

CCD

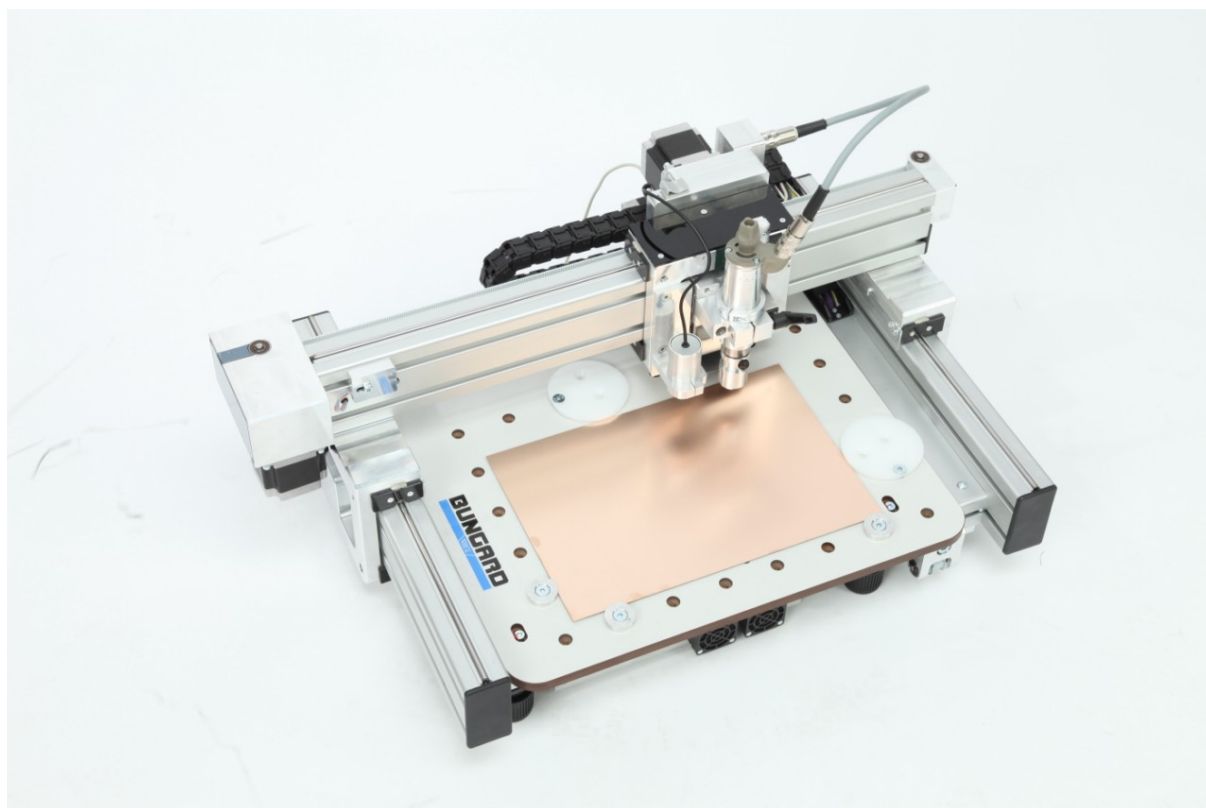
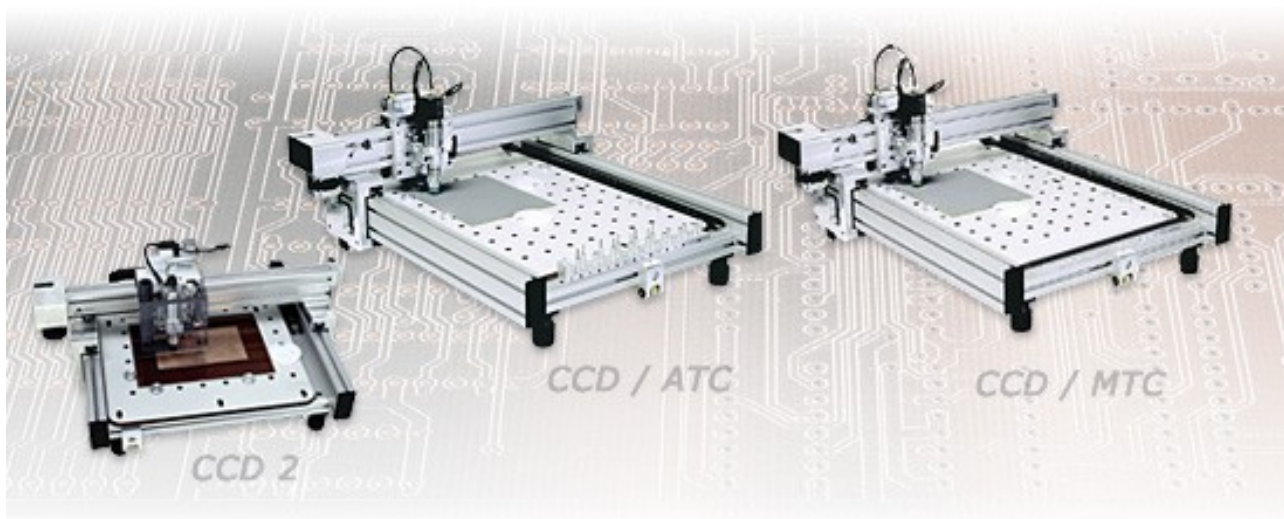


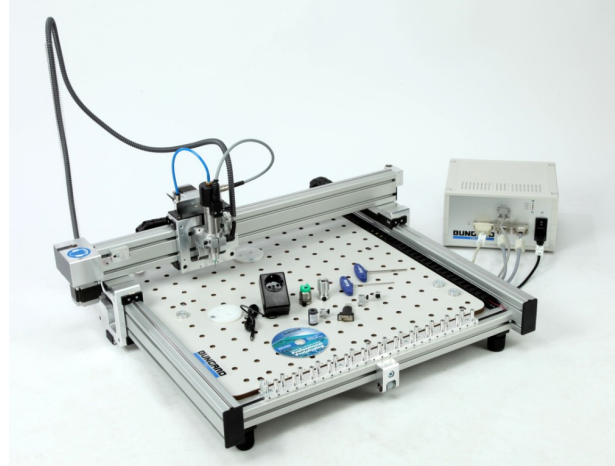
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General

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.



Special features:

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 be 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

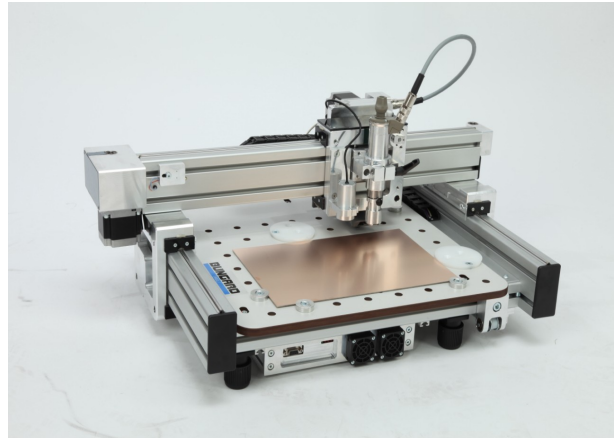
Spindle:

- 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 (=18000 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

- **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)
- Precision: +/- 1 step, typical repeatability ± 0.001 mm (± 0.04 mil)
- Position accuracy: 20 ppm (0.002%) over the entire work space (9,9 μ m 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 8 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 (0,1 μ m)
- 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)

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Technical Data

General

Power supply:	110-240 V, 50-60 Hz + vacuum cleaner(1500W)
Range of RPM:	30.000 – 63.000
Travelling speed:	1 – 9000 mm/min
Software resolution:	0,0001mm (0,1µm)
Mechanical resolution:	step resolution: Software selectable: 1 mil, ½ mil, ¼ mil (= 6.35 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	CCD/2/ATC	MTC	ATC	MTC/XL	ATC/XL
Weight kg	30	30	35	35		
Dimensions mm	700x550x300	700x550x300	700x800x300	700x800x300	950x950x300	950x950x300
Work area mm	270x325	270x325	325x495	325x495	500x600	500x600
Tool change	no	16	no	16	no	25

