

Bungard Plating System

Bath Setup Instructions and Process flow chart

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Bath Setup

Bath Product	Quantity for 10 l	Replenish for 10 m ²	Unit content
Bath 1			
DI Water	9.7 l		
DS270	0.3 l	30 ml	500 ml*
Bath2			
DS400	10 l	2 l	25 l*, 5l
Bath 3			
DS400	9.5 l	2 l	see above
DS500	0.5 l	50 ml	500 ml*, 250 ml
Bath 4			
DI Water	4.6 l		
DS650 L	4.3 l	430 ml	5l*
DS650 P	1.0 l	100 ml	5l*
DS650C	0.1 l	10 ml	500 ml*
Bath 5	for 30 l		
DI Water	12.0 l		
sulphuric acid, pure (98%)	3.5 l		
CU 400 C	11.0 l		25 l*
CU 400 A	120ml	1l / 8000 Ah	1 l*, 5 l
			eq. 0.375 l/10m ²
DI Water	fill up to 30 l		
sodium chloride	4 g		

- = content of one Starter Set for Compacta L30

Exothermic reactions are possible when mixing chemicals! Mix in a suitable container outside of the machine. Do not give water on acid! Always give the acid to the water! Wear protective clothing!

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Bath Setup Instructions and Process flow chart

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Process Flow in Compacta Plating Line

Step	Process	Time	Temp. °C	Remarks
1	DS270	7 min	65-70	Cleaner Conditioner
R	Static rinse	1 min		
	Spray Rinse	1 min		
2	DS400	1 min	20-25	Pre-Dip
	No rinse!			
3	DS500	7 min	20-25	Activator
R	Static Rinse	1 min		
	Spray Rinse	1 min		
4	DS650	4 min	45	Intensifier
R	Static Rinse	1 min		
	Spray Rinse	1 min		
5	CU 400	23 min	20-25	18 µm Cu plating, 0.8µm/min, 3A/dm ²
R	Static Rinse	1 min		
	Spray Rinse	1 min		

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Cleaner / Conditioner DS 270 is an alkaline cleaner-conditioner to be used in the Plating System process to thoroughly prepare and condition any substrate used in the PCB manufacturing. It contains conditioning agents which activate glass fibres and dielectric, allowing for a reliable absorption of the catalyst. DS270 can be easily removed from the copper surface in the following rinse steps, making the process selective.

Bath Make-Up for 10 litres

De-mineralized water 9.7 litres

Cleaner/Conditioner DS270 0.3 litres

Warm up to working temperature - important to shake the Cleaner/Conditioner drum gently before use.

Process parameters

Temperature 60-70 °C

Treatment time 7 minutes

Agitation Important with board movement. Solution movement is recommended.

Capacity 1 litre ready made solution treat 5 m² surface.

Bath maintenance / Replenishment

To compensate drag out, add 30 ml DS270 for each 10 m². Compensate for evaporation with additions of DI water.

Equipment required

(if not using the Compacta Plating Line)

Tanks Stainless steel or PPE tanks are recommended

Hanger Stainless steel acid proof (Steel 316).

Heaters Teflon or stainless steel

Ventilation Recommended

Solution movement Recommended

Rinse Optimal to have a warm static rinse followed by a dual cascade/spray rinse.

Analysis

Cleaner/Conditioner DS270 is maintained by replenishment per m². No special analysis is required here.

Waste Disposal

Waste is to be disposed and/or treated according to local regulations. For more information see safety data sheet.

Safety / Precautions

Avoid contact with eyes and skin. Wear protective gloves, goggles. If swallowed, give immediately something to drink. Do not induce vomiting. Seek medical advice. In case of skin- or eye contact, rinse immediately with water for at least 15 minutes. In case of eye contact seek medical advice.

Physical aspect

Cleaner/Conditioner DS270 gives a clear solution with a characteristic smell.

Storage

Store in original package at room temperature. Close the cap tight after use.

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Pre-Dip DS400 is used in the Plating System process as a predip before the Activator DS500. It contains a special additive which prepares the panels for the activation process step and prevents contamination of the Activator DS500.

Bath Make-Up Pre-Dip DS400 is a ready-made solution

Process parameters

Temperature	20-25 °C
Treatment time	1 Minute
Agitation	Board movement is recommended.
Capacity	1 litre ready made solution treat 25 m ² surface.

