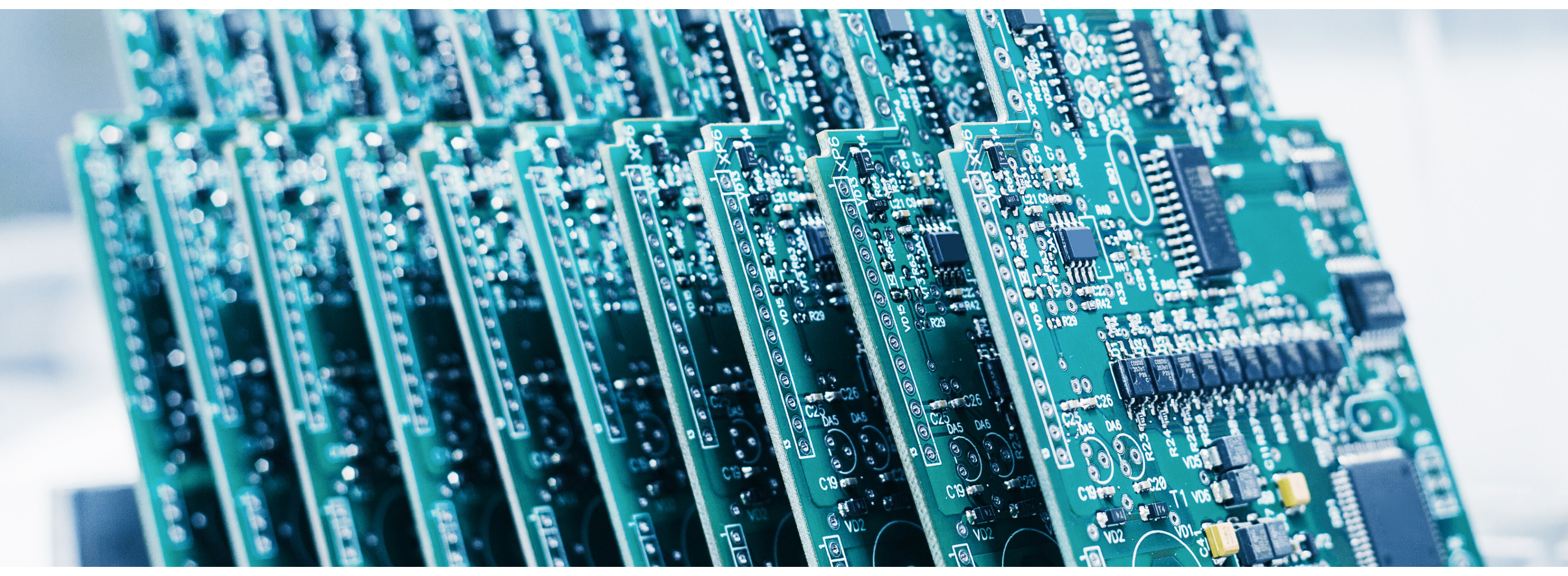
Acrylic Conformal Coatings

Conformal coatings are applied to printed circuit boards (PCBs) to protect them from environmental stress such as salt, corrosion, humidity, and moisture, mitigate tin whiskers, and provide a barrier to electrically insulate components. A wide variety of conformal coating types are available, each with their own strengths and weaknesses.

Acrylic conformal coatings are liquid conformal coatings that often require use of solvents. Acrylics are easy to rework but have poor chemical resistance. They excel on printed circuit boards for moisture protection. However, in applications with possible exposure to solvents, acrylic conformal coatings do not provide the best protection.

Strengths

- Ease of Rework
- Simple Drying Process
- Good Moisture Resistance
- High Fluorescence
- Ease of Viscosity Adjustment



Weaknesses of Cure Type

Solvent Evaporation

- High VOC potential
- Difficult to maintain viscosity
- Requires close monitoring of solvent concentration, hence creates a 2-part scenario
- Flammability
- High probability of reversion under temperature and humidity stress conditions

Heat Cure

- Cure is dependent on thickness
- Component mass affects time and temperature of cure process
- Susceptible to cure inhibition
- Shrinkage (3% – 10%), potential for damaging fragile (e.g., glass) components
- Should be used with caution for low temperature components

UV Cure

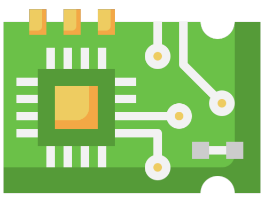
- One-component coatings require accurate application material to avoid shadowed areas
- Two-part systems require meter mix equipment
- Some coatings are more difficult to rework
- UV intensity and wavelength effects cure
- Some secondary cure mechanisms require heat exposure

Amorphous Fluoropolymer

Conformal coatings are applied to printed circuit boards (PCBs) to protect them from environmental stress such as salt, corrosion, humidity, and moisture, mitigate tin whiskers, and provide a barrier to electrically insulate components. A wide variety of conformal coating types are available, each with their own strengths and weaknesses.

