Item number: 117 269

ProtoMat® S100
Tutor Data

Tutorial
2.1, English

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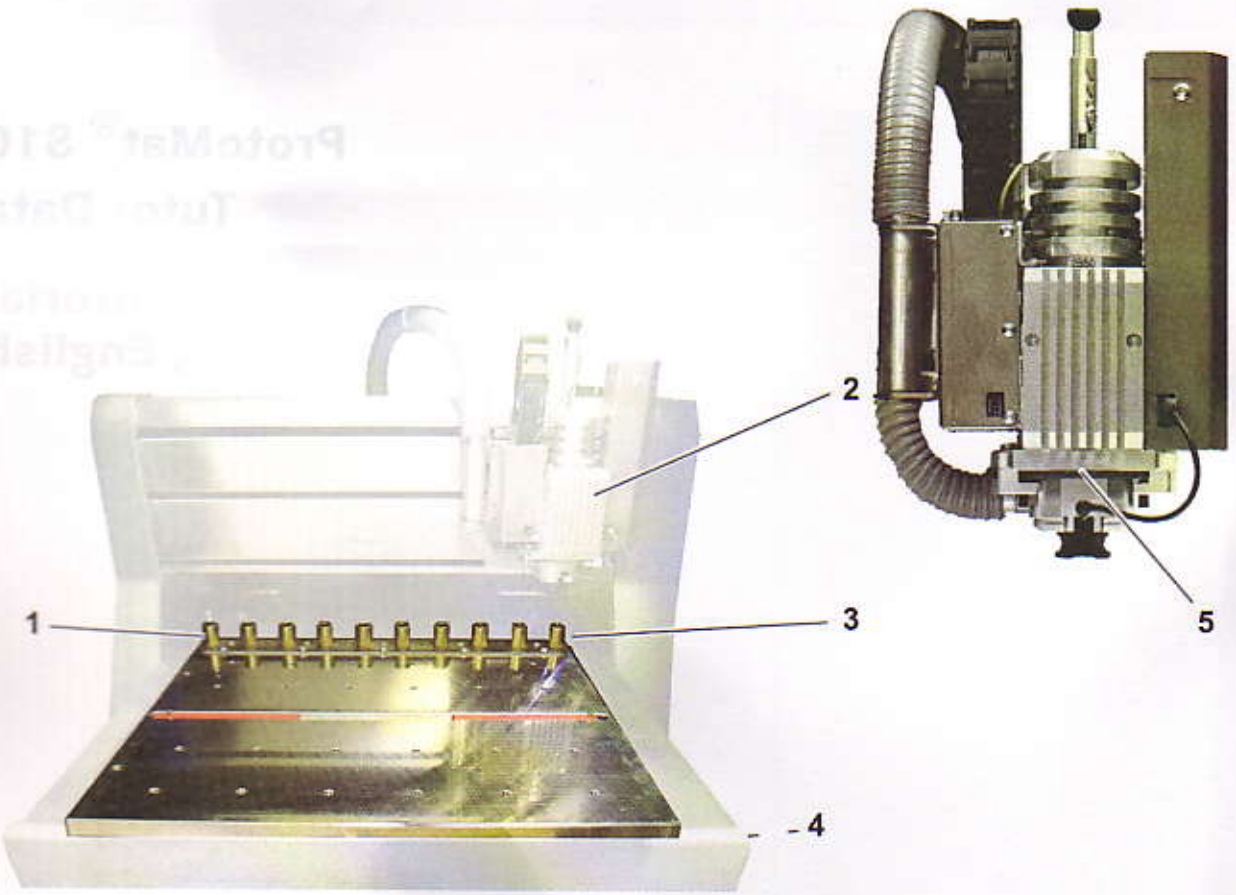
About this document

This manual allows you to familiarize yourself with the most important functions of the ProtoMat® S100 and the LPKF CircuitCAM software. You will use the Tutor data included in the scope of delivery to produce a double-sided printed circuit board. (The printed circuit board must be galvanically through-hole plated on external devices.)

Detailed information on the circuit board plotter and the LPKF BoardMaster software can be found in the operating manual of the ProtoMat® S100.

