# Application wizard

# User's Manual

**Version 1.0**

ROFIN-SINAR LASER

THE MARK OF EXCELLENCE

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This manual describes the status of this product at the time of publication. It does not necessarily reflect future versions of the product.

This original manual is in German. Manuals in other languages are translations of the original manual.



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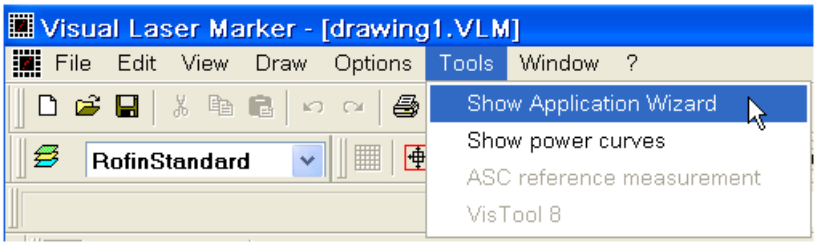
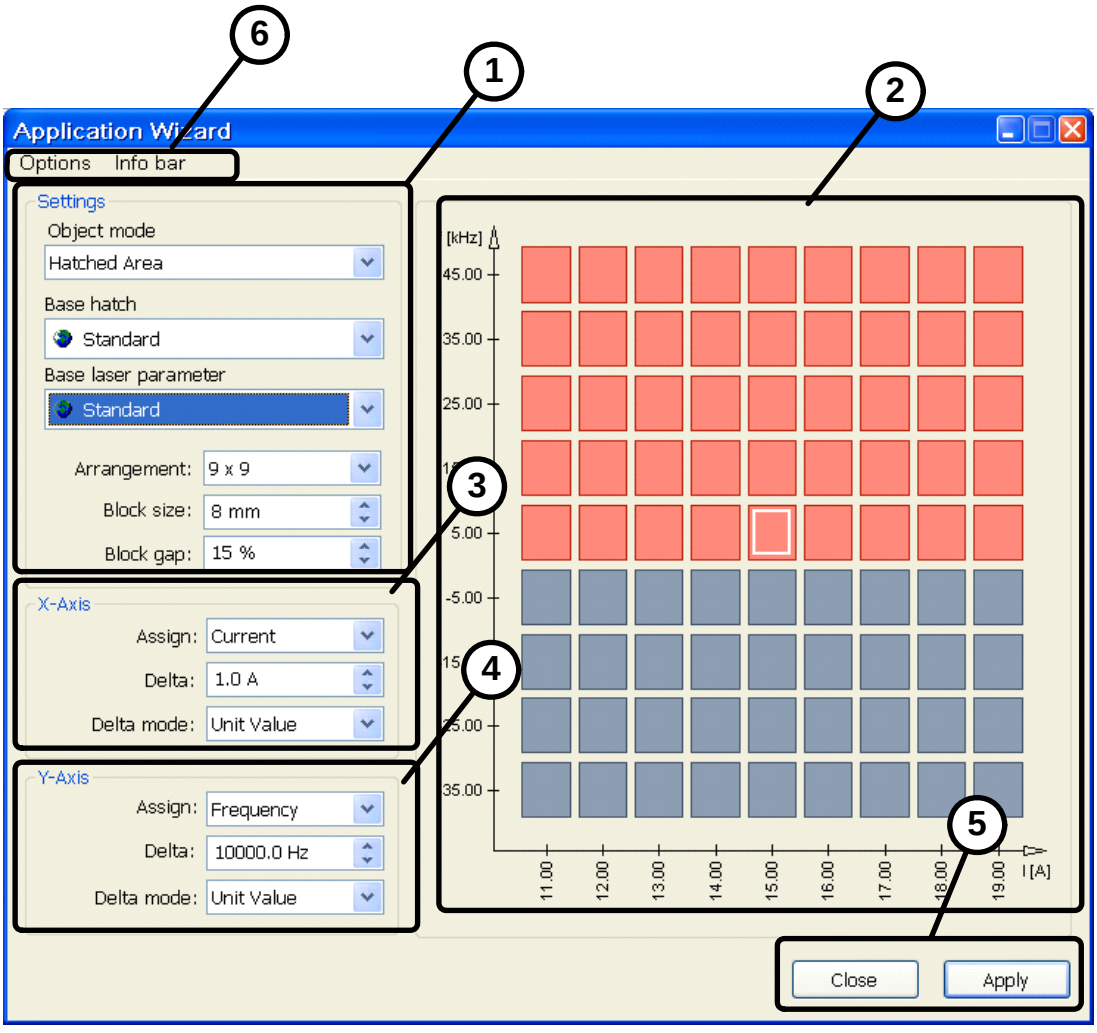
# 1 Introduction

