A large, abstract graphic on the left side of the page consists of numerous thin, blue lines that curve and overlap, creating a sense of depth and motion.

BoardMaster 5.0

Manual

Order Code: 114167

LPKF
Laser & Electronics



BoardMaster 5.0

Manual 5.0, English

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Item no. 114167

Preface

This Manual introduces you to operation of *BoardMaster 5.0 for Windows™*. LPKF *BoardMaster* is a program for automatic control of HP-GL-compatible LPKF circuit board plotters.

LPKF *BoardMaster* is capable of reading in, displaying and processing production data in LMD format (generated in LPKF CircuitCAM) as well as production data generated in HP-GL format

BoardMaster takes over complete control of the circuit board plotter. The WYSIWYG (What You See Is What You Get) display for the data to be processed, manual control of the circuit board plotter on the *Windows* surface as well as the present tool library with all required information ensures virtually complete automation of circuit board prototype production.

This Manual shows you the path from LMD/HP-GL circuit board data generated by *CircuitCAM* or other programs, over job preparation right up to completion of the circuit board prototypes with the circuit board plotter.

The Manual introduces the basic control possibilities of *BoardMaster* step by step, allowing you to quickly complete your first circuit board in a simple manner.

Notes on this Manual

Basic use of the *Windows* surface is not covered in this Manual. If you are not familiar with use of the various *Windows* objects, please first refer to your *Windows* documentation.

I. Outline

This Manual is divided up into the following chapters:

1. Safety Precautions
2. Installation
3. Introduction
4. BoardMaster User Surface
5. Introduction to Basic Functions
6. Introduction to Basic Functions of the *ProtoMat H100*
7. Introduction to Basic Functions of the *ProtoMat S62*
8. Menu Bar
9. Appendix
10. Index

II. Conventions Used in this Manual

Bold text is used to emphasize important information.

Illustrations are numbered continuously.

Example: Fig. 5

› **Prompts for action** are identified with an arrow.

Italic sections are used to indicate reactions resulting from an action.

Words printed in italics indicate proper names.

Key inscriptions and menu terms are printed in **BOLD CAPITALS**.

III. Notes on the symbols Used



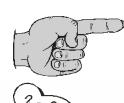
Danger!

This symbol is used to warn of danger to life or health.



Caution!

This symbol is used to identify hazards which may cause damage.



Note!

This symbol is used for notes intended to help you to avoid malfunctions in operation or help you to improve your procedures.

Machine greenhorn:

This symbol indicates important tips and information for those not already familiar with LPKF milling technology.



Legend

Shearing angle: In the ideal case the angle between X and Y-axis is 90 degrees. This results in a shearing angle of 0 degrees. The shearing angle is the relation of the two axes with respect to each other.

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1.0 Safety Precautions

Always observe the following points for your own safety. The use of *BoardMaster alone* represents only a minor hazard potential.



- Ensure that your computer is properly connected to the line power and to the circuit board plotter!
- Ensure that no one is present in the hazard area of the circuit board plotter during data transfer between *BoardMaster* and the circuit board plotter!
- Ensure that no one can enter the hazard area of the circuit board plotter and come into contact with the tools during operating phases controlled by *BoardMaster*!
- Ensure that it is not possible for unauthorized persons to operate *BoardMaster* when working with the circuit board plotter, for example during manual tool change or alignment of the base material!
- In the event of an emergency, shut off the circuit board plotter and PC connected to the circuit board plotter immediately!
- Always observe the safety precautions specified in the Manual for the circuit board plotter!
- Also observe other safety precautions in this Manual!

2.0 Installation

2.1 System Prerequisites

The **minimum** system prerequisites for installation of *BoardMaster* are:

- Pentium Processor 700 MHz or faster
- 128 MB main memory (256 MBytes recommended)
- XGA graphic card (recommended display resolution 1024 x 768 pixels)
- Microsoft Windows 2000/XP
- 4 x CD ROM drive
- RS 232 interface or USB, depending on type of LPKF *ProtoMat* machine

BoardMaster requires approx. 16 MB of free hard disk capacity for installation.

2.2 Scope of Delivery.

The *BoardMaster* scope of delivery includes:

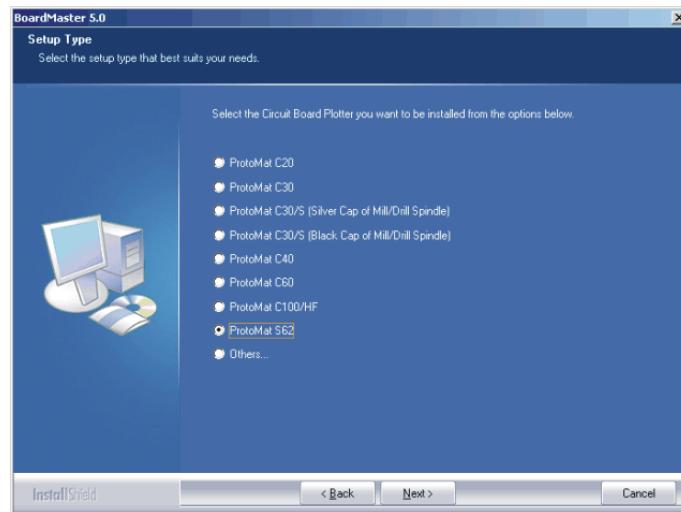
- One program CD ROM
- This Manual

2.3 Installation

As soon as you have inserted the CD in the PC drive and if the autostart function of this drive is activated, the CD browser will start automatically. Its menu guidance will lead you through the installation of the LPKF programs.

If autostart is not activated on your PC, start the CD browser by double-clicking on the file **SETUP.EXE**.

Figure 1: Component selection



During installation, the appropriate initialization files are assigned to *BoardMaster* by selection of the circuit board plotter. The setup initialization files (*.MCH) contain information on the circuit board plotter used (resolution, max. speed, motion range, etc.), the tool libraries to be used and production phases. These points are treated in detail in the following chapters.

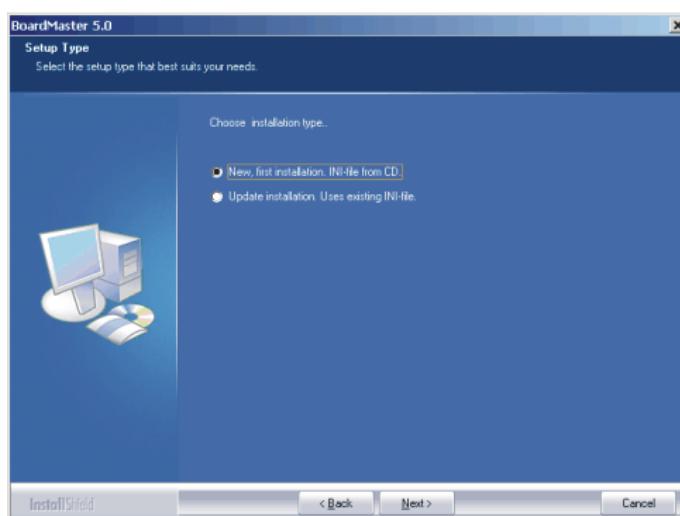


Note for update customers: The initialization file (*.INI) for your existing *BoardMaster* version is copied during installation of the update so that your user-specific settings are not lost.

New and update installation:

During installation of *BoardMaster*, the following window appears:

Figure 2: Component Selection



Select **NEW, FIRST INSTALLATION** if you are installing *BoardMaster* and your circuit board plotter for the first time. The setup program will request you to place the configuration CD supplied with the circuit board plotter and containing the specific INI file in the CD-ROM drive.

If you do not want to use this initialization file (*.INI), e.g. test installation without plotter connected, press <ESC> when Setup requests you to insert the configuration diskette. The Setup program then installs *BoardMaster* with standard settings.

Select **UPDATE INSTALLATION** if the Setup program is to add your present initialization file (*.INI) to your update installation. You will then be requested to select the directory containing the INI file. Here, you can press <ESC> to install *BoardMaster* with standard settings.

2.4 Directories Generated During Installation.

During installation, the installation program generates a directory "C\Program files\LPKF50", for storing the programs and other required files as a standard feature.

The following subdirectories are created in the directory "LPKF50" for *BoardMaster*:

- **BMaster** contains the program files for *BoardMaster* as well as all required configuration files.
- **Data** contains the data files for *BoardMaster*. This is the standard directory where all data generated by *CircuitCAM* is stored.
- **cfg_*** Subdirectories for configuration scripts

3.0 Introduction

This and the following chapters provide basic information on the operating principles and a first impression of *BoardMaster* to familiarize you with the user surface



Note: As a beginner, always read the following chapter and Chapter 4 carefully before starting to work with *BoardMaster* in combination with your circuit board plotter. Chapter 5 then presents a practical introduction into the basic methods of operation.

3.1 From Pen Plotter to Circuit Board Plotter

Conventional pen plotters, such as are used for printout of large graphics and drawings, have a paper transport for moving the paper back and forth along one axis (X axis). The print head containing various pins of different sizes and colors, can be moved along the second axis (Y axis). The print head can therefore be moved to any position on the paper. The print head is then lowered while the head/paper is moving so that the plotter can draw. It must be possible for the plotter to change the pins in order to draw lines of different thicknesses and colors.

The circuit board plotter operates according to the same principle with a few differences:

The base material, here the copper-coated circuit board material, is not transported; it is held tightly on a machine base plate. Instead of drawing, milling and drilling operations are accomplished. Some terms used in the *BoardMaster* software may be irritating because they are taken over from the old pen plotter technology. For this reason, we have listed the basic terms in a comparative list for better understanding:

Pen plotter	Circuit board plotter
Pen (thick, thin, black, red)	Tools (drill, milling cutter, ...)
Drawing paper as processing material	Circuit board base material as processing material
Pen change (thick, thin, ...)	Tool change (universal cutter, end mills,...)

3.2 HOME Position and Reference Hole System

The HOME position is a reference point programmed in the software. This point serves *BoardMaster* as a reference position for orientation on the machine base plate. The circuit board plotter can be controlled correctly by *BoardMaster* only when this point is adjusted correctly. The Home position must be located on the reflection axis (reference hole system) of the machine for production of circuit boards coated on both sides. The base material is turned around this reflection axis. Inaccuracies in the HOME position lead to an offset in processing the base material after turning.



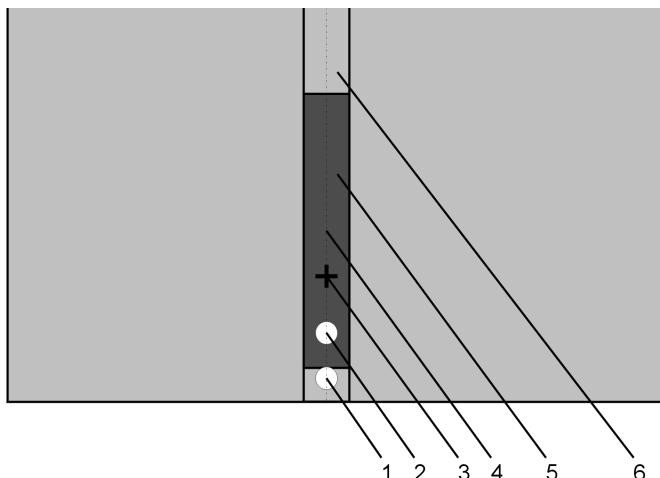
Note: The Home position is set at the factory and its position for a ProtoMat S62 is different from the position of the rest of the Proto-Mat circuit board plotters.



Note: The parallelism of the reference hole system is ensured only for the current position of the reference hole strips. The front reference hole strip must be pushed against the reference pin in the reference hole groove (referenced). If you use base material of different sizes later, it will be necessary to drill an additional reference hole in the !rear! reference hole strip for each format (see Chapter „Creating a New Reference Hole System“ on page 108). The position of the pusher for the various holes should be noted or marked on the circuit board plotter. This ensures parallelism for the various formats and eliminates the possibility of mix-ups.

It is only necessary to reprogram the HOME position in exceptional cases (offset on double-sided circuit boards) or possibly after transport of the machine or loss of the individual .INI file (see „Checking and Correcting HOME-Position“ on page 113).

Figure 3: Front Pilot Pin



1- Reference pin

2- Front pilot pin

3- HOME position, (distance depending on type of machine)

4- Reflection axis

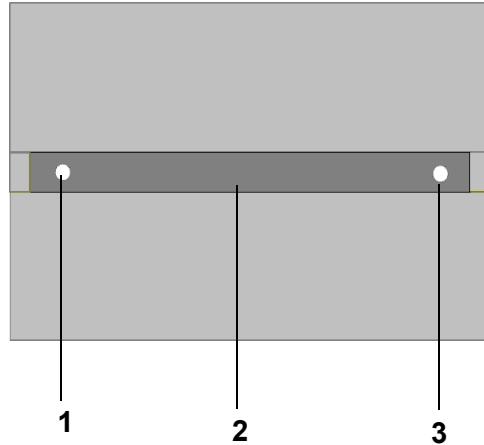
5- Reference strip

6- Reference hole groove



Note: In this Manual, we assume that the recommended standard settings are made during installation. This applies for the name of the program group as well as the directories created.

Figure 4: Reference pin system
S62



- 1- HOME Position
- 2- Reference pin groove
- 3- PAUSE Position

3.3 Starting *BoardMaster*

After installation of *BoardMaster*, the Start menu contains a new program group "LPKF Laser & Electronics", as well as a new linkage on your Windows desktop.

For error-free operation with your circuit board plotter, it is absolutely necessary to observe the switch-on sequence specified below:

- First switch on the circuit board plotter.
- Then start *BoardMaster* only after the green operating indicator on the circuit board plotter illuminates.

Otherwise, the communication accomplished even when *BoardMaster* is starting, cannot be performed.

Start *BoardMaster* as follows:

- › Click once on the entry **BOARDMASTER 5.0** in the program group **LPKF LASER & ELECTRONICS** in the **START** menu or double click the **BOARDMASTER 5.0** icon on your desktop.



Note: During start-up the following image appears before the main menu or the wizard (input assistance) is displayed:

Figure 5:



This image may be visible for up to 8 seconds, which is related to the communication between the PC and the machine, it does not represent an error. After that, the program start is automatically continued.

3.4 Plotter Ready (!!All ProtoMat Versions!!).

After starting LPKF *BoardMaster*, the following prompt appears if the plotter was **not** switched on previously:

Figure 6: Machine Switch On



- › Switch on the circuit board plotter (machine).
- › As soon as the green operating indicator on the circuit board plotter illuminates, click **OK!**



Caution! Clicking CANCEL starts *BoardMaster* without contact to the machine, i.e. the port is set to zero. This mode is suitable only for test operation or for editing data. To set the port please refer to Chapter „Serial Interface“ on page 71.

If this prompt remains visible, check whether the machine is connected correctly.



Note: If you previously used a version BoardMaster 4.0 or older, the communication to the machine cannot be established immediately due to the changed interface programming. In this case click on **CANCEL** if

the prompt **SWITCH ON MACHINE** appears and proceed according to the description in chapter „Serial Interface“ on page 71



Note: The following information applies only to BOARDMASTER in connection with the *ProtoMat 95s, 95s/II, and S62!! If you do not use a ProtoMat 95s/II or another of the mentioned machines, please continue with chapter „Wait Message“.*

After starting *BoardMaster* for the circuit board plotter *ProtoMat 95s/95s/II, H100 and S62*, the **TOOL STATUS** dialog box appears:

Figure 7: Tool Status



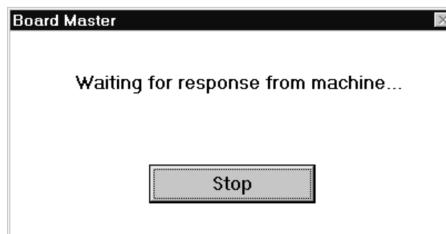
CAUTION: It is absolutely necessary to establish where a tool is located at switch on. Then, the free tool position can be entered in the tool box. Note: Position 1 = Tool 1 all the way to the right. Position 30 = Tool 30 is therefore all the way to the left in the tool box

After starting *BoardMaster* for the first time, the **TOOL STATUS** dialog box appears as illustrated above. The actual status, meaning where a tool is located and which position is free in the plotter tool box for this tool, must be defined by the user. Each time the program is restarted, the tool status present the last time the program was closed is displayed. This can then be confirmed simply by pressing **OK**. If the status displayed does not coincide with the actual status, it is necessary for the user to correct the status. Then, the program asks whether the tool is to be put back in the tool box upon exiting *BoardMaster*.

3.5 Wait Message

As long as *BoardMaster* is waiting for a reply from the circuit board plotter (i.e. circuit board plotter is in motion), a box with a corresponding message is displayed:

Figure 8: Board Master



The box disappears as soon as the head has arrived at the tool change position!



Always wait this long and do not click the Stop button!!

This message is also output when the machine is still busy editing the last command from the command buffer. This is not an error message! It is possible to change to other applications while the box is displayed. As soon as the plotter sends the requested reply to the PC, the box disappears and the program is continued normally.

After clicking the Stop button, an (additional) error message appears:

Message: “**Do you really want to cancel the current process?**”
 Yes No



Note: If you really want to cancel the current process, it is discontinued only after clicking the YES button a number of times.

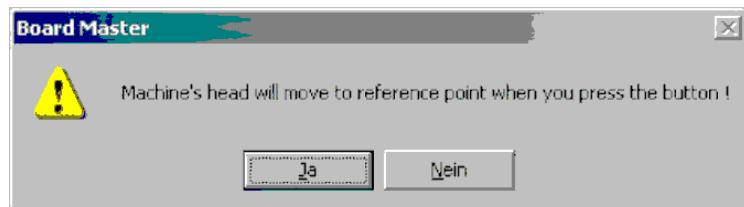
3.6 Switching Off the Circuit Board Plotter.

When switching off the circuit board plotter, first quit *BoardMaster* before switching off the machine. In the opposite sequence, recurring error messages are possible, which can be cancelled only by repeatedly actuating the **YES** button.

(Error message: **Do you really want to cancel the current process...**)

Before *BoardMaster* is actually switched off, a menu is displayed asking where the machining head is to be displaced to:

Figure 9: „Go to“ Menu

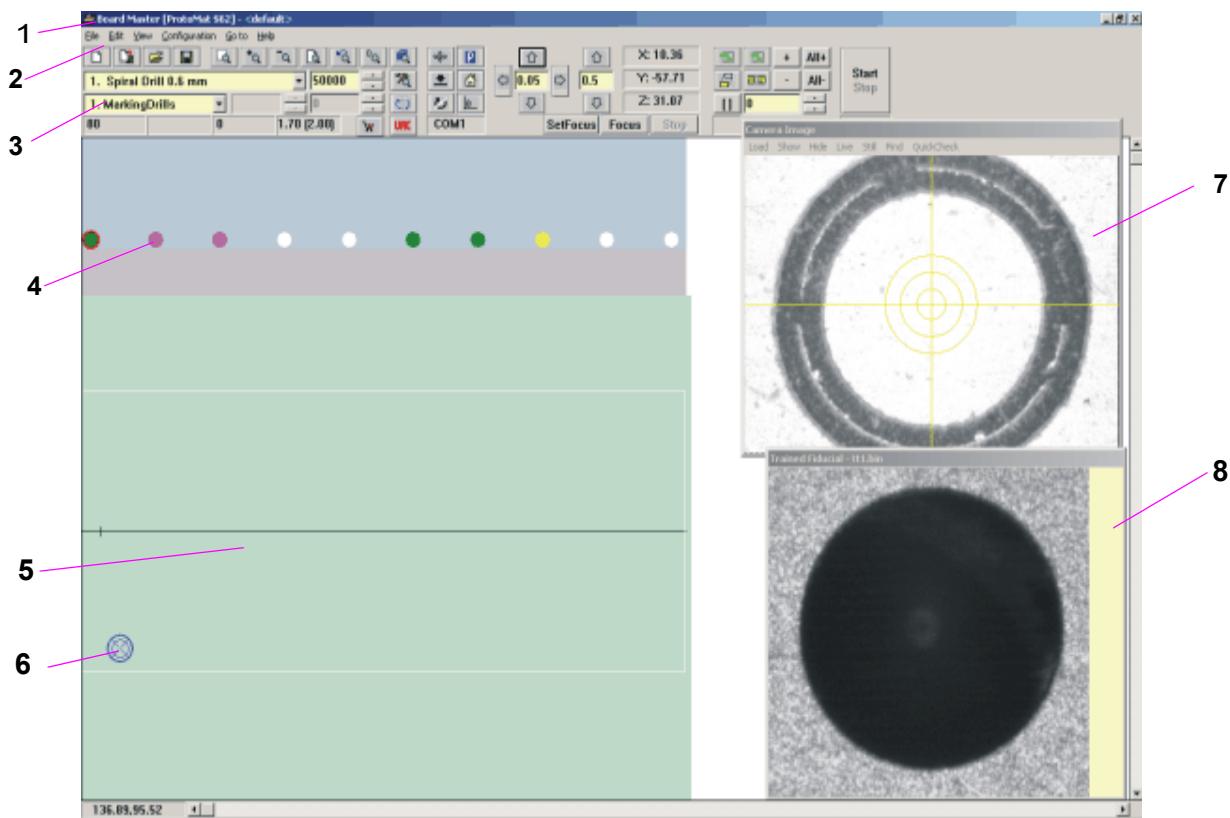


- › Click on **Ja** to make the machine head go to the reference point (i.e. zero position).

4.0 BoardMaster User Surface

The following illustration shows the *BoardMaster* user surface:

Figure 10: User surface



1-Title bar

2-Menu bar

3-Function bar

4-Tool change position(for S62)

5- Working area (only *ProtoMat H100* and *S62* with camera option)

6- Blue cross hairs represent the current position of the mill/drill head

7- Imaging window from head camera (only for camera system)

8- Reference picture „Fiducial“ (only for camera system)

A job is a completely edited production file containing information on the size of the base material, HP-GL or LMD data used, its positioning as well as all production phases and tool assignments.

The format of such a file is described in greater detail in the following chapters.

You can import the file “tutor.lmd” or any other desired file after starting *BoardMaster* for test and practice purposes by selecting the entry **IMPORT - LMD OR LPR** in the **FILE** menu.

The user surface for *BoardMaster* is subdivided into a number of areas:

- The **Title bar** shows the name of the program indicating the type of circuit board plotter used as well as the name of any job loaded or created.
- The **Menu bar** lists the menus available.
- The **Function bar** contains various buttons, displays and functions for control of the circuit board plotter and for modification of a job.
- The **Working area** graphically displays the current top view of the circuit board plotter.
 - This area is itself divided up into the actual **motion range** of the circuit board plotter (displayed in dark gray) and the area of the **base material** used (displayed in light gray) with the **circuit board data** to be processed. **Only in this area you can lower the head, therefore all data must be placed in this area.#**
You can adapt the graphic display of the working area to your specific requirements with the functions in the **VIEW** menu.
- The **Display scroll bars** are located on the right of and below the working area and serve for moving the visible section into the working area.
- The **Current mouse cursor position** is indicated at the left next to the horizontal scroll bar.
- The **Status bar** below the horizontal scroll bar provides information on buttons, displays or areas where the mouse cursor is presently located.
- The **tool changing position** (for S62) represents the stations 1-10 of the tool magazine.

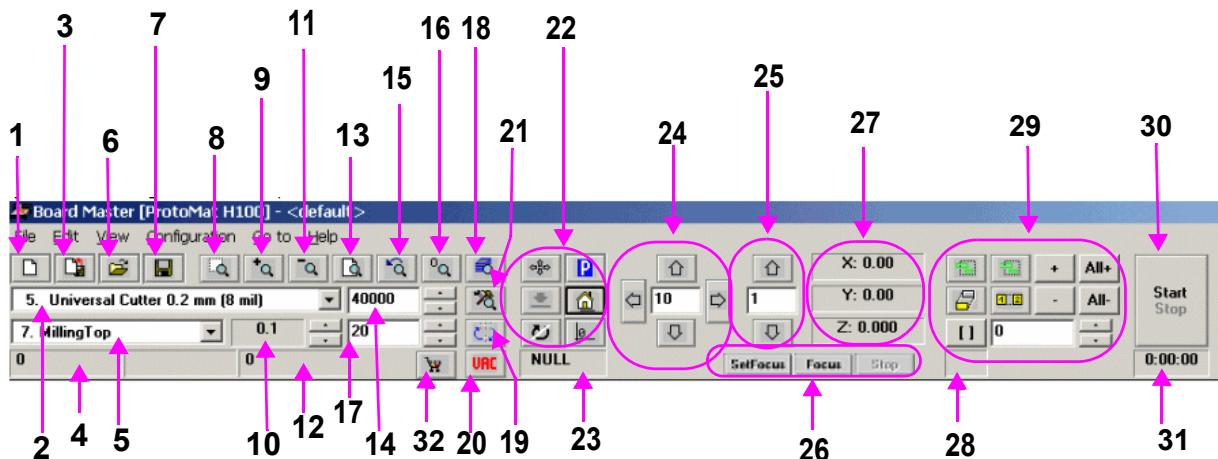
4.1 Function Bar

The function bar in *BoardMaster* includes functions for positioning and copying projects on the base material as well as for control of the connected circuit board plotter. Moreover, the function bar provides important status information on the machining process.