Applications

	CCD/2	CCD/2/ATC	MTC	ATC	MTC/XL	ATC/XL
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	√	√	√	√	√	√

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	CCD/2	CCD/2/ATC	MTC	ATC	MTC/XL	ATC/XL
Housing production	√	√	√	√	√	√
Wave solder pallets	√	√	√	√	√	√
Panel cutting, Reworking PCBs	√	√	√	√	√	√
Test adapter drilling	√	√	√	√	√	√
Inspection templates	√	√	√	√	√	√
Cooling	(√)	√	√	√	√	√

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

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

Options

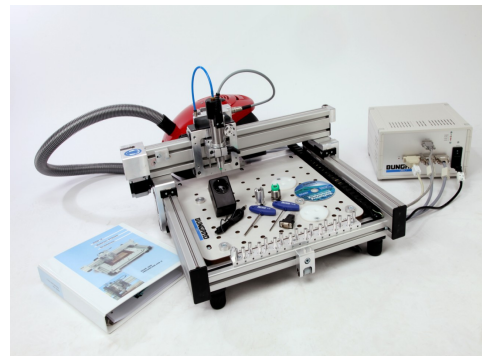
Vacuum table, protection hood or protection rack, converter software IsoCam, fiducial recognition and calibration with camera, laser exposure of photo resists, aluminium work table, routers engine adapter for plastic milling and many more.

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
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
start adapter for vacuum cleaner
manual
USB/serial adapter
Set of Allen Keys
ATC: Air hose



Safety instructions

General

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.

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.

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 equalisation.

On the rear of all machines, there is one socket for a 3.5 mm audio plug, to be used with the vacuum cleaner switch box (pict.6). This adaptor will turn the vacuum cleaner on and off together with the spindle. It comes in a black plastic housing with AC inlet and outlet for European mains sockets and should be used with the vacuum cleaner that we supply, or i. e. with a liquid cooling pump for aluminium routing. If you connect other devices, power rating must not exceed 1500 Watt.

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 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.

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.

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
- tools (drills/routers)



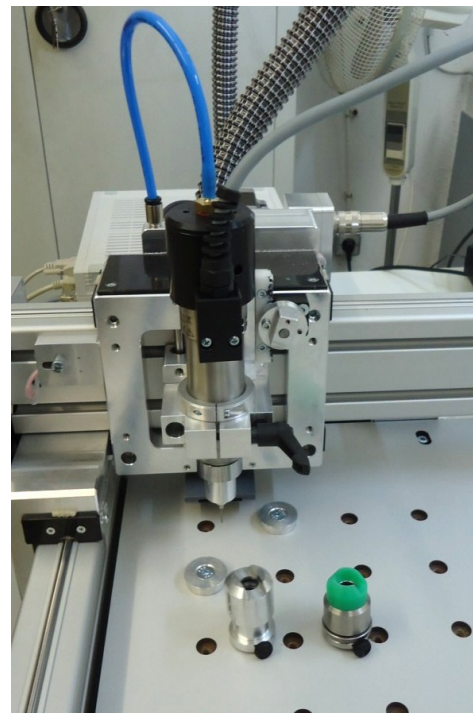
Examine the packaging for transport damage.

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.

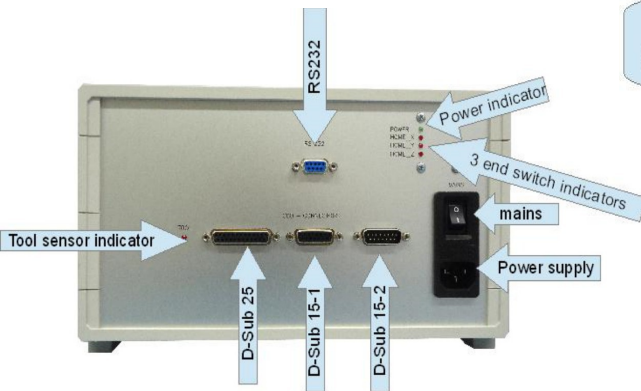
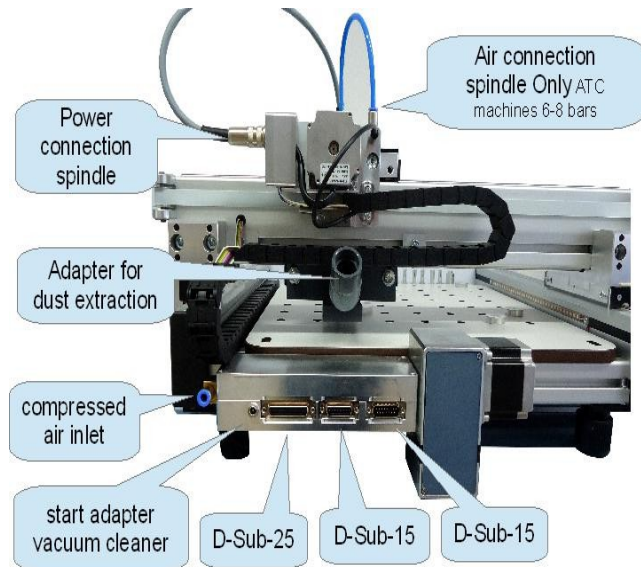


Connect the supplied vacuum cleaner. The suction tube is connected to the suction nozzle underneath the Y-Axis (CCD/2: X-Axis) See picture below). Included in the delivery is a start adapter. Put this start adapter into the multiple socket and plug the the power supply of the vacuum cleaner into this adapter. The small cable with the cinch plug is inserted into the motor connection box of the CCD (CCD/2: the socket is in the back of the control box underneath the machine table. If you run the vacuum cleaner with this adapter, the cleaner only starts, when the spindle is turning.



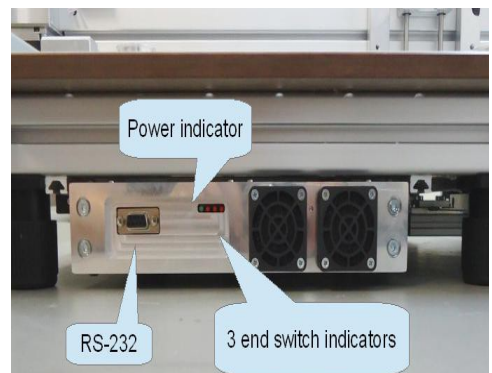
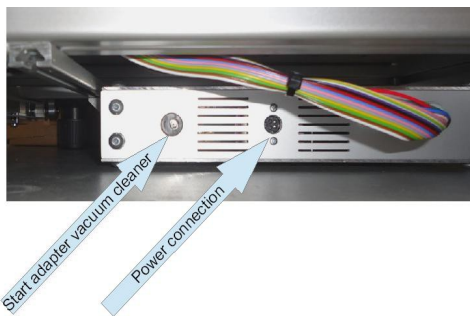
MTC, ATC: Connect the 25-pin and two 15-pin cable from the controller to the terminals on the back of the machine. Ensure proper connection and tighten the screws! The cables are **not** interchangeable. Do the same with on the control unit side. After that connect the RS232 to the PC (possibly via the USB / serial adapter). At last plug in the power supply.

ATC: connect machine to compressed air supply (6-8 bar, oil free; not included in deliver)



CCD/2: the control unit is underneath the machine. At the front there a two fans the socket for the RS232 plug and the diodes for power and the end switches XYZ.

