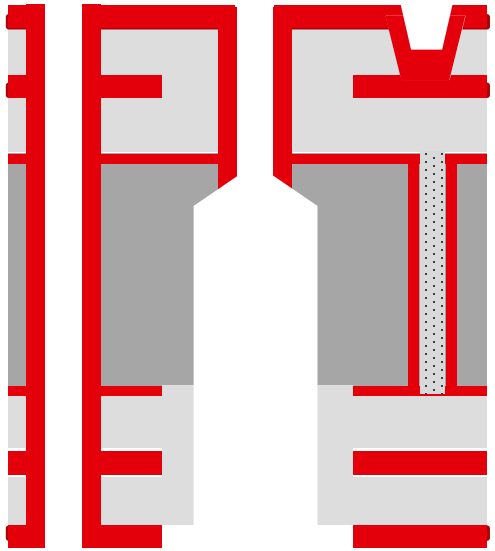


Use Micro Via as much as possible

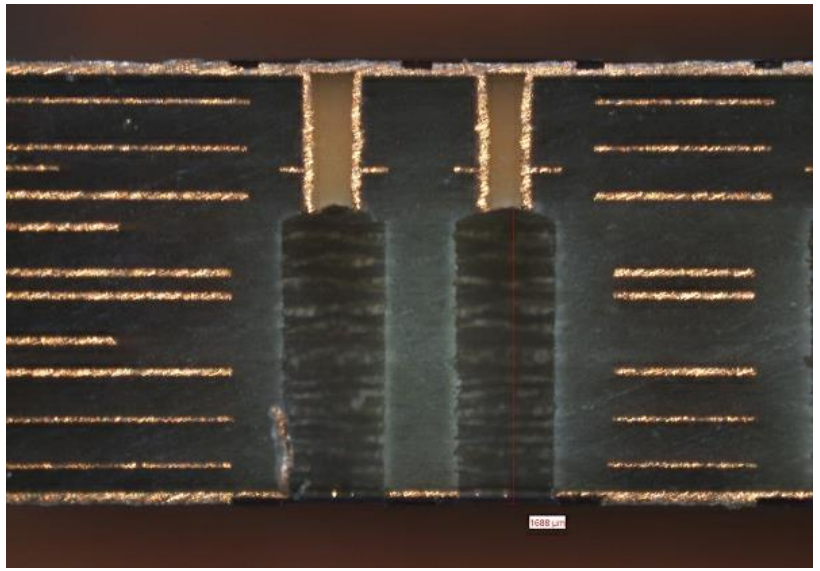
- Small footprint
- Short stub length
- In volume minimal extra cost → Stitching Via
- More reliable than Back Drilling



HDI- Approach

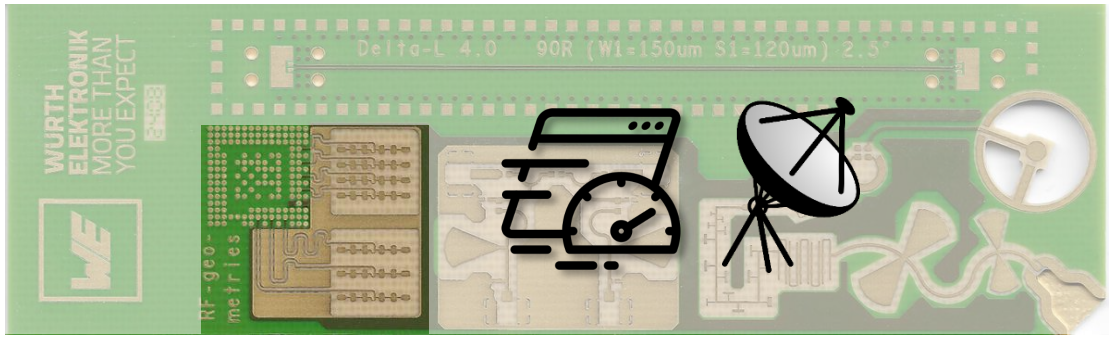


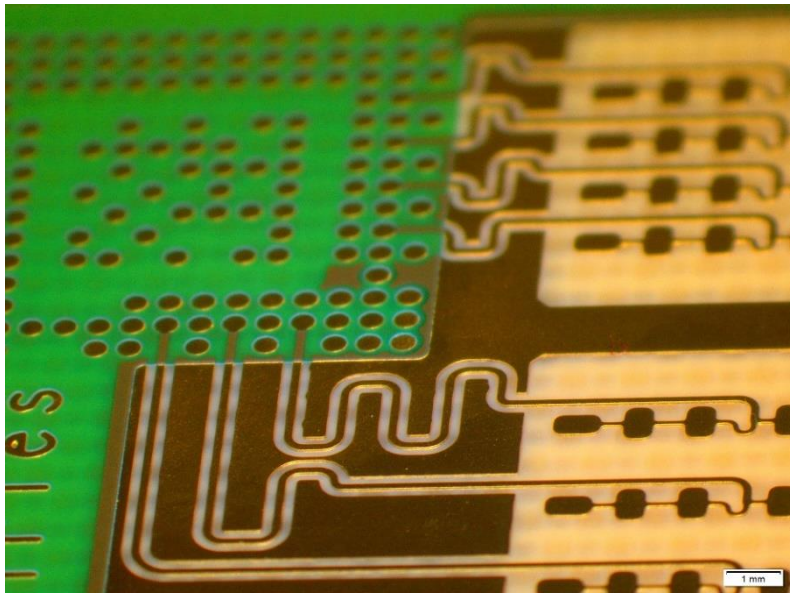
Back Drilling



HIGH.SPEED PHYSICAL PCB SAMPLE

Mix of Analog and Digital





- Definition of critical impedance tracks
  - Standard layout 150 µm
  - Impedance track 150.1 µm
- Analog layout often needs tight etching tolerances

