Lacquering

Protection and insulation of electronic assemblies

Heicks Industrieelektronik GmbH

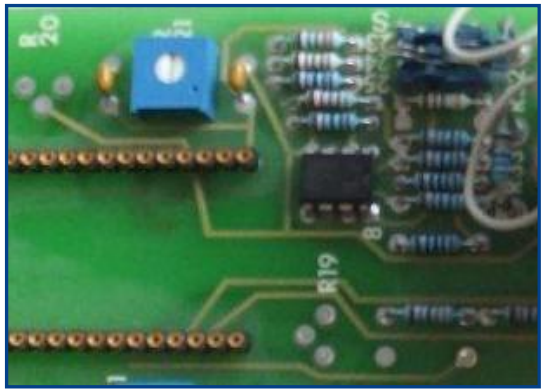
Dipl.-Ing. Rudolf Heicks

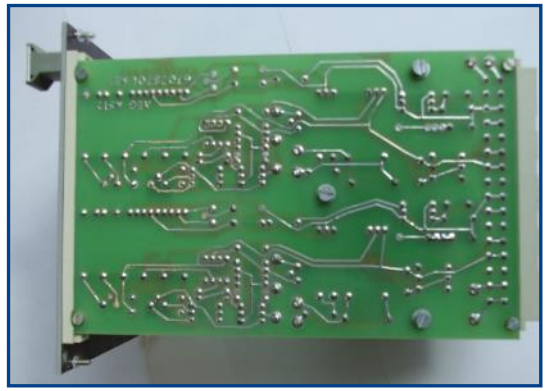
Agenda

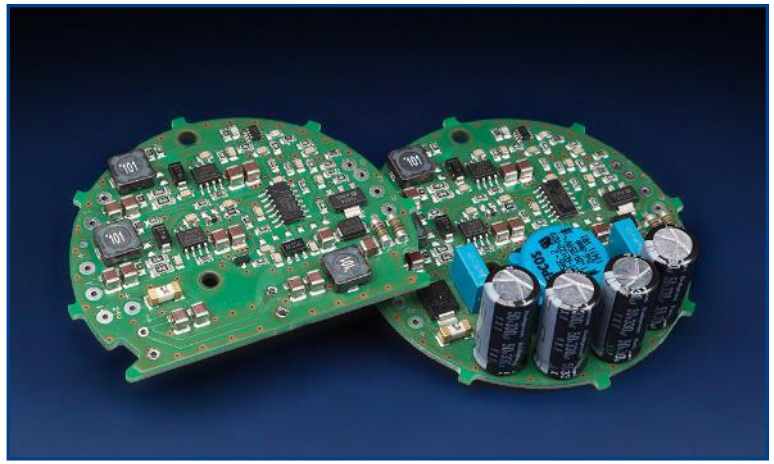
- What…
  happens due to moisture exposure?
- What…
  protective measures are possible?
- What…
  measures are to be taken?
- Which…
  cleaning processes are used?
- What…
  preliminary work can be done?
- How…
  are the coatings applied?
- How…
  do I check the quality of the coating?

Rising climate threat

- Formerly
  - Large components
  - Large conductor distances
  - Low placement density
  - Low climate influences
- Today
  - Ever smaller components
  - Very small conductor spacing
  - Steadily increasing placement density
  - High climate influences