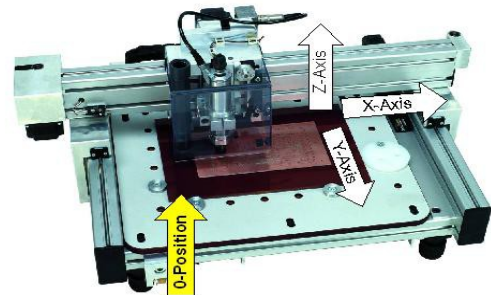
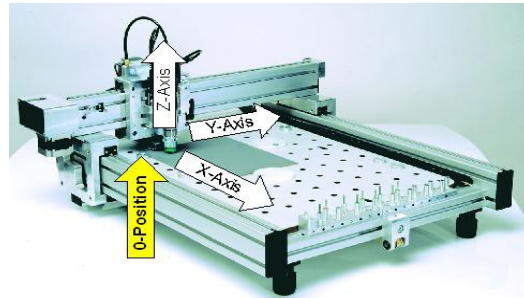
At the back there are the connectors for the vacuum cleaner start adapter and the power supply. Connect the machine with the RS232-cable to the computer (if needed via USB/serial converter). After that connect the machine with the vacuum cleaner start adapter and the external power supply.



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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: 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.



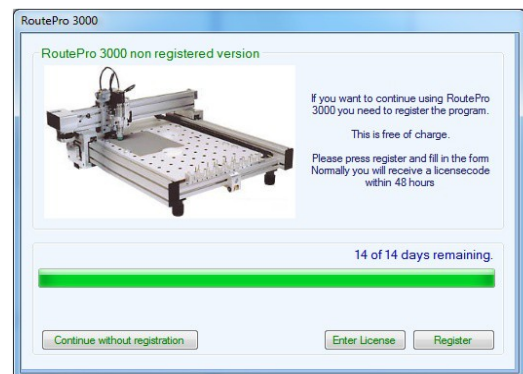
USB/Serial adapter: If you want to operate the CCD via a free USB port on your computer, then you first put the USB / serial adapter into the free USB-socket. Normally a routine for detecting new hardware including driver installation will start.

Insert at this point the small CD that came with the adapter and follow the instructions on the screen. This installation is in two stages, which look very similar. First a USB device is installed, secondly a virtual COM port. So you will be prompted twice to install a driver. Do not stop the process after the first time. Even if you later plug in the same adapter into a different USB port, you possibly are again prompted to install the driver.

With Windows 7, it may be necessary to install the driver via the device manager.

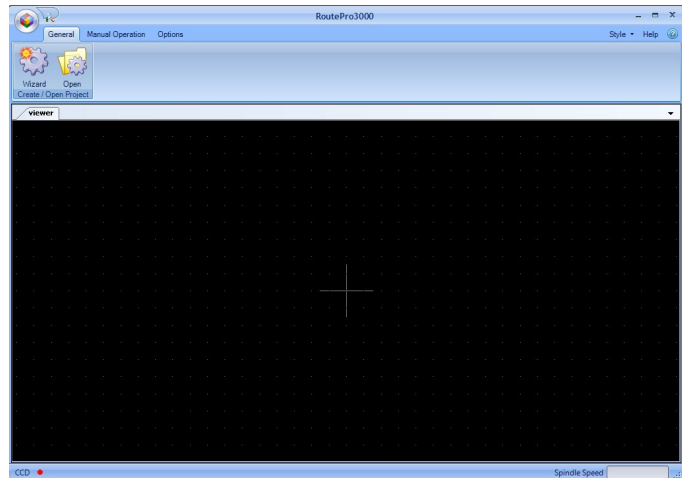


RoutePro3000: Now insert the enclosed CD into your computer drive and start SetupRoutePro3000.exe. Depending on the system the modules **Windows Framework 4** and **Visual C++** must be installed on your system. In general this happens automatically. For this and for the registration of the software an internet connection is required. For the start we can skip the registration procedure by clicking **continue without registration**. Please refer to the installation guide and the RoutePro3000 online help for details.

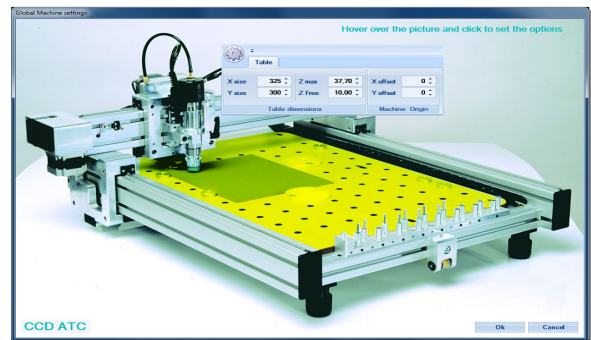


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After successful installation your screen should look like this:



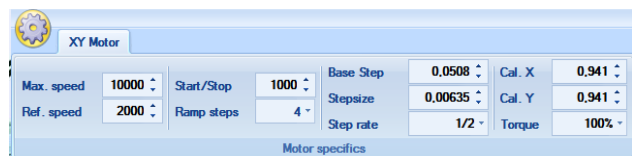
Please check the settings of the machine by clicking on the **Options** tab and then on **ma-
chine**. You will see a picture of a CCD. If you hover the mouse over the different functional areas of the machine, you will notice a colour change. Click on the areas to open the function dialogue. If you 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.



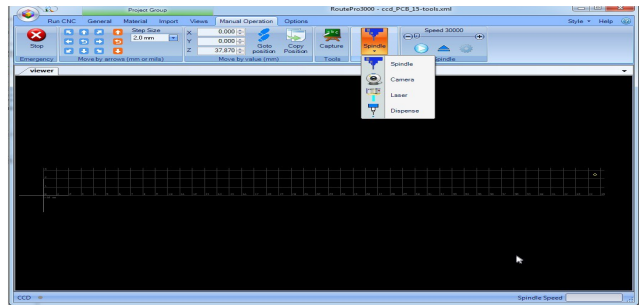
Please compare the values in the machine configuration of the software to the documentation provided with the machine.



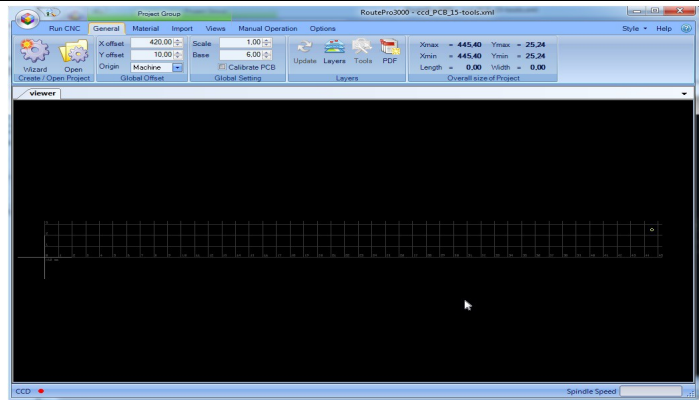
CCD

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.

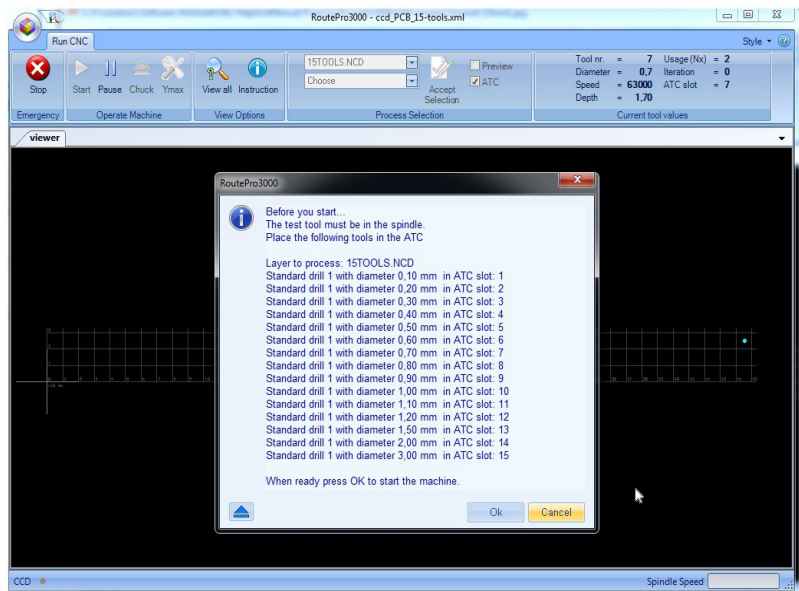


ATC: Check the function of the tool changer. Go to tab **General** and click on **Open** to load the project file ccd_PCB_-15tools. (XL-Version: -25 Tools). This project file is located after a normal installation at C:\Program Files



(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.



