CCD 2   CCD / ATC   CCD / MTC

Bungard CCD
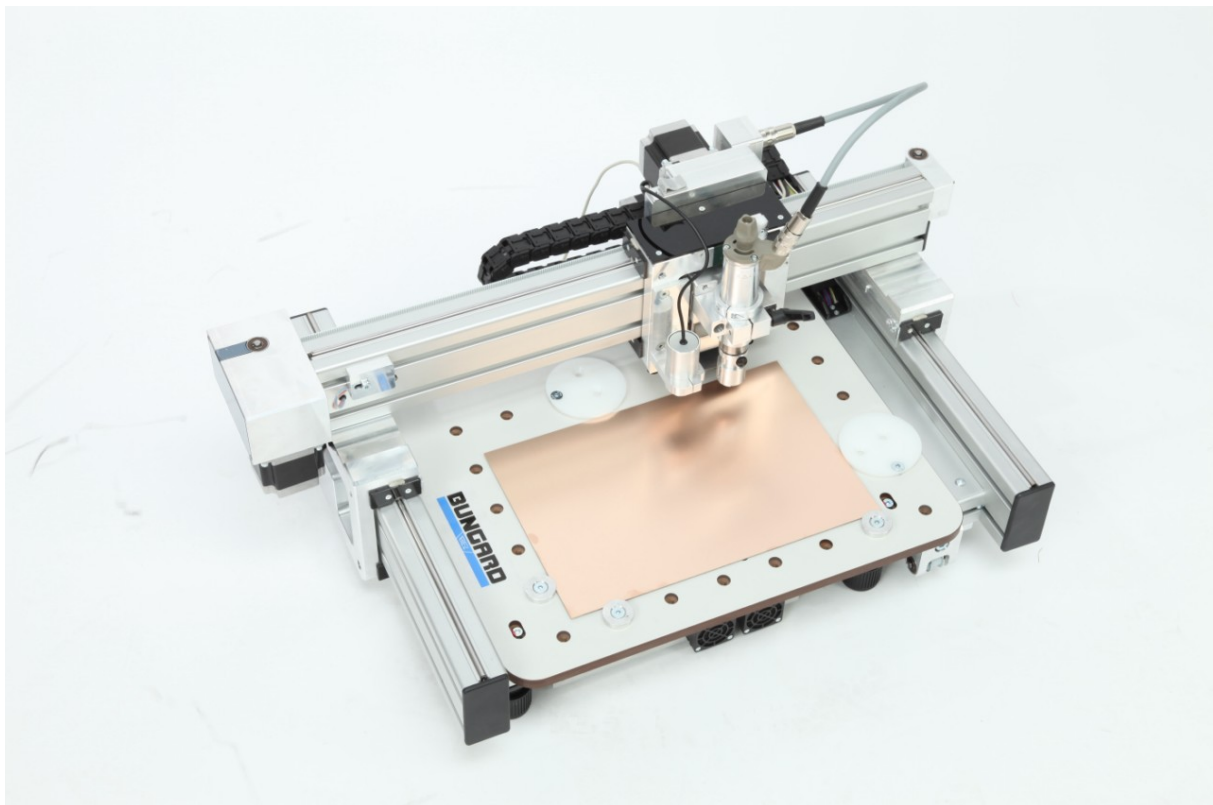
Translation of the Original instructions

BUNGARD
BEL

Table of content

General

The CCD is a high quality computer controlled drilling and milling machine with semi-automatic or automatic tool change. It allows direct processing of Excellon or Sieb&Meyer drill data or HP/GL data for the PCB production (drilling, milling, isolation routing) and milling / routing of plastics, aluminium and other metals.

In addition, the CCD can be upgraded with an attachment for dispensing of solder paste or glue, a laser imaging head for exposing photoresists and a camera for calibration and inspection tasks.
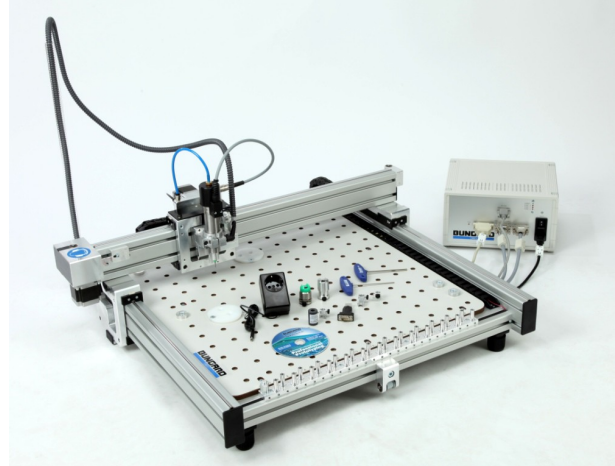
	Starting April 2016
Step resolution	3,18 (Premium - 1 µm)
Chip technology	32-bit
Data connection	Direct USB-port for easy installation
Data transmission	Buffer mode optional. Thus substantially improved milling behaviour and milling pattern
Cabeling	Chainflex cable
Table	Precision aluminium table, both sides milled over, for approximately zero height tolerance
RPM	3.000 – 63.000 (Premium: 3.000 - 100.000)
Torque adaption	Adjustable via machine configuration
Vacuum contact switch	1 Switch-plug with solid state 2000W max integrated in Controller
Power failure correction	PFC• with protection against short circuit, overload and overvoltage
Dosing	Fixture: 1 potential-free switching output for dosing
Laser exposure	integrated Controller for UV laser exposure 250mW
Adding automatic tool change	Pneumatic switching output f.automatic tool change
Cover switch	4mm connection socket for cover switch/emergency stop
Software	RoutePro3000

BUNGARD \BEL/
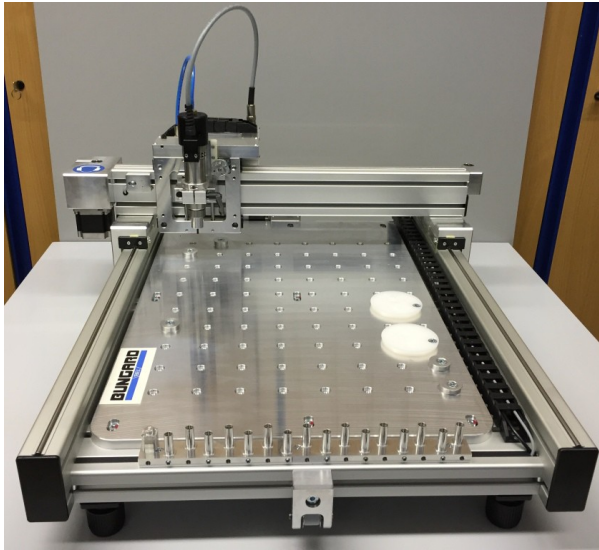
Mechanic:

- rigid and flat construction with low moving weights and high quality bearings for high-speed positioning
- Machine bed with universal fixation system, suitable for clamp or span fixing or for reference pins (fiducials). Fixing pcbs with reference/fixing pins at no extra costs by using our standard backing boards. As an option a vacuum table can mounted underneath the base table to allow vacuum fixation of the PCB
- You can fix the PCB at the machine zero position. Devices for span fixing included, clamp fixing for heavy-duty milling possible
- Integral depth limiting device for isolation milling and engraving on uneven surfaces is part of delivery, work level is roughly set by the Z stepper motor and fine adjustment is done with the micrometer screw of the depth limiter
- Removable, spring-load pressure foot for drilling of flexible and uneven PCBs
- Stack processing of several boards at once is possible (typical stack: three 1.6 mm thick boards plus one underlay/base sheet)
- Working depth not limited by depth sensor, only by flute length of the tool (standard: 5..10 mm)
- All common PCB drills/mills with 1/8" shank, with industry-standard length setting by collar can be used
- Control unit, full set of cables
- Independent controller to connect the CCD to any standard PC via USB or serial port

Spindle:

- KaVo high precision spindle motor, 150 Watt, 63 000 RPM, with heavy-duty long-life bearings, including 1/8" (3.2 mm) chuck
- Software controlled spindle speed. Electronic spindle load control with software feedback. Spindle quick start and quick stop
- Drill speed: 5 hits/s (=18.000 holes per hour)
- **MTC:** Fast, semi-automatic tool change by quarter turn of the fixing knob. The machine is locked there, no height recalibration required
- **ATC:** Automatic tool change, simultaneous 16 out of 99 tools per Job

BUNGARD
BEL

- **ATC/XL:** simultaneous **25** out of 99 tools per Job
- **ATC:** drill break detection and length calibration

Drive system:

- High load-2x2-phase stepper motors on all 3 axis for real milling applications and correct adjustment of the cutting speed for all tools
- Maximum position speed per axis: 9000/mm/min (=150 mm/s)
- Maximum working speed per axis: 9000/mm/min (=150 mm/s), individual setting for every tool independent from the positioning speed
- Step resolution: Software selectable: 1 mil, ½ mil, ¼ mil (= 6.35 Micrometer). (Premium: 1 µm)
- Precision: +/- 1 step
- Position accuracy:20 ppm (0.002%) over the entire work space (9,9 µm with a work area of 495 mm)
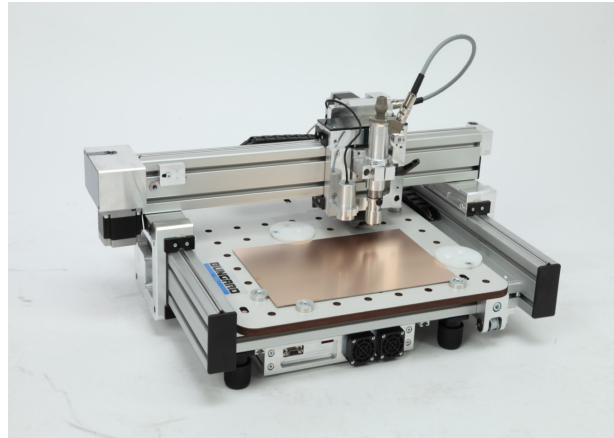
Software:

- Fully integrated Windows control software for online machine control in real time, with convenient user interface, including full tool management and plausibility checks
- RoutePro3000 for Windows XP - Windows 10 64-bit, project-related work flow, expandable by modules (laser exposure, fiducial recognition, dispensing and much more. See at: http://www.bungard.de/index.php?option=com_content&view=article&id=155&Itemid=191&lang=english)
- Resolution: 0,0001mm (0,1µm)
- Use of open format standards such as Excellon or Sieb & Meyer drill data and HP/GL data for milling. These can be opened and edited with a simple text editor
- You can individually adjust position speed for X-, Y- and Z-axis as well as the working speed (feed), spindle speed (RPM) and depth for each tool. This results in:
- continuous use of the appropriate cutting speed over the entire RPM-range, no need for 100 000 RPM spindles, no excessive wear of expensive bearings
- All machine parameters (speed, acceleration ramps, X / Y / Z dimensions / scaling, tool break detection) can be individually set in the RoutePro software
- Simple Teach-In Function for drill and route data (to copy an existing board)
- Smallest tool diameter: 0.1 mm (zyl. Micro cutter at 63 000 1/min)

BUNGARD
BEL

Technical Data

General

Power supply:	110-240 V, 50-60 Hz + vacuum cleaner(2000W)
Range of RPM:	3.000 – 63.000
Travelling speed:	1 – 9000 mm/min
Software resolution:	0,01µm
Mechanical resolution:	step resolution: Software selectable: , 1/4 mil, 1/16 mil (= 3.175 Micrometer)
Tool diameter:	0.1mm – 3,145mm (recommended, bigger tool diameter possible)
Position accuracy:	20 ppm (0.002%) over the entire work space:
Maximum position speed per axis:	9000/mm/min (=150 mm/s)
Maximum working speed per axis:	9000/mm/min (=150 mm/s), individual setting on a per-tool basis, independent from position speed
Drill speed:	5/s (= 18.000 holes/h= 300 holes/min)
Required accessories:	Computer, ATC: compressed air 6 bar
Board fixation:	span fixing, clamp fixing, reference pin system, stack processing possible Option: vacuum fixation