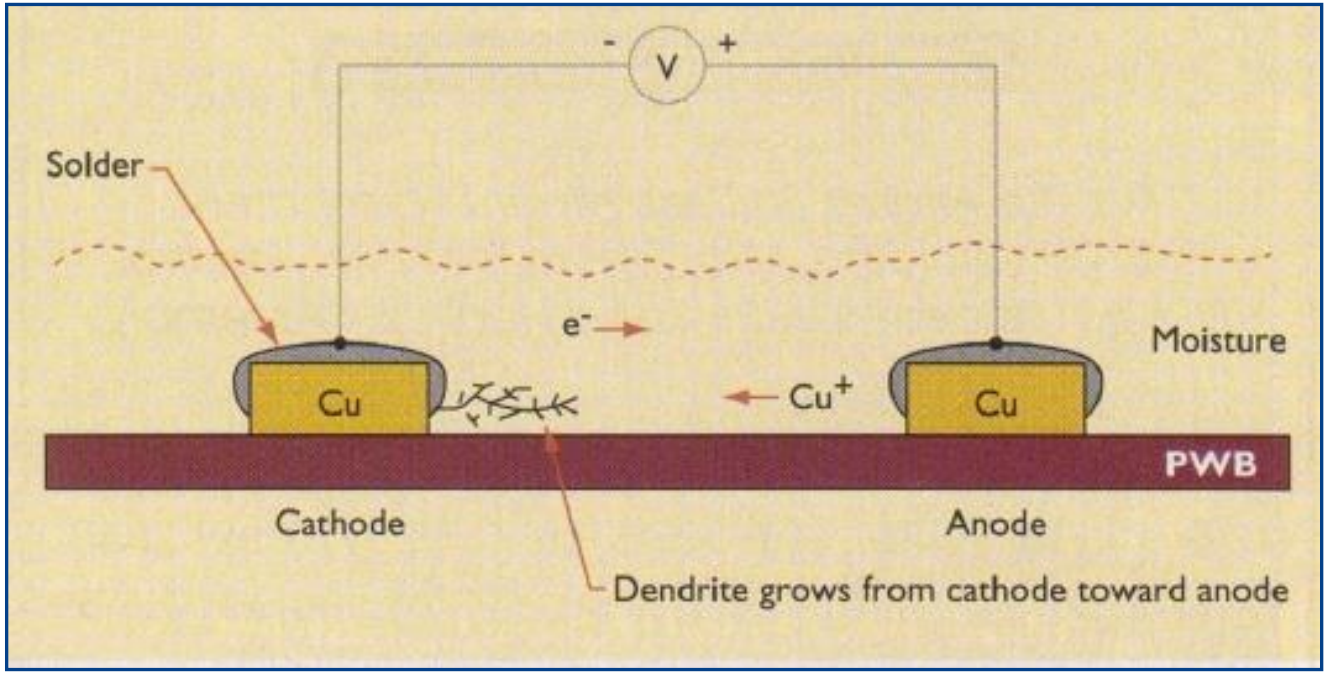
Electromigration process

- Humidity & contamination (Fluxer/Salt/Fingerprints)

→ Electronic migration

→ Dissolution of metallization at the anode

→ Dendritic crystallization at the diode



Quelle: EP&P/October 1999

Electronic migration

Exposure to humidity is the most frequent reason for failure of PCBs due to electronic migration.

→ This causes failures in performing or the total breakdown of the assembly group.

Elektromigration an einer elektronischen Baugruppe (Source: AUCOTEAM GmbH)

Agenda

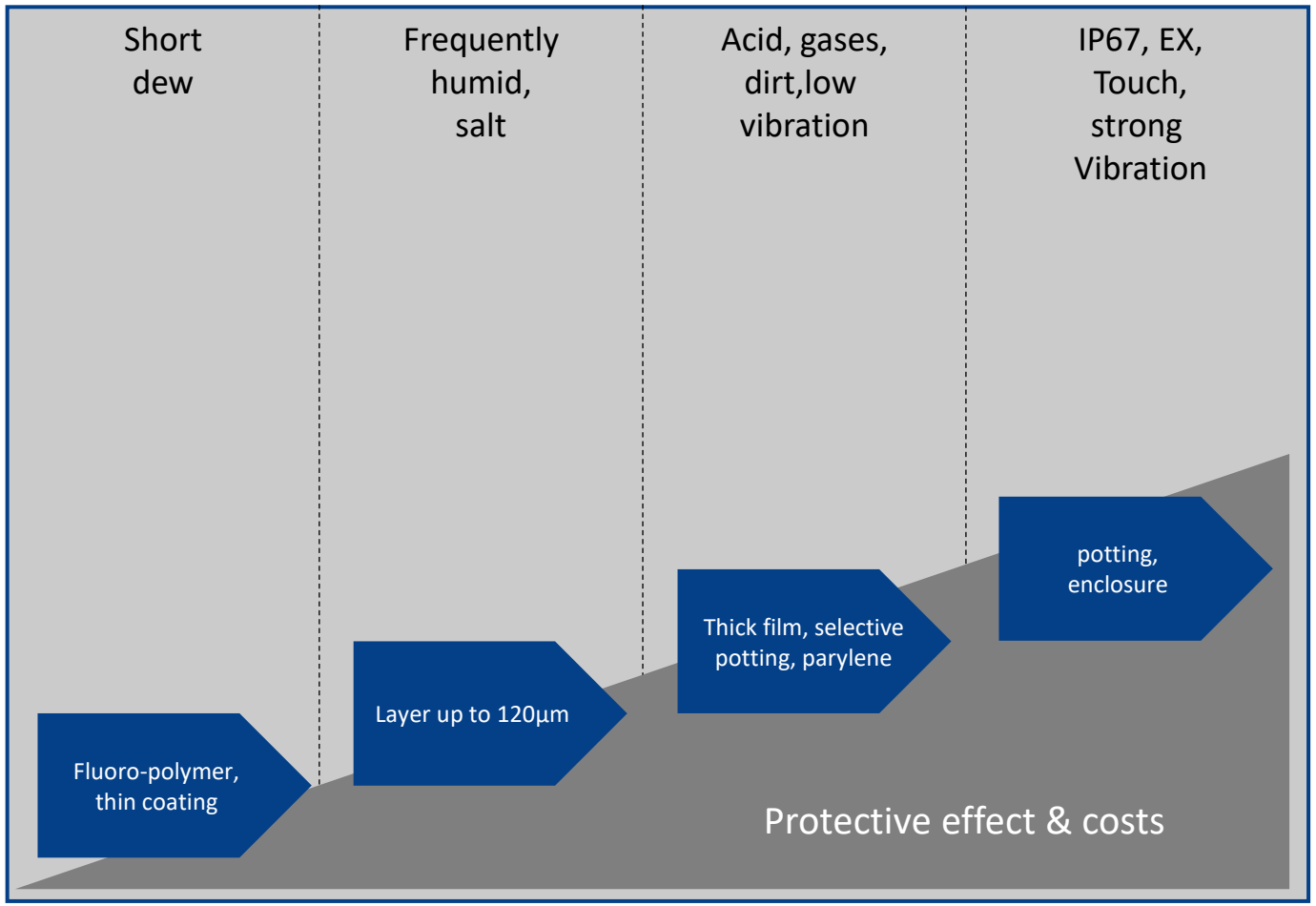
- What…
  happens due to moisture exposure?
- What…
  protective measures are possible?
- What…
  measures are to be taken?
- Which…
  cleaning processes are used?
- What…
  preliminary work can be done?
- How…
  are the coatings applied?
- How…
  do I check the quality of the coating?