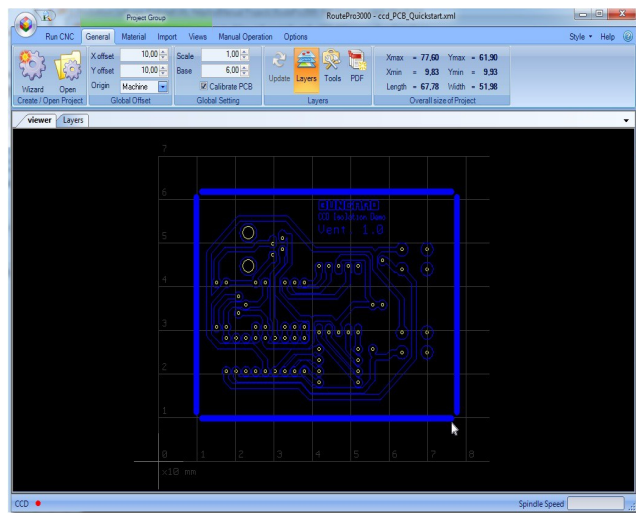
Press **OK**. The machine now moves to the tool sensor, checks the test tool and places it in slot number 0. Then the spindle moves back to the sensor to check whether the tool was correctly dropped. After that it continues to slot number 1 to load the first tool. The length of tool 1 is checked at the sensor, the spindle starts and a positioning and drilling movement is performed. After that the machine checks if the tool is not

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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.

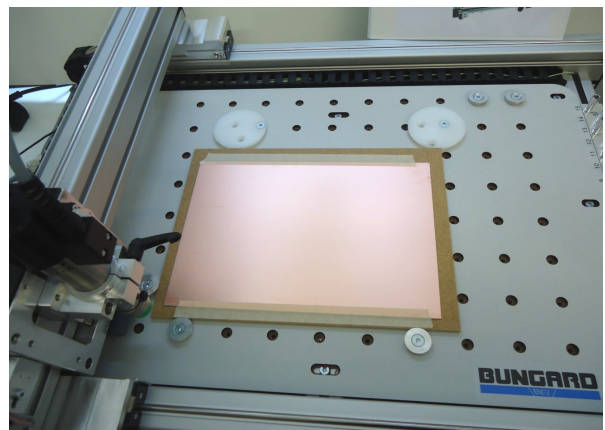
After the last tool, the spindle picks again the test tool and moves to the machine zero point.



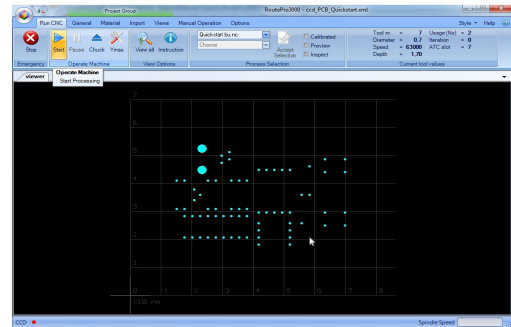
All CCDs: Make a first drill and routing attempt!

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.

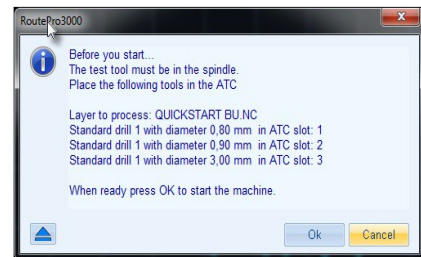
Fix a standard drill backing board using the provided clamps on the machine table. Now fix a PCB with at least 160 x 100 mm dimension about 5 mm off the machine zero point (in this project the offset for X and Y is set to 10 mm, we recommend first to use this setting when you create a new project. Always compare the thickness of your backing board and your PCB with the values shown in the software !!!!!)



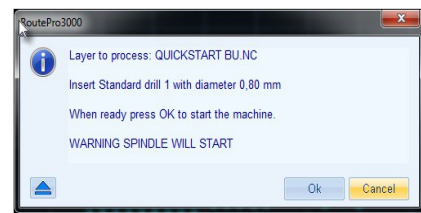
Go to to tab **Run CNC**.....



..... 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!

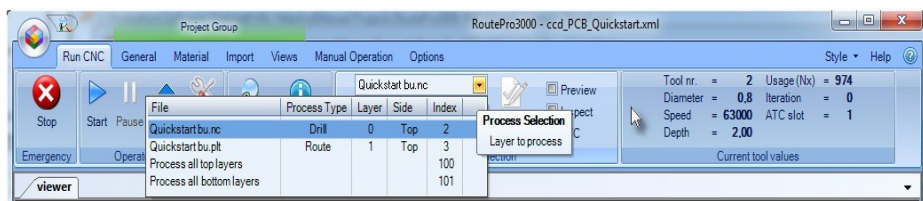


With a manual machine, you are asked to insert the current tool into the spindle.



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.

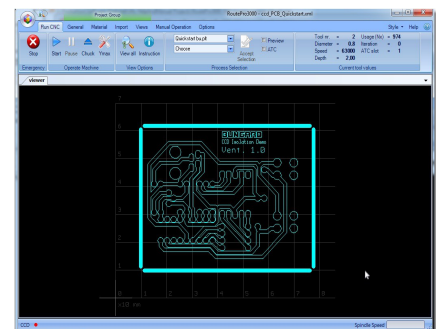
When the drill layer is finished change to the routing layer



With click on **Start** the machine again makes a reference run and the processing is carried out in the same manner as with drilling.

If you do not use a depth limiter and a decoupled spindle, but get the milling height from the software, you can compensate tolerances in backing board and PCB by clicking **PgUp** and **PgDn**. After the next vector the machine will continue routing with the changed height.

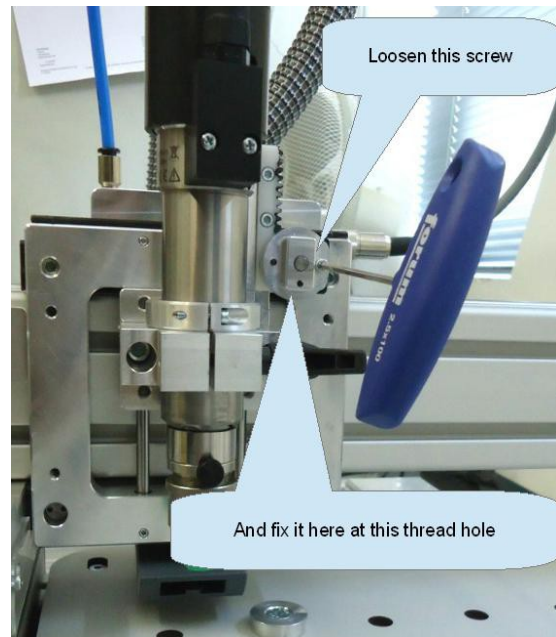
The change you made is displayed on the upper right (**current tool values**) at **depth**.



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!