Tolerance increase by:

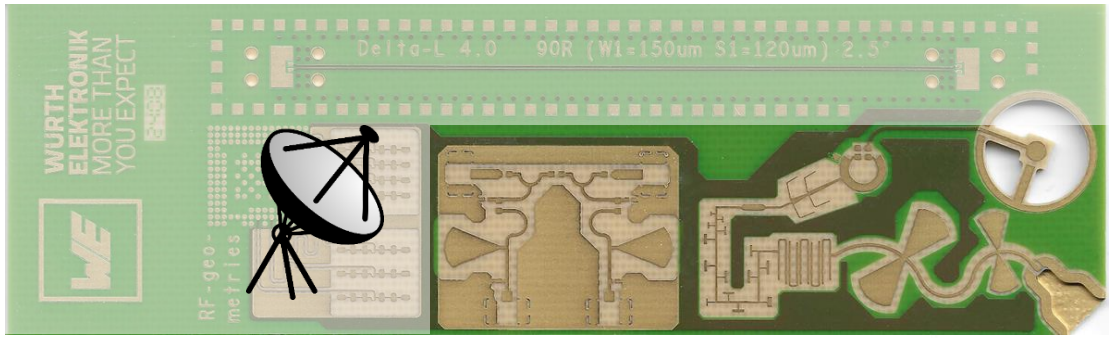
- High copper
- Big via array
- Combination of via technologies on same layer like via type VII + THT

Tolerance decrease by:

- Low copper
- Homogenious Layout

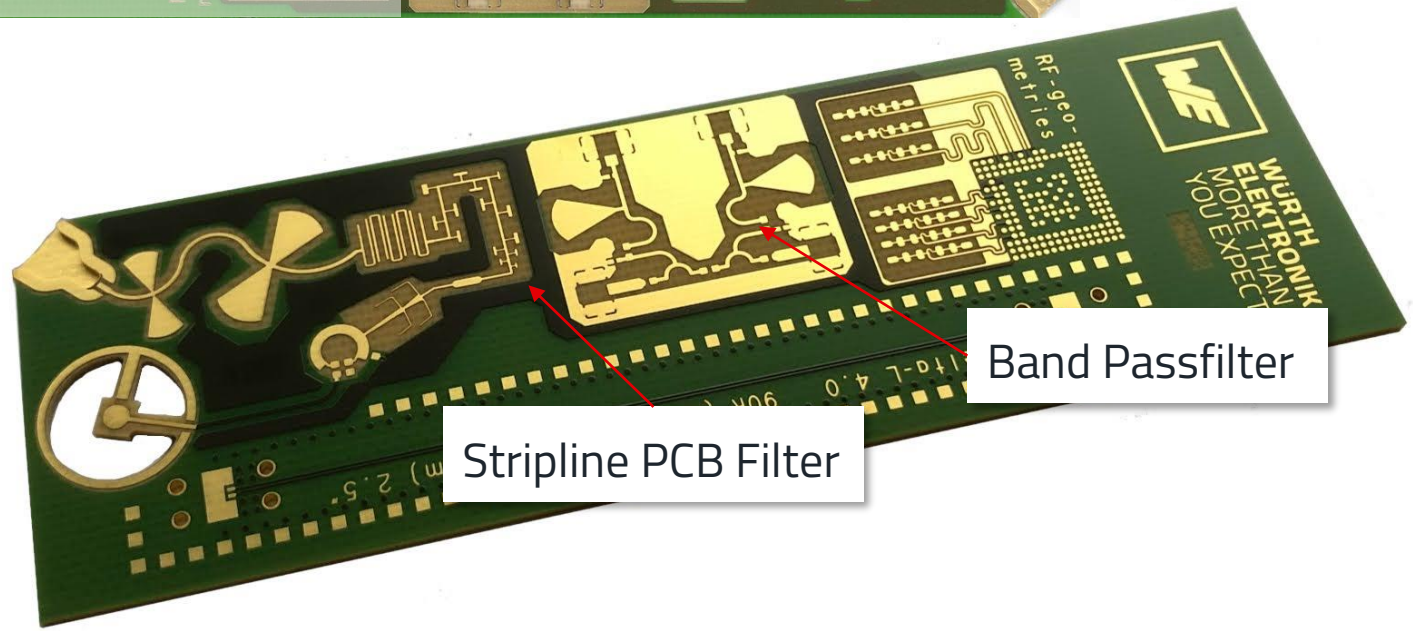
HIGH.SPEED PHYSICAL PCB SAMPLE

RF Filters & Antennas



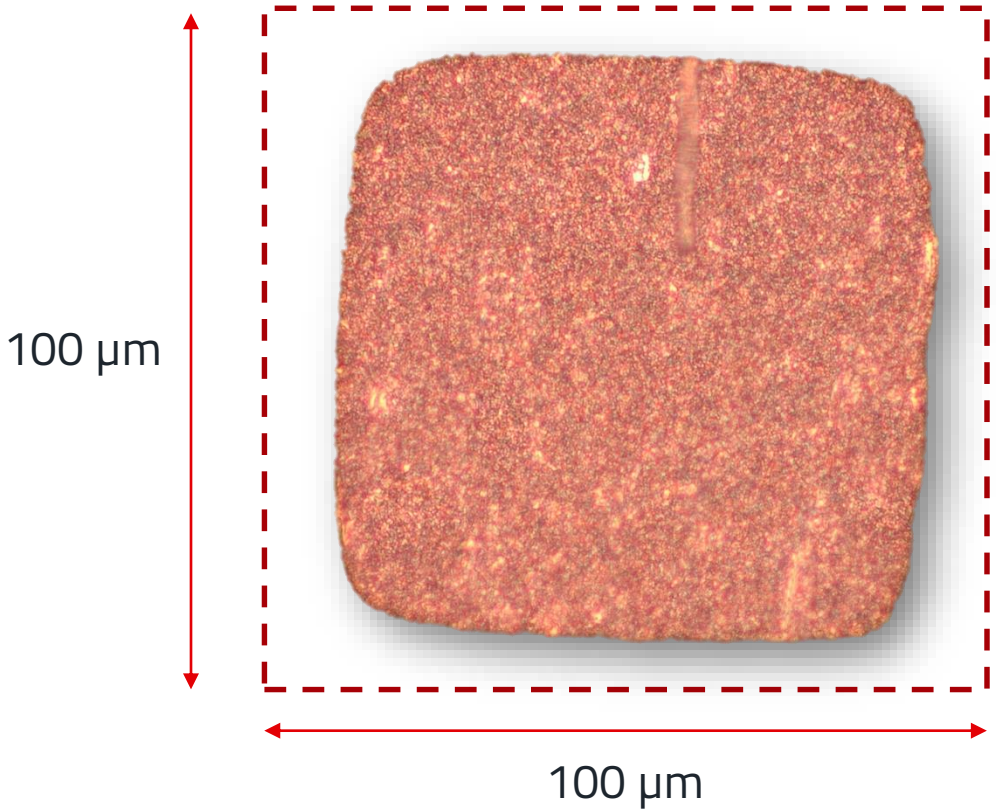
For Filters & Antennas

- Definition of critical structure size necessary
- Maybe „Design In“ necessary
- Definition of Quality Control Process useful

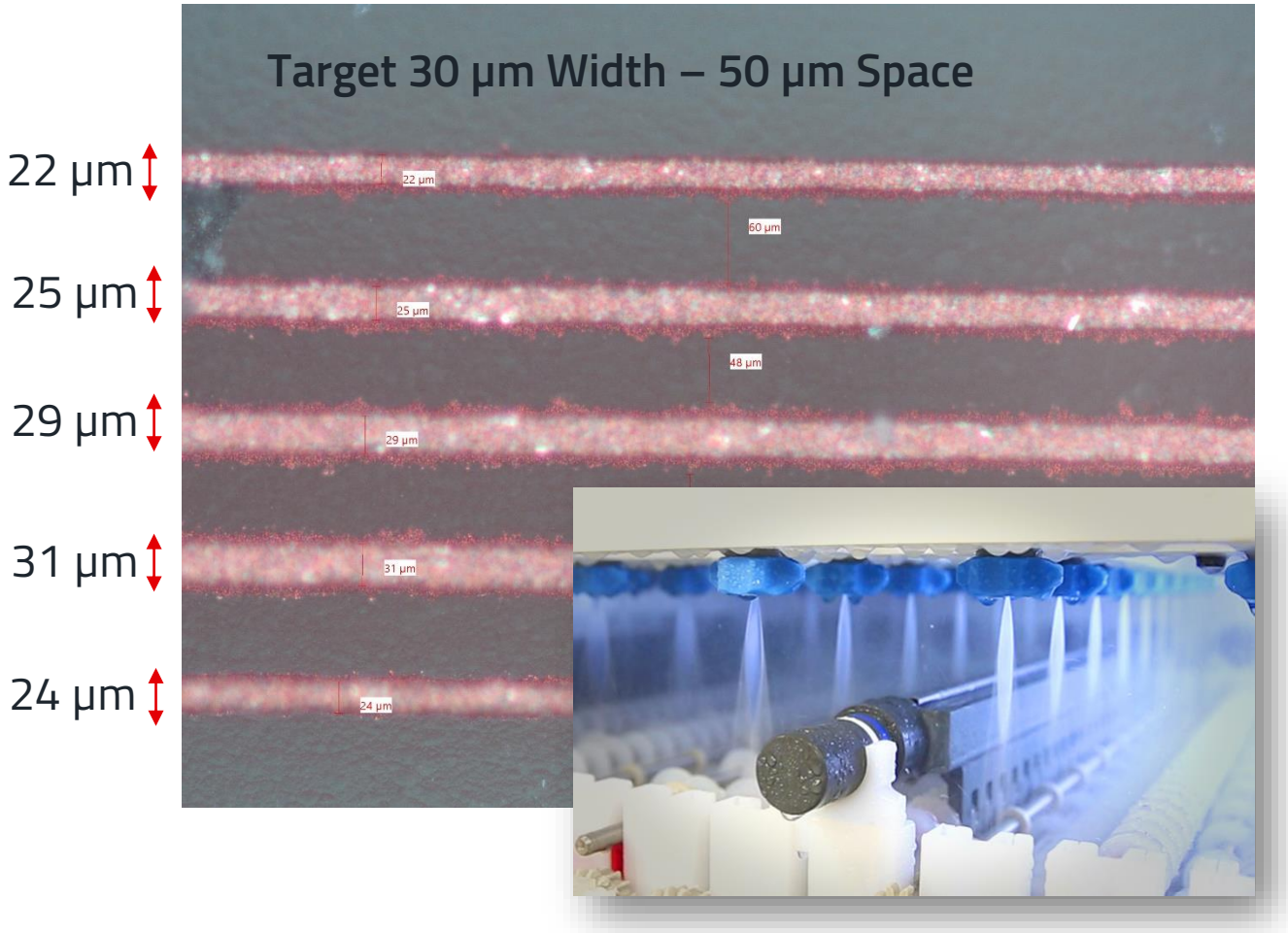


ETCHING TOLERANCE – DESIGN IN NECESSARY?