Possible protective measures

	Fluorpolymere	Varnishing	Parylene	Moulding
	Immersion in coating bath	Painting, Dip coating, Selective Varnishing	Vacuum process with 5 different powders	Potting with epoxy resin, polyurethane or silicone
Advantages	• ultra thin transparent layer starting with 0,5-1µm • No health hazard • No environmental impact • Plugs do not need to be masked	• Low priced • Quick process term	• ultra thin transparent and pinhole free layer starting with 0,2 µm / 5µm to 25µm • No degassing of dissolvent/plasticizer • Absolute biocompatible and biostable • Chemically steady • Low weight • High temperature stability • Prevents whisker formation • Process takes place on ambient temperature • Texture conserving (real conformal Coating) • Excellent electrical isolation, high voltage resistance • Highest protection against corrosion • Immediately after the process, the parylene has its final properties • No aging	• Strong protection against humidity due to very thick coating • Stabilisation of components
Detriments	• Protection limited • Hollow bodies such as relays and switches can become full in the dipping process and can be emptied poorly • dipping grooves • Relay contacts that have no sliding contacts can be isolated.	• Protection limited • emission of dissolvent is possible • not free of pinholes • uneven layer thickness • edge alignment • nearly no wetting of components	• Process under vacuum (components have to be vacuum proof) • Long process term • Not permanently UV-resistant	• Long (setting) hardening period • high weight • degassing is possible • limited thermo-mechanical reliability

Determine the need for protection

- The requirements for the lacquer are based on this
- Depending on the demand for protection, the costs for processing & material increase
- Specifications determine the quality of the paint, purity, lacquer quality



Advantages of protective coating / potting

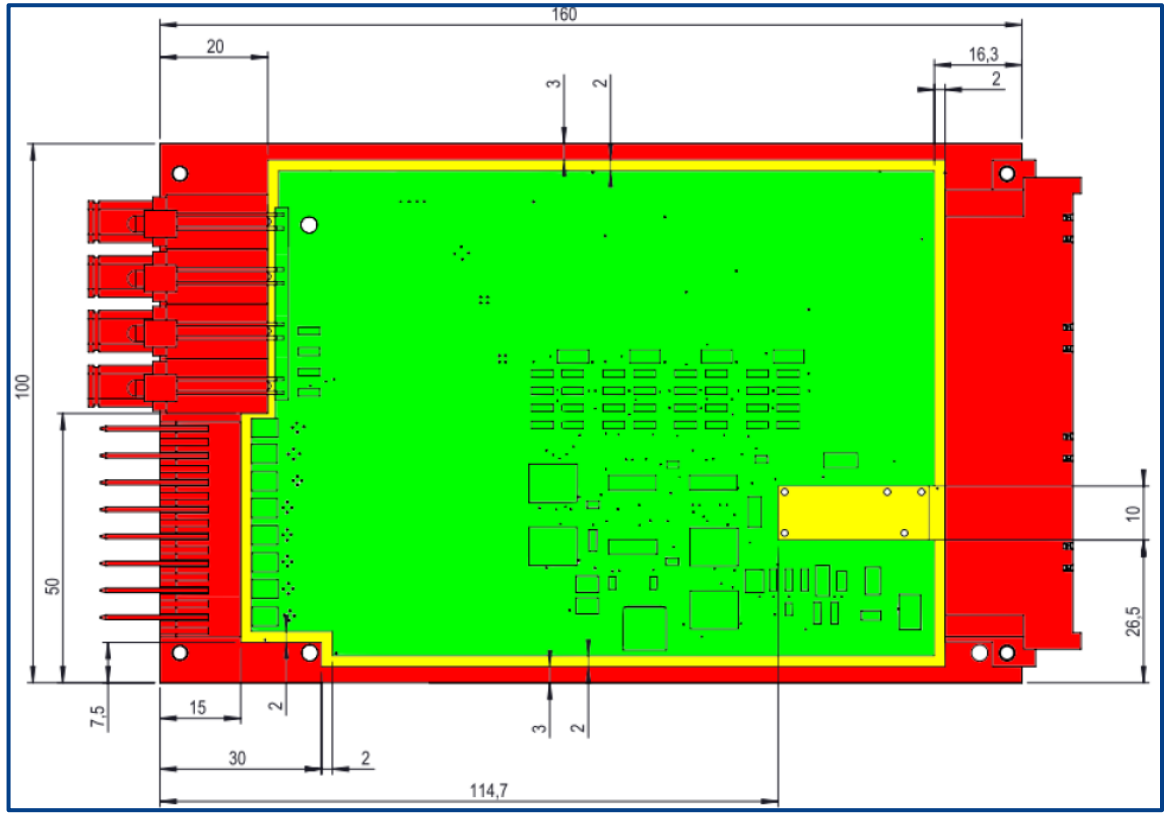
- Improved dielectric properties
- Higher dielectric strength
- Protection against premature failures due to:
  - corrosion
  - Humidity, dew
  - Migration, conductive residues
  - Contact with gas, dust, oil
  - Fungi and pest infestation
  - Mechanical load and vibration (potting)

Agenda

- What…
  happens due to moisture exposure?
- What…
  protective measures are possible?
- What…
  measures are to be taken?
- Which…
  cleaning processes are used?
- What…
  preliminary work can be done?
- How…
  are the coatings applied?
- How…
  do I check the quality of the coating?