Bath maintenance

To compensate water drag in, take out 1 l old solution and add 1 l fresh solution DS400 every 5 m²

Equipment required (if not using the Compacta Plating Line)

Tanks	PPE or PVC tanks are recommended
Hanger	Stainless steel acid proof
Heaters	Teflon or quartz
Ventilation	Not necessary
Rinse	Do not rinse after Pre-Dip! Let the liquid drip off and take the board to the Activator bath

Analysis

Analysis procedures are available, but we consider them for Experts only and will send them on request.

Waste Disposal

Waste is to be disposed and/or treated according to local regulations. For more information see safety data sheet.

Safety / Precautions

Avoid contact with eyes and skin. Wear protective gloves, goggles. If swallowed, give immediately something to drink. Do not induce vomiting. Seek medical advice. In case of skin- or eye contact, rinse immediately with water for at least 15 minutes. In case of eye contact seek medical advice.

Physical aspect PreDip DS400 is a clear solution with a sweet pleasant smell.

Storage Store at room temperature and in a dark place

Last revision 030717 db

Analysis (Experts only)

Specific gravity should not fall below 1.12 g/cm^3 (new solution = 1.18 g/cm^3). To bring the specific gravity to the right value take out 10% of the bath and add the same quantity of new Pre-Dip DS400.

Experts should analyse the solution periodically to ensure that there is less than 1.000 ppm copper in the bath. If copper is present in excess of 1 000 ppm, replace the entire bath or exchange old against fresh solution to reduce copper to below 500 ppm.

Pipette 10 ml working solution into a 250 ml conical flask.

Add 100 ml DI water.

Add 2 ml buffer solution pH 10.

Add a knife end of Murexide Indicator.

Titrate with 0.01M EDTA until the violet ending point.

Record ml used to titrate.

Calculation: $\text{ml } 0.01\text{M EDTA} \times 63,5 = \text{ppm copper}$

pH 10 buffer solution (1 litre): 70 g NH_4Cl + 570 ml NH_4OH 25% + Distilled water to volume

Murexide Indicator (200 g): 1 g Murexide + 199 g NaCl

Plating System Step 3: Activator DS500

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Activator DS500 is a new generation low acid colloidal Palladium bath used in the Plating System process. It creates a dense, uniformed distribution of drill hole activation necessary to achieve the highest conductivity and consistent perfect coverage.

Bath Make-Up for 10 litres

Pre-Dip DS400	9.5 litres
Activator DS500	0.5 litres

Process parameters

Temperature	Room Temp. Do not allow temperature to exceed 50 °C
Treatment time	7 minutes
Agitation	Slow Board and solution movement is important

Bath maintenance

Add 50 ml of Activator DS500 for each 10 m² . A relative old bath should be analysed periodically to ensure that there is less than 2000 ppm copper in the bath. If copper is present in excess of 2000 ppm, the entire bath should be replaced. Compensate drag out by ready-made solution. *Never add water.*

Equipment required

(if not using the Compacta Plating Line)

Tanks	PPE or PVC tanks are recommended
Hanger	Stainless steel acid proof
Heaters	Teflon or quartz, low specific heat, less than 1 W/cm ²
Ventilation	Recommended
Solution movement	Important to have solution movement during warm-up

Analysis

(Experts only)

The analysis requires a DR 700 colorimeter to measure the concentration of the Activator. Further analysis concern the acidity and tin concentration. We will supply detailed information to experts if required. The normal handling of the bath is done on a base of replenishment by throughput.

Operating Conditions

	Range	Optimum
DS500	3,5-5%	5%
Pd	210-300 ppm	300 ppm
Sn ²⁺	10-14 g/l	13 g/l
HCl	11-15 g/l	14 g/l

Waste Disposal

Waste is to be disposed and/or treated according to local regulations. See safety data sheet.

Safety / Precautions

The Activator contains hydrochloric acid and could cause burns to skin and eyes. Avoid contact with eyes and skin. Wear protective gloves, goggles. If swallowed, give immediately something to drink. Do not induce vomiting. Seek medical advice. In case of skin- or eye contact, rinse immediately with water. In case of eye contact seek medical advice.

Physical aspect

Activator DS500 is a black solution with a sweet pleasant smell.