Test-Pattern - not suitable for series production

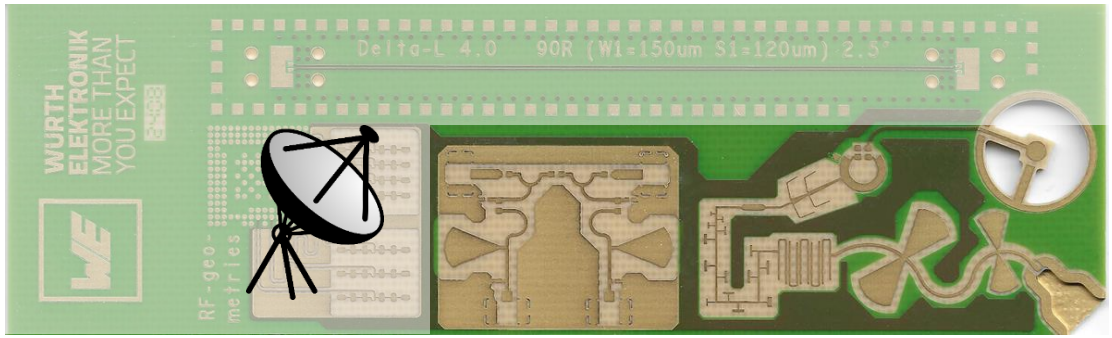


Can be optimized by Design In:



HIGH.SPEED PHYSICAL PCB SAMPLE

RF Filters & Antennas



- Be creative!