Set process sequence

1. Cleaning PCBA
2. Masking PCBA
   a) **Red**: must not coat
   b) **Yellow**: Can be coated (tolerance range)
   a) **Green**: coatinged



Source: HIMA Paul Hildebrandt GmbH

3. Activate assembly with low-pressure plasma / apply primer
4. Apply protective coating

Agenda

- What…
  happens due to moisture exposure?
- What…
  protective measures are possible?
- What…
  measures are to be taken?
- Which…
  cleaning processes are used?
- What…
  preliminary work can be done?
- How…
  are the coatings applied?
- How…
  do I check the quality of the coating?

Select cleaning method

a) Plasma cleaning

b) Aqueous cleaning

c) HFE-cleaning

d) Ultrasonic cleaning

e) IPA-cleaning

Source: AAT Aston GmbH

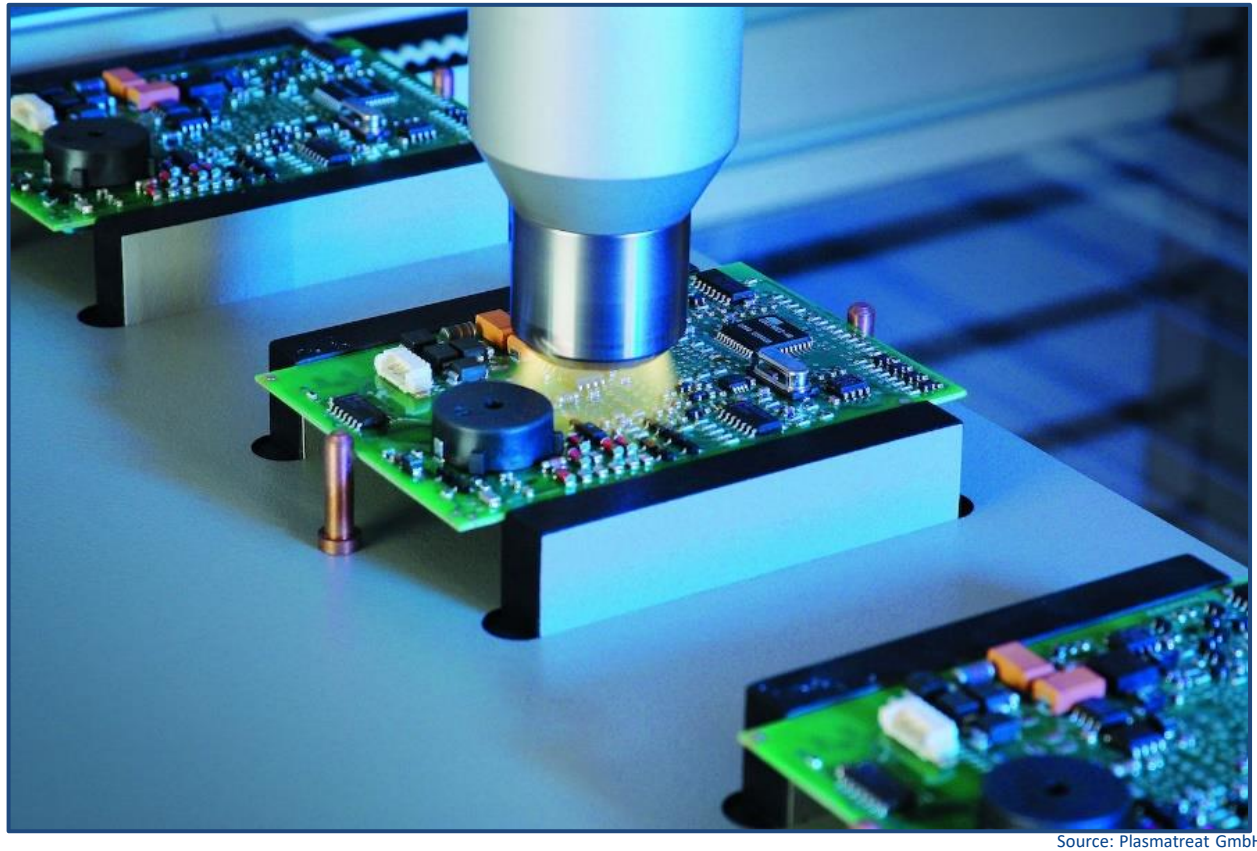
Agenda

- What…
  happens due to moisture exposure?
- What…
  protective measures are possible?
- What…
  measures are to be taken?
- Which…
  washing processes are used?
- What…
  preliminary work can be done?
- How…
  are the coatings applied?
- How…
  do I check the quality of the coating?

Bonding enhancement

Adhesion improvement of the coating, parylene or potting by increasing the surface tension by means of

- Cleaning,
- Plasma activation or
- Applying an adhesion promoter / primer.

