MiniContac RS

User manual

Order Code: 10030565

LPKF
Laser & Electronics

Laser & Electronics

MiniContac RS

Manual 5.3, English

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Translation

Item number: 10030565

Overview

Chapter	Description
1	Product description This chapter contains all general information about the unit.
2	Safety Instructions This chapter contains all relevant information for the safe use of the unit.
3	Function description This chapter contains all information about the unit's functions.
4	Transport and storage This chapter contains all information on transport and storage of the unit.
5	Installation and preparing operation This chapter contains all instructions on proper installation and preparing the unit for operation.
6	Operation This chapter describes in detail the operation of the unit.
7	Troubleshooting This chapter provides useful advice on eliminating minor faults of the unit.
8	Service and repair This chapter contains all servicing and maintenance measures.
9	Storage This chapter describes the decommissioning of the unit.
10	Appendix This chapter contains useful information about this manual and about consumables.

Symbols used

WARNING

› **This symbol warns of hazards to life or health.**

CAUTION

› **This symbol warns of hazards of material damage.**

Tip: This symbol is used for advice on how to prevent malfunctions or how to improve process flow.

Formatting conventions

Bold text is used to emphasise important information.

Menu items are printed in **BOLD CAPITALS**.

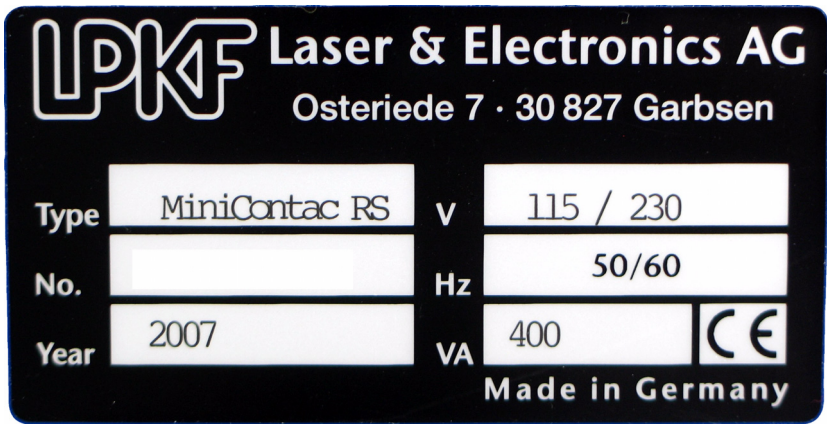
ITALIC CAPITALS identify the names of the chemicals used.

Contents

1. Product description

1.1 Brand and type identification

Fig. 1: Type plate MiniContac RS



The MiniContac RS unit has the item number 119987.

1.2 Scope of delivery

The MiniContac RS unit is shipped with the following items:

2	phosphated copper anodes with anode bags
2	circuit board holders (1 x with electric connector, 1 x w/o electric connector)
3	covers (1 for tanks 1&2, 1 for tank 3, and 1 for tank 4)
1	measuring cup
1	collecting tank
1	digital thermometer
1	spray bottle
1	wiper
1	roll of adhesive tape
1	tube clamp
1	this manual

For operating the unit you will need further accessories and consumables that have to be ordered separately (see chapter 1.5, "Accessories and consumables", on page 13).

1.3 Manufacturer/Distributors/Customer Service

LPKF Laser & Electronics AG
Osteriede 7
D-30827 Garbsen
Germany

Phone	+ 49 - 51 31 - 70 95 - 0
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1.4 Certification

1.4.1 Declaration of Conformity (German)

EG-Konformitätserklärung nach Maschinenrichtlinie 98/37/EG, Anhang II A

Der Hersteller / Inverkehrbringer

LPKF Laser & Electronics AG
Osteriede 7
30827 Garbsen
Germany

erklärt hiermit, dass folgendes Produkt

Produktbezeichnung:	Anlage zur Durchkontaktierung von Leiterplatten
Serien-/Typenbezeichnung:	MiniContac RS

den Bestimmungen der (den) oben gekennzeichneten Richtlinie(n) - einschließlich deren zum Zeitpunkt der Erklärung geltenden Änderungen - entspricht.

Wir unterhalten ein von der BVQI zertifiziertes Qualitätssicherungssystem nach ISO 9001 und haben daher bei der Entwicklung und Herstellung nachstehende EG Richtlinien und EN Normen beachtet.

Folgende harmonisierte Normen wurden angewandt:

- EN 349:1993 Sicherheit von Maschinen - Mindestabstände zur Vermeidung des Quetschens von Körperteilen
- EN 292-1:1991 Sicherheit von Maschinen - Grundbegriffe, allgemeine Gestaltungsleitsätze - Teil 1: Grundsätzliche Terminologie, Methodik
- EN 292-2:1991+A1:1995 Sicherheit von Maschinen - Grundbegriffe, allgemeine Gestaltungsleitsätze - Teil 2: Technische Leitsätze und Spezifikationen
- EN 1050:1996 Sicherheit von Maschinen - Leitsätze zur Risikobeurteilung
- EN 626-1:1994 Sicherheit von Maschinen - Reduzierung des Gesundheitsrisikos durch Gefahrstoffe, die von Maschinen ausgehen - Teil 1: Grundsätze und Festlegungen für Maschinenhersteller
- EN 60204-1:1997 Sicherheit von Maschinen - Elektrische Ausrüstung von Maschinen - Teil 1: Allgemeine Anforderungen
- EN 61000-3-2:2000 Elektromagnetische Verträglichkeit (EMV) - Teil 3-2: Grenzwerte - Grenzwerte für Oberschwingungsströme (Geräte-Eingangsstrom bis einschließlich 16 A je Leiter)
- EN 61000-6-2:2001 Elektromagnetische Verträglichkeit (EMV) - Teil 6-2 - Fachgrundnormen - Störfestigkeit - Industriebereich
- EN 61000-6-3:2001 Elektromagnetische Verträglichkeit (EMV - Teil 6-3: Fachgrundnormen - Fachgrundnorm Störaussendung - Wohnbereich, Geschäfts-und Gewerbebereiche sowie Kleinbetriebe

Folgende nationale oder internationale Normen (oder Teile/Klauseln daraus) und Spezifikationen wurden angewandt:

- EN55022 Klasse B Funkstörspannung, Funkstörstrahlung
- EN61000-4-3 Störfestigkeit
- EN61000-4-2 Störfestigkeit
- EN61000-4-6 Wechselstrom Netzein- und ausgänge
- EN61000-4-4 Wechselstrom Netzein- und ausgänge
- EN61000-4-5 Wechselstrom Netzein- und ausgänge
- EN61000-4-11 Wechselstrom Netzein- und ausgänge

Folgende weitere EU-Richtlinien wurden angewandt:

- EMV-Richtlinie 89/336/EWG
- Niederspannungsrichtlinie 73/23/EWG

Ort: Garbsen

Datum: 25.08.2006

Bernd Lange (Vorstand)

1.4.2 Declaration of conformity

EC declaration of conformity according to Machine Directive 98/37/EC, Annex II A

The manufacturer / seller

LPKF Laser & Electronics AG

Osteriede 7

D-30827 Garbsen

Germany

hereby declares that the following product

Product designation:	System for through-plating of circuit boards
Series/type designation:	MiniContac RS

conforms to provisions of the directive(s) identified above - including the modifications effective at the time of this declaration.

We maintain a quality assurance system compliant with ISO 9001 that has been certified by BVQI, which ensures that development and manufacturing are compliant with the following EC directives and EN standards.

The following harmonised standards were applied:

- EN 349:1993 Safety of machinery - Minimum gaps to avoid crushing of parts of the human body
- EN 292-1:1991Safety of machinery - Basic concepts, general principles for design - Part 1: Basic terminology, methodology
- EN 292-2:1991+A1:1995Safety of machinery - Basic concepts, general principles for design - Part 2: Technical principles and specifications
- EN 1050:1996 Safety of machinery - Principles for risk assessment
- EN 626-1:1994Safety of machinery - Reduction of risks to health from hazardous substances emitted from machinery - Part 1: Principles and specifications for machinery manufacturers
- EN 60204-1:1997Safety of machinery - Electrical equipment of machines - Part 1: General Requirements
- EN 61000-3-2:2000Electromagnetic compatibility (EMC) - Part 3-2: Limits - Limits for harmonic current emissions (equipment input currents up to and including 16 A per phase)
- EN 61000-6-2:2001Electromagnetic compatibility (EMC) - Part 6-2 - Generic standards - Immunity for industrial environments
- EN 61000-6-3:2001Electromagnetic compatibility (EMC) - Part 6-3 - Generic standards - Emission standard for residential, commercial and light-industrial environments

The following national and international standards (or parts/clauses thereof) and specifications were observed:

- EN55022 Class BRadio interference voltage, radio interference emission
- EN61000-4-3Interference immunity
- EN61000-4-2Interference immunity
- EN61000-4-6AC mains voltage inputs and outputs
- EN61000-4-4AC mains voltage inputs and outputs
- EN61000-4-5AC mains voltage inputs and outputs
- EN61000-4-11AC mains voltage inputs and outputs

The following additional EC directives were applied:

- EMC directive 89/336/EEC
- Low-voltage directive 73/23/EEC

Location: Garbsen (Germany)

Date: 2006-08-25

Bernd Lange (Chairman)

1.5 Accessories and consumables

WARNING

Danger of poisoning! Danger of chemical burns!

The chemicals used are poisonous and corrosive.

› Always wear protective gloves and goggles when handling the chemicals.

› Do not remove warning labels from the canisters of the chemicals or apply warning labels if not present and store the empty canisters for uncontaminated disposal of used chemicals.

The following chemicals that are not included but can be ordered from LPKF are required for through-plating using the MiniContac RS unit:

6.00 l	*CLEANER 110*
5.00 l	*CLEANER 210*
4.00 l	*AKTIVATOR 310*
16.00 l	*COPPER PLATER 400*
0.25 l	*SHINE 400*

You also need:

	distilled/de-ionised water
4	Containers/canisters for disposal of spent chemicals
1	Basin/sink for rinsing the circuit boards
1	window wiper with soft blade

2. Safety Instructions

- **Never put your hands into the machine while it is in operation!**
- **Avoid any contact with the fluids used! In case of skin contact rinse immediately with plenty of water, in case of eye contact rinse immediately with plenty of water and consult an ophthalmologist!**
- **Do not prepare or consume food while operating the unit!**
- **Wash your hands after operating the unit!**
- **Wear suitable protective clothing while operating the unit (protective goggles and protective gloves)!**
- **Do not drink the fluids.**
- **Do not spill any of the fluids!**
- **Any user modifications of the unit jeopardise the unit's safe operation and result in the loss of warranty!**
- **Note that some materials may produce hazardous fumes or gases during processing. Contact your supplier about such hazards.**
- **Ventilate manually every 10 minutes when using the unit in rooms without ventilation system.**
- **Observe the notes and instructions on the canisters and/or the separate safety data sheets of the chemicals!**
- **Use the chemicals only for their specified purpose!**
- **Keep your workspace clean!**
- **The unit may only be used in a clean and undamaged state. Inspect the safety devices regularly!**
- **Always keep a legible and complete copy of this manual at the unit's work station.**
- **Only sufficiently qualified and authorised persons may operate the unit.**

(Page 1 of 2)

- **Operators must have read this manual and know the safety instructions.**
- **Take special care to rinse the circuit boards thoroughly. No chemicals of one tank may reach the next tank. The circuit board holders also have to be rinsed thoroughly after use.**
- **Do not clean the circuit boards with steel wool or similar materials. Even the smallest metal particles can utterly spoil the chemicals.**
- **Always keep the tanks covered and as clean as possible. This will ensure a long service life of the chemicals.**
- **Ensure that the holes are flawless. Use the proper drilling parameters.**

(Page 2 of 2)

3. Function description

3.1 Function and scope of application

The MiniContac RS unit is made for galvanic through-plating of circuit boards using the black hole process and for galvanic reinforcement of copper surfaces. Via holes of a minimum diameter of 0.2 mm can be plated.

The unit can be used for double-sided and multi-layer circuit boards.

Tip: The surfaces of the copper deposited in the through-plating process are smoother and more homogenic when using circuit boards with a protective copper film compared to using circuit boards without such protective film. Thus, always use circuit boards with protective copper film if possible.

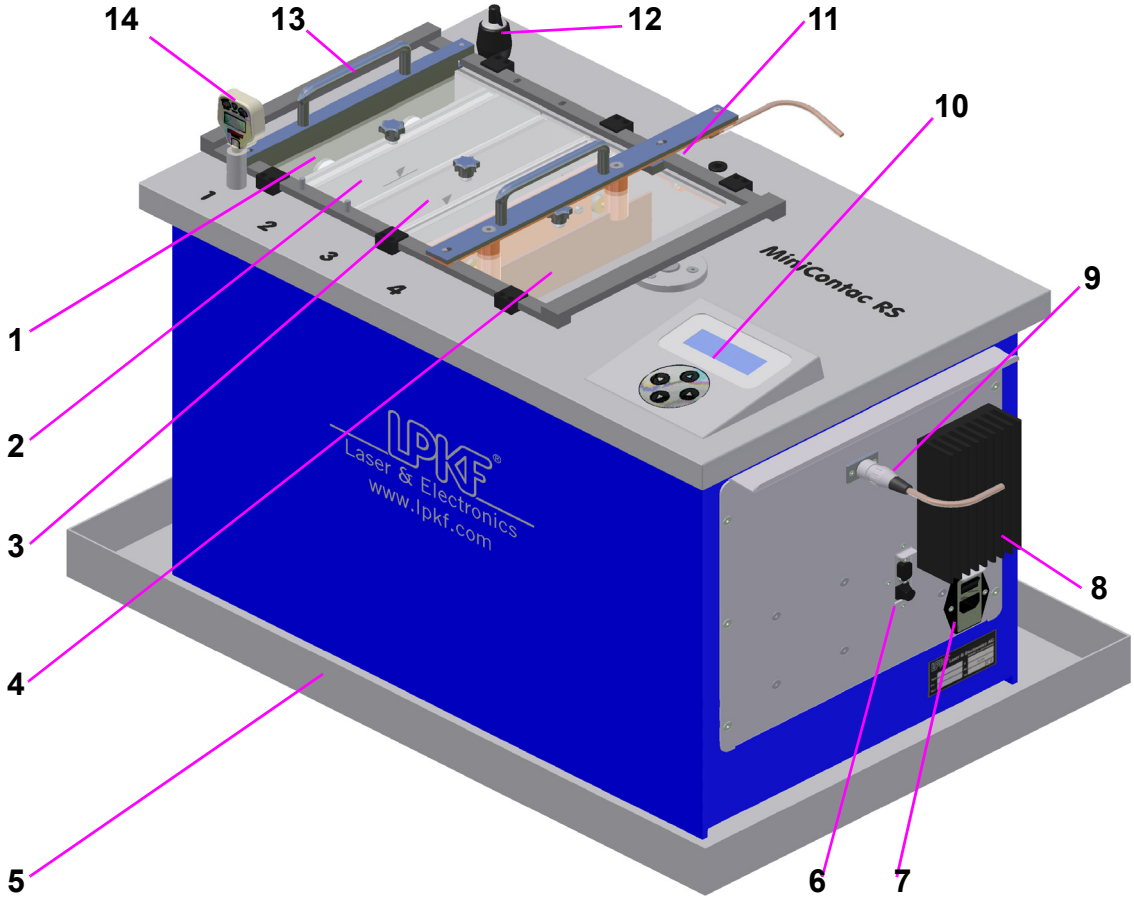
3.1.1 Unit description

The unit consists of a durable plastic and metal case containing the tanks for the chemical baths, the motion mechanism, the circuit board holders, and the control panel with status display.