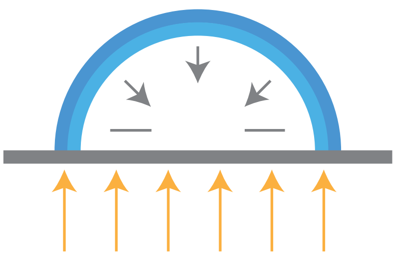
Fluoropolymer coatings are typically ultra thin, which make them easy to remove. These conformal coatings have good resistance to oils, acids, solvents, and water. Boards that have been coated with a fluoropolymer conformal coating are hydrophobic.

Strengths



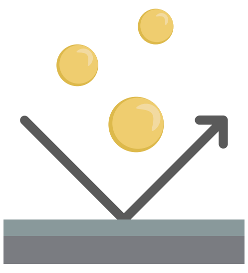
Low Dielectric Content

High Glass Transition Temperature

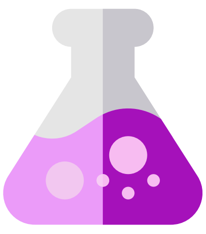


Low Surface Energy

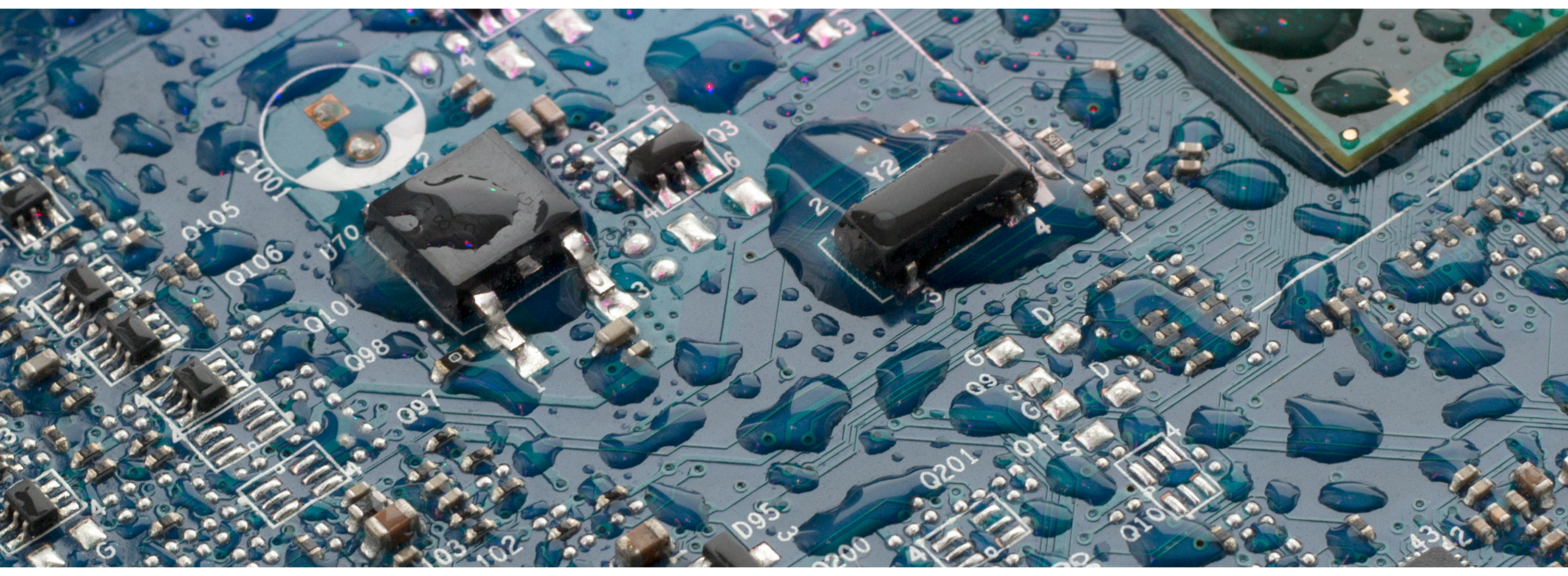
Low Water Absorption



Good Solvent & Oil Resistance



Common Acid Resistance



Weaknesses of Cure Type

Solution Deposition

- Requires special liquids for polymer swelling
- Limited solubility which limits film thickness
- May require glass temperature anneal
- Requires special surface treatment for greatest adhesion
- Poor resistance to some acids and alkalines