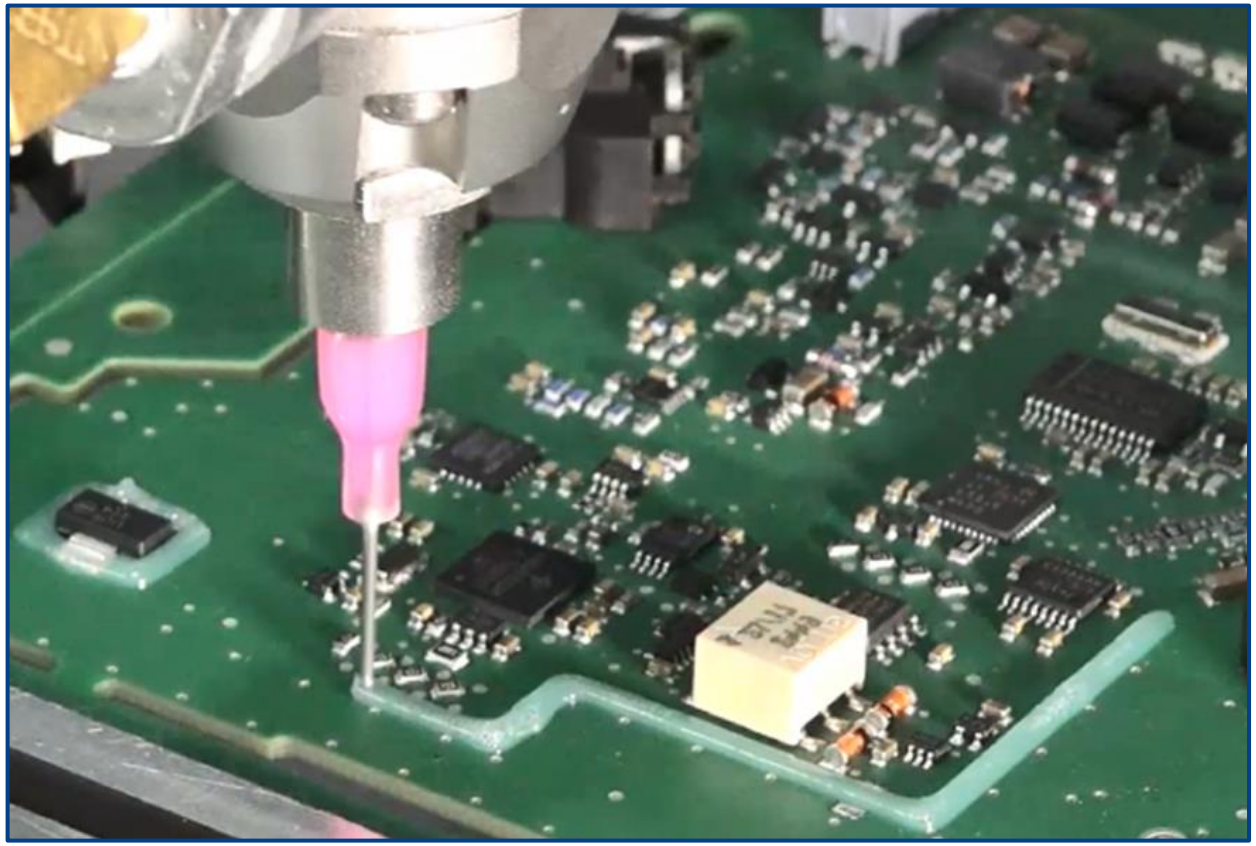


Source: Plasmatreat GmbH

Dispense / Dam&Fill

Plugs or elements on substrates that have to be sealed, glued or enclosed.

- Thick-film coatings can protect SMD connectors, which are "thirsty" for lacquer, from contamination of the thinner coating lacquer.
- Delineating specific areas on an assembly before potting
- Mostly use of highly viscous, thixotropic materials.



Source: Rehm Thermal Systems GmbH

- What…
  happens due to moisture exposure?
- What…
  protective measures are possible?
- What…
  measures are to be taken?
- Which…
  washing processes are used?
- What…
  preliminary work can be done?
- How…
  are the coatings applied?
- How…
  do I check the quality of the coating?

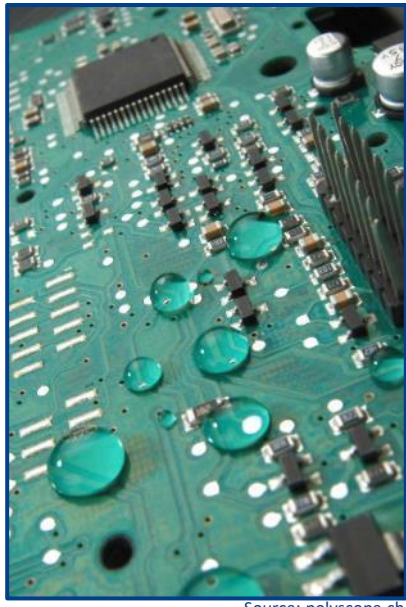
Application procedures

- Fluorpolymere

- Lacquer / Thick-film coating
  - Brush varnish
  - Manual spray lacquering
  - Dip coating
  - Selective dip coating
  - Automatic selective protective coating

Fluorpolymers

- Fluoropolymers are non-flammable, safe to handle and do not endanger health or pollute the environment.
- The coating bath for electrical assemblies and printed circuit boards consists of 2% fluoropolymers (solid) in 98% hydrofluoroether (HFE solvent).
- After a dwell time of approx. 15-60 seconds, the assembly is removed from this liquid, leaving a film of approx. 0.5-1µm as a protective coating.
- Then follows approx. 5 minutes drying time