The control panel is located on the right of the unit top and the main switch is located on the right side panel of the unit.

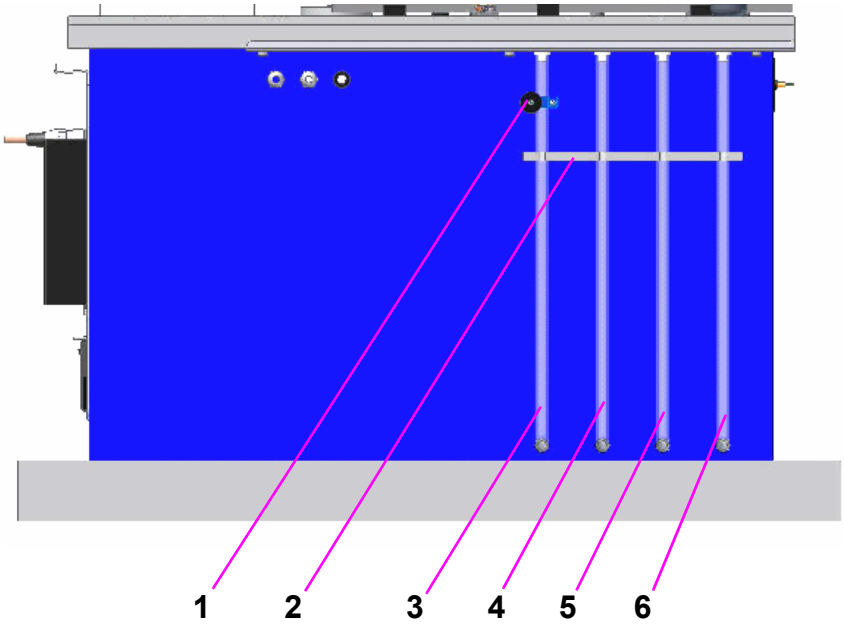
Note: The MiniContac RS unit does not provide tanks for rinsing or drying. The processed circuit boards have to be rinsed in an external basin or sink.

Fig. 2: MiniContac RS



1 Tank 1
2 Tank 2
3 Tank 3
4 Tank 4
5 Collecting tank
6 Service interfaces
7 Mains switch
8 Heat sink
9 Cathode socket
10 Control panel
11 Circuit board holder with electrical connection (cathode)
12 Heating element
13 Circuit board holder w/o electrical connection
14 Digital thermometer

Fig. 3: Rear view of MiniContac RS with drainage tubes

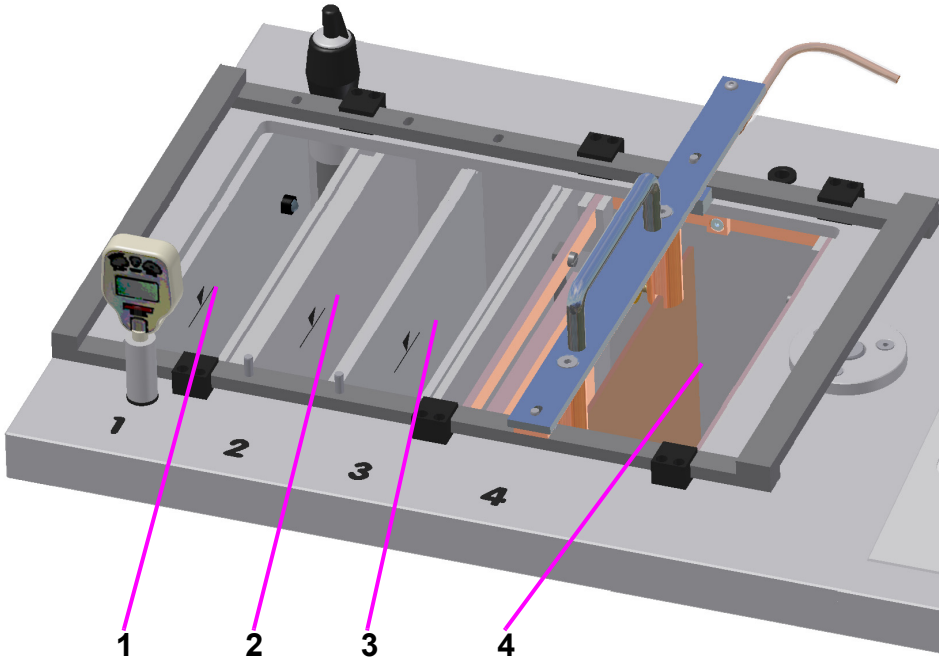


1 Tube clamp
2 Clamp rail
3 Drainage tube for tank 4
4 Drainage tube for tank 3
5 Drainage tube for tank 2
6 Drainage tube for tank 1

There is a drainage tube for each tank at the rear of the unit. Leaking fluids are collected in the collecting tank of the MiniContac RS unit. If you frequently find fluids in the collecting tank contact the LPKF service.

3.1.2 Description of the individual tanks

Fig. 4: Tank configuration



1 *CLEANER 110*
2 *CLEANER 210*
3 *AKTIVATOR 310*
4 *COPPER PLATER 400*

Table 1: Tank specifications

	Tank 1	Tank 2	Tank 3	Tank 4
Function	Degreasing	Cleaning	Activation	Copper-plating
Chemical	CLEANER 110	CLEANER 210	AKTIVATOR 310	COPPER PLATER 400
Dimensions w x l x d	45 x 363 x 328 mm	45 x 363 x 328 mm	45 x 363 x 246 mm	152 x 363 x 328 mm
Chemical volume	5 l	5 l	3.8 l	14.3 l
Heating	yes, 55 °C	no (room temperature 18 - 25 °C)		
Cover	combined		single	single

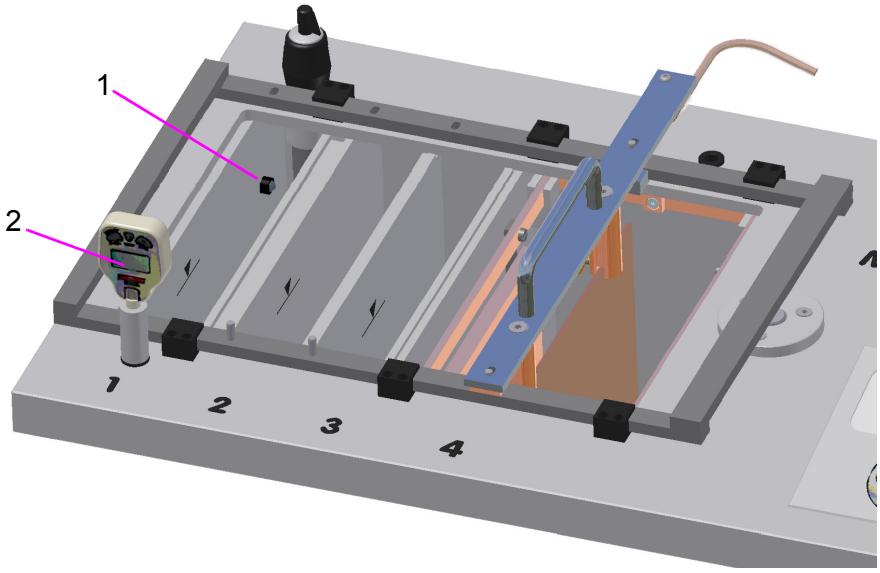
The amount of chemicals supplied in canisters is larger than the tank volume, so ensure that the marked fill level of the tanks is not exceeded when filling. The tanks must not be filled higher than the triangular marks or approx. 5 mm below the copper rails in case of tank 4(see chapter 5.3.2, "Filling the tanks", on page 35).

Tip: The MiniContac RS unit does not provide tanks for rinsing and drying. The processed circuit boards have to be rinsed in a separate basin or sink.

3.1.3 Fill level sensor

A fill level sensor is located at the rear left side wall of the first tank to monitor the fill level. If the sensor is not covered by fluid when the unit is switched on an error message is displayed (see chapter 7.2, "Error codes", on page 53) and the heating will remain switched off. If the sensor is covered by fluid when the unit is switched on the heating element is activated and starts heating the chemical bath. The temperature is preset.

Fig. 5: Fill level sensor



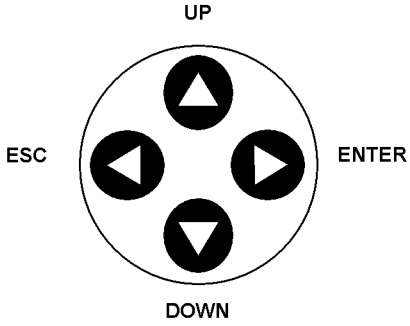
1 Fill level sensor

2 Digital thermometer

3.1.4 Control panel

The keys of the control panel have the following functions:

Fig. 6: Control panel keys



UP select menu item or value above

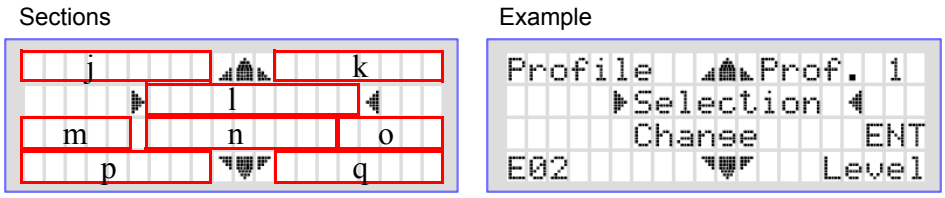
ESC leave menu item and return to higher menu level

ENTER confirm menu selection or value

DOWN select menu item or value below

The display screen has 4 rows of 20 character elements each. The following figure shows the screen sections and an example screen.

Fig. 7: Display



1 current menu
2 active profile
3 current menu item or value
4 "ESC“ or set phase time
5 following menu item or explanation
6 "ENT“ or remaining time
7 message segment 1
8 message segment 2

Note: The factory default language setting of unit is English, the chapter "The Setup menu" on page 24 describes the setting of the language.

The keys function as follows:

- Use the p and q keys to select a menu item or a value.
- Press the t key to leave the current menu (**ESC**).
- Press the u key (**ENT**) to activate the selected menu.
- For confirming changed values move the cursor to the right by pressing the u key several times and press the u key one more time to confirm the changed value.

The following pages provide details on the individual menus.

3.1.5 Menus

The following menus can be selected:

Table 2: Menu levels

Level 1	Level 2	Level 3	Level 4
Profiles	Selection	Profile 1 - 9	
	Change	Profile 1 - 6, 8 + 9	T bath 1
			T bath 2
			T bath 3
			T bath 4
			Current
			RPP
Phases	Phase 1 - 4	Start	
		Pause	
		Change	
		End	

Level 1	Level 2	Level 3	Level 4
Setup	Save		
	Signal	Yes	
		No	
	Fact. set		
	Message	Yes	
		No	
	Language	German	
		English	
	Interface	RS 232	
		Ethernet	
	Version		
	Chemie	Max. Ah	
		Cur. Ah	
		Refilled	Yes
			No
Service	For LPKF service personnel only! Password required!		

The Profiles menu

Profiles 1 to 7 have been pre-edited by LPKF for use with 9 x 12 “ circuit boards. Profiles 8 and 9 can be defined by the user.

Table 3: Profile data

Pro-file	Application (values for 9 x 12“ circuit boards)	Via hole diameter	Bath Time in minutes				Cur-rent in A	RPP
			1	2	3	4		
1	standard	A 0.4 mm	65	5	15	90	12	off
2	standard with RPP	ƒ 0.4 mm	65	5	15	90	12	on
3	multi-layer	A 0.4 mm	80	10	25	120	12	off
4	multi-layer with RPP	ƒ 0.4 mm	80	10	25	120	12	on
5	flexible circuit board	A 0.4 mm	80	5	15	60	10	off
6	flex. circuit board with RPP	ƒ 0.4 mm	80	10	25	60	10	on
7	Initialisation		see "Initialisation" on page 36					
8	User-defined							
9	User-defined							

The data in above table can be changed individually via menu item **CHANGE** (see chapter 6.1, "Changing settings", on page 39).

Menu item **SELECTION** allows you to select one of profiles 1 to 9. If the selection is saved the selected profile will be still active when the unit is switched on the next time.

The Phases menu

The circuit board has to be processed in the sequence of **PHASE 1** through **PHASE 4** (degreasing, cleaning, activation, and copper-plating). The phases have to be selected and started individually in the menu.

Input	Comment
START	The phase is started or continued and the time countdown is running.
PAUSE	The phase is interrupted, the time counter is on hold, and settings can be checked or changed.
CHANGE	Current values of the phase (processing time in phases 1-4, in phase 4 also electric current and RPP) can be changed (see chapter 6.1, "Changing settings", on page 39).
END	Phase is finished, leave the current phase by subsequently pressing the t key.

The Setup menu

The **Setup** menu has the following functions:

Table 4: Setup functions

Function	Input	Comment
Save		Saving settings in the EEPROM
Signal	Yes / No	Beeper on / off
Fact. set		set factory defaults
Message	Yes / No	Message service on / off
Language	German/ English	Language selection
Interface	RS 232/ Ethernet	Interface selection (LPKF service personnel only)
Version		Display firmware version
Max. Ah (Chemie)	number of ampere-hours	Setting of the amount of electric energy used (measured in ampere-hours) before the prompt to add chemical should be displayed

Function	Input	Comment
Cur. Ah (Chemie)		Display of ampere-hours used since last adding of chemical
Ergänzt (Chemie)	Yes / No	Confirmation whether chemical was added; entering "Yes" resets the counter to "0"

Changing the settings is described in chapter 6.1, "Changing settings", on page 39.

The Service menu

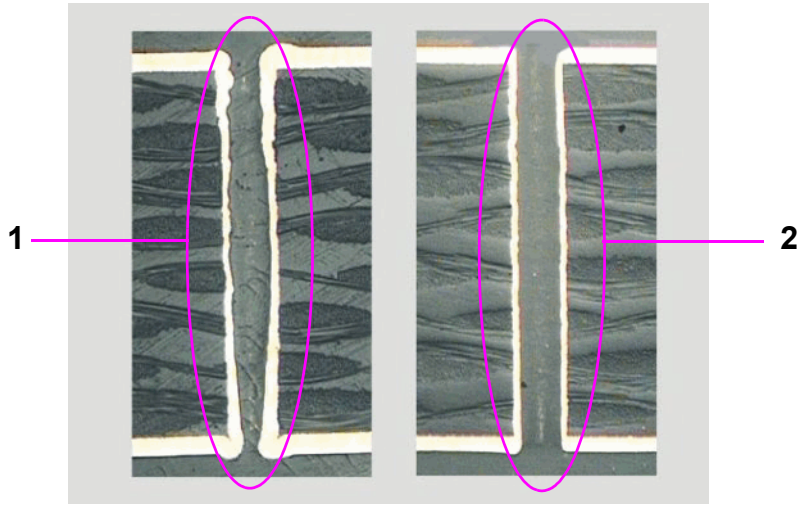
The **SERVICE** menu is used exclusively by LPKF service personnel.

3.1.6 Reverse Pulse Plating

The “Reverse Pulse Plating“ mode is activated in profiles 2, 4, and 6 pre-edited by LPKF (see table 3 on page 23). Reverse Pulse Plating is implemented in the special LPKF control circuit that monitors the the whole through-plating process.

Conventional electroplating results in increased deposition of material on the rims of the via holes due to the distribution of flux lines. This so-called "dog-bone effect" of edge buildup during metal deposition occurs especially at a large depth-to-diameter ratio of the via holes (see 1 in the figure).