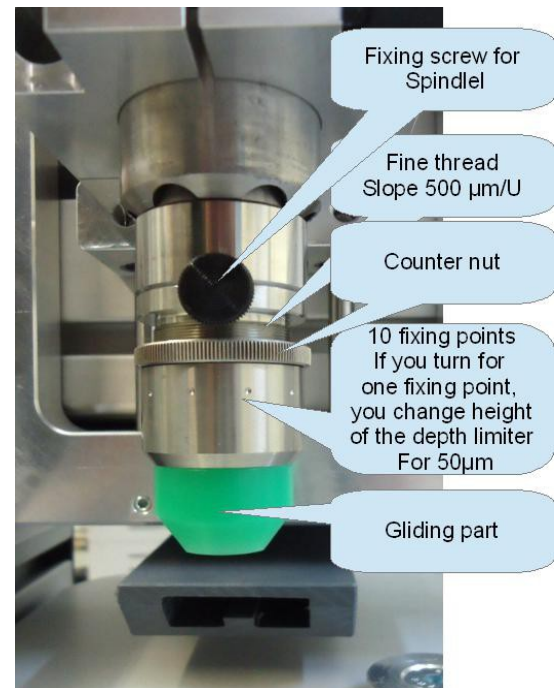
If you use the depth limiter, the spindle of the Z-axis needs to be decoupled. To do so remove a little screw from the Z-axis clutch using the supplied Allan key and deposit the screw temporarily in the threaded hole as shown in the picture.



The depth limiter 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.

To set the depth, first adjust the milling depth roughly by eye-sight. Then select an uncritical milling line, at best outside of the actual design or a board cur line and make a test. If the track is too deep, turn the depth limiter a little lower. If the track is not deep enough, turn the depth limiter a little higher. Repeat this procedure till you are content with the result. Then process the complete tool. These procedure may seem a little complicated, but in reality it takes about one minute and will give perfect results!



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.

Installation Manual RoutePro3000

System requirements:

CCD with Controller 2006 or younger.

Computer with Windows XP SP3 till Windows 8 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.

Content:

New machines: all necessary files including the specific parameters for your machine are packed into the file "SetupRoutePro3000.exe", which is located on the delivered CD. The folders documents, licenses and projects are stored additionally on the CD, so you have access to help files and licenses prior to installation.

Existing machines with RoutePro2008: You can download the current Routepro3000 version with all necessary files including our standard parameters for machine and tools from the customer area of our homepage. Please register on our homepage with your customer ID. If you are not a direct customer, please register with the name of your dealer and the customer number you have with him). After installation you have to adapt the parameters for your machine from RoutePro2008 into RoutePro3000 (correction factors, table size, values for sensor and tool slots). If you want to read the help file prior to installation, you can download the help file from our homepage.

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.

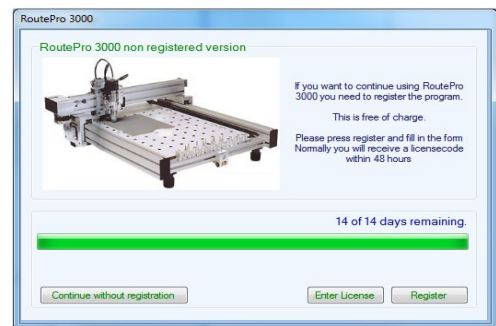
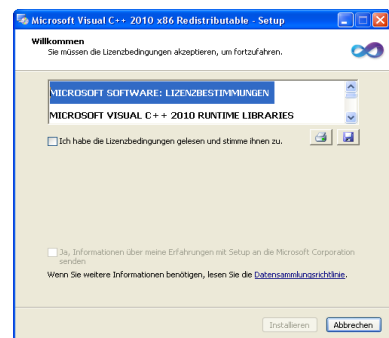
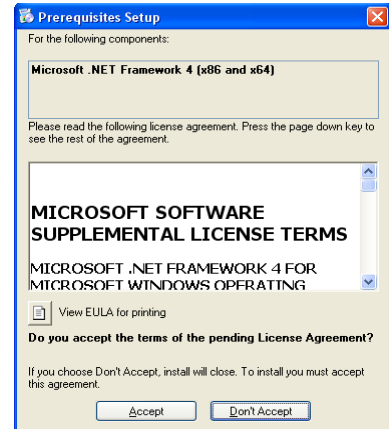
Make sure your resource data are in the correct location.

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

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 re-start of RoutePro3000 may be required in this case.

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.



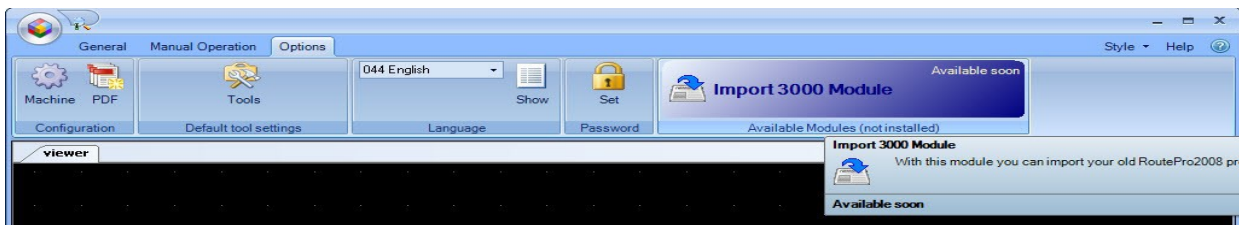
CCD

The standard 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 anymore. 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.

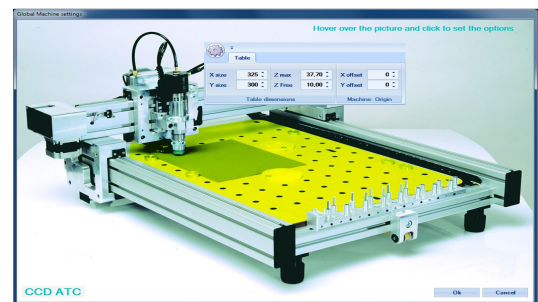
To test the modules, please go to **options** and wait till your desired modules shows up at the field **available modules**. Click on your desired module. After that you can activate your test license. It may be necessary to restart RoutePro3000.

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. We will show you how it is done.



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.

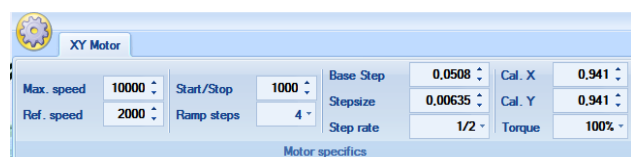
If you update from RoutePro2008 to Route Pro3000, you need to establish the correct parameters for your machine. Process like this: Start RoutePro3000 and go to options and machine. Hoover over the CCD-picture and insert correct parameters for XYZ-motors, spindle, tool slots, sensor and table. You can 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.



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.

Now your Software RoutePro3000 is ready to use.

Have fun with your CCD and the new software Routero3000!



Detailed Instructions

Control unit and mechanics

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.

Control unit

MTC, ATC: There is a stand-alone control unit with 3 cable connections to the mechanics unit. There are one cable with 25 pin Sub-D connectors and two cables with 15 pole Sub-D connectors. The connections are unique and cannot be interchanged.



Pic. 1: ATC Controller



Pic. 2: CCD/2 Power supply till 2013

From 2013 industrial power supply

CCD/2: The control unit is located underneath the mechanics unit, but the power supply comes as a stand-alone box and connects to the machine back by one cable.



Pic. 3: CCD/2 control unit (back view)



4: CCD/2 control unit (front view)

The control unit on the machine front is linked to one of the computer's serial or USB ports. The USB connection is achieved by a USB to serial converter cable that is included with the machine. This comes with its own software drivers on CD, as explained later. You may use a 1:1 9pole Sub-D cable instead and connect it to any of the computer's free COM ports. The actual port to be used will be detected automatically by software.

The front panels of all control units have some status LEDs with the following meanings: POWER: Supply voltage is present. HOME X, HOME Y, HOME Z: These LEDs give a visual control on the state of the reference switches. They are all lit after a successful reference run. TOOL: On machines with automatic tool change this LED corresponds to the drill break detector and turns on and back off if a drill was found to be OK.

