Copprint LF-301

Updated: March 2023

Nano Copper Paste

for Paper Substrates

Application Notes

Overview

Copprint LF-301 is a solvent-based copper paste for additive printing of thin electronic patterns on paper substrates. Copprint LF-301 contains Nano and Micro Copper particles, and enables oxidation free, high conductivity copper printing in an air environment, with rapid self-sintering and curing at 260°C in a R2R system. Copprint LF-301 is the highest performance, most sustainable, lowest cost Copper paste suited for manual, semi-automatic or reel-to-reel screen-printing applications.

The application notes provide instructions and guidelines for optimal screen printing with Copprint LF-301 including:

Printing guidelines and recommendations

1. Copprint LF-301 Storage

Copprint LF-301 should be stored below -10°C. Mix the paste in the original container before printing using a paste mixer (Figure 1) - Eg. ZB500S, solder paste mixer, 15min at 300rpm, or manually until homogeneous in composition throughout.

Figure 1
ZB500S, solder paste mixer

2. Screen Printing

Copprint LF-301 is suited for screen printing on paper substrates.

Pour the requisite volume of paste needed for printing to a new container and verify that it reaches room temperature before printing.

Select your desired screen mesh. The mesh defines the printed pattern layer thickness and pattern resolution. The LF-301 paste is designed for the deposition of thin copper layer on paper, in the range of 3-6um. We recommend printing using a screen mesh of 150-200 /cm, NBC-MESH (Japan) L150/030 – L200/027.

Recommended substrate:

Substrate	Name	Supplier	Notes
Paper	ProPointTM	Pixelle www.pixelle.com	Print on glossy side. Optimal thermal resistance. Good adhesion properties.
	CraftPoint™ Reflections #60		
	Supercoat SW80	Mitsubishi https://www.mpm.co.jp/eng/	

Other types of paper may be compatible with LF301 and processing conditions. We suggest comparing performance on any new substrate with performance on a recommended substrate.

Do not return any unused paste to the original container. Close and seal the original container and return to storage at -10°C.

3. Drying

After printing, dry the pattern immediately. Drying in a conveyor belt oven with hot air is recommended. For lab scale testing we use a Reflow oven T-961 from Puhui (www.puhuit.com)

Figure 2
Reflow Oven

The reflow oven is set to enable the following temperature profile (90C in this module):

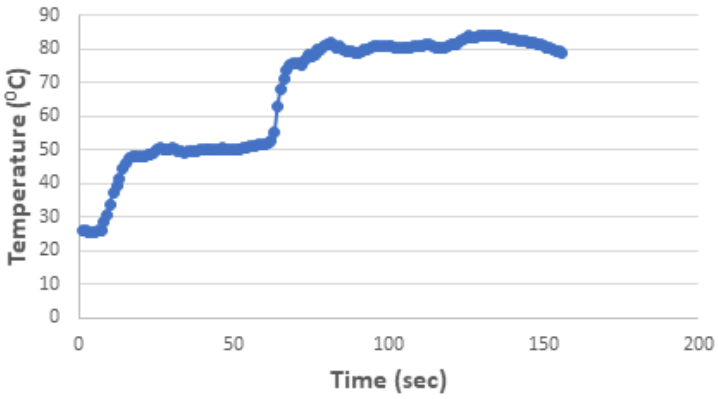


Figure 3. Temperature profile of the single cycle run (reflow oven)

Other manufacturers and drying equipment models may be suitable. Actual settings must be found for each type of equipment, over-drying will harm obtained electrical performance.

4. Sintering

The dried printed pattern should be sintered within 72 hours, more preferably, within 24 hrs after drying. The sintering process is based on thermal heating in air environment. No inert atmosphere (like nitrogen) is required.

The sintering takes place under ‘snap heating’ (Achieving the desired temperature quickly in a few seconds).

In order to obtain that snap heating process, we suggest using one of the following techniques:

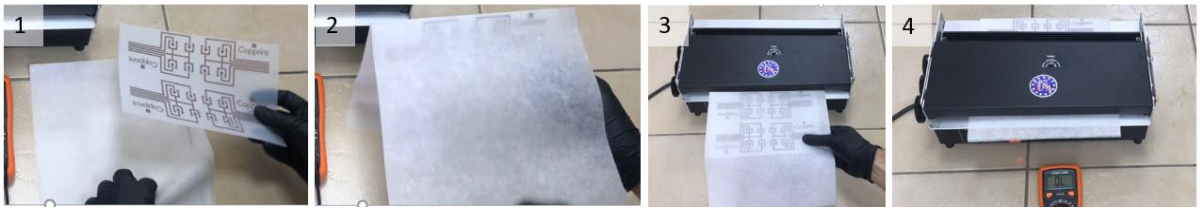
1. Lab scale: Laminator or hot press
2. High-throughput manufacturing: Hot roller

Sintering with the laminator should be done when sample is protected from scratches by placing between a folded piece of baking paper / silicon paper (see photo below and how-to movies). It is important to use a new sheet of baking paper for each sintering cycle (after the baking paper is heated to high temperature it becomes wrinkled, which if used for another sintering cycle will affect sintering quality).