In the following we assume the in-factory basic settings of your system, the use of previously drilled LPKF base materials.

System overview



1 Tool position 1
2 Milling/drilling head
3 Tool position 10
4 Main switch
5 Setting wheel for the milling depth limiter

Preparation

WARNING

Risk of personal injury and material damage!
Be sure to read the ProtoMat® S100 operating manual and observe the safety instructions contained therein, before starting work.

I. Starting the system

1. Switch on the circuit board plotter at the main switch.
   The lighting of the milling/drilling head goes on.
2. Switch the dust extraction to the automatic mode.
3. Switch the computer on.

BoardMaster 5.1.....

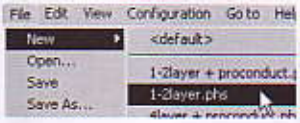
4. Double-click on the **BoardMaster** icon.
   or:
   Click on **Start** > **Program Files** > **LPKF Laser & Electronics** > **BoardMaster....**
   The **Tool Status** window is opened.
5. Make sure that the data given in the **Tool Status** window are those of the current tool positions in the circuit board plotter.

[ ] Now you can set up the circuit board plotter.

II. Setting up the circuit board plotter

1. Make sure that there are no objects in the traversing range of the circuit board plotter/traversing table.

2. Click on the **Move to Pause** button.
3. Place the base material along with the drilling plate on the traversing table or directly on the vacuum table and fasten it with non-residual adhesive tape.



4. In the BoardMaster main menu, click on **File** > **New** and select the production type **1-2layer.phs**.

[ ] Continue with → Defining the work area.

III. Defining the work area

In order to define the work area, you first have to define the front left and then the back right corner point. In doing so, make sure that the milling depth limiter base is completely above the base material and that the dowel pins are outside the work area.

1. Click on the **Move with mouse** button.
2. Drag the mouse pointer with the left mouse button pressed to the front left corner point of the desired work area.

3. In the main menu, click on **Configuration** > **Material** > **Set Low Corner**.

   The front left corner point is read in.

4. Click on the **Move with mouse** button.
5. Drag the mouse pointer with the left mouse button pressed to the back right corner point of the desired work area.

6. In the main menu, click on **Configuration** > **Material** > **Set High Corner**.

[ ] The back right corner point is read in, and the work area is displayed in the BoardMaster window.

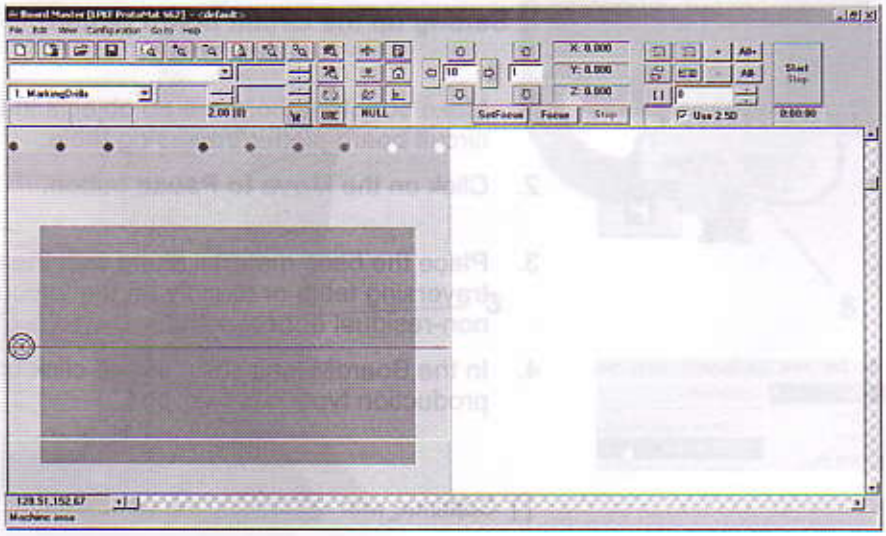


Fig. 1: Setup work area (dark-gray)

Processing the layout data by means of CircuitCAM

The layout data have to be processed to production data in CircuitCAM and must be exported to the LMD-format.