4.1.1 Brief Summary of Function Bar

This short summary contains a list of all features in the function bar. The individual features and meanings are explained briefly. Each function includes a reference to the corresponding page in the manual containing a detailed explanation when present. The hot keys for the function are also listed following the page number.

Figure 11: Overview function bar

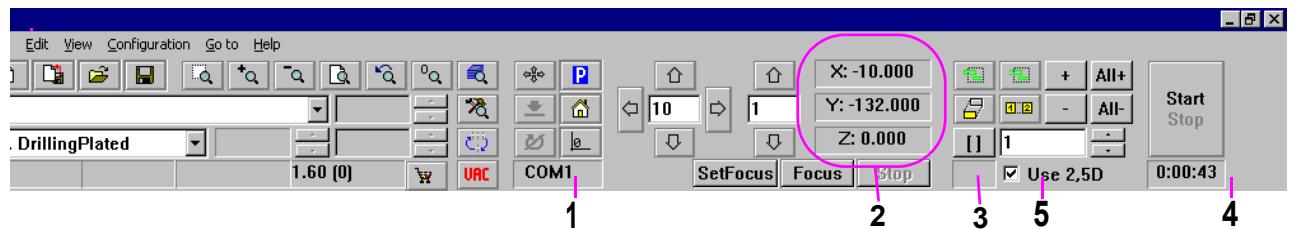


- 1- New file (page 88); (Strg+N)
- 2- Display/select active phase (page 25)
- 3- Import LMD-file (page 88); (Strg+I)
- 4- No function
- 5- Display/select active tool (page 25)
- 6- Open job file (page 88); (Strg+O)
- 7- Save file as job (page 88), (Strg+S)
- 8- Zoom window (page 100)
- 9- Zoom in x 1,5 (page 100), (Page up key)
- 10- Tool penetration depth (for H100)
- 11- Zoom out x1,5 (page 100), (Page down key)
- 12- Number of drills or length of milling lines mm
- 13- Total view of operating area (page 100, („Pos1“))
- 14- Speed of milling/drilling spindle
- 15- Previous (page 100), („Insert“)
- 16- Reload LMD data (also screen refresh)
- 17- Display: Drilling time in sec. or feed in mm/sec.

- 18- Phase configuration (page 83)
- 19- Tool position - dialogbox
- 20- Vacuum On/Off (not for all machines)
- 21- Configuration „active Tool library“ (page 70, Strg+T)
- 22- Controlling functions for Milling/Drilling head
- 23- Display interface (page 71)
- 24- Moving Milling/Drilling head in X-/Y-direction
- 25- Moving Z-Axis -Z / +Z (page 25)
- 26- Special camera functions (only for camera option, page 29)
- 27- Display: X-,Y-,and Z-position in mm
- 28- Vector index display
- 29- Copy, Shift, Select, Mark (page 26/page 28)
- 30- „Start“ / „Stop“ (page 29))
- 31- Estimated processing time (hr:mm:ss)
- 32- Open connection to the LPKF internet shop

4.1.2 Status information

Figure 12: Status-Information-I



1. Interface

This display provides information on the interface set for transferring the control data. Here NULL means that the data is not sent to an interface. When the mouse is moved over this display field, the values set for the interface are indicated in the status bar.

2. Actual position of milling drilling head

This display shows the actual position in all 3 axis.

3. Number of vectors

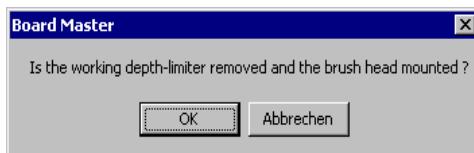
The number of vectors which have already been processed is displayed.

4. Estimated Processing Time

For current production phase. This display indicates the estimated time in hours:minutes required for processing the enabled production phases. Individual selections are not taken into consideration here.

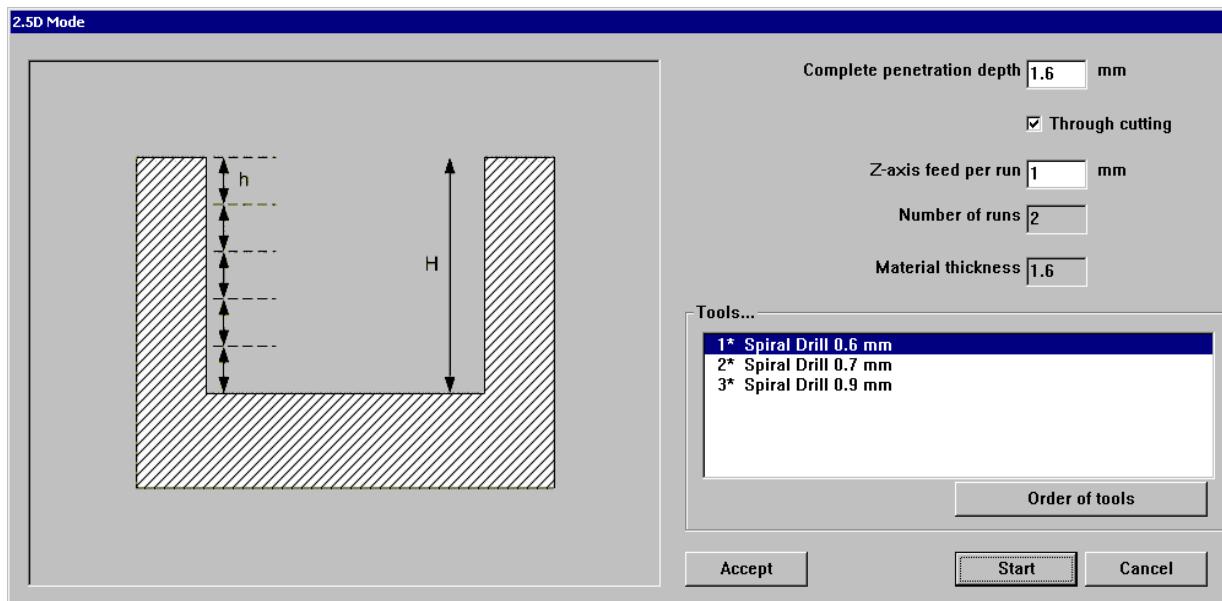
5. 2.5D Modus

The thickness of the material is divided into various processing layers. The number of layers depends on the depth with which the tool penetrates the material. The penetration depth must be individually adapted to each tool. The settings that are made can be stored in the hob. When the option is enabled with a checkmark, then the following dialog appears:



In „2.5D“ mode the working depth limiter is of no use, instead you should mount a brush. If the dialog is terminated with **ESCAPE** then the whole process is cancelled. If it is confirmed with **OK** then the following dialog appears:

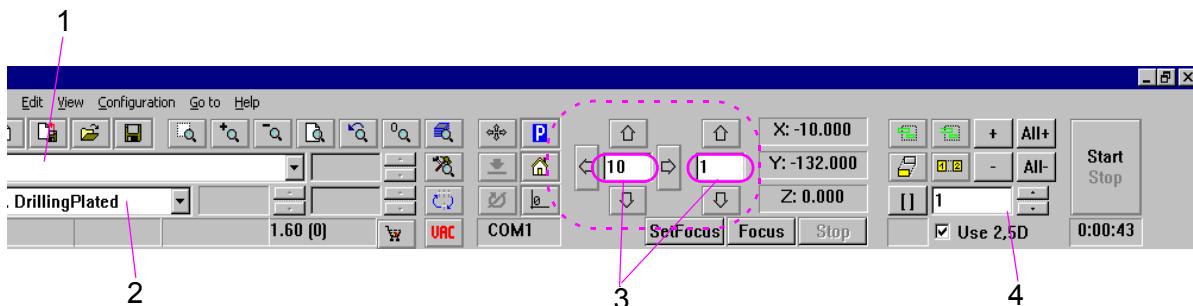
Figure 13: 2.5D Mode



4.1.3 Changeable Settings

The display fields indicated here can be edited and thereby adapted to your requirements.

Figure 14: Status-Information-II



1. Tool

This list field shows the tool used for the current production phase.

2. Current Production Phase

The current production phase is indicated in this list field.

3. Step Width for Manual Control

This text field allows definition of the step width by which the milling-drilling head is moved each time one of the six Arrow buttons (outlined with dotted line in figure above) is clicked.

You can mark the text field and increase or decrease the value in defined steps with the + or - button.

4. Vector Index

This text field allows you to define the vector index. An index is counted with each line segment or arc segment. Here, it is possible to define the vector index at which processing is to be started, for example.

4.1.4 Positioning Functions



Move Project

You can activate this button to move a project in the operating area. Position the cursor on the project to be moved, press the left mouse key and drag the project to the desired position with the mouse key depressed.

The project appears as a dark area while it is being moved.



Duplicate Project

You can activate this button to duplicate a project and position the copy in the operating area. Position the cursor on the project to be duplicated, press the left mouse key and drag the copy of the project to the desired position with the mouse key depressed.

The copy of the project is represented as a dark area during duplication.



Note: Each time a project is moved or duplicated it is necessary to reactivate the corresponding button.

Click a project with the right mouse key to open the PLACEMENT dialog box and display the settings for this project.

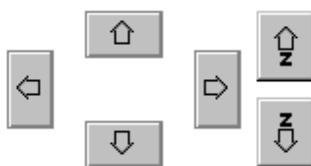
In this dialog box you can correct the reference point values for positioning projects on the same X and Y coordinates (align). If the control key is pressed and held down, while clicking and holding down the left mouse key on the project, the project is moved only in the X or in the Y direction.

You can also use the PLACEMENT dialog box for rotating a project (after positioning with the mouse) by changing the setting ROTATION.

4.1.5 Control Functions for Manual Control



Danger! After activating one of the following buttons on the function bar, the connected circuit board plotter is put into motion! Ensure that no one can move into the hazard area of the plotter during the operating phases controlled by *BoardMaster*!



Manual Control

The head can be moved in the directions +X, +Y, -X and -Y with the aid of the arrow keys. Pressing one of the arrow keys once, moves the head by the value entered on the function bar in the entry field STEP FOR MANUAL CONTROL in the selected direction. (See "Changeable Settings" on page 25). Motion in the X and Y direction can also be accomplished by holding down the Ctrl key on your keyboard and pressing the arrow keys on the keyboard. The Z-axis can be moved with the keyboard by pressing the Ctrl key and actuating the Page↑ or Page↓ key.

**Moving by Mouse**

After activating this button, the head can be moved to the position in the operating area which you click with the left mouse key. If you continue to hold down the left mouse key, you can move the mouse and the head follows the motion of the mouse after it has reached the mouse starting position. This function allows the head to be moved to any desired location very quickly for defining the material size. To control the XY table with the mouse motion again it is first necessary to activate the button again.

**Moving to the Home Position**

When this button is clicked, the machining head moves to the Home Position. This position is principally moved to in order to check the existing reference hole system or to produce a new one.

**Zero point**

When this button is clicked, the machining head moves to the zero point of the X-Y coordinate system. This position is generally moved to before switching the circuit board plotter off.

**Vacuum**

By clicking on this button you can switch the vacuum system on or off. Please note that the vacuum system cannot be switched off when the machining spindle is running.

**Machining spindle on / off**

By clicking on this button you can switch the machining spindle on or off.

**Pause Position**

When this button is clicked, the machining head moves to the Pause Position. This position is used when material is to be exchanged or when material is to be turned round.

4.1.6 Selection functions

Before selecting, you must have activated all phases to be assigned data and which you want to process. Detailed information on activation is given in the chapter "Phases". Data must be selected before it can be sent to the plotter for processing. Only data in the activated phases can be selected.

The following buttons are available on the function bar for selecting the data:



Mark All

Activate this button to mark all data for the enabled production phases. The data marked are displayed in a lighter color on the monitor.



Cancel All Marking

Activate this button to cancel all marking of the data.



Select Area

Activate this button to select a data area. For this purpose, press the left mouse key and hold it down while dragging the mouse over the desired area.

This function also selects lines crossing the area. The selected data are displayed in white on the monitor.



Select Area (only inside)

Activate this button to mark a data area. For this purpose, press the left mouse key and hold it down while dragging the mouse over the desired area.

This function marks lines crossing the marked area only up to their first support coordinate outside of this area. The marked data is indicated in white on the monitor.



Note: It is necessary to reactivate the corresponding button each time an area is selected.



Add Selected Data to Marking

Activate this button to add selected data to the marking.



Delete Selected Data from Marking

Activate this button to delete selected data from the current marking.



Selected Lines

You can increase or decrease the number in the window with the small arrow buttons to the right. Each number stands for a certain vector (section of line). The entire job is processed vector for vector in the sequence of this numbering. It is possible to select a certain vector or a number of vectors for subsequent marking. For this purpose, it is necessary to select the number of the corresponding line with the aid of the right arrow button. Then, it is necessary to activate the function

"Selected lines" by clicking . You can then increase or decrease the number with the arrow buttons to select each selected vector and display it in white on the monitor. These selected lines can be marked by

clicking  or added to a marking. If vectors already marked are selected in this manner, they can be unmarked by clicking  . This function can be deactivated by clicking  .

Furthermore this function allows to select a project to start with a determined vector index value. Enter the vector value from which the project is to be processed. Confirm the function with  and then the vector value is increased using the keyboard entry (for example by adding a number, e.g. 564 becomes 5640). The subsequent routes are then represented in white and can be added to the selection by pushing the  button.

4.1.7 Control Functions for Production Phase



Danger! After activating one of the following buttons on the function bar, the connected circuit board plotter is put into motion! Ensure that no one can move into the hazard area of plotter and come into contact with the tools during the operating phases controlled by *BoardMaster*!



Start

Activate this button to transfer the marked data for the enabled production phase to the plotter over the serial interface.



Stop

Activate this button to discontinue data transfer to the plotter after starting.



Caution: After activating the Stop button, the plotter does NOT STOP IMMEDIATELY; first, it continues to process the data in the buffer!

Activation of the Stop button only interrupts transmission of data to the plotter!

4.1.8 Camera Functions

Set Focus

Use the arrow keys to move the machining head with camera until the image is focussed. Then press this key to have the current Z value stored in the INI file as vocus position.

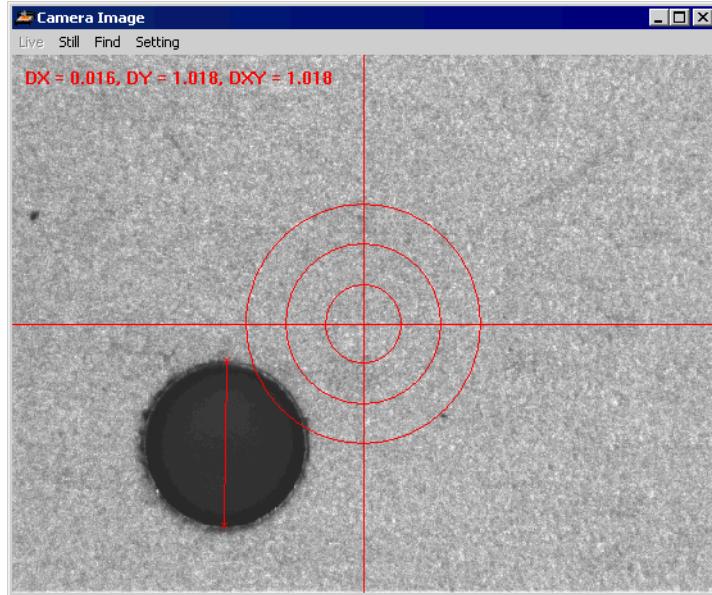
Focus

Press this button to have the camera moved back to the focus position when it is currently in a different position.

Stop

Pressing this button stops ongoing reading processes of the camera, e.g. when fiducials are being read in.

4.1.9 Camera Image Fiducial Recognition (only for S62/100 with camera option)



Note: This image can only be seen when the phase for fiducial recognition is selected.

When the camera is successfully calibrated, such a live image can be seen.

Still

The image is „frozen“ and the menu item **LIVE** becomes visible, so that it is possible to switch between the two modes.

Live

The image is again represented in real time and the menu item **STILL** becomes visible. Thus it is possible to switch between the two modes.

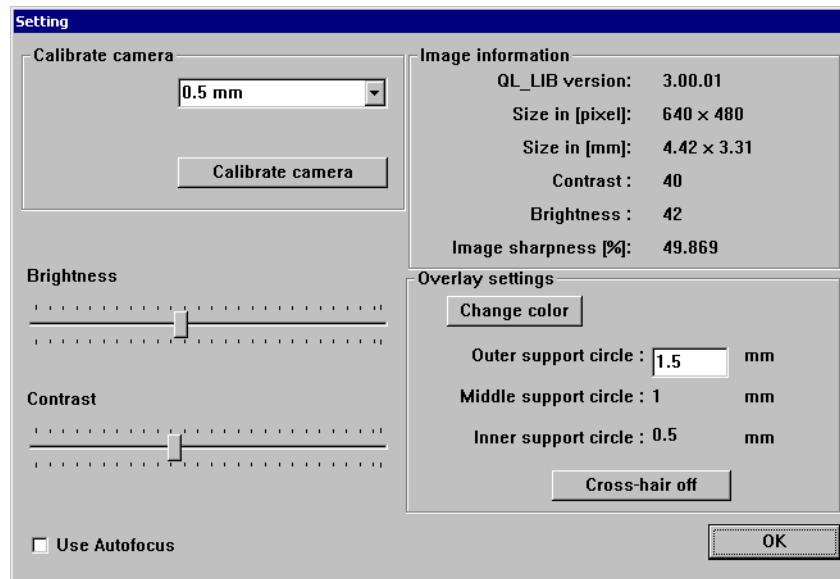
Find

When the menu item **FIND** is activated, a standard fiducial is searched in the image area. The result is shown in a message as quality and stance to the image center.

Setting

After activation of this menu item the following dialog is opened:

Figure 15: Setting



Calibrate camera

The camera can be calibrated with the selected values.

Brightness

Setting the brightness of the camera.

Contrast

Adjusting the contrast of the camera.

Image Information

Shows the current setting of the camera.

Overlay Settings

Changing the color, switching the cross hairs on and off and adjusting the size of the support circles are possible.

Use Autofocus

If this field is activated, the camera automatically determine the focus. This setting exists only for machines with a Z axis.

5.0 Introduction to Basic Functions

This section describes step by step the basic procedure for producing a double-sided, not through-plated circuit board with *BoardMaster*. **If you use the machine *ProtoMat H100* please skip this chapter and continue with chapter „Introduction to the Basic Functions of the *ProtoMat H100*“ on page 40 ! If you use the machine *ProtoMat S62* please skip this chapter and continue with chapter „Introduction to the Basic Functions of the *ProtoMat S62*“ on page 56 !** Simply follow the instructions to familiarize yourself within a very short time with the basic principles of working with *BoardMaster* and your circuit board plotter:

To start *BoardMaster*:

- › Click once on the entry **BOARDMASTER 5.0** in the program group **LPKF LASER & ELECTRONICS** in the **START** menu or double click the **BOARDMASTER 5.0** icon on your desktop to start *BoardMaster*.

Configuring *BoardMaster*:

BoardMaster can communicate with your circuit board plotter correctly only when *BoardMaster* addresses the right PC port and this port is also set correctly.

- › If not already accomplished, define the serial port by selecting the entry **PORT** in the menu **CONFIGURATION** and check or correct the values as required (see Chapter „Serial Interface“ on page 71).
- › If necessary, also check the settings for the serial port in the **WINDOWS SYSTEM CONTROL** under **System, Device Manager, Connections**. The required settings, which differ depending on the circuit board plotter connected, are shown in figure 54, "Interface parameters" on page 72.



Note: Close *BoardMaster* after checking and, if applicable, configuring the port setting, before continuing with this introduction!

- › Switch on the circuit board plotter (see machine manual).
The circuit board plotter moves to the tool change position.
- › Wait until the green ready indicator on the circuit board plotter illuminates.
- › Click once on the entry **BOARDMASTER 5.0** in the program group **LPKF LASER & ELECTRONICS** in the **START** menu or double click the **BOARDMASTER 5.0** icon on your desktop to start *BoardMaster*.
- › Move the circuit board plotter to the pause position by clicking **GO TO... - PAUSE** on the menu bar.

Positioning base material:

We recommend using the base material already present on the circuit board plotter. The first base material board is already mounted for precisely this reason to make introduction easier for you. Drilling and positioning material of other sizes is not described here. If required, read the Chapter „Creating a New Reference Hole System“ on page 108 as well as the Chapter „Drilling Reference Holes in Base Material“ on page 106.

- › Fasten the base material with adhesive tape on all four sides (we recommend Tesakrepp 5250).

In order to process data created with *CircuitCAM* or similar software, it is first necessary to import them into *BoardMaster*.



Particularly for those not familiar with LPKF milling technology, it is helpful to have the base material actually to be processed displayed visibly on the monitor.
For this purpose, you can define this area.
However, this definition has no effect on the production sequence!
It serves only as a viewing aid. If required, proceed as follows:

Defining view of material size:

Define the size of the base material used by reading the Chapter „Defining the Base Material Size“ on page 85 and use the method described there for “Determining size by moving machining head”. Then continue your work here.

Importing production data:

The “Working Instructions” for *BoardMaster* indicating the method for processing the base material are contained in the production data. They are generated by *CircuitCAM* or a similar program and must first be imported:

You can import the LMD production data (e.g. TUTOR.LMD) generated by the *CircuitCAM* software or the HP-GL project files already generated by *BoardMaster*. At this point, we will now import a file in LMD format (Tutor.lmd).

- › Import the file Tutor.LMD by clicking the entry **LMD or LPR...** in the submenu **IMPORT** in the menu **FILE** and select a file (e.g. “Tutor.LMD”). This file can be found in the directory C:\Program files\LPKF50\Data\.

Assigning tools:

A tool must be assigned to each production phase so that *BoardMaster* “knows” which tool to use for each individual program phase (milling cutters, drills of different sizes, engraving, etc.). As a rule, *BoardMaster* accomplishes this itself, as is the case when importing Tutor.lmd. However, if you are processing an HPGL file, this will have to be accomplished manually. In this case, please read the next Chapter „Assigning Tools“ on page 90 before continuing here.

- › If you are working with an HP-GL file, assign the appropriate tools/phases to the imported production data for projects (**EDIT - TOOL ASSIGNMENT**). Otherwise, simply continue on to the next processing step.

Positioning production data:

You now have the possibility of positioning the imported production data as desired on the base material to define how they are to be machined later.

- › Position the imported production data or projects by selecting the entry **PLACEMENT...** in the menu **EDIT** or click the button  on the function bar. You can then move the image of the production data with the mouse and position it by holding down the left mouse key.

Storing job:

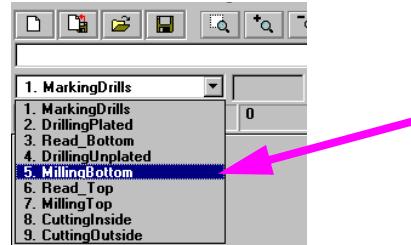
- › Store the job after positioning all projects by selecting the entry **SAVE AS** in the menu **FILE** and then save the job under the desired name.

Selecting first production phase:

Each production phase such as "Milling bottom" must be selected separately and prepared for processing (assignment of correct tool, etc.). Start with the first production phase:

- › Select the production phase **Milling bottom** from the function list in the list box **PRODUCTION PHASE** (see figure below).

Figure 16: List Field „Production Phase“



Selecting data:

Theoretically, it is possible to process only certain sections of this production phase by correspondingly selecting the data. For this reason, it is always necessary to first select the desired areas to be processed. Since the entire production phase is to be processed here, we select all data for this phase:

- › Select **All+** to select all data.



