Attracting Tomorrow

Cold Plasma Technology

piezobrush® PZ3

relyon plasma
A TDK group company
Regensburg, Germany

TDK Electronics AG
Piezo and Protection Devices
Munich, Germany

piezobrush® PZ3 – a handy plasma source

Piezobrush PZ3 is a relyon plasma* product based upon TDK‘s CeraPlas technology.
Relyon Plasma has been researching surface activation with cold plasma for various applications for years.

Function

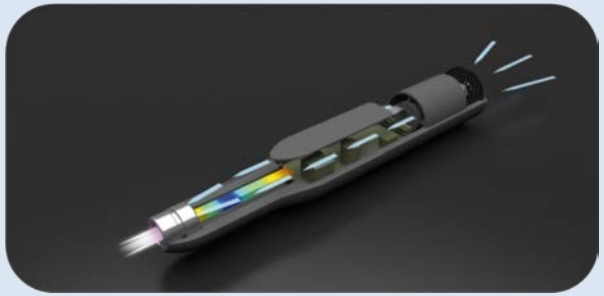
- Piezoelectric Direct Discharge technology (PDD®) by low input voltage is transformed to high output voltage
- The ambient process gas (typically air) is dissociated and ionized

Possible applications

- Activation of surfaces by increasing the wettability to optimize adhesive processes such as gluing, printing, coating, varnishing, etc.
- Surface treatment
- Superfine cleaning

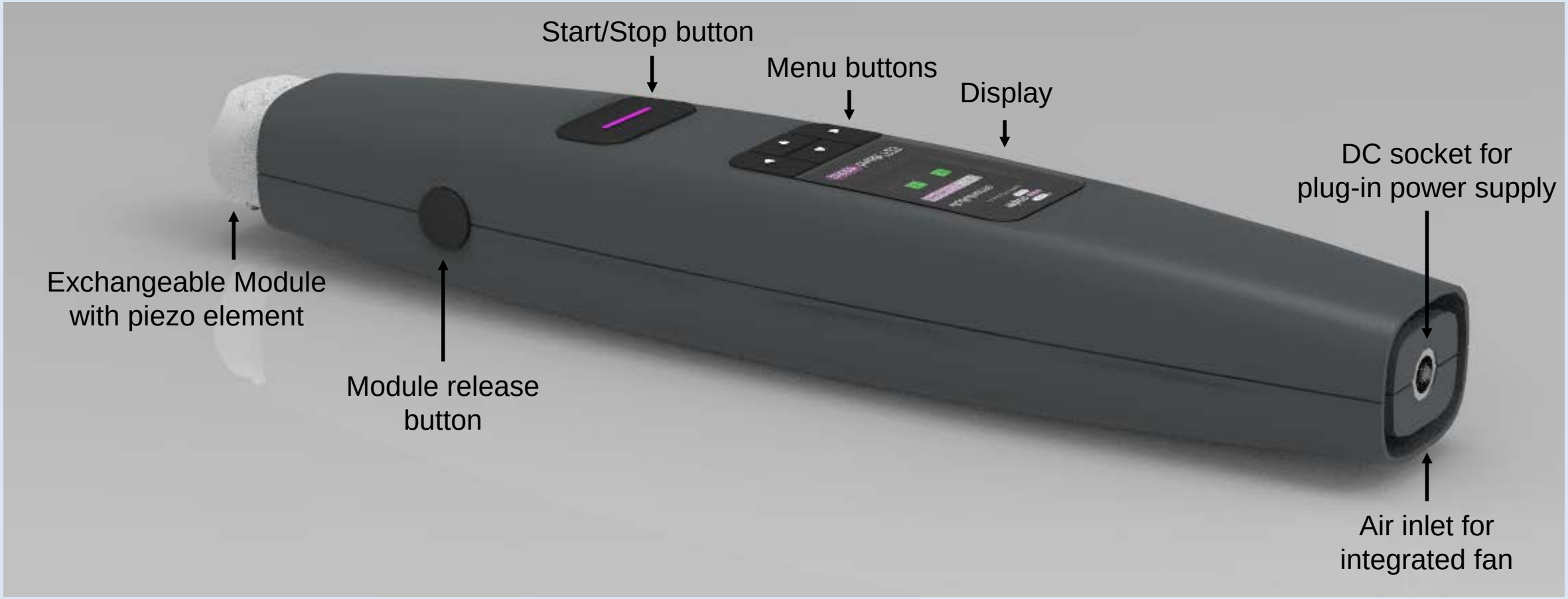
Field of application

- Assembly of pre series or small scale production
- Professional model making
- Development and optimisation of production processes in electrical engineering industry
- Research in medical and food industry
- Dental laboratories