Fig. 8: Dog-bone effect



1 with dog-bone effect **2** without dog-bone effect

Reverse pulse plating uses short inverted pulses during which the circuit board acts as an anode. This causes parts of the bulging material to be removed so that the overall copper deposition is more uniform (see 2 in the figure).

3.2 Safe and correct use

The unit must be used only as described in this manual. Any other application is not permitted or needs prior approval of LPKF AG.

3.3 Specifications

Dimensions:

Width:	750 mm
Length:	500 mm
Height:	525 mm
Weight:	approx. 47 kg (tanks empty)

Power requirements:

Voltage:	230 V + 15/ -30 % at 50 - 60 Hz
	115 V + 15/ -30 % at 50 - 60 Hz
Input power:	400 VA

Ambient temperature:	18 - 25 °C (64 - 77 °F)

max size of base material:	230 x 330 mm
max size of circuit board	approx. 200 x 260 mm

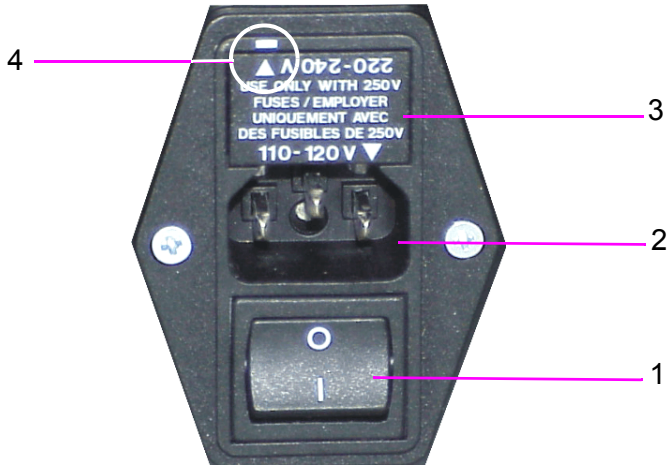
Note: For changing the input voltage the fuse module next to the mains switch has to be inserted in the corresponding orientation (see "Checking/Setting the mains voltage setting" on page 34).

Note: To ensure proper function of the chemical baths the ambient temperature range must be strictly adhered to.

3.4 Power supply

The power supply connector is located on the right side panel next to the mains switch.

Fig. 9: Power connector and mains switch



1 Mains switch
2 Mains cable connector
3 Voltage module (with mains fuses)
4 Mark

3.5 Energy consumption

In constant use, the unit consumes approximately 0.3 kWh per hour.

3.6 Emission

The unit itself does not produce emissions. In the case of the chemicals used refer to the safety data sheets of the chemicals.

4. Transport and storage

4.1 Transport

WARNING

Lifting hazard — heavy object.

The unit weighs approx. 47 kg. Single person lifting could cause muscle strain or back injury.

› Always have two persons of adequate physical strength lift, move, or install the unit.

CAUTION

Risk of breakage!

Unit can be damaged when transported.

› Transport the unit only proper packaging.

› Transport utilities must be designed for loads greater than 70 kg.

4.2 Storage

Store the unit in a frost-free and dry place.

5. Installation and preparing operation

5.1 Safety measures before installing

Mains power (230/115 V) must be supplied via a Residual Current Device (RCD, aka GFI, Ground Fault Interrupter).

A sufficiently large, horizontal, and firm workspace must be provided for the MiniContac RS unit.

5.2 Unpacking, disposal of packing materials

Note: Unpack the unit carefully and store the packing material. This facilitates safe packing and shipping of the unit if the unit has to be serviced.

Unpacking the unit

WARNING

Lifting hazard — heavy object.

The unit weighs approx. 47 kg. Single person lifting could cause muscle strain or back injury.

› Always have two persons of adequate physical strength lift, move, or install the unit.

1. Lift off the the lid of the transport box.
2. Remove the enclosed smaller components from the box.
3. Remove the collecting tank from the box.
4. With the aid of at least one more person, lift the unit out of the box.
5. Store the packing material for later transport of the unit.

[ ] The unit is unpacked and can now be set up.

5.3 Setting up and putting into service

CAUTION

Risk of damage!

The foam packaging of the heating element can melt and contaminate the unit.

› The foam packaging of the heating element must be removed before putting the *MiniContac RS* unit into service!

Tip: The unit and the chemical baths must be initialised, which takes approx. **300 minutes**, before producing the first through-plated circuit board. Please bear this **lead time** in mind when putting the unit into service.

5.3.1 Assembling

Installing the unit

WARNING

Lifting hazard — heavy object.

The unit weighs approx. 47 kg. Single person lifting could cause muscle strain or back injury.

› Always have two persons of adequate physical strength lift, move, or install the unit.

1. Transfer the unit and its accessories to a firm, horizontal and sufficiently large workspace.
2. Place the collecting tank on the workspace surface.

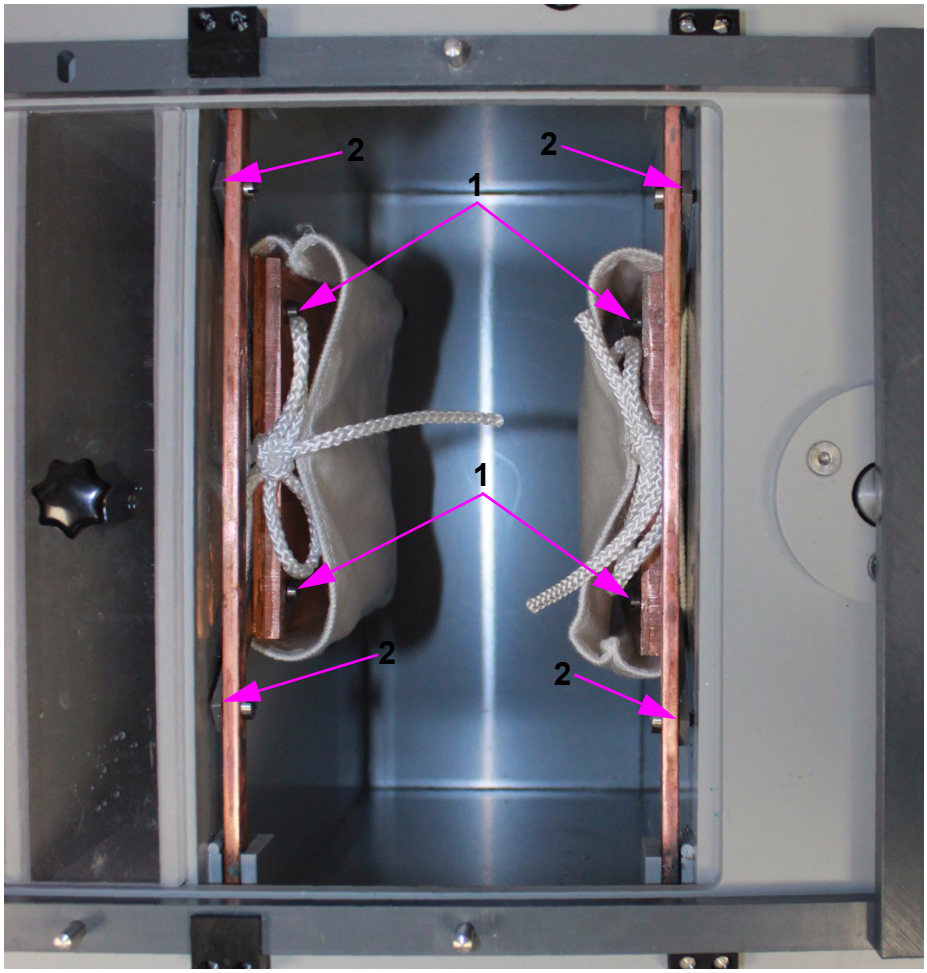
   Note: When setting up the unit bear in mind that you need additional basins or a sink (not included) for rinsing the circuit boards.
3. With the aid of at least one more person set the unit into the collecting tank.

[ ] The unit is set up and you can now mount the copper anodes.

Mounting the copper anodes

The phosphated copper anodes supplied with the unit have to be installed in **tank 4**. Proceed as follows:

Fig. 10: Copper anodes



1 Anode bolts (see arrows) **2** Anode rails (see arrows)

1. Unscrew the lower anode bolts (**1**) from the anode rails (**2**) in tank 4.

Note: Do not unscrew the anode rails!

2. Put some padding (e.g. the foam packaging of the heating element) on the bottom of tank 4 for protection.
3. Remove the copper anodes from their packing material.
4. Set the first copper anode in its cloth bag on the padding in tank 4 and screw it to the anode rail using the anode bolts.
5. Repeat this step with the second copper anode.
6. Remove the padding from tank 4 and ensure that no residues remain in the clean tank.

7. Tie a knot of the laces of the anode bags directly above the copper anodes and place the lace ends into the anode bags.

[ ] The copper anodes are mounted you can now insert the thermometer.

Inserting the thermometer

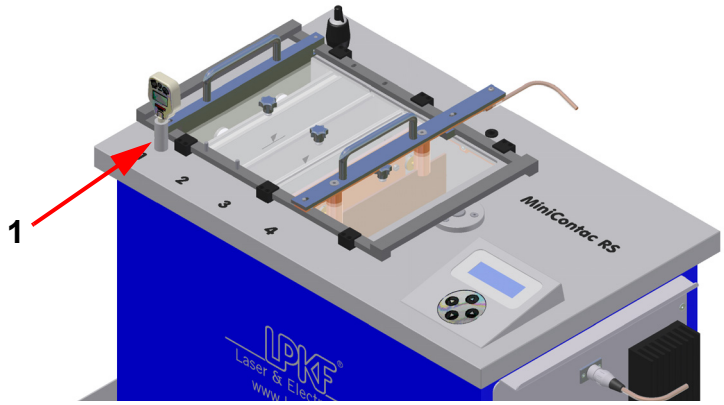


Fig. 11: Thermometer position

1 Thermometer position

1. Remove the thermometer from its packaging.

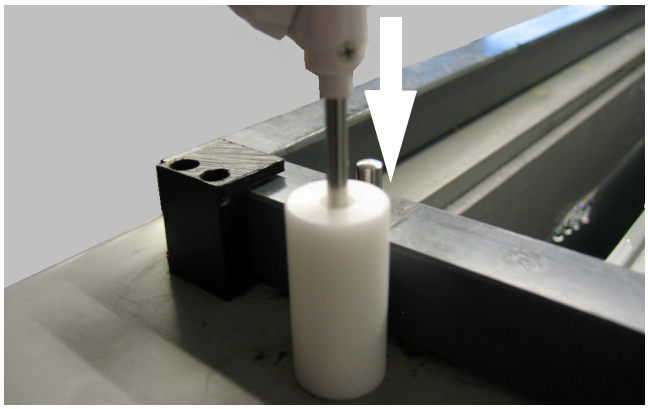


Fig. 12: Inserting the thermometer

2. Insert the thermometer in its intended opening in front of tank 1.

[ ] The thermometer is mounted.

Checking/Setting the mains voltage setting

The voltage setting can be switched between 110-120 V and 220-240 V. The current setting is identified by the white triangle behind the current voltage setting pointing to the rectangular mark (4) on the rim (see figure below). In order to switch the voltage proceed as follows:

1. Insert a flat screwdriver into the notch on the underside of the module and carefully extract the module (3).
2. Rotate the module by 180°.

3. Re-insert the module in such a way that the other white triangle points to the white mark on the rim.

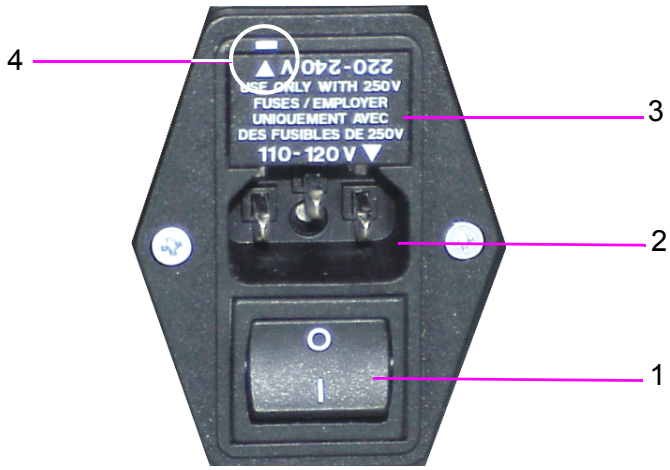


Fig. 13: Power connector and mains switch

1 Mains switch
2 Mains cable connector
3 Voltage module (with mains fuses)
4 Mark

Connecting the mains cable

1. Plug the mains cable into the connector (2).

[ ] The electric connection is made and you can now fill in the chemicals.

5.3.2 Filling the tanks

Filling in chemicals

WARNING

Danger of chemical burns!

Contact with the chemicals causes chemical burns.

› **Wear suitable protective clothing while operating the unit (protective goggles and protective gloves)!**

The tanks have been cleaned and rinsed before shipping so the through-plating chemicals can be filled in without further preparation.

1. Fill *CLEANER 110* into **tank 1** up to the triangular mark.

Tip: Always ensure that tank 1 is properly filled with *CLEANER 110*. Replace evaporation losses with distilled or de-ionised water **only if need be**.

2. Fill *CLEANER 210* into **tank 2** up to the triangular mark.

3. Fill *COPPER PLATER 400* into **tank 4** up to approx. 5 mm below the copper rails.
4. Use the supplied measuring cup for measuring exactly 2 ml of SHINE 400 per litre of COPPER PLATER 400 filled, but only 28 ml maximum.
5. Add the measured quantity to **tank 4**.
6. Shake the canister containing *AKTIVATOR 310* thoroughly (approx. 1 minute).

   Note: Tank 3 for the *AKTIVATOR* chemical must be absolutely dry and clean before filling and should be filled last.
7. Fill *AKTIVATOR 310* into **tank 3** up to the triangular mark.
8. Fill the supplied spray bottle with distilled or de-ionised water.

[ ] The tanks are filled with the chemicals and the unit can be initialised.

5.3.3 Initialisation

Initialising the unit

CAUTION

Risk of damage!

The circuit board holder with electric connector is to be used in tank 4 only.

› The circuit board holder with electric connector may only be used in tank 4.

After mounting the copper anodes and filling the tanks you can put the unit into service. Proceed as follows:

1. Switch on the unit (mains switch to **I**).

   The unit starts heating the chemical bath in tank 1 and indicates this in the status display.
2. Wait until the operating temperature of approx. 55 °C is reached. Check the temperature of the chemical bath in tank 1 using the thermometer.
3. Insert a dummy circuit board (old double-sided circuit board) in the circuit board holder without electric connector.
4. Rinse the dummy board thoroughly in an external basin or sink.
5. Insert the dummy board into **tank 1**.
6. Select **PROFILE 7** (Initialisation, see page 23) and start the **PHASES** menu (see "Menus" on page 22).
7. Select and start **PHASE 1**.

   When the time counter is down to 0, a beep sounds and the status display prompts you to rinse the board.

8. Acknowledge the end of **PHASE 1** by selecting and confirming **END**.
9. Take the circuit board out of the tank and rinse it thoroughly in an external basin or sink.

Note: Phases 2 and 3 are not needed for initialisation!

10. Fasten the circuit board to the circuit board holder with electrical connector.
11. Ensure that the cathode connector is plugged properly.
12. Insert the circuit board into **tank 4**.
13. Select and start **PHASE 4**.

This phase takes **approx. 300 minutes!** When the time counter is down to 0, a beep sounds and the status display prompts you to rinse the board.

14. Finish **PHASE 4** by selecting and confirming **END**.
15. Rinse the circuit board thoroughly with tap water and dispose of properly.
16. In the menu **SETUP** , submenu **CHEMIE**, confirm the item **ERGÄNZT** (see "The Setup menu" on page 24).

    The ampere hour counter is reset to 0.