The application wizard assists in finding the correct laser parameters for the optimal marking result on the material to be marked. Different laser parameters can be quickly and easily assigned to a defined number of boxes, in a matrix. The matrix is transferred directly into the drawing and the material can be marked with the matrix from the VLM program. The laser parameters can be graduated increasingly finely from test marking to test marking, until one of the boxes contains the set of laser parameters for an optimum marking result. This set of laser parameters can then be saved, making it available for all drawings.

The application wizard is opened in the VisualLaserMarker Editor menu under Tools > Show application wizard:



| | |
|---|---|
| Settings ① | |
| Object mode | Select whether it is a hatched surface, lines or a specific drawing object to be marked. |
| Basic hatch parameters | Select a hatch parameter. |
| Basic laser parameters | Select an existing global set of laser parameters. |
| Alignment | Specifies the number of boxes in the matrix (is always a square made up of an uneven number of boxes). |
| Block size | Specifies the side lengths of the boxes for the marking. |
| Block spacing | Specifies the side lengths of the boxes for the marking. |
| Matrix display ② | Using the selected laser parameters and their values and units on the X and Y axes<br>red box: Parameters are in the range in which the laser can operate<br>blue box: Parameters are outside the range in which the laser can operate<br>white frame: identifies the box located precisely in the middle of the matrix. |
| X-axis ③ | |
| Assignment | Select the laser parameter for the X axis of the galvo mirror. |
| Delta | Specifies the increments in which the laser parameters are to change on the X axis from box to box. |
| Delta mode | Specifies whether the value on the X axis is to change in the same increments (set via unit or percent) or exponentially. |
| Y-axis ④ | |
| Assignment | Select the laser parameter for the Y axis of the galvo mirror. |
| Delta | Specifies the increments in which the laser parameters are to change on the Y axis from box to box. |
| Delta mode | Specifies whether the value on the Y axis is to change in the same increments (set via unit or percent) or exponentially. |
| Buttons ⑤ | |
| [Close] | Closes the application wizard<br>If changes were made since the last [Apply], these changes will be lost. |
| [Apply] | Transfers the application wizard matrix across as a drawing object into the VLM layout and saves the set values. When the application wizard is opened, the values set at the last [Apply] will be set. |
| Menus ⑥ | |
| Options | Select what additional information on the matrix (e.g. legends) is to be marked as well. |
| Info bar | Select the laser parameters whose values are to be marked as well (maximum of 4 possible). |

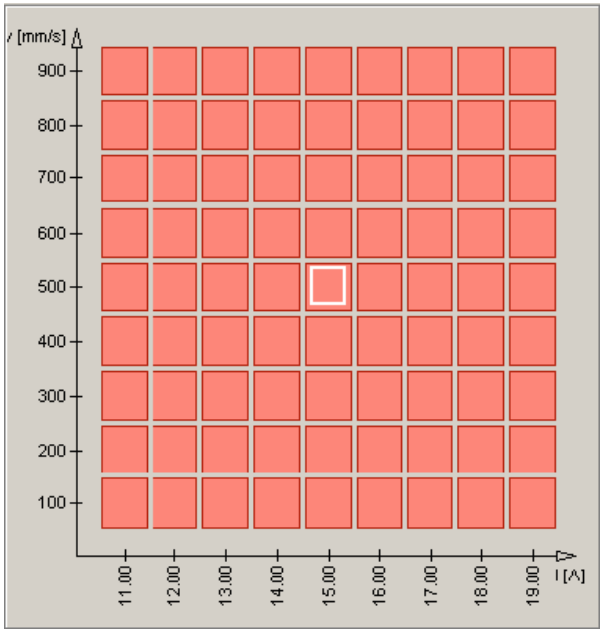
# 2 Functional Description

The sections below describe the effects of the various settings in the application wizard on the display in the application wizard window, and on the drawing and the marking result.