I. Importing the layout data to CircuitCAM

1. On the desktop double click on the CircuitCAM symbol.

   or:
   Click on **Start** > **Program Files** > **LPKF Laser & Electronics** > **CircuitCAM...** .

2. In the **Front-To-End** tool bar, click on the **Import** button.

3. In the
   `C:\Program Files\CicuitCAM ...\ExampleData\Prototyping` directory select the following files with the **Ctrl** key depressed:
   `Tutor.boa; Tutor.BOT; Tutor.drd; Tutor.TOP`

4. Click on **Open**.

   The **Import** window is opened with the selected files.

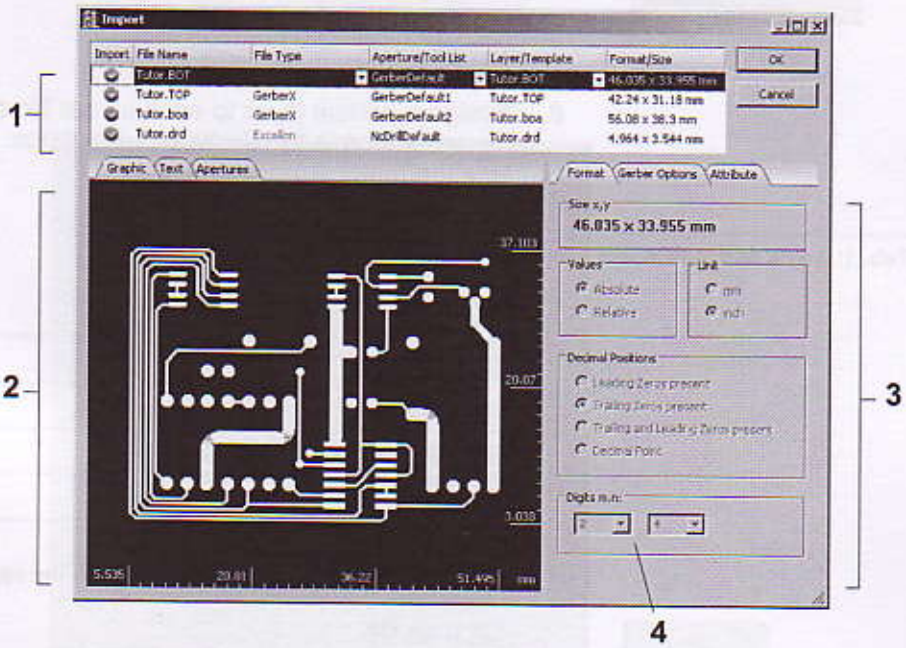
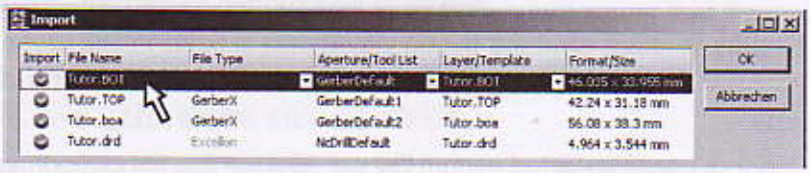


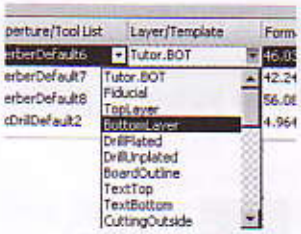
Fig. 2: Import settings for layout files (Ex.Tutor.boa)

1 File list
2 Register card **Graphic**
3 Register card **Format**
4 Resolution **Digits m.n:**

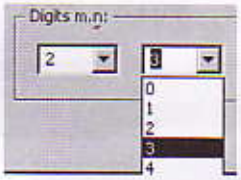
5. In order to assign the desired layer and resolution to a layout file:
   – In the file list, click on the name of the desired tutor file (column **File name**), to select the file.