Comparison

	CCD/2/Eco	CCD 2	CCD/2/ATC	CCD/MTC	CCD/ATC	CCD/XL/MTC	CCD/XL/ATC	CCD/Premium
Weight kg	30	30		35		49		80
Dimension mm	700x550x300	700x550x300		700x800x300		950x950x300		950x950x300
Working area mm	270x325x38	270x325x38		325x495x38		500x600x38		400 x 500 x 64
Tool change	nein	nein	16	nein	16	nein	25	30
Software resolution	0,01 µm	0,01 µm		0,01 µm		0,01 µm		0,01 µm
Mechanical resolution	3,175 µm	3,175 µm		3,175 µm		3,175 µm		1 µm
RPM	5.000 - 35.000	3.000 - 63.000		3.000 - 63.000		3.000 - 63.000		5.000 - 100.000
Table	Spezial-MDF	Aluminium		Aluminium		Aluminium		Aluminium

Applications	CCD/2/ Eco	CCD/2	CCD/2/ ATC	CCD/ MTC	CCD /ATC	CCD/XL/ MTC	CCD/XL/ ATC	CCD Pre-mium
Milling and drilling single- and double-sided PCBs	✔	✔	✔	✔	✔	✔	✔	✔
Milling/drilling RF- & microwave substrates	(✔)	✔	✔	✔	✔	✔	✔	✔
Milling/drilling multilayer with up to 16 layers *	✔	✔	✔	✔	✔	✔	✔	✔
Contour routing of PCBs	✔	✔	✔	✔	✔	✔	✔	✔
Milling flexible, rigid-flex PCBs **	(✔)	(✔)	(✔)	(✔)	(✔)	(✔)	(✔)	✔
Engraving front panels/labels	✔	✔	✔	✔	✔	✔	✔	✔
Machining cut outs in front panels	✔	✔	✔	✔	✔	✔	✔	✔
Milling SMT soldering paste stencils	✔	✔	✔	✔	✔	✔	✔	✔
Housing production	✔	✔	✔	✔	✔	✔	✔	✔
Wave solder pallets	✔	✔	✔	✔	✔	✔	✔	✔
Panel cutting, Reworking PCBs	✔	✔	✔	✔	✔	✔	✔	✔
Test adapter drilling	✔	✔	✔	✔	✔	✔	✔	✔
Inspection templates	✔	✔	✔	✔	✔	✔	✔	✔

*) we generally recommend to etch at least the inner layers of a multilayer PCB

**) For flexible materials vacuum fixation is a nice option

Options

Vacuum table, protection hood or protection rack, converter software IsoCam, fiducial recognition and calibration with camera, laser exposure of photo resists, aluminium work table, routers engine adapter for plastic milling and many more.

Accessories

Measuring microscope	Compressor	Accessory set	Drills and Routers
Drill backing boards	Reference pins	Cooling device	PCBs with or without photoresist

Amount of delivery

mechanic unit
control unit with complete cabling
Superb and sturdy high frequency spindle with eddy current brake and load control
Integrated mechanical milling depth limiter and pressure foot
RoutePro3000 (Windows XP - Windows 8 64bit) for drilling and milling
Powerful, adjustable (500. .1500 W) vacuum cleaner, integrated start adapter for vacuum cleaner
Set of Allen Keys; ATC: Air hose

CE   **EG-Konformitätserklärung/Declaration of Conformity**

Hersteller / Supplier:	Bungard Elektronik GmbH & Co. KG Rilkestraße 1 51570 Windeck Germany
Bevollmächtigte Person für die Zusammenstellung der technischen Unterlagen: Person in charge	Jürgen Bungard, Geschäftsführer /general director Rilkestraße 1 51570 Windeck Germany
Produkt:	Bohr- und Fräsanlage Bungard CCD Drilling and milling machine Bungard CCD

Hiermit erklären wir, dass die oben beschriebenen Maschinen allen einschlägigen Bestimmungen der Maschinen-richtlinie 2006/42/EG entspricht.

Die oben genannte Maschine erfüllt die Anforderungen der nachfolgend genannten Richtlinien und Normen:

We hereby declare that the machines described above complies with all relevant provisions of the Machinery Directive 2006/42/EC.

The above machine meets the requirements of the following guidelines and standards:

- **Maschinenrichtlinie 2006/42/EG / Machinery Directive 2006/42/EC**
- **EMV-Richtlinie 2014/30/EG / EMC Directive 2014/10830EC**
- **Niederspannungsrichtlinie 2014/35/EG / Low Voltage Directive 2014/35/EC**

- **DIN EN 60204-1** Sicherheit von Maschinen - Elektrische Ausrüstung von Maschinen - Teil 1: Allgemeine Anforde-rungen / Safety of machinery - Electrical equipment of machines - Part 1: General requirements
- **DIN EN ISO 14121-1** Sicherheit von Maschinen - Risikobeurteilung - Teil 1: Leitsätze / Safety of machinery - Risk assessment - Part 1: Principles
- **DIN EN ISO 12100-1** Sicherheit von Maschinen - Allgemeine Gestaltungsleitsätze, Risikobeurteilung und Risikomin-derung / Safety of machinery - Basic concepts, risk assessment and risk reduction
- **DIN EN 55014-1 2012-05** Elektromagnetische Verträglichkeit, Anforderungen an Haushaltsgeräte, Elektrowerkzeu-ge und ähnliche Elektrogeräte, Teil 1: Störaussendung / Electromagnetic compatibility Requirements for household appliances, electric tools and similar electrical appliances Part 1: Emission
- **DIN EN 55014-2-2009-06** Elektromagnetische Verträglichkeit - Anforderungen an Haushaltgeräte, Elektro-werkzeu-ge und ähnliche Geräte - Teil 2: Störfestigkeit - / Electromagnetic compatibility - Requirements for household app-liances, electric tools and similar apparatus - Part 2: Immunity
- **Niederspannungsrichtlinie / Low Voltage Directive 2014/35/EG**
- **Maschinenrichtlinie / Machinery Directive 2006/42/EG/37/EG**

Windeck, 10.1.2017

Jürgen Bungard Geschäftsführer

Intended Use

The machines are determined for drilling and milling (routing) printed circuit boards and for milling (routing) and engraving aluminium plates. A special application is dosing of pastes or liquids onto panel-shape work pieces and the laser exposure of photo resists and solder mask. Any other type of application is permissive only with our consent.

Safety instructions

General

The machines are not determined to be connected or combined with other machines. However, they need to be connected to and be controlled by a compatible computer. The driver software is supplied with the machines and is relevant for security.

The machines may only be operated by qualified operators. Children and animals must be kept off!

The machine is manufactured using tested components according to standard guide lines for electrical safety. This does not relieve the user his duty of care when dealing with electrically powered devices.

Before performing any maintenance switch off the machine and unplug it.

Emergency Stop Facilities

The ESCape button on the computer stops the spindle and the stepper motors. This is indicated by a red message/icon on the computer screen. The main switch on the control unit or power supply unit cuts the machine from mains supply, but is not suitable for emergency stop: It does not allow programmed spindle lift and quick stop.

If the computer has stopped responding and thus the EMERGENCY STOP button does not work, you can stop the machine using the main switch of the control unit. In this case wait until the spindle has come to a standstill.

Protection against contact with moving parts

There is a round metal tube with a spring included with the spindle. This drill pressure foot shall be mounted to the spindle shaft to prevent incidental contact to the moving tool. Same function has the depth limiter when routing. The use of depth limiter and pressure foot is obligatory in the sense of the machinery directive and the general safety standards to ensure maximum work safety.

 It is not possible to entirely envelop the tool, as this would make the drilling and tool change actions impossible. In case this pressure foot was not placed correctly, the following danger remains:

WARNING: Do not touch the tool when the spindle is operational. Prior to any tool change action, wait until the spindle has come to a complete stop.

Under normal operating conditions and with the given work piece materials, there is no special danger from parts being propelled off the machine. However, special operating conditions or heavy work pieces may require that the machine is encapsulated. A protection cover is available as an option.

BUNGARD
BEL

Location

Put the machine onto a stable, even table and adjust the machine's 4 feet by turning them. A stable desk and a proper setting are important to prevent vibrations etc. Make sure you have enough room around the machine for tool change, mounting PCBs and maintenance work.

The machine may only be operated under normal temperature and humidity conditions, especially only in absence of corrosive or inflammable vapours. At temperatures lower than 10 °C or higher than 30 °C, there may occur the following problems: The spindle might not start running at low temperatures. The stepping motors might run hot or step losses may occur at more than 30 °C in the surrounding air.

In order to ensure a sufficient cooling, the equipment feet may not be removed, otherwise not enough air will pass through the controller – Overheating and destruction of the end phase may be the result.

The controller is designed to run at normal ambient temperatures (25°C) and should be operated in an open set up with dry, dust and aggressive steam free environment.

If the controller is used within a closed cabinet or room temperatures higher than 25°C, you have to supply additional measures for ventilation.

Increased dust load must be prevented by suitable measures.

Operation in an aggressive, dusty, humid, extremely hot or hazardous environment is at the user's own risk and responsibility.

The user has to care for appropriate precautions and protective devices, Any liability for damages arising in such an environment by the operation, are hereby expressly excluded.

Noise

With the HF-spindle running at full speed and the vacuum cleaner on, the noise pressure level at 1 m distance is 86 dB(A). Operators have to wear ear protection.

Dust

It is necessary that the standard vacuum cleaner is always being used during operation on printed circuit boards. The vacuum cleaner must be OFF during and after use of alcohol or other inflammable or explosive liquids (i. e. used for cooling when milling aluminium). Individual operating conditions may require that an extraction unit with higher rating or the optional protective enclosure be installed.

Power supply

The machine power supply has a wide range AC input. You can run it on any common single phase mains supply. If the power cord supplied with the machine is not suitable for your country, please replace it. In this case it is urgently required that you ensure correct grounding to PE.

Attention! You must disconnect the machine from the main supply and wait until DC voltages are low prior to opening the control unit or to pulling cards off from it. We deny any liability if alterations to any mechanical, electric or electronic components of the machine are made. Prior to any manipulation to the control unit, check that the machine has been disconnected from the main supply.

Please make sure to fix the cable connection with screws. Do not pull the cables while the machine is under power. First switch off controller and wait for potential equalization .

On the controller is a schuko socket. This is designed for the vacuum cleaner and is switched on and off via the spindle automatic. If you want to connect other loads (such as a liquid cooling valve for aluminum milling) to this socket, the power of the appliance should not exceed 2000 W.

For the connection of safety switches (e.g. hood switches) a shielded cable should be used, it must be kept as short as possible. This cable - just like all remaining connection/feeder cables between Controller and CCD - should not be laid parallel to power cables in order to prevent inductive or capacitive linking of high-energy transients and thus possible over voltage damage in the CONTROLLER.

Not avoidable crossings with power cables must be right-angle implemented to keep couple-strain as short as possible.

If in the proximity of the machines high inductive loads are operated like e.g. strong electric motors, exhaust fans, contactors etc., the employment of an opto coupler can be necessary for the connection of the hood contact/safety switch.

All damages due to over voltage, overheating, humidity, dust, corrosion or inappropriate connection of external or electronic devices are excluded of the guarantee. These repairs will be charged.

Maintenance

It is important that you regularly remove all dust and shavings from the machine. To clean and lubricate the steel shafts, especially those below the aluminium extrusions on the X-axis, use a cloth and some acid-free machine oil. On each end of the linear bearing housings, there are lubricating felt stripes. Regularly apply some oil to them.

The shafts on the Z-axis do not need special lubrication but must also be kept clean.

Note: The machine must not be used in corrosive or inflammable atmospheres. If it will not be used for a longer period or prior to transporting it, all steel shafts should be well lubricated.

The drive belts must also be kept clean from dust and shavings but must not not be lubricated. The belts are subject to wear. If they show damages like lateral fray-out or deformed teeth they should be replaced.

Tools

Only tools with ring (collar) should be used. The distance flange determines the spindle elevation over the table. The distance from the top edge of the ring to the tool tip is 21 mm. It is mounted to the spindle at the factory in a way that a drill (with ring is 0.5 mm over the machine table when the Z axis is completely down. You should not change this setting. Otherwise the mechanical position of the Z axis will be different from the one assumed by the driver software. Damage to the machine table may then result.

Software licenses

Please note that licenses may be linked to the computer. Before you change the computer or reinstall the operating system, you must deactivate the licenses!

Documentation

Our distributor / reseller in your country is encouraged and in charge of translating the German and / or English manual coming with the machine into your native language. A declaration of EU conformity is appending.