Storage

Store at room temperature and in a dark place

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Activator DS500 Analysis Procedure (Experts only):

Prepare the DR 700 550nm module software 000 (user defined).

1. Fill a vial to the 10 ml mark with DI water. (Not DS-400). This will be standard S 1.
2. Pipette 10 ml of a standard 5 % Activator DS500 working solution into a volumetric flask.
3. Dilute to the 100 ml mark with Pre-Dip DS400.
4. Fill the second vial to the 10 ml mark with this solution. This will be standard S 2.
5. Make the user defined program on the DR 700 according to the pages 17-23 in the DR 700 manual.
6. Make S 1 equal 0,000% and S 2 equal 5,000%.
7. Press calibrate.
8. Make the Zero with the S 1 sample.
9. Read bath samples S2.

DS-500 conc. %

After user defined program is installed, use as follows:

1. Turn on.
2. Press program and select 55.00.
3. Make the zero with DI water
4. Read a 1:100 diluted (in DS-400) bath sample

Acidity

1. Pipette 1 ml stirred bath in a beaker.
2. Dilute to 100 ml with deionized water.
3. Add few drops of Methyl red indicator.
4. Titrate with 0,1 M Sodium hydroxide to a yellow endpoint.

Calculation: ml 0,1 M Sodium hydroxide x 3,65 = g/l HCl

Tin

1. Measure 200 ml of DI Water to a beaker.
2. Add 20 ml concentrated hydrochloric acid.
3. Pipette 5 ml stirred bath to the solution.
4. Add 10-11 drops of starch solution.
5. Titrate with 0.1N Iodine solution to dark endpoint.

Calculation: ml 0.1N Iodine solution x 1,187 = g/l Sn²⁺

Plating System Step 4: Intensifier DS650

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Intensifier DS650 is used the Plating System process after the activator step. It strongly improves board plating ability by creating a conductive metallic layer inside the holes. The solution is made up from three parts, the names ending with L, P and C

Bath Make-Up for 10 litres

DI water	4 litres
DS650 L	4.3 litres
DS650 P	1 litre
DS650 C	0.1 litre

Important to follow the above sequence when setting up the bath. Top with DI water up to level.

Process parameters

Temperature	45 °C
Treatment time	4 minutes
Agitation	Board movement, do not use air agitation
Capacity	1 litre ready made solution treat 100 m ² surface
Density	1.18-1.22 g/cm ³

Equipment required (if not using the Compacta Plating Line)

Tanks	PPE or PVC tanks are recommended
Hanger	Stainless steel acid proof
Heaters	Teflon or stainless steel
Ventilation	Recommended
Solution movement	Important
Filtration	Recommended

Bath maintenance

For each 10 m² surface add 430 ml DS650 L, 10 ml DS650 C, 100 ml DS650P

Analysis (Experts only)

The Analysis requires a DR 700 colorimeter to measure the concentration of the Intensifier. We will supply detailed information to experts if required. The normal handling of the bath is done on a base of replenishment by throughput.

Safety / Precautions

The Intensifier is an alkaline solution and could cause burns to skin and eyes. Avoid contact with eyes and skin. Wear protective gloves, goggles. If swallowed, give immediately something to drink. Do not induce vomiting. Seek medical advice. In case of skin- or eye contact, rinse immediately with water. In case of eye contact seek medical advice.

Waste Disposal

Waste is to be disposed and/or treated according to local regulations. See safety data sheet.

Physical aspect DS650 L and P are clear solutions, DS650 C is deep blue.

Storage Store at room temperature and in a dark place. Avoid contact with acids.

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Plating System Step 4: Intensifier DS650

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Analysis (Experts only)

Intensifier DS650 P and L

Method/Procedure:

1. Pipette 10 ml of the INTENSIFIER DS-650 working solution into a 100 ml measuring flask. Dilute to mark with DI water.
2. Pipette 4 ml of this solution into a 250 ml conical flask.
3. Add about 100 ml of DI water.
4. Add 3-5 drops of Methylorange Indicator.
5. Titrate with 0.1 N HCL to red end point. Record Titrate A
6. Pipette 4 ml of diluted solution into another 250 ml conical flask.
7. Add about 100 DI water.
8. Add approximately 10 ml of Barium Chloride solution (80 g/l).
9. Add 3-5 drops of Phenolphthaleine Indicator
10. Titrate with 0.1 N HCl until the colour disappears. Record Titrate B

Calculation: $(\text{Titrate A} - \text{Titrate B}) \times 5.75 = \% \text{ DS650 L}$. $(\text{Titrate B}) \times 21.5 = \% \text{ DS650 P}$

Note: The Phenolphthaleine Indicator end point is slow and it is necessary to add the 0.1 N HCL dropwise very slowly close to the end point. If the end point is approached too quickly a too high reading will be obtained.