Vacuum Deposition

- Requires pressure of 10 Torr ‘ 5 Torr [0.193 PSI ‘ 0.097 PSI] or less
- May require glass temperature anneal
- Requires special surface treatment for greatest adhesion
- Poor resistance to some acids and alkalines
- Poor abrasion resistance

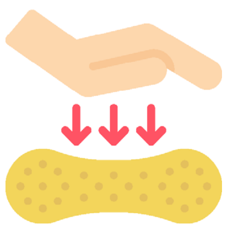
Epoxy Conformal Coatings

Conformal coatings are applied to printed circuit boards (PCBs) to protect them from environmental stress such as salt, corrosion, humidity, and moisture, mitigate tin whiskers, and provide a barrier to electrically insulate components. A wide variety of conformal coating types are available, each with their own strengths and weaknesses.

Epoxy-based coatings are usually two-part systems with limited pot life. Similar to polyurethanes, they provide good moisture and chemical resistance. A major downfall is that they are almost impossible to remove chemically for rework.

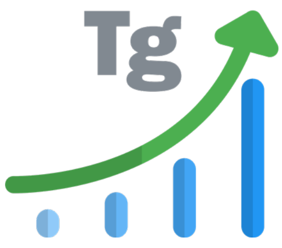
Strengths


Useful to 150°C [302°F]