BUNGARD
BEL

Installation Manual RoutePro3000

System requirements:

CCD with Controller 2006 or younger.

Computer with Windows XP SP3 till Windows 10 64 bit. 1,3 GHz Processor, 6 GB main memory and 200 MB free disc space.

Internet connection during setup and registration. The internet connection is necessary to install updates like Visual C++ and Framework 4. In addition you can register your RoutePro3000-version and, if there, activate licenses for special modules (laser, dispense, calibrate etc.).

After installation you can of course work offline.

Procedure:

Read the manual of RoutePro3000. Connect CCD to your computer. Then install RoutePro3000: Double-click on "SetupRoutePro3000.exe" and follow the routine. Depending on your system Microsoft Framework 4 and Microsoft Visual C++ will be installed automatically. If you do not have the latest firmware on your CCD controller, then your controller will be flashed automatically. A restart of Route-Pro3000 may be required in this case (With machines younger than 2016, it can be necessary to do the upgrade manually (see below).

If you use special modules like laser, calibration or dispensing, then please read the special instruction for these modules coming with the hardware and refer to the applying help topics in the RoutePro manual/help system.

The standard version of RoutePro3000 is for free, but after a trial time of 14 days, you need to fill out a register form. The registration process is described in the help file. Please note: from 2014 on you do not need to apply for a license any more. After filling out the registration form you can directly work. With internet connection and without. In addition you have the chance to create error reports, which help us to help you either to directly solve your problem or to get information where a bug fix may be required.

After successful registration you can test all available modules for a trial period of 14 days.

To test the modules, please go to **options** and wait till your desired modules shows up at the field **available modules.** Click on your desired module. After that you can activate your test license. It may be necessary to restart RoutePro3000.

After 14 days a license has to be acquired. Please note that special hardware needs to be obtained for the modules (laser head, camera, etc.). To apply for a license, you need to have a Computer with internet connection. If you do not have an internet connection, please contact us to apply for an offline license.

In Regards of the license system, please read the corresponding chapter in the RoutePro3000 help. The topic is there very well explained.

For different machines it can be necessary to use a different routine:

New machines

The SetupRoutePro3000.exe file is located on the CD. All necessary files, including the machine and tool parameters, are located in this setup. The documents, licenses, and projects folders are also stored on the CD, so that you can, for example, read the help before the installation, or have access to the licenses without installing RoutePro3000.
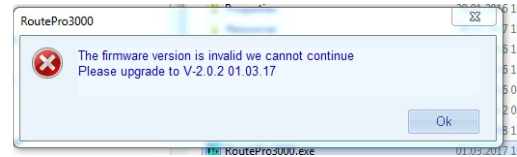
Existing machines with RoutePro3000: We created a separate file "UpdateRoutePro3000.exe". This file does not contain the resource data and thus your already existing parameters for machine and tools will not be overwritten. This Update version can also be downloaded from our homepage.

Make sure your resource data are in the correct location.

(standard: C:\Program Files\RoutePro3000\Resources)

BUNGARD
BEL
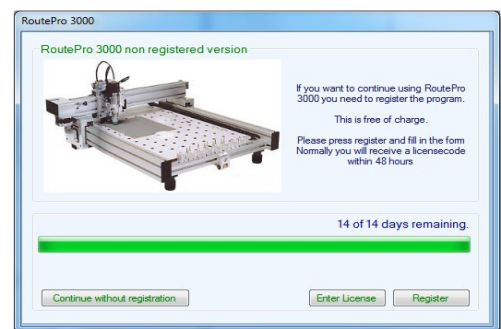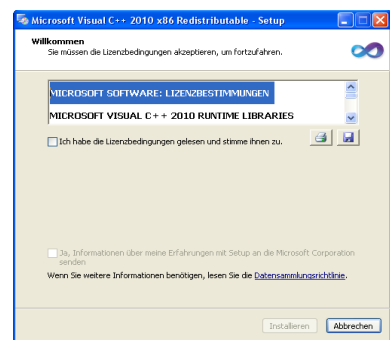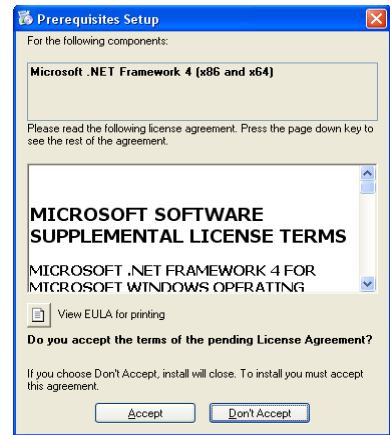
Existing machines younger than 2016 (CCD3000)

For an update, it may be necessary to update the firmware. For machines older than 2016 (Atmel versions), this happens automatically. For machines younger than 2016 (CCD3000-Alvidi), the controller must be updated manually . When you start the update for RoutePro3000, the warning message appears that the firmware is not up-to-date. In this case, open the UpgradeFW.exe file. This is usually found at: C: \ Program Files (x86) \ RoutePro3000 \ Firmware Upgrade. Follow the instructions of the software. Then you can start RoutePro3000 normally.

Existing machines with RoutePro2008

The SetupRoutePro3000.exe file is located on the CD. All necessary files including the machine and tool parameters are in this setup. The documents, licenses, and projects folders are also stored on the CD, so that you can, for example, read the help before the installation, or have access to the licenses without installing RoutePro3000. After installation, you have to transfer the specific machine parameters of your machine (correction factors, table, sensor and tool positions) from RoutePro2008. Alternatively, you can change your old machine configuration (routepro.rpc) via the **OPTIONS - MACHINE – (tooth wheel) - IMPORT RPC**

If you have a new machine the CD coming with the machine is already adapted to your specific machine. No further action beyond registration and activating licenses need to be done. Still we recommend to compare the machine parameters at **options** – **machine** with the PDF print out coming with the machine.

If you update from RoutePro2008 to Route Pro3000, you need to establish the correct parameters for your machine. Process like this: Start RoutePro3000 and go to options and machine. Hoover over the CCD-picture and insert correct parameters for XYZ-motors, spindle, tool slots, sensor and table. You can copy the values from your RoutePro.ini-file of your older Software RoutePro2008. Alternatively you can print screenshots from your RoutePro2008 software and copy the values from the screenshots.
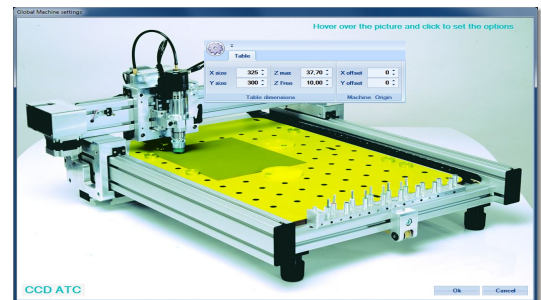
Please note: there is one exception concerning the Z-position of the tool slots. In RoutePro2008 the z-position of the tool slots was 0.5 – 1 mm less than z-max. E.g. if z-max was **37.65**, then z-position of the tool slots was approx. 37.00mm. In RoutePro3000 the table is the **0-Position** of the **z-axis** and you almost put the tool to 0. So now you have to insert 0.5 – 1.0 mm in the ATC-tool position table.

Attention: Back up your RoutePro3000 version regularly and also the associated licenses. If you want to change the computer or re-install the operating system: First, deactivate the licenses!
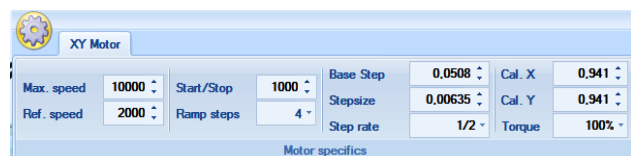
Only after successful deactivation the licenses are available on the new computer!

For more details on installing and using RoutePro3000, see the RoutePro3000 Help. Now you can use the RoutePro3000 software with your CCD.

The current RoutePro3000 version is available at:

http://www.bungard.de/downloads/software/UpdateRoutePro3000.zip

Have fun with your CCD and the new software Routero3000!

Short Instructions/Setup

You need:

- if possible a second person to lift the machine off the box
- a small screw driver to secure the cables
- a multiple socket
- a drill backing board
- adhesive tape
- PCB material
- tolls (drills/routers)

Examine the packaging for transport damage.

Open the lid of the packaging, remove anchoring straps and, with the help of a second person, lift the machine out of the box and set it to its destination. The ground should be level and stable. Align the 4 levelling feet so that the machine does not wobble. Examine the machine for possible transport damages.

Manual test: With no cable connected, check manually whether all three axis move freely. Check if the supplied spindle easily rotates.

Setup: Install the supplied Spindle. With the manual spindle (4010) connect power cable to machine.

With the ATC (4054) also connect air supply to the socket of the Y-axis. The spindle is factory set in a way so that a drill or milling tool with the correct length (21 mm from the tool tip to top of the ring; 38mm total length) can be lowered to a maximum of 0.5 mm above the table. Thus touching the table with the tools is not possible.