* A TDK group company

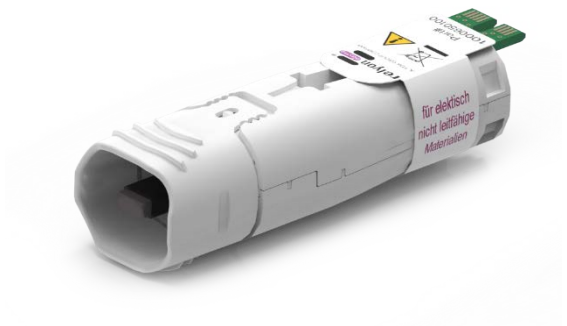
Device overview and details



piezobrush® PZ2 VS piezobrush® PZ3

	piezobrush® PZ2	piezobrush® PZ3 professional set
Electrical connection [V / Hz]	110-240 / 50-60, 15 V DC	110-240 / 50-60, 24 V DC
Power consumption, max. [W]	30	18
Weight [g]	170	110
Sound level [dB]	57	45
Plasma temperature [°C]	<50	<50
Treatment speed [cm^2/s]	4	5
Treatment distance, typ. [mm]	2-10	2-10
Treatment width, max. [mm]	20	29
Process control	Not available	Power adjustment; error detection; 3 different types of process control with visual and acoustic feedback
Interchangeable plasma source	No	Yes via modules
Ordering Code	Z63000Z2910Z 1Z62	B54324D5120A140

piezobrush® PZ3 modules



	Module “Standard”	Module “Nearfield”
Treatment of	Non-conductive substrates / material	Conductive substrates / material
Material examples	Plastics (PTFE, PE, PA, PP, etc.), glass, ceramics, paper, natural fibres, etc.	Metals (steel, aluminium, alloys, etc.), carbon fibre composites, doped semiconductors, wood, rubber, organic tissue etc.
Specialty	-	Integrated dielectric barrier at the tip
Plasma temperature [°C]	<50	<70
Treatment speed [cm^2/s]	5	3
Treatment distance, typ. [mm]	5-10	0.5-5
Treatment width, max. [mm]	5-29	10-15
Ordering Code	B54321P5100A020	B54321P5100A120, available in Oct. 2020

Behind the scenes

Technology

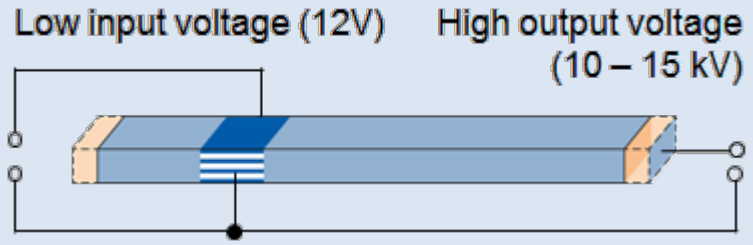
TDK‘s CeraPlas element – a piezo based plasma generator in a single component

High voltage generation

- A single piezoelectric component generates high voltage in minimum space
- Vibrating system with mechanically coupled input and output sides for the transformation of low input voltage to high output voltage

Plasma generation

- Electrical discharge due to a local high electrical field
- Dielectric barrier discharge process on output electrode



