

„MILLE FEUILLE“ FOR THE ANNIVERSARY: BASIC PHYSICAL PCB SAMPLE WE.FAN!

WÜRTH ELEKTRONIK MORE THAN YOU EXPECT

AGENDA

BASIC physical PCB sample WE.fan

1. BASIC and standard – what is the difference?
2. Base materials
3. Production steps of a multilayer
4. Physical PCB sample WE.fan
5. TOP 3 questions from 100 webinars answered in detail



Andreas Schilpp
Technical Marketing



BASIC AND STANDARD – WHAT IS THE DIFFERENCE?

Definitions

STANDARD

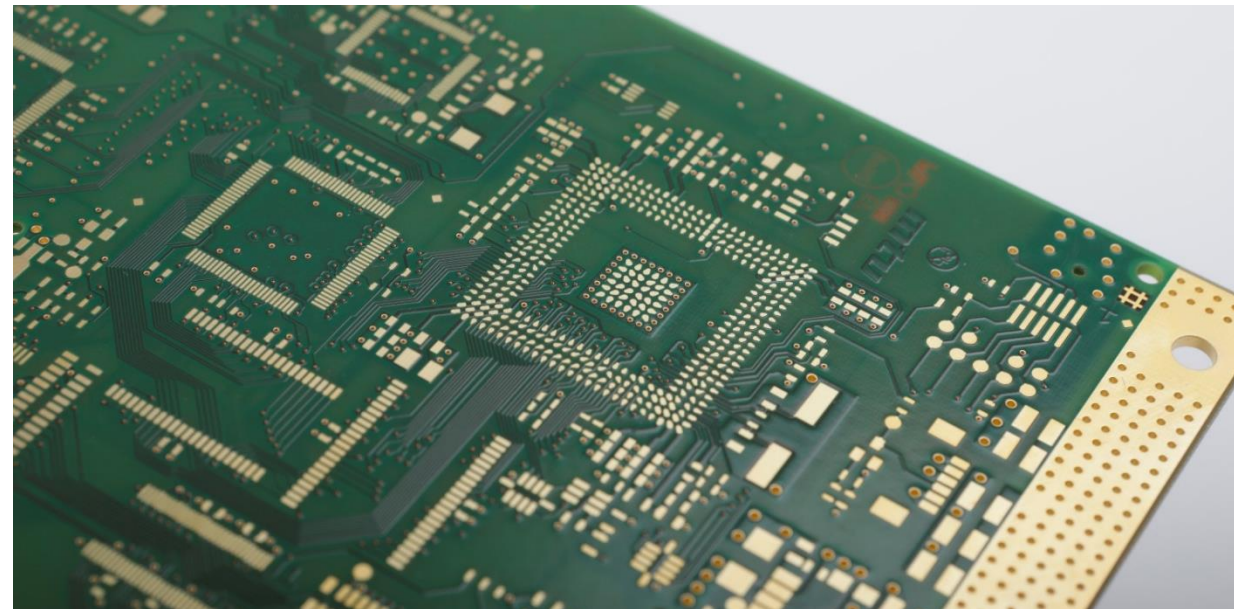
- a category or classification
 - available from all plants
 - at a favorable standard price
 - other categories are
 - Advanced
 - (Leading Edge / State-of-the-Art)
- Standard / Advanced are available in all technologies

Further example for standards

- Standard Stackup
 - Material in stock, processes standardized
 - Standard processes ensure high quality and favorable prices with short delivery times

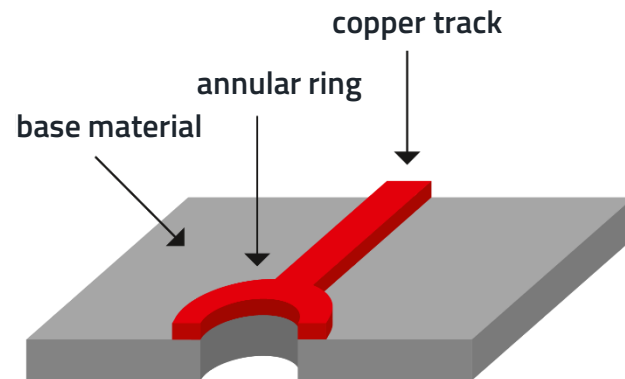
BASIC

- a technology. By BASIC technology we mean
 - single-sided,
 - double-sided and
 - multilayer printed circuit boards.

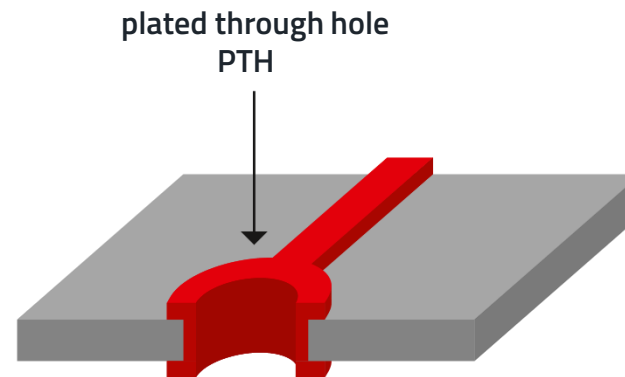


DIFFERENT TYPES OF PCBS

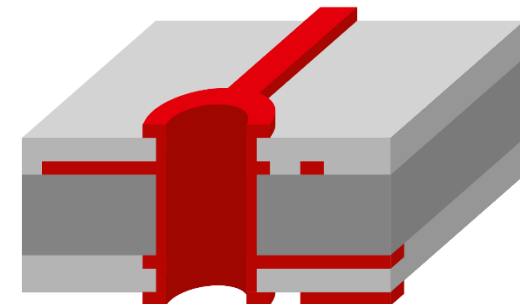
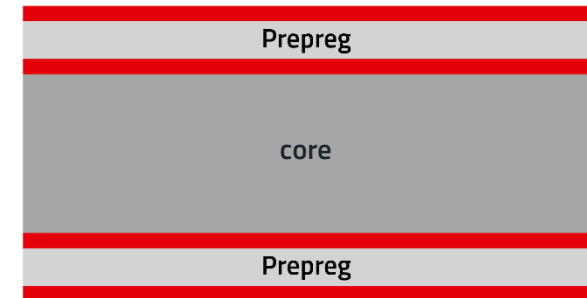
Single sided PCB



Double sided PCB

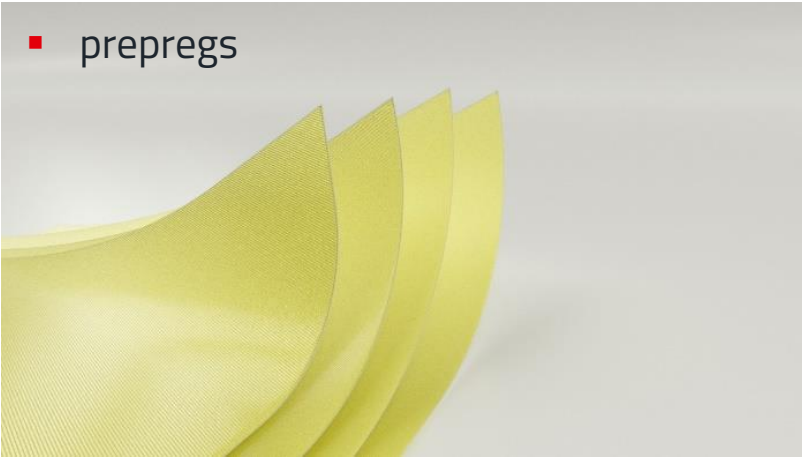


Multilayer

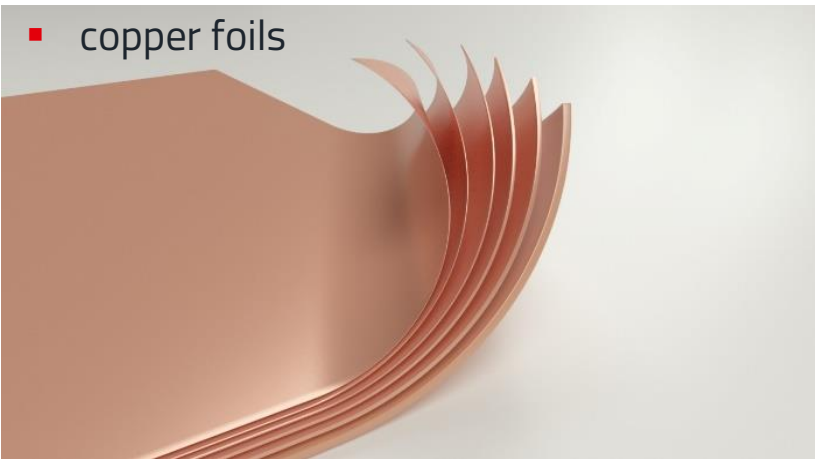


BASE MATERIALS

- prepregs



- copper foils



- You can find many more details on base materials in the webinar:

„[Basics of printed circuit board production, part 1](#)“

- inner layer core



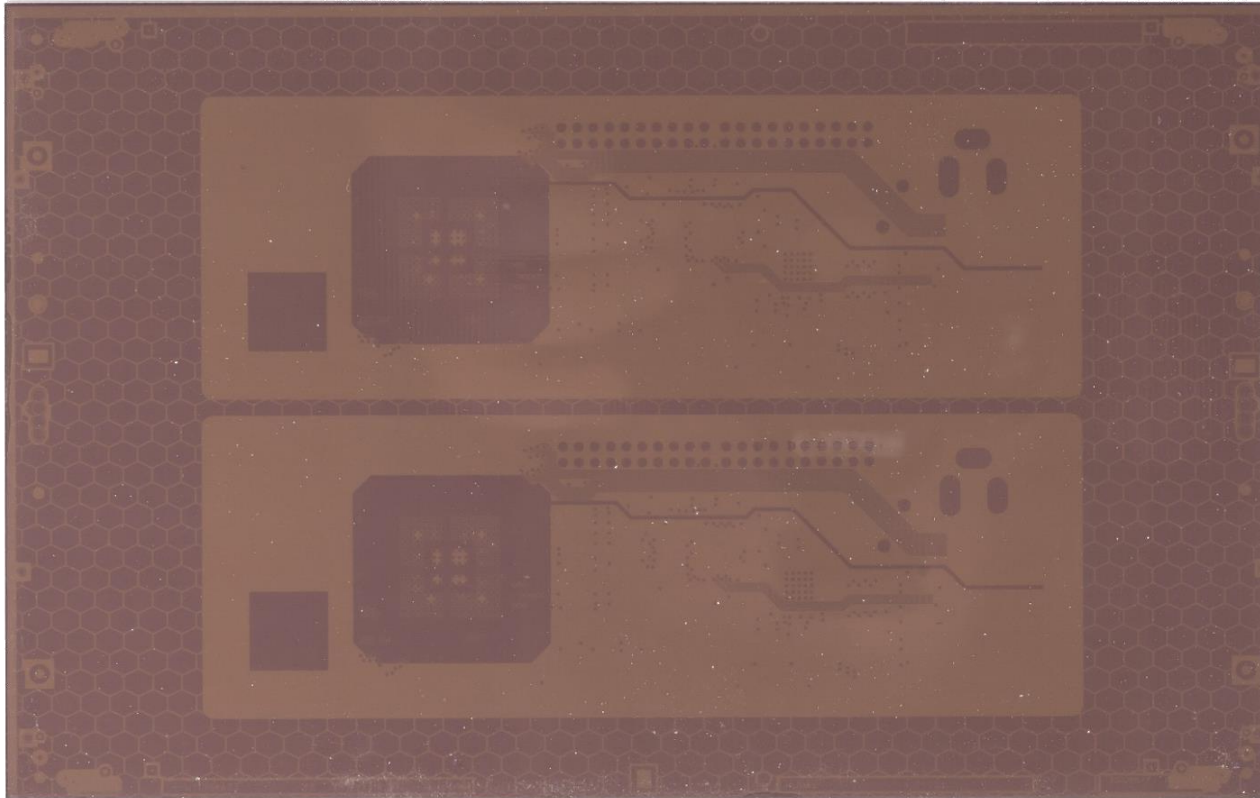
PRODUCTION OF MULTILAYERS STEP-BY-STEP



- base material



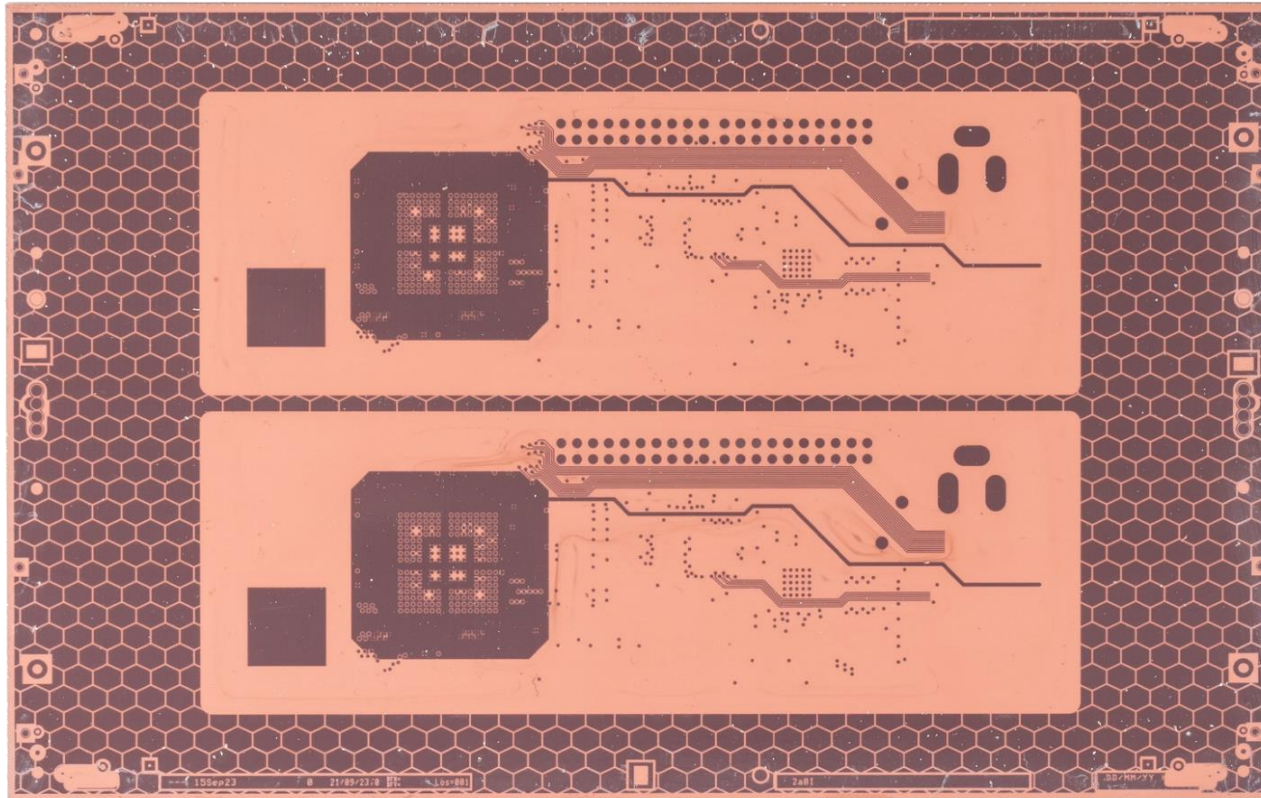
PRODUCTION OF MULTILAYERS STEP-BY-STEP



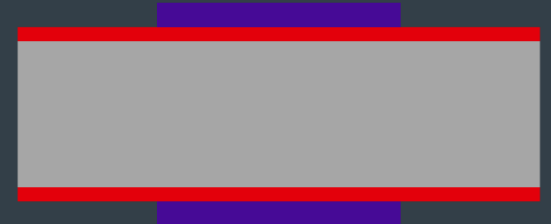
- photoresist imaging



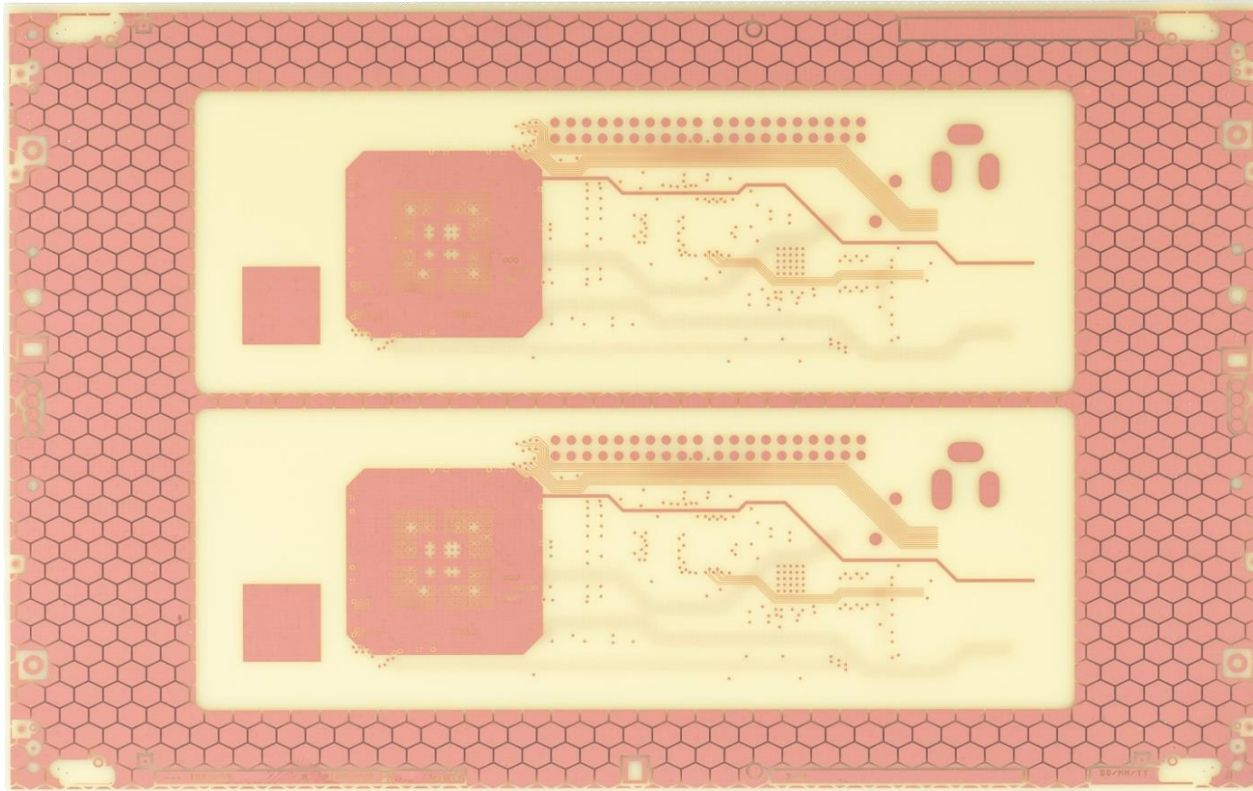
PRODUCTION OF MULTILAYERS STEP-BY-STEP



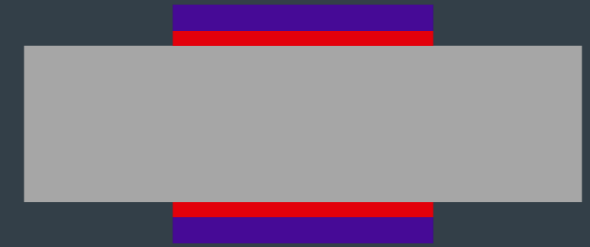
- post development



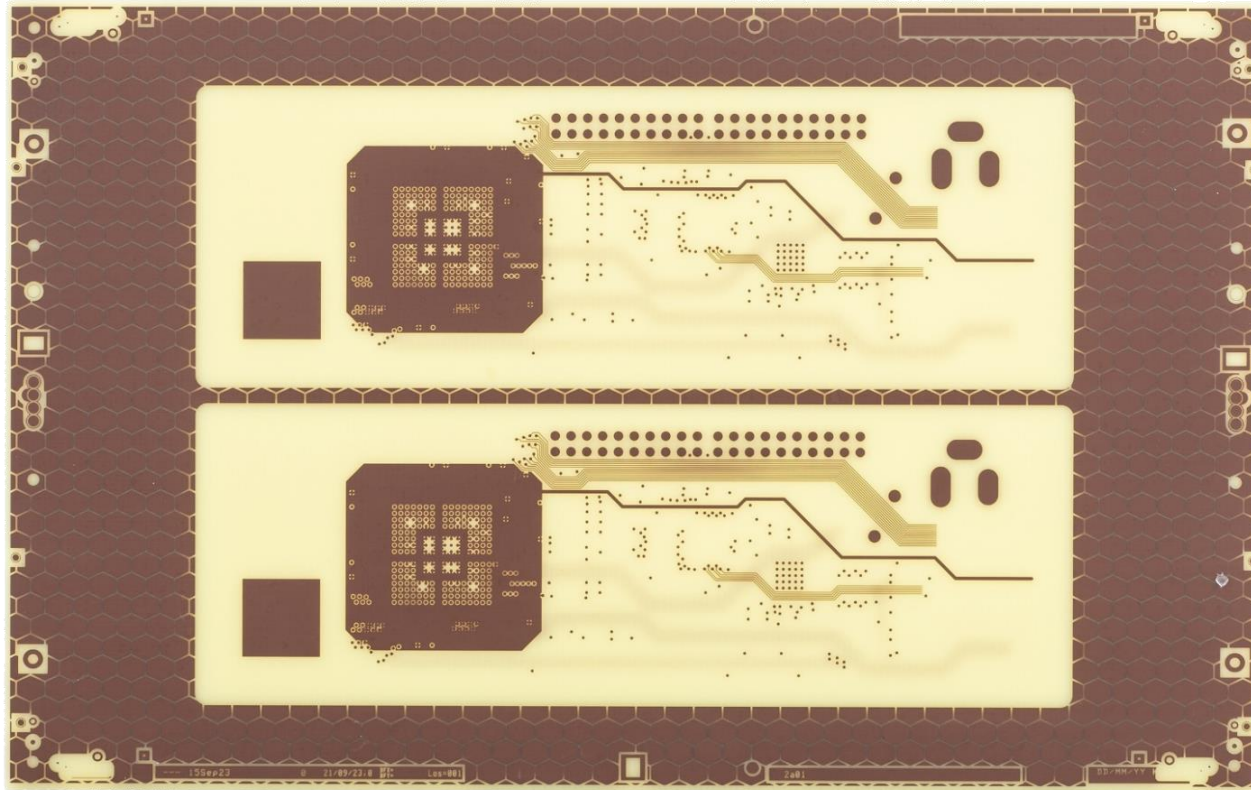
PRODUCTION OF MULTILAYERS STEP-BY-STEP



- acid etching, resist stripping