BUNGARD
BEL
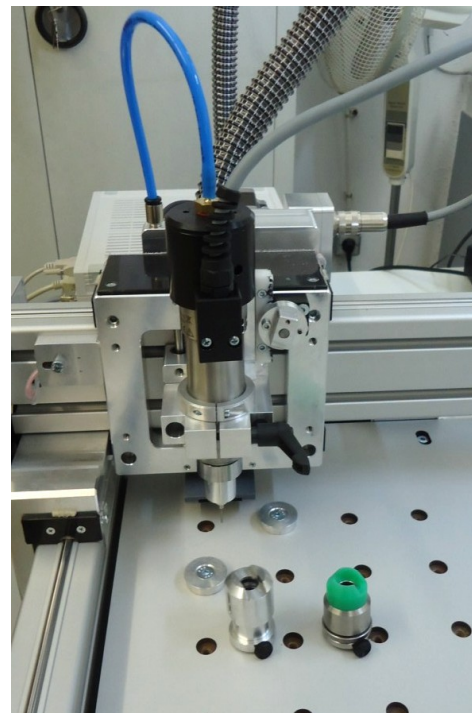
MTC, ATC: Connect the two 15-pin cables from the control unit to the connections on the back of the mechanics. Make sure that the plugs are properly seated and the plugs tightly screwed! The cables cannot be interchanged. Then connect the cable on the controller. Insert the spindle cable between the controller and the machine. Then establish the USB connection between the controller and the PC (short cable connection
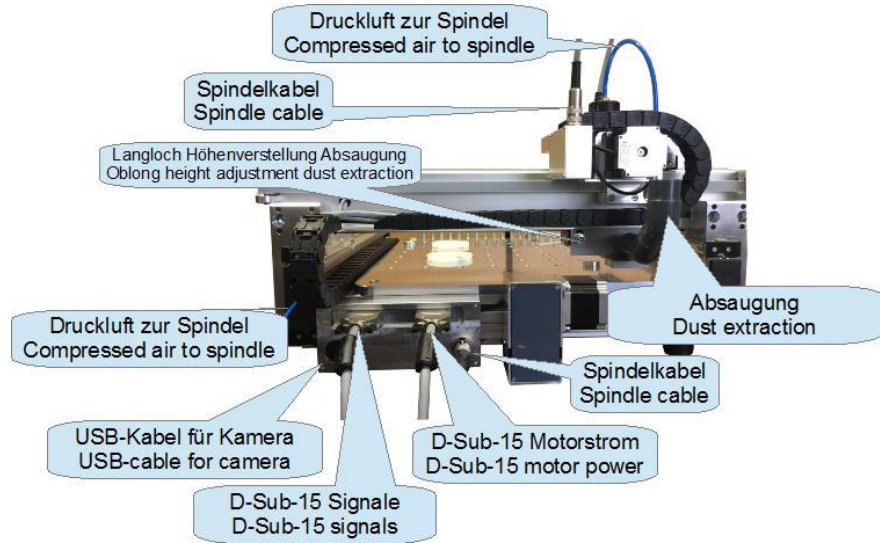
advantageous) and then connect the power supply. Connect the vacuum cleaner to the controller and insert the suction hose.
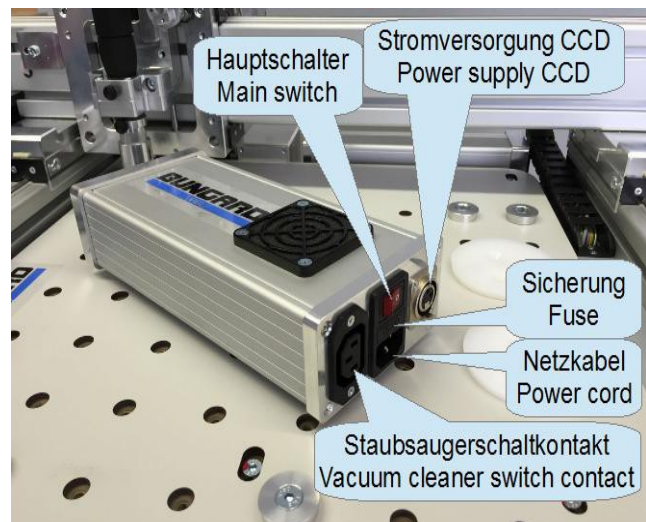
ATC: connect machine to compressed air supply (6-8 bar, oil free; not included in deliver)
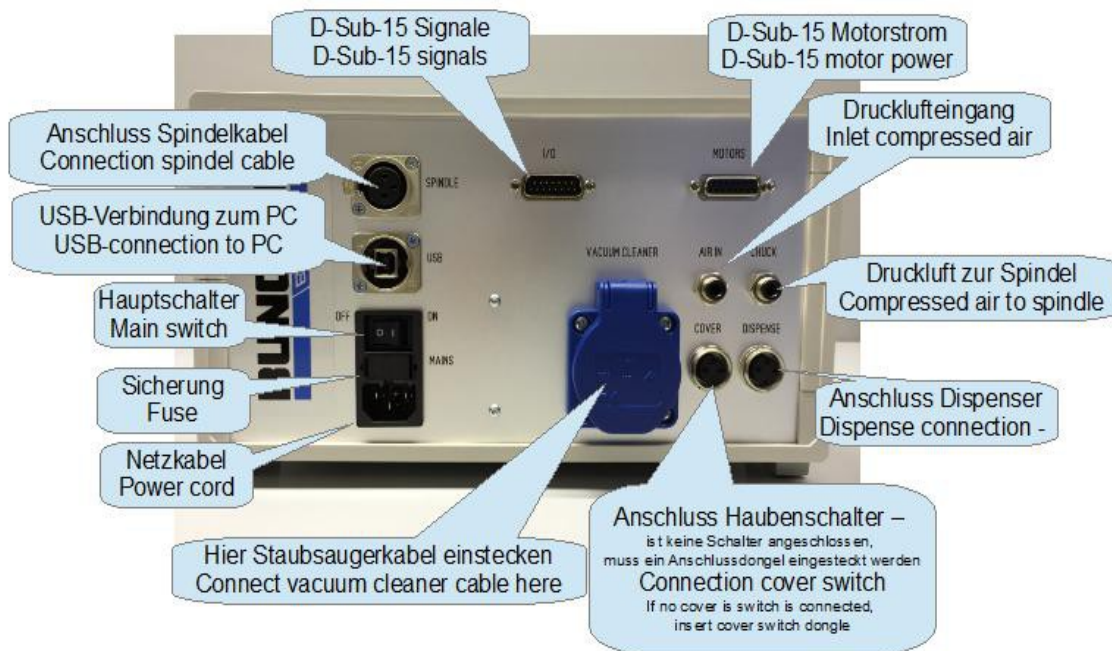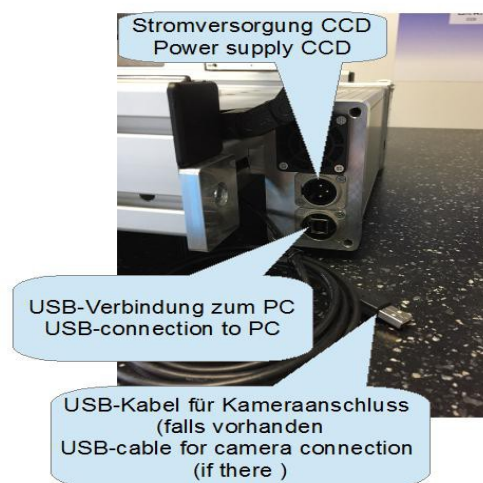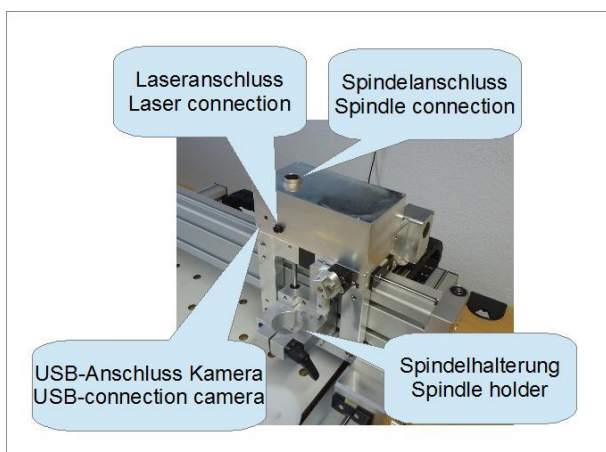
The machine is delivered with a dongle for the cover switch. If the dongle is not inserted into the socket on the controller (CCD/2: connection box), the machine does not move. In the dongle there are 2 connectors bridged. If a hood is subsequently to be connected with the cover switch, then the dongle must be opened, the bridge must be removed and the cables from the door switch connected to the "bridge contacts".

Coverswitch Dongle
(plug in at cover socket in controller frontpanel)

CCD/2 and CCD/2/Eco: the machine has a separate power supply. Please connect the power cable, the connecting cable to the machine and the vacuum cleaner. An adapter from Schuko to a cold plug is included.

Hauptschalter
Main switch

Stromversorgung CCD
Power supply CCD

Sicherung
Fuse

Netzkabel
Power cord

Staubsaugerschaltkontakt
Vacuum cleaner switch contact

On the left-hand side of the machine are
the USB connection from the machine to the PC and the plug for the power supply.
Now please insert the spindle into the spindle holder and connect the connection cable.

Laseranschluss
Laser connection

Spindelanschluss
Spindle connection

USB-Anschluss Kamera
USB-connection camera

Spindelhalterung
Spindle holder

Stromversorgung CCD
Power supply CCD

USB-Verbindung zum PC
USB-connection to PC

USB-Kabel für Kameraanschluss
(falls vorhanden
USB-cable for camera connection
(if there)

BUNGARD
BEL

In the picture on the right you can see an axis and zero-point overview. All CCD machines are set up, so that the motor connection box with the cables is located on the left and the stepper motor of the Y-axis facing the front. On the right there are the tool slots (ATC-machines). If you stand in front of the machine that way, then the **machine zero** is on the **front left**, the **X-axis** is on the **table level** between motor connection box and tool slots, the **Y-axis** is the upper **cross traverses** and the **Z-axis** with the spindle sits on the traverse and **moves vertically**.

The only exception is the CCD/2 and the CCD/2/Eco: this machine is set up in a way that the RS232 port and control diodes are pointing forward. Again, the **zero point** is at the **front left**, but the **Y-axis** is in the **table level** of the table and the **X axis** is the **cross-traverses** over the table and on this X-axis hangs the **Z-axis** with the spindle.
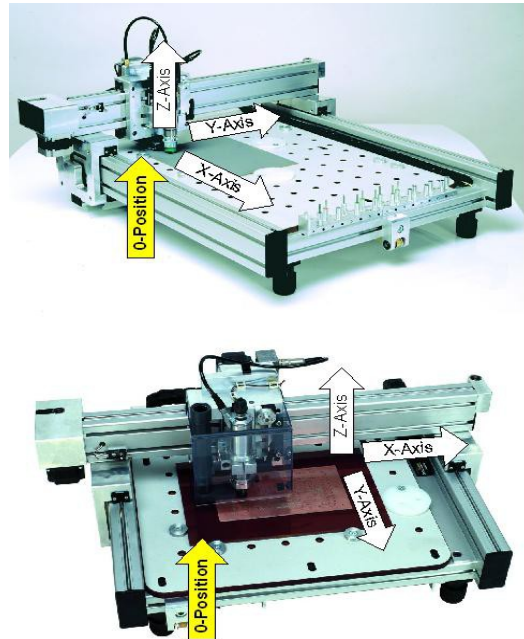
RoutePro3000 installation software:

Insert the supplied CD into your computer drive and start SetupRoutePro3000.exe. Depending on the system, the **Windows Framework 4** and **Windows Visual C ++ modules** must be installed on your system. This usually happens automatically if your PC is connected to the Internet. Possibly a reboot is required. In the first dialog, click Register. Enter your contact information in the next dialog. The transmission of contact data is voluntary. An Internet connection is not required to use the software.

The machines from 2016 are usually recognized automatically. A driver installation is not required. If problems arise in this regard, please contact support@bungard.de.
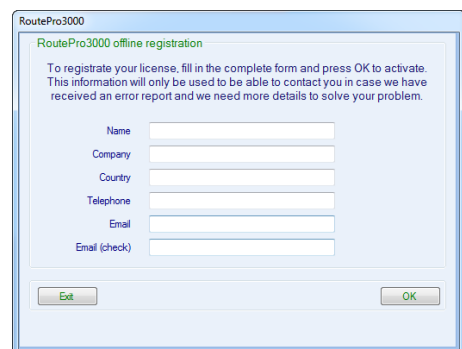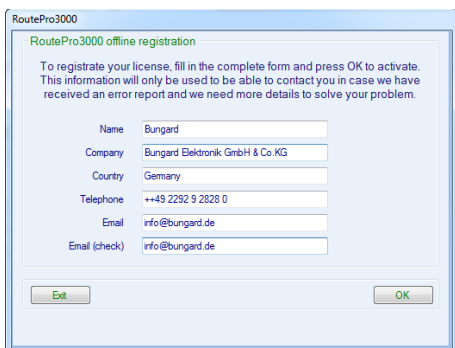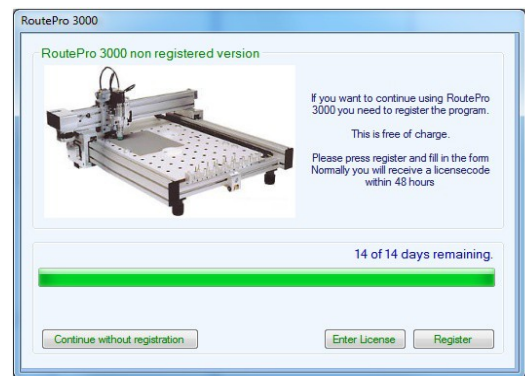
After successful installation your screen should look like this:
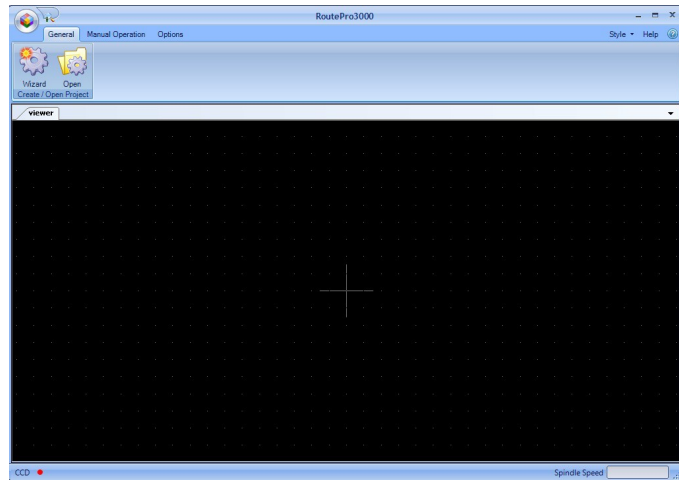
Please check the settings of the machine by clicking on the **Options** tab and then on **machine**. You will see a picture of a   CCD. If you hover the mouse over the different functional areas of the machine, you will notice a colour change. Click on the areas to open the function dialogue. If you drive over the table, you can access the table settings for example.
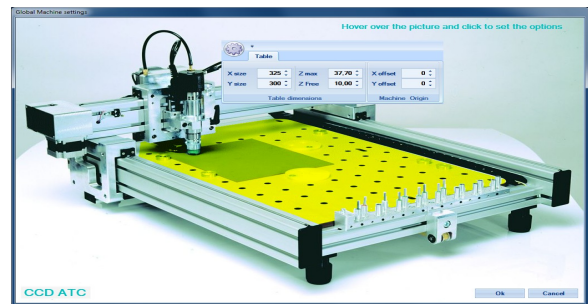
In each function dialogue there is a small tooth wheel. Click on this tooth wheel and you can either load a different machine configuration (be careful! Your machine only works correctly with the correct machine configuration!) or access the advanced features, such as correction factors.