[ ] The initialisation is finished and the unit is ready for operation.

5.4 Storage and conservation in the intervals of normal usage

It is essential that the tanks are covered immediately after use in order to prevent contamination of the chemical baths. Switch off the unit (mains switch to **0**) for longer periods of non-use (e.g. weekends).

For longer periods of non-use (several days) observe the notes in chapter 8.1, "Routine inspection".

5.5 Intended operators

The MiniContac RS unit may only be operated by persons with at least basic knowledge of circuit board manufacturing including multi-layer manufacturing for electronics.

5.6 Storage of the documentation

Keep a legible copy of this manual and the chemicals documentation near the unit.

6. Operation

WARNING

Danger of chemical burns!

Contact with the chemicals can cause chemical burns.

› Wear suitable protective clothing while operating the unit (protective goggles and protective gloves)!

CAUTION

Chemicals can be ruined!

Contaminants can cause chemical reactions and degrade the through-plating or ruin the respective chemical bath.

› Never use oil-contaminated compressed air for blow-off!

CAUTION

Chemicals can be ruined!

The chemical baths can be ruined by carry-over from the previous baths.

› Use the supplied adhesive tape to seal the edges of multi-layer circuit boards to prevent carry-over.

The circuit board should be drilled only with carbide drills that are suitable for the board material and are in mint condition. Comply with the drill parameters found in the drill's manual or the tool libraries of *BoardMaster*.

Preferably use FR4 with a copper layer of 5 or 9 µm (depending on availability). As this material has a protective copper film, rinsing suffices to clean the drilled holes.

When using base material without protective film, e.g. FR4 18/18 µm, you need to deburr the drilled board and brush or scrub the surface, e.g. with a non-woven synthetic (do not use steel wool). Rinse the circuit board thoroughly, especially the holes.

Before processing the circuit board select the profile suitable for your requirements. If you should use board material of dimensions other than 9 x 12 “, you will have to edit the profile according to the board dimensions employed (see "The Profiles menu" on page 23).

6.1 Changing settings

Changing profile

In order to change the individual menu items proceed as follows (example: **T bath 2** in **PROFILES**):

1. Select the menu item to be changed (see "Menu levels" on page 22).
2. Edit the time setting as follows:

3. Select the digit using the u key.
4. Choose a number by pressing the p or q key.

   Note: You can abort by pressing the t key (corresponds to **ESC**).

5. Press the u key several times to move the cursor to the last entry position and press the u key one more time (corresponds to **ENT**).

   The value entered is stored.

6. Press the t key (**ESC**) as many times as needed to reach the main menu.

[ ] The change is completed.

Note: If any problem arises contact the LPKF customer service.

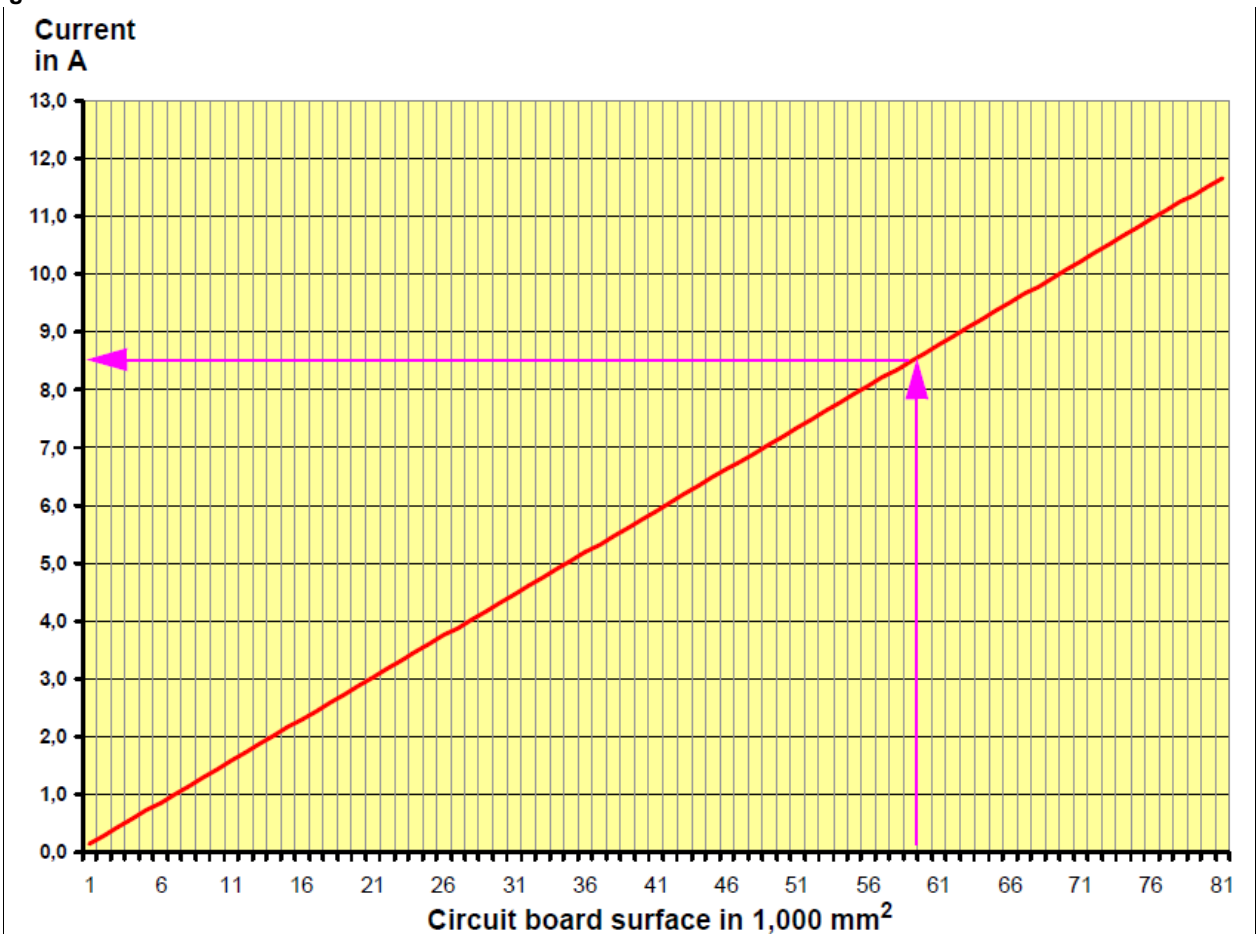
Calculating the current

When using circuit boards of dimensions other than provided in the profiles, the current has to be recalculated and the profile has to be edited accordingly (see "Changing settings" on page 39). The current is calculated as follows:

1. Calculate the circuit board surface w x l in mm^2.

2. Read the current value from the following graph:

Fig. 14: Current calculation



Tip: For a circuit board of 200 x 300 mm (60,000 mm^2) a current of 8.6 A must be set.

3. Change the setting of the current via the menu.

Note: If you operate the unit at too high current settings the surface of the circuit board is degraded and the service life of the chemical bath is also reduced.

6.2 Latching the circuit board holder

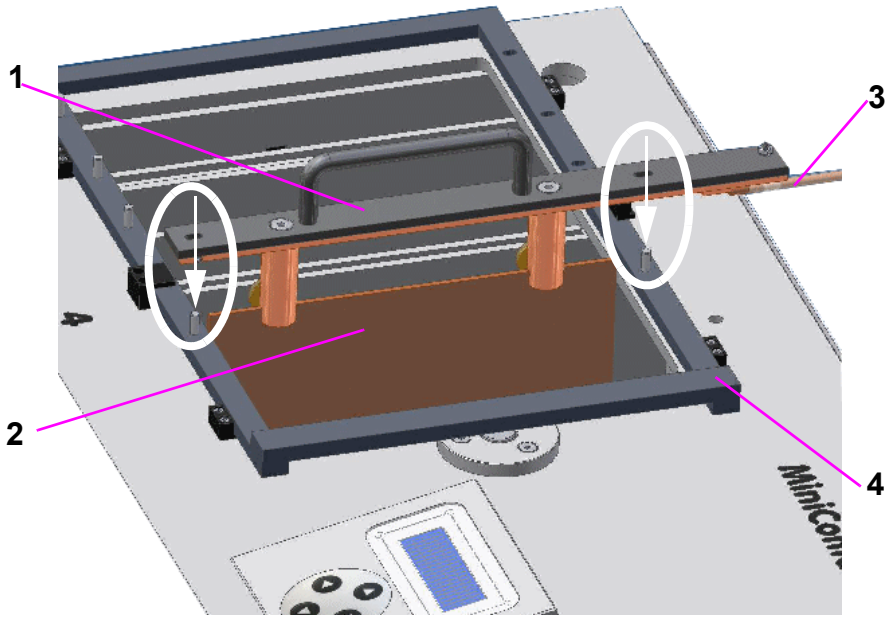
Latching the circuit board holder

Handle the circuit board holders as follows:

Note: This procedure is for both circuit board holders, with and without cathode connector.

1. Fit the holes of the circuit board holder onto the pins on the tank frame (see figure below).

Fig. 15: Inserting the circuit board holder



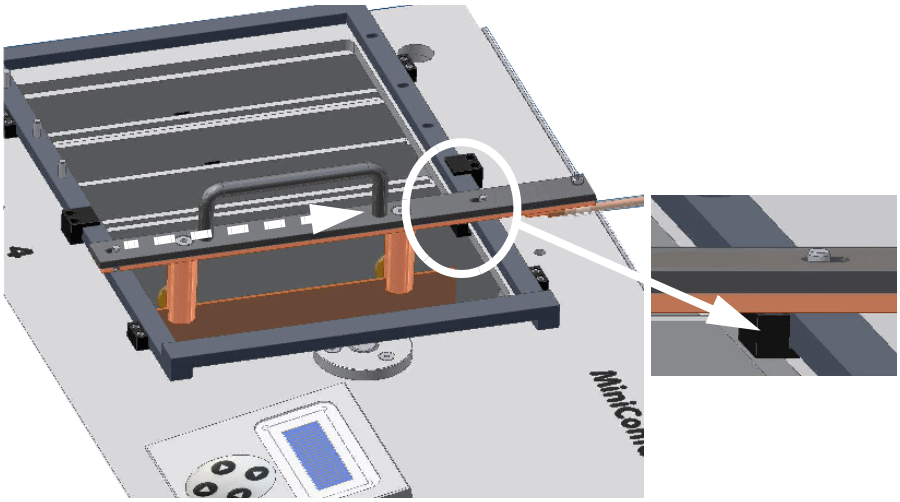
1 Circuit board holder
2 Circuit board
3 Plug for cathode board holder
4 Frame

2. Lift the front end of the circuit board holder for approx. 3 cm and knock it several times (8-10 times) on the frame before setting it down again.

   Note: This removes air bubbles from small via holes.

3. Shift the circuit board holder towards the back so that the clasp locks into place under the frame (see figure below).

Fig. 16: Latching the circuit board holder



6.3 The through-plating process

WARNING

Danger of chemical burns!

Contact with the chemicals can cause chemical burns.

› Wear suitable protective clothing while operating the unit (protective goggles and protective gloves)!

Tip: Depending on tank temperature, current, circuit board size and condition of the chemicals, an average of 0.1 - 0.2 µm copper are deposited per minute. Thus, approx. 6 - 12 µm copper are deposited per hour. Please note that these values are only estimates for the attainable copper layer thickness that can vary with a unit for laboratory use such as the MiniContac RS unit.

If you need exact values for the copper thickness in the via holes it is advisable to manufacture several test circuit boards and use micrographs to measure the actual thickness.

Once you have found the parameters for the desired thickness you can start through-plating the real circuit board.

We recommend using the parameters specified by us to obtain satisfactory through-plating results.

Note: Ensure that the room temperature is in the range of 18-25 °C as the chemical baths do not work outside this range.

Note: Use the supplied adhesive tape to seal the edges of multi-layer circuit boards to prevent carry-over.

6.3.1 Work prerequisites

Ensure that:

- The unit is switched on (mains switch to **I**).
- Bath 1 is heated (operation temperature of approx. 55 °C is displayed on the digital thermometer).

6.3.2 Work process

WARNING

Danger of chemical burns!
Contact with the chemicals can cause chemical burns.
› Wear suitable protective clothing while operating the unit (protective goggles and protective gloves)!

Fastening the circuit board

1. Fasten the base material to the circuit board holder.
2. Rinse the circuit board thoroughly in an external basin or sink.

Phase 1: Degreasing the circuit board

1. Insert the circuit board with several knocking movements (see "Latching the circuit board holder" on page 41) into tank 1.

2. Select and start **PHASE 1**.

   When the time counter is down to 0, a beep sounds and the status display prompts you to rinse the board.

3. Acknowledge the end of **PHASE 1** by selecting and confirming **END**.
4. Take the circuit board out of the tank and rinse it thoroughly with tap water in an external basin or sink.

   Note: It is necessary to rinse the circuit board **immediately** after taking it out of bath 1 to prevent the degreasing agent from hardening. To rinse the circuit board move it up and down in a jet of water for about 15 times or at least 30 seconds. Ensure that the circuit board fastenings are also rinsed in order to minimise carry-over.

[ ] The circuit board is degreased and ready for cleaning (phase 2).

Phase 2: Cleaning the circuit board

1. Insert the circuit board with several knocking movements (see "Latching the circuit board holder" on page 41) into tank 2.

2. Select and start **PHASE 2**.

   When the time counter is down to 0, a beep sounds and the status display prompts you to rinse and subsequently dry the board.

3. Acknowledge the end of **PHASE 2** by selecting and confirming **END**.
4. Take out the circuit board and rinse thoroughly with tap water in an external basin or sink.

5. Using the spray bottle supplied with the unit, rinse the circuit board with distilled or de-ionised water. Make sure that the via holes are also rinsed thoroughly in this step.

   Note: Take special care rinsing the circuit board otherwise the *AKTIVATOR* chemical is ruined by trace elements of the tap water (chlorine, calcium carbonate etc.) and has to be replaced completely.

6. Blow off the circuit board with oil-free compressed air until the water is removed from the holes.

Note: The circuit board does not have to be completely dry but make sure that the holes are completely cleared for the next phase. Too much water dilutes the *AKTIVATOR* chemical!

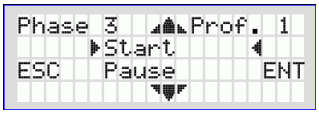
7. Cover tanks 1 and 2 to avoid evaporation losses.

   Note: Keep tank 4 covered as well.

[ ] The circuit board is cleaned and ready for activation (phase 3).

Phase 3: Activating the circuit board

1. Insert the circuit board with several knocking movements (see "Latching the circuit board holder" on page 41) into tank 3.



2. Select and start **PHASE 3**.

When the time counter is down to 0, a beep sounds and the status display prompts you to dry the board.

3. Acknowledge the end of **PHASE 3** by selecting and confirming **END**.
4. Take the circuit board out of the tank and wipe off the *AKTIVATOR* on both sides letting the liquid drip back into tank 3 using the wiper shipped with the unit.

   Note: If you are using base material without protective film use a separate wiper with a soft blade so that the *AKTIVATOR* is not scraped out of the via holes.

5. Tap the almost dry circuit board on a soft surface so that surplus *AKTIVATOR* is removed even from small via holes.
6. Unfasten the board from the circuit board holder.
7. Let the circuit board dry thoroughly (e.g. using a hair dryer, max. temperature 95 °C, +/- 5 °C for 4 minutes +/- 1 minute) and remove surplus *AKTIVATOR* by tapping the board in turns on a soft surface.

   Note: Drying the *AKTIVATOR* can also be achieved using a drying cabinet at 100 °C max. (95 °C, +/- 5 °C for 4 minutes +/- 1 minute).