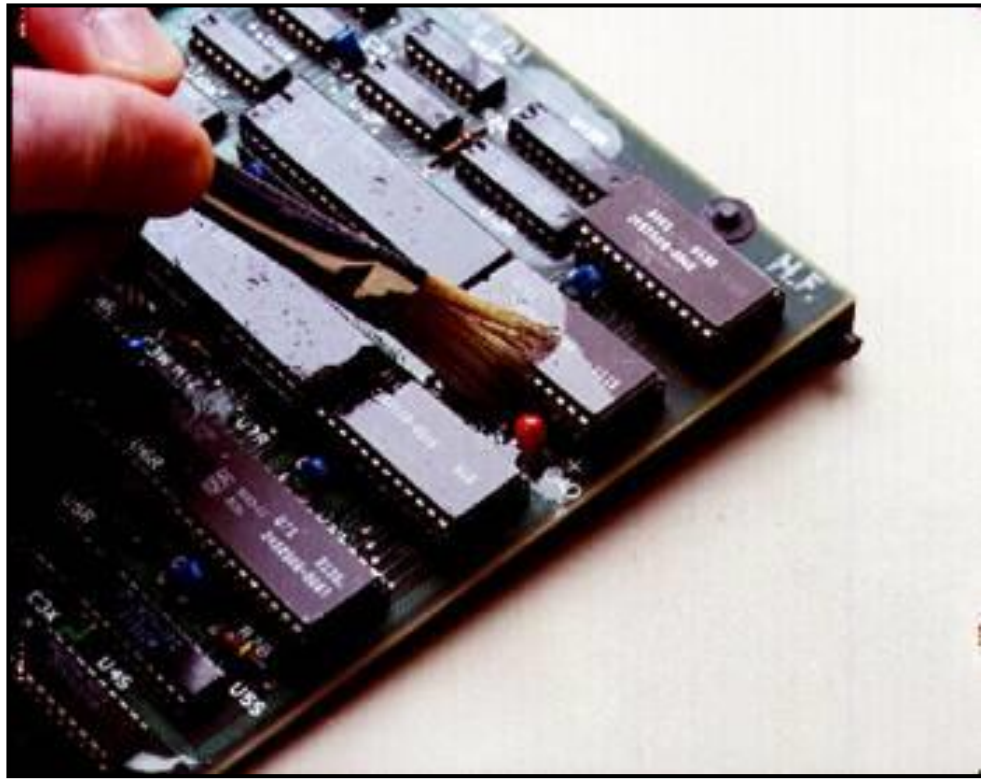


Source: polyscope.ch

Source: Puretecs GmbH

Brush varnish

- Low capital expenditure
- Good suitable for repair
- Not reproducible
- Depends directly on the operator
- Mostly very labor intensive
- No consistent quality
- Occupational safety, solvents
- Mostly only for small quantities



Source: AAT Aston GmbH

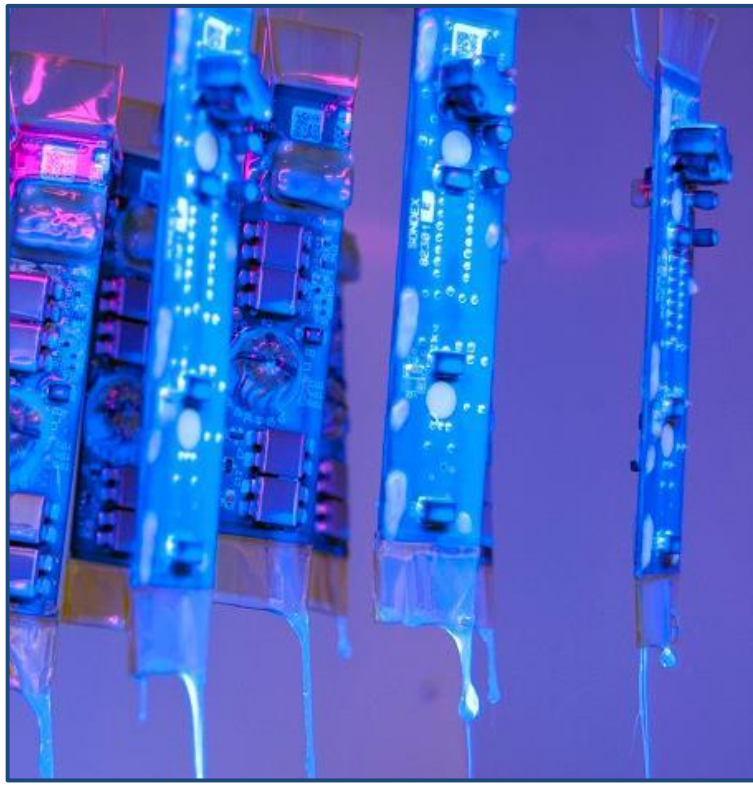
Manual spray lacquering

- Several assemblies in parallel
- Depends directly on the operator
- Safety and environmental aspects
- High material loss
- No consistent quality
- Very labour-intensive, masking work
- No selective coating possible