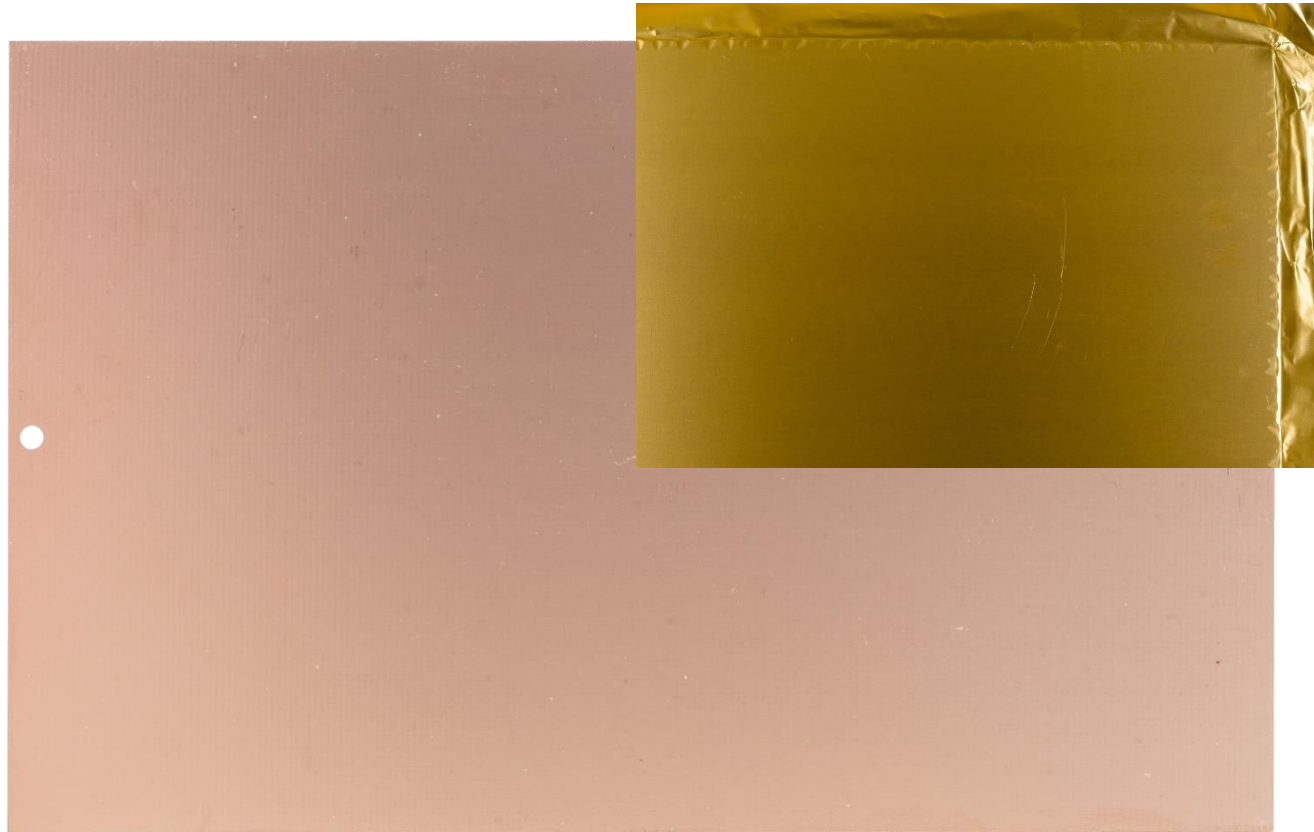
PRODUCTION OF MULTILAYERS STEP-BY-STEP



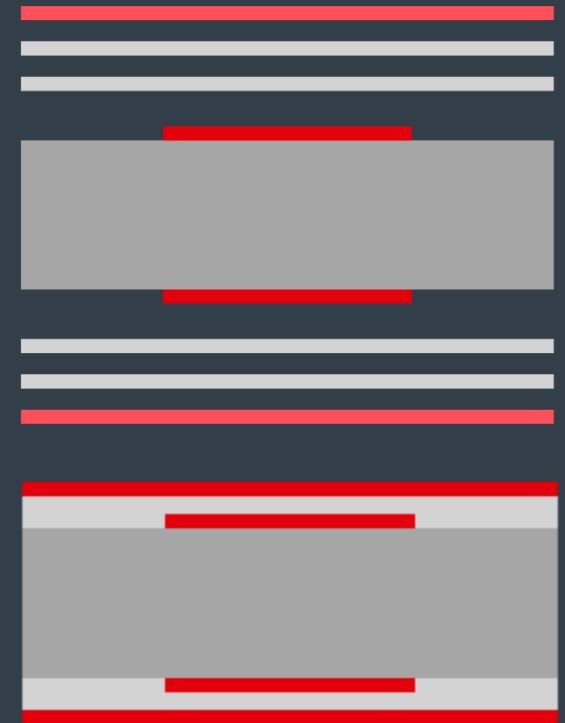
- AOI and adhesion promotion



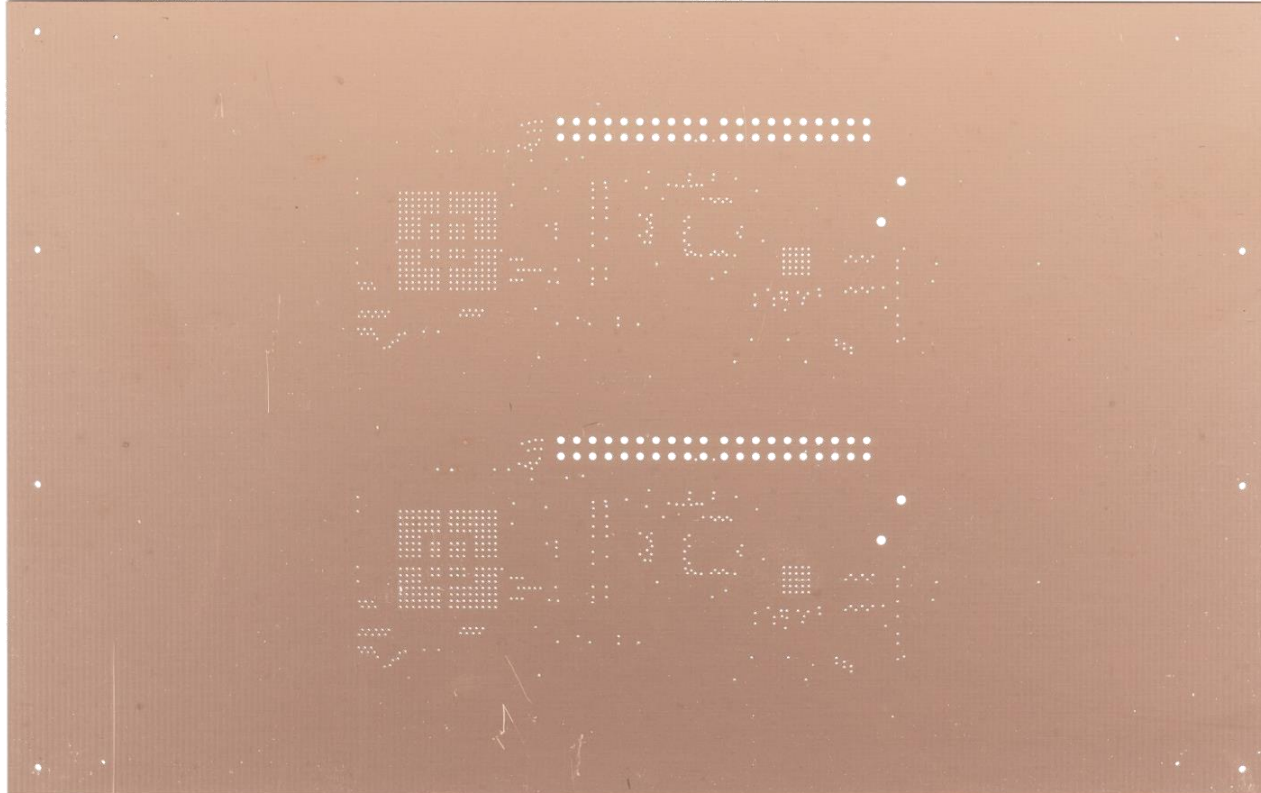
PRODUCTION OF MULTILAYERS STEP-BY-STEP



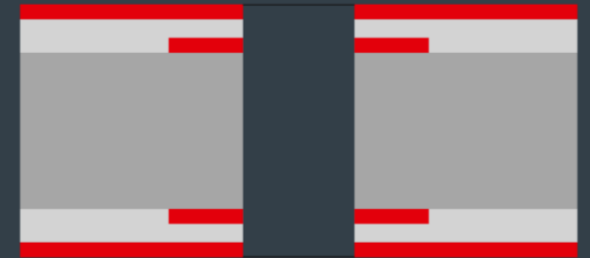
- lay-up, lamination
- X-ray drilling, edge cutting



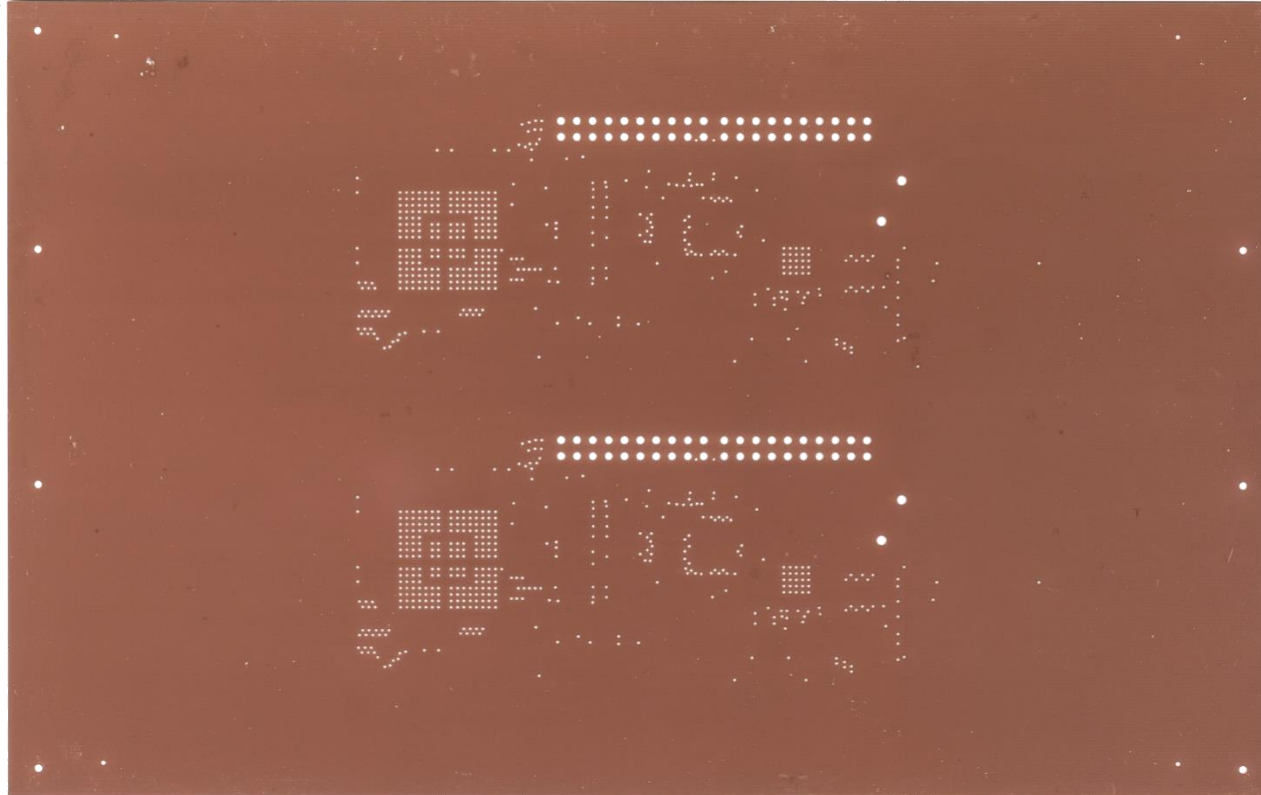
PRODUCTION OF MULTILAYERS STEP-BY-STEP



- mechanical drilling



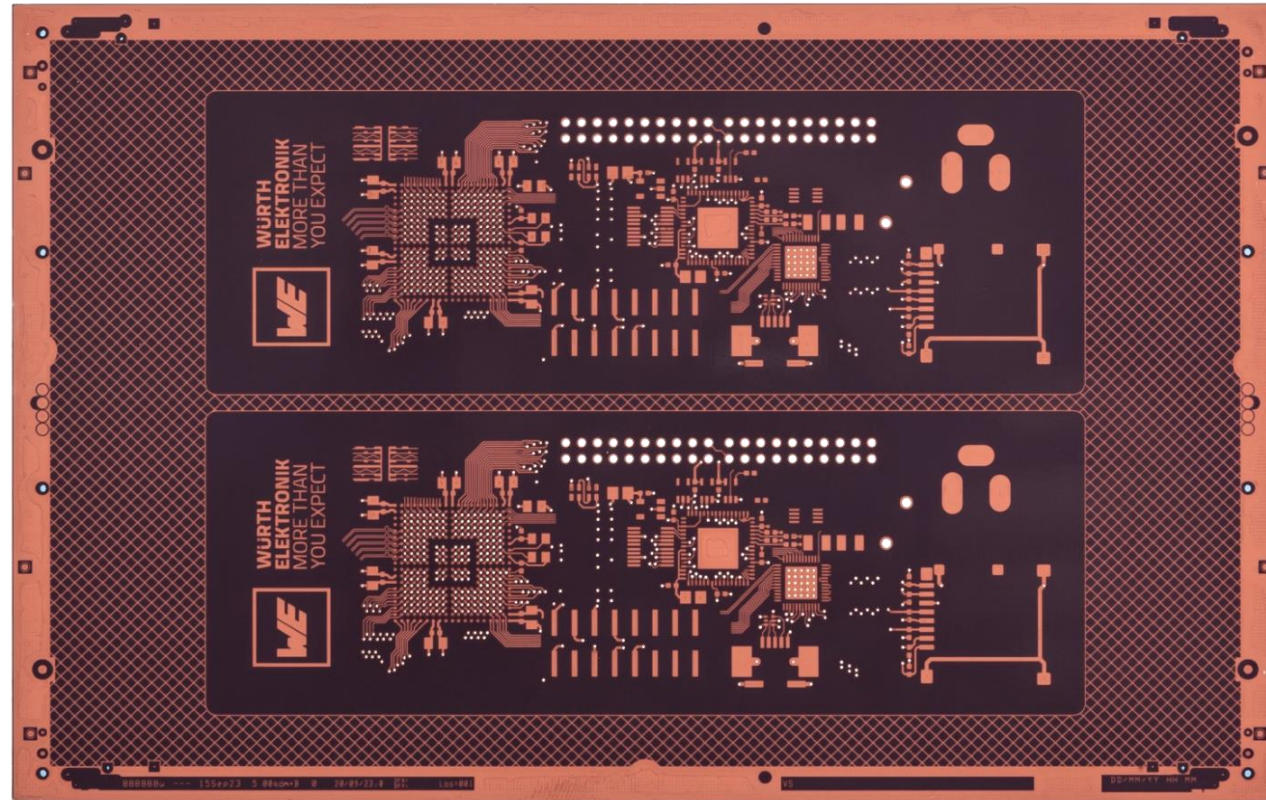
PRODUCTION OF MULTILAYERS STEP-BY-STEP



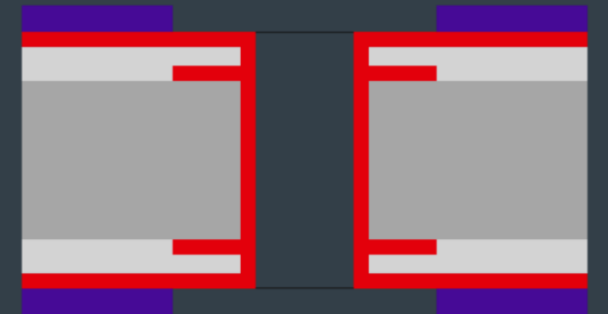
- direct plating
- electro-panel-plating