Fig. 3: Selecting a layout file





   – In the column **Layer/Template**, click on the dropdown list and select the desired layer.
   (→ Tab. 1: „Layer assignation and resolution (Digits m.n)")



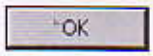
   – On the **Format** register card, field **Digits m.n**, click on the desired dropdown list and select the desired value for the resolution (selectable for Tutor.drd only).
   (→ Tab. 1: „Layer assignation and resolution (Digits m.n)")

6. Assign a certain layer to each layout file and, if necessary, change the resolution in the Digits m.n input box.
   Use the follwing settings:

Tab. 1: Layer assignation and resolution (Digits m.n)

File name	Layer/Template	Digits m.	n
Tutor.BOT	BottomLayer	2	4
Tutor.TOP	TopLayer	2	4
Tutor.boa	BoardOutline	2	4
Tutor.drd	DrillPlated	2	3

The settings are instantly displayed on the register card **Graphic**.



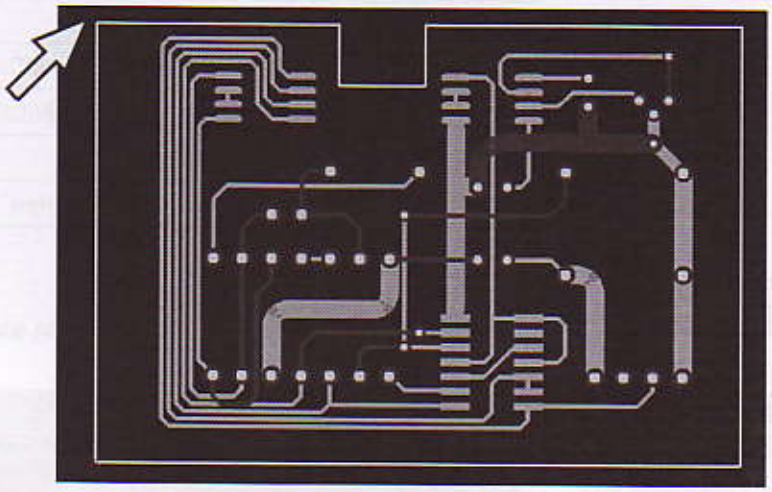
7. Click on **OK**.

[ ] After you have imported all layout files, the data will be displayed in the CircuitCAM graphic window.

II. Generating contours and ligaments

1. Click on the top left corner of the contour line.

Fig. 4: Marking contour line

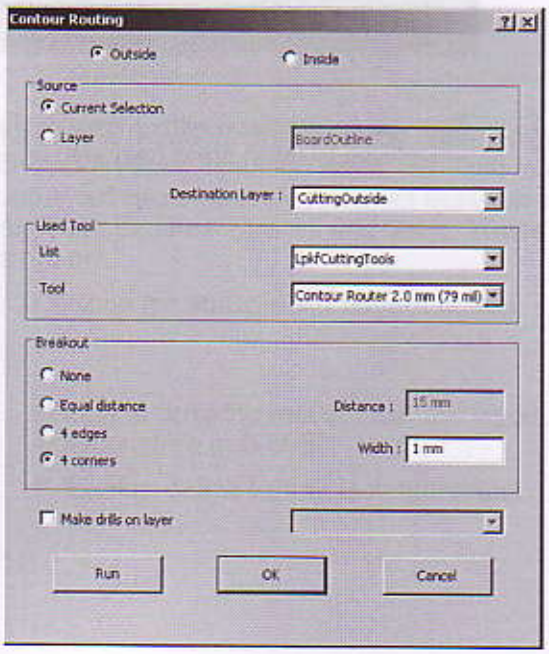


The contour line is highlighted by marks.

2. Click on the **Contour Routing** button.

The **Contour Routing** window is opened.

Fig. 5: Settings for contour milling



3. Select the following settings:

Outside		
Source	Current Selection	
Destination layer:	CuttingOutside	
Used tool	**List**	LpkfCuttingTools
	Tool	ContourRouter 2.0 mm (79 mil)
Breakout	**4 corners**	
	Width	1 mm

Run

4. Click on **Run**.

The contour is displayed as a line 2 mm in width.