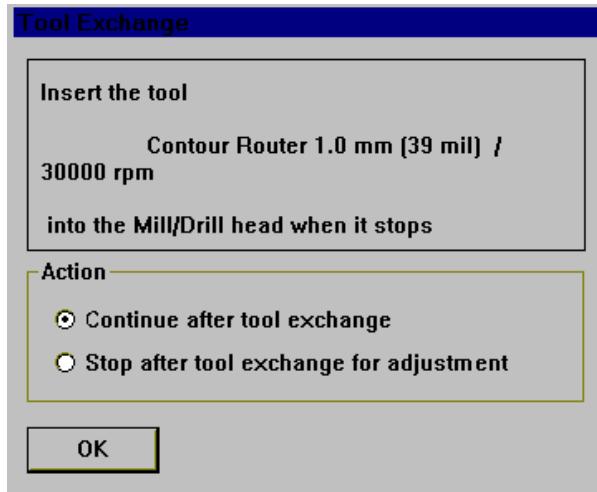
Danger! Activating one of the following buttons on the function bar, sets the connected circuit board plotter in motion! The danger of pinching and crushing exists!

Ensure that no one can enter the hazard area of the circuit board plotter during the operating phases controlled by *BoardMaster* or come into contact with the tools!

Starting machining operation for selected production phase:

- Start**
Stop
- › Click **Start** on the function bar to send the selected data for the current production phase to the circuit board plotter via the serial port.
- If you use a machine without automatic tool change, the machine first moves to the tool change position if not already positioned there and the following message appears:*

Figure 17: Tool Change



This message always appears when a tool is to be changed. If you use a *ProtoMat H100* then skip the following steps and proceed with chapter „Introduction to the Basic Functions of the *ProtoMat H100*“ on page 40.

- › Now install the first tool required in the machining head (see machine manual).
- › Click “Stop for change after tool transfer” and then click **OK** to close the message box.
- › Now set the cutting depths if you are operating the circuit board plotter for the first time. For this purpose, see “Adjustment of milling and drilling depth” on page 67.

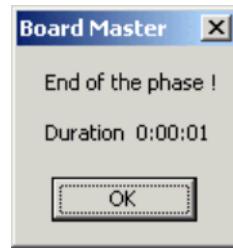


Switch on the vacuum!

- Start**
Stop
- › Click **Start** again.

The production phase “Milling bottom” is run. Then the following message appears:

Figure 18: Phase End

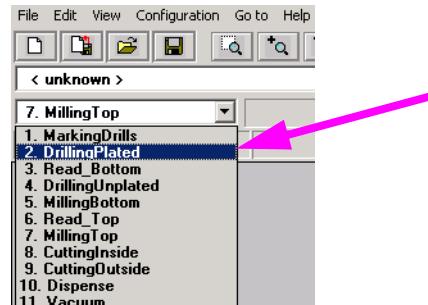


- › Click **OK**.

Selecting second production phase:

- › Select the production phase **Drilling Plated** on the function bar in the list box **PRODUCTION PHASE** (see figure below).

Figure 19: List field „Production Phase“



Selecting data:

- › Select **All+** to select all data.



Danger! Activating one of the following buttons on the function bar, sets the connected circuit board plotter in motion! The danger of pinching and crushing exists!

Ensure that no one can enter the hazard area of the circuit board plotter during the operating phases controlled by *BoardMaster* or come into contact with the tools!

Starting drilling operation for selected production phase:



- › Click **Start** on the function bar to send the selected data for the current production phase to the circuit board plotter via the serial port.

The message ...(see figure „Tool Change“ on page 35) appears.

- › Now install the required tool.
- › Click **STOP FOR CHANGE AFTER TOOL TRANSFER** and then **OK** to close the message box.

- › Adjust the drilling depth (see "Adjusting Milling and Drilling Depths" on page 105).
- › If necessary, click **CONTINUE AFTER TOOL TRANSFER** and then click **OK**.

Switch on the vacuum!



- › Click **Start Stop** on the function bar.
- The production phase is completed.*

Continue to comply with the subsequent drill requests by installing the tool (drill) as requested and then click **OK** until the production phase is completely processed.

Turning base material:

- › After drilling and milling the bottom, move the head to the **Pause** position (menu bar **Go to... - Pause**) and turn the base material around the X axis and fasten it again with adhesive tape.

Selecting third production phase:

- › Select the production phase **Milling top** on the function bar in the list box **PRODUCTION PHASE**.

Figure 20: List field „Production phase“



Selecting data:

- › Select **All+** to select all data.



Danger! Activating one of the following buttons on the function bar, sets the connected circuit board plotter in motion! The danger of pinching and crushing exists!
 Ensure that no one can enter the hazard area of the circuit board plotter during the operating phases controlled by **BoardMaster** or come into contact with the tools!

Starting milling operation for selected production phase:



Switch on the vacuum!



- › Click **Start** on the function bar.

The selected data for the current production phase are transferred to the circuit board plotter via the serial port.

The operations for changing tools and setting the milling/drilling depth are repeated. Proceed as described for the first production phases.

Selecting fourth production phase:



Note: In this production phase, the circuit board is cut out of the base material. During this operation, pay attention to the cutting depth of the milling tool used here. (!)In this particular case(!) adjust the milling depth visually! If required, in the same manner as adjusting the drilling depth. Here, it is important that the cutter cut through the entire thickness of the base material without cutting deeply into the drilling subsurface!

- › Select the production phase **Cutting outside** on the function bar in the list box **PRODUCTION PHASE**.

Selecting data:

- › Select **All+** to select all data.



Danger! Activating one of the following buttons on the function bar, sets the connected circuit board plotter in motion! The danger of pinching and crushing exists!

Ensure that no one can enter the hazard area of the circuit board plotter during the operating phases controlled by *BoardMaster* or come into contact with the tools!

Starting milling operation for selected production phase:



Switch on the vacuum!



- › Click **Start** on the function bar.

The selected data for the current production phase are transferred to the circuit board plotter via the serial port.

The operations for changing tools and setting the milling/drilling depth are repeated. Proceed as described for the first production phases.



Note: Observe that it is always necessary to switch the auto motor function back on before proceeding after any adjustment of the drilling or milling depth!

- › When the production phase “Cutting outside” has been completed, move the circuit board plotter to the **PAUSE** position.

The double-sided circuit board is now finished. It can be broken out of the base material carefully. If you want to process the data for other production phases (dispensing, milling inner layers of a multiple layer

board, etc.), follow the instructions above in the same manner for these phases. For this purpose, read the corresponding chapter in the Manual.

6.0 Introduction to the Basic Functions of the ProtoMat H100

With this chapter we want to show step by step the principal procedure for the prototype production of a double-sided unprinted PCB by means of *BoardMaster* specially when using the *ProtoMat H100*. If you use a different circuit board plotter than the *ProtoMat H100* then please read chapter „Introduction to Basic Functions“ on page 32! Just follow the instructions and within a short time you will be familiar with the basic work procedure with *BoardMaster* and your circuit board plotter:

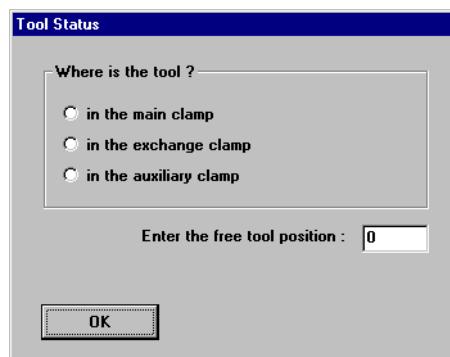
- › First switch on the machine at the main switch (see machine manual)!

Start *BoardMaster*:

- › Click once on the entry **BOARDMASTER 5.0** in the program group **LPKF LASER & ELECTRONICS** in the **START** menu or double click the **BOARDMASTER 5.0** icon on your desktop in order to start *BoardMaster*.

The following message appears:

Figure 21: Tool Status



Click on the correct position. If there is not yet any tool within the machine or if the tool magazine is occupied, do not click on any of the three possibilities, only click on **OK**. If there is a tool at any of the three positions, click on the position and enter the tool position below at which the tool is properly entered in the tool magazine.

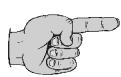
When the machine is first put into operation there will not be a tool present. Programming and preparation of the tool magazine will be dealt with later in this introduction. In this case, too, just click on OK.

Configuring *BoardMaster*:

BoardMaster can only communicate correctly with the circuit board plotter when *BoardMaster* addresses the correct interface of the PC and when this interface is correctly adjusted.

- › If this is not already done, define the serial interface by selecting menu **CONFIGURATION** and there the entry **INTERFACE...**, check and if necessary adapt the values correspondingly (see chapter „Serial Interface“ on page 71).

- › If necessary, check the settings of the serial interface in the **WIN-DOWS- SYSTEM CONTROL** under **System Devices Manager Connections**. Necessary setting parameters are shown in figure 54 on page 72, they depend on the type of circuit board plotter that is connected.



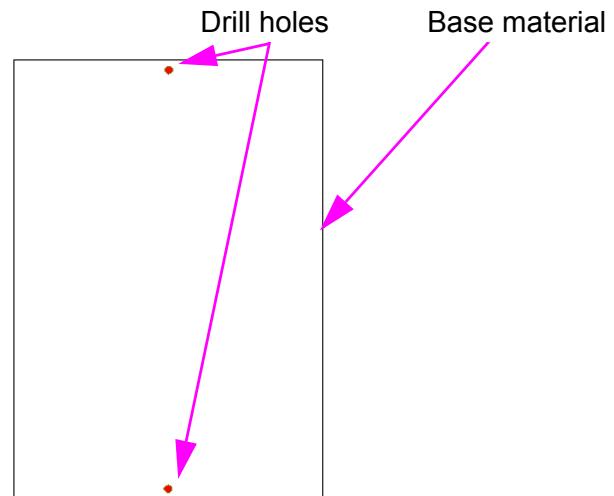
Note: Close the **BoardMaster** program after control and any configuration of the interface adjustment before continuing with this introduction!

- › Click on the **BOARDMASTER 5.0** symbol under **PROGRAMS - LPKF50** in the **START** menu or double-click on the **BOARDMASTER 5.0** symbol on your **Desktop** in order to start **BoardMaster**.
- › Click on the **MOVE TO ... - PAUSE** in the menu bar to move the circuit board plotter to the pause position.

Preparing the base material:

- › Now use, for example, an upright drilling machine to drill a 3 mm hole in the middle of both short sides at 5 mm distance away from the edge (see following figure):

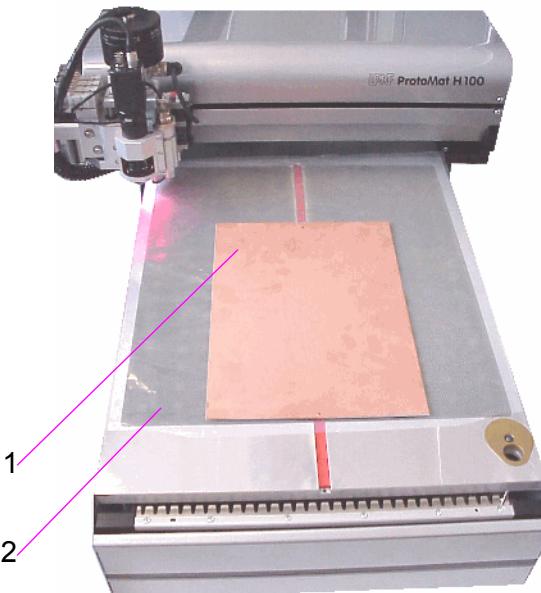
Figure 22: Drill holes in the base material



Putting on the base material:

- › Now put the base material on the pins in the area of the free internal surface (see following figure):
- › Put one of the film masks contained in the delivery on the honeycomb surface so that this surface is fully covered, except for the free internal surface for the base material (see figure below).

Figure 23: Material and film mask



1- Base material

2- The whole surface marked in dark gray (honeycomb material) must be covered by the film



Note: For *ProtoMat H100* machines the tools must be allocated to the tool magazine before milling. The tools must, of course, also be inserted in the tool magazine. This work step is postponed on purpose as *BoardMaster* can later display which tools are really needed for the corresponding job after the data are read in and prepared.

In order to be able to process data that are prepared using *CircuitCAM* or a similar software, they must first be imported into *BoardMaster*.



For those who are so far unfamiliar with the LPKF milling technology it is helpful to have the base material that is actually processed visibly displayed on the screen. To do this, you can determine this area. The determination has no influence on the course of the production, it is merely an assistance for the view. In case of need, proceed as follows:

Determining the view of the material size:

Determine the size of the base material that is used by reading chapter "Defining the Base Material Size" on page 85 and using the method **Determining the size by moving the machining head** described there. Then continue work from here.

Importing production data:

The „work instruction“ for *BoardMaster* which determines the way in which the base material is processed is contained in the production data. The data is prepared by *CircuitCAM*, for example. It must be imported first:

You can import LMD production data prepared by software *CircuitCAM* (e.g. TUTOR Fiducial.LMD) or HP-GL project files already prepared by *BoardMaster*. In the following we will import a file in LMD format (TutorFiducial.lmd).

- › Import the file TutorFiducial.LMD by clicking in menu **FILE** to the sub-menu **IMPORT** and there on entry **LMD or LPR...**. There you can select a file (e.g. „TutorFiducial.LMD“). This file is located in the directory LPKF50\Data\.

Allocating tools:

In order for *BoardMaster* „to know“ which tool is to be used for each individual production phase (milling, drilling of different sizes, engraving, and so on), a tool must be allocated to each production phase. This is usually done by *BoardMaster*, ...this is also the case with the import of Tutor.lmd. If you have a HPGL file in process, you must do this manually. In this case please read chapter "Assigning Tools" on page 90 first before continuing work here.

- › If you work with a HP-GL file. Allocate the corresponding tools/phases to the imported production data or projects, respectively (**PROCESSING-MATERIAL ALLOCATION**). If not, continue with the next working step.

Placing production data:

It is now possible to place the imported production data anywhere on the base material where they are to be milled later.

- › Place the imported production data or projects by going to menu **PROCESSING** and selecting entry **PLACING...** or click on the button  in the function bar. Then you can move the mouse to the image of the production data and move these by keeping the mouse key pressed.

Saving a job:

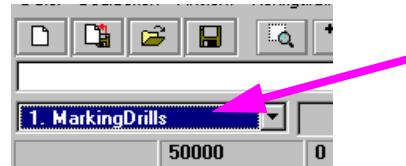
- › Having placed all projects, store the job by selecting menu **FILE** and entry **SAVE** to store the job under any name of your choice.

Selecting first production phase:

Each production phase, like „milling the solder side“ (Milling Bottom) must be selected individually and prepared for processing (inserting the correct tool and so on). Now start with the first production phase:

- › First check whether in the function bar in the list field **PRODUCTION STEP (see figure below)** the production phase **Marking Drills** is selected. If this is not the case, select it.

Figure 24: List field „Production Phase“



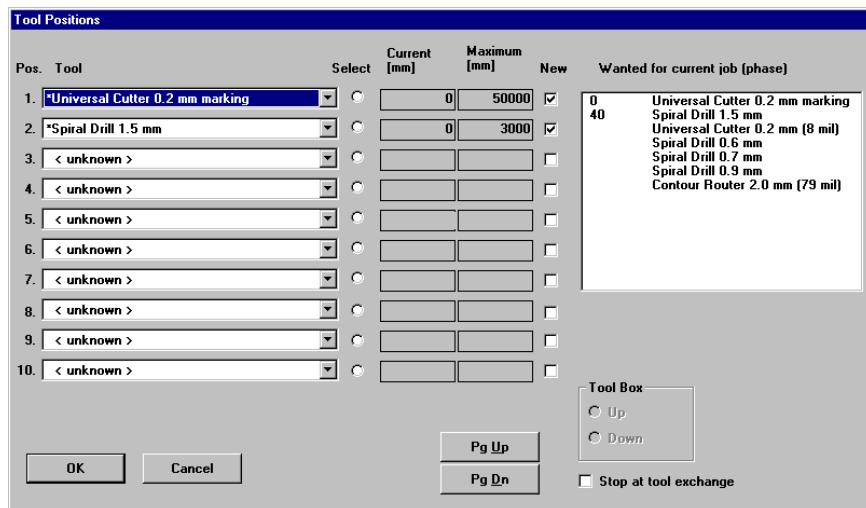
Configuring tools for automatic tool change:

- › Configure the tool positions by clicking with the right mouse key on the list field **TOOL** in the function bar (or button ).
- › Click on the radio button „Lift Magazine“..
The tool magazine is lifted so that the tools can be inserted in the magazine.

In the current window on the right you see the tools required for this job. These must be inserted in the tool magazine as follows:

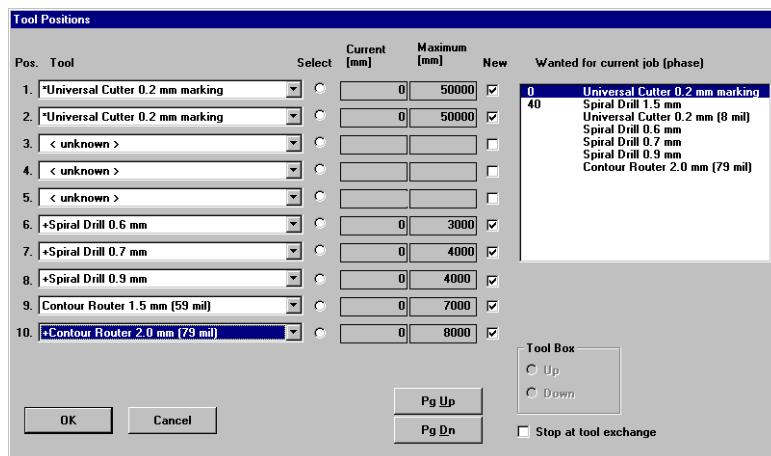
- › Now you manually set the „UniversalCutter 0.2 mm (marking)“ on position1 (see following figure):

Figure 25: Tool magazine



- › Now click on the button at the side to open the „Pos.tool“- window of position 1, and select the tool „UniversalCutter 0.2 mm“.
- › Proceed in the same way for all other tools. At the end the window with the listed tools could look like this:

Figure 26: Listed tools



Now the tool magazine is equipped and programmed for the job.

- › Click on the radio button **LOWER MAGAZINE**.
- › Click on **OK**.
- › Save the data as job by clicking on **SAVE FILE**.

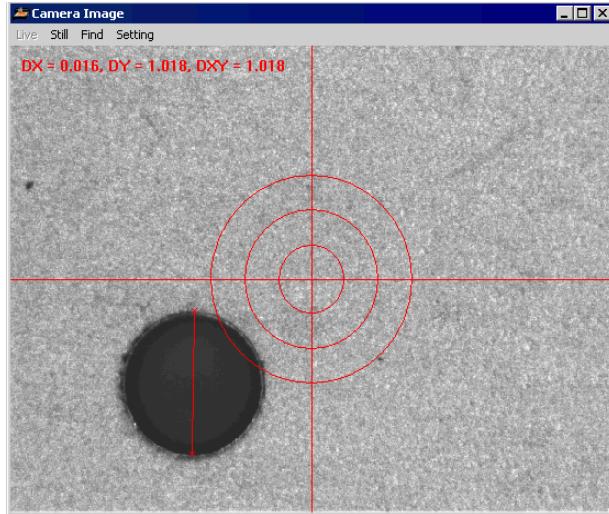
6.1 Learning Fiducial

Here the image processing software for the recognition of fiducials is calibrated. Fiducials are learnt and the scale is adapted. For the H100 circles or drill holes, respectively, can be used as fiducials. Considering the available camera image area, drill holes with a diameter of 1.5mm are especially favourable.

For the calibration proceed as follows:

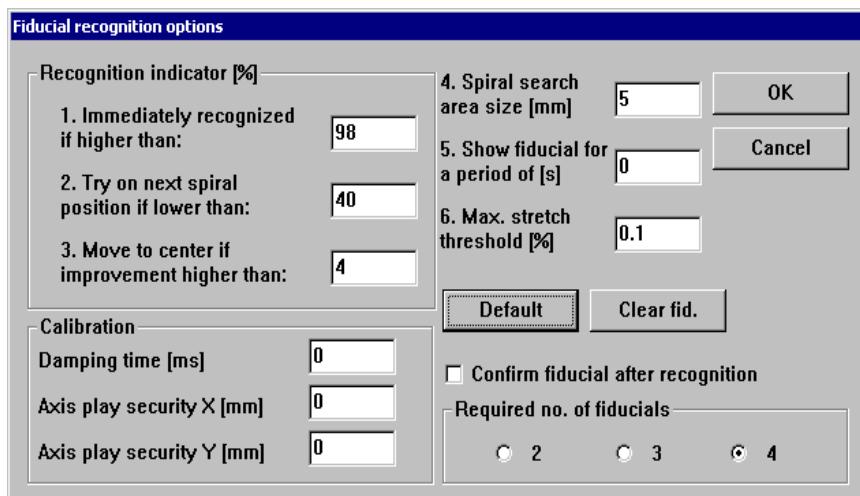
- › Choose a 1.5 mm drill (see "Manual Tool Change" on page 102) and drill a hole on the free area on the basis material.
- › Move the camera directly over the hole (see following image). To do this, use function "Camera >> Head" from the menu "Move to".

Figure 27: Drill hole in camera field



- › Open the dialog **FIDUCIALS** from menu **CONFIGURATION**.

Figure 28: Settings fiducial recognition



Explanation of the settings:

IMMEDIATELY RECOGNIZED IF HIGHER THAN

The fiducial is considered as immediately recognized if the percentage recognition is higher than the entered value. In this case it is not tried to get an improved result. If the value is smaller, the detected center of the fiducial is moved to the center of the camera image to perform a further recognition.

TRY ON NEXT SPIRAL POSITION IF LOWER THAN

When the recognition is lower than the entered value, the next position in the search area is moved to. The search area is traversed starting from the middle in a square-shaped and helical way. The distance between the search positions is selected such that the whole search area is covered.

MOVE TO CENTER IF IMPROVEMENT IS HIGHER THAN

This parameter is connected to „Immediately recognized if higher than“. If an improvement higher than the entered value is achieved by moving the fiducial to the center of the image, then another displacement is performed. At each recognition the center of the fiducial is determined again, and used when another displacement takes place. This displacement and recognition is continued until the improvement is lower than the entered value, or the value for „Immediately recognized if higher than“ is reached.

SPIRAL SEARCH AREA SIZE

This defines the area in which a fiducial is searched for. This area is checked in a helical way, starting from the center of the fiducial in the LMD data. The area should not be defined larger than 2 mm as the search process may then take a very long time.

SHOW FIDUCIAL FOR

This determines for how many seconds each fiducial is shown in the camera image after a successful recognition before the next fiducial to be searched for is moved to.

MAX. STRETCH THRESHOLD

During fiducial recognition the distances between the recognized fiducials are detected. If the difference of the detected fiducials and the fiducials of the LMD data is too big, then the alignment will not take place. A corresponding error message is displayed. The entered value determines the maximum percentage difference.

DAMPING TIME

The value must be increased when the machine vibrates heavily during the fiducial recognition, thus increasing the accuracy.

SECURITY

No adjustments are to be made here.

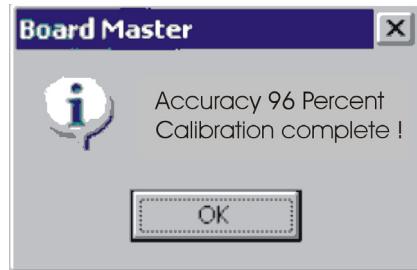
DEFAULT

A click on the button **DEFAULT** sets all settings back to the original values. Thus all values are set as after the start of the program.

- › To start, press the button **CALIBRATE** in the static field.

If the calibration was successful, then BoardMaster displays the following message.

Figure 29: Fiducial recognition



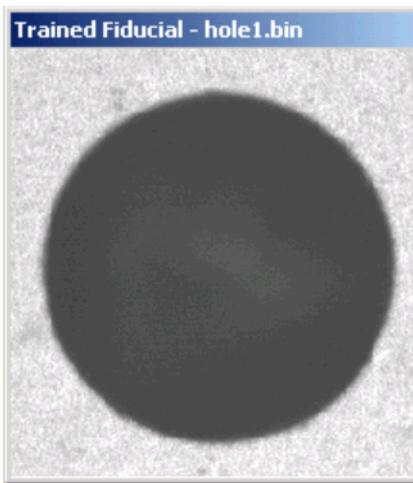
- › Confirm the message by clicking on **OK**.

There may be several reasons if the calibration was not successful, which can be recognized through the corresponding *BoardMaster* message:

Error	Correction
Brightness too low!	Increase value for brightness. Close <i>BoardMaster</i> and start grabber software "IdsDemo". An optimum value is 150 (see also installation frame grabber card)
Image contrast too low	Increase value for contrast. Close <i>BoardMaster</i> and start grabber software "IdsDemo". An optimum value is 300 (see also installation frame grabber card).
Hole not round or too much burr.	Drill again with new tool. Speed for lowering head is too high. Decrease the speed for lowering by adjusting the throttle valve (see machine manual)

The representation of the hole to be measured should be as shown in the following figure.