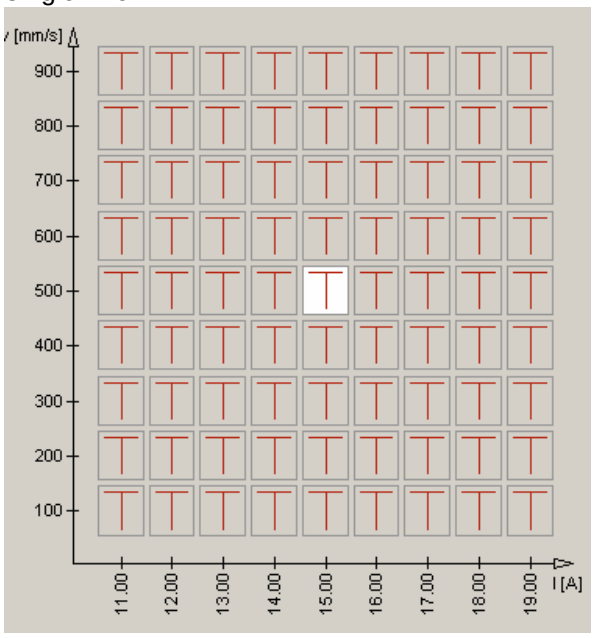
## 2.1 Surface to be marked

In the Settings section, the Object mode field is used to define whether the test marking is carried out with hatched surfaces (Hatched Surface), with lines (Single Line) or with a specific drawing object (Custom).

Hatched Surface:



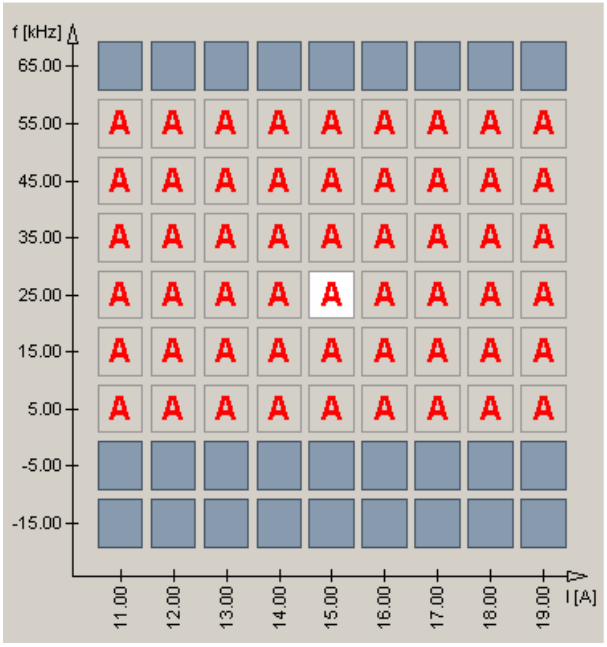

Single Line:

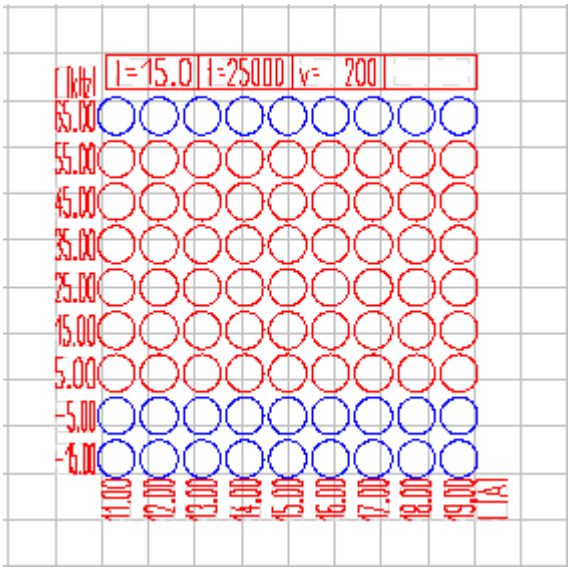



Custom type:

Display in the application wizard:

Display in the drawing:



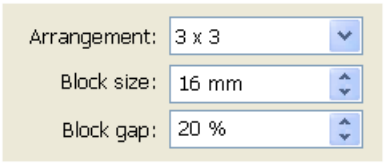



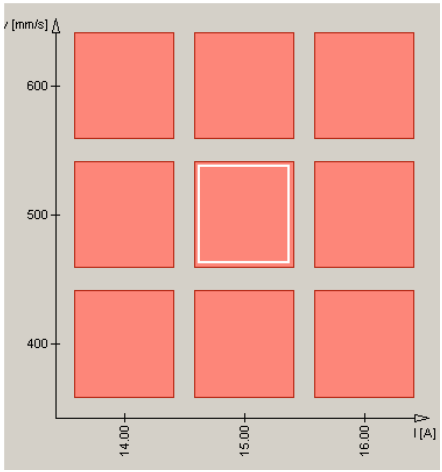

## 2.2 Matrix

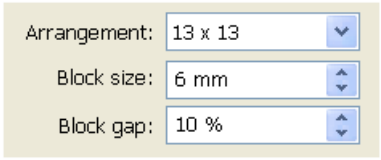
The matrix definition is set in the Settings section:

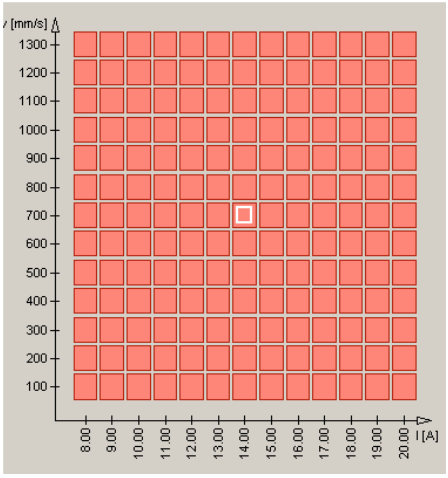
| | |
|---|---|
| Alignment | Number of boxes. There is always the same number of boxes on the X and Y axes. The number is uneven on both axes, meaning that the box is located precisely in the middle of the matrix. This box is identified with a white frame. After a laser parameter set is selected, the parameters from the basic parameter set are assigned to this box. |
| Block size | Side length of the boxes in mm (in the marking) |
| Block spacing | Distances between the boxes (percentage of the page length) |

**Examples:**






## 2.3 Additional information to be marked

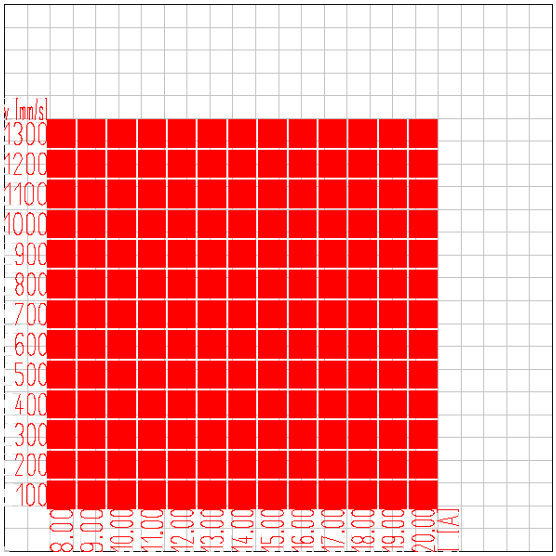
In addition to the matrix, the following can be transferred into the drawing and marked:

- Legends for X and Y axes
- Laser parameter values

The information that can be transferred into the drawing can be combined in any way and are set in the Options menu. All marking objects transferred from the application wizard into the drawing are pasted into the drawing as a grouped element with the name LPWIZARDGROUP.