DS 650 P and DS 650 L concentration should be maintained between 80 and 100 %

Addition Table DS650 P and L

For 10 l	100 %	90 %	80 %	70 %
DS650 P	-	0.1 l	0.2 l	0.3 l
DS650 L	-	0.44 l	0.88 l	0.13 l

Intensifier DS650 C

It is important to follow the concentration in the solution by using the HACH DR 700 colorimeter instrument.

Method/Procedure:

1. Turn on the DR 700 and by using the “up arrow” select software program 4.1.
2. Pipette a 2 ml sample of INTENSIFIER DS-650 bath into a 100 ml measuring flask.
3. Dilute to the mark (50:1 dilution).
4. Fill two vials vial to the 10 ml mark with this solution. First vial = zero reference
5. Add the reagent pillow to the second vial.
6. Cap and mix for 2 minutes
7. Push the zero bottom for zero reference.
8. Push the Read bottom for the sample.
9. Multiply the result showed on the display by 50 to have the copper concentration in mg/l.

Calculation: Maintain the working solution at 180 to 200 mg/l (ppm) copper.

0.5 ml/l DS-650 C increase copper content by 10 mg/l (ppm)

Addition Table DS650 C

For 10 l	190 ppm	180 ppm	160 ppm	140 ppm
DS650 C	5 ml	10 ml	20 ml	30 ml

Plating System CU400 is a high throw, high speed, bright acid copper plating process especially designed for direct plating. It produces highly levelled, bright smooth copper deposits on properly prepared and conductive PCB at both high and low current density levels. When correctly operated, CU400 bath will produce hole wall to surface ratio of 1:1. CU400 is particularly suited to pattern-plating and to high aspect ratio fine line PCB. By its properties and operating conditions, it suits perfectly the Compacta plating lines.

Operating conditions	Range	Optimum
Copper sulphate pentahydrate	80-100 g/l	90 g/l
Sulphuric acid	180-210 g/l	200 g/l
Chloride (as Cl -)	50-80 mg/l	70 mg/l
CU 400 A	4-8 ml	6 ml
Temperature	20-30 °C	27 °C
Current density	0,1-8 A/dm ²	2-3 A/dm ²

Agitation	Air or mechanical agitation
Plating rate	0,8 µ/min at 3 A/dm ² with air agitation
Replenishment	1 litre of brightener for every 8000 Ah
Anodes	Phosphorised copper
Anode bags	Polypropylene
Heaters	Teflon or titanium
Filtration	If required, on PP filters only

Solution Make-Up for 30 litres

1. Add 12 litres DI water to well cleaned plating tank
2. Add slowly, with agitation, 3.5 litres chemically pure quality of concentrate sulphuric acid (Caution: wear suitable protective clothing).
3. Let the solution cool down.
4. Add 11 litres copper concentrate CU 400 C
5. Add 4 g sodium chloride NaCl
6. Fill up with DI water to nearly 30 l.
7. Check the temperature 20-25 °C
8. Run the bath with a dummy PCB for 2 to 3 hours at 1 A/dm²
9. Add 120 ml of brightener CU 400 A.

Solution Maintenance

Chloride: To promote smooth deposit and increase the CU400 bath's tolerance to impurities, the chloride concentration must be maintained above 60 mg/l. An out of balance chloride level causes burning and irregular deposit in the current density areas.

Agitation: The CU400 solution should be agitated by air. The air tubes should be directly under the board. Clean, low pressure air, not compressed air, should be used to avoid impurities getting into the bath.

Temperature: It is recommended that the CU400 solution should be operated at between 20-30°C. Loss of brightness and levelling occurs at temperatures above 30 °C.

Filtering: Filtration over activated carbon is not recommended, as this removes the brightener from the bath.