Possible Connection for a waveguide

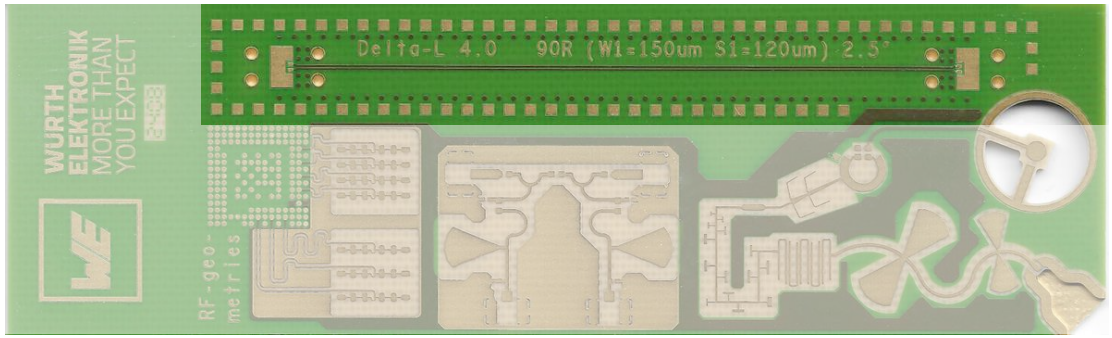
Depth Milling

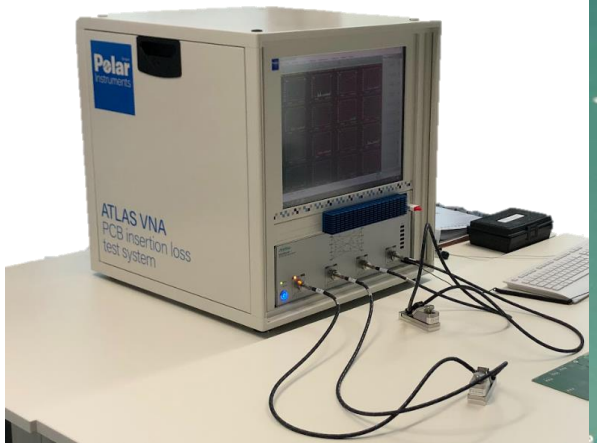
Edge Metallisation

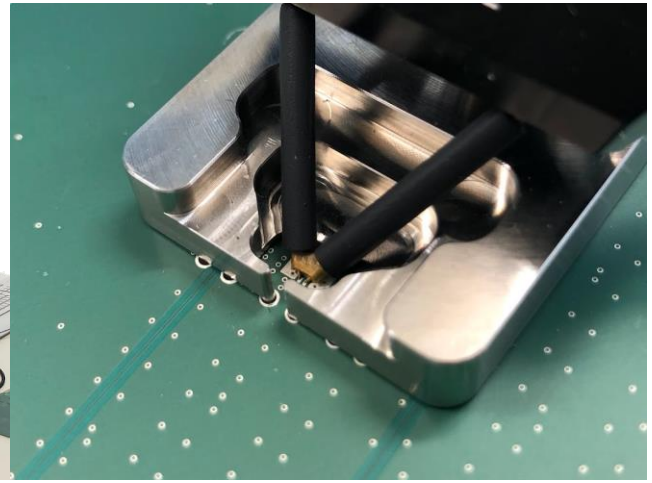
Etching

HIGH.SPEED PHYSICAL PCB SAMPLE

Delta L 4.0 Coupon

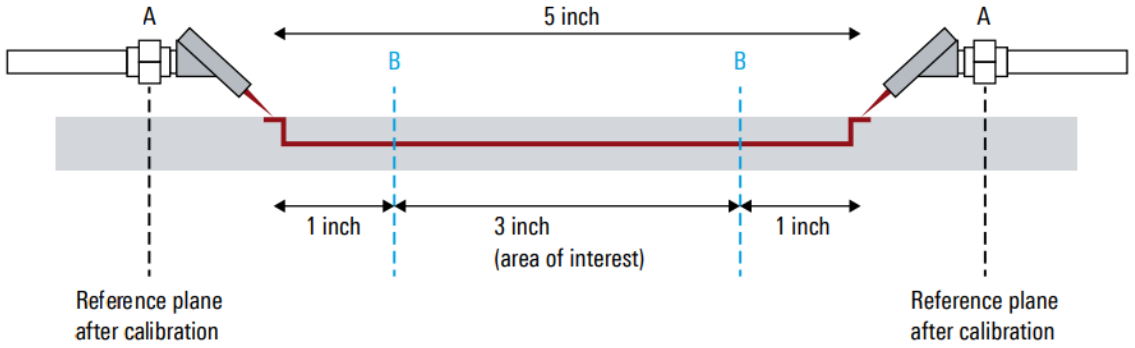




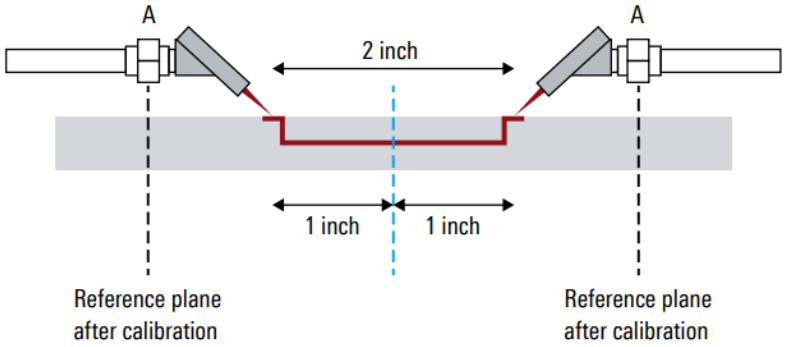


- First PCB supplier in Europe capable of measuring HIGHSPEED Values an PCB-Test coupons with the Delta-L4.0 Test Method
- Can be offered as service also for external Coupons
- Up to 40 GHz
  - S- parameters (Scattering parameters)
  - Dissipation factor
  - Effective Dielectric Constant

ATLAS SYSTEM DELTA-L4.0



Reference plane A (calibration at coaxial interface)



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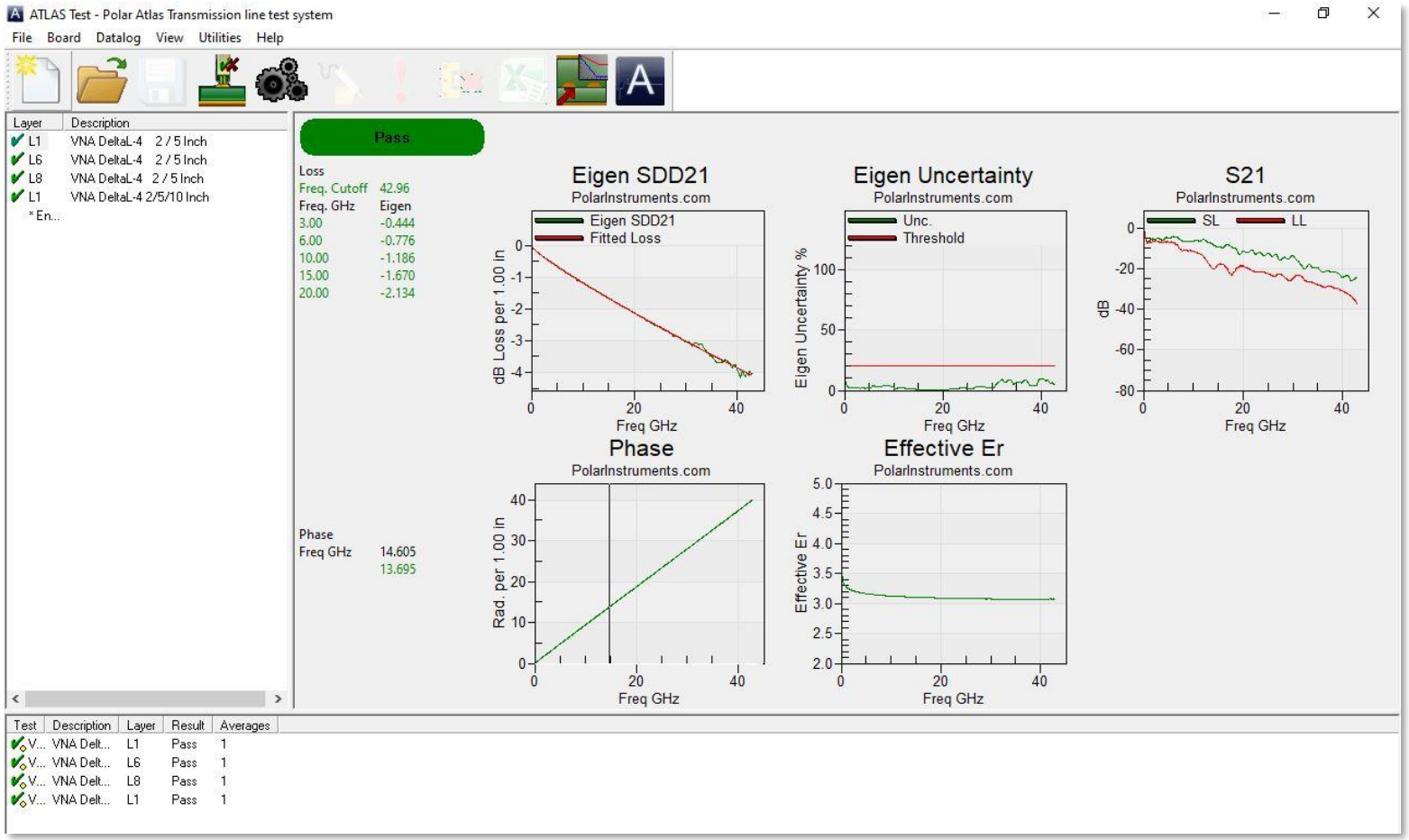
intel®
Delta-L4.0