Figure 30:



Here fiducial recognition is finished.

Marking data:

It is possible to process only parts of this production phase by marking them correspondingly. Therefore the required areas which are to be processed must be selected first. As here the whole production phase is to be processed, all data of this phase are marked.

- › Select **All+** for marking all data.



Danger! Activating the following button in the function bar causes the circuit board plotter to move, danger of crushing! Make sure no persons come within the travel area of the circuit board plotter or come in contact with the tools.

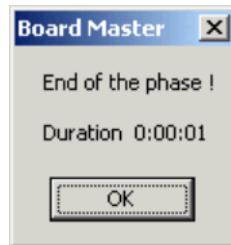
Starting the milling process of the selected production phase:



- › Click on the **Start** button in the function bar to send the marked data of the current production phase via the serial interface to the circuit board plotter.

*Production phase „Marking drills“ is being processed.
The following message appears:*

Figure 31:

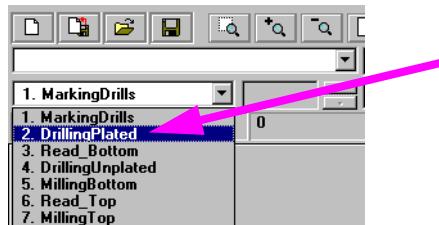


› Click on **OK**.

Select a second production phase:

- › In the function bar in the list field **PRODUCTION PHASE** select the production phase **DrillingPlated** (see figure below).

Figure 32: List field „Production phase“



Mark data:

- › Select **All+** for marking all data.



Danger! Activating the following button in the function bar causes the circuit board plotter to move, danger of crushing! Make sure no persons come within the travel area of the circuit board plotter or come in contact with the tools during production phases.

Start

- › Click on **Start** in the function bar.

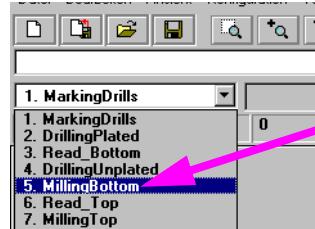
The production phase is processed.

Now continue to follow the drill request by inserting the tool (drill) upon request and subsequent clicking on **OK** until the production phase is completely processed.

Select third production phase:

- › In the function bar and in the list field **PRODUCTION PHASE** select the phase **MillingBottom**.

Figure 33: List field „Production phase“



Mark data:

- › Select **All+** for marking all data.



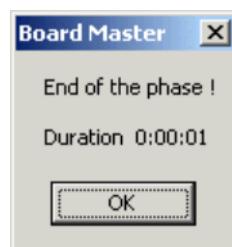
Danger! Activating the following button in the function bar causes the circuit board plotter to move, danger of crushing! Make sure no persons come within the travel area of the circuit board plotter or come in contact with the tools during production phases.

Starting the milling process of the selected production phase:

- › In the function bar click on **Start Stop**.

Data of the current production phase is sent to the circuit board plotter via the serial interface. When processing is finished, the following window appears:

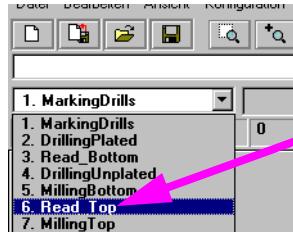
Figure 34:



Select fourth production phase:

- › First turn the base material. To do this, lift it and turn it around its longitudinal axis so that the former bottom side is now on top. Make sure the base material is well positioned on the reference pins.
- › In the function bar and in the list field **PRODUCTION PHASE** select the phase **ReadTop**.

Figure 35: List field „Production phase“



- › Select **All+** to mark all data.

- › Click on **Start Stop** in the function bar.

The machine automatically traverses to all three fiducials.

After the successful fiducial recognition the main screen is again displayed. You can now see three little crosses on the fiducials.

Select new production phase:

- › Now select production phase **MillingTop**.
- › Click on **ALL+**.
- › Click on **START**.
- › When the production phase is processed, move the head to **MOVE TO/PAUSE**.

P



Note: Altogether the following production work steps must be processed in order to produce a double-sided PCB:

- **Marking Drills**
- **Drilling Plated**
- **Milling Bottom**
- **Read Top**
- **Milling Top**
- **Cutting Outside**

Note for the Read phases:



A Read-Phase must be performed each time when it was necessary to remove the PCB from the machine base plate (e.g. during multilayer production), e.g. „Read-Bottom“ after the PCB was through-plated.

When you have performed the previous work steps, you must now process the production phase **Cutting Outside**.

The work steps now are repeated. Proceed as described for the first production phases. You must only select the production phase Cutting Outside and process it according to the previous procedure. Then you have produced your first PCB.

Select fourth production phase:

During this production phase the board is milled out of the base material.

- › In the function bar and in the list field **PRODUCTION PHASE** select the phase **CuttingOutside**.

Mark data:

- › Select **All+** to mark all data.



Danger! Activating the following button in the function bar causes the circuit board plotter to move, danger of crushing. Make sure no persons come within the travel area of the circuit board plotter or come in contact with the tools during production steps.

Start the milling process of the selected production phase:

- › Click on **Start** in the function bar.

The selected data of the current production phase are sent to the circuit board plotter via the serial interface.

- › When the production phase **CUTTING OUTSIDE** is completely processed, move the circuit board plotter to the **PAUSE** position.

The double-sided board is now finished. It may be broken out of the base material with due care. If you want to process the data of other production phases (milling of inner layers of a multilayer and so on) then follow the description above in the same way for these phases. Read the corresponding chapters in the manual.

7.0 Introduction to the Basic Functions of the ProtoMat S62

With this chapter we want to show step by step the principal procedure for the prototype production of a double-sided unprinted PCB by means of *BoardMaster* specially when using the **ProtoMat S62**. If you use a different circuit board plotter than the **ProtoMat S62** then please read chapter „**Introduction to Basic Functions**“ on page 32! Just follow the instructions and within a short time you will be familiar with the basic work procedure with *BoardMaster* and your circuit board plotter:

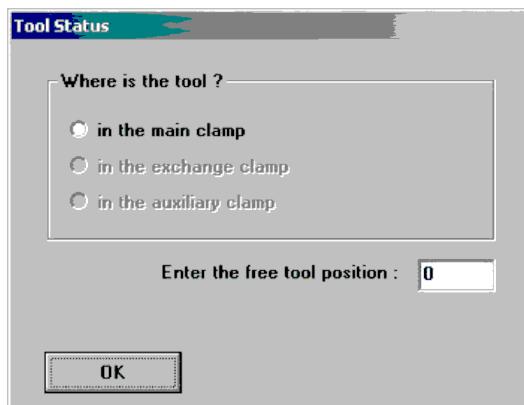
- › First switch on the machine at the main switch (see machine manual)!

Start BoardMaster:

- › Click once on the entry **BOARDMASTER 5.0** in the program group **LPKF LASER & ELECTRONICS** in the **START** menu or double click the **BOARDMASTER 5.0** icon on your **Desktop** in order to start *BoardMaster*.

The following message appears:

Figure 36: Tool Status



Click on the correct position. If there is not yet any tool within the machine or if the tool magazine is occupied, only click on **OK**. If there is a tool at any of the three positions, click on the position and enter the tool position below at which the tool is properly entered in the tool magazine.

When the machine is first put into operation there will not be a tool present. Programming and preparation of the tool magazine will be dealt with later in this introduction. In this case, too, just click on OK.

Configuring BoardMaster:

BoardMaster can only communicate correctly with the circuit board plotter when *BoardMaster* addresses the correct interface of the PC and when this interface is correctly adjusted.

- › If this is not already done, define the serial interface by selecting menu **CONFIGURATION** and there the entry **INTERFACE...**, check and if necessary adapt the values correspondingly (see chapter „**Serial Interface**“ on page 71).

- › If necessary, check the settings of the serial interface in the **WIN-DOWS- SYSTEM CONTROL** under **System Devices Manager Connections**. Necessary setting parameters are shown in figure 54 on page 72, they depend on the type of circuit board plotter that is connected.



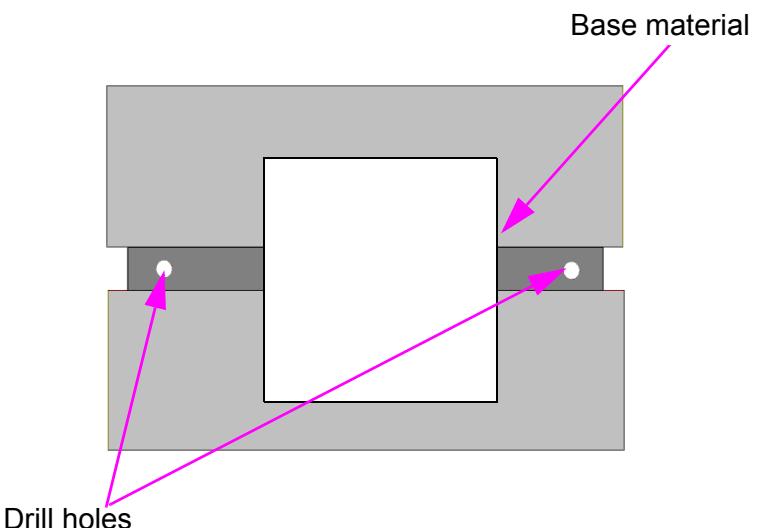
Note: Close the **BoardMaster** program after control and any configuration of the interface adjustment before continuing with this introduction!

- › Click once on the entry **BOARDMASTER 5.0** in the program group **LPKF LASER & ELECTRONICS** in the **START** menu or double click the **BOARDMASTER 5.0** icon on your **Desktop** in order to start **BoardMaster**.
- › Click on the **MOVE TO ... - PAUSE** in the menu bar to move the circuit board plotter to the pause position.

Preparing the base material:

- › Now use, for example, an upright drilling machine to drill a 3 mm hole in the middle of both short sides at 5 mm distance away from the edge (see following figure):

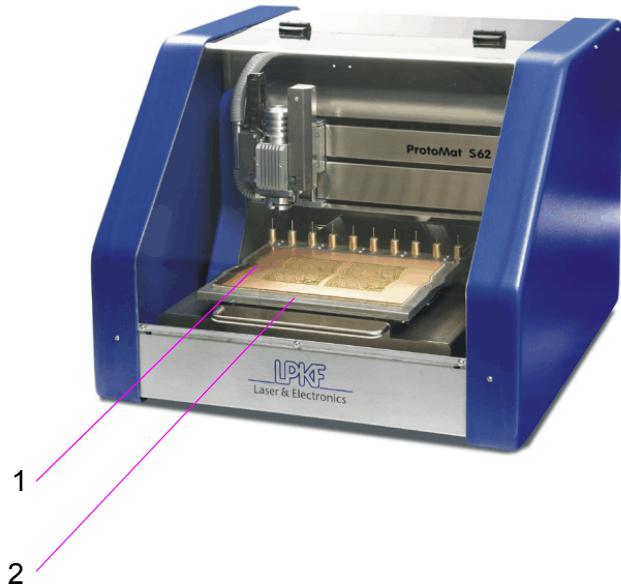
Figure 37: Drill holes in the base material



Putting on the base material:

- › Now put the base material on the pins in the area of the free internal surface (see following figure):
- › Put one of the film masks contained in the delivery on the honeycomb surface so that this surface is fully covered, except for the free internal surface for the base material (see figure below).

Figure 38: Material and film mask



- 1- Base material
 2- The whole surface marked in white must be covered by the film



Note: For ProtoMat S62 machines the tools must be allocated to the tool magazine before milling. The tools must, of course, also be inserted in the tool magazine. This work step is postponed on purpose as BoardMaster can later display which tools are really needed for the corresponding job after the data are read in and prepared.

In order to be able to process data that are prepared using *CircuitCAM* or a similar software, they must first be imported into *BoardMaster*.



**For those who are so far unfamiliar with the LPKF milling technology it is helpful to have the base material that is actually processed visibly displayed on the screen.
 To do this, you can determine this area.
 The determination has no influence on the course of the production, it is merely an assistance for the view.
 In case of need, proceed as follows:**

Determining the view of the material size:

Determine the size of the base material that is used by reading chapter "Defining the Base Material Size" on page 85 and using the method **Determining the size by moving the machining head** described there. Then continue work from here.

Importing production data:

The „work instruction“ for *BoardMaster* which determines the way in which the base material is processed is contained in the production data. The data is prepared by *CircuitCAM*, for example. It must be imported first:

You can import LMD production data prepared by software *CircuitCAM* (e.g. TUTOR Fiducial.LMD) or HP-GL project files already prepared by *BoardMaster*. In the following we will import a file in LMD format (TutorFiducial.lmd).

- › Import the file TutorFiducial.LMD by clicking in menu **FILE** to the sub-menu **IMPORT** and there on entry **LMD or LPR...**. There you can select a file (e.g. „TutorFiducial.LMD“). This file is located in the directory LPKF50\Data\.

Allocating tools:

In order for *BoardMaster* „to know“ which tool is to be used for each individual production phase (milling, drilling of different sizes, engraving, and so on), a tool must be allocated to each production phase. This is usually done by *BoardMaster*, ...this is also the case with the import of Tutor.lmd. If you have a HPGL file in process, you must do this manually. In this case please read chapter "Assigning Tools" on page 90 first before continuing work here.

- › If you work with a HP-GL file. Allocate the corresponding tools/phases to the imported production data or projects, respectively (**PROCESSING-MATERIAL ALLOCATION**). If not, continue with the next working step.

Placing production data:

It is now possible to place the imported production data anywhere on the base material where they are to be milled later.

- › Place the imported production data or projects by going to menu **PROCESSING** and selecting entry **PLACING...** or click on the button  in the function bar. Then you can move the mouse to the image of the production data and move these by keeping the mouse key pressed.

Saving a job:

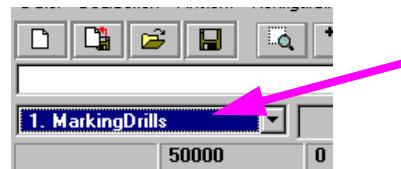
- › Having placed all projects, store the job by selecting menu **FILE** and entry **SAVE** to store the job under any name of your choice.

Selecting first production phase:

Each production phase, like „milling the solder side“ (Milling Bottom) must be selected individually and prepared for processing (inserting the correct tool and so on). Now start with the first production phase:

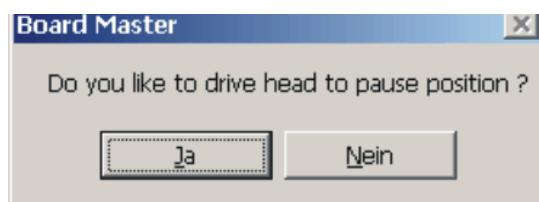
- › First check whether in the function bar in the list field **PRODUCTION STEP (see figure below)** the production phase **Marking Drills** is selected. If this is not the case, select it.

Figure 39: List field „Production Phase“



Configuring tools for automatic tool change:

- › Configure the tool positions by clicking with the right mouse key on the list field **TOOL** in the function bar (or button ).
- A message is displayed asking if the machining head is to be moved to the pause position.*

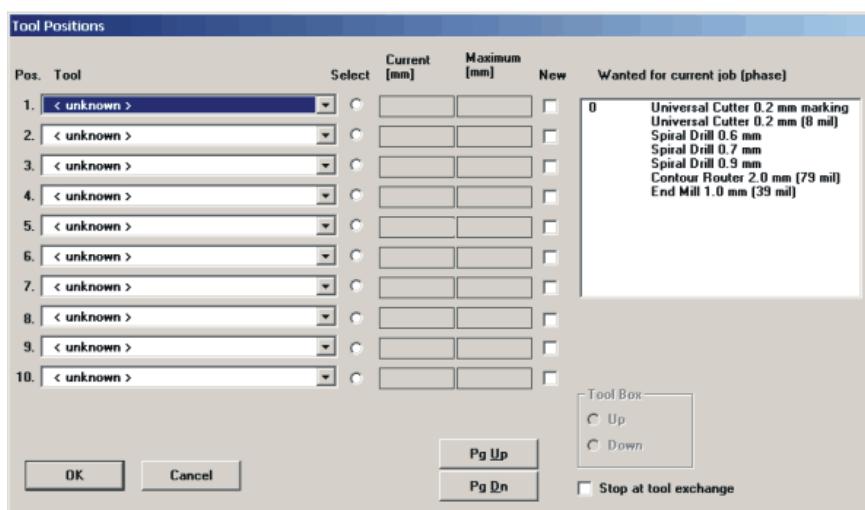


- › Confirm with Yes/Ja

In the current window on the right you see the tools required for this job. These must be inserted in the tool magazine as follows:

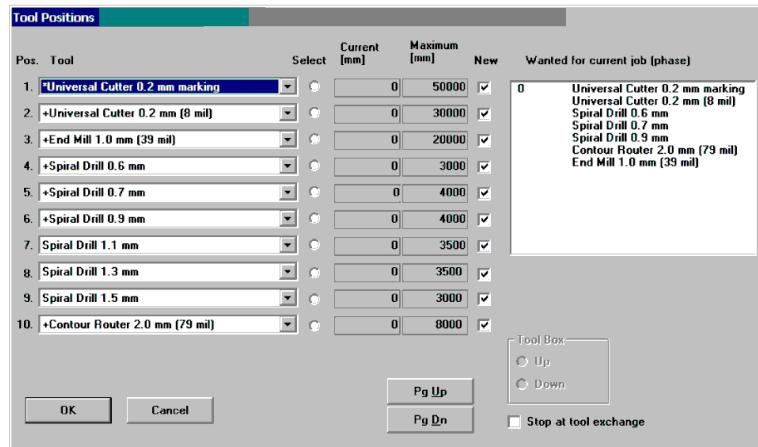
- › Now you manually set the „UniversalCutter 0.2 mm (marking)“ on position1 (see following figure):

Figure 40: Tool magazine



- › Now click on the button at the side to open the „Pos.tool“- window of position 1, and select the tool „UniversalCutter 0.2 mm“.
- › Proceed in the same way for all other tools. At the end the window with the listed tools could look like this:

Figure 41: Listed tools



Now the tool magazine is equipped and programmed for the job.

- › Click on the radio button **LOWER MAGAZINE**.
- › Click on **OK**.
- › Save the data as job by clicking on **SAVE FILE**.

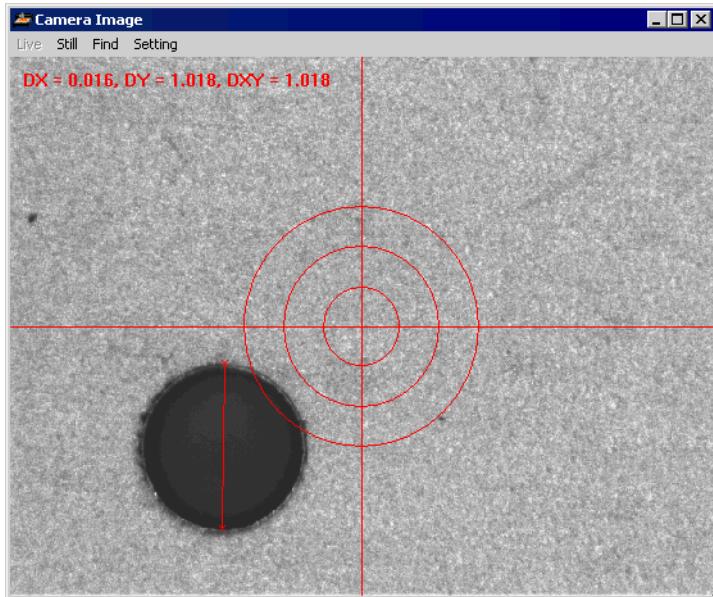
7.1 Learning Fiducial (Option)

Here the image processing software for the recognition of fiducials is calibrated. Fiducials are learnt and the scale is adapted. For the S62 circles or drill holes, respectively, can be used as fiducials. Considering the available camera image area, drill holes with a diameter of 1.5mm are especially favourable.

For the calibration proceed as follows:

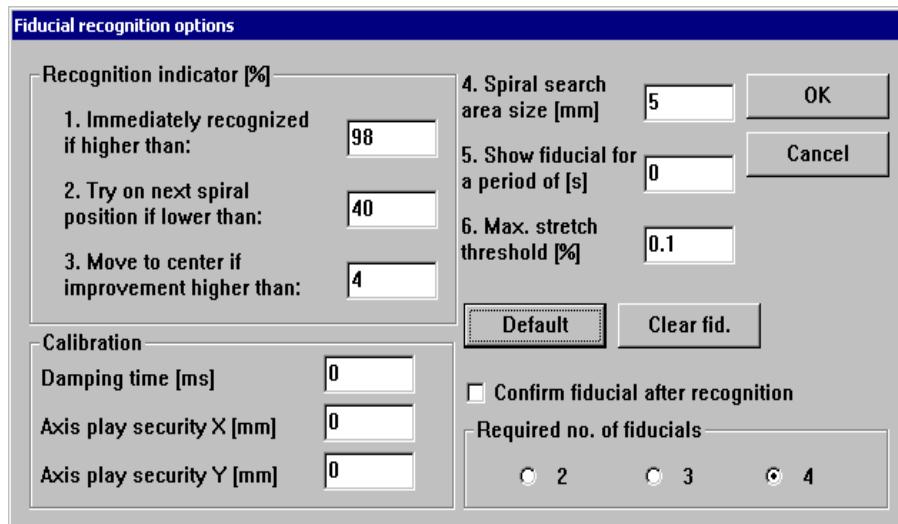
- › Choose a 1.5 mm drill (see "Manual Tool Change" on page 102) and drill a hole on the free area on the basis material.
- › Move the camera directly over the hole (see following image). To do this, use function "Camera >> Head" from the menu "Move to".

Figure 42: Drill hole in camera field



- › Open the dialog **FIDUCIALS** from menu **CONFIGURATION**.

Figure 43: Settings fiducial recognition



Explanation of the settings:

IMMEDIATELY RECOGNIZED IF HIGHER THAN

The fiducial is considered as immediately recognized if the percentage recognition is higher than the entered value. In this case it is not tried to get an improved result. If the value is smaller, the detected center of the fiducial is moved to the center of the camera image to perform a further recognition.

TRY ON NEXT SPIRAL POSITION IF LOWER THAN

When the recognition is lower than the entered value, the next position in the search area is moved to. The search area is traversed starting from the middle in a square-shaped and helical way. The distance between the search positions is selected such that the whole search area is covered.

MOVE TO CENTER IF IMPROVEMENT IS HIGHER THAN

This parameter is connected to „Immediately recognized if higher than“. If an improvement higher than the entered value is achieved by moving the fiducial to the center of the image, then another displacement is performed. At each recognition the center of the fiducial is determined again, and used when another displacement takes place. This displacement and recognition is continued until the improvement is lower than the entered value, or the value for „Immediately recognized if higher than“ is reached.

SPIRAL SEARCH AREA SIZE

This defines the area in which a fiducial is searched for. This area is checked in a helical way, starting from the center of the fiducial in the LMD data. The area should not be defined larger than 2 mm as the search process may then take a very long time.

SHOW FIDUCIAL FOR

This determines for how many seconds each fiducial is shown in the camera image after a successful recognition before the next fiducial to be searched for is moved to.

MAX. STRETCH THRESHOLD

During fiducial recognition the distances between the recognized fiducials are detected. If the difference of the detected fiducials and the fiducials of the LMD data is too big, then the alignment will not take place. A corresponding error message is displayed. The entered value determines the maximum percentage difference.

REQUIRED NO. OF FIDUCIALS

Here is determined how many fiducials must be recognized so that the alignment can be performed. If the number of recognized fiducials is lower, then an error message is displayed. If the number of required fiducials is set to 3, but 4 fiducials are present in the data and 4 fiducials have also been recognized, then the alignment after 4 fiducials is used.

DAMPING TIME

The value must be increased when the machine vibrates heavily during the fiducial recognition, thus increasing the accuracy.

SECURITY

No adjustments are to be made here.

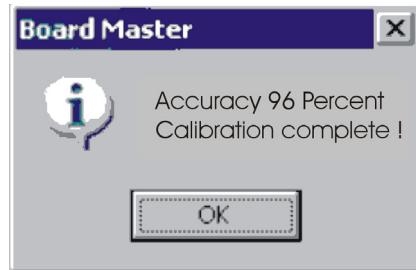
DEFAULT

A click on the button **DEFAULT** sets all settings back to the original values. Thus all values are set as after the start of the program.

› To start, press the button **CALIBRATE** in the static field.

If the calibration was successful, then BoardMaster displays the following message.