Please compare the values in the machine configuration of the software to the documentation provided with the machine.
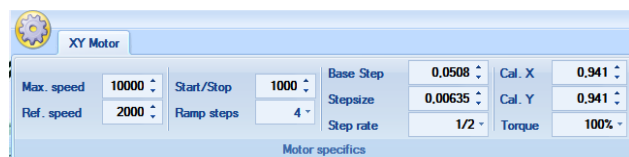
Function Test in manual Operation:

Close the machine configuration and go to the tab **Manual Operation**.

Check the function of the axis by clicking on the arrow buttons. When you first click on one arrow, the machine will perform a reference drive. Make sure that the control diodes light up when reaching the 0-position. You can also check the function of spindle as well as camera, dispenser or laser, if there.
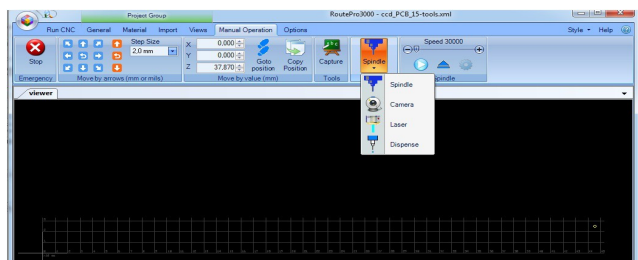
(ATC) tool slots

At the front of the machine there is a bar with 16 tool slots, numbered from 0 to 15 (XL: 26 pots). Number 0 always takes up the test pin, the routers and drills are located in the remaining round aluminum slots. Each tool can be moved up and down in the slot and is urged upwards by a spring. The position of the slots is stored to the software via entries in the configuration menu.

The drill break sensor is located to the left of tool slot 0. The operating software checks each drill for breakage after use. This sensor is also used to detect too long tools and sort them out so that they can not cause any damage.

Tool change MTC + CCD/2)

To open the chuck, press the button at the top of the spindle until it locks and turn it to the left. Repeat this until you can remove the tool from the chuck. For better access, you can lift the spindle, but it is not recommended to lift it completely out of the holder. Tool change during the program execution is carried out with energized motors. The current position of the axes is thus locked.

ATC: Check the function of the tool changer. Go to tab **General** and click on **Open** to load the project file ccd_PCB_-15tools. (XL-Version: -25 Tools). This project file is located after a normal installation at C:\Program Files (x86)\RoutePro3000\Projects\ccd_PCB_15-tools
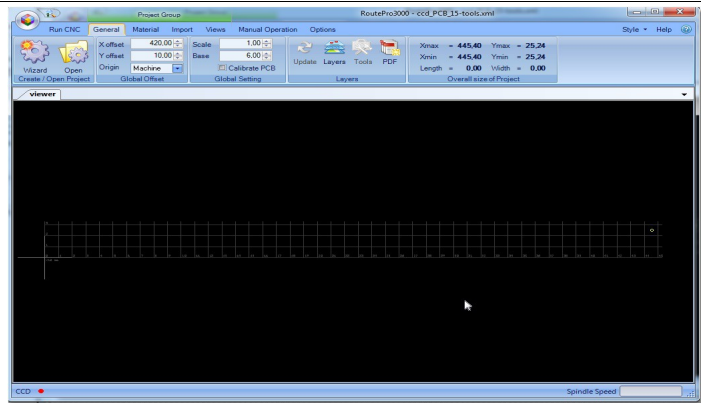
Go to tab **Run CNC** and click on the triangle **START**. The next dialogue asks you to place the tool to the corresponding tool slots. Make sure that the tools have a length of 38 mm and the distance between the top of the ring to the tool tip is 21 mm. Furthermore, a test tool must be in the spindle and the tool slot 0 must be empty. Check the correct fitting of the tools in the slots. Since there are tolerances in the ring diameters, it can be necessary to adjust the slots. You can easily widen them with a screwdriver and tighten them by pressing from outside against the lamellae.
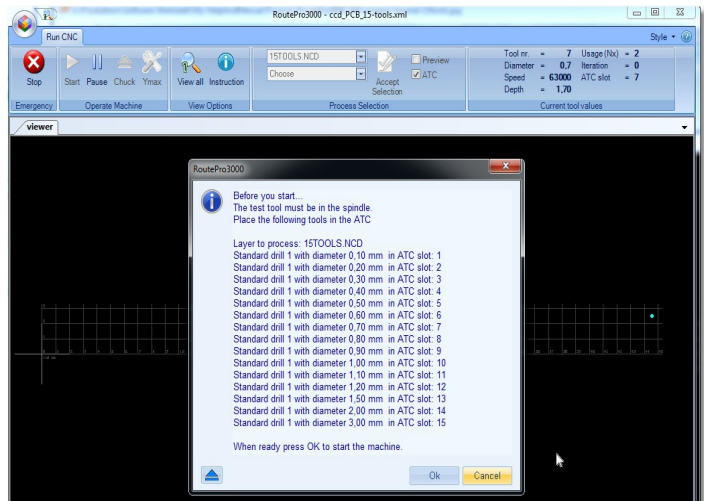
Press **OK**. The machine now moves to the tool sensor, checks the test tool and places it in slot number 0. Then the spindle moves back to the sensor to check whether the tool was correctly dropped. After that it continues to slot number 1 to load the first tool. The length of tool 1 is checked at the sensor, the spindle starts and a positioning and drilling movement is performed. After that the machine checks if the tool is not broken and sets the tool again in slot 1. This cycle is repeated until all 14 (XL 25) tools are checked. Please be prepared to either press the **ESCAPE** key (= emergency stop) on your keyboard or click on the red **X** in the top left in the RoutePro3000 window to directly stop the machine in case the tools were not picked properly or a collision is about to happen. This may happen in case of a transport damage or if you drive the machine with incorrect parameters.

Make sure that the LEDs of the limit switches and the tool sensor go on and off again when the machine reaches the corresponding positions.

After the last tool, the spindle picks again the test tool and moves to the machine zero point.

All CCDs: Make a first drill and routing attempt!

To do so load the project file ccd_PCB_quickstart.xml. You will find this file on your C-drive at: C:\Program Files (x86)\RoutePro3000\Projects. This is a single sided board with 3 different drills, a simple isolation and a cut-out-routing.
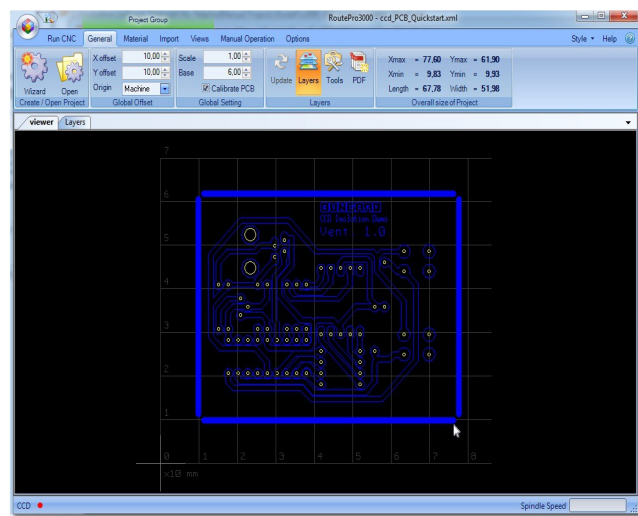
Fix a standard drill backing board using the provided clamps on the machine table. Now fix a PCB with at least 160 x 100 mm dimension about 5 mm off the machine zero point (in this project the offset for X and Y is set to 10 mm, we recommend first to use this setting when you create a new project. Always compare the thickness of your backing board and your PCB with the values shown in the software !!!II!)

BUNGARD
\BEL/
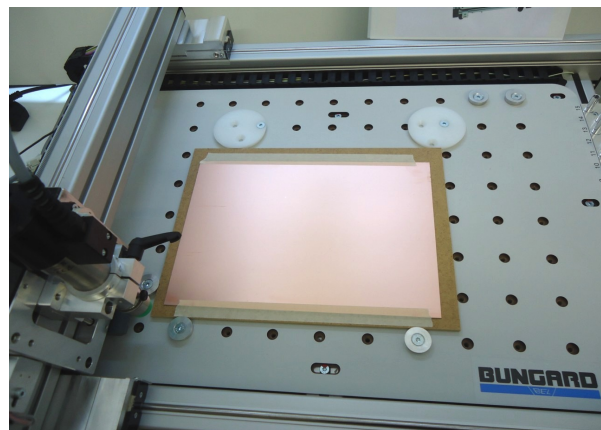
Go to to tab **Run CNC**.....
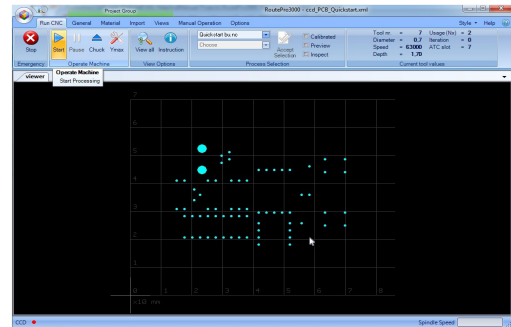
…..... and click Start. The machine will perform a reference run. Make sure that all 3 end switch diodes light up. With an ATC machine the software will ask for test tool in the spindle and whether the tools are correctly positioned in the ATC bar. Again take care that slot 0 is free!
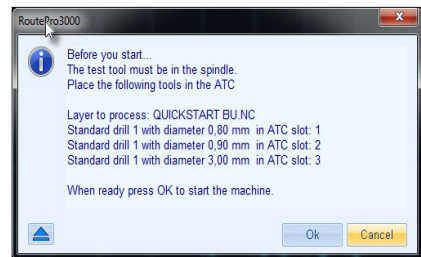
With a manual machine, you are asked to insert the current tool into the spindle.
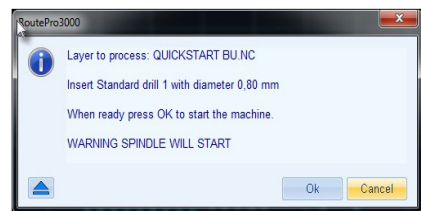
After clicking **OK**, the drilling begins. This is fully automatic with an ATC. For manual machines, the first tool is processed, then the machine moves up into the Z limit switch and you will be prompted to insert the next tool.

When the drill layer is finished change to the routing layer
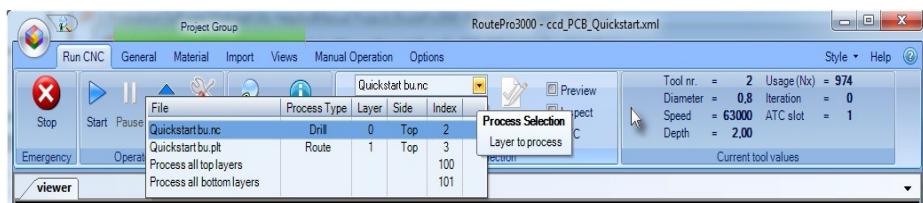
With click on **Start** the machine again makes a reference run and the processing is carried out in the same manner as with drilling.
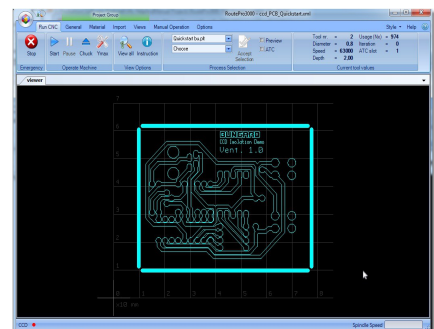
Milling Depth Limiter and Drill Pressure Foot

We generally recommend to use a depth limiter for isolation milling to compensate the tolerances of table, backing board and PCB.

Caution: If the depth limiter is operated together with an automatic tool changer, then the opening of the green slider must point towards the tool slots, otherwise tool or tool slot will be damaged!

