

Front Panel Decoration

Printing Inks for the Production of Front Panels for Domestic Appliances

Screen
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Front panels play a key role among the different input systems, since no household appliance is without: washing machines, dryers, dishwashers, ovens, or microwave ovens ("white goods"). It is becoming more and more standard to equip these devices with a capacitive touch interface.

So, apart from the established materials PMMA or PC, the focus also turns to high quality glass substrates. Glass features a durable and dirt-repellent surface - virtually destined for the manufacturing of such input systems.

With this TechINFO we would like to share our experience gained from plenty of test series with you, and describe the benefits, as well as the combination possibilities for multi-layered prints.



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1. Common Substrates

Used are mainly high-quality white or transparent injection molded plastic materials like PMMA, PC, and compounds made of PMMA and PC.

Glass materials (soda-lime glass, white glass) and metals made of steel, aluminium, and brushed stainless steel are also used.

2. Areas of Application and End Products

Front panels and faceplates are used for input systems of appliances like:

- Washing machines
- Dishwashers
- Dryers
- Microwaves
- Ovens/ faceplates
- Refrigerators and freezers
- Small appliances like coffee machines
- Vacuum cleaners

3. Requirements for Products and Inks

- Adhesion according to DIN/ASTM (GT0/5B)
- High chemical resistance
- High mechanical resistance
- Cold tests
- Heat storage
- Peel and rub resistance
- High temperature resistance with lowest DE deviations
- Thin ink layers
- High electrical resistance values of the ink film
- Good printability of the ink
- Constant „batch to batch“ quality

Humidity tests like:

- Heat soak 72 h at 65°C /95%RH
- Water steam test
- Alternating climate chamber test

Optical requirements like:

- High optical density
- Colour coordinates (Lab-values)
- Brightness value of white (L-value)
- Good ink flow
- High edge definition

4. Ink Recommendations Second Surface

We recommend the following solvent-based ink systems for second surface printing onto transparent plastic or glass materials:

Ink System	1K / 2K	Material
Mara® Switch MSW	1K + 2K	PMMA, PC
Mara® Star SR	1K + 2K	PMMA, PC
Mara® Glass MGL	2K	Glass
Tampa® Glass TPGL	2K	Glass



Multi-layered prints on PMMA:

In order to achieve highest resistances, and to meet specified requirements, these inks can be used on plastic faceplates as 1- or 2 K inks. Exemplary print sequence below:

Colour Shade	Mesh
1. Text MSW	120-34
2. Larger areas MSW	120-34
3. Blocking layer MSW 181	100-40 OD: > 3.5
4. Blocking layer MSW 181	100-40 OD: > 5.4

Multi-layered prints on glass:

On glass faceplates, MGL and TPGL must be processed with 5% hardener MGLH! Exemplary print sequence, e. g. for black frames:

Colour Shade	Mesh
1. MGL 188 + 5% MGLH	165-27 OD: > 4.5
2. MGL 188 + 5% MGLH	165-27 OD: > 6.0

Special inks:

Black ink with high electrical resistance, transparent shades that can be backlit with LED lamps (so-called diffusor and filter inks), as well as high opaque shades are available.

5. Ink Recommendations First Surface

For first-surface screen or pad printing onto metal faceplates made of e. g. aluminium or brushed stainless steel (incl. coated or varnished) we recommend the following solvent-based 2K inks:

Ink System	Application
Mara® Pur PU	Screen
Tampa® Pur TPU	Pad
Tampa® Tech TPT	Pad
Mara® Star SR	Screen
Mara® Glass MGL	Screen
Tampa® Glass TPGL	Screen + Pad

6. Use of Auxiliaries

The inks must be mixed with the hardener specified in the respective Technical Data Sheet. It is recommended to allow the ink/hardener mixture to pre-react for 15 minutes. Then, depending upon the climatic conditions, the ink can be adjusted to the desired viscosity by adding compatible auxiliaries (thinner, retarder).

7. Drying

Drying and intermediate drying is carried out with multi-zone tunnel dryers, suitable IR dryers, or drying ovens.

Final drying on PMMA and PC

The following possibilities are suited for the final drying process of a multi-layered print:

- Tunnel dryer at 60°C/20 min.
- NIR or K-NIR drying process
- Oven drying at 60°C / 20-30 min.

Final drying on glass

We recommend the following final drying:

- Oven drying at 140°C / 30 min. or
- NIR / K-NIR drying process

By this process the ink film will achieve the best drying degree (minimizing the risk of residual solvents), as well as best crosslinking, and therewith highest chemical and humidity resistance.