Figure 44: Fiducial recognition



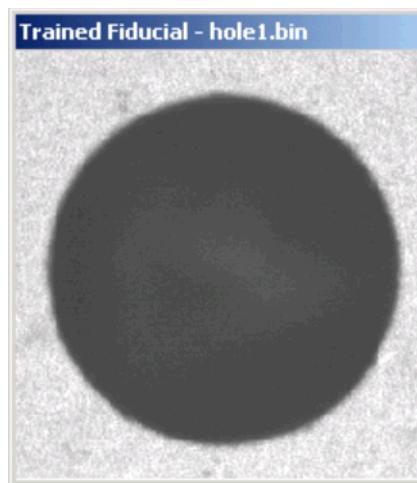
- › Confirm the message by clicking on **OK**.

There may be several reasons if the calibration was not successful, which can be recognized through the corresponding *BoardMaster* message:

Error	Correction
Brightness or image contrast too low!	Adjust setting at the objective and adjust brightness.
Hole not round or too much burr.	Drill again with new tool. Speed for lowering head is too high. Decrease the speed for lowering by adjusting the throttle valve (see machine manual)

The representation of the hole to be measured should be as shown in the following figure.

Figure 45:



Here fiducial recognition is finished.

Marking data:

It is possible to process only parts of this production phase by marking them correspondingly. Therefore the required areas which are to be processed must be selected first. As here the whole production phase is to be processed, all data of this phase are marked.

- › Select **All+** for marking all data.



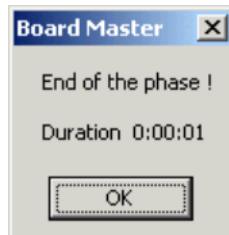
Danger! Activating the following button in the function bar causes the circuit board plotter to move, danger of crushing! Make sure no persons come within the travel area of the circuit board plotter or come in contact with the tools.

Starting the milling process of the selected production phase:

- › Click on the **Start** button in the function bar to send the marked data of the current production phase via the serial interface to the circuit board plotter.

*Production phase „Marking drills“ is being processed.
The following message appears:*

Figure 46:

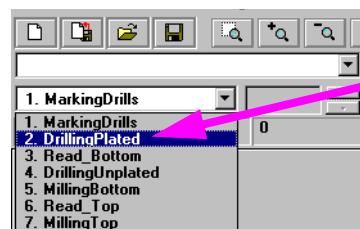


- › Click on **OK**.

Select a second production phase:

- › In the function bar in the list field **PRODUCTION PHASE** select the production phase **DrillingPlated** (see figure below).

Figure 47: List field „Production phase“



Mark data:

- › Select **All+** for marking all data.



- › Click on **Start** in the function bar.

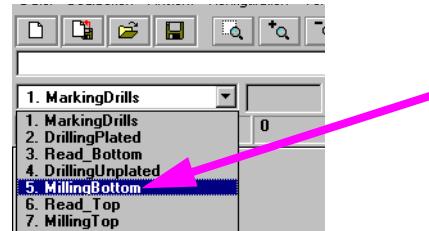
The production phase is processed.

Now continue to follow the drill request by inserting the tool (drill) upon request and subsequent clicking on **OK** until the production phase is completely processed.

Select third production phase:

- › In the function bar and in the list field **PRODUCTION PHASE** select the phase **MillingBottom**.

Figure 48: List field „Production phase“



Mark data:

- › Select **All+** for marking all data.

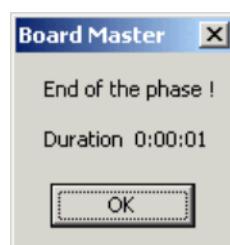
Starting the milling process of the selected production phase:



- › In the function bar click on **Start**.

Data of the current production phase is sent to the circuit board plotter via the serial interface. When processing is finished, the following window appears:

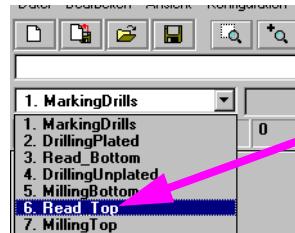
Figure 49:



Select fourth production phase:

- › First turn the base material. To do this, lift it and turn it around its longitudinal axis so that the former bottom side is now on top. Make sure the base material is well positioned on the reference pins.
- › In the function bar and in the list field **PRODUCTION PHASE** select the phase **ReadTop**.

Figure 50: List field „Production phase“



- › Select **All+** to mark all data.

- › Click on **Start** in the function bar.

The machine automatically traverses to all three fiducials.

After the successful fiducial recognition the main screen is again displayed. You can now see three little crosses on the fiducials.

Select new production phase:

- › Now select production phase **MillingTop**.
- › Click on **ALL+**.
- › Click on **START**.
- › When the production phase is processed, move the head to **MOVE TO/PAUSE**.

 **Note: Altogether the following production work steps must be processed in order to produce a double-sided PCB:**

- **Marking Drills**
- **Drilling Plated**
- **Milling Bottom**
- **Read Top (only with camera option)**
- **Milling Top**
- **Cutting Outside**



Note for the Read phases:

A Read-Phase must be performed each time when it was necessary to remove the PCB from the machine base plate (e.g. during multilayer production), e.g. „Read-Bottom“ after the PCB was through-plated.

When you have performed the previous work steps, you must now process the production phase **Cutting Outside**.

The work steps now are repeated. Proceed as described for the first production phases. You must only select the production phase Cutting Outside and process it according to the previous procedure. Then you have produced your first PCB.

Select fourth production phase:

During this production phase the board is milled out of the base material.

- › In the function bar and in the list field **PRODUCTION PHASE** select the phase **CuttingOutside**.

Mark data:

- › Select  to mark all data.

Start the milling process of the selected production phase:

- › Click on  in the function bar.

The selected data of the current production phase are sent to the circuit board plotter via the serial interface.

- › When the production phase **CUTTING OUTSIDE** is completely processed, move the circuit board plotter to the **PAUSE** position. 

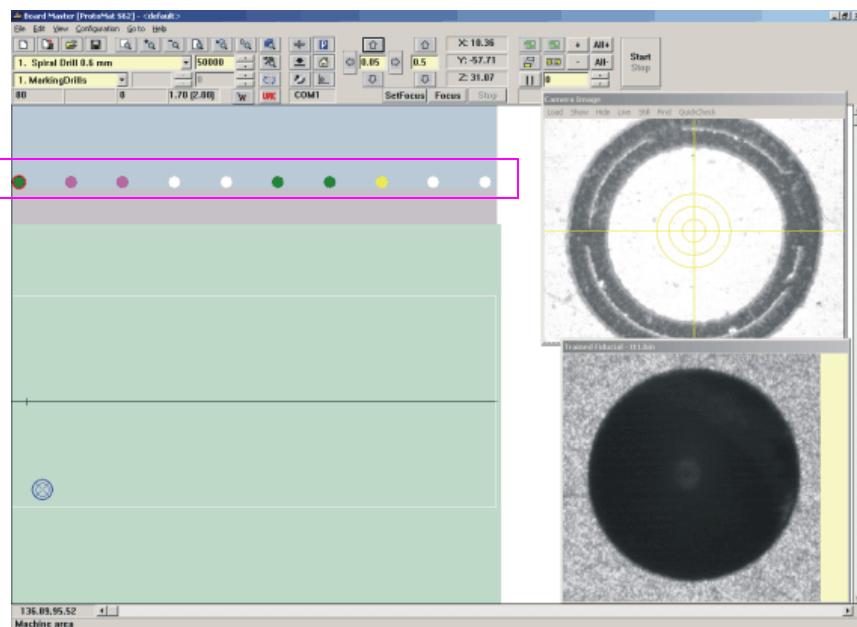
The double-sided board is now finished. It may be broken out of the base material with due care. If you want to process the data of other production phases (milling of inner layers of a multilayer and so on) then follow the description above in the same way for these phases. Read the corresponding chapters in the manual.

7.2 Additional Functions

7.2.1 Tool Holder

Tool holders that are mounted at the S62 machine are represented on the screen in the following way:

Figure 51:



The dots below the menu and function bars (see rectangle) represent the tool holders of the machine: The color represents the kind of tool in the holder.

Green dot:	drill
Orange dot:	universal milling cutter /micro-milling cutter
Blue dot:	RF endmill
Violet dot:	end mills
Yellow dot:	contour cutter
Light green dot:	Endmill long

Dot displayed with a red ring around it:
Tool position reserved - tool is presently in the collet

Dot displayed in white by the software:
Tool holder is free

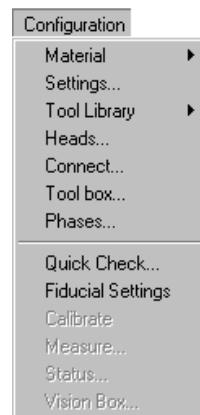
8.0 Menu Bar

This chapter introduces the menu functions in *BoardMaster* in their typical sequence of use.

8.1 CONFIGURATION Menu

This menu contains all functions required for configuration of *BoardMaster* as well as the connected circuit board plotter:

Figure 52: Configuration menu



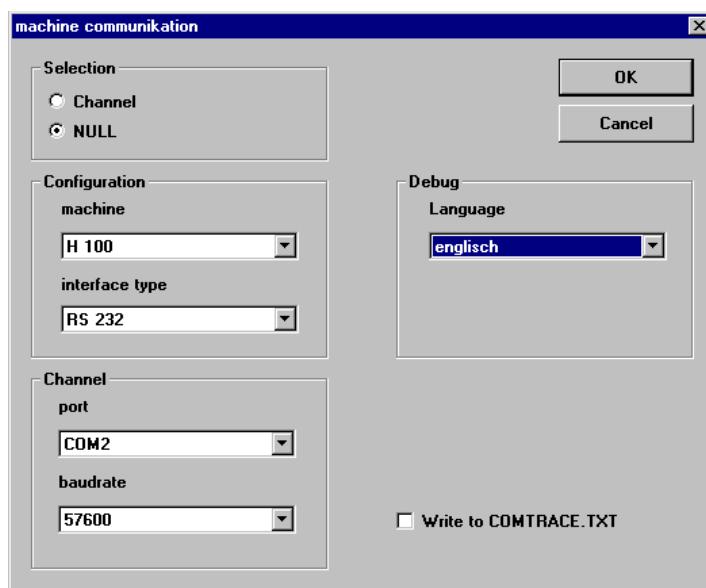
8.1.1 Serial Interface

An interface is preset by the manufacturer in the INI-file. If the machine is to be connected to a different interface at your computer (COM2 instead of COM1) or if you used version *BoardMaster* 4.0 or an older version, than *BoardMaster* will first start without communication build-up. The interface and its configuration can then be selected later in *BoardMaster* under „configuration -> interface“. It is important that the correct configuration is selected which corresponds to the connected ProtoMat machine. Otherwise the communication will not be built up correctly.



Note: When the communication has been successfully established, it is absolutely necessary to terminate *BoardMaster* for a short moment and then restart it so that the modified settings are written in the INI file.

Figure 53: Machine communication



Machine

Selectable machine configurations.

H100 - 2003:-

ProtoMat H100 built in 2003

H100 -2004:-

ProtoMat H100 built in 2004

H60:

ProtoMat H60

S Series (Firmware 2.3.3):

ProtoMat S62

SMCU_2AX:

ProtoMat 91s, 91s/Vs, 92s, C20, C30, C30s, C40, C60, C100/HF, M30/s, M60, M100, L60, X60

SMCU_2AX Toolchange:

ProtoMt 95s, 95s/II

SMCU3AX:

ProtoMat D100, M60/3D

Virtual Machine:

Demo-Modus for offline operation

X60:

ProtoMat X60/II

X60 III: ProtoMat X60 / II

Interface

Usable communication ports of the control computer. Selectable are „RS 232“ or „USB“ (USB only for *ProtoMat* machines with LPKF motion.net™ controllers. A firmware update may be required)

Port

Here the PC connection is selected which is connected to the machine.

Baudrate

9600 or 57600, depending on type of connected *ProtoMat* machine.

Language

If an error occurs during operation, then *BoardMaster* gives necessary hints to the problem in a dialog. The language of the dialog may be set here.

Write to Comtrace.txt

The dialog between the PC and the machine via the serial interface can be written in a separate file to help error detection. The file produced is called „Comtrace.txt“ and is located in the main directory of *BoardMaster*, C:\Program Files\LPKF50\Bmaster.

The following table lists all parameters of the serial interface which can be set for the various circuit board plotters:

Figure 54: Interface parameters

Circuit board plotter	Baudrate	Data bits	Stop bits	Parity	Protocol	Fifo
LPKF 91 / 92 LPKF 101 LC, LC/VS, # HI-P and Automill	4800	8	1	none	Hard- ware	No
LPKF 91s / 92s ProtoMat 91s, 91s/VS, 92s*, 93s and 95s*# ProtoMat C20, C30*, C40, C60, C100/HF, M30*, M60 and X60	9600	8	1	none	Hard- ware	No
LPKF motion.net™ Controller	57600	8	1	none	Hard- ware	Yes
ProtoMat H100, H60, S62	57600	8	1	none	Hard- ware	Yes

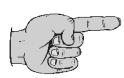
 **Note: When the ProtoMat S62 is used, the FIFO buffer must be switched on (see table above)!**

The adjustment of these parameters is done in the *Windows* system control.

Windows 2000/XP: System - Hardware - Device Manager
(Login as „Admin“!!!)

If the circuit board plotter is not correctly triggered after the start of the data transfer, check the connection between PC and plotter.

Also make sure that the parameters of the serial interface in the *Windows* system control match the parameters listed in the table.



Note: The cause of incorrect communication often is an incorrectly adjusted protocol of the serial interface. Make sure that the protocol set is *Hardware-Handshake* and not *XON/XOFF*.

8.1.2 Machine Settings

Select the entry **SETTINGS...** in the menu **CONFIGURATION** to open the following dialog box:

Figure 55: Machine parameter

Machine settings				
Name : <input type="text" value="ProtoMat S62"/>	<input checked="" type="checkbox"/> HF spindle			
Number of tool positions : <input type="text" value="10"/>	<input checked="" type="checkbox"/> Automotor			
	<input checked="" type="checkbox"/> Milling depth sens.			
Startup	<input checked="" type="checkbox"/> Tool box			
	<input checked="" type="checkbox"/> Vacuum table			
	<input checked="" type="checkbox"/> Camera			
	Vacuumtable height [mm]: <input type="text" value="13.5"/>			
	Switch off vacuum after [min]: <input type="text" value="0.5"/>			
Unit	<input checked="" type="radio"/> mm <input type="radio"/> inch			
Controller	<input type="radio"/> SMCU <input checked="" type="radio"/> SMCU II			
Maximum speed	Resolution [mm]	Null [mm]		
Rotation [1/min]: <input type="text" value="62000"/>	X <input type="text" value="0.001"/>	X <input type="text" value="0"/>		
Moving [mm/s]: <input type="text" value="110"/>	Y <input type="text" value="0.001"/>	Y <input type="text" value="0"/>		
Z speed [mm/s]: <input type="text" value="27"/>	Z <input type="text" value="0.001"/>	Z <input type="text" value="0"/>		
Home [mm]	Pause [mm]	Scale factor	Size [mm]	Corrections
X <input type="text" value="10"/>	X <input type="text" value="318.246"/>	X <input type="text" value="1"/>	X <input type="text" value="318.246"/>	Y Angle: <input type="text" value="0"/>
Y <input type="text" value="132"/>	Y <input type="text" value="325.725"/>	Y <input type="text" value="1"/>	Y <input type="text" value="325.725"/>	X-Flip Corr: <input type="text" value="0"/>
Z <input type="text" value="0"/>	Z <input type="text" value="0"/>	Z <input type="text" value="1"/>	Z <input type="text" value="46.466"/>	Y-Flip Corr: <input type="text" value="0"/>
				Sensor Corr. [mm]
				Drill offset [mm]: X <input type="text" value="0"/> Y <input type="text" value="0"/>

UNIT

Click on one of the two options to have the length, diameter coordinates and so on displayed either in inch or metrically.

NAME

This text field displays the type of circuit board plotter as it appears in the *BoardMaster* title bar. This serves only for information purposes and has no effect on the operation.

NUMBER OF TOOL POSITIONS

The number in this text field indicates the number of tool change positions. For the circuit board plotter *ProtoMat 95s* this is always 30, for the *ProtoLaser* always 23, for the circuit board plotter *LPKF Automill* always 7, and for all other circuit board plotters it is always 1.

SEND

Click on this button to send the command in the entry field to the left of the button to the circuit board plotter.

For this function it is not necessary to click first on the button **UNLOCK**.
For the command syntax please read the manual of the circuit board plotter.

ROTATION

The number in this text field indicates the maximum speed of rotation of the spindle of the circuit board plotter.

SPEED OF MOVING

The number in this text field indicates the maximum speed of movement of the circuit board plotter when the machining head is lifted.

RESOLUTION

The numbers in these two fields define the distance which the circuit board plotter moves in X or Y direction at one step of the stepping motor. Do not change these values under any circumstances as otherwise the correct scaling of the output cannot be guaranteed.

Sensor correction [mm]

This value (in millimeters) compensates the installation position of the sensor with respect to the tool measurement. This value is part of the H100 factory settings and it is stored in the ini-file.

Automotor

If there is a check mark the machining motor is switched before start of a production phase and it is switched off when the phase is finished.

Angle correction

Compensates for a shearing angle that developed subsequently (see page 5) between the axes. This setting may only be made under the instructions of the Support Department of the LPKF AG.

Flip correction

This compensates for an error that occurs during turning of the PCB-. This setting should only be made under instruction of the Support Department of the LPKF AG.

Milling depth sensor

This function activates the measurement of the surface milling tools (only H100).

All parameters specific to a plotter are defined in this dialog field. They are stored in an initialisation file (*.INI). LPKF offers two types of control for the circuit board plotters:

SMCU II-control

Control type SMCU II for ProtoMat H100, ProtoMat X60 (machines from year 2004 on), ProtoMat H60, ProtoMat S62

SMCU I-control

LPKF 91s, LPKF92s, ProtoMat 91s, 91s/VS, 92s*, 93s and ProtoMat 95s as well as ProtoMat C20, C30*, C60, C100/HF, M30*, M60 and X60

BoardMaster is capable to operate two types of control. Selection of the control type is done in the group field **CONTROL** and is preset for the circuit board plotter selected in the setup.



Note: The type of control should not be changed as otherwise the correct data transfer with the corresponding syntax is no longer possible.

To prevent a change by mistake of the parameters listed in the dialog field **MACHINE PARAMETERS** if you want to make a deliberate modification you have to click on the button **UNLOCK** to enable the editing of a parameter.

During installation, the machine parameters of your plotter are read from the initialisation disk that is supplied together with the plotter. Thus all

important values like machine size and the position of the *HOME* position (data origin on the axis of reflection) are already programmed at the factory. The circuit board plotter is immediately ready for operation.

All important information like *HOME*-position and area of travel must be sent from *BoardMaster* to the control of the circuit board plotter.

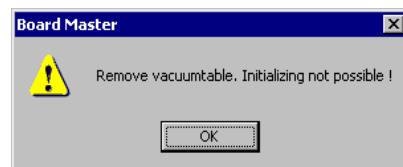
In case the individual INI-file is lost it may be necessary to newly initialise the plotter.

If the plotter parameters must be set anew or corrected, please follow the instructions in chapter „Initialization of Circuit Board Plotter“ on page 110.

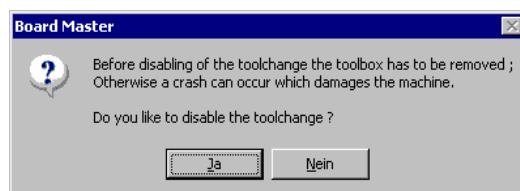
A chain of commands in plotter syntax can be entered in the text field **START LINE**. The commands are stored in the initialisation file when *BoardMaster* is closed and are sent to the circuit board plotter when *BoardMaster* is started.

All entries in the dialog field **MACHINE PARAMETER** are transferred to the plotter when **OK** is clicked to leave the program and they are stored in the initialisation file when *BoardMaster* is closed. Thus they are available at each new start of the program.

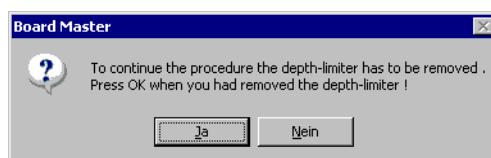
When you are trying to determine the travel area of the axes (initialization) and the vacuum table is activated, then the following note appears:



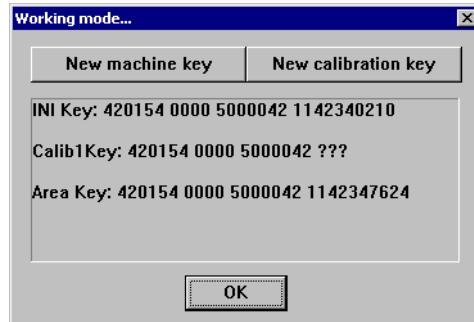
When you are trying to disable the tool change, the following message appears:



The following safety inquiry is displayed during the attempt to determine the travel area of the axes (initialization). When „No“ is answered the intended process is cancelled.



After clicking on **KEY** the following dialog appears:



By clicking on **NEW MACHINE KEY** the serial number of the machine is stored together with a time stamp.

By clicking on **NEW CALIBRATION KEY** the existing calibration table is adjusted to the machine code.

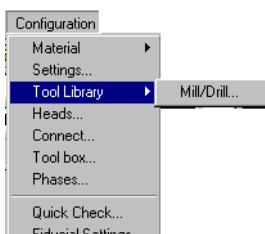
This modification is never required, except that the machine control is changed. Then a new key allocation is required during calibration.

8.1.3 Tool Parameter

The *BoardMaster* program provides tool libraries containing tools available from LPKF with all specific tool settings. The tool library files are available in three versions: *.TOL for drilling and milling tools, *.DIS for dispensing needles and *.VAC for evacuation needles (only with LPKF AutoContac). All lists can be changed and stored for later use.

The submenu **TOOL LIBRARY** in the menu **CONFIGURATION** provides access to the various tool libraries:

Figure 56:



Libraries:

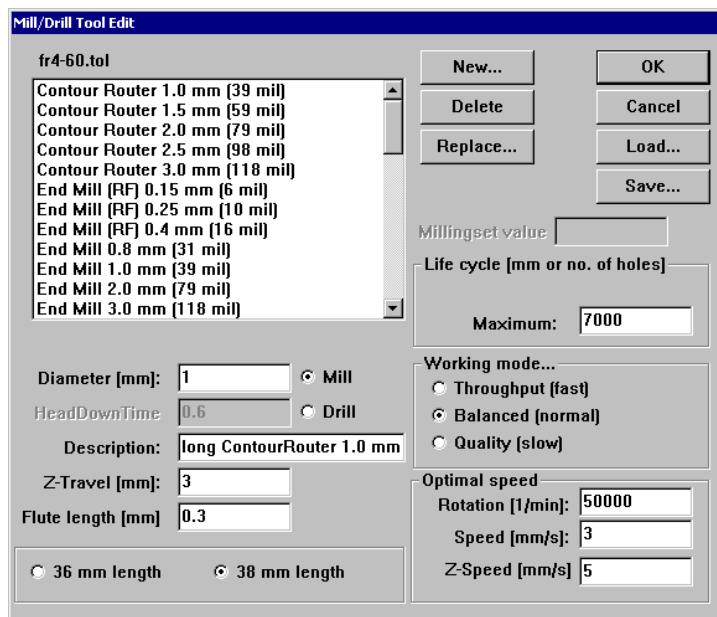
Example for C60:

FR4-60.tol -	Processing of FR4 base material
FR3-60.tol -	Processing of FR3 base material
Alu-60.tol -	Processing of aluminum base material
Film-60.tol -	Processing of film foils
Kapt-60.tol -	Processing of solder resist or stencil foils
Plastics.tol -	Processing of plastic materials
DisStd.dis -	Dispensing (Not H100!)

FR4-60.tol is loaded as default. Please select before starting depending on material.

- › Select the entry **MILL/DRILL HEAD** in the menu **CONFIGURATION** in the submenu **TOOL LIBRARY** to open the following dialog box:

Figure 57: Mill/Drill Tool Edit



All tools required for operation of the circuit board plotter are defined in the tool library with their characteristic properties. The individual settings are described here to allow you to change or add additional tools.

NAME

This list field contains the name of the tool. The selection of the name should provide information on the type of tool to facilitate later selection in other program sections. After selecting a tool in the list field, you can display its settings and change them if required. The names selected here must coincide with those in *CircuitCAM*. This name allows automatic tool assignment when importing LMD files.#

DIAMETER

The number in this text field indicates the diameter of the tool. This value allows automatic tool assignment when importing LMD files and the display of the actual diameter in the graphic working area.

HEAD DOWNTIME

The number in this text field indicates the time interval in seconds between the command "Lower head" and the command "Raise head" for the drilling tool.