Surface activation with plasma

Untreated surface: Round droplet

- Low surface energy
- Insufficient wetting
- Weak bonding

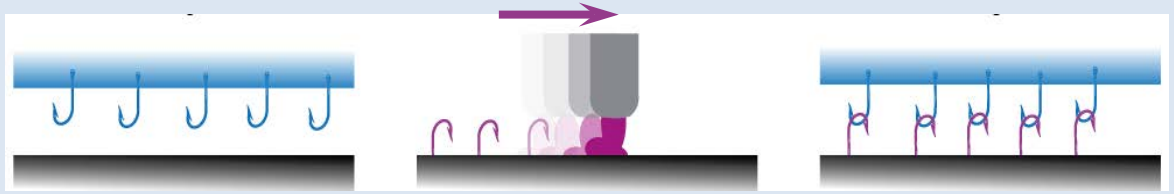
Treatment with atmospheric plasma

After plasma treatment: Flat droplet

- High surface energy
- Increased wetting
- Strong bonding

Behind the scenes

Surface activation of polymers Enhancing adhesion



Untreated surface:
No sites available for chemical bonding

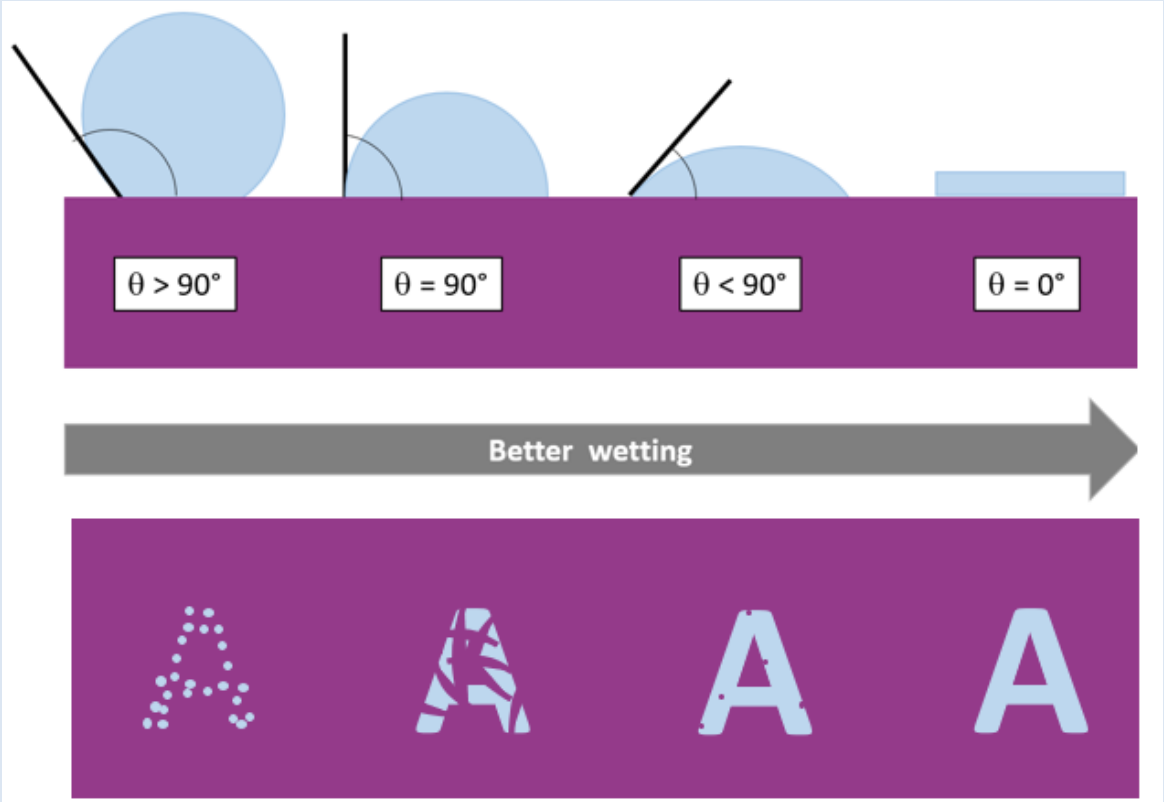
- Low surface energy
- Insufficient wetting
- Weak bonding