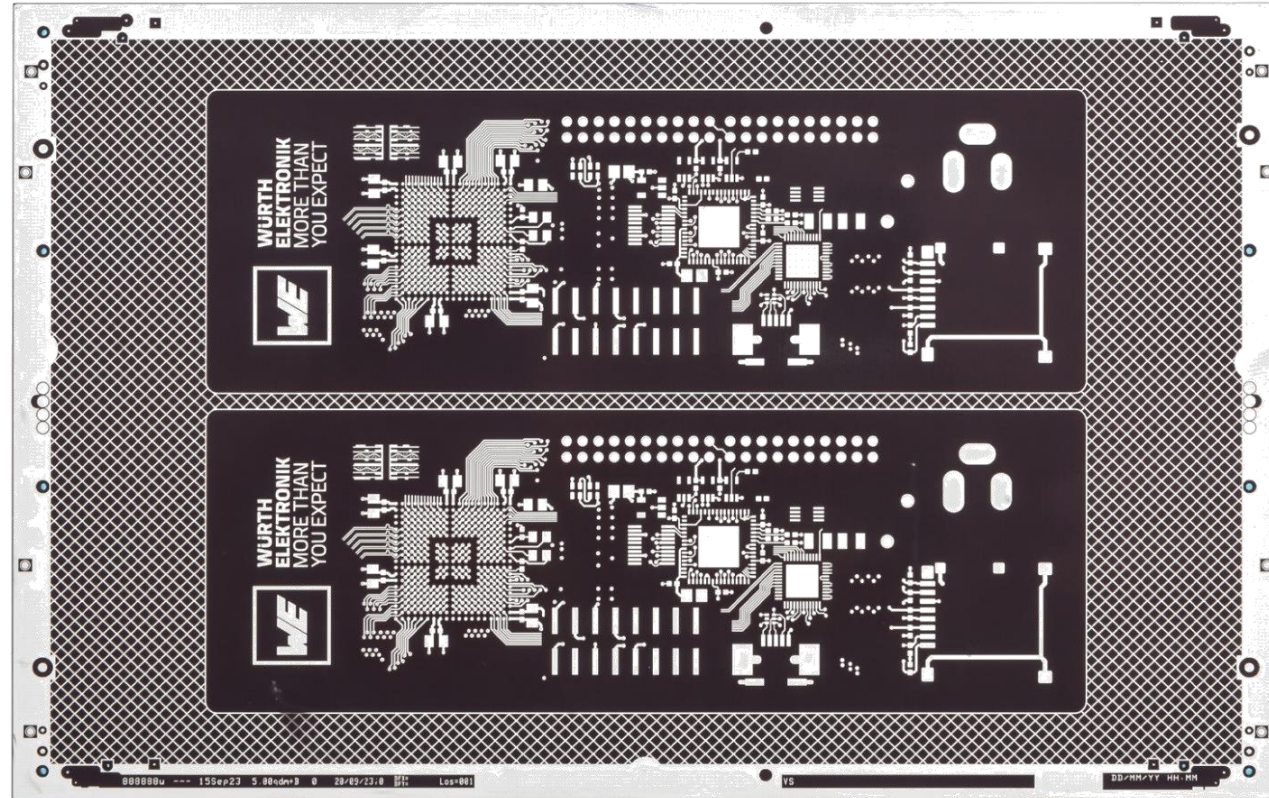
PRODUCTION OF MULTILAYERS STEP-BY-STEP



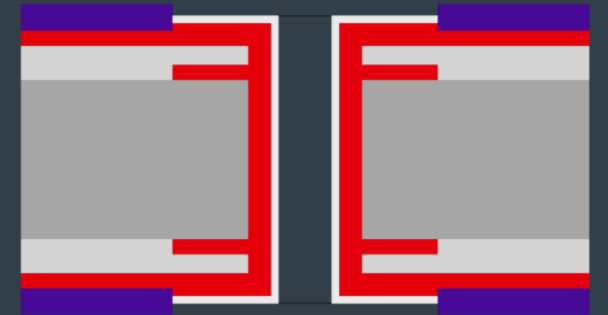
- photoresist imaging, developing



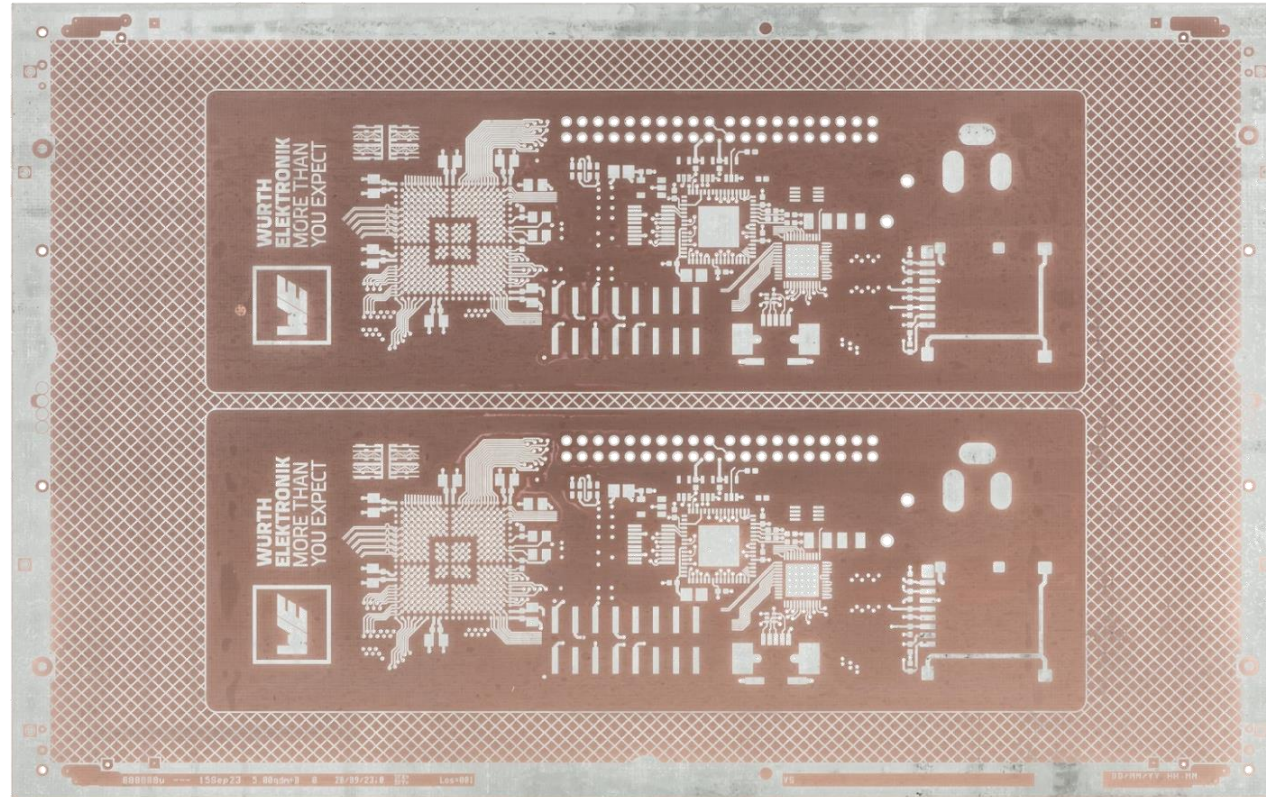
PRODUCTION OF MULTILAYERS STEP-BY-STEP



- pattern plating
- tin resist



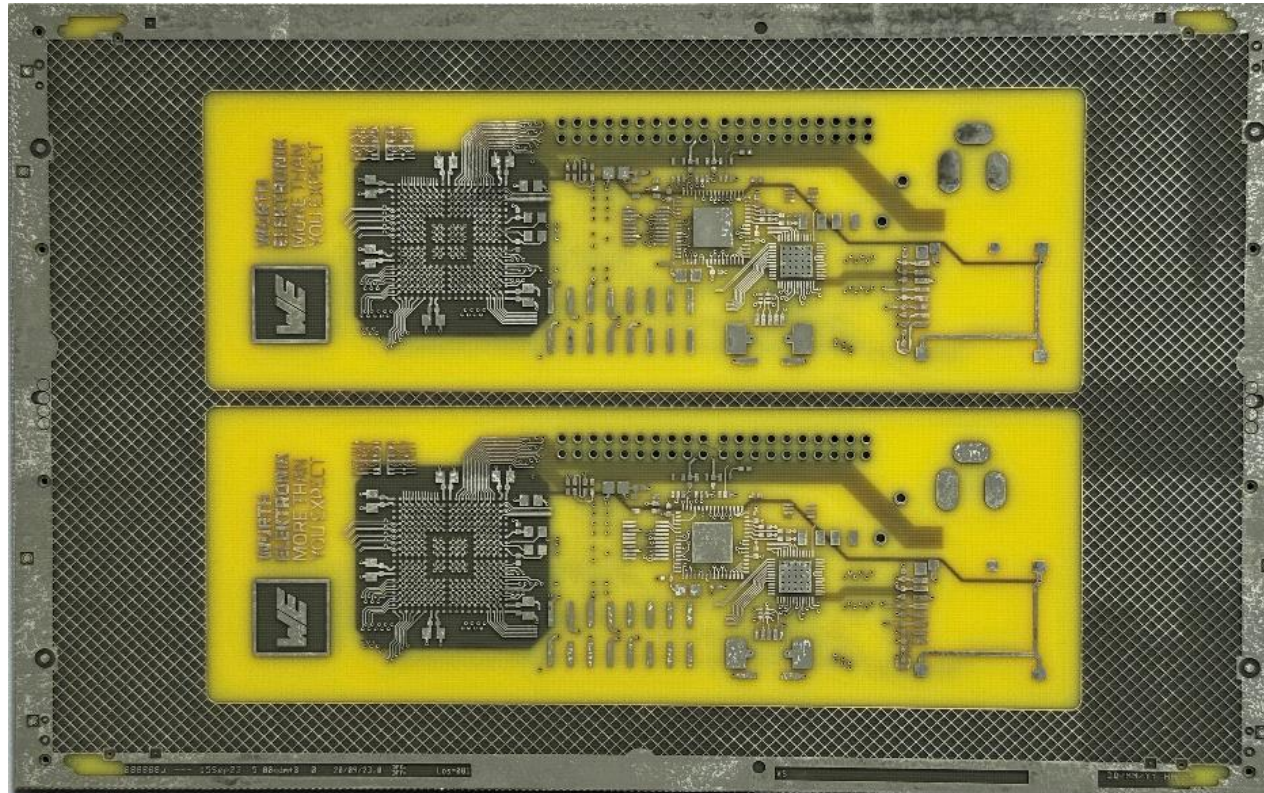
PRODUCTION OF MULTILAYERS STEP-BY-STEP



- photoresist stripping



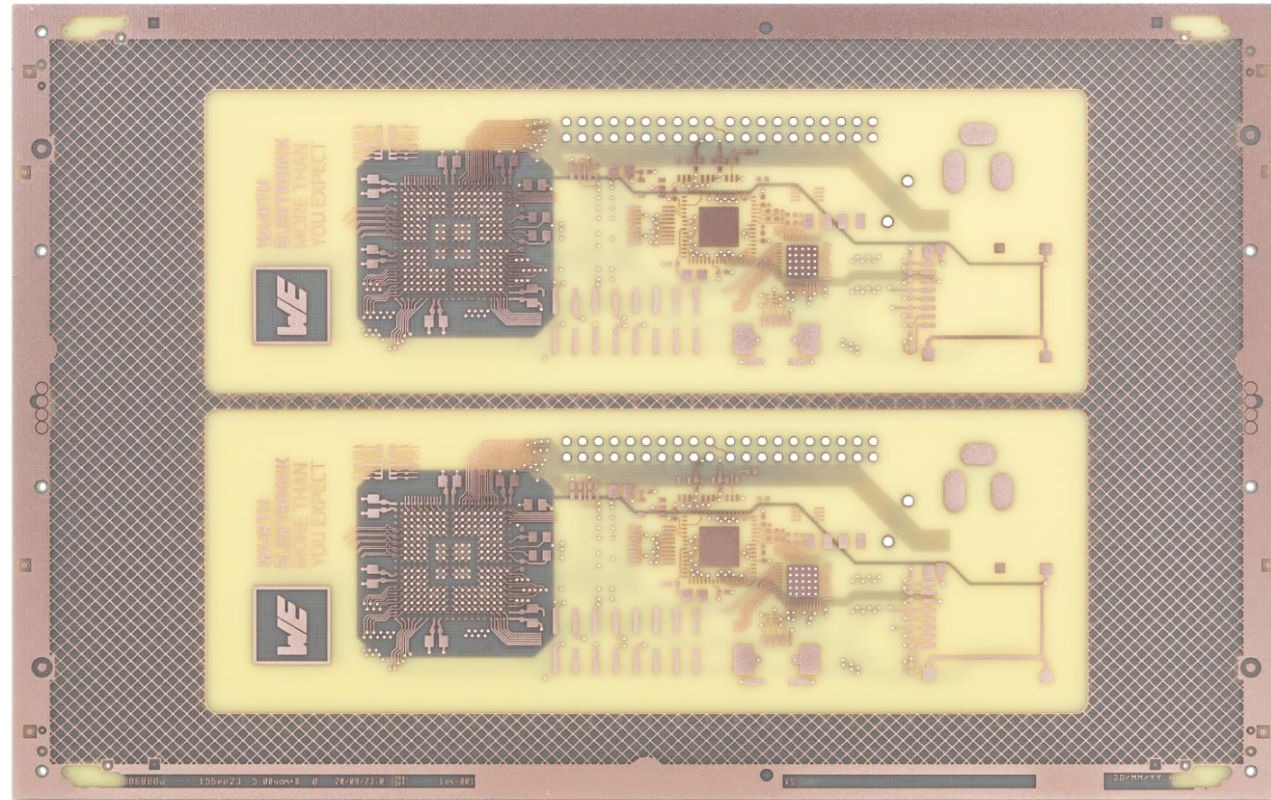
PRODUCTION OF MULTILAYERS STEP-BY-STEP



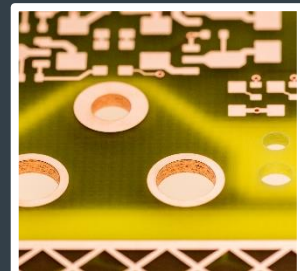
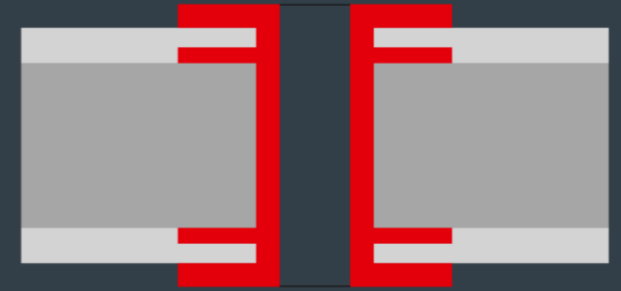
- alkaline etching