If you use the depth limiter, the spindle of the Z-axis needs to be decoupled. To do so remove a little screw from the Z-axis clutch using the supplied Allan key and deposit the screw temporarily in the threaded hole as shown in the picture.

The depth limter is mounted from below to the spindle and locked with the black screw. To change the tools, we recommend to quickly take off the depth limiter. The green slider is a consumable item and can be exchanged if necessary.

The head is set with a fine thread with 500µm pitch and secured with a lock nut. On the lower part 10 adjustment points are located at regular intervals, so if you turn the fine thread from one adjustment point to the next, you change the milling depth 50 microns.

There are several ways to set the depth:

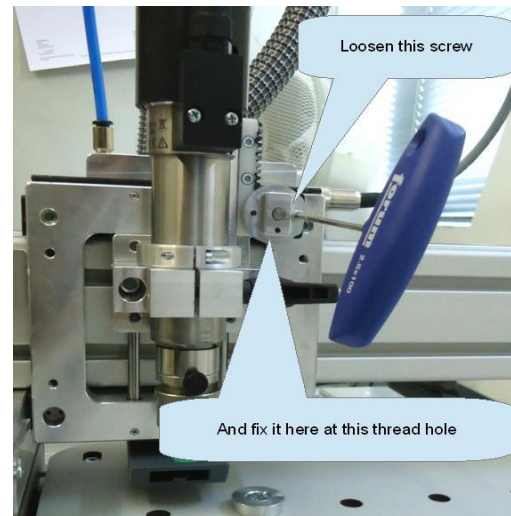**Setting option 1:** Go to the tab **Manual Operation** and move the axis using the arrow keys. The actual milling depth results from the difference in the height of the green gliding part and the tool tip. Therefore, carefully turn the screw part of the Depth Limiter while the spindle is running until the tool just touches the plate. Always make sure that the green gliding part and then the cutter tip touches the surface. Warning: Do not touch the rotating tool!

Option 2: Go to Run CNC and mark a milling path (SELECT – WINDOW SELECT), preferably an uncritical, e.g. The later outer contour. Set the green gliding part visually; Tend to be too high rather than too deep and mill this path. Check the milling path and, if necessary, set the Depth limiter lower. Repeat until the milling depth / width is correct.
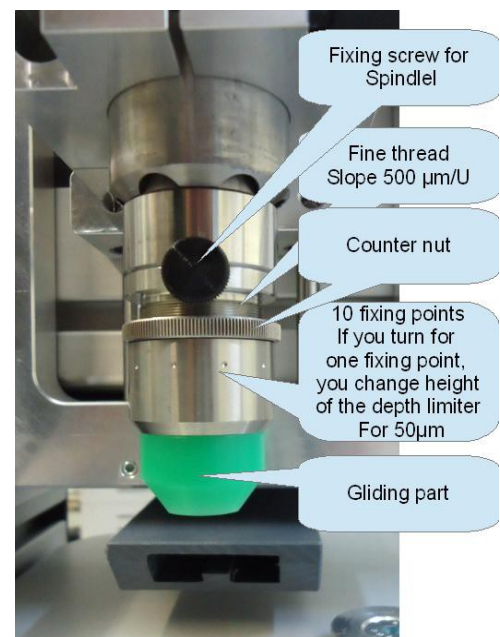
Your machine is now set up, controlled and you have already processed two projects with your machine. This introduction ends at this point. Further details and answer to special questions you can find in the detailed instructions below and the RoutePro3000 help files.

Maintenance

Regularly remove the dust and the chips after working and use a vacuum cleaner or a broom. The steel shafts of the guide profiles should be regularly wiped with a lint-free, slightly acid-free oil soaked cloth - also the shafts, which are on the bottom of the profiles!

At the sides of the linear bearing housing are felt wipers, which clean the shafts automatically during the process. Give these felts regularly a few drops of an acid-free and thin liquid machine oil. Best use a disposable syringe with thin cannula for that. The felts ensure that there is always a thin oil film on the steel shafts and this ensures easy running and protects the shafts against corrosion.

12 lubrication felts

Guiding profiles

The guide shafts of the Z-axis should be regularly cleaned of dust and debris. They do not require any further lubrication since the ball bushings running on them contain a permanent lubricant filling.

Note: The machine is not suitable for use in corrosive or explosive environments and must be protected against moisture and corrosion. In case of long-term non-use, storage or transport, the rails must be lubricated.

The toothed belts should also be freed regularly from dust and chips. They must not be lubricated and require no further care. Toothed belts are wear parts and must be replaced if wear phenomena, such as fraying, pronounced constrictions, etc., occur.

The toothed rack and the drive pinion of the Z-axis must also be regularly cleaned of residues and greased easily with a grease suitable for plastic sliding bearings.
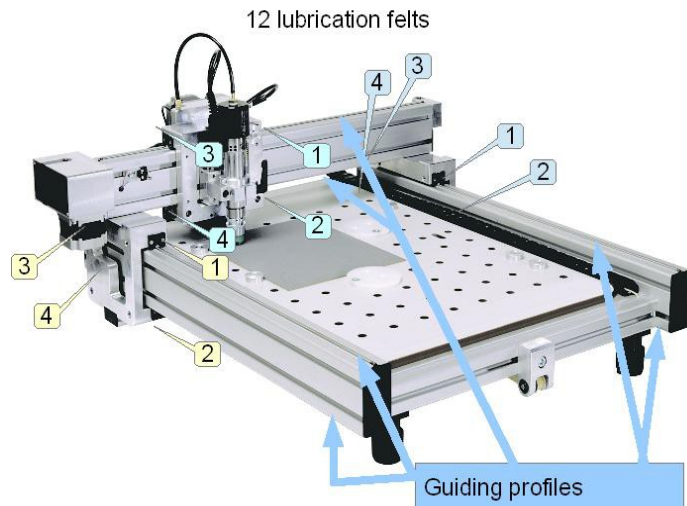
Fixing the boards

Clamp fixing

The machine table has holes each 50 mm. They serve to fix the aluminium and plastic flanges coming with the machine and allow to clamp on all four edges 1 base sheet and 1 - 3 boards of the same size of 1.5 mm. The two flanges near to the machine's zero position determine the board zero position. Use the two big white plastic disks with the 3 eccentric mounting holes to clamp the boards. The small eccentric flanges can be used to align the board(s) in parallel to a main axis. This fixing method is in most cases sufficient for all drilling applications, as well as for fixing a base sheet for isolation milling and contour cut-out routing. Disadvantage: backing board and PCB must have the same size.

Span fixing

You may insert screws into the holes in the machine table. Using stripes of metal or PCB material, this offers you the possibility to fix the plates from on top. This method will apply mainly for engraving aluminium. Disadvantage: the metal stripes lie on top of the plate and may be touched by the spindle.

Reference pins / Isolation milling

Use a drilling base that is significantly larger than the board. Create a drill file with two or six reference holes. These reference holes form a mirror axis, which is needed to reference the bottom layer of your PCB. We recommend to place the reference holes outside the design, at best on the long side of the PCB. In our software IsoCam an automatic function to generate these reference holes is included .

The drill backing board needs to be thick enough to provide a secure grip for the reference pins/rivets. A 6 mm MDF board is recommended. Instead of steel pins (which stick out of the board and possibly interfere with the milling action), we prefer rivets. The flat head of these rivets is almost level with the PCB and does not interfere with the depth limiter.

This fixing method has two advantages: The board is held securely, even for a later cutting out the PCB from the raw material. And a perfect match between top and bottom of the milled board is ensured by the fact that the mirror axis in the software and the physical mirror axis of the reference holes match exactly.

Also use reference pins in the wet process technique, if you first drill the board, then remove the board from the machine to make through hole plating and etch the tracks and after that return to the machine to make the final cut out routing.

Adhesive tape

simplest, fastest and cheapest method. The adhesive tape can be drilled and routed without problems. In contrast to the clamping and span-method, you can process only one board at a time. If you need to reference a double sided PCB, you can use the fiducial recognition option of Route-Pro3000.

Vacuum fixation

As an option all CCDS can be equipped with a vacuum table. This table can be connected to a vacuum pump (membrane or better: side channel pump) or a vacuum cleaner. The vacuum table sucks through the mounting holes of the CCD-table. You can put an MDF-drill backing board on the table and close the remaining fixing holes with foil or screws. The MDF is permeable to air, but you can enhance the vacuum effect by drilling small suction holes in the MDF.

Vacuum fixation is handy when processing flexible and semi-flexible materials. However, a possible bow in the board and tolerances in the material is not compensated. Thus the use of the depth limiter is still recommended.

BUNGARD BEL

Drilling bare boards

When making double sided PCBs with chemical through hole plating, the first step is to drill the holes. Any photo processing of tracks and pads will follow later.

Use a raw cut piece of copper clad laminate and put it, together with a base sheet of the same size, on the machine table. Align to the X- or Y-axis and fix like described under "clamp fixing".

Alternative: Use a big base sheet and fix it by use of the plastic disks. Put the board to be drilled on top and push it to the machine's zero position. Using adhesive tape, fix the board to the base sheet. Advantage: The fixture position is independent from the board size. The adhesive tape can be drilled through without damage to the drill.
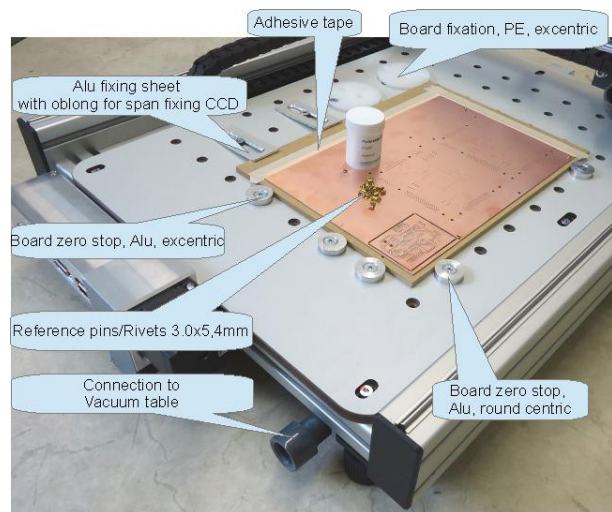
Pre-sensitized base material

In the same way as above, pre-sensitized base material still covered with its protection foil may be drilled **prior to exposure**. As to our experience, this gives best results: There is only one positioning operation necessary at exposure time. The drilled image will perfectly fit the etched board structures. If possible produce your artwork with **transparent drill holes** in the pads. This will make the referencing process very simply.

Etched PCBs

The already etched board should be drilled. The position of the holes must be exactly the same as the position of the solder pads.

Look at the layout as the first drill hole with its own tool designation 2 or 6 reference / registration holes (for example with IsoCam). Place a new drilling pad on the machine table, attach the raw board with tape, and drill the holes in the circuit board and support. Now expose, develop and etch your board as usual. The reference holes also help to position the film. After etching, pin the board by means of reference rivets on the drilling pad and drilling the board.

Routing

Also for routing a base sheet is strongly recommended! Fix the plate by span or clamp fixing. Pay attention that it lies straight and even.

If, for example, there is a circle to be routed in FR4 material, the inner part of it will most certainly remain where it was on the base sheet. This will of course work only if you use a sharp router and set an appropriate speed. In IsoCam you can place gaps in the cut out. These "bridges" prevent the cut outs to be propelled away.

Engraving

The engraving front panels requires a good flatness of the board. Otherwise, the font thickness varies with the depth of penetration of the V-cut-router. Here is a safe clamp fixation indispensable. For engraving you can work with the depth limiter. However, in this case the cooling is less efficient, because the milling tool is almost completely enclosed. Another trick is to bend the engraving plate a bit, so the the sides of the plate point upward. Now, when you span down both sides the engraving plate will lie flat on the base.

Modules and Extensions

Various hardware and software extensions are available with the software platform RoutePro3000. These modules are currently available:

Plus 3000

LaserPro 3000

DispPro 3000

Document 3000

Calibrate 3000

Inspect 3000

API 3000

QR-Code 3000

All modules can be tested 14 days free of charge and without obligation. To do this, open RoutePro3000 and go to TAB Options. In the right area is an animation on which the still available modules are displayed one after the other. By clicking on the appropriate module, you can activate the test license. Please note: separate hardware is required for the LaserPro 3000, DispPro 3000, Calibrate 3000, Inspect 3000 and QR-Code 3000 modules.