MILL/DRILL

The tool can be defined as a milling or drilling tool by clicking one of these two options.

DESCRIPTION

An additional description of the tool can be entered in this text field. However, this specification has no significance for the production sequence.

LIFE CYCLE

The number in the text field **MAXIMUM** specifies the maximum cutting path or maximum number of holes for the tool. In the text field

PRESENT; the cutting path already cut or the current number of holes for the tool is indicated.

The tool change procedure can be started by clicking **REPLACE** and after replacing the old tool, the specification in the text field **PRESENT** is reset to 0.

OPTIMAL SPEED

The speed in the text field **ROTATION** defines the optimum rpm for the machining spindle. The number in the text field **MILLING** defines the optimum feed rate for milling tools.

Milling infeed [mm]

Value in millimeters for milling depth (engraving tools L=36mm) and infeed (cutting mills L=38mm). All milling tools that only machine the surface of the material or engrave it penetrate into the material with this value, after the zero position was detected by the depth sensor prior to that. Cutting mills are not detected by the depth sensor. Then the value only indicates the further infeed.

Working mode...

Here parameter sets or profiles can be assigned to each tool. There are the profiles **THROUGHPUT**, **BALANCED**, **QUALITY**. Parameters speed, acceleration and dwell times can be stored for each of the three axes, they apply to „lower head“ (drilling) and „head down“ (milling). These profiles are stored in an MCH-file and are preset for the various working mode profiles.



Note: The speed is used automatically only for circuit board plotters with variable spindle speed. For all other circuit board plotters with variable motor speed, the optimal speed must be set by hand on the control. The optimal speed to be set is, however, indicated by *BoardMaster* upon tool change.

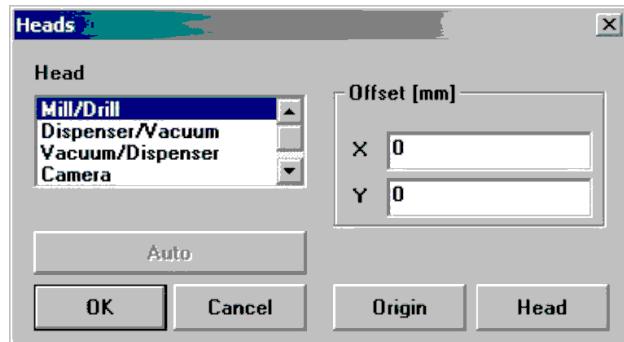
All changes in the tool library can be stored in a tool file (*.TOL) and loaded again later. The file to be loaded when *BoardMaster* is started can be defined in the machine file “*.MCH” with the command “#INCLUDE”. This also applies for production phases, the dispenser and vacuum tools.

All changes are stored in a tool file (*.TOL) when the **SAVE...** button is pressed and can be loaded again later by pressing the **LOAD...** button.

8.1.4 Heads Dialog Box

The **HEADS** dialog box can be reached by clicking **HEADS** in the menu **CONFIGURATION**.

Figure 58: Heads -Mill Drill



The various tool heads are listed in the left half and the offset associated with the specific heads are listed in the right half:

Mill/Drill head: The milling/drilling head serves as a reference for all other options mounted on the head. Its offset should therefore always be set to X = 0 and Y = 0.

Dispenser (not for S62): The distance between the dispenser/vacuum needle (*LPKF AutoContac*) and the machining head can be defined here. A detailed explanation of how this offset can be calculated is given in the Chapter.

Light dot/camera: The distance between a light dot or camera option mounted on the machining head and the machining head is defined here. This can be used for precise positioning for reloading circuit boards already completed.

A detailed description of how these offsets are calculated is given in the following chapter.

Auto (only S62)

When a metal sheet is put on the table, this function is used to calibrate the camera offset automatically.

8.1.4.1 Adjust Camera Offset

Adjust camera offset (factory setting existent)

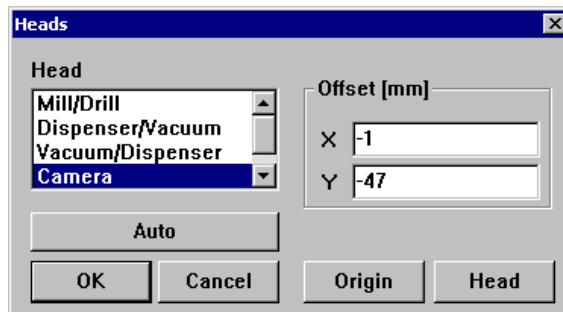
- › Select a 0.8 mm drill and drill a hole on a free area of the base material.



Caution: Do not move the machining head anymore!

- › In menu **CONFIGURATION** open the dialog **HEADS**.
- › Click on entry **LIGHT SPOT/CAMERA**.

Figure 59: Heads

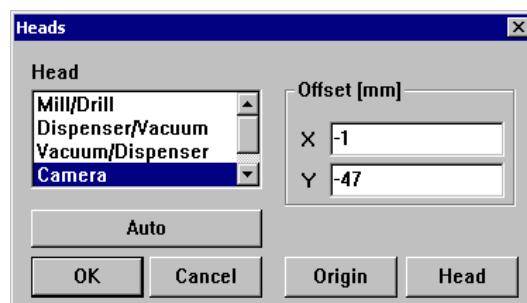


- › Press button **ORIGIN**.
The button then turns to gray.

- › Press button **AUTO**.

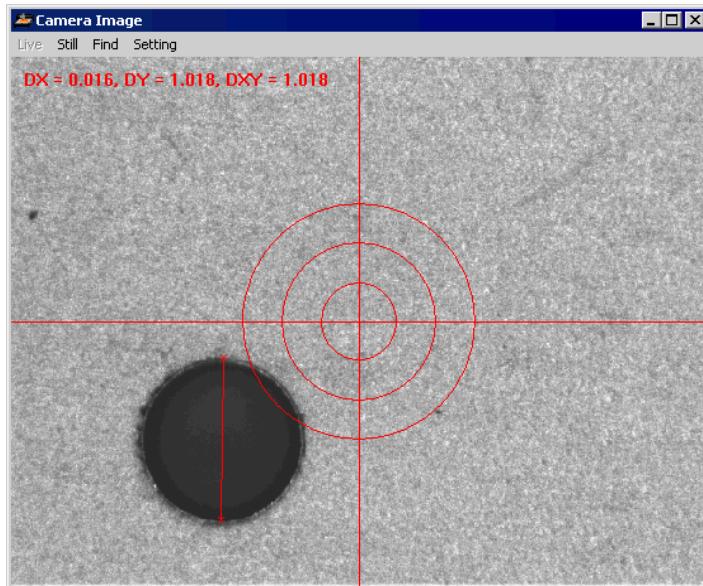
*By clicking on **AUTO** a hole is drilled at the current position. The image processing then measures the position of the hole and then automatically determines the camera offset.*

Figure 60: Heads II



- › Quit this dialog by clicking on **OK**.
- › Now move the head as long as the cross wires of the camera image are exactly in the center of the hole. For better positioning decrease the step width to 0.005 mm.

Figure 61: Camera



- › Open the **HEAD** dialog box again.
- › Press the button **HEAD** to accept this new position.
*Then the coordinates in the field **OFFSET** should change.*
- › Quit this dialog with **OK**.

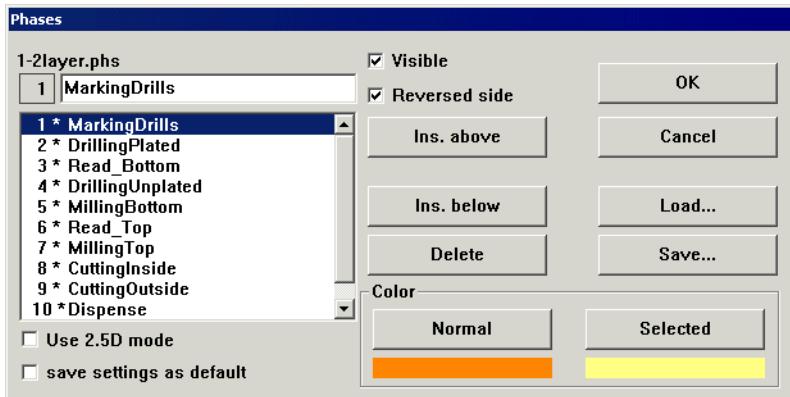
8.1.5 Phase... - Production Phases

All data to be transferred to the circuit board plotter by *BoardMaster* must be assigned to a certain production phase. These production phases define a work sequence which does not require any manipulations by the user. An example of such a manipulation would be through contacting the circuit board or turning the base material. The only exception here is manual tool change. This assignment is prepared in *CircuitCAM* and is accomplished automatically in *BoardMaster*.

Some production phases are already defined in the initialization file. However, you can adapt these production phases to your specific requirements at any time. The names of the production phases must coincide in *CircuitCAM* and *BoardMaster*.

- › Select the entry **PHASES...** in the menu **CONFIGURATION** to open the following dialog box:

Figure 62: Phases



All standard defined production phases are listed in the list field. After selecting a production phase, you can view its settings and change them if required.

Two settings are required for each production phase:

- The color with which the data assigned to this production phase is to be displayed. This setting serves for differentiation of the various production phases on the working area.
- Definition of the circuit board side (visible = component side or reversed = soldering side) for the production phase. Mark the indicator box **REVERSE SIDE** for all production phases for processing the bottom of the circuit board. All other production phases for which the indicator box **REVERSE SIDE** is not marked, are defined for processing the top.

To create a new production phase:

- › Mark the production phase in the list field in front of or in back of the new production phase you want to add.
- › Enter the name of the production phase in the text field.
- › Click **INS ABOVE** or **INS BELOW** to insert the production phase at the corresponding point in the list field.

Press the **SAVE** button to store all changes in the **PHASES...** dialog box in a phase definition file (*.PHS) so that it can be loaded again later by pressing the **LOAD** button.



Note: On one-sided material, the option “**REVERSE SIDE**” should be activated for the phase “**CUTTING OUTSIDE**”! This eliminates the necessity of turning the base material.

Meaning of the phase files

1-2layer.phs

Production of single and double-sided boards

4layer.phs

Production of 4 layer multilayer boards (sequential build-up method)

6layerpin.phs

Production of 6 layer multilayer boards (registration pin method)

8layerpin.phs

Production of 8 layer multilayer boards (registration pin method)

soldermask.phs

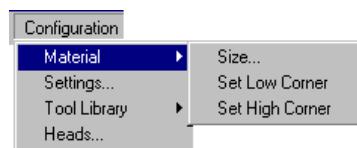
Cutting of solder foil „system EasySolder“

8.1.6 Defining the Base Material Size

When preparing a new job, it is first necessary to define the size of the base material used. This is necessary to display the actual processing surface available in the working area and therefore allow optimum positioning of the circuit board data.

The material size can be defined in the menu **CONFIGURATION** in the submenu **MATERIAL**:

Figure 63: Material Size



This submenu offers two possibilities for defining the material size:

- Determination of size by moving circuit board plotter and reading in coordinates.
- Manual entry in the **SIZE** dialog box.

Determining the size by moving the machining head:

Precise determination of the base material size can be accomplished with the circuit board plotter connected with the functions **SET X,Y-MIN** and **SET X,Y-MAX** in the submenu **MATERIAL** in the menu **CONFIGURATION**.



Danger! The following instructions should be read before starting the circuit board plotter as it sets the plotter in motion!

Ensure that no one can enter the motion range of the circuit board plotter. Danger of pinching and crushing!

Also observe the safety precautions in the circuit board plotter manual!

- › Move the machining head of the circuit board plotter with the arrow keys to the “front right corner” (X/Y-Min) on the circuit board material.
- › Select the entry **SET X, Y-MIN** in the submenu **MATERIAL** in the menu **CONFIGURATION**.
- › Move the machining head of the circuit board plotter with the arrow keys to the “rear left corner” (X/Y-Max) on the circuit board material.
- › Select the entry **SET X,Y-MAX** in the submenu **MATERIAL** in the menu **CONFIGURATION**.

After the base material size has been defined, it is displayed in dark gray in the *BoardMaster* working area.

Always observe the specified sequence for setting the coordinates (first front right corner, then rear left corner)!

When defining the material size, observe attachment strips and the size of the working depth limitation as well as the position of the reference hole pins.

When a new job is defined; the already defined material size is deleted.

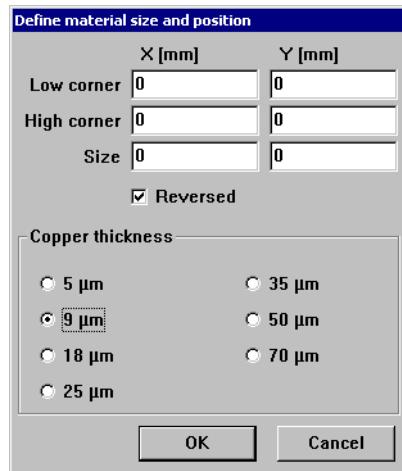
Manual entry in SIZE dialog box:



Note: This possibility for defining the size should only be used for preparing a job when the circuit board is not connected, because precise entry in consideration of the positioning on the circuit board plotter and the position of the reference holes in the base material is not possible.

Select the entry **SIZE...** in the submenu **MATERIAL** in the menu **CONFIGURATION** to open the following dialog box:

Figure 64: Material size and - position



The size of the base material can be defined by manually entering the corresponding values in the text fields. The size calculated from the values in the upper text fields is displayed in the text field **SIZE**.

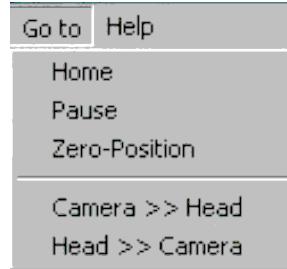
After exiting this dialog box by clicking **OK**, the base material area is displayed in dark gray in the working area

Always observe that the minimum values (possibly negative sign) are entered under X-MIN / Y-MIN and the maximum values under X-MAX / Y-MAX.

8.2 Go To Menu

This menu contains functions for moving the machining head to the corresponding positions:

Figure 65: Go To Menu



Danger: When an entry in the menu GO TO is selected, the connected circuit board plotter starts moving! The hazard of pinching and crushing exists!
For this reason, ensure that no one can enter the motion range of the circuit board plotter during the operating phases!

HOME Select this entry to move the machining head to the HOME position (data origin).

PAUSE Select this entry to move the machining head to the PAUSE position (standard Xmax/Ymax) .

Zero Position Select this entry to move the machining head to the tool changing position (standard Xmin/Ymin).

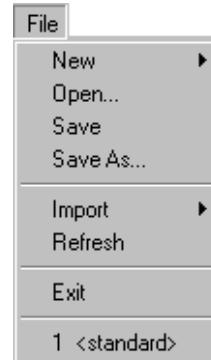
Camera >> Head Select this entry to move the camera (if option is present) to the current machining head position.

Head >> Camera Select this entry to move the machining head back # to its original position.

8.3 File Menu

The functions in this menu serve for handling jobs and projects in *BoardMaster*.

Figure 66: File Menu



NEW Select this entry to create a new job in *BoardMaster*.

OPEN

Select this entry to open a job already present in *BoardMaster*. Version 3.x job files can also be loaded. However, it is necessary to reassign the tools, because the tool names are not identical and *BoardMaster* cannot find the old names.
(See "Introduction to Basic Functions" on page 32)

SAVE

Select this entry to store the job opened in *BoardMaster* under the file name indicated on the *BoardMaster* title bar.

SAVE AS...

Select this entry to store the job opened in *BoardMaster* under a new file name.

IMPORT

This submenu contains functions for importing production data or projects into *BoardMaster*:

Figure 67: LMD Import-II



LMD OR LPR...

Select this entry to import LMD files (*CircuitCAM* production data) or LPR files (*BoardMaster* HP-GL projects) into *BoardMaster*. Version 3.x LMD files can also be imported. However, it is necessary to reassign the tools ("Assigning Tools" on page 90 and the production phases, because these names are not identical and *BoardMaster* cannot find the old names).

HP-GL INTO

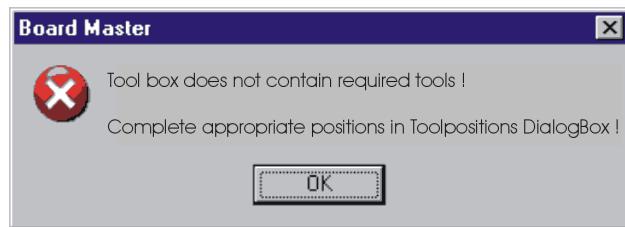
In this submenu, select the entry

NEW LPR..., to import the HP-GL files into *BoardMaster* and assign them to a new project.

<STANDARD>, To import the HP-GL files into *BoardMaster* and assign them to the *Standard* project.

After importing LMD files, data is positioned immediately in the middle of the working area for the circuit board plotter. Moreover, the production data and the required tools are automatically assigned to the data: If it is not possible for *BoardMaster* to assign one or more tools, the following message appears:

Figure 68: Import

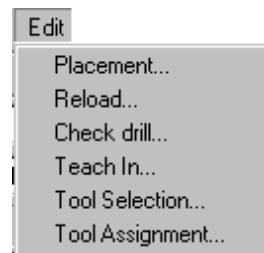


In this case, it is necessary to assign the tools manually in the tool assignment dialog box or to complete the tool library before importing the data again.

After exporting the files, all tools required are listed in the *CircuitCAM* report window.

8.4 Edit Menu

Figure 69: Edit Menu

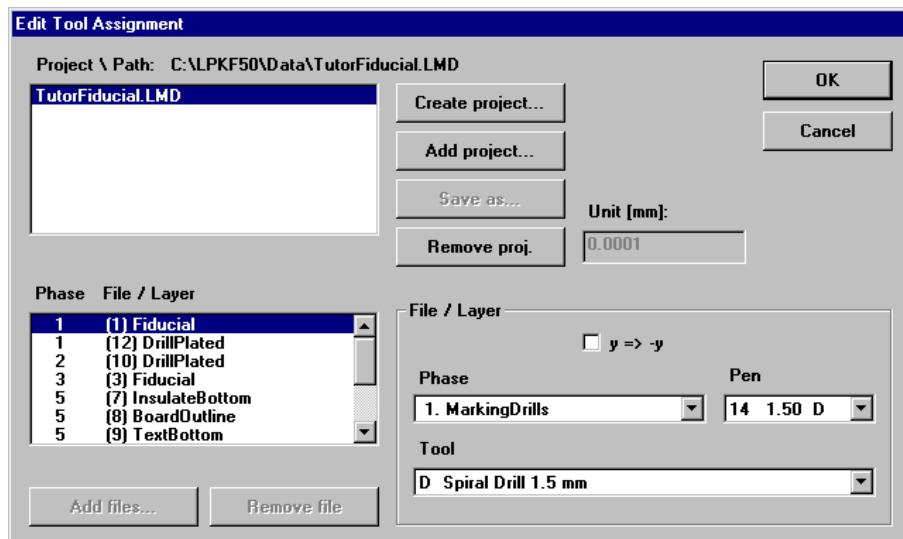


8.4.1 Assigning Tools

Each job in *BoardMaster* consists of one or more projects. Here, a project is designated to be a circuit board imported as LMD file or HP-GL project.

Select the entry **TOOL ASSIGNMENT** in the **EDIT** menu to open the following dialog box:

Figure 70: Edit tool assignment



Generally, the production data is read in by importing it in the file menu. These projects can, however, also be inserted at this point (LMD file from *CircuitCAM*) or generated (HP-GL files).

The LMD files generated during export in *CircuitCAM* contain the production data for the entire circuit board. The LMD files imported into *BoardMaster* are listed in the project list. The *CircuitCAM* layers with their production phases (phase) are listed in the field **Phase file/Layer**. Each of these entries contains one or more pieces of tool information (pins) with the assigned tools from the *BoardMaster* tool library (tool).

If automatic tool assignment was not possible (see above), it is necessary to perform it here:

- › Select the **Layer** from the list, for which this assignment is missing.
- › Open the **Pen** list field and check whether a tool is assigned to each "pin".
- › If not, select the tool to be used here from the **Tool** list field.

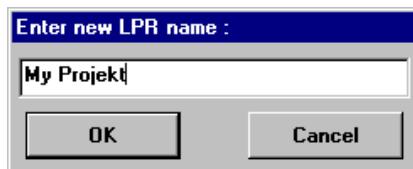
Repeat this until all tools have been assigned correctly.

To create a new project:

Such a project (LPR) consists of one or more HPGL files.

- › Click **CREATE PROJECT...** to create a new project.
- › Assign a name for the project in the dialog field **ENTER NEW LPR NAME:**

Figure 71: Enter new LPR name



- › Click **OK** to close the dialog box.
- › Enter the resolution for the HP-GL files associated with the project in the text field **UNIT**.

The HP-GL files have a standard resolution of 0.025 mm. If you want to use data with a different resolution, please change the setting for the HP-GL unit:

- › Click **ADD** to add the desired HP-GL files to the project.



Note: All HP-GL files for a project must be located in the same directory.

You can remove HP-GL files from a project by marking the corresponding entry in the list field **PHASE FILE/LAYER** and clicking **REMOVE**.

It is necessary to assign the following information to each HPGL file with production data in **FILE/LAYER**:

PHASE Select phase to be assigned to the production data.

PIN/TOOL Select the pin for the HP-GL file in the **LIST** field pin to which the tool selected in the list field **TOOL** is to be assigned.

Y=>-Y Activate this control box to allow simultaneous, coincidental display of both sides of the circuit board for production data generated as a mirror image (generally, the bottom for all production data).

- › Click **SAVE AS** to store the project as an LPR file.

In order to reopen a project stored as LPR file, after restarting the *BoardMaster* program, select the entry **LMD OR LPR...** in the submenu **IMPORT** in the **FILE** menu.

or:

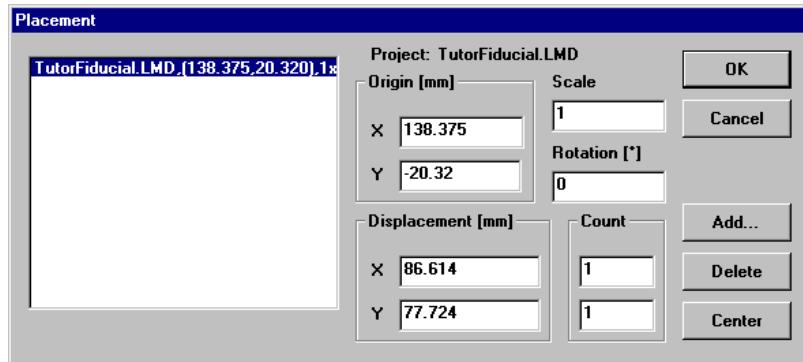
Click **ADD PROJECT** to add a project. This can be an LMD file generated with *CircuitCAM* or an LMD file (HP-GL project file) generated with *BoardMaster*.

8.4.2 Placing Projects

After you have imported or generated the required projects, you can place them in the *BoardMaster* working area. Imported projects are automatically positioned in the center of the working area or the predefined base material.

Select the entry **PLACEMENT...** in the **EDIT** menu to open the following dialog box:

Figure 72: Placement



To place a project:

- › Click **Add...** and select a project from the list. Or:#
Select the project whose positioning you want to change on the left side in the list field.
- › Enter the desired scale for the project in the text field **SCALE**.

The default value for the scale is 1, indicating scale 1:1. However, you can also define another scale here, for application such as front plate and plate engraving.

- › Enter the desired position for the project in the working area in the text field X and Y under **ORIGIN**. These values refer to the *HOME* position for the circuit board plotter and the data origin.

If you do not know the exact position of the data in the coordinate system, you can enter the value 0 and 0 here and position the project in the working area with the aid of the function bar/mouse.

- › Select the appropriate offset for the project in the working area under **ROTATION**.
- › If you want to complete more than one prototype for a project, define the number of multiple boards under **COUNT**. Enter the number of boards in the X direction in the first text field and the number of boards in the Y direction in the second text field.
- › Enter the interval of the boards under **DISPLACEMENT**. Enter the displacement of the boards in the X direction in the first text field and the displacement of the boards in the Y direction in the second text field.

The displacement of the boards in relation to one another must correspond to at least the length and width of the circuit boards, because otherwise, the boards would overlap.

Multiple boards can also be created with the function bar.

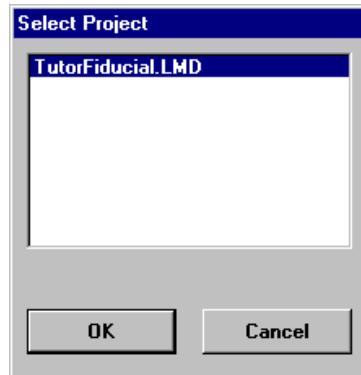
Centering a project on the base material:

- › Select the corresponding project in the list field.
- › Click **CENTER** to position the selected project in the center of the base material.