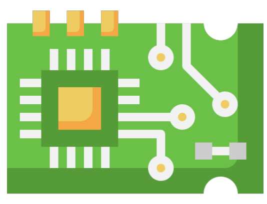

Harder Durometer

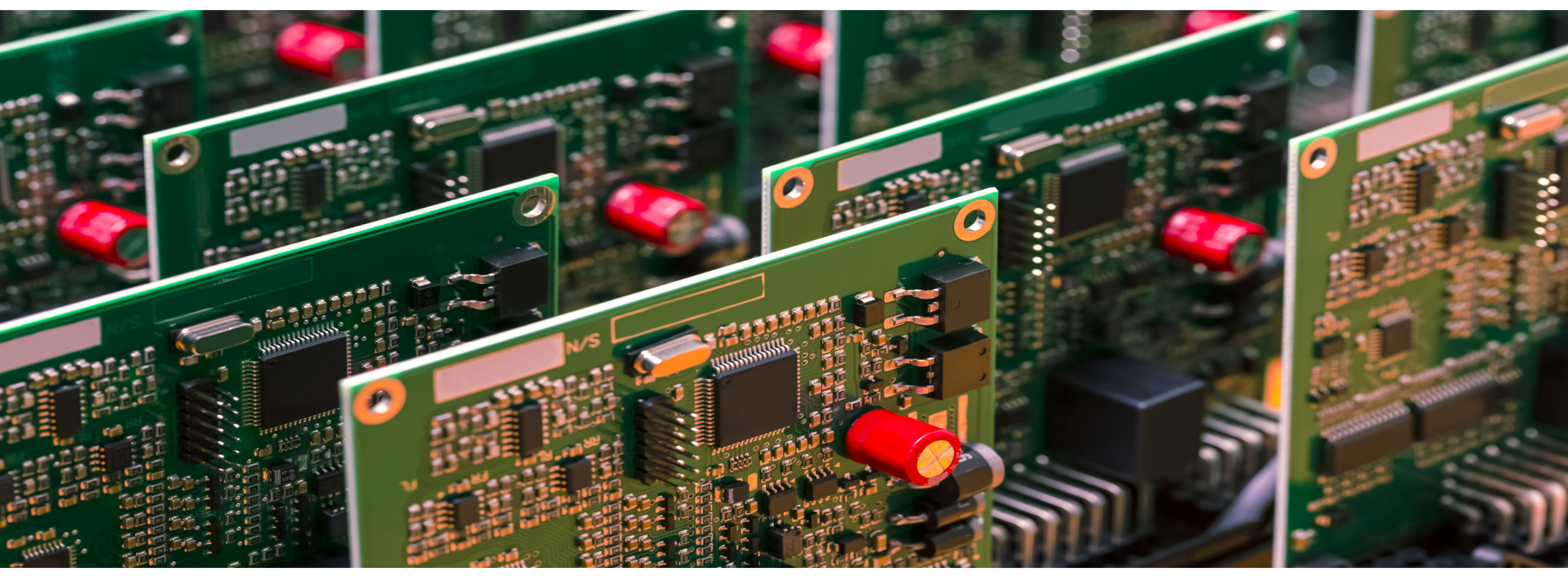

Abrasion Resistance


CTE Closer to Epoxy PCB Substrates



Higher Tg


Dielectric Properties



Weaknesses of Cure Type

Solvent Evaporation

- Higher chloride contamination potential
- Process intensive, difficult to maintain viscosity, complex mix ratios
- Potential for high stress during temperature cycling conditions
- Difficult to rework
- High probability of reversion under temperature and humidity stress conditions

Heat Cure

- Cure is dependent on thickness
- Component mass affects time and temperature of cure process
- Susceptible to cure inhibition
- Selective coating quality (edge definition) could be impacted
- Shrinkage (3% – 10%), potential for damaging fragile (e.g., glass) components
- Should be used with caution for low temperature components

UV Cure

- One-component coatings require accurate application material to avoid shadowed areas
- Two-part systems require meter mix equipment
- Some coatings are more difficult to rework
- UV intensity and wavelength effects cure
- Some secondary cure mechanisms require heat exposure

Catalyzed

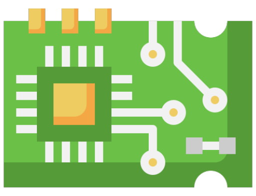
- Cure inhibition
- Short work life
- Contamination sensitive
- Difficult to rework
- Pungent odor

Fluorinated Poly-Para-Xylylene

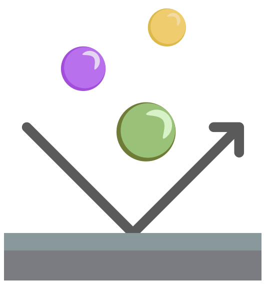
Conformal coatings are applied to printed circuit boards (PCBs) to protect them from environmental stress such as salt, corrosion, humidity, and moisture, mitigate tin whiskers, and provide a barrier to electrically insulate components. A wide variety of conformal coating types are available, each with their own strengths and weaknesses.

Commonly referred to as parylene F, fluorinated poly-para-xylylenes are applied at very high temperatures with a vacuum-coating process. Therefore, they cost significantly more compared to other technologies. They offer a number of benefical qualities, including low dielectric constant and great thermal stability.

Strengths



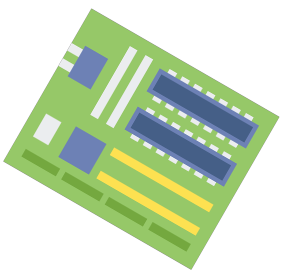
Excellent Uniformity Regardless of Part Geometry - no Pinholes, Fillets, or Bridging