There are no user serviceable parts inside the control units. The potentiometers on the PCBs are factory set. Do not change.

Do not pull the plug while machine is under power. Switch off controller first and wait for potential equalisation.

Mechanics Unit

Set up

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.

MTC, ATC: Connect the one 25 pole and two 15 pole cables coming from the control unit. They cannot be interchanged.



5: ATC motor connection box



6: start adapter for vacuum cleaner

(ATC) Compressed air connection

The machine requires compressed air of at least 6 bar to open and close the spindle chuck. A compressor is not included with the machine, but an air hose is. At the left rear of the machine there is an air valve, as shown on the left side of the above picture. Connect the air hose's free end to that valve. The other end of the hose has a standard connector for compressed air outlets.

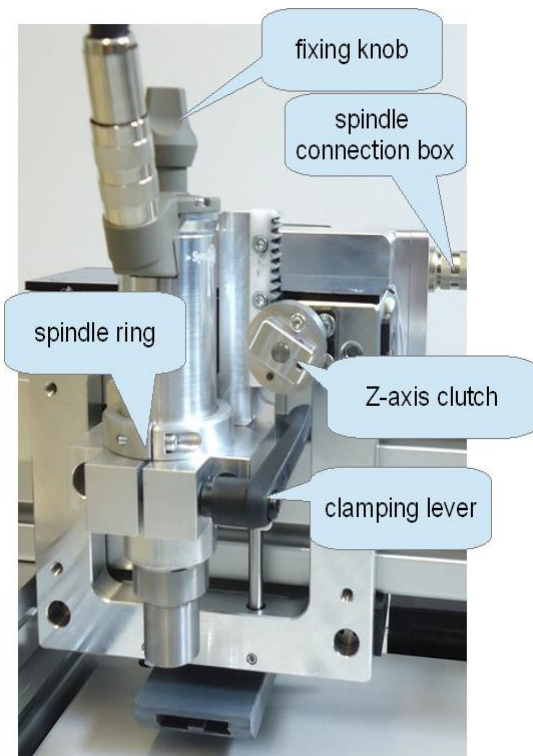
Vacuum cleaner

On the rear of all machines, there is one socket for a 3.5 mm audio plug, to be used with the vacuum cleaner switch box (pict.6). This adaptor will turn the vacuum cleaner on and off together with the spindle. It comes in a black plastic housing with AC inlet and outlet for European mains sockets and should be used with the vacuum cleaner that we supply, or i. e. with a liquid cooling pump for aluminium routing. If you connect other devices, power rating must not exceed 1500 Watt.

The machine comes with a small vacuum cleaner. After connecting it to the switch box, put it on the table at the rear of the machine and fix the hose to the suction nozzle which is at the rear of the Y axis (grey tube on top end of pict. 5). Take care that the hose can freely follow the machine's movement.

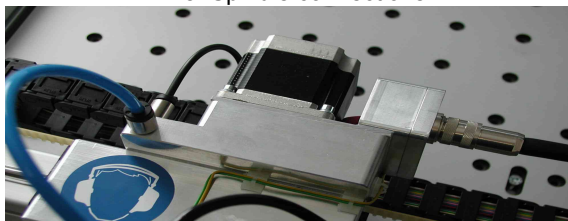
The chip removal may appear to be somewhat poor. This is due to the fact that the shavings are leaving the drill bit at high speed, but not necessarily in the direction of the nozzle. Anyhow, further encapsulation of the tool is not possible.

Mounting the spindle



7: Spindle

8: Spindle connections



Referring to picture 7, release the black lever by a 90 degree left turn so that the spindle holder clamp opens. Carefully drop the spindle into the clamp and push it downwards so that the distance flange (aluminium collar) lies firmly on the holder's top. Turn the spindle in a direction so that the cable and the connector housing do not interfere with the Z-axis' movement. Fix the plug to the connector box located to the right of the Z stepping motor (see picture 8) and tighten the plug screw. Turn the lever to close the holder clamp until the spindle is well tightened.

ATC: Use the short piece of air hose coming with the spindle to connect it to the quick mount fitting on top of the Y-axis slider, as on the left part of picture 8. There must be the "test pin" or at least a drill bit in the chuck when the spindle is not in use. Else, damage to the chuck may occur.

Important: The distance flange determines the spindle elevation over the table. 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.

Only tools with ring (collar) should be used. The distance from the top edge of the ring to the tool tip is 21 mm. The spindle distance flange was factory set with respect to that 21 mm active tool length.

Spindle accessories

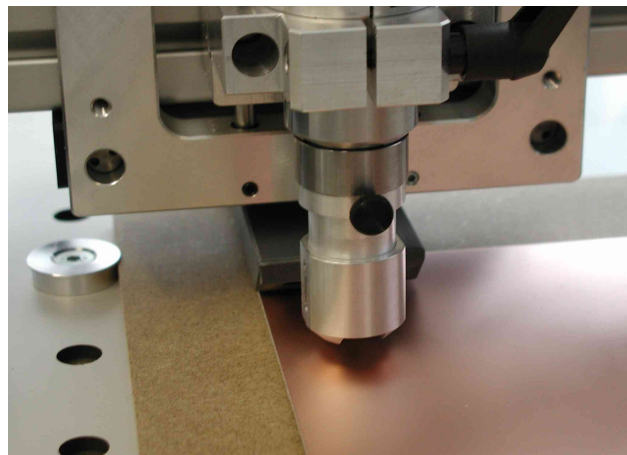
A drill pressure foot and a depth limiter are supplied in the box with the spindle, as well as some cleaning tools for the spindle chuck.

Drill pressure foot

The drill pressure foot serves to push the board down before the drill bit hits it. This is particularly useful if the board is not flat and plain or if you drill more than one board at once (you can drill stacks of 3 boards of 1.6 mm). Also this pressure foot serves as a protection so that you cannot touch the rotating tool. It is fixed to the spindle shaft by the screw with the black knob.



Abb. 9: Drill pressure foot .



10 mounted to spindle

ATC: The drill pressure foot can stay on the spindle shaft during automatic tool change. It is though necessary that the slot in the foot faces towards the tool holders, in a position as shown in picture 10.

MTC: The pressure foot must be removed for tool change. After each tool change the drill pressure foot must be put back in place for safety reasons.

Depth limiter

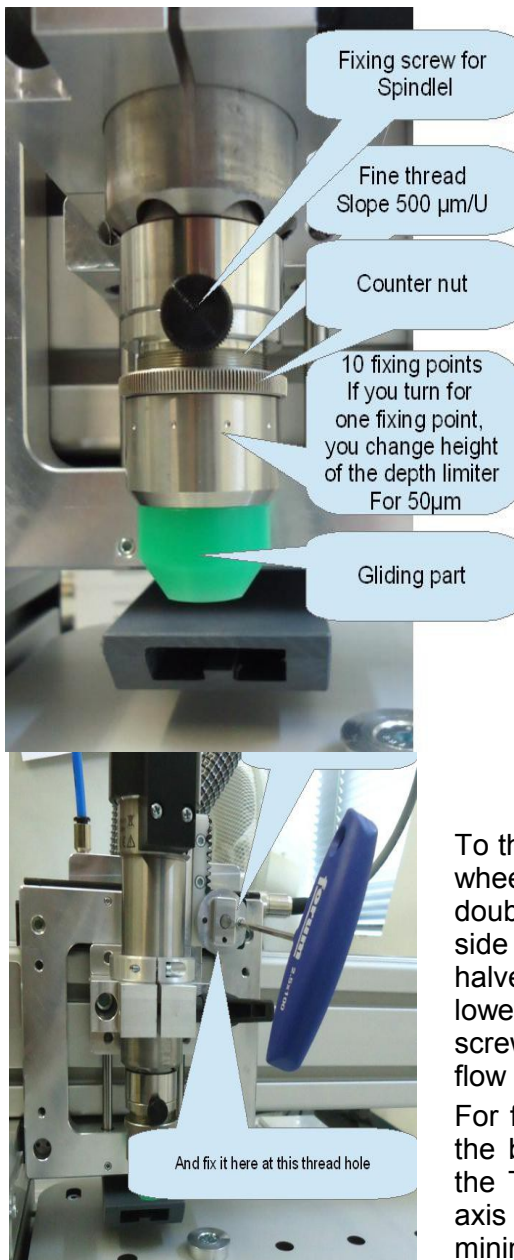


12: Depth limiter ...