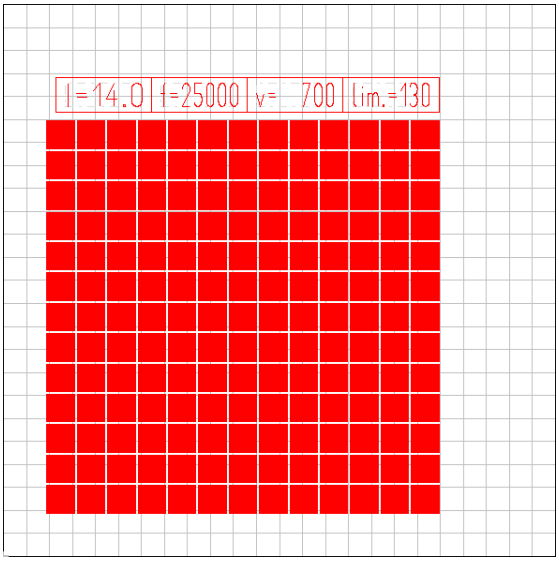
### Legends for X and Y axes

If Mark axis legend is selected, the legends for X and Y axes are transferred into the drawing and marked as well.

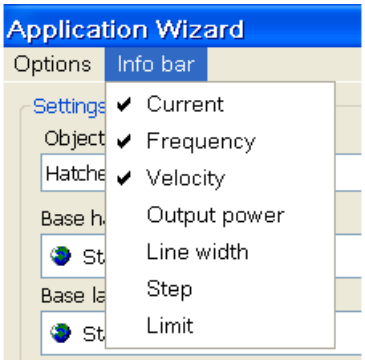


### Laser parameter values

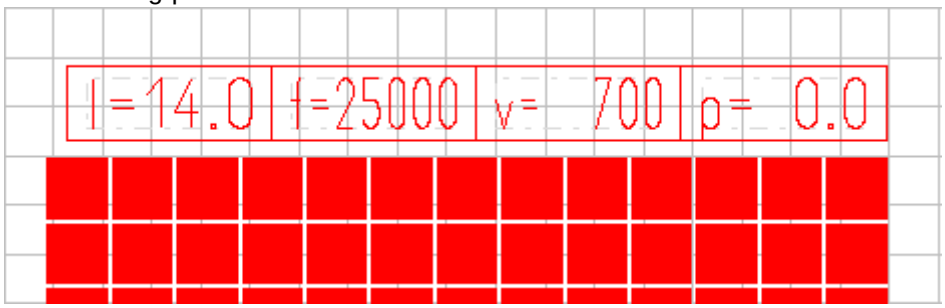
If Mark info bar is selected, the values of up to four laser parameters are transferred into the drawing.




If the Infobar has been activated, a section with four fields is generated above the actual application matrix as well. Each of these fields can be assigned to a laser parameter and is then automatically marked with the value of this parameter. Laser parameters are normally entered here that are not changed in the application matrix. In the Infobar menu, it is possible to select which laser parameters are to appear in the infobar. If more than four parameters are selected here, only the first four are actually transferred into the drawing.



In this example, only the values for current intensity, frequency, speed and power are marked although the remaining parameters also have a checkmark:



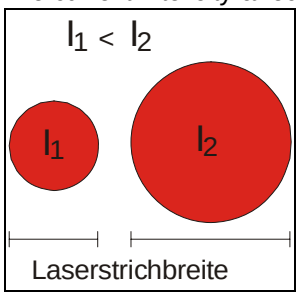

If the values for the laser parameters on the X and Y axes are located (in the example above, the current intensity and speed laser parameters) are selected in the Infobar menu, the value of the box positioned precisely in the middle of the matrix is displayed here. The remaining laser parameters have the same value for all boxes, and that value is displayed in the infobar.