Source: Rehm Thermal Systems GmbH

Dip coating

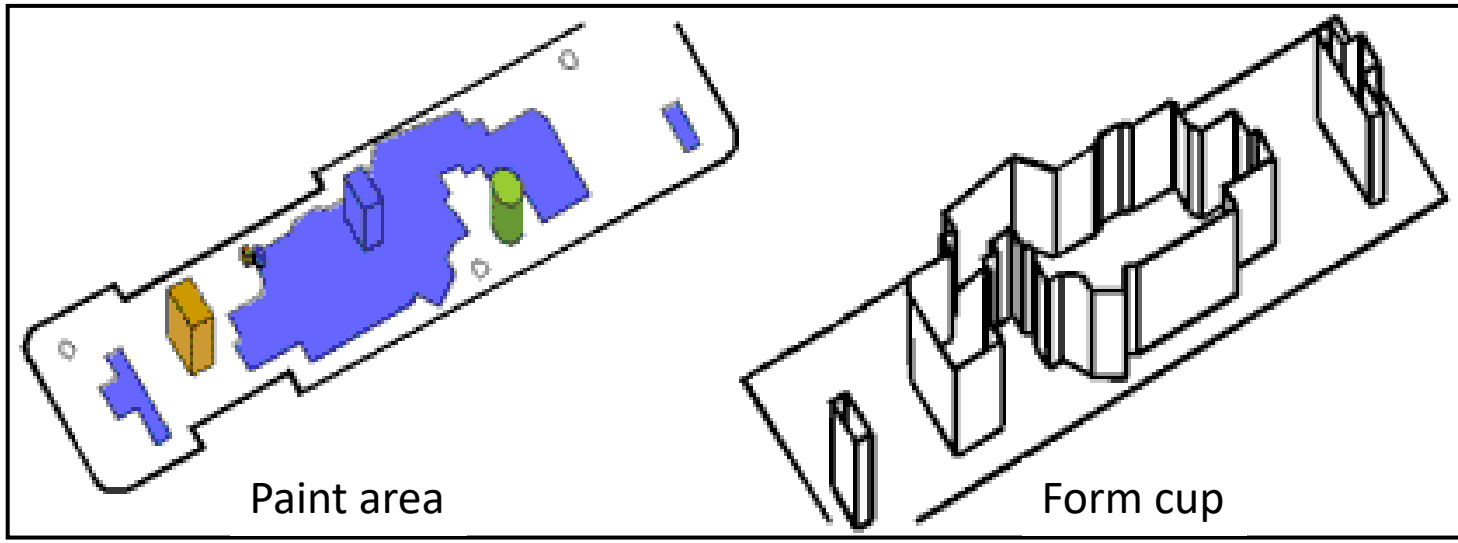
- Both pcb sides at the same time
- Several assemblies in parallel
- Also possible automatically
- Masking work necessary in advance
- No selective coating possible
- Uneven layer thickness
- Contamination lacquer container
- Solvent evaporation



Source: Rehm Thermal Systems GmbH

Selective dip coating

- Like dip coating, additionally with molds to avoid masking work necessary in advance
  - ➢ Additional investment costs per assembly type



source: AAT Aston GmbH

Automatic selective protective coating

- No masking necessary, no rework, flexible
- Uniform lacquer application
- Very well reproducible
- Reduced varnish consumption
- Process control/supervision
- High investment costs
- Coating on one side only
- No coating under components

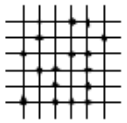
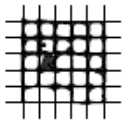
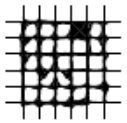
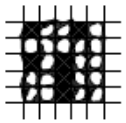
Agenda

- What…
  happens due to moisture exposure?
- What…
  protective measures are possible?
- What…
  measures are to be taken?
- Which…
  washing processes are used?
- What…
  preliminary work can be done?
- How…
  are the coatings applied?
- How…
  do I check the quality of the coating?

Liability check

- Cross-cut testing is a very quick and easy method for assessing the adhesion of coating systems.
- A 25 mm wide semi-transparent adhesive tape with an adhesive strength of 43 ± 6 g/mm is used.
- The grid pattern consists of a 10x10 grid of 1mm² squares
- The centre of the tape is placed over the grid pattern and the area is smoothed by a finger
- Within 90 seconds after the tape is applied, it is removed with a smooth movement at an angle of 180°.
- The evaluation of the test is done visually with the naked eye by comparison with Table 1