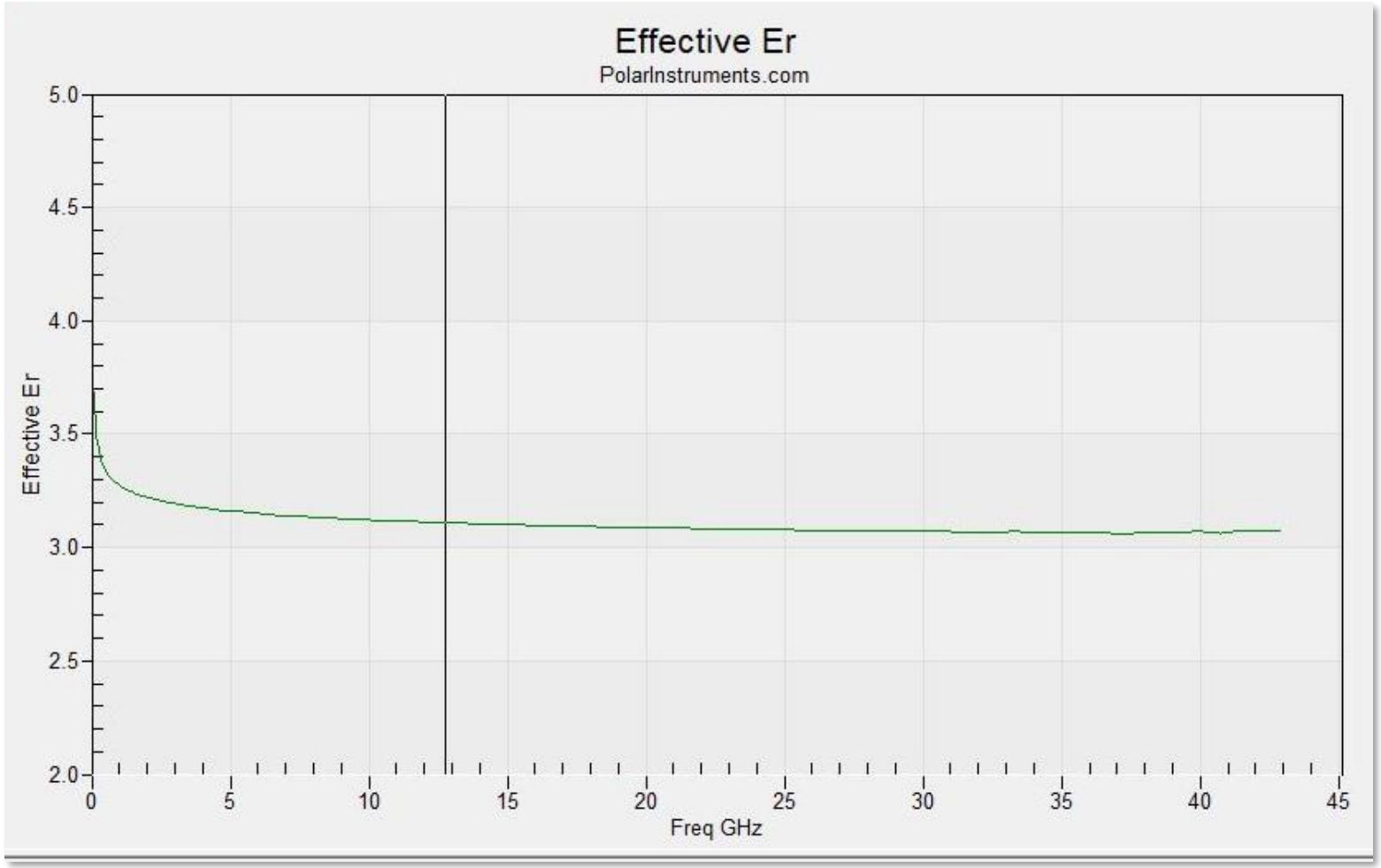
ATLAS SYSTEM DELTA-L4.0

Measurements

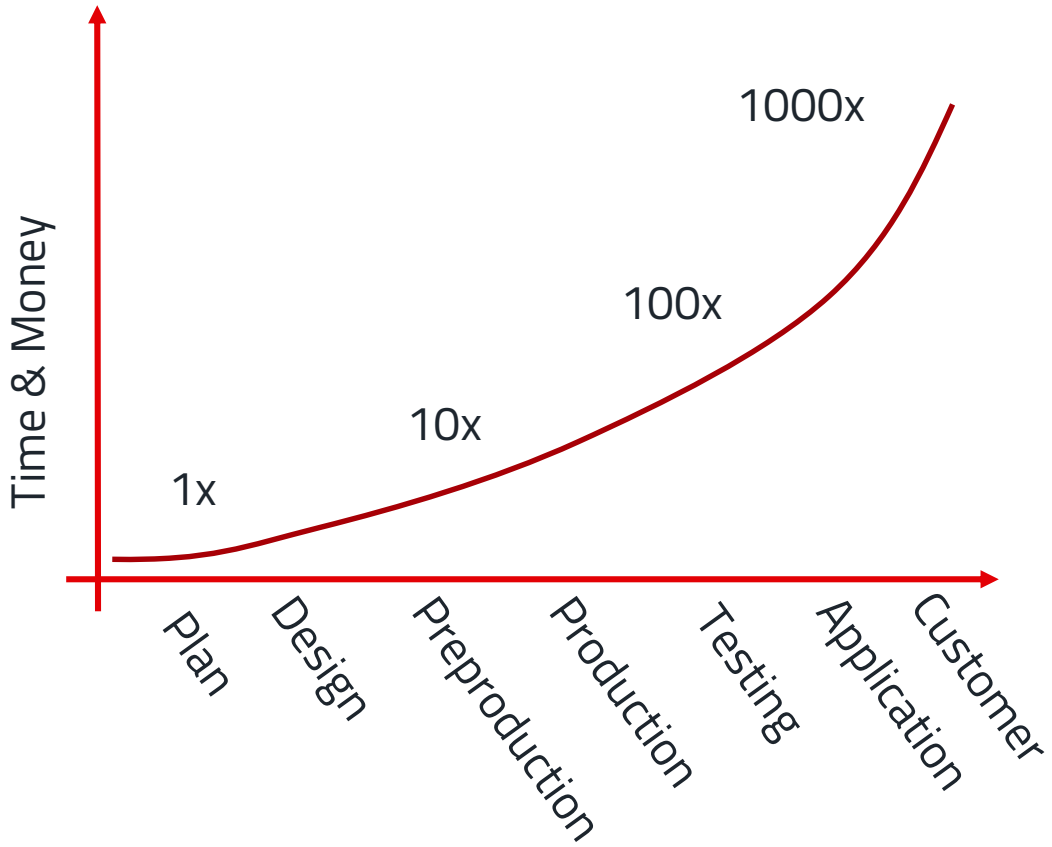


ATLAS SYSTEM DELTA-L4.0

Measurements