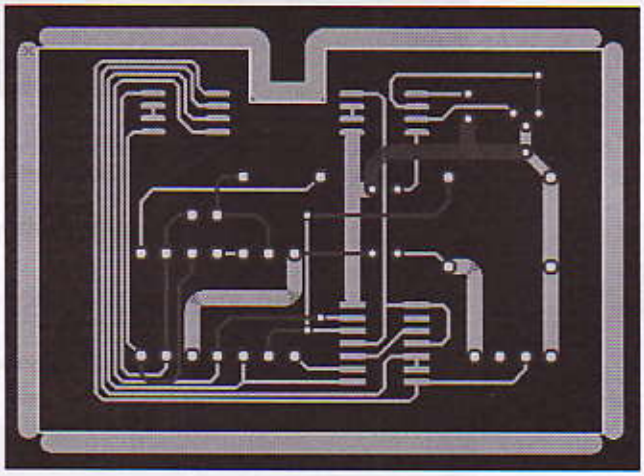


Fig. 6: Contour with ligaments

Now you can continue with → Inserting further ligaments (optional), → Defining isolation areas (optional) or → Calculating the isolation.

III. Inserting further ligaments (optional)

1. Click on a corner of the contour line highlighted in yellow.

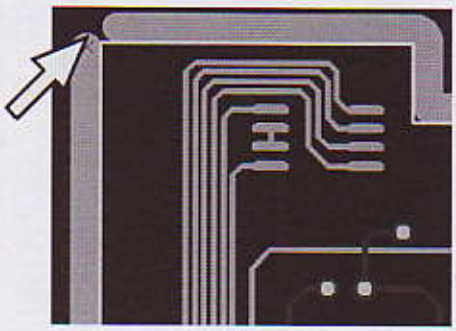


Fig. 7: Positioning a ligament

The asterisk shows the current ligament position. It can be moved by means of the +/- keys.

2. Move the asterisk by means of the +/- keys (keyboard) to the desired ligament position.

   Note: Ligaments can only be placed at the corner points and centers of a contour segment. With each key press, the asterisk will jump to the next possible bridge position.

3. Click on the **Breakout Tab** button.

[ ] The contour line will be interrupted at the selected position.

IV. Defining isolation areas (optional)

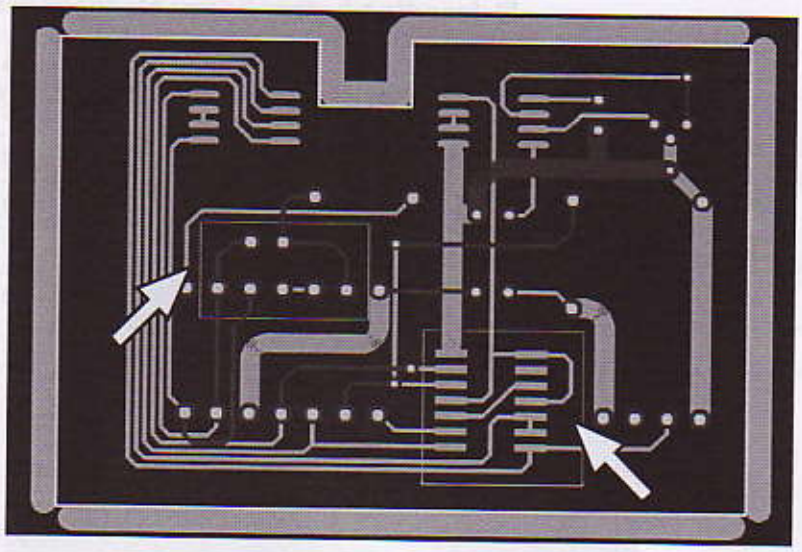
In a simple isolation, only isolation lines will be milled around the conductor tracks. Isolation areas are used to define areas in which the copper will be completely removed between conductor tracks. This will only leave conductor tracks and lands. These areas are also referred to as rub out.