   Note: Ensure that the holes are not blocked by residues.

8. If you are using FR4 base material with copper film remove the film after drying.

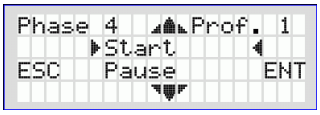
[ ] The circuit board is ready for copper plating (phase 4).

Phase 4: Preparing the copper plating

1. Remove any oxide layers on the circuit board holder with electrical connector using sandpaper (copper gleam must be visible at the bolt and the flat surfaces).
2. Fasten the circuit board to the circuit board holder with electrical connector.
3. Ensure that the cathode connector is plugged properly.

Phase 4: Starting copper plating

1. Insert the circuit board with several knocking movements (see "Latching the circuit board holder" on page 41) into tank 4.



2. Select and start **PHASE 4**.

During this phase it must be checked whether all via holes are plated with copper.

Phase 4: Checking the circuit board

1. After approx. 15 to 20 minutes select and confirm **PAUSE** in order to interrupt the through-plating process.

   The countdown is halted.

2. Take the circuit board out of the tank.
3. Rinse the circuit board thoroughly in an external basin or sink.
4. Check the circuit board:
   - Check whether the circuit board edge is copper-plated already.
   - For multi-layer circuit boards the edges of which you have sealed with adhesive tape, use a magnifying glass to inspect the largest via hole whether it is copper-plated already.

If the circuit board edges (or holes) are already copper-plated the process works fine. Otherwise:

- Check the parameter settings (current, RPP).

Phase 4: Resuming the copper plating

1. Reinsert the circuit board with several knocking movements (see "Latching the circuit board holder" on page 41) into tank 4.
2. Select and confirm **START**.

   The countdown is resumed.

When half the time is over a beep is sounded and you are prompted to turn around the circuit board.

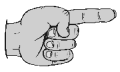
3. Take the circuit board holder with the circuit board out of the tank, turn it 180 °, and re-insert it with several knocking movements into the tank (see "Latching the circuit board holder" on page 41).
4. Select and confirm **START**.

   When the time counter is down to 0, a beep sounds and the status display prompts you to rinse and subsequently dry the board.
5. Acknowledge the end of **PHASE 4** by selecting and confirming **END**.

PHASE 4 can be repeated as often as needed by pressing the u key.

Phase 4: Finishing the copper-plating

1. Take the circuit board out of bath 4 and let the chemical drip back into the bath.



Tip: By letting the chemical drip from the circuit board back in to bath 4 you save chemicals and simultaneously protect the environment.

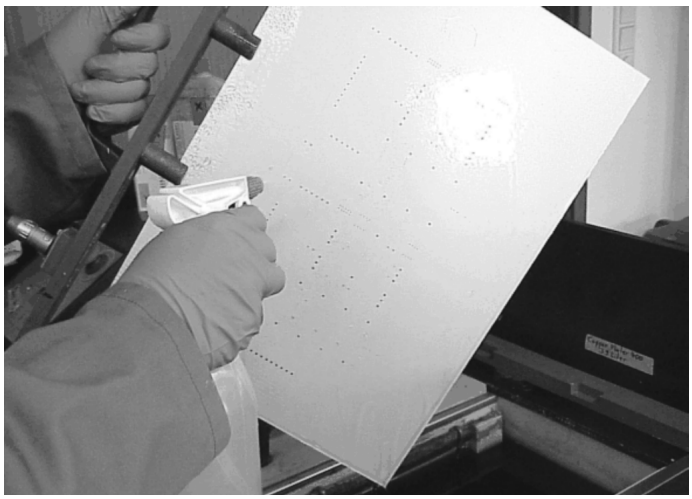


Fig. 17: Spraying the circuit board

2. Holding the circuit board above bath 4, spray the circuit board on both sides with distilled or de-ionised water using the supplied spray bottle and let the liquid drip into bath 4, thus balancing evaporation losses.

Rinsing and drying the circuit board

1. Rinse the circuit board in an external basin or sink with running water for at least 30 seconds.

WARNING

Danger of chemical burns!

If not rinsed properly, the operator can touch residual acid remaining on the circuit board.

› Do not let the rinse time be less than 30 seconds.

CAUTION

Environmental hazard!

The contaminant load of the rinse water will be exceeded if not thoroughly diluted.

› Do not let the rinse time be less than 30 seconds.

2. Blow off the circuit board with oil-free compressed air.
3. Dry the circuit board quickly, using warm air if possible (e.g. with a hair dryer but not in a drying cabinet).

   Note: This should be done as quickly as possible to prevent the copper from oxidising.

[ ] The through-plating of the circuit board is finished and the board can be processed further.

6.4 Process sequence

6.4.1 Standard circuit board

Phase	Operation	Bath (time in **minutes**)				Fastening circuit board to holder	Wiping	Rinsing		Drying		
		1	2	3	4			Rinsing (tap water)	Spray-rinsing (de-ionised water)	Blowing off	Tapping	Drying 95 °C
Phase 0: Process preparation												
0.1	Fasten circuit board to holder w/o electrical					**X**						
0.2	Rinse circuit board							**>30 s**				
Phase 1: Degreasing												
1.1	Insert circuit board into bath 1	**65**										
1.2	Rinse circuit board							**>30 s**				
Phase 2: Cleaning												
2.1	Insert circuit board into bath 2		**5**									
2.2	Rinse circuit board							**>30 s**				
2.3	Spray-rinse circuit board								**>15s**			
2.4	Blow off circuit board									**>10s**		
Phase 3: Activation												
3.1	Insert circuit board into bath 3			**15**								
3.2	Wipe circuit board						**X**					
3.3	Tap circuit board										**>15s**	
3.4	Dry circuit board											**4-5 Min**
Phase 4: Through-plating												
4.0	Fasten circuit board to holder with electrical					**X**						
4.1	Insert circuit board into bath 4				**20**							
4.2	Rinse circuit board							**>30s**				
4.3	Check circuit board											
4.4	Insert circuit board into bath 4				**25**							
4.5	Turn circuit board				**45**							
4.6	Spray-rinse circuit board								**<10s**			
4.7	Rinse circuit board							**>30s**				
4.8	Blow-dry circuit board									**>1 Min**		

6.4.2 Multi-layer circuit board

Phase	Operation	Bath (time in **minutes**)				Fastening circuit board to holder	Wiping	Rinsing		Drying		
		1	2	3	4			Rinsing (tap water)	Spray-rinsing (de-ionised water)	Blowing off	Tapping	Drying 95 °C
Phase 0: Process preparation												
0.1	Fasten circuit board to holder w/o electrical					**X**						
0.2	Rinse circuit board							**>30 s**				
Phase 1: Degreasing												
1.1	Insert circuit board into bath 1	**80**										
1.2	Rinse circuit board							**>30 s**				
Phase 2: Cleaning												
2.1	Insert circuit board into bath 2		**10**									
2.2	Rinse circuit board							**>30 s**				
2.3	Spray-rinse circuit board								**>15s**			
2.4	Blow off circuit board									**>10s**		
Phase 3: Activation												
3.1	Insert circuit board into bath 3			**25**								
3.2	Wipe circuit board						**X**					
3.3	Tap circuit board										**>15s**	
3.4	Dry circuit board											**4-5 Min**
Phase 4: Through-plating												
4.0	Fasten circuit board to holder with electrical					**X**						
4.1	Insert circuit board into bath 4				**20**							
4.2	Rinse circuit board							**>30s**				
4.3	Check circuit board											
4.4	Insert circuit board into bath 4				**40**							
4.5	Turn circuit board				**60**							
4.6	Spray-rinse circuit board								**<10s**			
4.7	Rinse circuit board							**>30s**				
4.8	Blow-dry circuit board									**>1 Min**		

6.4.3 Flexible circuit board

Phase	Operation	Bath (time in **minutes**)				Fastening circuit board to holder	Wiping	Rinsing		Drying		
		1	2	3	4			Rinsing (tap water)	Spray-rinsing (de-ionised water)	Blowing off	Tapping	Drying 95 °C
Phase 0: Process preparation												
0.1	Fasten circuit board to holder w/o electrical					**X**						
0.2	Rinse circuit board							**>30 s**				
Phase 1: Degreasing												
1.1	Insert circuit board into bath 1	**80**										
1.2	Rinse circuit board							**>30 s**				
Phase 2: Cleaning												
2.1	Insert circuit board into bath 2		**10**									
2.2	Rinse circuit board							**>30 s**				
2.3	Spray-rinse circuit board								**>15s**			
2.4	Blow off circuit board									**>10s**		
Phase 3: Activation												
3.1	Insert circuit board into bath 3			**15**								
3.2	Wipe circuit board						**X**					
3.3	Tap circuit board										**>15s**	
3.4	Dry circuit board											**4-5 Min**
Phase 4: Through-plating												
4.0	Fasten circuit board to holder with electrical					**X**						
4.1	Insert circuit board into bath 4				**15**							
4.2	Rinse circuit board							**>30s**				
4.3	Check circuit board											
4.4	Insert circuit board into bath 4				**15**							
4.5	Turn circuit board				**30**							
4.6	Spray-rinse circuit board								**<10s**			
4.7	Rinse circuit board							**>30s**				
4.8	Blow-dry circuit board									**>1 Min**		

6.5 Waste Disposal

Do not let spilled chemicals reach the sewer system.

The rinse water of the through-plating process can be disposed of via the sewer system (see appendix).

Never pour spent chemicals down the drain, fill into canisters for disposal and dispose of at a certified chemical treatment plant.

Refer to the documentation of the chemicals for the appropriate method of disposal (neutralisation, hazardous waste disposal, chemical-physical treatment).

Always check and adhere to local and national regulations for the internal or external disposal of waste.

Local and national regulations always take precedence over our recommendations.

7. Troubleshooting

7.1 Safety advice

CAUTION

Risk of damage!

The unit contains sensitive electronic circuitry.

› Have only adequately trained persons or the customer service do the troubleshooting.

7.2 Error codes

If the unit has detected an error this is indicated by an error code on the display. On the lower left of the display an "E" for "error" and a corresponding code number is displayed. On the lower right of the display the error name is displayed. At the same time a beep is sounded.

Table 5: Error codes

Code	display	Cause	Remedy
01	I < 1A	Current interrupted in tank 4	Re-insert the circuit board into tank 4 and select and confirm START.
			Check the electric contact of the circuit board and holder
			Remove the protective copper film
			Check the anode plug and cable
			see "Cleaning the anode rails" on page 54
02	Level	Fill level of tank 1 is too low	Fill up tank 1 with CLEANER 110 up to the triangular mark.
		Fill level sensor is defective	Switch off the unit. Report the error to customer service.
03	VDD	Voltage VDD faulty	
04	Temp	Overheated heat sink	
05	24V	24V voltage faulty	
06	3V	Plating voltage faulty	
08	TempSen	Temperature sensor is defective	

Code	display	Cause	Remedy
16	I Motor	Motor overload	see "Easing frame movement" on page 55
		Motor is defective	Switch off the unit. Report the error to customer service.

7.3 Other fault indicators

Table 6: Other faults

Fault indicator	possible cause	Remedy
Bath 1 remains at room temperature	Heating element or heating fuse is defective	Switch off the unit. Report the error to customer service.
Unit cannot be switched on	no mains connection	Check mains connection
	Mains fuse is defective	see "Replacing the fuse" on page 55
	Internal fault	Switch off the unit. Report the error to customer service.

7.4 Simple troubleshooting

7.4.1 Cleaning the anode rails

Removing deposits on the anode rails

During longer operation periods deposits of the galvanising chemical can form on the anode rails. These deposits can interrupt the electric current and thus prevent the copper-plating.

1. Unplug the mains cable.
2. Drain tank 4 into a clean and dry container (e.g. canister) as described in steps 1 to 6 in "Draining the tanks" on page 60.
3. Rinse tank 4 thoroughly.
4. Unscrew the copper anodes (see fig. 10, "Copper anodes", on page 33).
5. Remove the anodes with the anode cloth bags.

6. Rinse or replace the anode bags and rinse and scrub the anodes clean with a plastic brush.
7. Brush off the deposits on the anode rails towards the bottom of the tank using a plastic brush.
8. Carefully polish the anode rails around the threaded holes on both sides using sandpaper.
9. Rinse the tank thoroughly using tap water.
10. Set the copper anodes complete with their cloth bags into tank 4 and screw them to the anode rails using the anode bolts.
11. Let the rinse water drain completely and dispose of via the sewer system.
12. Seal the tube with the stopper and re-insert it back into the clamp rail.
13. Pour the drained chemical through a fluted filter (alternatively use several nested paper coffee filters) into another clean and dry container (e.g. a canister).
14. Pour the filtered chemical back into the tank.

[ ] The deposits on the anode rails are removed.

7.4.2 Easing frame movement

Easing frame movement

After a long time of operation it can happen that the frame seizes or becomes sluggish and thus overloads the motor.

1. Unplug the mains cable.
2. Loosen the guidance blocks of the frame.
3. Re-fasten the guidance blocks so that the frame can be easily moved.

[ ] The frame moves easily.

7.4.3 Replacing the fuse

Replacing the fuse

The mains fuses are two glass fuses (2.5 A slow at 230 V, 5 A slow at 115 V) and are located in the voltage setting module. The fuses are located on opposite sides of the module and each fuse is mounted on the side that is nearest to the triangular mark of its corresponding voltage.

1. Disconnect the mains cable.

2. Insert a flat screwdriver into the notch on the underside of the module and carefully extract the module (**1** in the figure below).

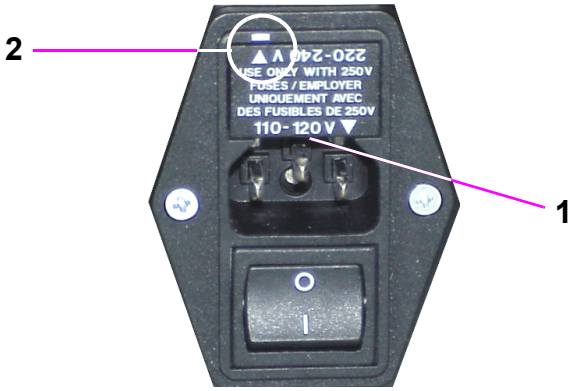


Fig. 18: Mains fuses at the mains connector

1 Voltage module (with mains fuses) **2** Mark

3. Replace the defective fuse.
4. Re-insert the module oriented in such a way that the white triangle behind the voltage rating corresponding to your mains voltage points to the white mark of the rim (**2** in above figure).
5. Reconnect the mains cable.

[ ] The fuse is replaced.

7.5 Customer service

Germany:

LPKF Laser & Electronics AG

Osteriede 7

D-30827 Garbsen

Phone:	+ 49 - 51 31 - 70 95 - 0
Fax:	+ 49 - 51 31 - 70 95 - 90
E-mail:	info@lpkf.com
Website:	http://www.lpkf.com

Outside Germany:

Contact your local distributor, refer to http://www.lpkf.com/ for contact details.

8. Service and repair

8.1 Routine inspection

Tank 4 has to be inspected visually once a week for copper sulphate crystals on the walls and in the corners of the tank.

These crystals have to be put back into the bath.

CAUTION

Chemical bath can be ruined!

No copper sulphate crystals nor residues of the *COPPER PLATER 400* bath may reach the neighbouring *AKTIVATOR* bath, the *AKTIVATOR* bath would be ruined. In such a case the warranty is forfeited.

› Keep the *AKTIVATOR* bath covered.

8.2 Service and repair by user

8.2.1 Unit

The unit itself requires no servicing.

It is essential that the tanks are covered immediately after use in order to prevent contamination of the chemical baths.