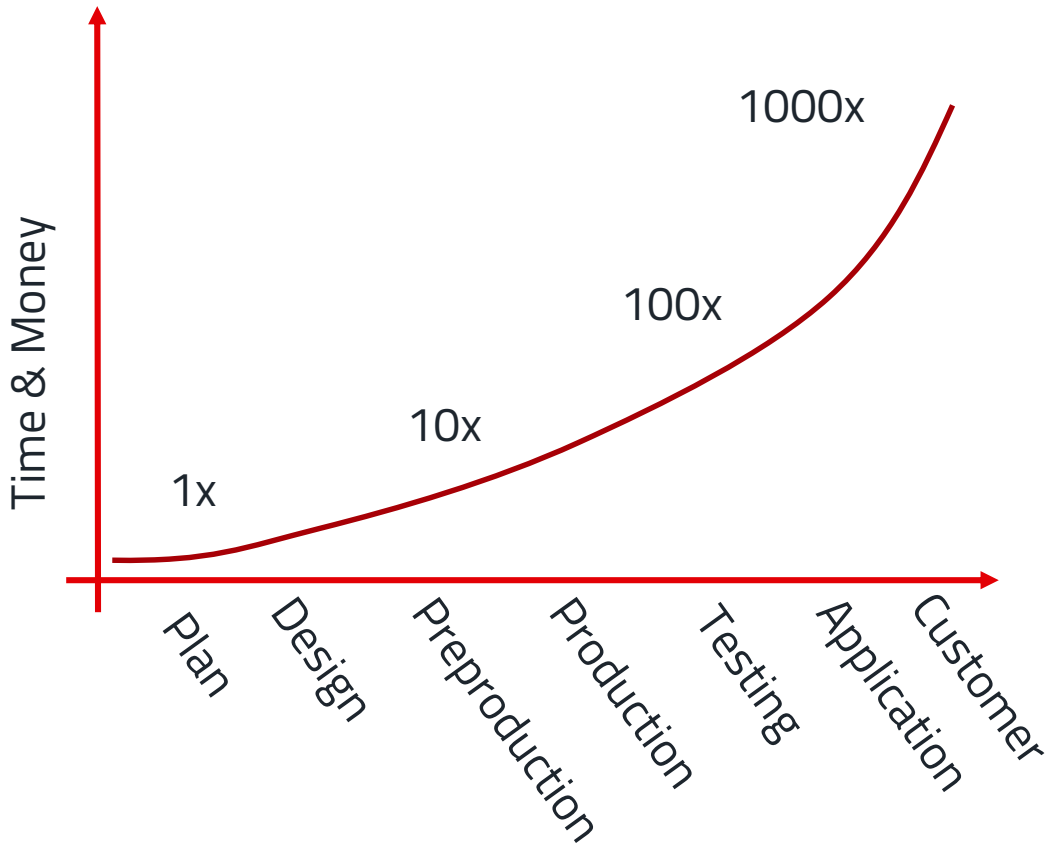
SUMMARY



Approach to a new High Speed Design :

- Experience?
- Competence?
- Trial & Error?
- Simulate before Fabricate?