Anodes: Phosphorised anodes with a minimum of 0,02% phosphorus should be used in the CU400 solution. Other anodes may cause excessive brightener consumption, poor levelling, and roughness. The anode areas should be twice the cathode area and napped polypropylene anode bags should be used.

Troubleshooting

Problem: Burning and roughness

Cause	Correction
Copper concentration too low	Adjust copper sulphate level.
Acid content too high	Dilute bath with water.
Temperature too high	Cool solution.
Anode bags contaminated	Clean or replace anode bags.
Poor agitation	Increase air flow. Agitate cathode if possible.
Too high current density	Decrease current.
Brightener out of balance	Filter over active carbon to reduce brightener concentration
Chloride content too low	Replenish as required.

Problem: Voids in holes

Cause	Correction
Particles in solution	Filter bath. Spray rinse boards prior to electroplating. Check all solutions for suspended matters.

Problem: Lack of response to brightener

Cause:	
Anode polarisation	Balance copper sulphate ratio: (add DI water and run test at low A rating) Check for metallic contamination, i.e. iron, nickel, zinc. Check anode bags for blocked pores, or too tight bags. Check chloride content. Low chloride content will cause anode polarisation.
Chloride out of balance	May be indicated by narrow bright range. Maintain the solution level.
Temperature too high	Cool solution.
Solution needs carbon treatment	Filter solution over active carbon

Problem: Poor metal distribution

Cause	Correction
Air agitation too low or too high	Adjust air flow.
Mechanical agitation too fast	Reduce agitation rate.
Temperature too high	Cool solution.
Phosphorus content of anodes bad	Replace anodes.
Anodic current density too high	Reduce current density.
Anode to cathode ratio too small	See requirements for Anodes.
Heavier deposit on one side of panel	Balance anode area to cathode area.
Poor levelling	Increase current density. Increase cathode area. Filter bath. Check rinse quality

Problem: Matt deposit

Cause	Correction
Current density below 2 A/dm ²	Increase current density.
Temperature too high	Cool solution.
Lack of brightener	Replenish as necessary
Air agitation too low	Increase air.
Loose anode contacts	Check for proper contact.

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Plating System Step 5: Copper bath CU400

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Analysis (Experts only)

Cu²⁺:

1. Pipette 2.0 ml sample into a 250 ml E-beaker.
2. Add 80 ml DI water.
3. Add 1-2 ml buffer solution* with pH 10.
4. Add a pinch of murexindicator.
5. Titrate with 0.1 M EDTA from greenish to purple endpoint.

Calculation: $\text{g/l Cu}^{2+} = 3,177 \times \text{ml } 0,1 \text{ M EDTA}$

* Buffer solution pH 10:

1. Dissolve 70 g NH_4Cl in 570 ml NH_4OH . (d=0,90)
2. Add DI water until 1000 ml.

H₂SO₄:

1. Pipette 5.0 ml bath into a E-beaker.
2. Add 100 ml DI water.
3. Add 5-6 drops of methyl orange.
4. Titrate with 1.0 M NaOH to greenish endpoint.

Calculation: $\text{g/l H}_2\text{SO}_4 = 9.81 \times \text{ml NaOH}$

Chlorides:

The potentiometric method is recommended.

Potentiometric method:

1. Pipette exactly 50 ml bath into a 100 ml cup.
2. Place one silver-(Ag) and one mercury sulphate-(HgSO₄) electrode in a cup and connect them to a potentiometer.
3. Titrate with 0.02 M silver nitrate solution. (AgNO₃)
4. Add silver nitrate in small doses, for instance 0.2 ml each time.

Note potential after every addition. The total addition of silver nitrate that gives the greatest potential decrease is used in the calculation.

Calculation: $14.18 \times \text{ml } 0.02 \text{ M AgNO}_3$ at maximum.

Visual method:

1. Pipette 10 ml bath into an 100 ml E-beaker.
2. Add exactly 5 ml reagent solution*. If the solution becomes clear this means that the bath contains less than 15 mg/l Cl. If the solution stays turbid, add another 5 ml reagent solution. Every addition of 5 ml corresponds to 15 mg/l of Cl.

* The reagent solution: 0.170 g mercury nitrate ($\text{Hg}(\text{NO}_3)_2$) dissolved in (200 ml nitric acid diluted by 1:1 with DI water). Add 0.10 g AgNO₃ and dilute the solution to 1000 ml.