## 2.4 Laser parameters

The laser parameters for the X and Y axis are set in the X axis and Y axis sections of the application wizard. The following seven laser parameters are available for both axes:

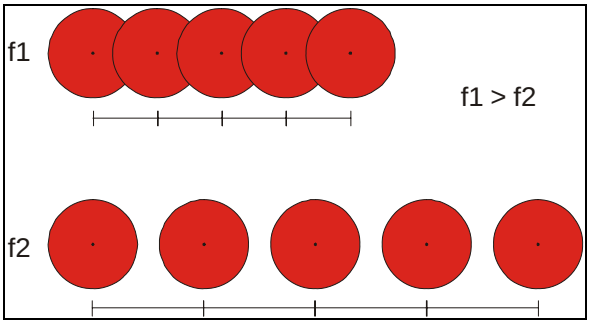
**Current intensity**

The current intensity affects the depth and contrast as well as the laser stroke width of the marking.




**Frequency**

The laser works by switching on and off briefly (Pulse). For this reason, it is not lines but individual dots that are marked. The higher the pulse frequency, the more closely the dots are positioned after one another, i.e the distances between the center points of the individual points become less. A line is produced where the dots overlap. The more the individual dots overlap, the greater the marking contrast.




**Speed**

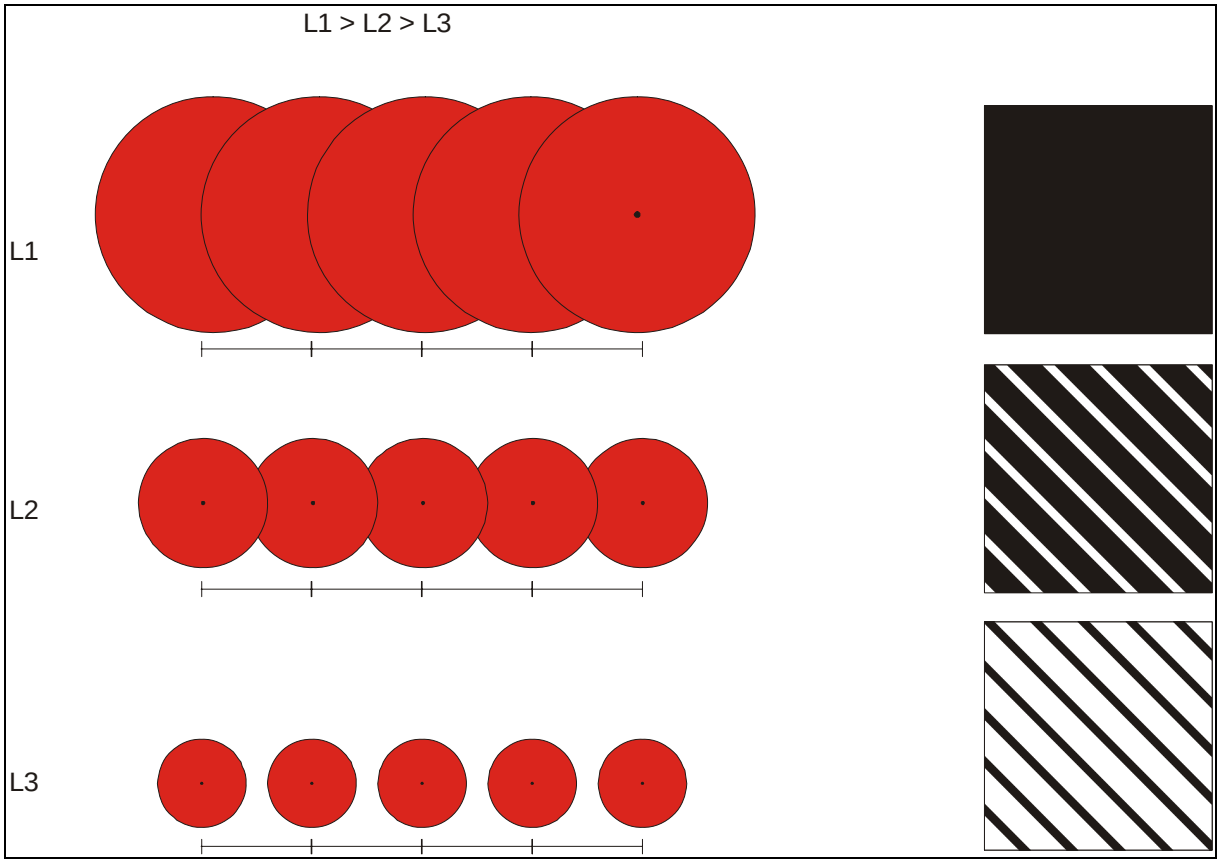
Marking speed on the work piece in [mm/s]. The marking speed determines the time required for marking a layout.