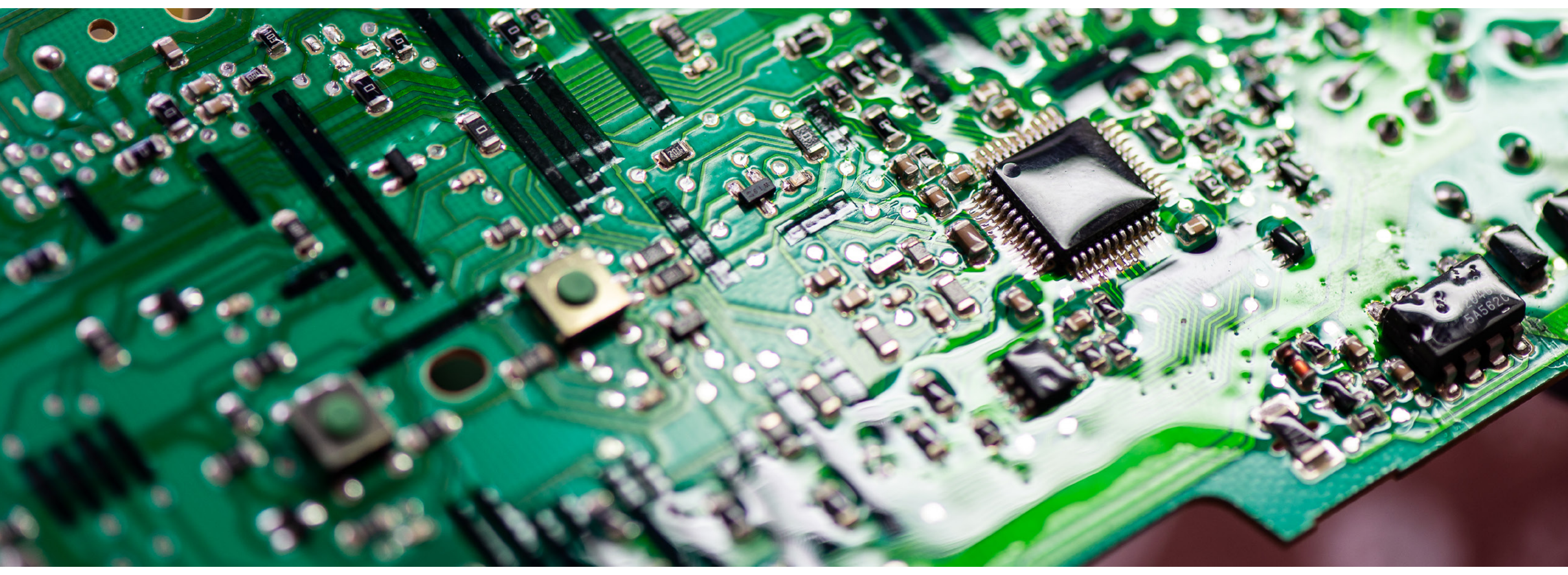
Chemical Inertness/Barrier Properties Insoluble in Organic Solvents, Acids, or Bases, with Very Low Permeability Rates

High Temperature Stability (450°C [842°F]) and Increased UV Stability

Low Environmental Impact Process



Low Dielectric Constant



Weaknesses of Cure Type

Vapor Deposition Polymerization

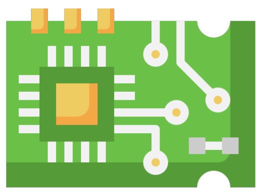
- Parts are processed by batches in a vacuum chamber, not an in-line process
- Masking required for no-coat areas
- Coating removal and rework generally requires specific equipment, abrasion/micro-blasting most common technique
- The coating is deposited at a rate slower than the conventional poly-para-xylylenes
- Requires special deposition equipment different than that for the C, D, and N poly-para-xylylene varieties

Poly-Para-Xylylene C, D, N

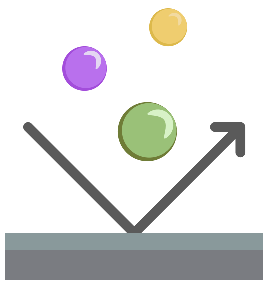
Conformal coatings are applied to printed circuit boards (PCBs) to protect them from environmental stress such as salt, corrosion, humidity, and moisture, mitigate tin whiskers, and provide a barrier to electrically insulate components. A wide variety of conformal coating types are available, each with their own strengths and weaknesses.

Commonly referred to as parylenes, poly-para-xylylenes are applied at very high temperatures with a vacuum-coating process. Therefore, they cost significantly more compared to other technologies.

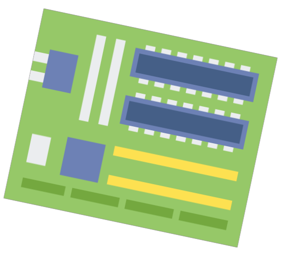
Strengths



Excellent Uniformity Regardless of Part Geometry - No Pinholes, Fillets, or Bridging



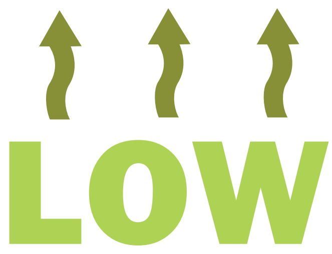
Chemical Inertness/Barrier Properties Insoluble in Organic Solvents, Acids, or Bases, with Very Low Permeability Rates