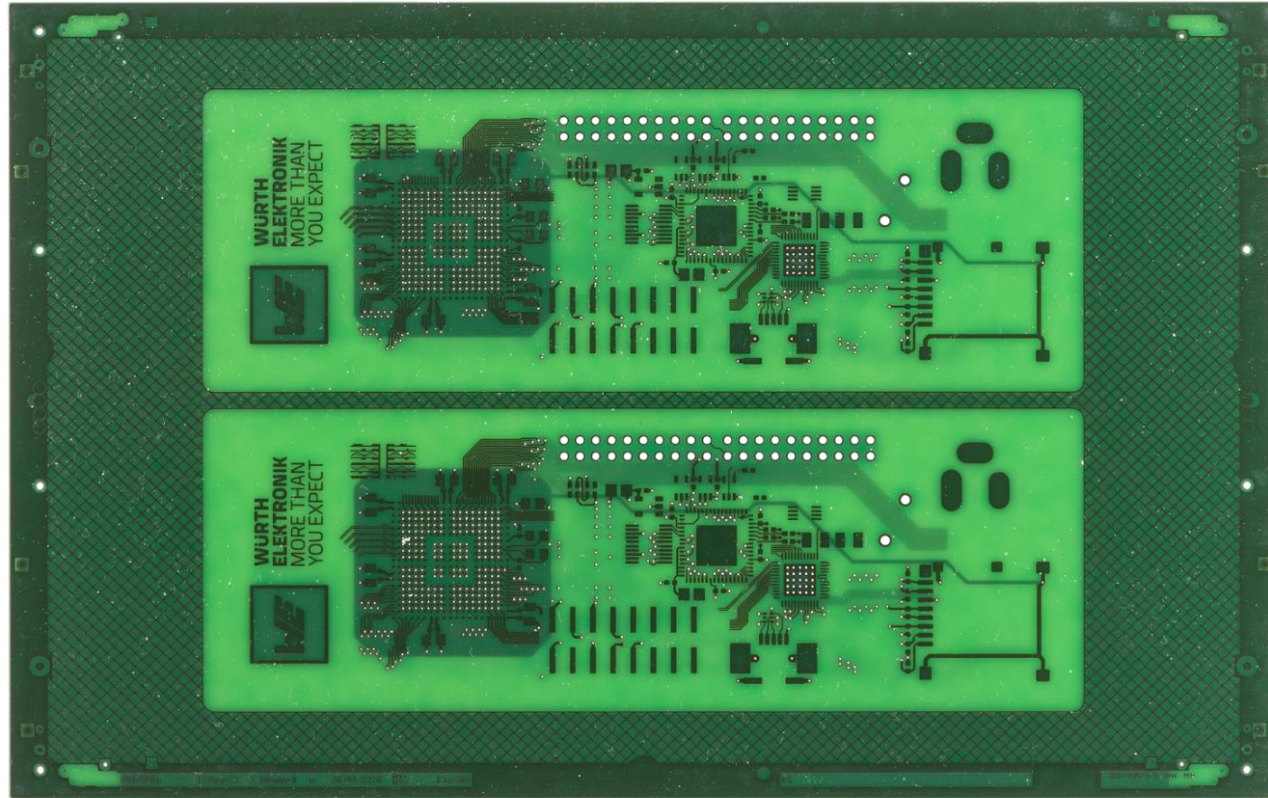
PRODUCTION OF MULTILAYERS STEP-BY-STEP



- tin resist stripping

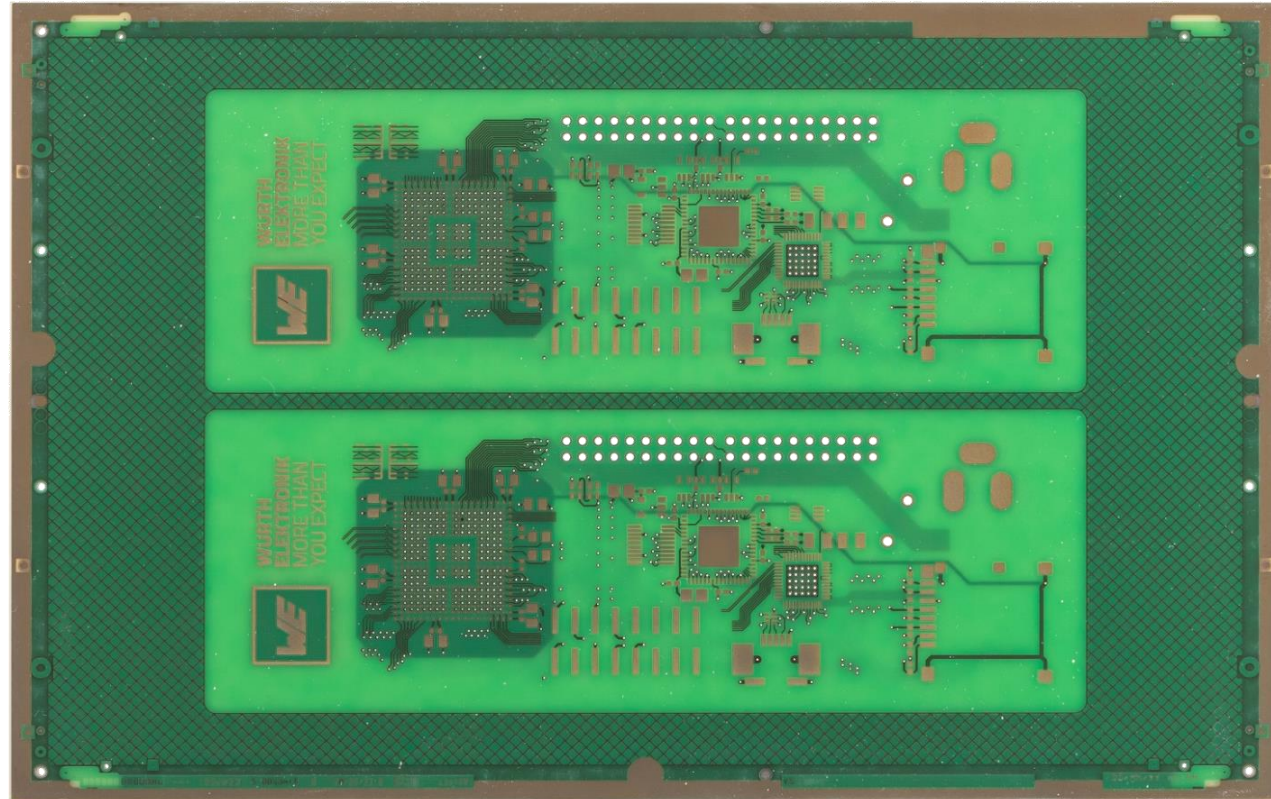


PRODUCTION OF MULTILAYERS STEP-BY-STEP



- solder resist coating

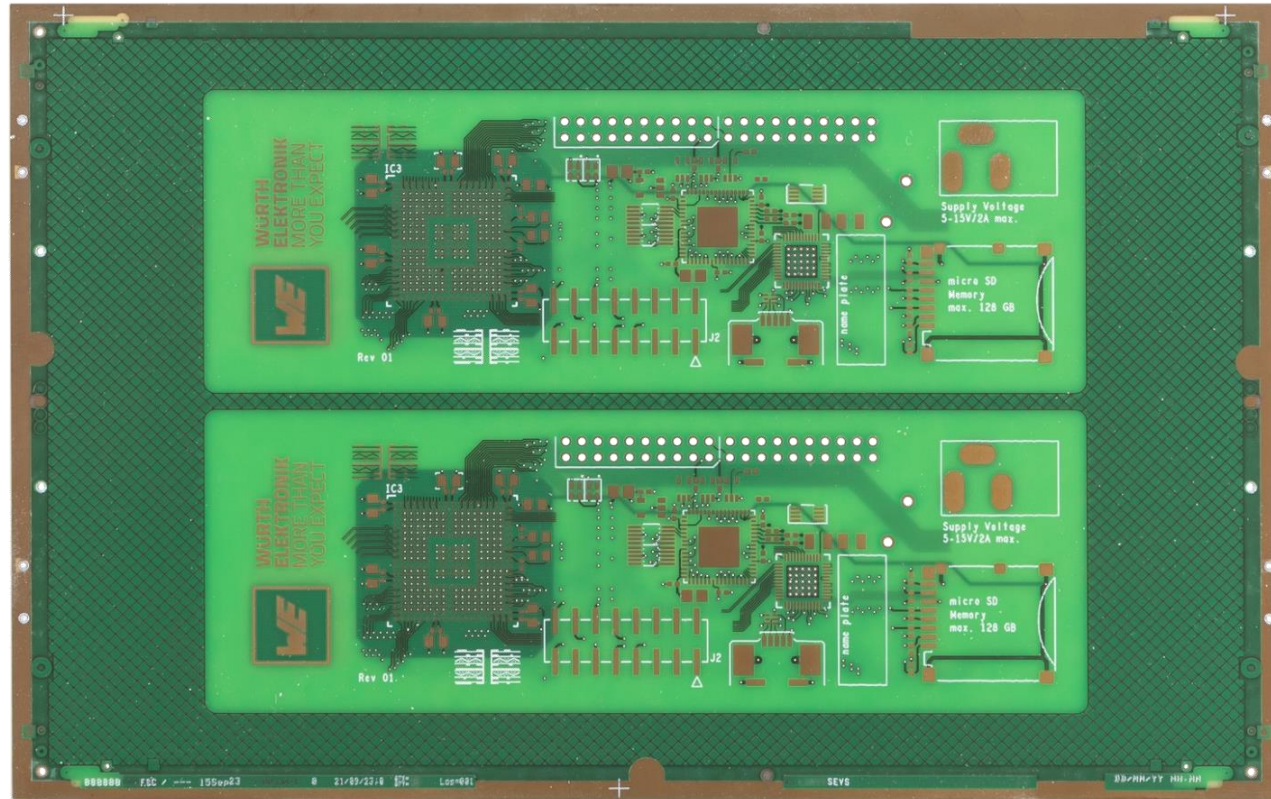
PRODUCTION OF MULTILAYERS STEP-BY-STEP



- solder resist developed

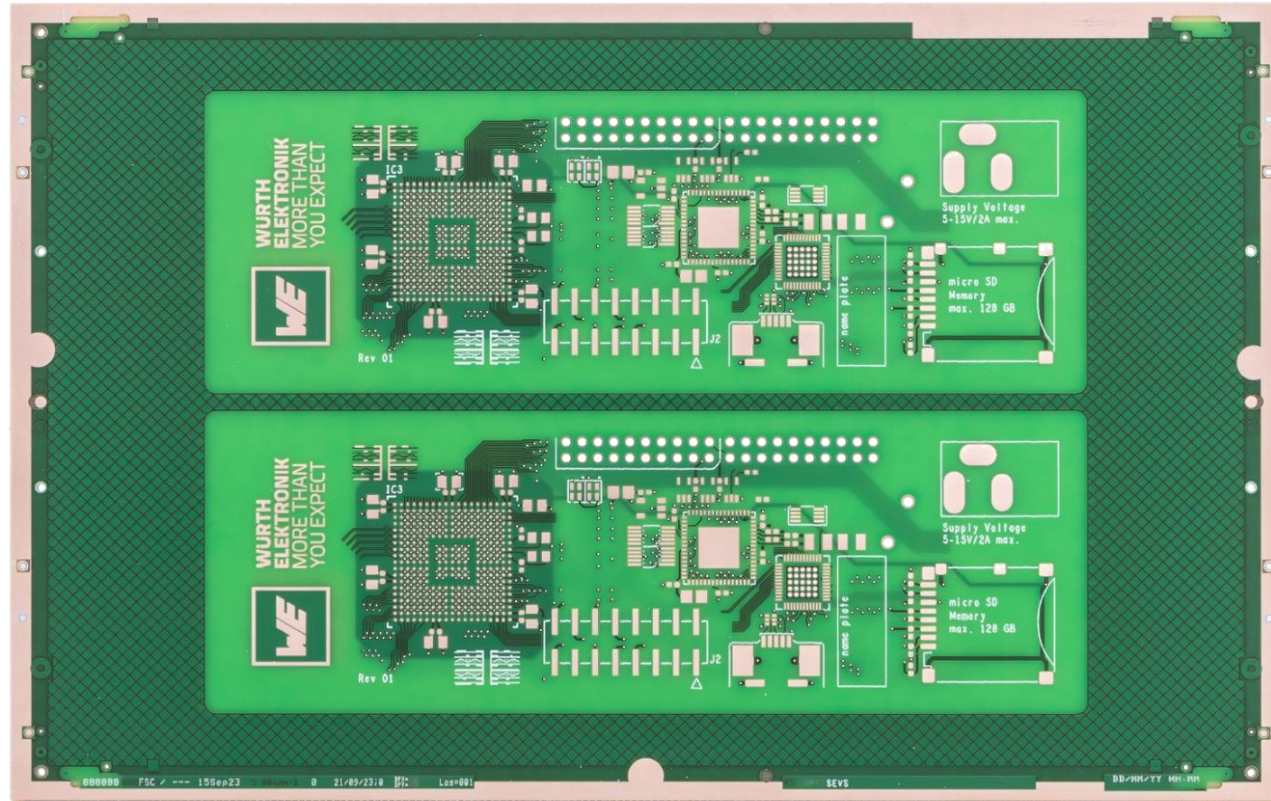


PRODUCTION OF MULTILAYERS STEP-BY-STEP



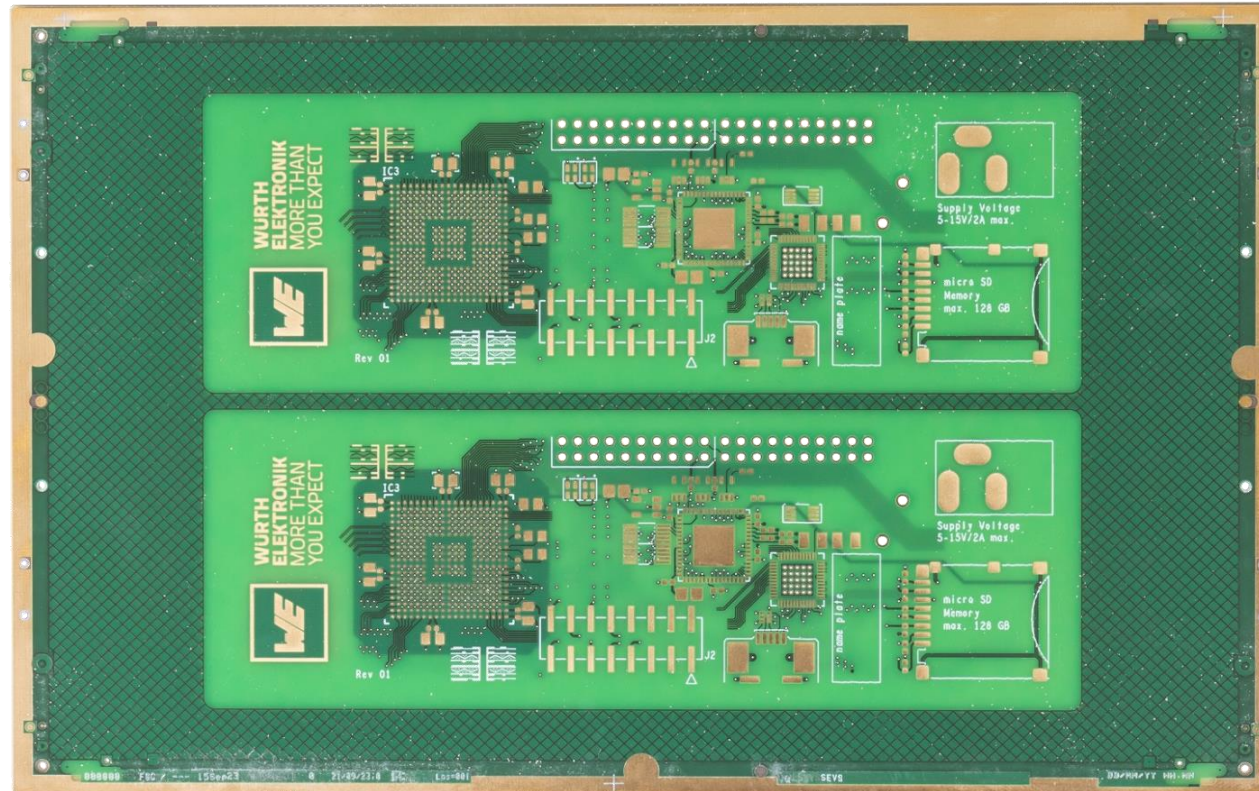
- legend print
- curing

PRODUCTION OF MULTILAYERS STEP-BY-STEP

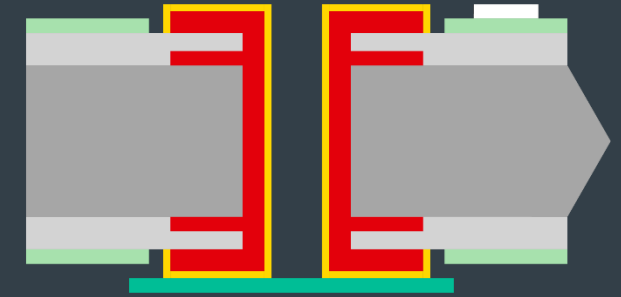


- cleaning process prior to surface finish application

PRODUCTION OF MULTILAYERS STEP-BY-STEP



- ENIG surface finish
- option: peelable mask
- separate, wash

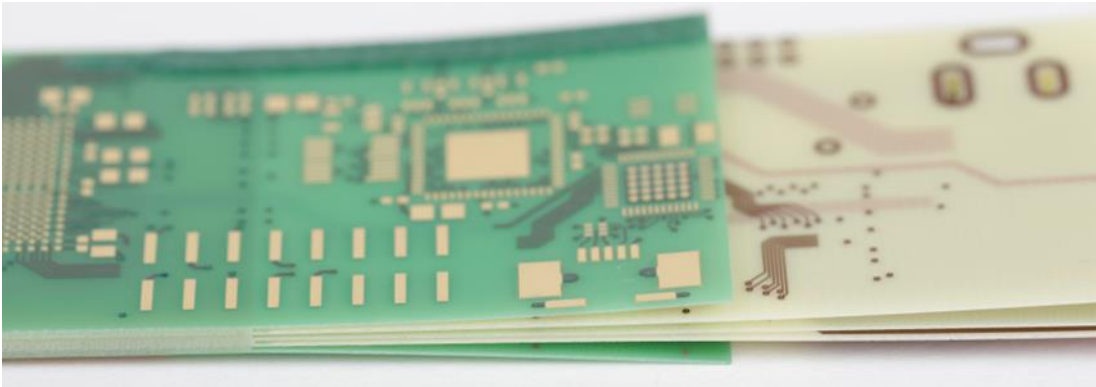


- electrical test
- final inspection and documentation
- packing and shipping

PHYSICAL PCB SAMPLE IN DETAIL

Overview BASIC sample WE.fan

- Naming WE.fan: = fans



Multilayer

not laminated
all materials

not laminated
only cores

- All manufacturing phases in one sample
- Order here: www.we-online.com/wefan



STACKUP



FANS



CONTOUR



VIA WITH
PLUGGING



STRUCTURES



PEELABLE MASK



COMPONENTS



DATA MATRIX CODE
(DMC)



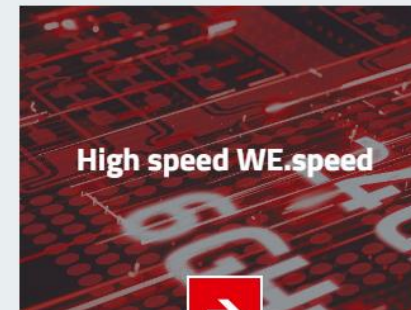
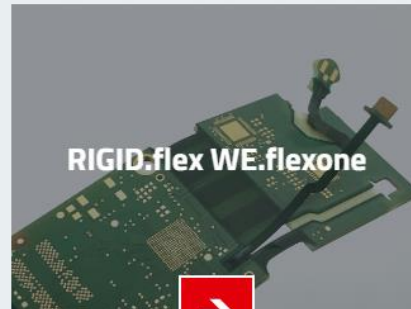
QR CODE