We will briefly present the individual modules here. You will find more detailed information on our homepage at:

 http://www.bungard.de/index.php/de/produkte/software/routepro-3000

Plus 3000

With this module activated you will get the following extra features:

- You may load up to 32 layers per project !!
- In the Wizard you may select the type of project, depending on your selection, the project will be stored under the project type name. This can be useful to separate projects meant for PCB or stencils etc.
- You may position the machine by moving and clicking with the mouse in the camera screen. It will also try to center the drill hole. This can be useful if you want to capture the holes from an existing PCB.
- Under the tab GENERAL you may set the origin of your material. This can be the zero position of machine but can also be calculated from the material position.
- Under the Views tab you now have the following extra' s:
    - Show material
    - Set the intensity of the line grid
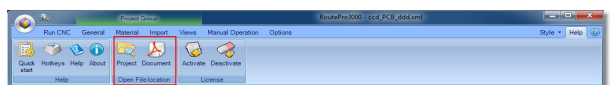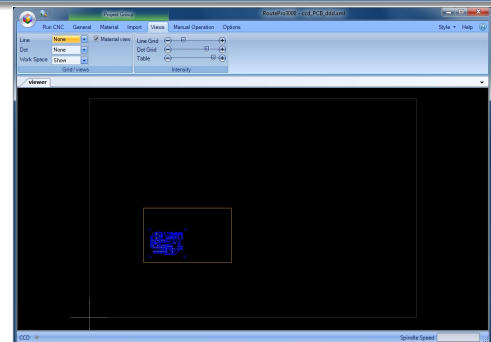
- Set the intensity of the dot grid
- Set the intensity of the table view
- Show the mounting holes
- Show the ATC tool-slots and depth sensor
- Under the Help tab you'll find two buttons to open the location of the current project and the documentation.

LaserPro 3000

The Bungard laser unit is an add-on-item for the Bungard CCD to expose photoresists, solder masks and Alucorex. The laser is mounted into the spindle holder instead of the high frequency spindle and is controlled by the RoutePro3000 software.
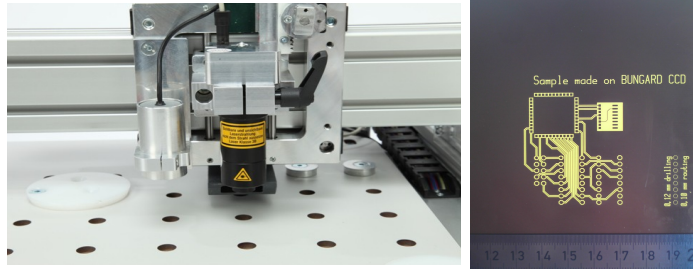
The Bungard laser exposure unit is an answer to the demand of many operators for higher precision, faster processing speeds and reduced tool costs, as it is the case for example with isolation milling.

DispPro 3000

The dispensing module DispPro3000 is an extension of the CCD for dispensing solder paste or glue.

Instead of being controlled by a foot switch, a pneumatic manual dispensing unit is controlled over the software RoutePro3000. A dosing cartridge of the dispenser is mounted into the holder of the high-frequency spindle.

The module is not a fully automatic dispensing unit, but a dosing aid for a manual dispenser.

The machine drives precisely to each dosing point and dosing time dosing height are precisely controlled.

Further settings like viscosity control and control of the dosing volume are not supported. The control of these parameters is subject to the user.

Document 3000

This documentation module will provide outstanding documentation which you can use for future reference. You may also handout the project documentation to your customer along with the finished boards.

Calibrate 3000

With the calibration module, you can visually calibrate the position of your board. The software moves and rotates the board according to the actual position of the calibration marks or registration holes.

For this purpose, the machine automatically drives to certain registration points on the layout and the user centers the cross mark of the camera over the mark and acknowledges the position. Registration holes can be easily inserted e.g. with IsoCam. Height calibration is also possible with the help of standardized templates.

The calibration function is useful if you e.g. do not want to work with reference pins for double-sided boards, or the board has been changed by other process steps (pressing multilayer, galvanic through hole plating), so the reference pins may lead to inaccuracies.

Another typical application is the rework, eg if after components assembly the circuit board can no longer be fixed with reference pins to the base.

Inspect 3000

This module is an extension to the calibration module of RoutePro3000. With this module you can use a Bungard CCD for AOI-drives (Automatic Optical Inspection).

API 3000:

All our customer highly estimate the precision and sturdiness of the Bungard CCD. The open system just invites to adapt the Bungard CCD for customer specific applications.

Unfortunately we are not able to realize all customer requests.

For that reason all builders and makers have now the opportunity to develop their ideas for the Bungard CCD. We offer the interface so you can remote control the CCD with your own application.

This enables you to mount tools or measuring devices onto the CCD, these devices will then transfer data to your application and your application again interacts according to the data input with the CCD.

QR-Code 3000

With the QR code module, you can document the manufacturing process of your boards and work pieces for internal quality assurance and external customers. Pressing a button RoutePro3000 generates for your project a QR code that includes for example your company name, the operator, the project name or the project path. Of course, the output can be customized.

The generated QR code can be printed directly from RoutePro3000 with a label printer, so you can stick it on your board, or its packaging. Any commercial 2D scanner and most smartphones are then able to read the information from the QR code.

Alternatively, you have the option to implement the storage path of the project in the QR code. If you do that and you want to produce the same board again after some time, you can open RoutePro3000, scan the QR code on the board and RoutePro3000 automatically opens the correct project.

In the near future there will be a module that performs directly after scanning the QR code certain operations. This transforms the Bungard CCD to a semi-automatic production machine.

How to activate Software-licenses:

If you have purchased one of the modules described above, you will get the license either with your RoutePro3000 CD or the license is simply sent by e-mail. Save the license on your CCD computer (for example, at: C: \ Users \ Public \ Documents \ ccdprojects \ License). Keep a backup copy of the license.

You need an Internet connection for activation. Go to the Tab HELP and click ACTIVATE. For details, see the RoutePro3000 Help
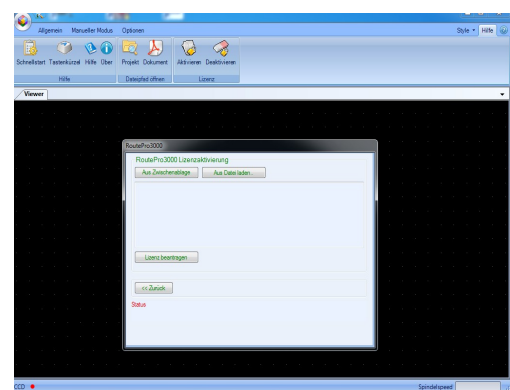
Drill and route parameter

Standard drill

High performance special drill from wear resisting solid carbide, long type, shank dia. 1/8" (3,175mm), total length 1,5" (38mm) right hand cut

Application: for all standard products

Parameter

Material: FR 4   **Spindle type: Kavo 4010 and 4054**

D = Diameter in mm   f = chip load/feed in µm /U (Feed / RPM x 1000)

F = Feed in mm/min   n = RPM in 1/min

V_s= cutting speed in m/min (Diameter. x π x RPM in m/min / 1000)

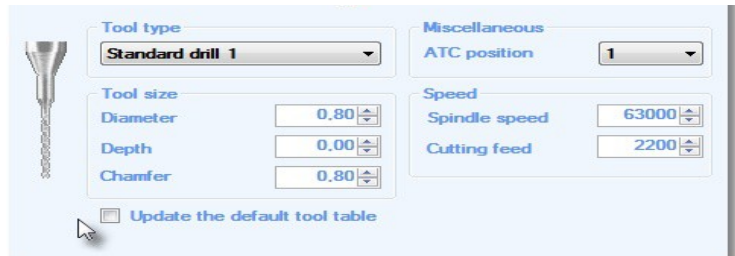| D	f	F	n	Vs	D	f	F	n	Vs
0,1	8	500	63000	20	1,6	48	3000	63000	317
0,2	12	750	63000	40	1,7	46	2900	63000	337
0,3	16	1000	63000	59	1,8	44	2800	63000	356
0,4	20	1250	63000	79	1,9	43	2700	63000	376
0,5	24	1500	63000	99	2,0	41	2600	63000	396
0,6	28	1750	63000	119	2,1	41	2500	60800	401
0,7	32	2000	63000	139	2,2	41	2400	58600	405
0,8	35	2200	63000	158	2,3	41	2300	56400	408
0,9	37	2300	63000	178	2,4	41	2200	54200	409
1,0	38	2400	63000	198	2,5	40	2100	52000	408
1,1	40	2500	63000	218	2,6	40	2000	49800	407
1,2	41	2600	63000	238	2,7	40	1900	47600	404
1,3	43	2700	63000	257	2,8	40	1800	45400	399
1,4	44	2800	63000	277	2,9	39	1700	43200	394
1,5	46	2900	63000	297	3,0	39	1600	41000	386

From Diameter 3.0 on, we recommend to pre-drill with a 1.7 mm drill.

These parameters in the table are approximate values that serve as a starting point for your own optimizations. They allow no warranty claims. Various optimization directions (tool life time, speed, hole quality) lead to different parameters.

BUNGARD
BEL

Spade type drill

Application/Advantages:

Drilling of complex multilayer

Very good hole quality at small drill deviation

Tool type		Miscellaneous	
Spade type drill 1		ATC position	1
Tool size		**Speed**	
Diameter	0,80	Spindle speed	63000
Depth	0,00	Cutting feed	2200
Chamfer	0,80		

Microvia-drill

with conical outer diameter

Application/Advantages:

Drilling of Microvias (blind holes)

Very good hole quality and position accuracy

Tool type		Miscellaneous	
Microvia drill		ATC position	1
Tool size		**Speed**	
Diameter	0,20	Spindle speed	63000
Depth	0,00	Cutting feed	1300
Chamfer	0,20		

Slot drill

Application/Advantages:

Drilling (Nibbling) of oblongs and slots

Tool type		Miscellaneous	
Slot drill		ATC position	1
Tool size		**Speed**	
Diameter	0,80	Spindle speed	63000
Depth	0,00	Cutting feed	1300
Chamfer	0,80		

Flex drill

Application/Advantages:

High productive processing of flexible and semi-flexible multilayer

Perfect hole quality

Reduction of nail head formation and ridge

Tool type		Miscellaneous	
Flex drill		ATC position	1
Tool size		**Speed**	
Diameter	0,80	Spindle speed	63000
Depth	0,00	Cutting feed	1300
Chamfer	0,80		

BUNGARD
BEL

Isolation milling tool

0.1– 0.6 mm

Solid carbide Micro cutter; single-flute router, right hand cut, right hand spiral flute, shank diameter 1/8"(3,175 mm), total length 1 1/2" (38 mm), straight end face

Micro cutter for routing slots in all common PCB materials, especially suitable for soft / tough materials such as copper foil or Teflon
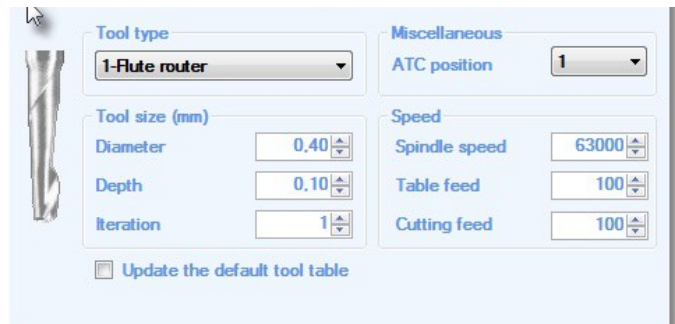
Routing parameters

FR4 for   Isolation milling tools

Material: FR 4	Spindle type: Kavo 4010 and 4054
D = Diameter in mm	f = chip size/Feed in µm /U (Feed / RPM x 1000)
F(XY)= Feed in table level in mm/min	F (Z) without = Feed in Z-direction without pre-drilling
n = RPM in 1/min	F (Z) pre-drilled = Feed in Z-direction with pre-drilling

D	f	F(XY)	n	F (Z) without	F (Z) pre-drilled	H
0,1	1	25-50	63000	100	200	0,1
0,2	1	50-75	63000	100	200	0,1
0,3	2	75-100	63000	100	300	0,2
0,4	2	100-150	63000	150	300	0,5
0,5	3	100-200	63000	150	400	1,0
0,6	3	100-200	63000	200	400	1,5
0,7	4	150-200	63000	200	500	2,5