**Power**

The power diagram can be created by the "CreatePowerCurves" program. This program is provided by ROFIN and installed with the VLM software (Start > VisualLaserMarker > Tools > CreatePowerCurves). This data can be used to calculate the current that is required for a specific output power.
The Power parameter – like the current intensity – affects the contrast and line width of the marking.

**Line width**

The adjustable line width relates to the laser stroke width and is used in the application wizard to calculate the hatching thickness. If the line width parameter is increased, the diameter of the individual dots is greater. The distance between the center points of the individual dots does not change. This means that the distance between the individual lines is reduced in the case of hatched areas. If the diameter becomes so large that the dots of the hatching lines overlap considerably, a complete surface is marked.




The Line Width parameter is ideal for determining the minimum overlap value required, e.g. in plastic marking.

**First pulse suppression: Limit and step**

First pulse suppression prevents power bursts on the first laser pulses. The Limit parameter determines the proportion of the laser power that is suppressed in the first pulse. The Step parameter determines the value for the gradual removal of pulse suppression with each further pulse. The parameters for first pulse suppression depend on the current, frequency, speed and material.

The two parameters Limit and Step are used to calculate the number of pulses after which the first pulse suppression is removed:
Number of pulses = Limit / Step

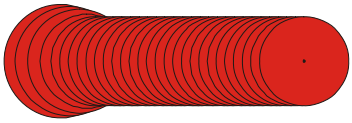
The table uses examples to show the number of pulses for different combinations of Limit and Step after which the first pulse suppression is removed in each case.

| Limit | Step | Number of pulses |
|---|---|---|
| 105 | 7 | 15 |
| 105 | 13 | 8 |
| 105 | 21 | 5 |
| 90 | 5 | 18 |
| 60 | 5 | 12 |
| 30 | 5 | 6 |

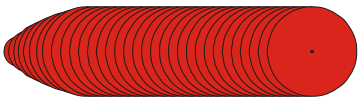
A good start value for calculating the best parameters for Limit and Step is: Limit 100 and Step 5.

With an optimal combination of Limit and Step, the marking is even from start to finish.

If the first pulse suppression is removed too quickly, or if the value for the Limit is too low, the laser is too thick at the start of the marking. This is reflected in the depth of marking and can result in damage to the material.



If the first pulse suppression is removed too late, or if the value for the Limit is too high, the laser is too weak at the start of the marking. This results in a weak line at the start of the marking. The marking may begin too late.



### Legends

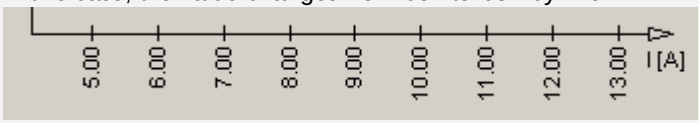
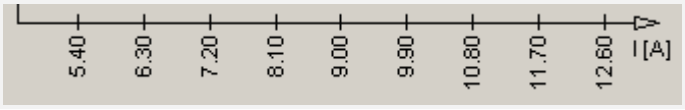
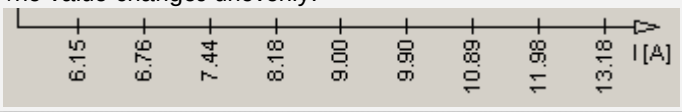
Once a laser parameter has been selected for an axis, the name of the parameter (where appropriate as an abbreviation) appear on the X or Y axis, as well as the unit, if available:

| Laser parameters | Abbreviation | Unit |
|---|---|---|
| Current intensity | I | A |
| Frequency | f | kHz |
| Speed | v | mm/s |
| Power | P | W |
| Line width | n.a. | mm |
| Limit | limit | n.a. |
| Step | step | n.a. |

If the Delta is changed, the values given on the X or Y axis change accordingly.