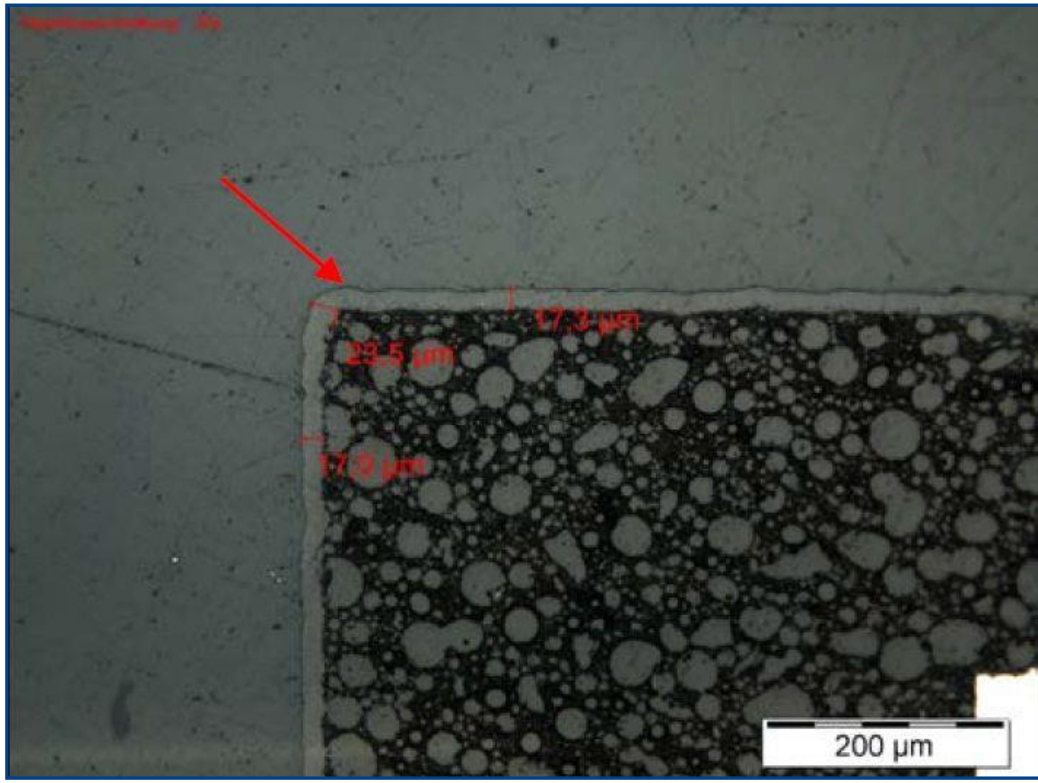
Table 1 — Classification of test results

Classification	Description	Appearance of surface of cross-cut area from which flaking has occurred (Example for six parallel cuts)
0	The edges of the cuts are completely smooth; none of the squares of the lattice is detached.	—
1	Detachment of small flakes of the coating at the intersections of the cuts. A cross-cut area not greater than 5 % is affected.	
2	The coating has flaked along the edges and/or at the intersections of the cuts. A cross-cut area greater than 5 %, but not greater than 15 %, is affected.	
3	The coating has flaked along the edges of the cuts partly or wholly in large ribbons, and/or it has flaked partly or wholly on different parts of the squares. A cross-cut area greater than 15 %, but not greater than 35 %, is affected.	
4	The coating has flaked along the edges of the cuts in large ribbons and/or some squares have detached partly or wholly. A cross-cut area greater than 35 %, but not greater than 65 %, is affected.	
5	Any degree of flaking that cannot even be classified by classification 4.	—

Layer thickness measurement

In each process, measuring plates are treated as reference samples. Subsequently, a coating thickness measurement is carried out on these using different measuring methods in order to determine the coating thickness.

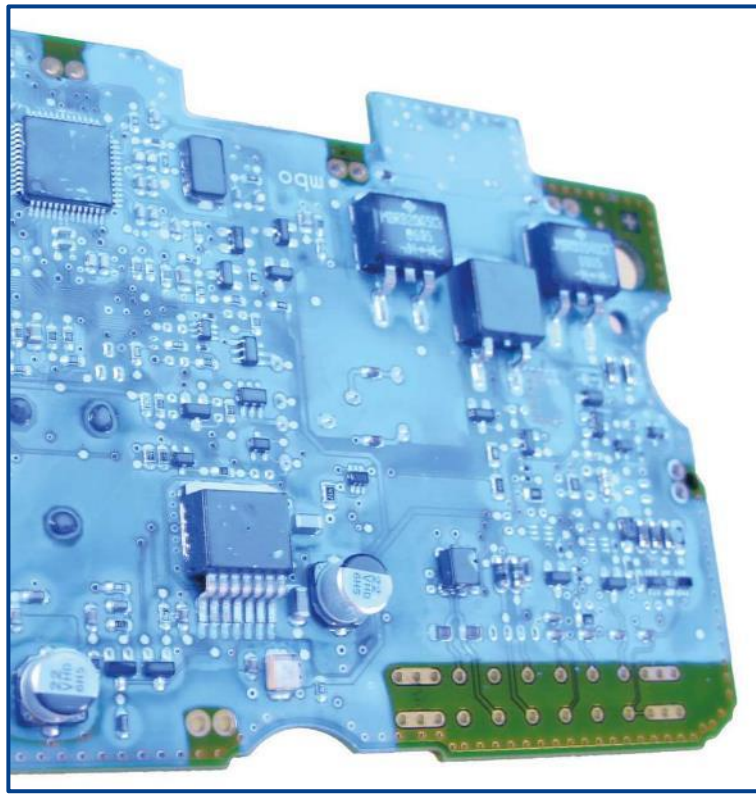
Among other things, microsection analyses are also possible to determine the layer thickness.



Source: HeicksParyleneLecture

Visibility

UV tracer or fluorescent settings allow easy checking for completeness of the coating under daylight or UV light (black light)



Quelle: INDUSTR.com

Thank you for your interest

Heicks Industrieelektronik GmbH

Am Schwarzen Weg 25 – 31

D – 59590 Geseke

Tel. 0 29 42 / 9 79 26 – 0

Fax 0 29 42 / 9 79 26 – 150

info@heicks.de

www.heicks.de