Carefully clean the unit regularly (depending on volume of through-plated circuit boards weekly or even daily).

Tip: Never use abrasives to remove chemicals that have dripped on the unit, use a soft cloth instead. Otherwise, the unit's surface gets scratched and removal of stains is made even more difficult.

8.2.2 Chemical Baths

CAUTION

Risk of scrap production!

Replacing or adding chemicals changes their effect.

› If chemical baths have been replaced or *SHINE 400* has been added the unit should be re-initialised with a dummy circuit board.

Bath 1 (Degreasing)

Product: *CLEANER 110*

Keep covered when neither tank 1 nor tank 2 is in use.

Evaporation losses can be replaced with distilled or de-ionised water if need be.

Replace the degreasing chemical after 3 months or when its colour has significantly changed.

Note: Avoid unnecessary heating as this shortens the service life.

Bath 2 (Cleaning)

Product: *CLEANER 210*

Keep covered when neither tank 1 nor tank 2 is in use.

Evaporation losses can be replaced with distilled or de-ionised water if need be.

Replace the chemical after 3 months or when its colour has significantly changed.

Bath 3 (Activation)

Product: *AKTIVATOR 310*

Keep covered when not in use.

The chemical bath is highly sensitive to contaminants and acid ions and thus requires careful handling.

Traces of *CLEANER 110*, *CLEANER 210*, *COPPER PLATER 400*, tap water, any acidic chemicals, iron particles or similar can shortly lead to malfunction of the chemical bath. In this case it is irrelevant whether it is in use or not. If the unit is not in use the bath should be stirred thoroughly once a week.

Note: After intervals of non-use (more than one day) stir the bath for 2 to 3 minutes with a fibre glass rod or similar. If this has created foam wait until it has subsided before inserting a circuit board.

Replace losses only with *AKTIVATOR 310* (fill up to triangular mark).

CAUTION

Chemical bath can be ruined!

The *AKTIVATOR* bath is highly sensitive.

› Never add water to the *AKTIVATOR* bath as this prevents the through-plating from working.

After a year at the latest, the bath has to be replaced.

After replacing the chemical ensure that it is thoroughly stirred.

Bath 4 (Copper-plating)

Product: *COPPER PLATER 400*

Keep covered when not in use and filter regularly (approx. every 3 weeks).

Note: The service life of the tank's contents is approx. one year. As the service life is influenced by careful operation and air pollution this is only an estimate and can vary.

Filtering bath 4

1. Drain approx. 5 litres from the tank into a clean and dry container (e.g. canister) using the same steps as in "Draining the tanks" on page 60.

   Note: Filtering this partial volume of the bath is sufficient as contaminates accumulate at the bottom of the tank where they are flushed through the drainage tube with this partial volume.

2. Pour the drained volume through a fluted filter (alternatively use several nested paper coffee filters) into another clean and dry container (e.g. a canister).
3. Pour the filtered chemical back into tank 4.
4. Replenish using *COPPER PLATER 400*.
5. Wipe the tank's rim with a cloth that has been moistened with distilled or de-ionised water.

Adding *SHINE 400*

The chemical additive *SHINE 400* is consumed depending on throughput. The unit has an internal counter for the ampere hours used. After 100 ampere hours the warning **W01 CHEMIE** is displayed. Complete the current plating process before adding 5 ml *SHINE 400* to the *COPPER PLATER* bath.

1. Complete the current plating process with all remaining steps.
2. Afterwards, add 5 ml of SHINE 400 to tank 4.
3. Re-initialise the unit with a dummy circuit board:
   - Phase 1: 10 minutes
   - Phases 2 and 3 are skipped
   - Phase 4: 60 minutes at 9 A, RPP off
4. Confirm adding the chemical in the setup menu (see "The Setup menu" on page 24).

[ ] The chemical *SHINE 400* has been added and the ampere hour counter is reset to 0.

Draining the tanks

WARNING

Danger of chemical burns!

Contact with the chemicals can cause chemical burns.

› Wear suitable protective clothing while draining or filling the unit (protective goggles and protective gloves)!

WARNING

Environmental hazard!

The chemicals used are poisonous and corrosive.

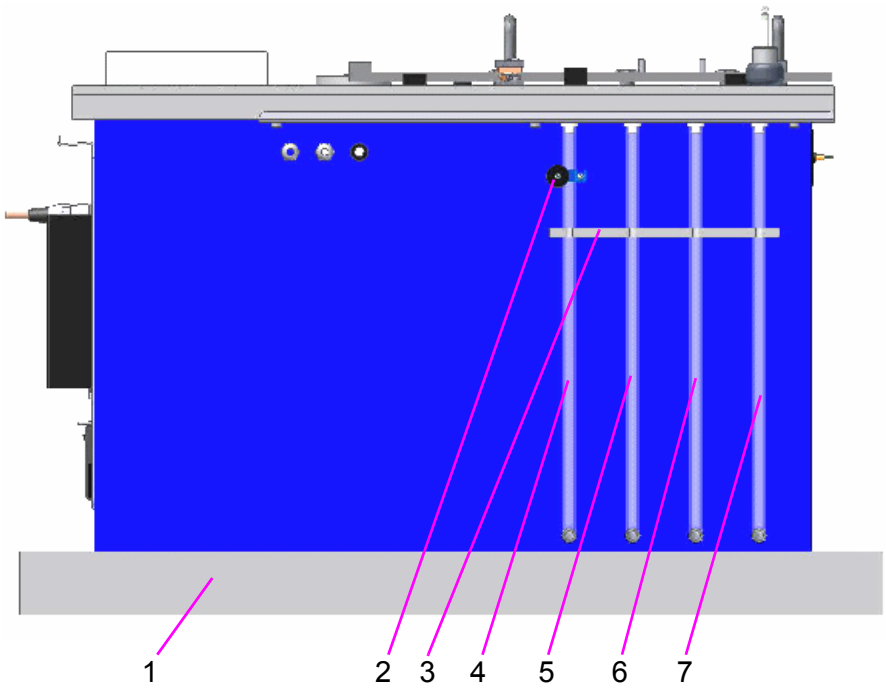
› Never pour spent chemicals down the drain, instead fill into canisters for disposal and dispose of at a certified treatment plant.

Tip: Keep the empty canisters of the chemicals shipment for uncontaminated disposal of spent chemicals.

You need:

- the canisters for disposal
- a bucket for collecting the rinse water
- a squirt bottle or running water for rinsing the tanks

Fig. 19: Rear view



1 Collecting tank
2 Tube clamp
3 Clamp rail
4 Drainage tube for tank 4
5 Drainage tube for tank 3
6 Drainage tube for tank 2
7 Drainage tube for tank 1

For draining each of the tanks (1 to 4) proceed as follows:

1. Pull the drainage tube from the clamp rail.
2. Clamp the tube shut above the fluid level with the tube clamp supplied with the unit.
3. While still holding the tube upwards pull off the stopper.
4. Insert the tube's end into the corresponding canister.
5. Open the clamp enabling the chemical to drain from the tank.
6. When the tank is drained completely put the tube's end into the bucket for the rinse water.
7. Tank 4: Rinse the anodes and the tank:
   - Unscrew the anode bolts (see fig. 10, "Copper anodes", on page 33).
   - Remove the anodes with the anode cloth bags.
   - Rinse and scrub the anodes clean with a plastic brush or replace them if they are overly worn.
   - Rinse or replace the anode cloth bags.
   - Rinse the tank thoroughly.
   - Reinsert the anodes with the anode cloth bags and fasten them with the anode bolts (see "Mounting the copper anodes" on page 33).
8. Tanks 1/2/3: Rinse the tank thoroughly.
9. Tank 3: Rinse the tank again with distilled or de-ionised water.
10. Let the rinse water drain completely into the bucket and dispose of via the sewer system.
11. Seal the tube with the stopper and re-insert it back into the clamp rail.
12. Dry the tank.

[ ] The tank is drained and can be refilled.

9. Storage

9.1 Decommissioning

Decommissioning the unit

1. Unplug the mains cable.
2. Wait until bath 1 has cooled down.
3. Drain the chemicals into their respective canisters.
4. Rinse the tanks of the unit thoroughly.
5. Rinse tank 3 with distilled or de-ionised water.
6. Unscrew the anode bolts (see fig. 10, "Copper anodes", on page 33).
7. Remove the anodes with the anode cloth bags.
8. Re-install the anode bolts.
9. Rinse the anode bags and rinse and scrub the anodes clean with a plastic brush.
10. Dry the anodes and anode cloth bags.

    Note: Depending on wear replace the anodes and anode bags before putting the unit back into service.

11. Dry the tanks.

[ ] The unit is decommissioned and can now be packed.

Packing the unit

1. Remove and pack the loose components (tank covers, digital thermometer etc.) of the unit.
2. Retrieve the original packaging from storage or procure safe packaging.

WARNING

Lifting hazard — heavy object.

The unit weighs approx. 47 kg. Single person lifting could cause muscle strain or back injury.

› Always have two persons of adequate physical strength lift, move, or install the unit.

3. Pack the unit.
4. Ensure safe transport in horizontal position by applying appropriate marks on the package (e.g. "fragile", "UP").

[ ] The unit is packed and can be transported or stored.

9.2 Storage

Store the unit in a frost-free and dry place.

9.3 Disposal

Disposing of the unit

1. Decommission the unit (see chapter 9.1, "Decommissioning").
2. Dispose of the chemicals separately as described in chapter 6.5, "Waste Disposal", on page 52.
3. Dispose of the unit in adherence to local regulations concerning plastics and electronic components.

[ ] The unit is disposed of.

10. Appendix

10.1 List of figures

10.2 List of tables

10.3 Through-plating log

Note: Use this log to monitor and analyse the service life of the chemicals.

				Chemical replaced / added	
Date	**Size base material w x l (mm)**	**Cur-rent**	**Time**	**Chemical**	**Vol-ume**

Copy this form and place it next to the unit.

10.4 Analysis results (German)

10.4.1 Analysis result 1

CHEMISCHES LABOR
DR. WIRTS + PARTNER
SACHVERSTÄNDIGEN GMBH

Analytik, Gutachten, Beratung

Chemisches Labor Dr. Wirts + Partner
Sachverständigen GmbH
Rutenbergstr. 59
D-30559 Hannover
Telefon: 0511 950798-0
Telefax: 0511 950798-29
E-Mail: Kontakt@Wirts.de
Internet: www.Wirts.de

DAkkS Deutsche Akkreditierungsstelle D-PL-14001-01-00

Prüfbericht

Prüfauftrags-Nr.:	**31204136** C	Datum: 18.07.2012 / Froböse
		Seite: 1/2
Auftraggeber:	LPKF Laser & Electronics AG Osteriede 7 30827 Garbsen	
Auftragseingang:	25.06.2012	
Auftragserteilung:	schriftlich durch Auftraggeber	
Projekt:	Spülwasser; LieferantenNr.: 71204	
Prüfauftrag:	Untersuchung auf Einleitparameter	
Proben-Nr.:	P12004235	
Probenahme:	20.06.2012 durch Auftraggeber	
Probenanlieferung:	22.06.2012 durch Paketdienst	

Verantwortlicher für den Prüfbericht — Diplom-Geologe Bruno Rütten

10.4.2 Analysis result 1 (cont.)

Seite: 2/2
vom: 18.07.2012
Prüfauftrags-Nr. 31204136

CHEMISCHES LABOR
DR. WIRTS + PARTNER
SACHVERSTÄNDIGEN GMBH

PROBE-NR.:	**P12004235**
Prüfgegenstand:	Spülwasser
Kennzeichnung:	Spülwasser nach chemisch Zinn Aufbau
Verpackung:	in 1l PE-Flasche
Probenmenge:	ca. 1 l
Trübung:	klar
Farbe:	farblos
Geruch:	ohne
Bodensatz:	gering
Untersuchungszeitraum:	25.06.2012 bis 06.07.2012

Parameter	Prüfverfahren		Einheit	Prüfergebnis
pH-Wert	DIN 38404, 5	a		**7,90**
Messtemperatur			℃	**19,6**
elektrische Leitfähigkeit	DIN EN 27888	a	µS/cm	**776**
Aluminium	EN ISO 11885	a	mg/l	**0,32**
Kupfer	EN ISO 11885	a	mg/l	**0,40**
Zinn	EN ISO 17294/2	a	mg/l	**1,6**
Zink	EN ISO 11885	a	mg/l	**0,08**
Eisen	EN ISO 11885	a	mg/l	**0,18**
Mangan	EN ISO 11885	a	mg/l	**0,10**
Schwefel gesamt	EN ISO 11885	a	mg/l	**57,7**
Sulfat, berechnet aus Schwefel	EN ISO 11885	a	mg/l	**173**
DOC-Gehalt	DIN EN 1484 (1997)	a	mg/l	**6,36**

Zeichenerklärung:
u.B. = unter der verfahrensbedingten Bestimmungsgrenze
i.A. = in Anlehnung an
a = akkreditiertes Verfahren
u = Unterauftrag
n.a. = nicht auswertbar

Beurteilung zu Prüfauftrags-Nr. 31204136 C:

Der Auftraggeber vertreibt Tauchzinnbäder zum Verzinnen von Leiterplatten. Bei diesen Arbeiten fällt Spülwasser zur Verwertung bzw. Entsorgung an. Zur Klärung, ob das bei der chemischen Verzinnung anfallende Spülwasser in die öffentliche Abwasserkanalisation eingeleitet werden kann, wurde dem hiesigen Labor eine Probe zur chemischen Untersuchung übergeben.
Das Untersuchungsprogramm wurde auf allgemeine Parameter, Schwermetalle und DOC abgestellt.

Die im Einzelnen erhaltenen Untersuchungsergebnisse sind vorstehend aufgeführt.

Das farblose, klare Wasser wies einen pH-Wert im Neutralbereich und eine normale Elektrolytbeladung auf. Die Schwermetallübersichtsuntersuchung ergab insgesamt unauffällige Anteile. Die organische Belastung des Wassers, ausgedrückt als DOC, war gering.

Unter Rückgriff auf das ATV-A115-Regelwerk „Einleiten von nicht häuslichem Abwasser in eine öffentliche Abwasseranlage“ entsprach das übergebene Spülwasser den Abwasseranforderungen. Damit kann das anfallende Spülwasser in die öffentliche Abwasserkanalisation eingeleitet werden.