SC/FT

0.6 – 3.0 mm

Solid carbide contour cutter with chip
breaker; right hand cut, main cutting
edge, right hand spiral flute with chip
breaker, shank diameter 1/8"(3,175 mm),
total length 1 1/2" (38 mm), G-point

Application/Advantages:

Low noise

Very good milling surface

Standard router for inner and outer contours

Very high dimension stability

For all common PCB materials

Routing parameter
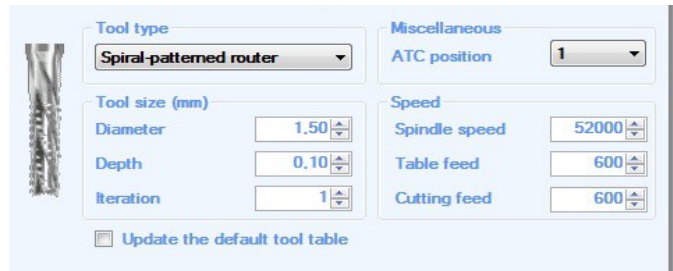### FR4 for SC/FT

Material: FR 4	Spindle type: Kavo 4010 and 4054
D = Diameter in mm	f = chip size/Feed in µm /U (Feed / RPM x 1000)
F(XY)= Feed in table level in mm/min	F (Z) without = Feed in Z-direction without pre-drilling
n = RPM in 1/min	F (Z) pre-drilled = Feed in Z-direction with pre-drilling

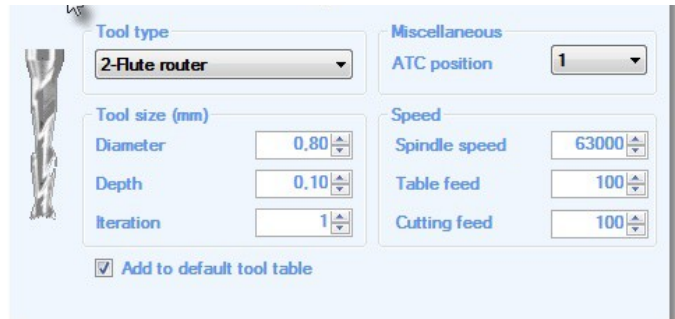| D	f	F(XY)	n	F (Z) without	F (Z) pre-drilled	H
0,6	3	100-200	63000	200	400	1,5
0,7	4	150-200	63000	200	500	2,5
0,8	5	300	63000	200	500	3,0
0,9	6	400	63000	200	500	3,0
1,0	8	500	63000	400	2000	4,5
1,1	9	500	60800	400	2000	4,5
1,2	10	500	58600	400	2000	4,5
1,3	12	600	56400	600	2000	4,5
1,4	14	600	54200	600	2000	4,5
1,5	16	700	52000	600	2000	4,5
1,6	18	700	49800	800	2000	4,5
1,7	22	800	47600	800	2000	4,5
1,8	26	900	45400	800	2000	4,5
1,9	30	1000	43200	800	2000	4,5
2,0	34	1000	38800	1300	2000	4,5
2,1	38	1000	36600	1300	2000	4,5
2,2	40	1000	34400	1300	2000	4,5
2,3	42	1000	32200	1300	2000	4,5
2,4	44	1000	30000	1300	2000	4,5
2,5	46	1000	30000	1300	2000	4,5
3,0	53	1000	30000	1300	2000	4,5

RPU

0.8 – 3.0mm Universal cutter

Solid carbide cutter, 2 flutes, right hand cut, right hand spiral flute, shank diameter 1/8"(3,175 mm), total length 1 1/2" (38 mm), fish-tail-point

Contour router for all common PCB materials. Especially suited for:

Flexible materials and long slots.

Also suitable for aluminium

Routing parameter for RPU

Material: Aluminium	Spindle type: Kavo 4010
D = Diameter in mm	f = chip size/Feed in µm /U (Feed / RPM x 1000)
F(XY)= Feed in table level in mm/min	F (Z) without = Feed in Z-direction without pre-drilling
n = RPM in 1/min	F (Z) pre-drilled = Feed in Z-direction with pre-drilling

D	f	F(XY)	n	F (Z) without	F (Z) pre-drilled	H
0,8	2	100	63000	200	500	3,0
0,9	2	100	63000	200	500	3,0
1,0	3	200	63000	400	2000	4,5
1,1	4	200	63000	400	2000	4,5
1,2	4	200	63000	400	2000	4,5
1,3	5	300	63000	600	2000	4,5
1,4	6	300	57000	600	2000	4,5
1,5	6	300	53000	600	2000	4,5
1,6	7	400	50000	800	2000	4,5
1,7	9	400	47000	800	2000	4,5
1,8	10	500	44000	800	2000	4,5
1,9	12	500	42000	800	2000	4,5
2,0	14	500	40000	1300	2000	4,5
2,1	15	600	38000	1300	2000	4,5
2,2	16	600	36000	1300	2000	4,5
2,3	17	600	35000	1300	2000	4,5
2,4	18	600	33000	1300	2000	4,5
2,5	18	600	32000	1300	2000	4,5

Bungard Elektronik GmbH & Co. KG, Rilkestraße 1, 51570 Windeck – Germany
Tel.: +49 (0) 2292/9 28 28 - 0, Fax: +49 (0) 2292/9 28 28 - 29, E-mail: support@bungard.de

BUNGARD
BEL

V-Cut-Router

G30°, G60° and G90°

Application/Advantages:

Scoring and chamfering of printed circuit boards

Milling isolation distances

Scoring of break lines
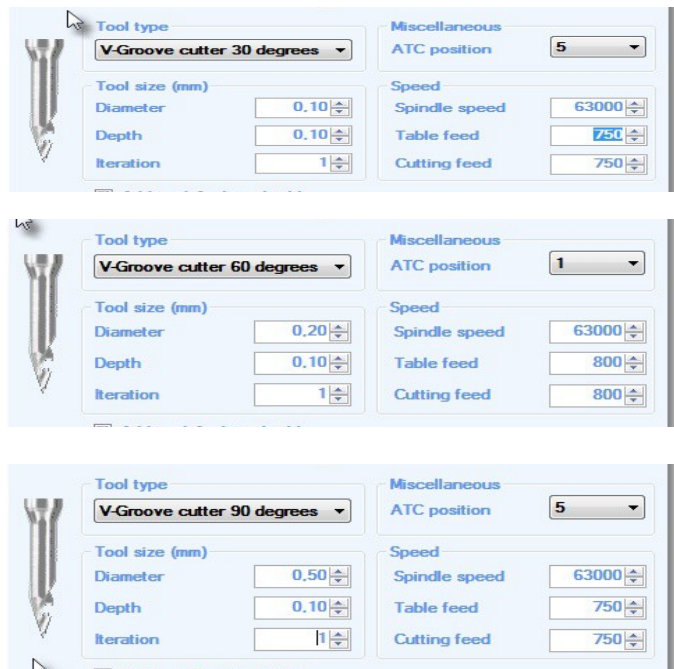
Parameter:

tool tip angel	30°			60°		
milling depth	RPM	feed	Track width	RPM	feed	Track width
mm	1/min	mm / min	mm	1/min	mm / min	mm
0.1	63000	800	0.05	63000	800	0.12
0.2	63000	800	0.11	63000	800	0.23
0.3	63000	700	0.16	63000	700	0.35
0.4	63000	700	0.21	63000	700	0.46
0.5	63000	600	0.27	63000	600	0.58
0.6	63000	600	0.32	63000	600	0.69
0.7	63000	500	0.38	63000	500	0.81
0.8	63000	500	0.43	52000	500	0.92
1.0	63000	400	0.54	42000	400	1.15
1.2	63000	400	0.64	35000	400	1.39
1.5	63000	400	0.80	30000	400	1.73

BUNGARD
BEL

3-Flute router

Solid carbide cutter, 3 flutes, right hand cut, right hand spiral flute, shank diameter 1/8"(3,175 mm), total length 1 1/2" (38 mm), fish-tail-point

Contour router for all common PCB materials. Especially suited for:

Low vibration cutting of metal boards, e.g. copper heat sheets
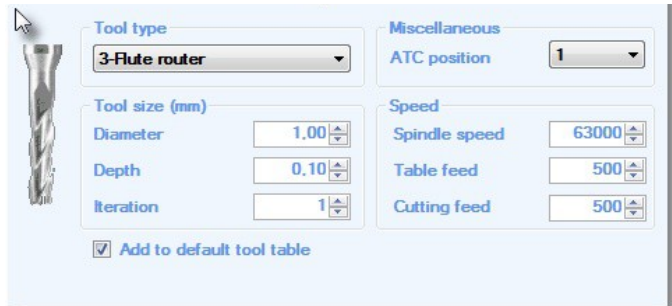
Diamond patterned router

Solid carbide contour router, diamond cut, main cutting edge, shank diameter 1/8"(3,175 mm), total length 1 1/2" (38 mm), „G"-point Standard, special points possible.

Standard contour router for routing inner and outer contours of single, double and multilayer boards.
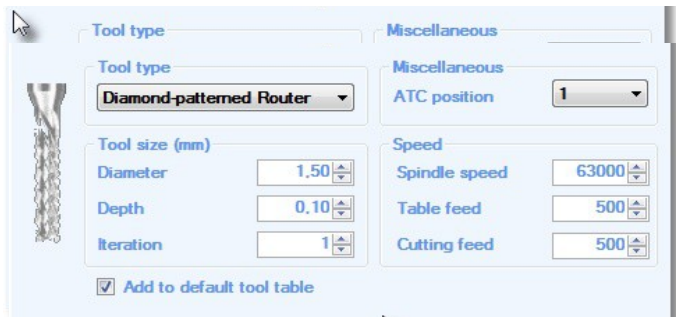
Contour finishing router

Burr-free cutting of Galvanic connectors (gold fingers) and metal surfaces

Guarantee

Prior to delivery all machines undergo an operational test on function and continuous strength. On the machine we provide a bring in warranty of 12 months from the date of purchase in respect of defects in material and workmanship. We offer a warranty at our choice by replacement of faulty parts or by repairing the machine in our factory. Old parts shall become our property.

Disclaimer of warranty

Bungard GmbH & Co.KG reserves the right to change or enhance its machines or machine specifications according to its judgement, if necessary. Bungard cannot be held responsible to implement aforesaid changes into machines sold already.

Bungard products and services are liable to the current prices and conditions, which are subject to change.

The instructions and definitions in this document are also subject to change and mark no assurance on the part of Bungard.

This manual contains informations of the Bungard CCD and is the translated English version.

Please regard the "Sales terms and delivery conditions". These are available after fulfilment of the contract.

We don't furnish a guarantee or warranty in cause of damages at material or hurts of people because of

Incorrect use of the machine

Wrong setup, installing and operating of the machine or incapable service

Use of the machine with defective safety equipment

Non-observance of the service manual in regard to transport, stocking, setup, installation and service of the machine

Unlicensed modifications at the machine

Incorrect or incomplete repairs

Destructive force effect at the machine in cause of foreign objects or external use of force

Use of non-original spare parts

normal wear parts.

We cannot accept subsequent claims from damage or destruction of work pieces worked on in the machine, because we have no knowledge or control over the operating conditions at your site. This is valid in a general manner also for requirements from damage to articles, buildings and persons as well as the environment.

We do not warrant that the function of the machine will meet the customer's requirements or that the operation of the machine will to this regard be error free.

In no event will we be liable to the customer for any incidental, consequential, or indirect damages of any kind, including loss of profit and prosecution for environmental pollution, even if we could have been aware of the possibility of such damages.

All information was arranged with great care. We reserve ourselves however mistake and technical changes without previous announcement.

Running the machine in corroding, humid, dusty, extremely hot or explosive atmosphere happens at the operator's own risk and responsibility.

We explicitly exclude any warranty for damages resulting from running the machine in in corroding, humid, dusty, extremely hot or explosive atmosphere.

Copyright

(C) 2017 Bungard Elektronik

Bungard Elektronik GmbH & Co. KG, Rilkestraße 1, 51570 Windeck – Germany
Tel.: +49 (0) 2292/9 28 28 - 0, Fax: +49 (0) 2292/9 28 28 - 29, E-mail: support@bungard.de

BUNGARD
BEL