- Generation of anchor groups
- Activation of surface
- Hardly any thermal input

After plasma treatment:
Corresponding bonding sites generated

- High surface energy
- Increased wetting
- Strong bonding

Example effect of surface wettability on printing results



Bonding improvement with cold plasma
A best practice example

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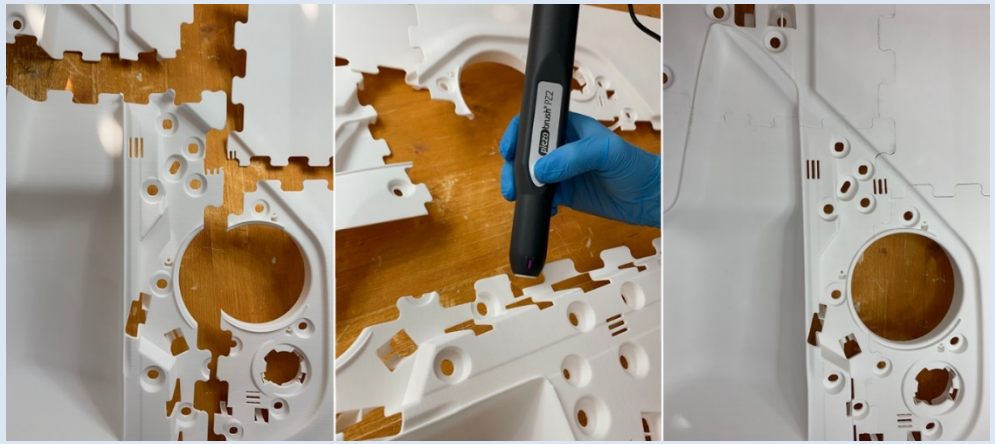
Interior door trim

- Initial situation: four individual parts from unfilled PA12 printed by selective laser sintering (SLS)
- Process:
  1. parts activated with cold plasma via piezobrush PZ2
  2. spotted with cyanoacrylate (superglue)
  3. structurally bonded with a two-component adhesive
- Finding: "Using the piezobrush PZ2 now opens up possibilities for bonding individual parts that were previously unthinkable."
  Ralf Deuke, Creabis, June 2019



Motorbike trim

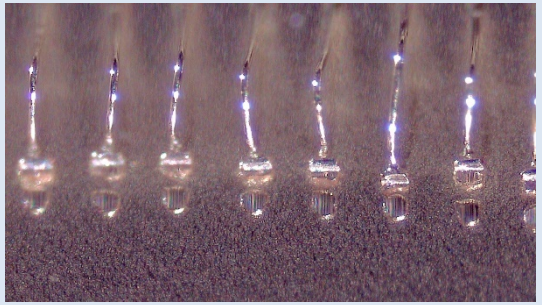
- Initial situation: 12 individual parts using 3D printing
- Process:
  1. parts activated with cold plasma via piezobrush PZ2
  2. spotted with cyanoacrylate (superglue)
  3. structurally bonded with a two-component adhesive
- Finding: Three times stronger bond than without surface activation
- Outcome: The trim installed on the motorcycle can even withstand speeds of over 200 km/h.

Source: https://www.relyon-plasma.com/plasmatechnologie-im-3d-druck/

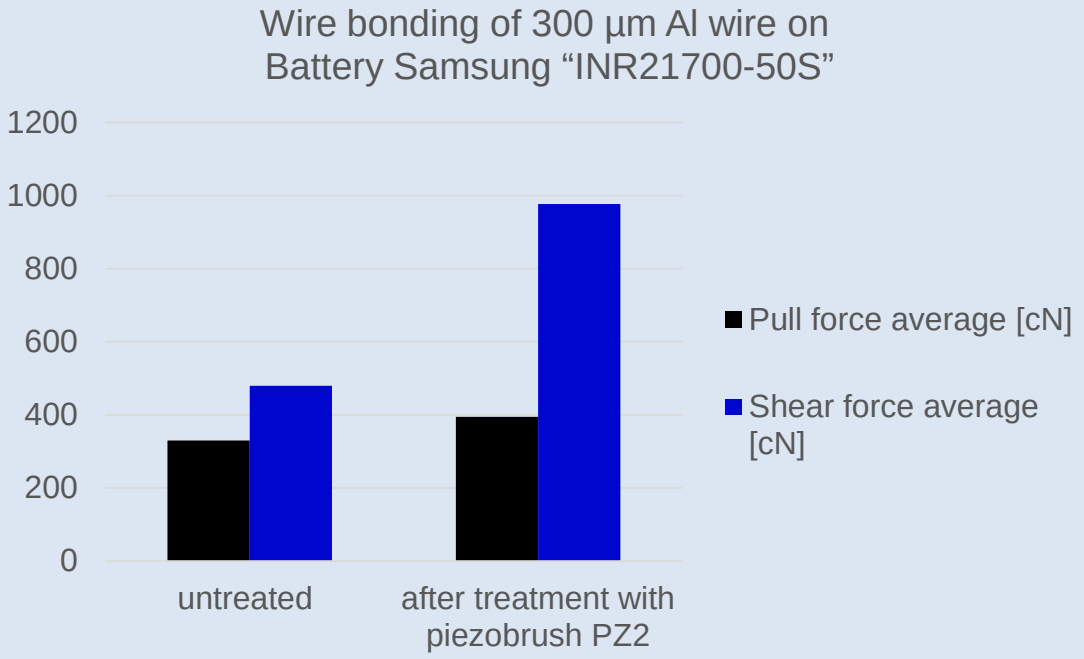
Wire bonding improvement with cold plasma