1. Click on the **Rubout All Layers** button.

2. Click and drag the mouse over the layout, in order to define an isolation area (rub out).

3. If desired, define further isolation areas.

Fig. 8: Defined isolation areas (rub out)



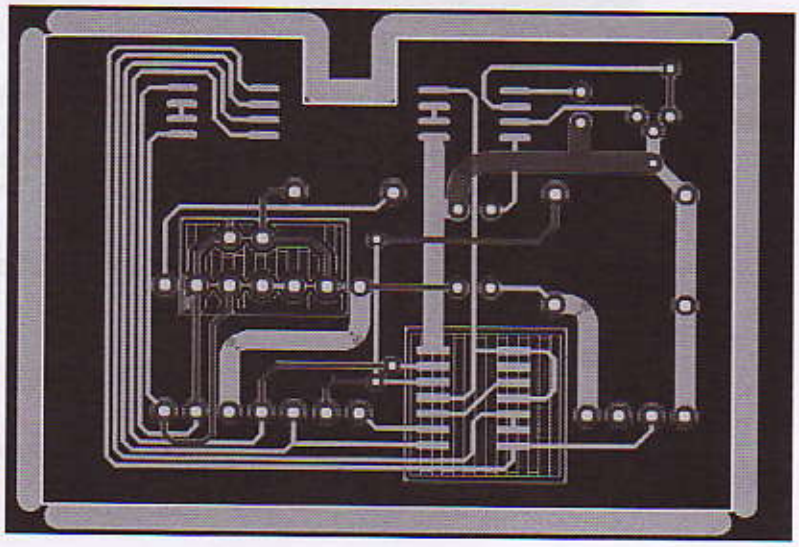
[ ] The desired isolation areas are defined.

V. Calculating the isolation

1. Click on the **Insulate All layers** button.

[ ] The isolation lines and areas (rub out) will be calculated and displayed.

Fig. 9: Calculated isolation



Note: By now, you can still define further isolation areas (→ Defining isolation areas (optional)), and recalculate the isolation.

VI. Exporting data as project

The export will automatically produce a **.cam* and a **.LMD* file. The latter is used for the production by means of the LPKF circuit board plotter and is referred to as a project. If BoardMaster is open when the export is carried out, the LMD file (project) will be automatically applied.

1. Make sure that BoardMaster is open and material size and position have been set up in accordance with the components fitted to the circuit board plotter.

2. Click on the **Export LPKFCircuitBoardPlotter** button.

   The **Save as** window will be opened.

3. Save the Tutor.cam file with any name in the desired directory.

   The *.LMD file is exported automatically to the same directory and will be imported in BoardMaster.

   CircuitCAM prompts the export of the *.LMD file and gives information about the directory used.

Fig. 10: LMD-file exported

4. Click on **OK**.

[ ] The data will be exported as a project. You can exit CircuitCAM now.

Production

If BoardMaster is open when the LMD file is exported (see "Exporting data as project" on page 11), it will be automatically imported as project. (An LMD file is referred to as a project in BoardMaster.)

Projects are managed for production in a job. A job always consists of one or more projects and information on the production type (e.g. single-/multilayered circuit board) and on the current production status.

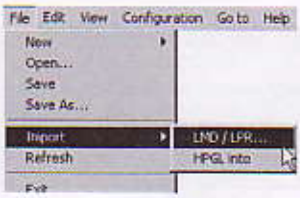
Note: If a job is already open in BoardMaster, the LMD data will be imported to BoardMaster as additional project.

Prerequisites

The following description assumes that the material has already been fixed on the traversing table and the work area has been set up (see "Setting up the circuit board plotter" on page 3).

I. Setting up a job

1. If the LMD file was not imported automatically to BoardMaster:
   - Click on **File > Import > LMD / LPR....**



   - Select the **.LMD* file generated in CircuitCAM and click on **OK**.

   Now the job can be set up individually.

2. To move a project on the base material:

   - Click on the **Move project** button.
   - Drag the project to the desired position in the work area with the mouse button pressed.

3. To copy a project:

   - Click on the **Copy project** button.
   - Drag the project with the mouse button pressed to the desired position in the work area .

   A copy of the project will be inserted at the desired position.

4. Click on (**File > Save/Save as...**), to save the job.

[ ] Now you can set up the first production phase.

II. Selecting the production phase

1. In the phase selection list, select the production phase **1. MarkingDrills.**

   Note: In this production phase, all bores are center-punched and, if available, the fiducials are drilled.