To add other projects for placement:

- › Click **ADD**.
- › Select the project to also be positioned on the base material in the list field:

Figure 73: Select Project



- › Click **OK** to close the dialog box.

To remove a project already positioned:

- › Select the corresponding project in the list field.
- › Click **Delete** to remove the positioned project from the base material.

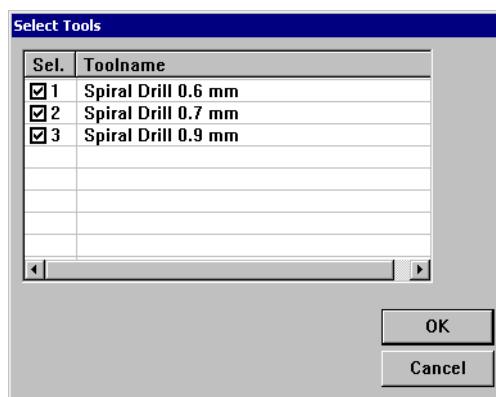
8.4.3 Select Tools

The **SELECT** dialog window can be used to disable individual tools for processing in the current production phase.

The dialog window shows all of the tools used in the current production phase. Normally all tools in the list are marked (dark background), i.e. enabled for use.

Clicking one of the tools allows it to be disabled (light background) or enabled (dark background). Disabled tools are not used for processing during the production phase, even though they are included in the project.

Figure 74: Select Tools



Example:

A dull drill is detected while drilling. By selecting only this tool, pressing **ALL+** and **START**, only the holes with this tool are repeated, all others are ignored.

Moreover it is possible to define in this list field, whether the **smallest tool is to be used first** (recommended for milling insulation), followed by the next thicker tool, or if the **current tool is to be used first** (for drilling, to avoid unnecessary tool changes).

Note: The order of the tools cannot be freely defined.



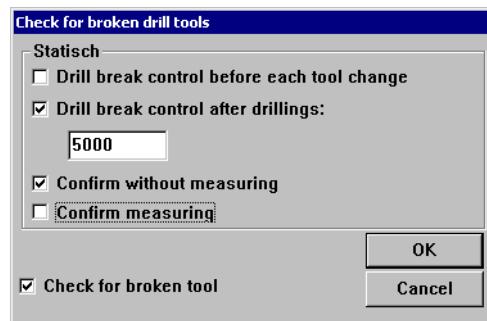
8.4.4 Check for Broken Drill Tools



Note: Functions described in the following apply only to machines with camera option.

Click **CHECK FOR BROKEN DRILL TOOLS...** in the edit menu to open the following dialog window:

Figure 75: Check for broken drill tools

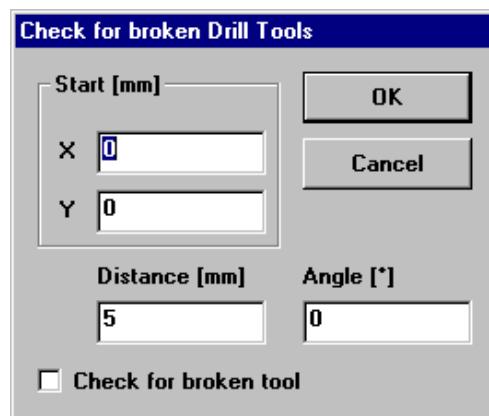


If the check box **CHECK FOR BROKEN TOOL** is enabled, then it can be adjusted whether the control takes place after each drilling process or after a given number of drilling processes. Moreover it is possible to work completely without automatic measurement. In this case the last adjusted drilling (in the image) must be confirmed. After an unsuccessful measurement the job can be canceled.



Note: The following setting applies only to machines without camera!

Click on **CHECK FOR BROKEN DRILL TOOLS...** in the menu **EDIT** to open the following dialog window:



If the check box **CHECK FOR BROKEN TOOL** is activated then *Board-Master* will generate a „final“ control drilling for each drill diameter of the current production phase at the position that is indicated in this dialog. That drilling is always done after the drillings of the board. Thus it can easily be checked whether a drill has broken during the production: if all controll drillings are present, there is no broken tool.

Start Enter the coordinate at which the control drilling is to take place.

Distance Enter the distance between the control drillings

Angle Enter an angle under which the row of control drillings is to be placed. 0° means it is parallel to the X-axis.

If **CHECK FOR BROKEN TOOL** is activated then the control drillings are positioned as small squares on the base material. The entry **DRILL BREAK CONTROL** is marked in the menu **EDIT**.

8.5 Reload Dialog Box

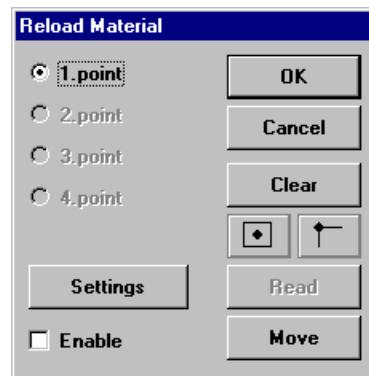
The function **RELOAD** serves for reloading a circuit board which has already been completed and cut, in order to drill additional holes, engrave text or separate the conductors for coding.

The prerequisites for using the reload function include a circuit board requiring reprocessing and the circuit board data as LMD file with at least two identifiable points (holes, reference marks, vectors), which can be assigned to the corresponding points on the circuit board.

The main purpose of the reload feature is to position the data so that it coincides with the circuit board to be processed. For this purpose, two identifiable points in the data (reference points) are assigned to the corresponding points on the circuit board to be processed.

When **RELOAD** is selected, the floating dialog box **RELOAD MATERIAL** is opened.

Figure 76: Reload Material



To reload, the following steps are required:



Danger: Activating one of the following buttons on the function bar, sets the connected circuit board plotter in motion! The danger of pinching and crushing exists!

Ensure that no one can enter the hazard area of the circuit board plotter during the operating phases controlled by *BoardMaster* or come into contact with the tools!

Work sequence:

- › Fasten the circuit board to be reloaded on the plotter.
- › Import the LMD file with the corresponding data for the circuit board.
- › If not already accomplished, open the **RELOAD MATERIAL** dialog box. Switch on the switch for **Point 1** and select the first reference point on the data (center point of solder eye or hole, corner point).

- › Move the mark to the desired position by clicking the keys



CENTER or CORNER.



- Hole selection only



- Pad selection only

- › Move the machining head with tool installed or the cross hairs on the camera (LPKF CircuitView Option) as exactly as possible to the appropriate point on the circuit board. For this purpose, use the motion keys on the function strip:#



- › Then click the **Read** button to store this point.
- › Switch on the switch for **Point 2** and repeat the procedure for the 2nd reference point.
- › Mark the check box **Enable**.
- › Exit the dialog box by clicking **OK** to activate “Reload”.
- › Select the data to be sent to the plotter. The data is converted to correspond to the position of the circuit board after clicking **Start**.

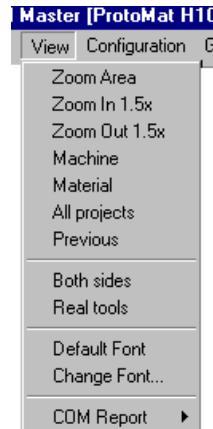
SETTINGS what is behind that???

Then cancel the mark in the **ENABLE** check box to prevent the data from being aligned for later jobs. Exit with **OK** and close the floating dialog box.

8.6 View Menu

You can adapt the graphic display of the *BoardMaster* working area to your specific requirements with the functions in the **View** menu:

Figure 77: View menu



ZOOM AREA	Select this function to display a freely selectable cutout of the working area to fill the screen. For this purpose, press the left-mouse key and hold down while moving the mouse to define the desired area. You can also select this function by clicking  on the function bar.
ZOOMING 1.5x	Select this function to increase the graphic display by a factor of 1.5.
ZOOM OUT 1.5x	Select this function to decrease the graphic display by a factor of 1.5.
MACHINE	Select this function to display the entire working surface of the circuit board plotter in the working area.
MATERIAL	Select this function to display the entire base material surface in the working area.
ALL PROJECTS	Select this function to display all positioned projects as largest possible in the working area.
PREVIOUS	Select this function to return to the previous screen display.
BOTH SIDES	Select this function to change back and forth between simultaneous display of both sides of the circuit board and display of only one side of the circuit board.
REAL TOOLS	Select this function switch display of the milled lines in the actual width ON and OFF. The actual width of the milled lines is defined in the tool library.
DEFAULT FONT	Select this function to change back and forth between the Windows system font and the font

set under **CHANGE FONT** for display of the text.

CHANGE FONT... Select this function to select the font to be displayed when the **DEFAULT FONT** is deactivated.

8.7 Selecting Production Phase

Before sending milling or drilling data to the circuit board plotter, it is first necessary to select the production phase to be processed. This can be selected on the function bar in the list field **PRODUCTION PHASE**:

Figure 78: Production Phase



Select the production phase to be processed next. Ensure that only one production phase is marked to which an HP-GL file or LMD file has also been assigned. Erroneous selection leads either to erroneous files being processed or no data being transmitted at all.

An example for the sequence for the production phases for a double-sided circuit board is given below:

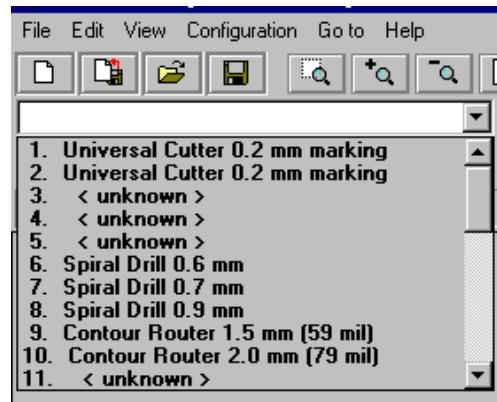
<u>Process</u>	<u>Production phase</u>
1. Drilling	DrillingPlated
2. Milling bottom	MillingBottom
Turning base material	
3. Milling top	MillingTop
4. Cutting outside	CuttingOutside

8.8 Tool Change

8.8.1 Manual Tool Change

All tools in the tool library are listed on the function bar in the list field **TOOL**. The list of tools used in the current production phase is located at the beginning (marked with “*”):

Figure 79: Tool Magazine display



If a production phase has not been selected, the first production phase in the list is active.

When processing a production phase, you are always requested to install the tool to be used next when a tool change is required.

If a different tool is selected from the list, the machining head moves to the tool change position. Simultaneously the message appears on the screen that the present tool is to be replaced with the tool just selected.



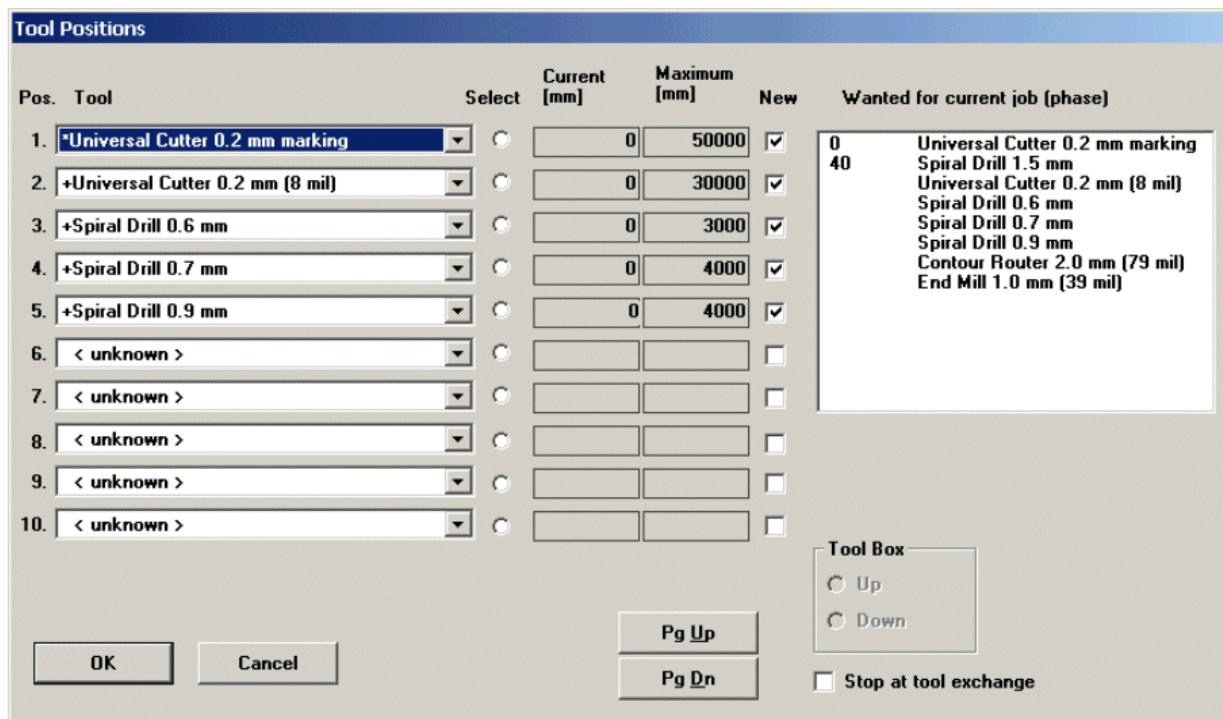
Danger:This instruction starts the circuit board plotter. Danger of pinching and crushing! Also observe safety precautions for changing tools in the circuit board plotter manual!

After changing the tool, and confirming the change by clicking **OK**, processing can be continued with the next control commands.

8.8.2 Automatic Tool Change

The dialog box shown in figure 80 on page 103 can only be called up when machines with automatic tool changing unit are used. (example *ProtoMat 95s*, *H100* and so on). If you now open the **TOOL** list field on the function bar, only the thirty or seven tool positions with their corresponding tool assignment are displayed instead of a list of all tools as for circuit board plotters with manual tool change.

Figure 80: Automatic tool change



Note: When the program is started for the first time, the tool <UNKNOWN> is assigned to each tool position, i.e. no tool entered. This is intended to cause the user to check the tools in the circuit board plotter magazines and assign the corresponding positions in the **TOOL POSITIONS** dialog box. It is absolutely necessary to ensure that the tools in the tool box coincide exactly with those assigned in BoardMaster in order to prevent using the wrong tools and therefore malfunctions.

Open the **TOOL POSITIONS** dialog box by clicking the **TOOL** list field with the right-mouse key:

A tool can be assigned to the tool positions 1 to 30 by selecting the tool required for the production phase from the appropriate list field.

If a tool position is not assigned to a required tool, this dialog box is opened automatically when the production phase is started. It is possible to continue only after all tools have been assigned a position!

The tools required for the selected production phase are listed in the list field **WANTED FOR CURRENT JOB (PHASE)**.

The option **SELECT** indicates the tool momentarily located in the machining head.

The **CURRENT** life cycle and the **MAXIMUM** life cycle are indicated following each tool.

It is necessary for the **New** check box to be switched on when a used tool is replaced by a new tool in the tool box. The current life cycle is then reset to 0.

When exiting *BoardMaster*, the tool assignment in *BoardMaster* are stored under the name extension *.TLS and automatically reloaded each time *BoardMaster* is started.

9.0 Appendix

9.1 Adjusting Milling and Drilling Depths

The following chapter does not apply to the ProtoMat H100!!!

To adjust the drilling depths:

- › Move the circuit board plotter first to the tool change position (menu bar **GO TO... - TOOL CHANGE POSITION**) and clamp the drill of your choice in the machining head against the stop (see machine manual)
- › Move the machining head with the aid of the arrow keys on the function bar and increment adjustment to the front edge of the base material and the drilling panel, i.e. the drill should not be over the base material, but rather over the plotter board.
- › Now press the machining head down by hand and check visually whether the drill would drill through the base material, however, not touch the plotter base plate in the lowered state.
- › If the drill head is adjusted too high or too low, adjust the drilling depth higher or lower with the knurled knob below the drilling head.

To adjust the milling head:

- › To adjust the milling depth, clamp a milling cutter into the machining head against the stop. For this purpose, move the machining head to the tool change position (menu bar **GO TO ...- TOOL CHANGE POSITION**).
- › Move the machining head with the aid of the arrow keys and increment adjustment to a free point on the base material where you can make a cut for checking.
- › Set the motion increment to 10 mm.



Switch on the vacuum!

- › Switch on the motor by clicking .
- › Click the  raise/lower button to lower the machining head.
- › Move the machining head with the arrow keys.
- › Click the  raise/lower button again to lift the machining head.
- › Switch off the motor by clicking .
- › Switch off the vacuum.

- › Move the machining head far enough away from the sample cut and check the depth of the cutting line with the aid of the measuring magnifier.

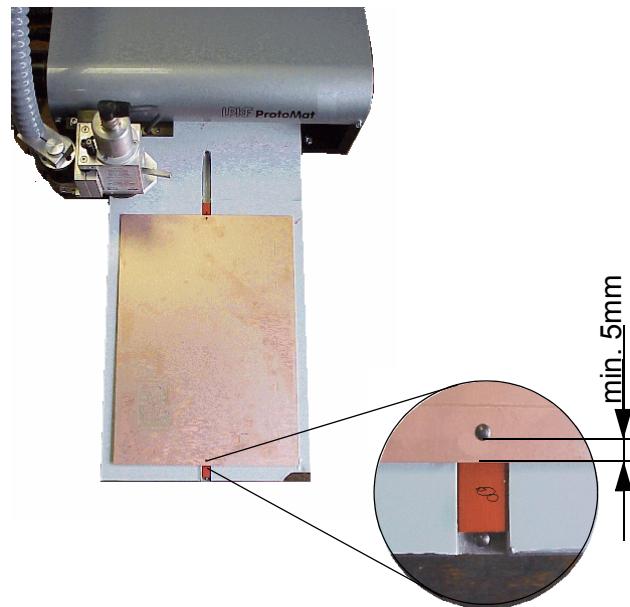
If the desired depth was not reached, adjust the milling cutter higher or lower with the knurled knob and repeat this operation until the desired depth or height is reached.

9.2 Drilling Reference Holes in Base Material

This is required if you want to use a new piece or difference piece of base material. The values specified here apply for the base material size present when the machine was delivered (Din A4; 297x210 mm, for ProtoMat S62 9" x 12"). For other base material sizes, it is necessary to set other increments and where applicable, drill new reference holes in the reference strip. To drill reference holes, it is necessary to ensure that the circuit board plotter is ready for operation and *BoardMaster* is opened. Then proceed as follows

- › Move the machining head to the **PAUSE** position by clicking the menu Go to... - Pause position
- › Carefully remove the reference pins with a pair of flat-nosed pliers. Ensure that the red reference hole strips do not slip and are not pulled out.
- › Position the drill template and base material on top of one another centered on the machine board and fasten it on the longitudinal sides with masking tape (we recommend Tesakrepp 5250).
- › Then select **Spiral Drill 3.0 mm** in the tool list field in BoardMaster.
The machining head moves to the tool change position.
- › Clamp this drill into the machining head against the stop (machine manual).
- › Move to the **HOME** position (menu bar Go to...- Home position)
- › Move the machining head with the aid of the arrow keys and increment adjustment across the base material in the negative X direction (not in Y direction under any circumstances), until an interval of approx. 5 mm is present between the front edge of the base material and drill (see figure 81, "Reference pin distance" on page 107)

Figure 81: Reference pin distance



- › Move the machining head 295 mm in the X direction (for this purpose, set increment to 295) and check visually whether a distance of approx. 5 mm is also present between the edge of the base material and drill to ensure that later holes are not drilled outside of the material (see figure above).
- › Switch on the motor by clicking
- › **Switch on the vacuum** and click the raise/lower button to lower the drilling head.
 - › Click the raise/button again to lift the drilling head.
 - › Switch off the motor by clicking
 - › Switch off the vacuum.
 - › Move the machining head back 287 mm in the negative X direction and drill the second hole there after performing the same steps as described above.
 - › Check whether the rear hole has been drilled all the way through. If not, move the machining head back 287 mm along the X axis over the rear hole and adjust the working depth limiter lower as required (machine manual)
 - › Redrill the hole according to the same instructions as above.
 - › Also check the front hole. If it is also necessary to rebuild it, move the machining head to above this hole and perform the same steps as for the first redrilling operation.



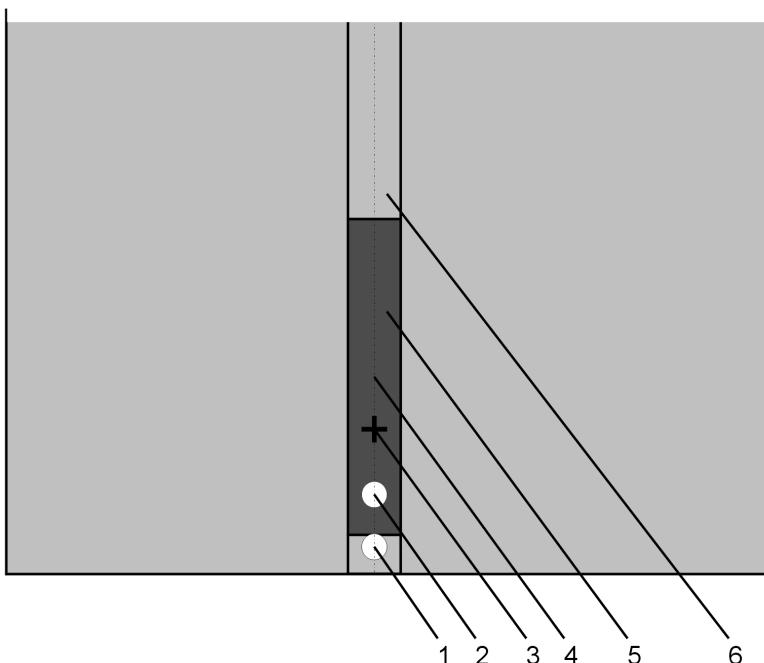
The circuit board plotter only drills the holes in the base material, because they have to be precise within 1/100th mm. On the other hand, the holes in the drilling template can be drilled with a normal drill. If you want to use a different size of base material, first drill new reference holes in the reference hole strip (see also Chapter "Creating a New Reference Hole System" on page 108).

9.3 Creating a New Reference Hole System

The following chapter does not apply to the ProtoMat H100!!!

The reference holes in the red reference hole strips become larger after a time from use and are therefore not as precise as at the beginning. It is then necessary to drill new holes in the strip. Replace the strip when too many holes are present.

Figure 82: Front pilot pin



- 1- Reference pin
- 2- Front pilot pin
- 3- HOME position, (distance is depending on type of machine)
- 4- Reflection axis
- 5- Reference strip
- 6- Reference hole groove



Danger! Remember that the tools are very sharp and may also be hot. Work only with vacuum switched on to prevent injuries from chips!

A new reference hole system can be created as follows:

- › First remove the base material and drilling panel as well as the reference hole pins.
- › If sufficient space is still present on the old reference hole strip, it can be reused. Otherwise, insert two new reference hole strips into the machine groove, whereby the front reference hole strip should be pressed against the front reference pin in the groove. The distance between the two reference hole strips should correspond approximately to the size of the base material along the X axis. (move the machining head to the pause position to change the reference hole strips; use command Go to...-Pause position on the menu bar).
- › Select **Spiral Drill Ref. 2.95** in the **Tool** list field (machine moves to Tool change position) and clamp it in so that the interval between the base plate and tip of the drill is 0.5 mm (a 0.5 mm thick plate can be positioned below as an aid). This means that it is not to be clamped against the stop in this exceptional case.

The message appears “Continue after changing tool”.

After installing the correct tool, confirm this message with **OK**.

- › Move the machine head to the HOME position and from there in the X direction (not Y direction under any circumstances) to a free location on the front reference hole strip with the arrow keys.
- › Switch to milling mode by clicking .



› **Switch on vacuum!**

- › Switch on motor by clicking  and drill a hole by pressing the raise/lower  button.
- › When the machining head has lowered completely into the reference hole strip, click the raise/lower button again  to raise it.
- › Switch off motor by clicking .
- › Then move the machining head 30 mm in the positive X direction, (not Y direction), because the HOME position should always be 30 mm away from the reference hole.
- › To store the new coordinates for the HOME position, click **Configuration** on the menu bar and then **Settings**. Then click **Unlock** and finally **Set Home**. The new coordinates for the HOME position are set and can be saved by clicking the **OK** button.
- › Move along the X axis to the second, rear reference hole strip and drill a hole there as well. Do not move in the Y direction under any circumstances.