UNDERSTANDING CIRCUIT BOARD TECHNOLOGIES

More physical PCB samples: Order your free sample now!!

- <https://www.we-online.com/physical-pcb-samples>

Order samples now free of charge!



ANNIVERSARY SURVEY ON THE 100TH PCB WEBINAR

Top 3 of the questions

- **Question:**

- Costs: What influence does the number of hole diameters in a design have on the price of the PCB?

- **Information:**

Drilling machines for volume production have a revolving tool chain with several thousand carbide tools

- **Answer:**

- The number of drilling diameters has a very small influence on the PCB price; each drilling machine is equipped with a large number of drilling tools in different diameters and the tools are changed automatically in a short time, even after the defined tool life has expired.
- In contrast, the following parameters have an influence on the costs:
 - Drilling diameter
 - Number of drill holes

MECHANICAL PROCESSING

Which influence do the drilling tools have on the PCB costs?

Comparison:

Ø 0.5 mm, Ø 0.35 mm und Ø 0.25 mm drill bits on 5 mm x 5 mm checkered paper



MECHANICAL PROCESSING

Which influence do the drilling tools have on the PCB costs?

Panel stacking for mechanical processing

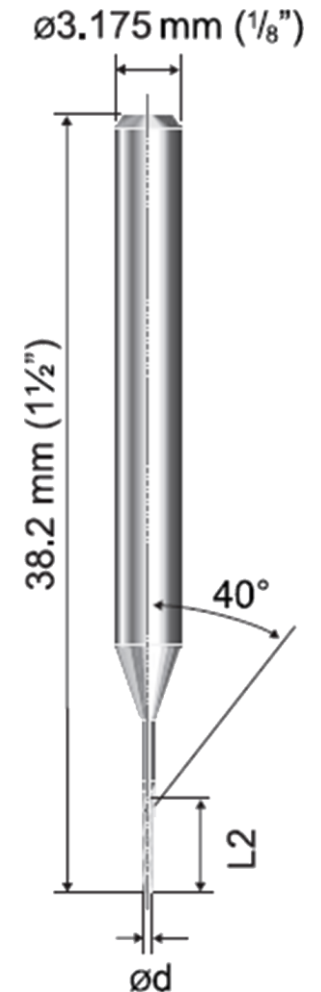
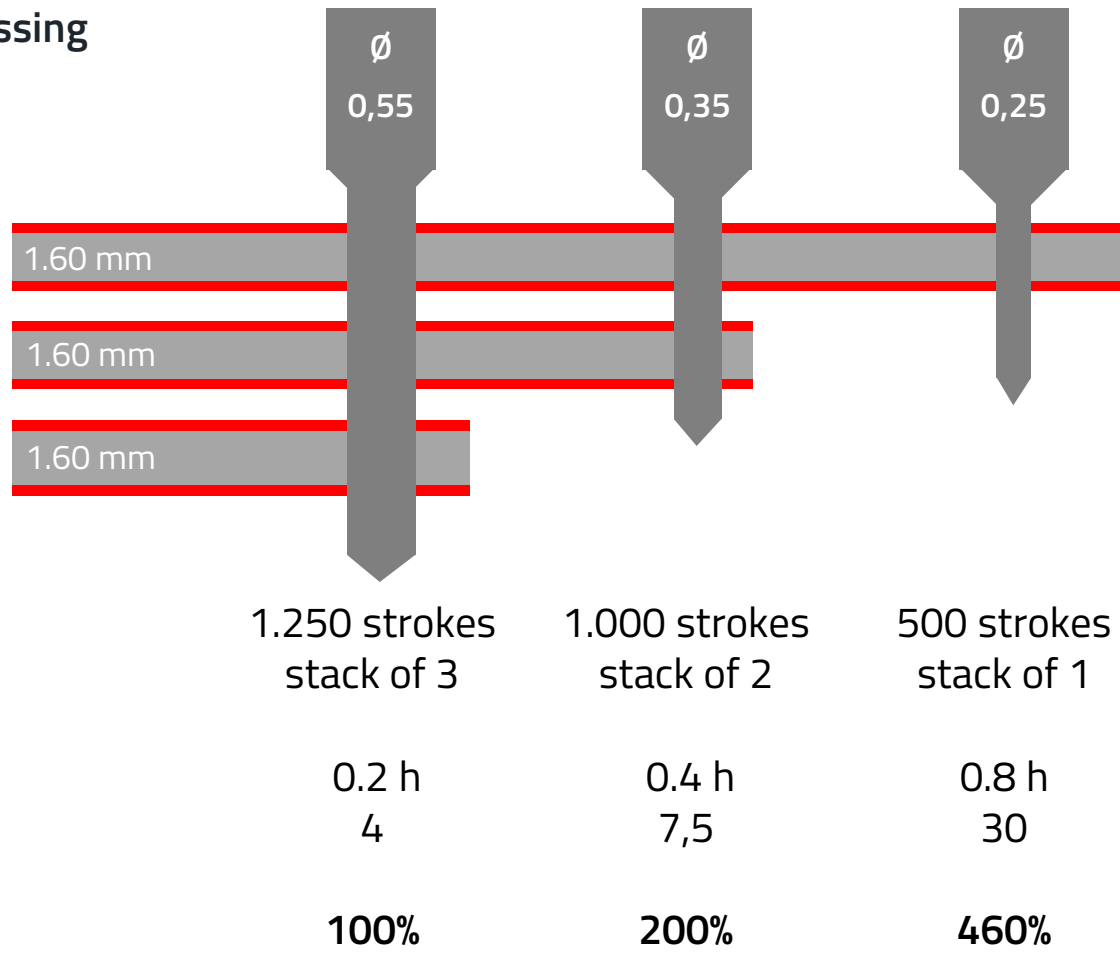
using „via drilling“ as an example