8. UV Technology

The use of UV-curable inks is tending upwards across-the-board. The inks contain no solvents, offering the following benefits:

- Unlimited mesh opening
- Excellent reproduction of details: printing of finest AM and FM halftones
- Stable colour accuracy during the print runs
- No residual solvents in multi-layered prints
- Very high electrical resistance
- Quick curing allows fast processing speed
- Higher quality and process safety for multi-layered printing
- No adjustment of the ink with thinner or retarder
- Low environmental impact, compliance with MAK values

UV Ink Recommendations Second Surface

We recommend the following UV-curable ink systems for second surface printing onto transparent plastic or glass materials:

Ink System	1K/2K	Material
Ultra Mold UVPC	1K	PMMA, PC
Ultra Glass UVGL	2K	PMMA, PC, Glass
Ultra Glass UVG3C	2K	PMMA, PC, Glass

Ink System	Motif
Ultra Mold UVPC	Text
Ultra Glass UVGL	Text
Ultra Glass UVGL	Diffusor ink, upon request
Ultra Glass UVGL	Blocking layer
Ultra Glass UVG3C	Blocking layer

Printing on PMMA faceplates:

The aptitude of the following print sequences has been proved on transparent PMMA by several print tests:

e. g. solely UV-curable

Colour Shade	Mesh
1. Text UVPC	140-31
2. Blocking layer UVG3C 188	165-27 OD: 2.3
3. Blocking layer UVG3C 188	165-27 OD> 4.0

e. g. combination UV / MSW

Colour Shade	Mesh
1. Text UVPC	140-31
2. Blocking layer MSW 181	100-40 OD: > 3.5
3. Blocking layer MSW 181	100-40 OD: > 5.4

Printing on glass:

Please find below an exemplary printing sequence for printing black on glass second surface (e. g. black frame):

Colour Shade	Mesh
1. UVG3C 188 + 4% HV8	165-27 OD: 2.5
2. UVG3C 188 + 4% HV8	165-27 OD: > 4.5

Use of Adhesion Modifier UV-HV 8

UVPC can be used as 1K ink. UVG3C must be mixed with 4% UV-HV 8, UVGL colour shades must be mixed with 2% UV-HV8. We recommend – for better initial adhesion – to allow the ink/hardener mixture to pre-react for 10-15 minutes before processing.

Tip: Pre-treatment of PMMA

We recommend Corona pre-treatment of the substrate surface which is to be printed with UV inks for best adhesion and humidity resistance.

Post-treatment / post curing:

Post-treatment, or intensified post curing improves the resistance and durability of the printed UV ink film. Best suitability for post-processing steps like gluing can be achieved by short post tempering, e. g. at 140°C/ 10 min., or running it through an IR dryer.

The necessity to do so may vary depending upon the production process, and process steps.

9. Mara® Glass MGHT – 1K Baking Ink

The solvent-based 1K baking ink Mara® Glass MGHT is suited for printing onto glass and heat-resistant materials like metal (incl. varnished metal). Please find the available colour shades listed below:

- Mara® Glass MGHT 180
- Mara® Glass MGHT 170
- Mara® Glass MGHT 910

e. g. Black printing sequence / Second Surface:

	Colour Shade	Mesh
1.	MGHT 180	165-27 OD: > 4.0
2.	MGHT 180	165-27 OD: > 5.5

e. g. White printing sequence / Second Surface:

	Colour Shade	Mesh
1.	MGHT 170	140-31
2.	MGHT 170	140-31
3.	MGHT 170	140-31
4.	MGHT 180	165-27 OD: > 5.5

Drying:

Overprintability is achieved after 5 min. at 180°C. The recommended baking temperature and time for the multi-layered print is 250°C/30 min. This allows the ink film's crosslinking process to accomplish and results in highest resistances.

Benefits:

- Very high chemical and mechanical resistances
- Outstanding temperature resistance, > 300°C (e. g. ITO-Sputtering processes)
- High resistance value >10¹²
- Smooth, homogeneous ink film

10. Pre-treatment of Glass Surfaces

When printing onto glass it is most advisable to determine the fireside for the print, and to pre-clean and pre-treat the glass surface for best adhesion and crosslinking. The glass surface must be free of any residues that could impair adhesion (dust, dirt, grease, etc.). Common methods are

- Pre-cleaning with demineralized water
- Pre-cleaning with special glass cleaners
- Flame pre-treatment
- Silane pre-treatment
- Plasma/Corona pre-treatment

11. Touch Panels on the Rise

There are various production methods and so-called "Display technologies" for the production of Touch Panels - more and more as capacitive systems. Here, the inks must feature a rather high electrical resistance in order not to interfere with the functioning of the input system.

Unlike resistive touchscreens, capacitive touchscreens require no pressure at all. They are not made from several layers but only one glass or plastic plate.

12. Verification of Electrical Resistance

After the production, the quality control verifies the resistance value of the ink, especially for black shades. The minimum value that must be reached is usually >10⁺⁹.

Decimal Divider/Multiples	PSpice-Syntax	Resistance
10 ⁺³	K, k	kilo-ohm
10 ⁺⁶	MEG, meg, Meg	megaohm
10 ⁺⁹	G, g	gigaohm
10 ⁺¹²	T, t	teraohm

13. Remark

The use of UV inks increases the process safety and production speed of multi-layered prints and expands the range of design possibilities especially for 4 colour process printing and technical halftone gradients

(AM and FM halftones). Effect inks and special inks round out the portfolio.

Marabu's solvent-based or UV-curable ink series form the ideal basis for applications in the industrial segment "input systems" with its special, demanding requirements, and the combination possibilities offered by screen and pad printing – and more and more digital printing.

Please refer to the respective Technical Data Sheets for up-to-date information and further details on the ink systems.

The advice in this TechINFO is based on our current knowledge. Nevertheless, before production start, the individual conditions (stencil, printing pressure, curing, post-processing, etc.) must be considered, tested and approved on site.

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