10.4.3 Analysis result 2

Seite 2/2
vom 03.07.2003
Prüfauftrags-Nr. 31490-P1C

CHEMISCHES LABOR
DR. WIRTS + PARTNER
SACHVERSTÄNDIGEN GMBH

Prüfergebnisse

Probenkennzeichnung:	Trinkwasser			
Labor-Nr.:	3 1 490 / 1			
Aussehen: Farbe: Trübung: Bodensatz: Geruch: Probemenge:	 farblos ohne ohne schwach unspezifisch ca. 1000 ml			
PARAMETER	PRÜFVERFAHREN:	PRÜFDATUM:	EINHEIT:	PRÜFERGEBNIS:
pH - Wert	DIN 38404 / 5 a	01.07.2003		8,0
Meßtemperatur			°C	14,6
elektrische Leitfähigkeit ber. auf 25 °C	DIN EN 27888 a		µS/cm	852
Kupfer	EN ISO 11885 a	01.07.2003	mg/l	0,023

Zeichenerklärung:
u.B. = unter der verfahrensbedingten Bestimmungsgrenze
i.A. = in Anlehnung an
a = Akkreditiertes Verfahren
u = Unterauftrag

10.4.4 Analysis result 3

Seite 2/4
vom 08.06.2000
Auftrags-Nr. 0 1218-P2C

CHEMISCHES LABOR
DR. WIRTS + PARTNER
SACHVERSTÄNDIGEN GMBH

Probenkennzeichnung:	Cleaner 110, Probe 1			
Labor-Nr.:	**0 1218/ 1**			
Aussehen: **Farbe:** **Trübung:** **Bodensatz:** **Geruch:**	 farblos klar ohne schwach, unspezifisch			
Folgende Ergebnisse beziehen sich auf die homogenisierte Wasserprobe incl. Bodensatz				
PARAMETER	**PRÜFMETHODE:**	**ANALYSEN-DATUM:**	**EINHEIT:**	**PRÜFERGEBNIS:**
pH - Wert **Meßtemperatur** **elektrische Leitfähigkeit ber. auf 25 °C**	DIN 38404/ 5 DIN 38404/ 8	24.05.00 24.05.00 24.05.00	 °C µS/cm	9,4 13,9 57,4
Chrom, gesamt	DIN 38406/ 22	30.05.00	mg/l	< 0,02
Chrom VI	DIN 38405/ 24	30.05.00	mg/l	< 0,03
Kupfer	DIN 38406/ 22	30.05.00	mg/l	0,028
Nickel	DIN 38406/ 22	30.05.00	mg/l	< 0,04
Zink	DIN 38406/ 22	30.05.00	mg/l	< 0,02
Blei	DIN 38406/ 22	30.05.00	mg/l	< 0,1
Cadmium	DIN 38406/ 22	30.05.00	mg/l	< 0,01
Quecksilber	DIN 38406 / 12	07.06.00	mg/l	< 0,0005
Arsen	Graphitrohr-AAS	05.06.00	mg/l	< 0,005
AOX - Gehalt	DIN 38409/ 14	31.05.00	mg/l	< 0,010
TOC - Gehalt	DIN 38409/ 3/1	29.05.00	mg/l	2,42
Mineralöl-Kohlenwasserstoffe	DIN 38409/ 18	26.05.00	mg/l	< 1,6

Zeichenerklärung:
u.B. = unter der verfahrensbedingten Bestimmungsgrenze
i. A. = in Anlehnung an
(Die 16 PAK - Einzelsubstanzen sind nachstehend aufgeführt.)

10.4.5 Analysis result 3 (cont.)

Seite 3/4
vom 08.06.2000
Auftrags-Nr. 0 1218-P2C

CHEMISCHES LABOR
DR. WIRTS + PARTNER
SACHVERSTÄNDIGEN GMBH

Probenkennzeichnung:	Cleaner 210, Probe 2			
Labor-Nr.:	**0 1218/ 2**			
Aussehen: **Farbe:** **Trübung:** **Bodensatz:** **Geruch:**	 farblos klar ohne schwach, unspezifisch			
Folgende Ergebnisse beziehen sich auf die homogenisierte Wasserprobe incl. Bodensatz				
PARAMETER	**PRÜFMETHODE:**	**ANALYSEN-DATUM:**	**EINHEIT:**	**PRÜFERGEBNIS:**
pH - Wert	DIN 38404/ 5	24.05.00		8,2
Meßtemperatur		24.05.00	°C	13,1
elektrische Leitfähigkeit ber. auf 25 °C	DIN 38404/ 8	24.05.00	µS/cm	28,2
Chrom, gesamt	DIN 38406/ 22	30.05.00	mg/l	< 0,02
Chrom VI	DIN 38405/ 24	30.05.00	mg/l	< 0,03
Kupfer	DIN 38406/ 22	30.05.00	mg/l	0,106
Nickel	DIN 38406/ 22	30.05.00	mg/l	< 0,04
Zink	DIN 38406/ 22	30.05.00	mg/l	< 0,02
Blei	DIN 38406/ 22	30.05.00	mg/l	< 0,1
Cadmium	DIN 38406/ 22	30.05.00	mg/l	< 0,01
Quecksilber	DIN 38406 / 12	07.06.00	mg/l	< 0,0005
Arsen	Graphitrohr-AAS	05.06.00	mg/l	< 0,005
AOX - Gehalt	DIN 38409/ 14	31.05.00	mg/l	< 0,010
TOC - Gehalt	DIN 38409/ 3/1	29.05.00	mg/l	7,65
Mineralöl-Kohlenwasserstoffe	DIN 38409/ 18	26.05.00	mg/l	< 1,6

Zeichenerklärung:
u.B. = unter der verfahrensbedingten Bestimmungsgrenze
i. A. = in Anlehnung an
(Die 16 PAK - Einzelsubstanzen sind nachstehend aufgeführt.)

10.4.6 Analysis result 3 (cont.)

Seite 4/4
vom 08.06.2000
Auftrags-Nr. 0 1218-P2C

CHEMISCHES LABOR
DR. WIRTS + PARTNER
SACHVERSTÄNDIGEN GMBH

Gutachterliche Stellungnahme zum Prüfbericht, Auftrags-Nr. 0 1218-P1C

Bei dem Betrieb einer Kontaktierungsanlage der Auftraggeberin fällt Waschwasser zur Entsorgung bzw. Verwertung an.
Zur Klärung, ob das Waschwasser in eine öffentliche Abwasserkanalisation eingeleitet werden kann, wurden dem hiesigen Labor zwei Proben zur chemischen Untersuchung übergeben.

Die Proben wurden neben allgemeinen Parametern auf Schwermetalle und organische Summenparameter geprüft.
Die im einzelnen erhaltenen Meßergebnisse sind vorstehend aufgeführt.

Bei Auswertung der Meßergebnisse war festzustellen, daß die Waschwasserproben, Labor-Nr. 0 1218/ 1 und 2 (Cleaner 110 und 210), einen leicht alkalischen pH-Wert aufwiesen. Die Schwermetallübersichts-untersuchung ergab jeweils nur geringe, unkritische Gehalte. Auch die geprüften organischen Summen-parameter wiesen nur geringe Werte auf.

Unter Bezug auf das ATV-Regelwerk, Arbeitsblatt A 115 "Einleiten von nicht häuslichem Abwasser in eine öffentliche Abwasseranlage" entsprachen die Proben, Labor-Nr. 0 1218/ 1+2 (Cleaner 110 und 210), den Abwasseranforderungen, so daß eine Einleitung in eine öffentliche Abwasserkanalisation möglich wäre.

10.4.7 Analysis result 4

Seite 4/8
vom 26.01.2004
Auftrags-Nr. 03 0687-GA

CHEMISCHES LABOR
DR. WIRTS + PARTNER
SACHVERSTÄNDIGEN GMBH

Arbeitsbereiche und Messergebnisse

Betrieb:	LPKF Laser & Electronics AG, Garbsen
Arbeitsbereich:	Galvanik
Datum:	18.11.2003

Arbeitsbereich / Messpunkt Nr.	Bezeichnung	Stoffe	Datum	Uhrzeit	Dauer (min)	Art der Probe nahme	Faktor für verkürzte Expositi-on	Konzen-tration (mg/m³)	Stoffindex I
1	*galvanische*	Formaldehyd (Gesamtprozess)	18.11.03	10.47	120	o / W	k=1	0,013	0,02
	Durchkontaktie-	Formaldehyd (saures Cu-Bad)	18.11.03	12.50	30	o / W	k=1	0,018	0,03
	rung								
2	***Contac-III***	Schwefeldioxid (Gesamtprozess)	18.11.03	10.47	120	o / W	k=1	< 0,4	< 0,31
		Schwefeldioxid (saures Cu-Bad)	18.11.03	12.50	30	(K *))		< 1,3 *)	
3		Schwefelsäure (Gesamtprozess)	18.11.03	10.47	120	o / W	k=1	< 0,05	< 0,5
		Schwefelsäure (saures Cu-Bad)	18.11.03	12.50	30	(K *))		< 0,2 *)	
4		Kohlenstoffdioxid	18.11.03	10.47	145	o / W	k=1	741 ppm	0,15

Erläuterungen:

p = personenbezogen
o = ortsfest
S = Schichtmittelwert
K = Kurzzeitwert
W = Worst-case-Betrachtung

*) die zur Zeit verfügbaren Analysenverfahren sind aufgrund geringer Nachweis-empfindlichkeit bei kurzen Messdauern nicht oder nur bedingt zur Kontrolle des Kurzzeitwertes geeignet

10.4.8 Analysis result 4 (cont.)

Seite 7/8
vom 26.01.2004
Auftrags-Nr. 03 0687-GA

CHEMISCHES LABOR
DR. WIRTS + PARTNER
SACHVERSTÄNDIGEN GMBH

Befund

"Arbeitsbereich Galvanik - galvanische Durchkontaktierungsanlage Contac-III":

Die ***Grenzwerte*** für Formaldehyd, Schwefeldioxid, Schwefelsäure und Kohlenstoffdioxid sind auch unter dem Aspekt einer Worst-case-Betrachtung (konstante Exposition über eine Schichtdauer von 8 Stunden) eingehalten. Üblicherweise beträgt der tatsächliche Aufenthalt an der Anlage etwa 2-3 Stunden pro Schicht. Es ergeben sich folgende Stoffindices:

Stoff	Stoffindex bei 8-stündiger Exposition	Stoffindex bei 3-stündiger Exposition
Formaldehyd	0,02	< 0,01
Schwefeldioxid	< 0,3	< 0,13
Schwefelsäure	< 0,5	< 0,19
Kohlenstoffdioxid	0,15	(0,06)

Eine Aufsummierung der Stoffindices wurde aus folgenden Gründen nicht vorgenommen:
Für Schwefeldioxid und Schwefelsäure sind die Grenzwerte erst kürzlich gesenkt worden. Aufgrund nicht ausreichender Empfindlichkeit liegen die Bestimmungsgrenzen der verfügbaren Analysenverfahren bei rd. ein Drittel bzw. der Hälfte des Grenzwertes, so dass eine "einfache" Aufsummierung der Stoffindizes zu einer verfälschten Betrachtung der tatsächlichen Situation führen würde. Eine Analyse des Produktionsablaufs und eine genauere Betrachtung der verwendeten Chemikalienbäder zeigt jedoch, dass unter vorschriftsmäßig eingehaltenen Produktionsbedingungen mit keiner erhöhten Gefahrstoffemission zu rechnen ist.
Der Messwert für Kohlenstoffdioxid lag mit 0,074 Volumenprozent deutlich unter dem Innenraumrichtwert von 0,15 Volumenprozent (DIN 1946, Teil 2) und weist auf einen gut belüfteten Raum.

Kurzzeitwerte

Die Kontrolle der Kurzzeitwerte von Schwefeldioxid und Schwefelsäure gestalten sich etwas schwieriger. Grund ist die kürzlich vorgenommene Absenkung der Grenzwerte, wobei zur exakten Überprüfung des 15-Minuten-Intervalls zur Zeit keine ausreichend empfindlichen Messverfahren zur Verfügung stehen.

Schwefeldioxid:

Aufgrund der Gleichartigkeit des Prozesses konnte hier ein "verlängertes" 30-Minuten-Intervall für die Messung herangezogen werden. Der Überschreitungsfaktor ist "1", d.h. die Konzentration soll zu keinem Zeitpunkt höher sein als der Grenzwert. Der Messwert lag unter der Bestimmungsgrenze von 1,3 mg/m³ (Grenzwert 1,3 mg/m³). Damit ist der *Kurzzeitwert* als sicher *eingehalten* zu betrachten.

10.4.9 Analysis result 4 (cont.)

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vom 26.01.2004
Auftrags-Nr. 03 0687-GA

CHEMISCHES LABOR
DR. WIRTS + PARTNER
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Schwefelsäure:

Auch hier konnte aufgrund des konstant gleichartig verlaufenden Prozesses ein 30-Minuten-Intervall für die Messung herangezogen werden. Der Überschreitungsfaktor ist auch hier "1". Der Messwert lag unter der Bestimmungsgrenze von 0,2 mg/m³ (Grenzwert 0,1 mg/m³).
Während der Benutzung des "sauren Cu-Bades" gab es keinerlei Hinweise auf eine Veränderung der Badstabilität. Auch eine geruchliche Belastung der Luft oder Reizwirkungen wurden nicht festgestellt. Somit ist auch hier von einer Einhaltung des Kurzzeitwertes auszugehen.

Bei vorschriftgemäßem Betreiben der Anlage sind die Grenzwerte für die oben genannten Stoffe gut eingehalten.
Eine Betrachtung der Randbedingungen für die Kurzzeitwerte ergibt, dass unter üblichen Betriebsbedingungen auch diese gut eingehalten werden können.

K.-D. Willaschek-Jühne
- Diplomchemiker -

Anlagen:

- Fotodokumentation
- Prüfbericht 32636-P1A
- Prüfbericht 32728-P1A
- Probenahmeprotokolle
- Messprotokoll - CO_2-Messung und Klimadaten
  (Kontinuierliche Messung: testo 445 mit CO_2-Fühler und Dreifachsonde (°C; %rF; m/s))

10.4.10 Analysis report

CHEMISCHES LABOR
DR. WIRTS + PARTNER
SACHVERSTÄNDIGEN GMBH

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Ihr Zeichen:	Unser Zeichen:	Ihr Gesprächspartner:	Datum:
---	05 0269-GWJ	Hr. Willaschek-Jühne	26.05.2005

Betrifft:
Galvanische Durchkontaktiersysteme LPKF MiniContac S und MiniContac III
hier: Gefahrstoffbelastung in der Luft am Arbeitsplatz

Bestätigung

Wir haben in unserem Gutachten 03 0687-GA vom 26.01.2004 über die Ergebnisse der Untersuchungen der Gefahrstoffbelastung in der Luft im Arbeitsbereich des Laborgalvaniksystems LPKF Contac III zur galvanischen Durchkontaktierung von Leiterplatten berichtet. Hier konnte bescheinigt werden, dass bei vorschriftgemäßem Betreiben der Anlage die Grenzwerte für Formaldehyd, Schwefeldioxid, Schwefelsäure und Kohlenstoffdioxid gut eingehalten sind.

Wir wurden nun gebeten, zu prüfen, in wie weit die in unserem Gutachten ermittelten Daten auch auf die neuen, deutlich kleiner dimensionierten Geräte LPKF MiniContac S und LPKF MiniContac III zur galvanischen Durchkontaktierung von Leiterplatten übertragbar sind.

Hierzu wurden uns für die Systeme LPKF MiniContac S und LPKF MiniContac III die technischen Daten, Angaben über die Dimensionierung der Anlagen, sowie die Beschreibung der Arbeitsabläufe übermittelt.

Eine Überprüfung dieser Daten zeigte, dass die verwendeten Chemikalienbäder in ihrer Zusammensetzung identisch mit den messtechnisch überprüften Bädern der Laborgalvanikanlage LPKF Contac III sind. Gleichzeitig sind die Behälter kleiner dimensioniert, d.h. die Volumina und insbesondere auch die Badoberflächen sind kleiner, beim System LPKF MiniContac S sogar deutlich kleiner als bei dem System LPKF Contac III. Da auch die Verarbeitungstemperaturen der Chemikalienbäder und weitere Verarbeitungsparameter der elektrochemischen Prozesse identisch sind, kann davon ausgegangen werden, dass die Emissionen von Gefahrstoffen eher noch geringer - auf keinen Fall aber höher - ausfallen, wie in dem messtechnisch überprüften System LPKF Contac III.

Damit können wir bescheinigen, dass beim vorschriftgemäßen Betrieb der Systeme LPKF MiniContac S und MiniContac III ebenfalls von einer Einhaltung der Arbeitsplatzgrenzwerte auszugehen ist.