- › Move machining head to side. Insert two reference hole pins into the holes now present in the reference hole strips using a fitting tool as an aid. Ensure that the pins are tightly seated, because any play in the fitting accuracy has a negative effect on the offset accuracy of the board.
- › Mark old holes with felt-tip pen so that they cannot be mixed up with the new holes.
- › Position pre-drilled base material and drilling panel above reference hole strips. Select the format for the base material so that the reference hole strips do not have to be moved by more than 10 mm, because otherwise the reference hole system loses accuracy.
- › Fasten the base material now positioned with adhesive tape in addition (we recommend Tesakrepp 5250) on all four sides.

9.4 Initialization of Circuit Board Plotter.



Danger! The following instructions start the circuit board plotter!

Ensure that no one can enter the hazard area of the circuit board plotter. The danger of pinching and crushing exists!

Also observe the safety instructions in the circuit board plotter manual!

- › Go to **Configuration** on the menu bar and click **Settings**.
- › Click **UNLOCK** to change the machine settings.
- › Click **INITIALIZATION** to start the initialization run.

During the initialization run, the machining head moves to the limit switches in all four directions of motion, thereby transmitting the values measured to *BoardMaster*. These values are displayed in the text fields **ZERO POINT** (Xmin/Ymin, always 0/0) and **SIZE** (Xmax/Ymax). These entries cannot be edited, they can only be reset by initializing.

The values in the text field **PAUSE** are identical to the values in the text field **SIZE**. However, they can be edited to move the *Pause* position to any desired position.



Note: The values in the text field **HOME** (data origin) are set to **Xmin** and **Ymax/2** as default. The **HOME** values determined in this manner are not the exact values leading to coincidence of the top and bottom during production of double-sided circuit boards. For this purpose, it is necessary for the **HOME** position to be located precisely on the plotter reflection axis.

To reset the Home position precisely on the circuit board plotter reflection axis, it is necessary to drill new reference holes. For this purpose, first remove the base material and drilling panel as well as the

reference hole pins. If no more space is present on the old reference hole strips, use new strips (see "Creating a New Reference Hole System" on page 108).

Then follow the following instructions:

- › After the circuit board plotter has come to a stop at the tool change position after initialization, select **Spiral Drill Ref. 2.95** from the **Tool** list and clamp it in so that an interval of 0.5 mm is present between the base plate and tip of the drill (a 0.5 mm thick plate can be placed beneath as an aid).

The machine moves to the tool change position and the message "Continue after tool change" appears.

Install the tool and confirm this with **OK**.

- › Move the machining head to the **HOME position** defined by initialization by clicking **GO TO** in the menu and then **HOME position**.
- › Move the machining head in the positive X direction with the arrow keys (not in Y direction under any circumstances) approx. 15 mm.
- › Move the machining head with the arrow keys to the middle of the front reference hole strip (this time X and Y axes). For this purpose, set the increment to 0.05 mm.
- › Move in the positive X direction to find a free point on the reference hole strip (if necessary, change increment setting).
- › Switch over to milling mode by clicking .



Switch on the vacuum!

- › Switch on the motor by clicking  and drill a hole by actuating the raise/lower button . Wait until the machining head has lowered completely into the material and then click the raise/lower button  again to lift the machining head.
- › Switch off the motor by clicking .
- › Move the machining head 30 mm in the positive X direction from the new reference hole (not in Y direction under any circumstance), because the HOME position should always be 30 mm away from the reference hole.
- › Go to **Configuration - Settings** on the menu bar. Click **Unlock** and then **Set Home**. The data for the current machining head position are read in as the new HOME position and can be saved by clicking the **OK** button
- › Move the machining head along the X axis to the rear reference hole strip and then drill the rear hole as described above by performing the concrete steps for drilling a hole (do not change anything in the menu Configuration again).

We recommend noting the values for the HOME position to prevent having to setup the circuit board plotter again if they are changed by mistake. However, after a new initialization run, it is always necessary to readjust the HOME position.

9.5 Checking and Correcting HOME-Position

This chapter does not apply to the ProtoMat H100 machine !



Caution! Before starting this check or correction of the HOME position, read the Chapter „Manual Tool Change“ on page 102 as well as the chapter on the operating depth limiter in the machine manual under all circumstances!

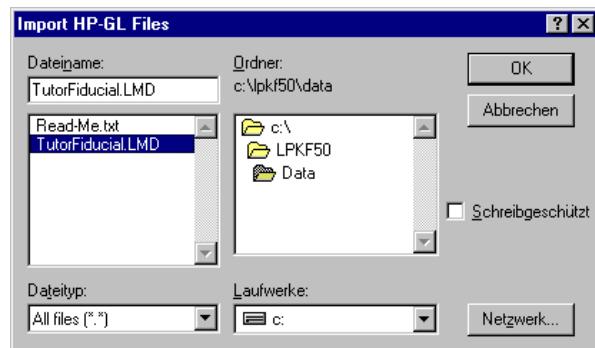
The test file Null-Pkt.LMD is supplied for installation to simplify checking the HOME position.

This data makes it possible to drill a hole on one side of the circuit board and cut a circle at the same point after turning the circuit board. This allows the location of the HOME position to be checked on both axis directions.

Proceed as follows:

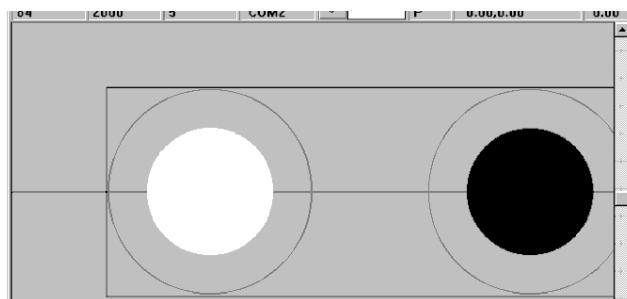
- › Drill reference holes in the double-sided base material ("Creating a New Reference Hole System" on page 108).
- › Fasten material and drilling base (2 mm) to the base plate with the aid of the reference hole pins (see also machine manual).
- › Start *BoardMaster* and select the point **LMD OR LPR** in the menu under **FILE, IMPORT**.
- › Then select the file **null-pkt.lmd** and click **OK** to import.

Figure 83: Import Zero Point-file



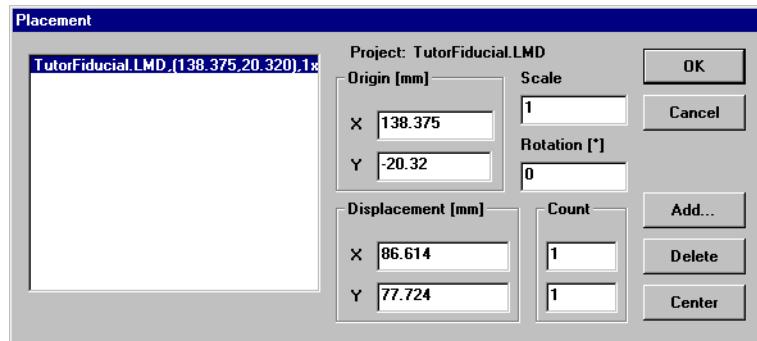
- › Zooming on the display by clicking the button and mark the section with the left-mouse key depressed.

Figure 84:



- › Click the project with the right-mouse key.

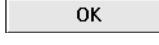
Figure 85:



#

#

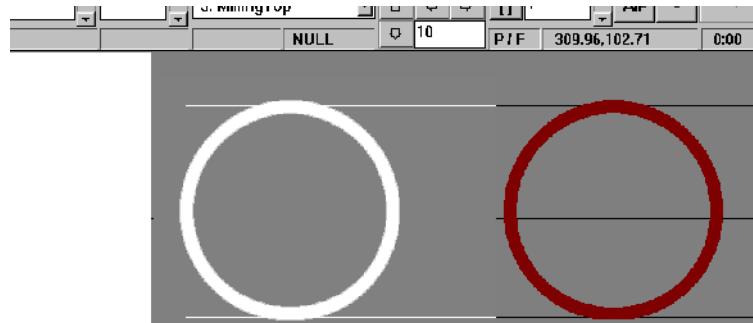
The Placement dialog box opens.

- › Define the position in the field **REFERENCE POINT** with x=0, y=0 and click .
- › Select the operation **DRILLING PLATED** in the list field for the production phases.
- › Click  and then mark the first hole with the left mouse key to press.
- › Then activate the hole selected for processing by clicking  and  then .

After changing the tool, the hole is drilled in the circuit board with the selected drill.

- › Then move to the Pause position and turn the circuit board around the X axis.
- › Select the operation **MILLING STOP** in the list field for production phases.
- › Click  again and mark the milling track corresponding to the first hole with the left-mouse key depressed.

Figure 86:



› Then activate the milling track for processing with  and press



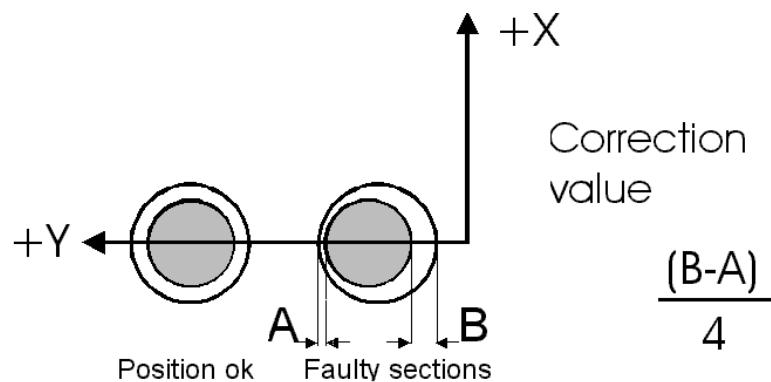
The required tool is changed automatically and a circular path is cut on the circuit board.



Note: If necessary, check the milling channel width and the setting for the milling depth before starting processing.#

Check whether the milling channel runs precisely around the center of the hole:

Figure 87:



If the cutting line does not run precisely around the center point, correct the Home position.#

This can be accomplished directly by changing the Home position in the machine settings dialog box ("Machine Settings" on page 74). #
The correction value can be calculated according to the formula indicated above. #

It is always necessary to add the correction value to the Y coordinate. After correction, the process should be repeated as a check. Here, it is practical to use the second hole and milling track in the test program if the same circuit board is to be used for checking.

- › Note the coordinates for the new Home position.

9.6 Special Features.

9.6.1 X Offset and Y Offset

These values indicate the interval between the metering needle and the drill in the X or Y direction. The values differ for the different types of cartridge holders and are between 32 and 35 mm for X and between 30 and 37 mm for Y.

Once determined, the offsets should be corrected only when the needle is no longer centered exactly above the holes in the circuit board during dispensing or evacuation. An increase in the value corresponds to an offset of the needle relative to the hole in the positive X or Y direction.

Important! The maximum processing range for dispensers is smaller than for drills and milling cutters by this value. If a dispensing/vacuum tool is selected, the limited operating range is indicated by a white frame.

This white frame can be used to correctly place a project with dispensing and vacuum phases on the circuit board. For this purpose, select a Disp/Vac tool in the **TOOL** combo box (function bar top left). The white frame is then visible.

9.6.2 Special Functions for ProtoMat 95s/95s/II/ H 100 S62

Service password dialog box

For service, the following box appears requesting entry of the password after clicking **SERVICE** in the dialog box **TOOL BOX...** in the **CONFIGURATION** menu.

Figure 88: Service Password



It is then possible to change the settings in the dialog boxes specified.

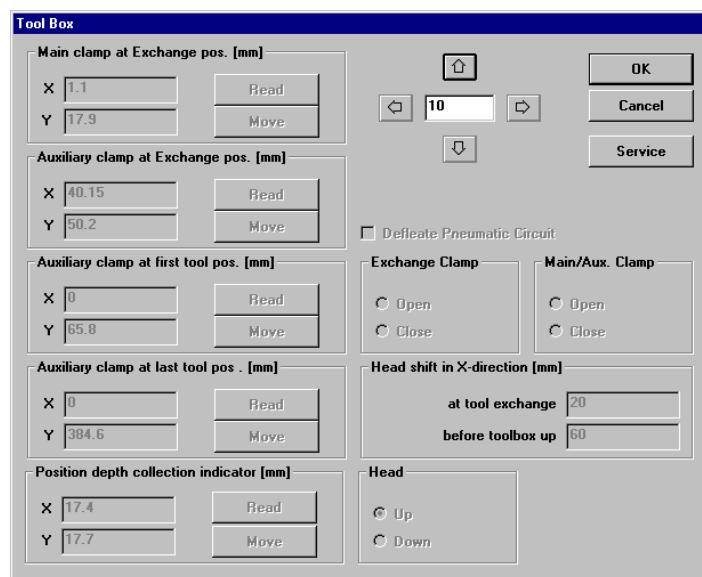


CAUTION: These changes should be accomplished only by personnel trained in the function and operation of the *ProtoMat 95s!* Always observe the operating notes and safety precautions to prevent injuries to humans and damage to the machine! If you are authorized to make such changes, enter the password [bmaster].

Tool box dialog box

Access to the tool Box dialog box is possible by clicking **TOOL BOX...** in the menu **CONFIGURATION**.

Figure 89: Tool Magazine



Here, a manual check of the positions preset by LPKF for automatic tool change is possible. Normally, it is not necessary for the user to make any changes, because this has no effect on the milling and drilling. The numerical values entered are a configuration example.

MAIN CLAMP AT EXCHANGE POS. defines the position of the machining head above the exchange position.,

AUXILIARY CLAMP AT EXCHANGE POS. defines the position of the auxiliary clamp above the exchange position.

AUXILIARY CLAMP AT FIRST TOOL POS. defines the position of the auxiliary clamp above the first tool in the tool box.

AUXILIARY CLAMP AT LAST TOOL POS. defines the position of the auxiliary clamp above the last tool in the tool box.

Position depth sensor [mm] defines the position of the processing head above the measuring area of the depth detection sensor.

The coordinates entered can be written over by the momentary position of the machining head by pressing the **READ** button. Check the position of the machining head carefully before activating Read. Clicking **CHECK** moves the head to the corresponding point to check the position.

These positions are set at the factory just as are the Home position and size of the plotter motion range (file **bm-95*.ini**).



CAUTION: Always observe that it is possible to write over the current, correct positions that a hazard for the user and damage to the machine are possible!

WAITING TIME

specifies the waiting time between the individual commands.

HEAD SHIFT IN X DIRECTION

indicates the motion path of the machining head in the # X direction during tool exchange or tool change# (manual replacement in tool box).

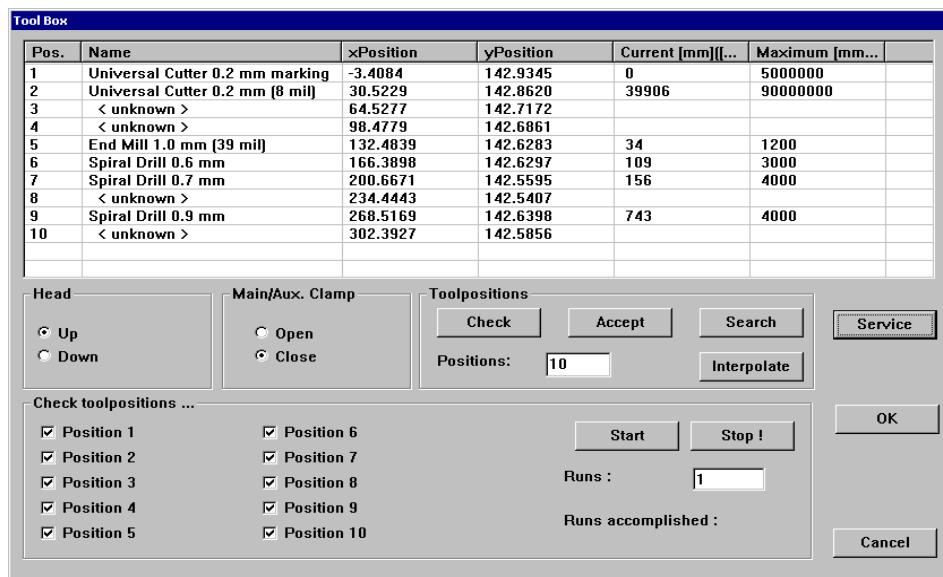
The status of the two combo boxes **EXCHANGE CLAMP** and **MAIN/AUX. CLAMP** must correspond to the status when the tool box was opened, because otherwise it is not possible to exit the **TOOL BOX DISPLAY**.

The check box **PNEUMATIC VALVE DOWN** can be activated to raise the tool box manually, e.g. check the tool changing positions.



Note! The circuit board plotter must be switched on and connected to exit the TOOL BOX WINDOW.

Figure 90: Tool Box Dialog S62



The TOOL BOX dialog provides information about the tool magazine of the machine. Moreover, properties can be modified.

Within the tool list, modifications may be made for Name, XY Position, life cycle.

Press the SERVICE button: you are asked to enter the service password. Subsequently all control elements that were so far inactive are then represented as active.

CHECK:

The position of the selected tool is checked. If there is no tool selected, the first position will be checked. The head with the camera moves to the set position.

ACCEPT

The values entered in the list are stored.

SEARCH (only possible with camera option)

Tool positions are newly measured.

INTERPOLATE

The positions are detected using the interpolation method. Basis values are the first and the last position. If you have made modifications, then you must press ACCEPT to store the values.

9.6.2.1 Checking and adjusting the tool positions by means of the camera

It may be necessary to check and adjust the tool positions in the magazine if there are problems occurring during tool change.

- › In order to check and adjust the tool positions of the magazin by means of the camera, first remove the tools from the magazine.
- › Put empty rings (measure inserts, supplied with the machine) into the tool holder positions.
- › Close the hood
- › In the menu bar choose **CONFIG** and then **TOOL BOX** to open the tool dialog box. (A first setting is already stored stemming from the first installation of BoardMaster at the factory site).
- › Press the **SERVICE** button
You are asked to enter the password
- › Enter password BMMASTER
- › Press button **SEARCH**

A message appears enquiring if measure inserts are placed in the tool holders. Confirm with Yes.



The ProtoMat plotter automatically starts the measurement program and the camera checks the tool holder positions from 1 to 10. This process may take up to 15 seconds for each position.

At the end of the measurement process the message appears that the position read is done. Confirm with OK.



- › Quit the tool dialog with **OK**
- › Open the hood and use a pointed tool (e.g. a small screw driver) to remove the tools from the tool magazine.
- › Open the tool magazin dialog under **CONFIG** in the menu bar
- › Confirm the enquiry „Move to pause position“
- › Insert the tools again in the tool magazine according to the tool list.

- › The measured settings are stored in the INI file. Quit and restart BoardMaster so that the values are taken over.



Note! If there occurs a disturbance during the measurement and no value can be measured for a position or the image in the camera field is blurred, it may be necessary to adjust the focus of the camera.

9.6.2.2 Checking and adjusting the tool positions without camera

The tool magazine must be completely filled with tools in order to check and adjust the tool positions in the magazine without a camera. The hood must be closed.

- › In the menu bar press **CONFIG** and then **HEADS**

There must be no offset entered in this field, should there be entered an offset then replace it by entering value zero.

- › Press the **SERVICE** button

The password is enquired

- › Enter password BMMASTER

- › Use the mouse key to displace the dialog box to the bottom of the screen, as you need to have access to the menu bar.

- › Use the mouse key to click on the first position in the tool list

- › Press **CHECK**

The machine moves to the first position of the tool magazine.

- › Enter a high step width, e.g. 35 mm, in the main dialog under Z

- › Press button **MOVE IN - Z DIRECTION**

The machine head moves downward

If the correct value is adjusted, the machine head moves completely to the bottom and upward again without the tool getting stuck in the collet or being removed from the magazine.

If the value is not correctly adjusted and the machine head does not move downward completely or the tool gets stuck, then modify the values for X or Y in the main dialog using small step widths of 0,1 mm and test by renewed moving of the head until the head can move downward completely and without problems.

- › Store the correct value by pressing the button **ACCEPT**.
- › Do the same for each tool holder position.
- › At the end quit the tool dialog box with **OK**
- › *Quit BoardMaster and start it again so that the values stored in the INI-file are taken over.*

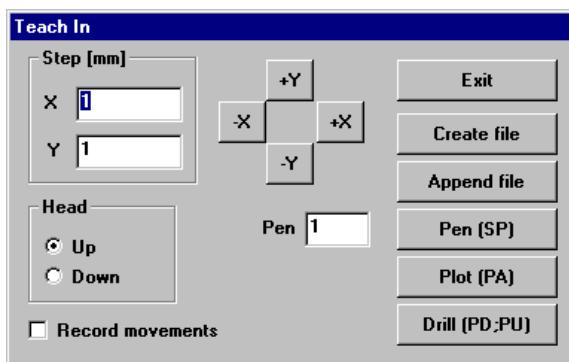
9.6.3 Teach-In Dialog Box

The following chapter does not apply to the ProtoMat H100!!!

BoardMaster offer the possibility of programming drilling and milling data from a template (film or circuit board) with the aid of a Teach-In process. For this purpose, fasten the template to the circuit board plotter and move to the individual positions to be programmed with the aid of the camera image in LPKF CircuitView (option). The HP- GL file completed in this manner can be read into *BoardMaster* after programming and output to the circuit board plotter.

When **TEACH-IN** in the **EDIT** menu is called, the following dialog box appears.

Figure 91: Teach-In



STEP [MM]

The values entered under **X** and **Y** [mm] indicates the distance moved when the motion buttons (+X, -X, +Y and -Y) are pressed once. To program the holes in an IC enter a value of 2.54 mm here. This corresponds to a pad interval of 1/10".

HEAD:

The command for lifting or lowering the head can be programmed by clicking one of the two radio buttons (**UP**, **DOWN**). The head remains in the selected position until the other radio button is activated. This function is not used to create a drilling file, but only for programming milling or contour data.

RECORD MOVEMENTS:

All movement command are stored in the selected file when this check box is activated.

PEN:

The pin number entered in this editing field is written to the selected file as the **Select pin** command. This allows all drilling data even with different diameters to be combined in one drilling file. Example: Pin 1 for 0.7mm, pin 2 for 0.9 mm, etc.

+X, -X, +Y, -Y:

These buttons serve for moving to a desired position. If one of these buttons is clicked, the machining head moves in the selected direction by the value entered under **STEP**.

EXIT:

Clicking this button discontinues the Teach-In process and closes the recorded drilling or milling file.

CREATE FILE:

After clicking this button *BoardMaster* requests entry of the name of a file in which the data to be programmed are to be stored. Here, it is possible to either create a new file or to write over a file already present.

APPEND FILE:

Pressing this button, selects a drilling or milling file which already exists to which the additional drilling or milling data are to be appended. The new data are appended at the end of the selected file.

PIN [SP]:

The pin or tool number selected under Pin is added to the drilling or milling file as the Select Pin (SP) command when this button is clicked. It serves for differentiation of the individual drill diameters.

PLOT [PA]:

With the aid of this button, the head (when **RECORD MOVEMENT** is switched off), can be moved at angles not equal to 90°.

DRILL [PD;PU;]:

Press this button to program a hole at a position moved to previously. This causes the command sequence **Pen Down, Pen Up** to be written into the file. This command chain corresponds to a drilling command for the circuit board plotter.

Procedure

- › Fasten the template (film or circuit board) on the circuit board plotter as parallel as possible to the axis
- › Open the **TEACH-IN** dialog box in the Edit menu
- › Press the key **CREATE FILE** to create a file in which the data is to be stored. Enter a name for the file.

After you have entered the corresponding name, the **TEACH-IN** dialog box reappears.

- › Switch on the option **RECORD MOVEMENTS**, before starting the reading operation.

The file to be created is an HPGL file meaning that it is also written according to the syntax for an HPGL file.

- › First enter the desired pin number under **PIN** and then click the **PIN (SP)** button.
- › Then move with the aid of the motion keys (+X, -X, +Y, -Y) to the hole positions to be read in and press the **DRILL (PD;PU)** button.

- › After reading in all of the required holes, the data is stored automatically, you can exit the **TEACH-IN** dialog box by pressing the **EXIT** button.

The coordinates recorded are then available in the HPGL file created previously.

- › Now select **IMPORT - HPGL TO - NEW LPR...** in the file menu, select the HP-GL file just created and enter a name for the new LPR project
- › To produce something with this newly created file using *BoardMaster* and the machine, open the **EDIT PROJECT** dialog box to assign all required product phases and tools to the HP-GL file.#

Moreover, set the unit corresponding to the machine resolution (e.g. 0.0079375) in the **EDIT PROJECT** dialog box (this value is also given in the settings **SETTINGS DIALOG BOX** in the **CONFIGURATION** menu).

Please do not forget to reset the unit back to the original value after completion of this operation.

- › Then continue as with LMD files imported from CircuitCAM.

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