Cores FR4.1 Tg150, filled
Thickness 1.60 mm

Tool life
Panel stacking

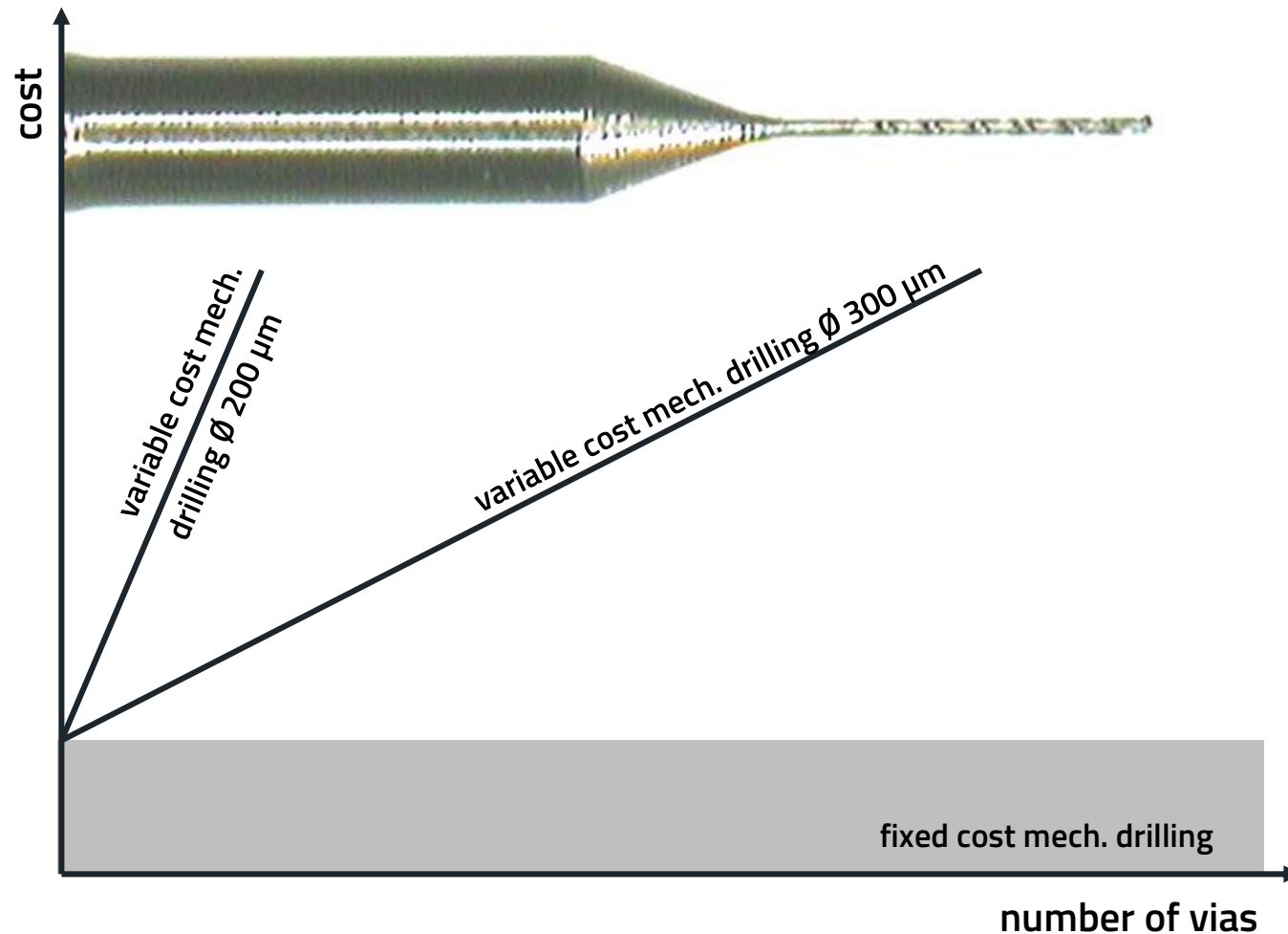
Time to drill 15.000 vias
Usage of drill bits for 15.000 vias

Price indicator (drilling process only)



MECHANICAL PROCESSING

Which influence do the drilling tools have on the PCB costs?



Ø 0.2 mm (0.55 € per bit)

Tool life: 750 strokes

Drilling frequency: 3 / s

Ø 0.3 mm (0.50 € per bit)

Tool life: 1.000 strokes

Drilling frequency: max. 8 / s

ANNIVERSARY SURVEY ON THE 100TH PCB WEBINAR

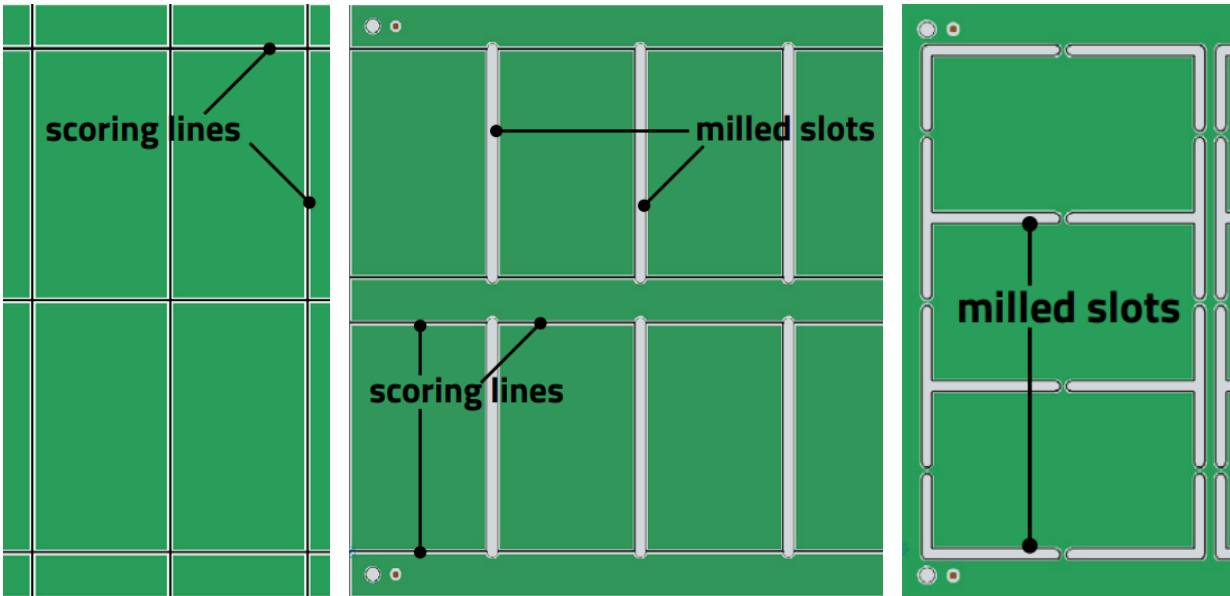
Top 3 of the questions

■ Question:

- Separation of panel: What does the choice of separation technology depend on and what are the advantages?

■ Answer:

- Milling can realize complex contours, V-scoring/notch milling can only cut straight lines
- Highly complex outlines or high demands on contour quality require a milling process
- Cutting a scored panel requires appropriate tools and puts a strain on the material and possibly components in the vicinity of the outline (be careful with ceramic components!)
- Milling is always more expensive than V-scoring
- Punching or sawing is used for very large quantities
- Laser cutting is used for thin materials, for example Flex



THE PCB ARRAY

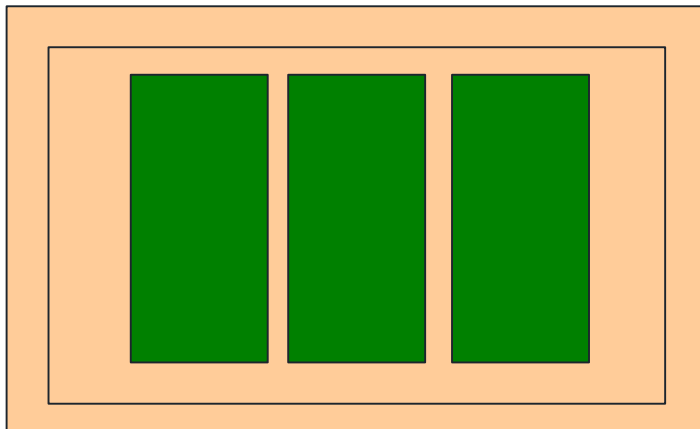
How to utilize and occupy the manufacturing panel properly?

How is the manufacturing panel occupied with PCBs?

- Every PCB manufacturer needs a border for registration and labelling → Non-useable space!

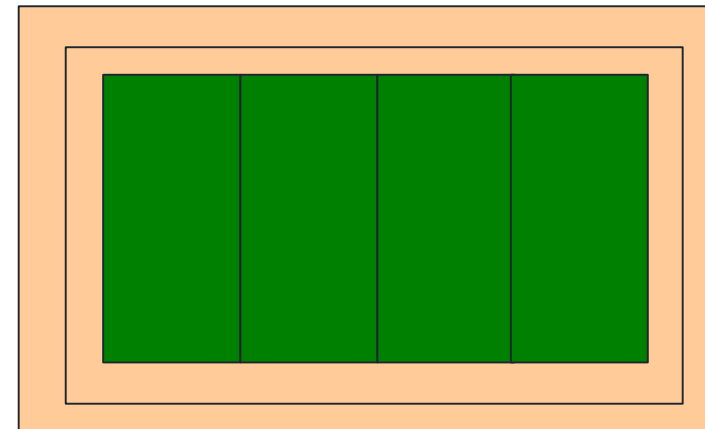
Example: Single PCBs

routing



or

V-scoring



In this example: 33% more circuit boards on the production panel

THE PCB ARRAY

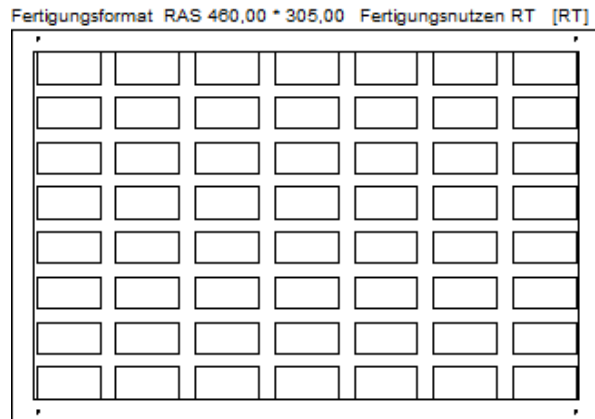
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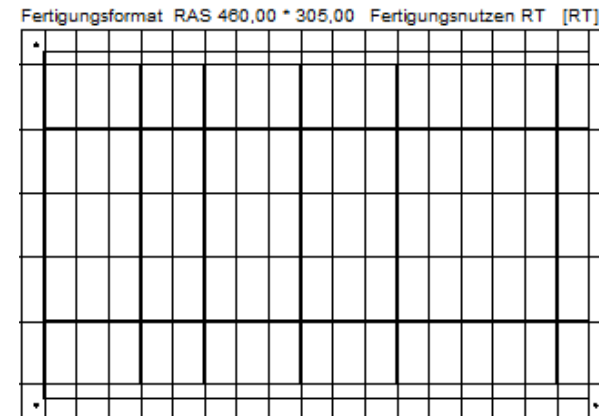
Example: Single PCBs – The smaller the PCB, the greater the effect!

routing



or

V-scoring



In this example: 56 PCBs vs. 85 PCBs

THE PCB ARRAY

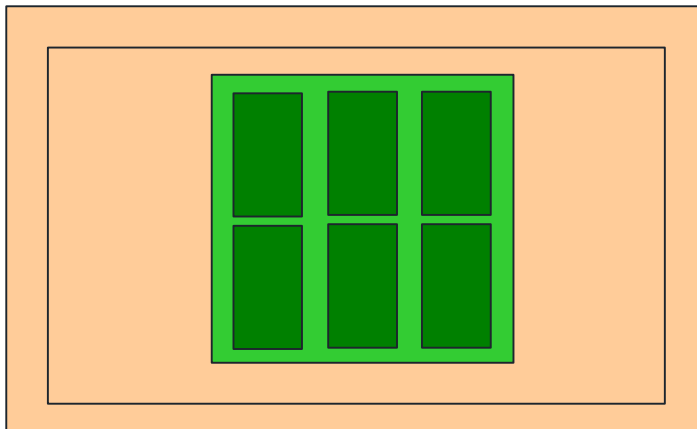
How to utilize and occupy the manufacturing panel properly?

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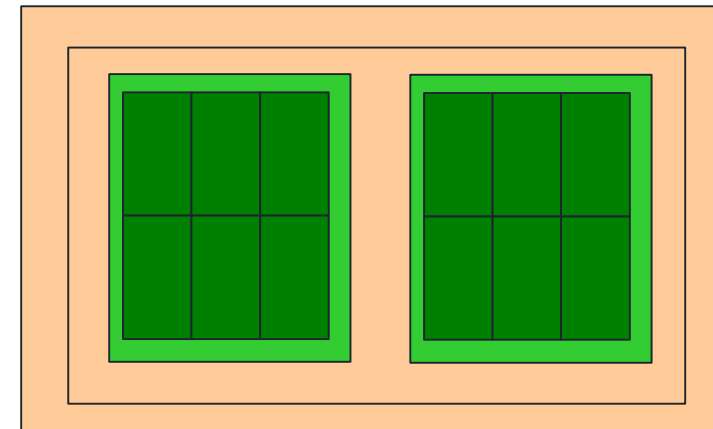
Example: PCBs in array

routing



or

V-scoring



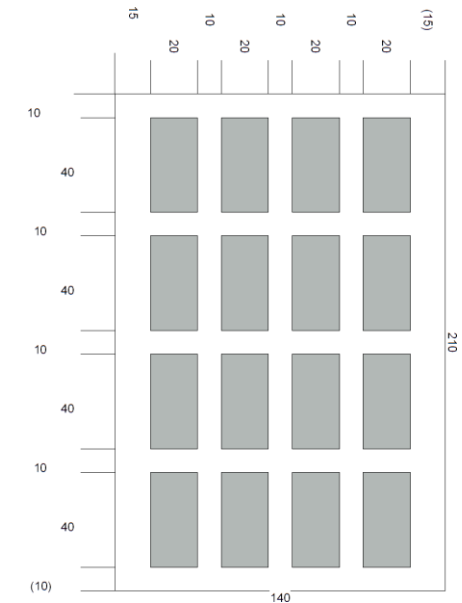
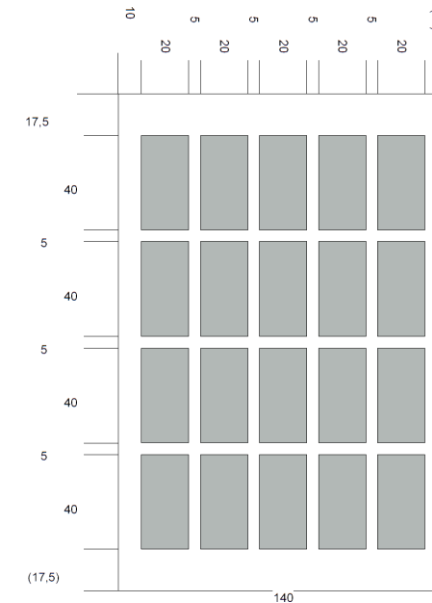
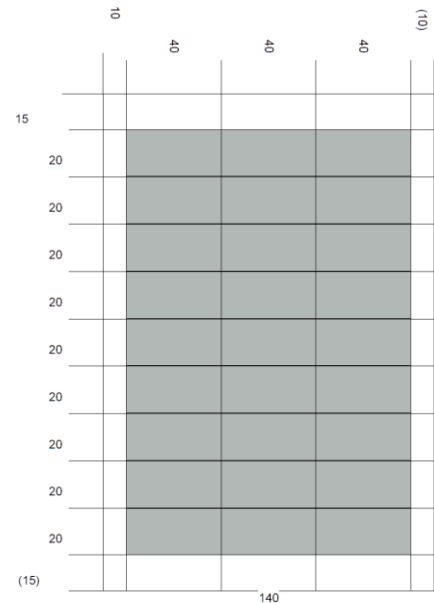
In this example: 100% more circuit boards on the production panel

THE PCB ARRAY

How to utilize and occupy the manufacturing panel properly?