11 mounted to spindle

During milling/routing, the depth limiter (DL) achieves a regulation of the Z axis work level in order to compensate for uneven board surfaces. The device is designed to work with tools that we supply, especially those of the G30 and G60 type. Note: The DL is not compatible with the cooling device's spray nozzle. If you add a DL to an existing machine, it may interfere with the vacuum cleaner suction nozzle.



We assume that the Z axis is in the upper position, as after a reference run. Keep the HF spindle in the spindle holder and insert a tool. Mount the DL to the lower spindle shaft. Be careful not to touch the tool tip. Shift the device up as far as possible and fix the small screw with the black knob that sits on its upper flange.

The DL has a fine threading and a counter screw. Loosen the counter screw and turn the lower part of the DL in order to adjust the height. Fasten the counter screw to fix the DL height setting. The conical green part of the DL acts as a sensor on the board surface. It can be removed separately and can be turned around so that the opening slot allows to cross over tools sitting in the ATC slots. For machines with manual tool change, the opening should show in the direction of the dust extraction nozzle.

The DL is not used for drilling and routing, so for these applications it should be removed. To do so, do not change the position of the counter screw on the fine thread, but just loosen the black knob and pull the DL off. Again, take care not to touch the tool tip.

Note: From December 2013 RoutePro3000 includes a function to bypass the depth limiter. See RoutePro3000 for details.

To the right top of the Z axis slider, you can see the Z axis cogwheel. It is mounted onto the Z axis shaft together with a double aluminium flange, as shown in picture 7. On the front side of the outer flange, there is a screw connecting the both halves. Remove this screw. You should now be able to lift and lower the Z slider for about 2 mm. For drilling and routing this screw should be always put back in place to eliminate the free flow of the Z slider.

For fine isolation milling, the DL shall be in place. It will follow the board surface and lift or lower the spindle accordingly. In the Tools Menu of RoutePro3000, the routing depth on the Z axis should be set between 0.1 and 0.5 mm so that there is a minimum possible travel against the spindle's weight load.

For setting the actual routing depth, the Z axis has to be lowered so far that the sensor touches the board.

Adjusting the depth limiter – Solution 1: Mount the depth limiter and adjust roughly by eye sight, so that the tool is just a little bit shorter than the green slider. Go to tab manual operation and lower the spindle with the arrow buttons till the green slider touches the board. Turn on the spindle and carefully turn the thread, till the tool touches the board. Turn ¼ turn deeper and your routing depth is reached. During set-up, the spindle should be running at low RPM, else the router tip will break. **Warning:** Do not touch the rotating tool!

Adjusting the depth limiter – Solution 2: Load your project and go to tab Run CNC. Mount depth limiter as described above and roughly adjust by eyesight. Select an uncritical milling line (e.g. a board cut line) and start routing. Press pause and check the track width. Adjust the depth limiter and continue, till the desired track width is reached.

(ATC) Tool slots

On the right side of the machine there is a bar with 16 tool slots. They are numbered from 0 to 15 (ATC/XL: 25 slots). Number 0 always takes the test pin. The drill and router bits go into the remaining 15 round aluminium slots. A tool can move vertically in this container and a spring will shift it up until the tool ring is on the same height as the tool slot.

The positions of the tool containers are known to the software by entries to the configuration file.

Left to the tool position No. 0 there is the tool sensor. The driver software operates the machine in a way, that after each drill was used it is checked in this sensor. The LED on the control unit front panel lights up when the drill is detected. This detector also acts as a sensor for too long drills, so that no damage to the machine bed can occur.

13: tool containers



(MTC) Tool change

To open the spindle chuck, press down the knob on top of the spindle and turn it left. Remove the tool and insert a new one. Press and turn right the knob to close the chuck. To gain better access to the tool, You may lift the spindle but it is not recommended to pull it off entirely. Tool changes during programmed drill operation will lock the stepper motor axes, so that no unwanted malpositioning can occur.

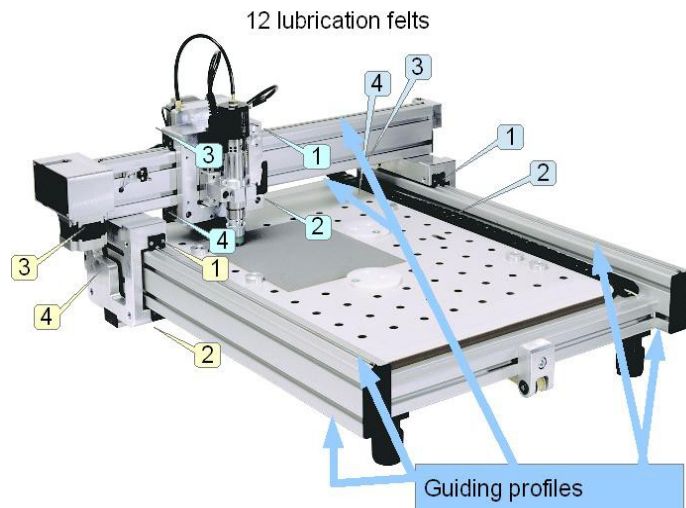
Maintenance

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 be lubricated. The belts are subject to wear. If they show damages like lateral fray-out or deformed teeth they should be replaced.



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.

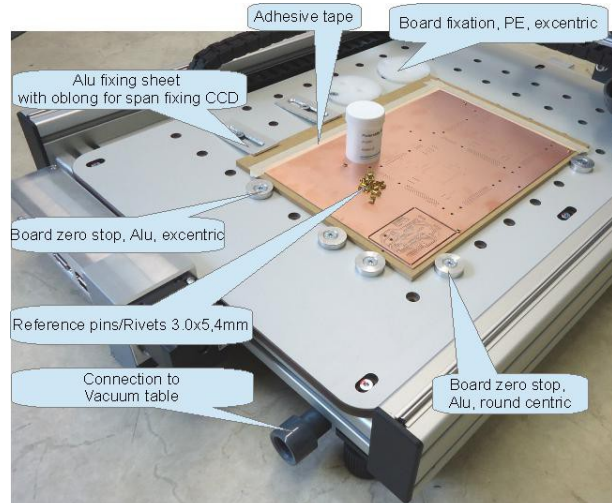
Also use reference pins in the wet process technique, if you first drill the board, then remove the board from the machine to make through hole plating and etch the tracks and after that return to the machine to make the final cut out routing.

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.

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 board already shows the tracks and pads. The drilling must exactly fit the pads.

When doing the layout, insert 2 or 3 reference holes with an extra tool number and diameter (use reference hole function of IsoCam). Use a fresh base sheet and drill these reference holes into it. Press steel pins or rivets into the holes and use this sheet as base sheet later when processing the boards.

Use the OFFSET command to move the machine's zero position to any place on the table. Fix the raw cut bare PCB to this location. Drill the reference holes related to the above used tool. Use the reference holes to position the film artwork. Develop and etch as usual. To drill the board, return to the machine and fix the board to the reference pins of the prepared base sheet.

If the film artwork does not exactly fit the drill coordinates, use the SCALE edit fields to enlarge or reduce the drill image size.

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.