SUMMARY



Approach to a new High Speed Design:

- **Plan**
  Impedance controlled Stack Up
- **Design**

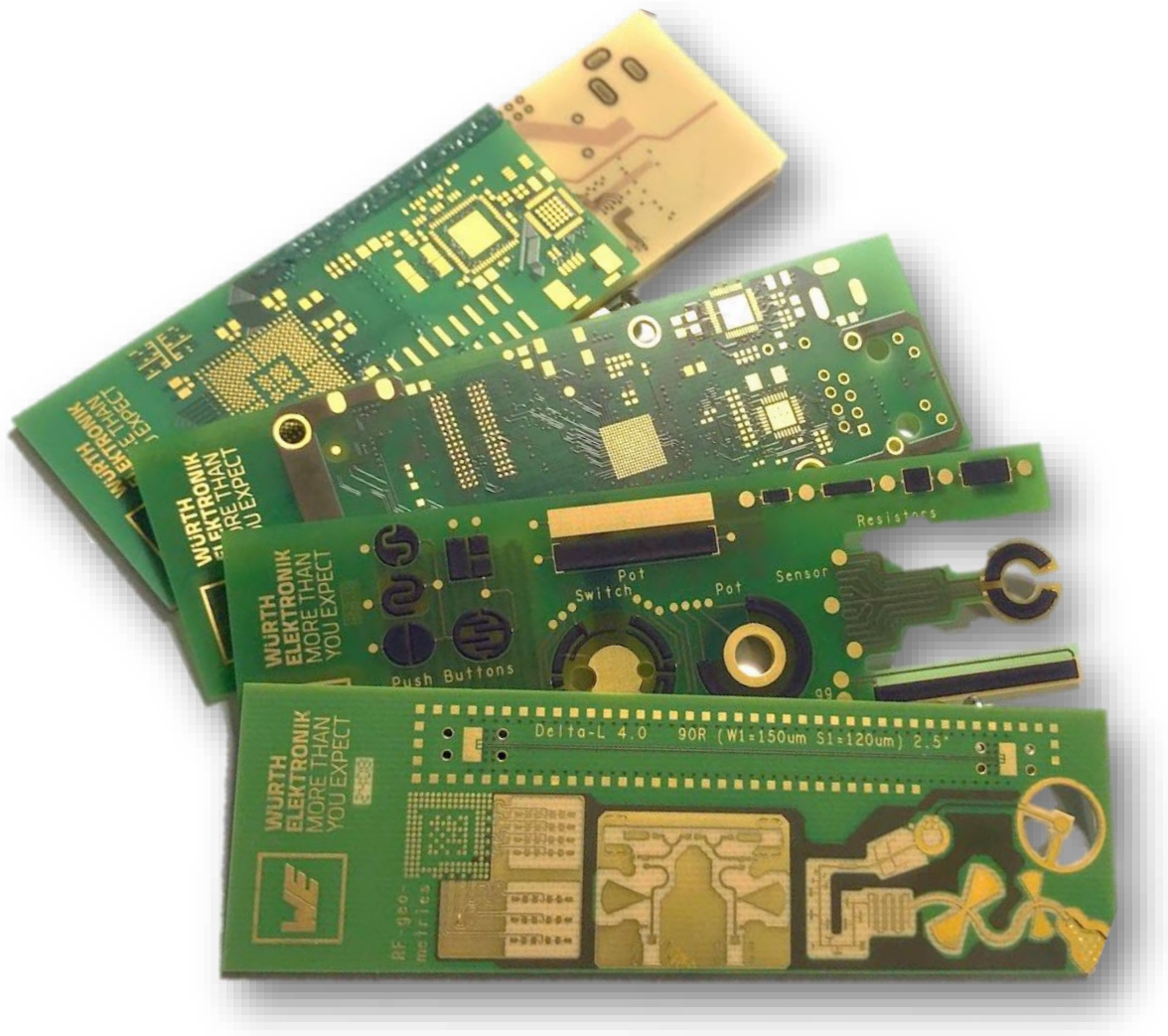
  Design Parameters & Guide Lines
  Design as Service by **WE**design Team
- **Preproduction**

  Feasibilty & DRC Check
  EQ-Process with Documentation
- **Production**

  Quality Control

  „Design In“ if necessary
- **Testing**
  Impedance Controll on every production panel

SUMMARY



- Würth Elektronik has High Speed Material qualified
  - Panasonic Megtron 6
  - Many others are available with WE-Asia
- **WE** can measure Material- and Layout parameters
  - Polar CITS880s Impedance Meter
  - Polar Atlas Delta L4.0 VNA Meter
- **WE** offers custom impedance controlled Stackups
  - 20 years of experience
- High Speed Designs can be complex -
  an early discussion about the Topic will lead to an optimal Solution

THANK YOU FOR YOUR ATTENTION!

Thanks to my colleagues for the support

Michael Matthes - WE Design

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