III. Setting up the tools

Before fitting the tool magazine with tools, you have to define the positions of the individual tools.

1. Click on the **Move to Pause** button.

2. Click on the **Tool Magazine Dialog** button.

3. Assign the required tools a position in the tool magazine. (The required tools are marked in the selection lists with * and +.)

4. Activate the **Stop at tool exchange**, in order to reset the milling depth/width after each tool pickup.

   The **Tool Positions** window should look like this:
   (Do not yet close the window.)

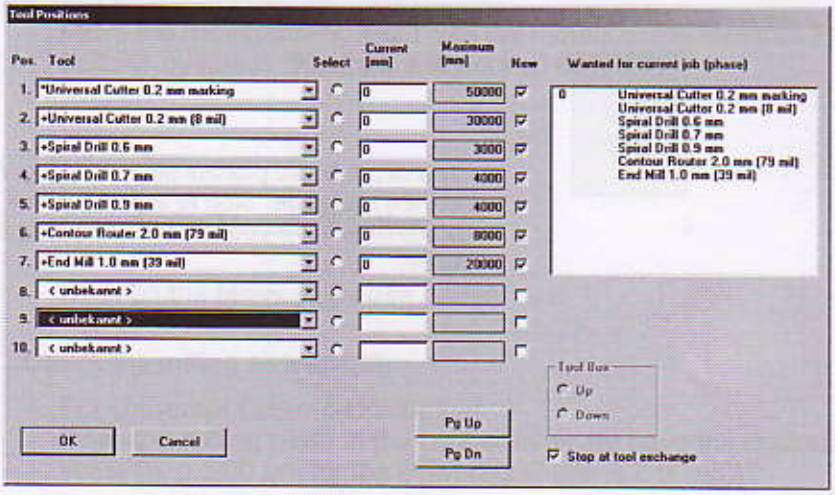
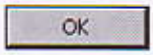


Fig. 11: Tools for the tutor file production

Inserting the tools



5. Insert the tools, with the tip pointing downward, as far as they will go into the tool positions defined by you.
6. Click on **OK**, to close the **Toolbox Positions** window.

[ ] The tools are completely set up.

IV. Activating the data for production

1. To activate all data for production:
   - Click on**All+**.

This completes the activation of all data for production

2. To activate a data area:
   - Click on the **Select Lines** or **Select Segments** button.

   - Draw up the desired data area with the mouse button pressed .
   - Click on the **+** button.

This completes the activation of the selected data for production.

Note: Use the **All-** or **-** buttons, to deactivate data or data areas already activated.

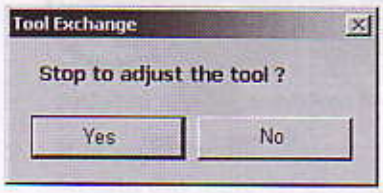
V. Starting the production phase

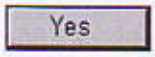
1. Click on **Start**.

The circuit board plotters starts working. As soon as a milling tool is picked up, the message "*Stop to adjust the tool ?*" appears, interrupting production. Now you can set the milling depth/width for the tool to be used.

VI. Setting the milling width (optional)

If during the tool setup you have activated the **Stop at tool exchange** option, the "*Stop to adjust the tool ?*" will appear, after picking up the tool.



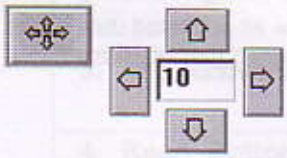


1. Click on Yes.

2. To create a test milling track:
   - Position the milling/drilling head on an area of the base material that is not required.

   - Click on the **Motor on** button.

   - Click on the **Lower head** button.



   - Move the milling/drilling head with the mouse or the **Move to X/Y** buttons by about 10 mm in the desired direction.

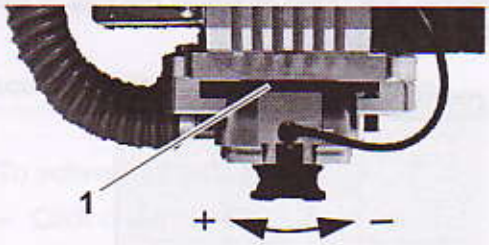
   - Click on the **Motor off** button.