K.-D. Willaschek-Jühne
- Diplomchemiker -

10.5 Analysis results

10.5.1 Analysis result 1

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DAkkS Deutsche Akkreditierungsstelle D-PL-14001-01-00

Test report

Test Order No.:	**31204136 C**	Date: 18.07.2012 / Froböse
		Page: 1/2
Customer:	LPKF Laser & Electronics AG Osteriede 7 30827 Garbsen	
Order received on:	25.06.2012	
Order placement:	In writing by customer	
Project:	Rinse water, Vendor No.: 71204	
Test task definition:	Examination of rinse wastewater parameters in regard to discharging	
Sample No.:	P12004235	
Sample drawn:	On 20.06.2012 by customer	
Sample delivery:	On 22.06.2012 by parcel service	

Responsible for the test report

Geologist Bruno Rütten, M.Sc.

i. A. S. Rütten

10.5.2 Analysis result 1 (cont.)

Page: 2/2
Date: 18.07.2012
Test Order No. 31204136

CHEMISCHES LABOR
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SAMPLE NO.:	P12004235
Test object:	Rinse water
Sample identification:	Rinse water after chemical tin plating
Packaging:	in 1 L PE bottle
Sample amount:	approx. 1 l
Turbidity:	clear
Colour:	colourless
Smell:	no smell
Sediment:	slight
Examination period:	25.06.2012 to 06.07.2012

Parameter	Test procedure		Unit	Test result
pH value	DIN 38404, 5	a		7.90
Measuring temperature			°C	19.6
Electric conductivity	DIN EN 27888	a	µS/cm	776
Aluminium	EN ISO 11885	a	mg/l	0.32
Copper	EN ISO 11885	a	mg/l	0.40
Tin	EN ISO 17294/2	a	mg/l	1.6
Zinc	EN ISO 11885	a	mg/l	0.08
Iron	EN ISO 11885	a	mg/l	0.18
Manganese	EN ISO 11885	a	mg/l	0.10
Sulphur total	EN ISO 11885	a	mg/l	57.7
Sulphate, computed from sulphur content	EN ISO 11885	a	mg/l	173
DOC content	DIN EN 1484 (1997)	a	mg/l	6.36

Legend:

u.B. = below the procedure dependent determination limit
i.A. = based on
a = accredited test method
u = subcontracted
n.a. = not quantifiable

Assessment regarding the Test Order No. 31204136 C:

The customer markets chemical tin plating baths for tin-coating of printed circuit boards. In the process, rinse water is generated which has to be treated or discharged. A sample of used rinse water has been submitted to our lab for chemical examination. The examination goal is to decide whether the used rinse water produced in the chemical plating process can be discharged into the public sewerage system.

The examination plan included general parameters, heavy metals and DOC (Dissolved Organic Carbon).

Individual examination results are summarized in the table above.

pH value of the colourless, clear water sample was in the neutral range, with normal electrolyte load. The screening for heavy metals has shown only inconspicuous concentrations. The organic load of the waste water, expressed as DOC, was very low.

Taking into account the collection of rules and standards ATV-A115 "Discharge of non-domestic waste water in a public sewerage system", the waste water sample analyzed in our lab complied with waste water requirements. Therefore, rinse water generated in the plating process can be discharged into the public sewerage system.

10.5.3 Analysis result 2

page 2/2
of July 29, 2003
Test order No. 31490-P2C

CHEMISCHES LABOR
DR. WIRTS + PARTNER
SACHVERSTÄNDIGEN GMBH

Test Results

Sample identification:	drinking water			
Laboratory No.:	3 1490 / 1			
Appearance: colour: turbidity: sediments: smell: sample quantity:	 colourless none none weakly non-specific 1,0 ltr			
PARAMETER	**TEST METHOD**	**TEST DATE**	**UNIT**	**TEST RESULT**
pH - value	DIN 38404 / 5 a			8,0
measurement temperature		July 1, 2003	°C	14,6
electric conductifity calculated at 25 °C	DIN EN 27888 a	July 1, 2003	µS/cm	852
copper	EN ISO 11885 a	July 1, 2003	mg/ltr	0,023

Note:

a = accredited method

10.5.4 Analysis result 3

page 2/4
of June 8, 2000
order No. 0 1218-P2C

CHEMISCHES LABOR
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sample identification:	Cleaner 110, sample 1
laboratory No.	0 1218/ 1
appearance colour turbidity: sediment: smell:	 colourless none without slightly non-specific

The results itemized herebelow are relating to the homogenized water sample incl. sediment.

PARAMETER	TEST METHOD	ANALYSIS DAY	UNIT	TEST RESULT
pH value	DIN 38404/ 5	24.05.00		9,4
measuring temperature		24.05.00	°C	13,9
electric conductivity at 25°C	DIN 38404/ 8	24.05.00	µS/cm	57,4
chromium, total	DIN 38406/ 22	30.05.00	mg/l	< 0,02
chromium VI	DIN 38405/ 24	30.05.00	mg/l	< 0,03
copper	DIN 38406/ 22	30.05.00	mg/l	0,028
nickel	DIN 38406/ 22	30.05.00	mg/l	< 0,04
zinc	DIN 38406/ 22	30.05.00	mg/l	< 0,02
lead	DIN 38406/ 22	30.05.00	mg/l	< 0,1
cadmium	DIN 38406/ 22	30.05.00	mg/l	< 0,01
mercury	DIN 38406 / 12	07.06.00	mg/l	< 0,0005
arsenic	Graphitrohr-AAS	05.06.00	mg/l	< 0,005
AOX - content	DIN 38409/ 14	31.05.00	mg/l	< 0,010
TOC - content	DIN 38409/ 3/1	29.05.00	mg/l	2,42
mineral oil hydrocarbons	DIN 38409/ 18	26.05.00	mg/l	< 1,6

Zeichenerklärung:
u.B. = below determinability limit set by analysis process
i. A. = leaning on

10.5.5 Analysis result 3 (cont.)

page 3/4
of June 8, 2000
order No. 0 1218-P2C

CHEMISCHES LABOR
DR. WIRTS + PARTNER
SACHVERSTÄNDIGEN GMBH

sample identification:	Cleaner 210, sample 2
laboratory No.	**0 1218/ 2**
appearance **colour** **turbidity:** **sediment:** **smell:**	 colourless none without slightly non-specific

The results itemized herebelow are relating to the homogenized water sample incl. sediment.

PARAMETER	TEST METHOD	ANALYSIS DAY	UNIT	TEST RESULT
pH value	DIN 38404/ 5	24.05.00		8,2
measuring temperature		24.05.00	°C	13,1
electric conductivity at 25°C	DIN 38404/ 8	24.05.00	µS/cm	28,2
chromium, total	DIN 38406/ 22	30.05.00	mg/l	< 0,02
chromium VI	DIN 38405/ 24	30.05.00	mg/l	< 0,03
copper	DIN 38406/ 22	30.05.00	mg/l	0,106
nickel	DIN 38406/ 22	30.05.00	mg/l	< 0,04
zinc	DIN 38406/ 22	30.05.00	mg/l	< 0,02
lead	DIN 38406/ 22	30.05.00	mg/l	< 0,1
cadmium	DIN 38406/ 22	30.05.00	mg/l	< 0,01
mercury	DIN 38406 / 12	07.06.00	mg/l	< 0,0005
arsenic	Graphitrohr-AAS	05.06.00	mg/l	< 0,005
AOX - content	DIN 38409/ 14	31.05.00	mg/l	< 0,010
TOC - content	DIN 38409/ 3/1	29.05.00	mg/l	7,65
mineral oil hydrocarbons	DIN 38409/ 18	26.05.00	mg/l	< 1,6

Zeichenerklärung:
u.B. = below determinability limit set by analysis process
i. A. = leaning on

10.5.6 Analysis result 3 (cont.)

page 4/4
of June 8, 2000
order No. 0 1218-P2C

CHEMISCHES LABOR
DR. WIRTS + PARTNER
SACHVERSTÄNDIGEN GMBH

Expert comments re.: Test Report, Order No. 0 1218-P1C

On operation of a Contact Bed Plant of Mandator's, wash water is produced which is either put to waste disposal, or is utilised.
To clarify whether the wash water can be introduced into a Public Sewerage System, two samples were handed over for chemical analysis to the undersigning laboratory.

The samples were analysed – further to general parameters – for heavy metals and for organic summation parameters.
The measuring results obtained in detail are itemised hereabove.

The evaluation of the measuring results proved that the wash water samples, Labor No. 0 1218/ 1 and /2 (Cleaner 110 and 210) had a slightly alkaline pH value. The heavy metals general analysis brought, in each case, no more than slightly non critical contents. The organic summation parameters showed, on examination, no more than slight values.

With reference to the ATV-Regelwerk, Arbeitsblatt A 115 "Einleiten von nicht häuslichem Abwasser in eine öffentliche Abwasseranlage" "(Discharge from nodomestc sewage in a public sewage plant) , the samples, Labor-No. 0 1218/ 1+2 (Cleaner 110 and 210) met the waste water requirements, so that an introduction into a Public Sewerage System might be possible.

10.5.7 Analysis result 4

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of Jan. 26, 2004
Order No. 03 0687-GA

CHEMISCHES LABOR
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Operating areas and measurement results

works:	LPKF Laser & Electronics AG, Garbsen
operating ranges:	Galvanics
date:	18.11.2003

Working area / measuring point No	Designation	Substances	Date	Time	Duration (min)	Sampling mode	Factor for shortened exposure	Concentration (mg/m³)	Substance index I
1	*galvanic*	Formaldehyde (total process)	18.11.03	10.47	120	o / W	k=1	0,013	0,02
	plating through	Formaldehyde (sour Cu bath)	18.11.03	12.50	30	o / W	k=1	0,018	0,03
2	***Contac-III***	Sulfur dioxide (total process)	18.11.03	10.47	120	o / W	k=1	< 0,4	< 0,31
		Sulfur dioxide (sour Cu bath)	18.11.03	12.50	30	(K *))		< 1,3 *)	
3		Sulfuric acid (total process)	18.11.03	10.47	120	o / W	k=1	< 0,05	< 0,5
		Sulfuric acid (sour Cu bath)	18.11.03	12.50	30	(K *))		< 0,2 *)	
4		carbon dioxide	18.11.03	10.47	145	o / W	k=1	741 ppm	0,15

Explanations:

p = relative to a person
o = stationary
S = average shift value
K = short time exposure value
W = worst case viewing

*) the analysis methods available at the present time are, by reason of their rather slight detectability response at brief measuring durations, not or only restrictedly suitable for the control of the short time value

10.5.8 Analysis result 4 (cont.)

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CHEMISCHES LABOR
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- **sulfur dioxide**
- **carbon dioxide**
- On the principals' request, the parameter list was completed by **formaldehyde,** because the chemical bath in Container 6 is holding formaldehyde in minor percentages.

Findings

"Operating range Galvanics - galvanic plating-through plant Contac III"

The Limit values for formaldehyde, sulfur dioxide, sulfuric acid and carbon dioxide **are retained**, too, under the worst case aspect (constant exposure through an eight hour shift duration). Usually, the actual dwell period at the plant will amount to approx. 2 - 3 hours per shift. The following substance indices will result:

Substance	substance index at 8-hour exposure	substance index at 3-hour exposure
Formaldehyde	0,02	< 0,01
Sulfur dioxide	< 0,3	< 0,13
Sulfuric acid	< 0,5	< 0,19
Carbon dioxide	0,15	(0,06)

The substance indices were not summed-up for the following reasons:
Only a short while ago, the limit values for sulfur dioxide and sulfuric acid were lowered. By reason of insufficient sensitivity, the limits of quantitation of the analysis methods available are at around one third respectively one half of the limit value, so that a "simple" summing-up of the substance indices would lead to an adulterated picture of the real and actual situation. An analysis of the production process and a closer observation of the chemical baths used does show, however - production conditions being adhered to strictly - an increased emission of hazardous substances will not have to be taken into account.
The measured value for carbon dioxide was, with a 0.074 volume percentage, distinctly below the indoor standard value of 0.15 volume percent (DIN 1946, Part 2), and does indicate a well-ventilated room.

Short time values
The control of the short time values of sulfur dioxide and sulfuric acid is involving some more difficulties; by reason of the lowering made, a short time ago, of the limit values so that - for an exact checking of the 15-minute interval - at present there are not available measuring procedures which would be sufficiently sensitive.

Sulfur dioxide:

The process homogeneity allowed, in this instance, the use of a "lengthened" 30-minute interval for the measurement. The excess factor is "1", i.e., the concentration shall not, at any time, be higher than the limit value. The measured value was below the limit of quantitation of 1.3 mg/m³ (limit value 1.3 mg/m³). With that

10.5.9 Analysis result 4 (cont.)

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the short time value is to be regarded as certainly respected.

Sulfuric acid:

Here, too, by reason of the process taking its constantly homogeneous course a 30-minute interval could be used for the measurement. The excess factor here too is "1". The measured value was below the limit of quantitation of 0.2 mg/m³ (limit value 0.1 mg/m³).
Whilst the "sour Cu bath" was being used, there were no indications of an alteration of the bath stability. Neither were there ascertained any smell load in the air nor any irritating influences. Thus there is to be assumed here, too, an adherence to the short time value.

If the plant is operated according to prescription, the limit values for the a.m. substances will be well adhered to.
An observation of the marginal conditions for the short time values shows that these, under usual operating conditions, can also be well kept.

K.-D. Willaschek-Jühne
- Diploma Chemist -

Enclosures:
- Photo documentation
- Test Report 32636-P1A
- Test Report 32728-P1A
- Sampling protocols
- Measuring protocol - CO_2 measurement and climate data (continuous measuring: testo 445 with CO_2 sensor and triple probe (°C; %rF; m/s)

10.5.10 Analysis report

CHEMISCHES LABOR
DR. WIRTS + PARTNER
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Your ref.	Our ref.	Person to contact	Date
---	05 0269-GWJ	K.-D. Willaschek-Jühne	26 May 2005

Certification

In our survey 03 0687-GA dated 26th January 2004 we reported about the results of our examinations regarding the pollution with hazardous substances in the work area of the galvanic system LPKF Contac III for galvanic through-plating of circuit boards. It could be confirmed that if the system is operated according to regulations the limit values for formaldehyde, sulfur dioxide, sulfuric acid, and carbon dioxide are well complied with.

We were asked to check to what extent the data determined in our test report can be applied to the new and significantly smaller system LPKF MiniContac S and MiniContac III for galvanic through-plating of circuit boards.

To do this, we were given the technical data, details about the dimensions of the systems as well as the description of the working procedures for the systems LPKF MiniContac S and LPKF MiniContac III.
An examination of this data showed that the chemicals baths that are used are identical to those of the baths of the galvanic system LPKF Contac III that were tested by us. At the same time the containers are smaller in size, i.e. the volumes and the surface areas of the baths are smaller, even significantly smaller for the LPKF MiniContac S, than those of the system LPKF Contac III.
As the processing temperatures of the chemical baths as well as other processing parameters of the electrochemical processes are identical, it can safely be assumed that the emission of hazardous substances is likely to be lower, but in no case higher than that of the metrologically tested system LPKF Contac III.

Thus we can certify that if the LPKF MiniContac S and LPKF MiniContac III are used according to regulations the limit values for workplace concentrations are complied with.

K.-D. Willaschek-Jühne

10.6 Glossary

Black Hole process

In this process, the circuit board is wetted with a graphite solution. The solution is dried. Subsequently, the graphite layer is removed from the copper. In the via holes where the surface is rough with glass fibres and epoxy the graphite remains and thus forms a conductive surface.

RCD

An RCD (Residual Current Device) is an electrical device that disconnects a circuit whenever it detects that the electric current is not balanced between the phase conductor and the neutral conductor. Such an imbalance can be caused by current leakage through the body of a person who is grounded and accidentally touching the energised part of the circuit. RCDs are designed to disconnect quickly enough to mitigate the harm caused by electrical shock in such a case.