Calculation basis:

- ML6 / Base material T_g 150
- PCB size 20 x 40 mm²
- Array size 210 x 140 mm²
- 100 µm L/S
- 500 drills
- 0.20 mm smallest drill-Ø
- ENIG



PCBs on a production panel

Number of production panels (1.000 PCBs ordered)

PCBs in an array

PCB outline

PCB distance in array

Price indicator

216

5

27

v-scored

0.00 mm

100%

160

7

20

routed

5.00 mm

117%

128

8

16

routed

10.00 mm

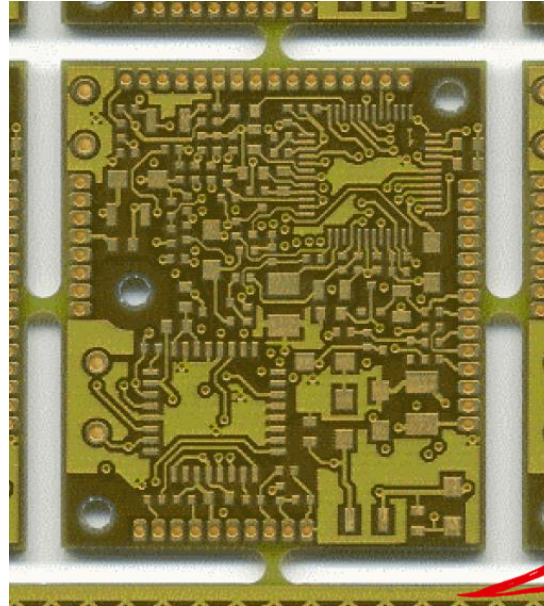
131%

MECHANICAL PROCESSING

What else has an influence on the price of PCBs?

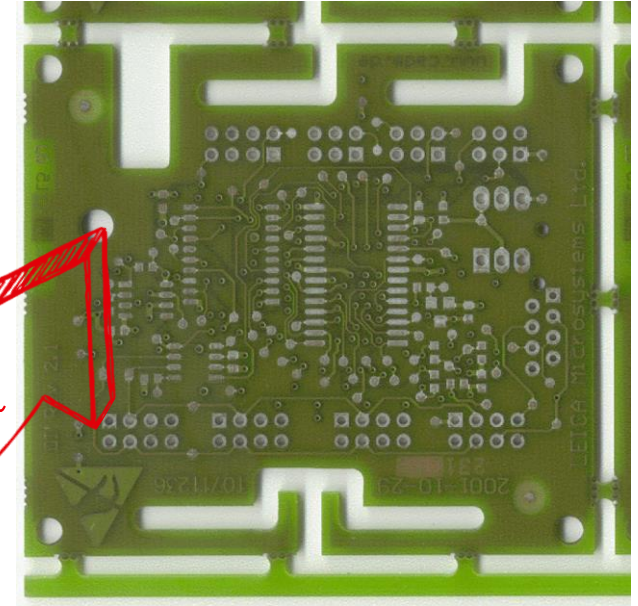
Routing contours

Complex routing contours can lengthen the routing paths and have a negative influence on the routing tool diameter



Standard routing contour

- 4x change in direction
- routing tool 2.4 mm



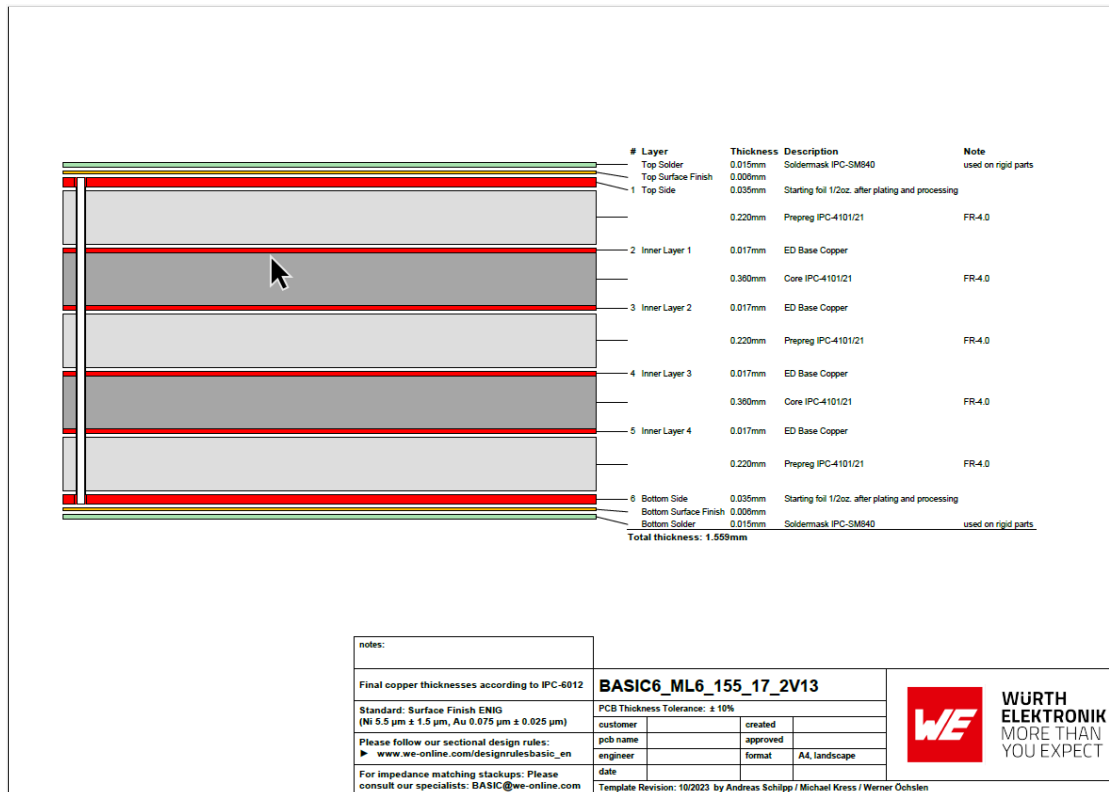
Complex routing contour

- approx. 30x change in direction
- high routing time
- routing tool 1.8 mm

ANNIVERSARY SURVEY ON THE 100TH PCB WEBINAR

Top 3 of the questions

- **Question:**
- How does the stackup influence the price of the PCB?



- **Answer:**
- Due to the type of material used
 - Cores or prepregs
 - Additional blind cores
- By the quantity of material used
- Due to the necessary processes
 - Multiple exposure processes
 - Especially pressing processes
 - Especially metallization processes

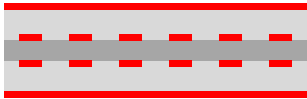
LAYER STACKUP

How does the PCB construction influence the price?

Comparison of a 4-layer multilayer with different thicknesses

- Standard: 1.55 mm / 1.60 mm
- Optimum: 1.00 mm
- Further standards: 0.80mm / 2.00 mm / 2.40 mm

0.50mm

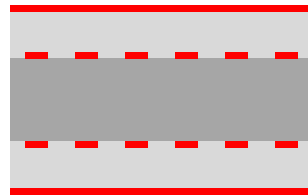


ML4_TG150_0.50_35

1x 0.10mm-035+035
4x prepreg 1080

Price indicator 107%

1.00mm

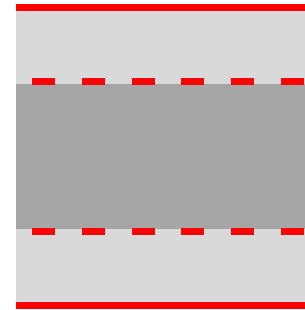


ML4_TG150_1.00_35

1x 0.41mm-035+035
4x prepreg 2116

Price indicator 96%

1.60mm

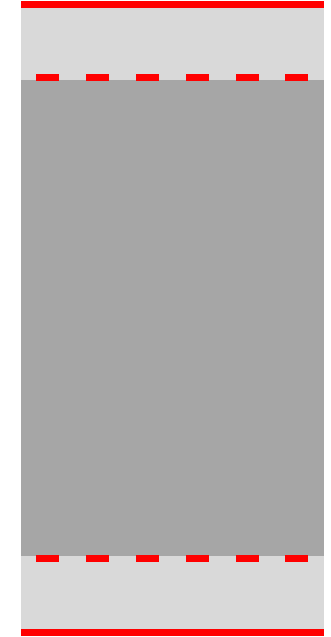


ML4_TG150_1.60_35

1x 0.71mm-035+035
4x prepreg 7628

Price indicator 100%

3.20mm



ML4_TG150_3.20_35

1x 2.40mm-035+035
4x prepreg 7628

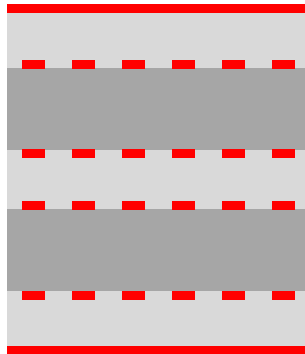
Price indicator 137%

LAYER STACKUP

How does the PCB construction influence the price?

Comparison of a 6-layer multilayer: 1.60 mm standard vs. individual stackup

Standard stackup

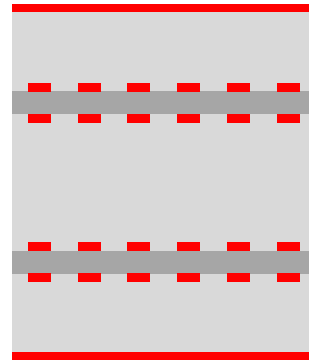


2x 0.36mm-035+035

6x prepreg 2116

Price indicator 100%

Specific stackup



2x 0.10mm-035+035

2x prepreg 2116

8x prepreg 7628

Price indicator 116%

Additional costs:

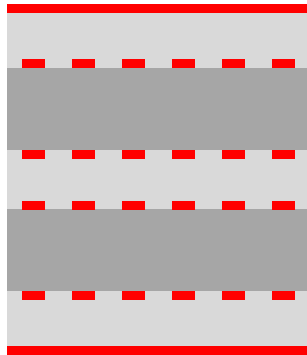
- Handling of thin laminate
- 4 preregs more in stackup

LAYER STACKUP

How does the PCB construction influence the price?

Comparison of a 6-layer multilayer: 1.60 mm standard vs. individual stackup

Standard stackup

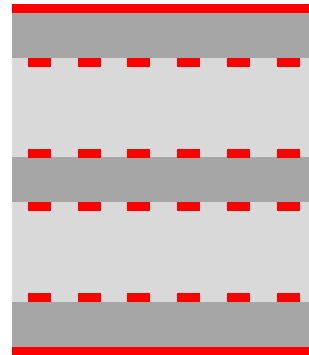


2x 0.36mm-035+035

6x prepreg 2116

Price indicator 100%

Core-based stackup



3x 0.20mm-035+035

4x prepreg 2116

2x prepreg 7628

Price indicator 122%

Additional cost:

- Multiple exposures of the outer layer cores (processed like an 8-layer PCB)
- More cores

Further cost drivers


- Filling cores in stackup

SUMMARY

BASIC physical PCB sample WE.fan

- BASIC is a technology
- Standard is a category or classification
- The BASIC physical PCB sample WE.fan shows many technological basics and some options
- Physical PCB samples of other PCB technologies are available from Würth Elektronik
- Further information on BASIC technology on our website www.we-online.com/basic
 - BASIC Design Rules
 - BASIC technology poster
 - FAQ section
 - BASIC Standard Stackups
- Würth Elektronik Webinars – also for BASIC technology– **more than you expect!**



A close-up, high-angle photograph of a green printed circuit board (PCB) with intricate white and silver circuit traces and numerous circular solder pads. The image is slightly blurred, creating a sense of depth.

THANK YOU VERY MUCH FOR YOUR ATTENTION!