   - Click on the **Move to Pause** button.

3. Check the milling width/depth:
   - For *Universal Cutter/Micro Cutter*:
     Does the milling width in the copper laminate have the desired value (e. g. 200 µm for the Universal Cutter 0.2 (8 mil))?
   - For cylindrically cut milling cutters of fixed milling width:
     Was the copper completely removed from the milling track?

4. If required:
   - Correct the milling width/depth at the setting wheel of the milling/drilling head.

Fig. 12: Setting the milling width



1 Setting wheel for the milling depth limiter

Note: For each step, the milling width changes by about 4 µm (*Universal Cutter*) and about 2.3 µm (*Micro Cutter*), respectively.

   - Mill another test track and check the milling width/depth again.

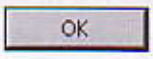
Once the desired milling width/depth has been set, you can continue the production phase.

VII. Continuing the production phase

1. Click on **Start**.

[ ] The current production phase will be started. Once all activated data of the production phase have been produced, the message "*End of phase* !" appears.

Fig. 13: Production phase completed.



2. Click on **OK**.

[ ] Now the next production phase can be started.

VIII. Starting the next production phase

In the phase selection list, the production phase selected last is always preselected.

1. Select the next production phase in the phase selection list.

   Note:
   The production phases designated **Info! ...** must be produced using external devices. The production phases designated **Read_...** are only required when the system is equipped with the VisionSystem (optional).

2. If required:
   Rotate the material around the mirror axis until the side to be processed is on top and fix it on the traversing/vacuum table (see table 2 on page 17).

3. Activate the desired data (see page 14) and start the production phase.

[ ] The required tool is picked up, and the production of the activated data starts. It may still be necessary to set the milling width/depth.

Tab. 2: Production phases for tutor files (double-sided circuit board with galvanic through-hole plating)

Production phase	Work steps	Processed material side
1. **MarkingDrills**	Center-punching the bores Drilling fiducials	Bottom
2. **DrillingPlated**	Drilling holes for the through-hole plating	Bottom
3. **Info! Galvanic Plating**	Galvanic through-hole plating (with through-hole plating station)	Both sides
4. **Read_Bottom** (only with VisionSystem)	Reading in fiducials	Bottom
5. **DrillingUnplated**	Drilling mounting holes (not for through-hole plating)	Top
6. **MillingBottom**	Milling	Bottom
7. **Read_Top** (only with VisionSystem)	Reading in fiducials	Top
8. **MillingTop**	Milling	Top
9. **CuttingInside**	Milling inner cutouts	Top
10. **CuttingOutside**	Milling contours	Top

Interrupting and saving the production

You can interrupt production at any time and continue at a later time or cancel it definitely.

1. Click once on **Stop** and wait until the data already sent to the circuit board plotter have been produced.

   Note: Clicking on **Stop** several times will continue production, possibly with further data.

2. To save the current production status:

   – Save the job under a new name.
   If possible, select a name containing the current processing status, for example `Tutor_JobDrillingPlated.job`.

   The job will be saved with the current processing status and can be opened and continued at a later time.

Canceling the production

1. To definitely cancel production:
2. Click on **File > Exit** to exit BoardMaster.

   or:
   Open another job.

3. When the message "*Save the job to the file ...*" appears:

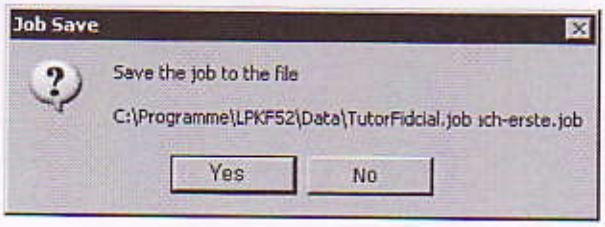
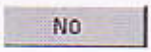


Fig. 14: Message when canceling a production



– Click on **No**.

Note: If you click on **Yes**, this job will be saved with the current production status (in the currently active phase) and opened with the status of the production phase processed last when opening it the next time.

[ ] The production is canceled.