Example Images of sintering in a laminator with protective sheet.

1-2: sample placed in a new folded piece of protective sheet (baking paper / silicon paper)

3-4: sample in holder sintered in the laminator.



For lab scale experiments we use an office laminator manufactured by the US compony TLC (contact details below). Even though it is intended for use up to 200C, its temperature can be set to 270-310°C by following our guidelines (a separated detailed file “Modification to TLC laminator”). *Watch Copprint Sintering Video using a laminator*.

Several versions are available at different sizes. A 220V version can be ordered directly from TLC, they ship worldwide.

Figure 6. TLC-5500 narrow laminator
https://www.amazon.com/gp/product/B00851HP18/ref=ppx_yo_dt_b_asin_title_o01_s00?ie=UTF8&psc=1

Figure 7. TLC 6000T wide laminator

https://www.amazon.com/6000T-Thermometer-Thermal-Laminating-Corp/dp/B0019WQ232/ref=sr_1_6?keywords=tlc+pouch+laminator&qid=1580296193&sr=8-6

A 220V version can be ordered directly from the manufacturer TLC:

Mr. P. Luu
Thermal Laminating Corporation (TLC)
USA, IL
Tel: (847)8696010
Fax: (847)8696095
tlcill@aol.com

TLC ships worldwide, please mention that you were referred by Copprint so that they will sell you directly and not refer you to a distributer.

4.1 sintering by Heat Press Machine

Optimal sintering conditions by a dual heated hot-press (figure 4) are: 30 sec@ 270°C (measured temperature). A close contact of the heating plates and the sintered pattern is required, high pressure is not required.

We recommend placing the printed pattern in the heat press when it is placed between two sheets of baking paper to prevent scratching and keeping the press clean.

A well sintered sample will have a lighter copperish color, as can be seen in Figure 5.

Figure 4
Hot Press machine

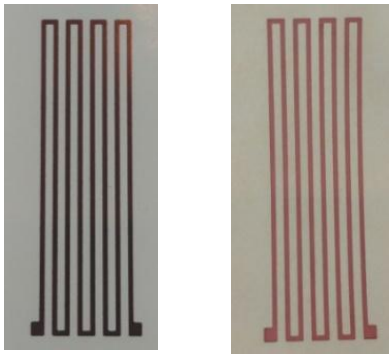


Figure 5
Non sintered (left) and sintered (right) printed pattern

A large hot-press can be purchased directly from one of two manufacturers:

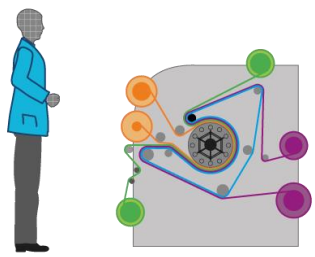
COLOR KING (this is the one shown in the movie)
http://www.color-king.net/product.php?id=995
Contact: Joseph@color-king.net

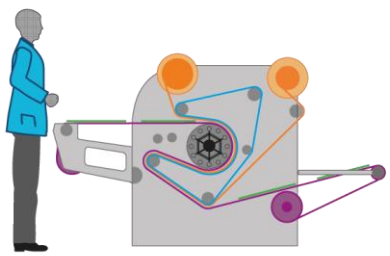
AUPLEX
http://www.auplexheatpress.com/a/products/Press/Dual_Heat_Press/2018/0516/41.html
contact: sarah@auplexheatpress.com

Caution: Always wear oven gloves when handling the heat press

4.2 High-throughput sintering by a hot roller

For large scale sintering, we recommend using a hot roller machine. As seen in the schemes below, the printed sheets (right) or roll (left) is driven between the hot drum and the belt. The contact (heating) time should be 5-10 sec and the drum temperature 270°C.





For more information about the hot roller system, please contact Klieverik:

Klieverik,
Edisonstraat 8, 7575 AT Oldenzaal, Netherland
+31 639216923
johan.Schenke@klieverik.com

General notes on sintering (with all methods):

Other commercially available equipment may not work well If the heating process is not snap and uniform.

Sintering efficacy can be verified by both resistance measurement and color change of the printed pattern. Dried, printed patterns prior to sintering appear brown; Sintered patterns are orange-pink (Figure 5).

5. Clean Up & Maintenance

After printing screens should be cleaned (within up to 2 hrs.) to avoid copper contamination on the mesh.

Screen cleaning instructions:

1. Wipe off any remaining Copper paste with a paper towel.
2. Wet both sides of the screen with Dowanol DB solvent.
3. Gently wipe the screen in a circular motion with a sponge / soft fabric soaked with Dowanol DB. Wipe till remainder of paste is softened (the liquid will turn dark).
4. Wash the screen with tap water. Wet screen areas that have remaining paste with Dowanol DB solvent.
5. Repeat steps 2-4 till the screen is totally clean.
6. Dry the clean screen with paper or dry fabric and leave it to dry.

Disclaimer

Copprint is not responsible for misuse of its products or their use in conjunction with unsafe or improperly maintained equipment or for uses other than intended as specified in this application note.

Product MSDS, Product TDS can be found at Copprint resources.

www.copprint.com