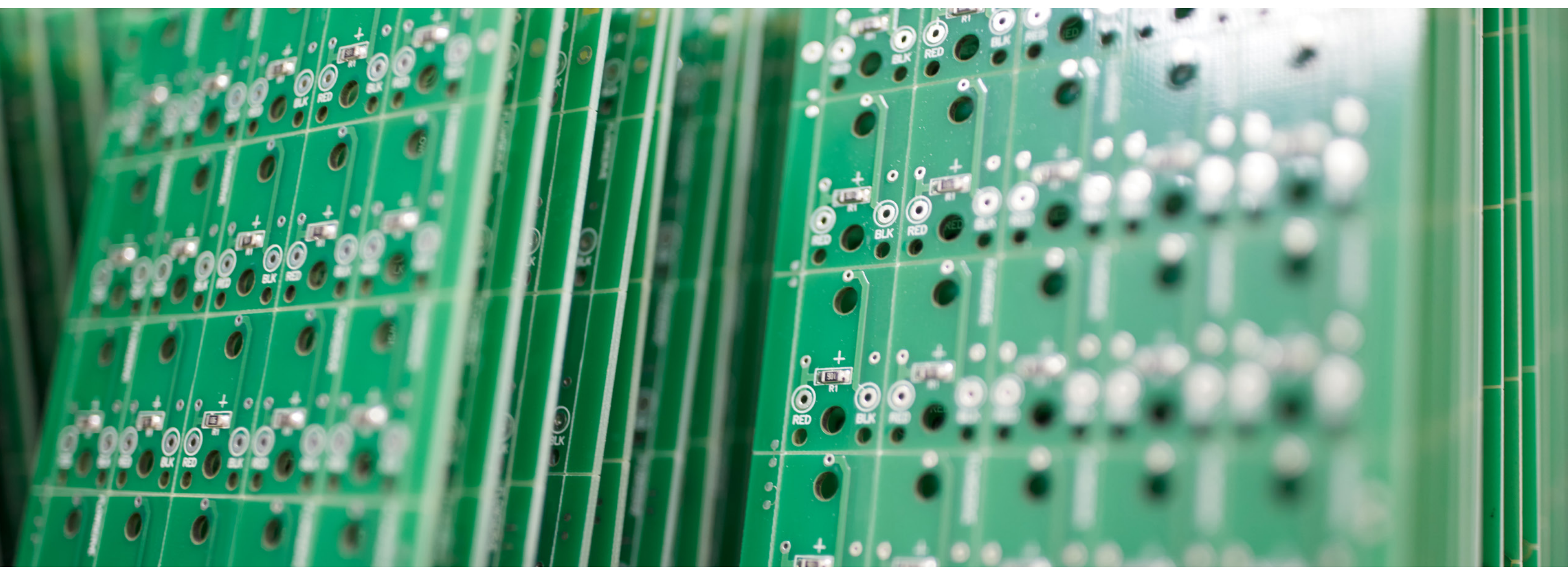
Minimal Added Mass

Biocompatibility Allows Use in Many Medical Applications

Low Environmental Impact Process



Low Outgassing



Weaknesses of Cure Type

Vapor Deposition Polymerization

- Parts are processed by batches in a vacuum chamber, not an in-line process
- Masking required for no-coat areas
- Coating removal and rework generally requires specific equipment, abrasion/micro-blasting most common technique
- Limited UV resistance and operating temperature limit, around 120°C [248°F] in the presence of oxygen
- Cannot be doped

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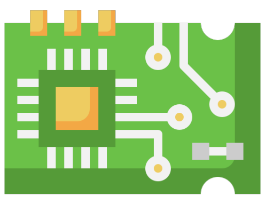
Polyurethane Conformal Coatings

Conformal coatings are applied to printed circuit boards (PCBs) to protect them from environmental stress such as salt, corrosion, humidity, and moisture, mitigate tin whiskers, and provide a barrier to electrically insulate components. A wide variety of conformal coating types are available, each with their own strengths and weaknesses.

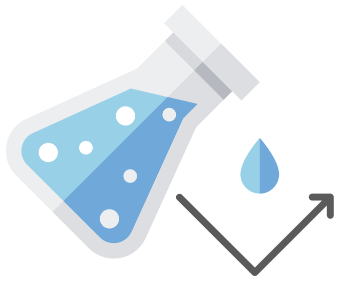
Polyurethane conformal coatings come as single-component, two-component, UV-curable, and water-borne systems. Although polyurethanes provide good chemical and moisture resistance, they are often hard to rework and have low tolerance in humid environments.