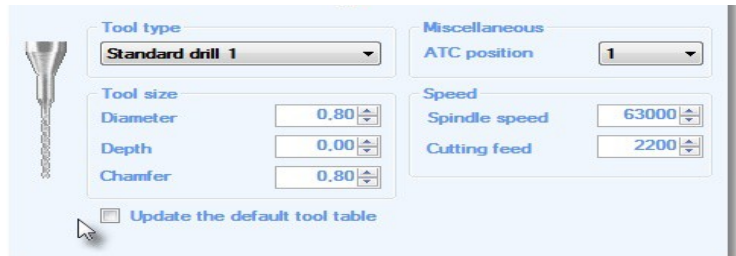
Engraving

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.

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 $\mu\text{m} / \text{U}$ (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
0,1	8	500	63000	20
0,2	12	750	63000	40
0,3	16	1000	63000	59
0,4	20	1250	63000	79
0,5	24	1500	63000	99
0,6	28	1750	63000	119
0,7	32	2000	63000	139
0,8	35	2200	63000	158
0,9	37	2300	63000	178
1,0	38	2400	63000	198
1,1	40	2500	63000	218
1,2	41	2600	63000	238
1,3	43	2700	63000	257
1,4	44	2800	63000	277
1,5	46	2900	63000	297

D	f	F	n	Vs
1,6	48	3000	63000	317
1,7	46	2900	63000	337
1,8	44	2800	63000	356
1,9	43	2700	63000	376
2,0	41	2600	63000	396
2,1	41	2500	60800	401
2,2	41	2400	58600	405
2,3	41	2300	56400	408
2,4	41	2200	54200	409
2,5	40	2100	52000	408
2,6	40	2000	49800	407
2,7	40	1900	47600	404
2,8	40	1800	45400	399
2,9	39	1700	43200	394
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.

Spade type drill

Application/Advantages:

Drilling of complex multilayer

Very good hole quality at small drill deviation

Tool type	Spade type drill 1		Miscellaneous	ATC position: 1	
Tool size	Diameter	0.80	Speed	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	Microvia drill		Miscellaneous	ATC position: 1	
Tool size	Diameter	0.20	Speed	Spindle speed	63000
	Depth	0.00		Cutting feed	1300
	Chamfer	0.20			

Slot drill

Application/Advantages:

Drilling (Nibbling) of oblongs and slots

Tool type	Slot drill		Miscellaneous	ATC position: 1	
Tool size	Diameter	0.80	Speed	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

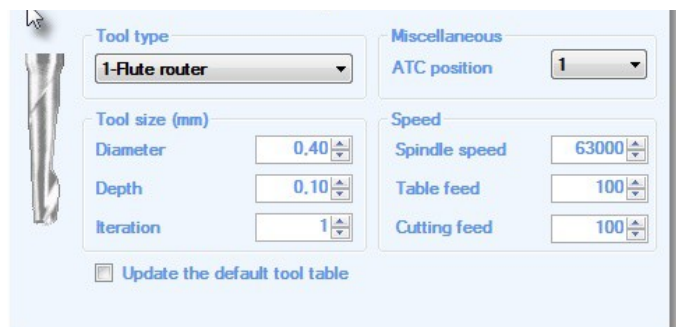
Tool type	Flex drill		Miscellaneous	ATC position: 1	
Tool size	Diameter	0.80	Speed	Spindle speed	63000
	Depth	0.00		Cutting feed	1300
	Chamfer	0.80			

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

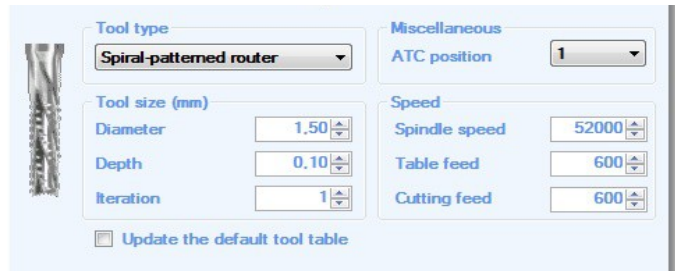
Material: FR 4	Spindle type: Kavo 4010 and 4054
D = Diameter in mm	f = chip size/Feed in μm /U (Feed / RPM x 1000)
F(XY)= Feed in table level in mm/min	F (Z) without = Feed in Z-direction without pre-drilling
n = RPM in 1/min	F (Z) pre-drilled = Feed in Z-direction with pre-drilling

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 $\mu\text{m} / \text{U}$ (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 $\mu\text{m} / \text{U}$ (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

V-Cut-Router

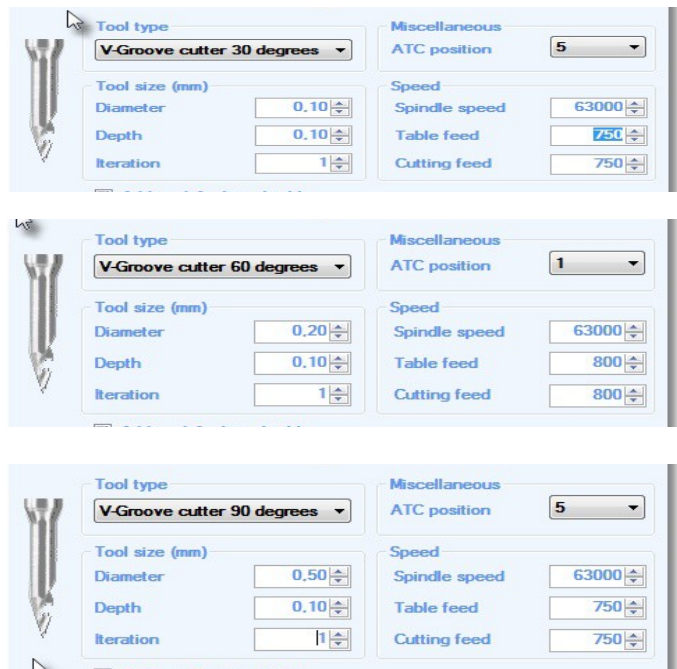
G30°, G60° and G90°

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	

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

The screenshot shows a software configuration window for a 3-Flute router. On the left is a small image of the tool. The interface is divided into several sections:

- Tool type:** A dropdown menu set to "3-Flute router".
- Tool size (mm):** Three input fields: Diameter (1.00), Depth (0.10), and Iteration (1).
- Miscellaneous:** An "ATC position" dropdown menu set to "1".
- Speed:** Three input fields: Spindle speed (63000), Table feed (500), and Cutting feed (500).
- At the bottom, there is a checked checkbox labeled "Add to default tool table".

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.

The screenshot shows a software configuration window for a Diamond-patterned Router. On the left is a small image of the tool. The interface is divided into several sections:

- Tool type:** A dropdown menu set to "Diamond-patterned Router".
- Tool size (mm):** Three input fields: Diameter (1.50), Depth (0.10), and Iteration (1).
- Miscellaneous:** An "ATC position" dropdown menu set to "1".
- Speed:** Three input fields: Spindle speed (63000), Table feed (500), and Cutting feed (500).
- At the bottom, there is a checked checkbox labeled "Add to default tool table".

Contour finishing router

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

The screenshot shows a software configuration window for a Contour-finishing router. On the left is a small image of the tool. The interface is divided into several sections:

- Tool type:** A dropdown menu set to "Contour-finishing router".
- Tool size (mm):** Three input fields: Diameter (1.50), Depth (0.10), and Iteration (1).
- Miscellaneous:** An "ATC position" dropdown menu set to "1".
- Speed:** Three input fields: Spindle speed (63000), Table feed (500), and Cutting feed (500).
- At the bottom, there is a checked checkbox labeled "Add to default tool table".

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

The warranty does not cover damage due to improper operation, ignorance of this manual and natural wear. Replacement or subsequent claims of damaged or destroyed work pieces can not be accepted, since we have no influence on the operation of the machine.

This applies mutatis mutandis to claims for damage to objects, buildings and people and the environment.

All information has been compiled with care. However we cannot guarantee this manual to be error free. We reserve the right to technical modifications and changes without prior notice.

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

For appropriate precautions and protective devices, the user has to care himself. Any liability for damage that is caused by the operation in such environment is hereby expressly excluded.

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