Wire bonding

- Initial situation: contaminations on metal surfaces (bond pads) of semiconductor components or carrier materials, which can result in non-stick on pad (NSOP) or so-called “lifts” (elevations of the bonds).
- Process:
  1. fine cleaning with cold plasma via piezobrush PZ2
  2. Wire bonding
- Finding: increased bonding by double times improved shear force and quarter times improved pull force



Increased bonding strength on contact surfaces



Source. relyon plasma

Improvements with cold plasma on pressure sensitive tapes (PST)

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Sticking

- Initial situation: example of self-adhesive labels for logos and embellishments to be stylish and to canvass for its respective brand unpeel after time of use.
- Process:
  1. Surface activated with cold plasma via piezobrush PZ2
  2. Sticking of PST on pre-treated surface
- Finding: increased bonding, improved maximum peel strengths and therefore improved durability
- Benefits in assembly process
  - ¬ Sustainable process as no chemicals needed
  - ¬ Flexible handling with the handheld device

Typical utilization of PST

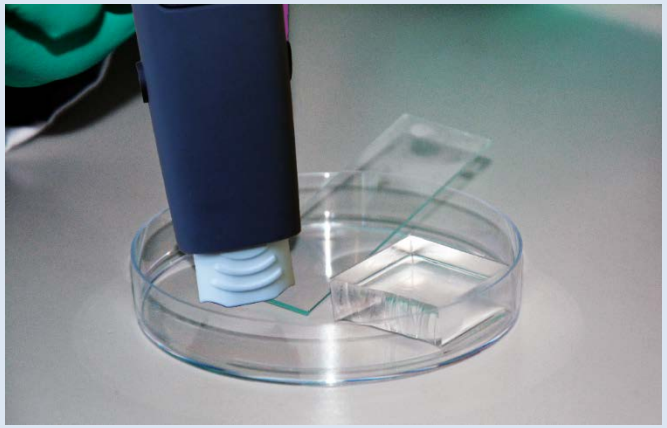
- Membrane keypads
- Type plate
- Display bond frames
- Self-adhesive labels
- Double sided cliché adhesive tapes (FlexPrint)

Source. relyon plasma

Cold plasma in medical market

Make use of these cold plasma features

- Sterilize and disinfect medical devices and equipment
  Even neutralization of methicillin resistant Staphylococcus aureus (MRSA)
- Preparation of many materials for improved adhesion
  - ¬ FEP bonding (known for the non-stick properties)
  - ¬ Connection of PDMS with glass
- Preparation of laboratory supplies for improved wetting
  - ¬ Activation of petri dishes



Dental market
Create and sterilize implants

Cold plasma supports by

1. Improving further processing of manufacturing of implants through functionalization
   - Bonding of individual components of different materials
   - Color adaption of implant to natural teeth color
2. Increasing of biocompatibility through optimized wettability
   - Improved acceptance of surrounding tissue
   - Control of homogeneous cell colonization and sterilization
3. Sterilization of surfaces

Source: https://www.relyon-plasma.com
https://www.deutsche-familienversicherung.de/zahnversicherungen/zahnzusatzversicherung/ratgeber/artikel/zahnkrone-arten-behandlung-und-kosten/

piezobrush® PZ3 professional set Summary

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The world's smallest plasma handheld device with PDD technology®

- Generates highly efficient cold plasma for the optimization of adhesion processes like gluing, printing and bonding
- Use on a variety of materials like plastic, metals, glass, ceramics, semiconductors, natural materials, etc.:
  - Module "Standard" is used for non-conductive materials like plastics
  - Module “Nearfield” is used for conductive materials like metals

Key benefits

- Easy, safe and intuitive plug-and-play technology
- Integrated display for process control and power settings
- Works with air as ambient process gas

Ordering code: B54324D5120A140

Design	Handheld unit with plug-in power supply and integrated fan
Electrical connection [V / Hz]	110-240 / 50-60
Power consumption [W]	18
Plasma temperature [°C]	<50
Weight [g]	110
Treatment speed [cm^2/s]	5
Treatment distance [mm]	2-10
Treatment width [mm]	5-29

www.tdk-electronics.tdk.com