Strengths



Good Dielectric Properties

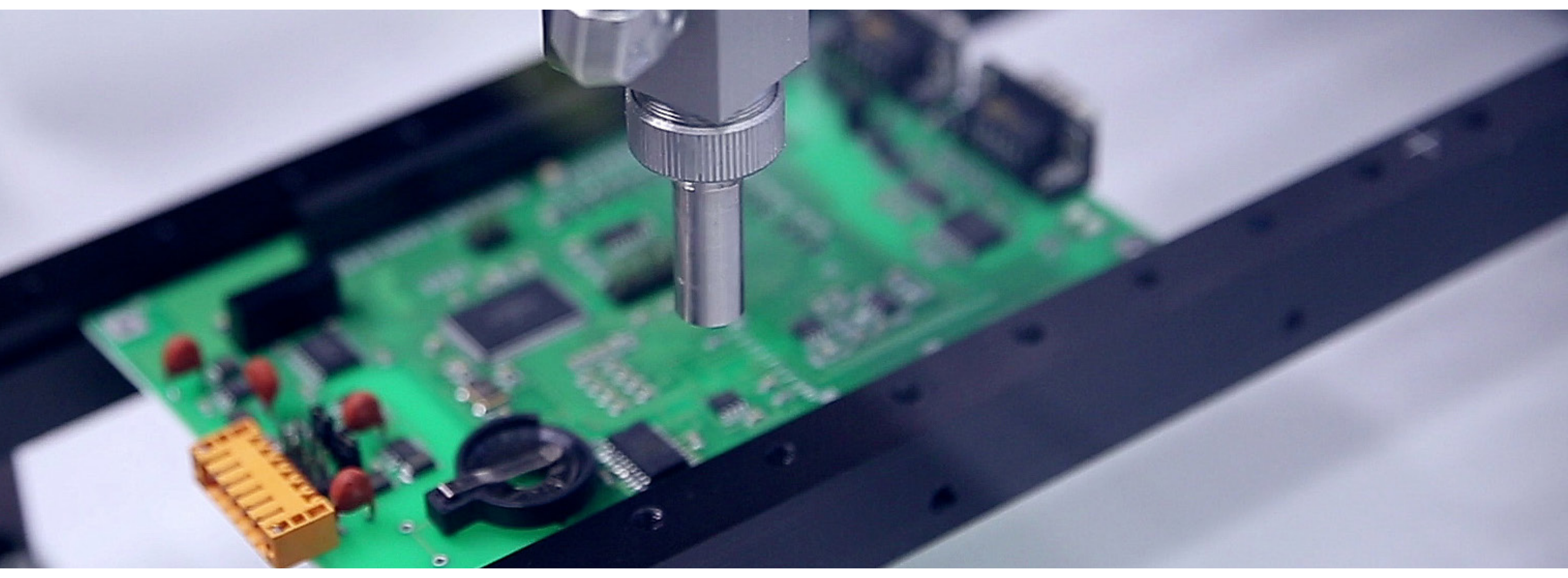
Good Moisture Resistance



Solvent Resistance

Less Reversion Potential

Abrasion Resistance



Weaknesses of Cure Type

Solvent Evaporation

- Moisture affects cure rate and desired properties
- Long complete cure time (up to 30 days)
- Health and safety concerns
- Potential for high stress during temperature cycling conditions
- High probability of reversion under temperature and humidity stress conditions

Heat Cure

- Cure is dependent on thickness
- Component mass affects time and temperature of cure process
- High VOC potential
- Reacts violently with presence of water
- Should be used with caution for low temperature components

UV Cure

- One component coatings require accurate application material to avoid shadowed areas
- Two part systems require meter mix equipment
- Some coatings are more difficult to rework
- UV Intensity and Wavelength effects cure
- Some secondary cure mechanisms require heat exposure

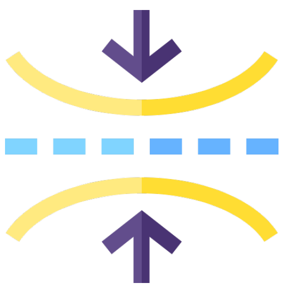
Silicone Conformal Coatings

Conformal coatings are applied to printed circuit boards (PCBs) to protect them from environmental stress such as salt, corrosion, humidity, and moisture, mitigate tin whiskers, and provide a barrier to electrically insulate components. A wide variety of conformal coating types are available, each with their own strengths and weaknesses.

Silicones are often used for very high- or low-temperature environments. They provide high humidity and corrosion resistance along with good thermal endurance but require thermal curing and have short pot lives. Silicone coatings are also prone to abrasion (low cohesive strength) and have high coefficients of thermal expansion.

Strengths

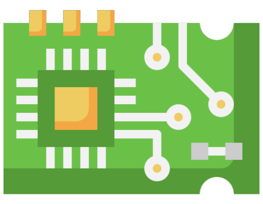
Stable Over Wide Temp. Range
(In General, -40°C to 200°C) [104°F to 392°F]



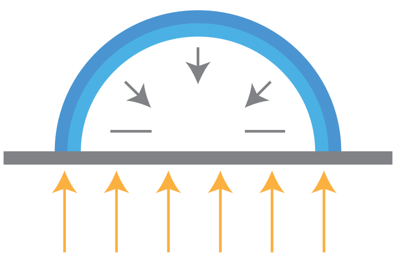
Flexible, Provides Dampening and Impact Protection

UV/Sunlight Resistance

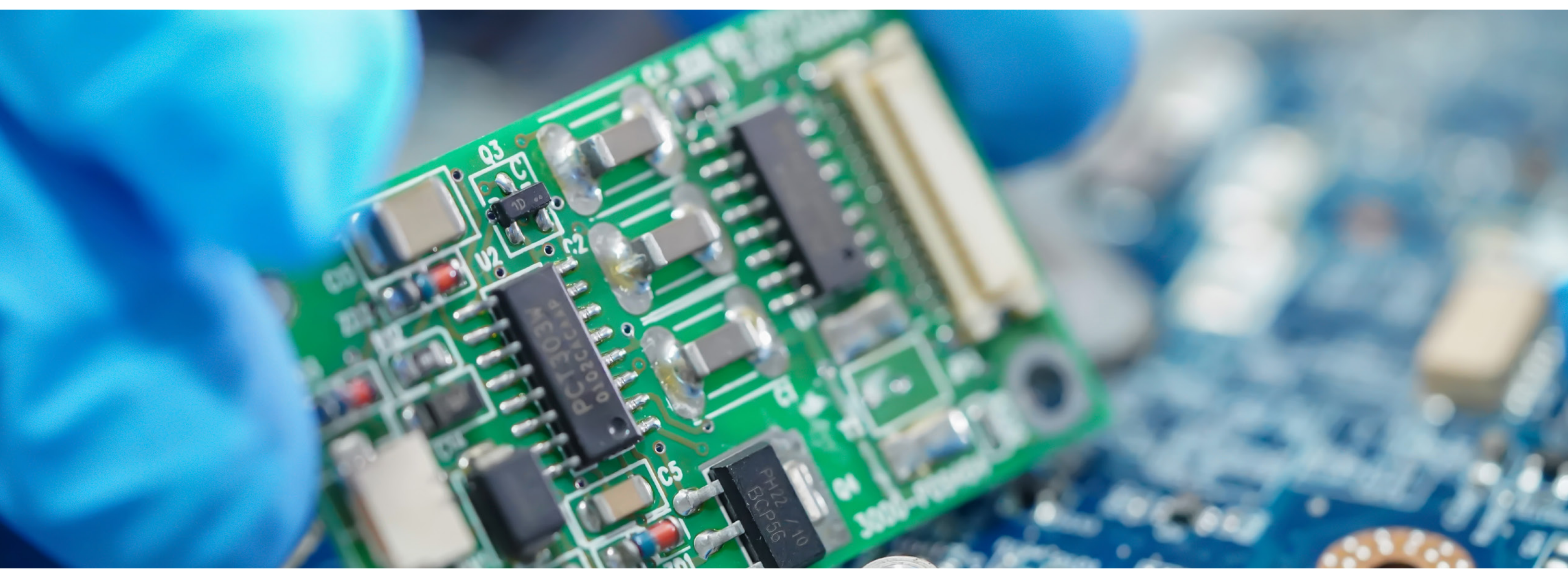
Good Moisture and Humidity Resistance



High Dielectric Strength



Low Surface Energy
(Enables Effective Penetration Under Components)



Weaknesses of Cure Type

Room Temperature Vulcanization (RTV)

- Requires humidity (minimum 20% RH) to cure and only intermittent solvent resistance
- Low abrasion resistance
- Short pot life
- TCE is ~300-350 ppm/°C
- If proper house keeping is not followed, there is a potential for cross contamination

UV Cure

- One-component coatings require accurate application material to avoid shadowed areas
- Potential for cure inhibition
- Low abrasion resistance
- UV intensity and wavelength affects cure
- Some secondary-cure mechanisms react with moisture, this can cause spray valves to become clogged

Catalyzed (Addition)

- Low abrasion resistance
- Potential for cure inhibition
- Adhesion may be difficult
- Only intermittent solvent resistance
- If proper house keeping is not followed, there is a potential for cross contamination