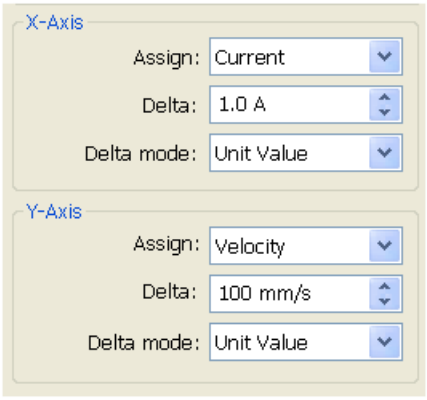
### Delta and Delta mode

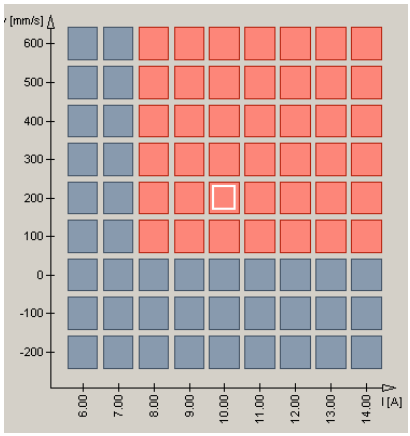
Delta mode specifies how the laser parameter value is to change from box to box. The Delta specifies the size of the steps with which the value changes.

| Delta mode | Description |
|---|---|
| Unit | The value changes in even steps. The difference from box to box is specified in the unit of the laser parameter value.<br>For example: Delta 1.0 A<br>In this case, the value changes from box to box by 1.0 A:<br>  |
| Percentage | The value changes in even steps. The difference from box to box is given in percent. The calculation is based on the laser parameter value for the box located in the middle of the matrix.<br>For example: The laser parameter value for the box in the middle is 9 A. 10% is set for the Delta.<br>The value changes from box to box by 0.9 A:<br>  |
| Exponential | The value changes exponentially. The difference from box to box is given in percent. The calculation is based on the laser parameter value for the previous value, starting from the middle of the matrix.<br>For example: The laser parameter value for the box in the middle is 9 A. 10% is set for the Delta.<br>The value changes unevenly.<br>  |

### Matrix

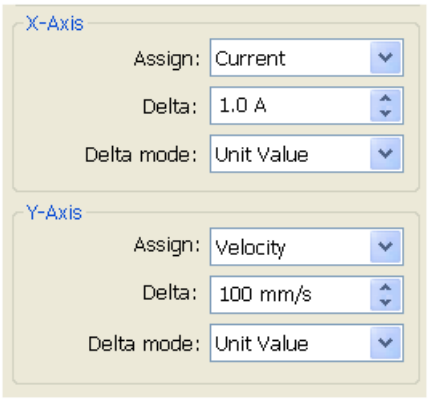
In the matrix, all boxes with laser parameter values that can be set by the laser are displayed in red. If there are values outside this range that the laser can set, these boxes are displayed in blue.

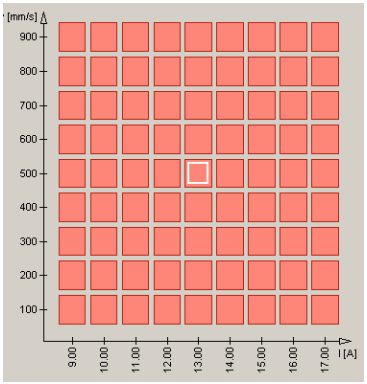



If there are blue boxes in the matrix, there are three options:

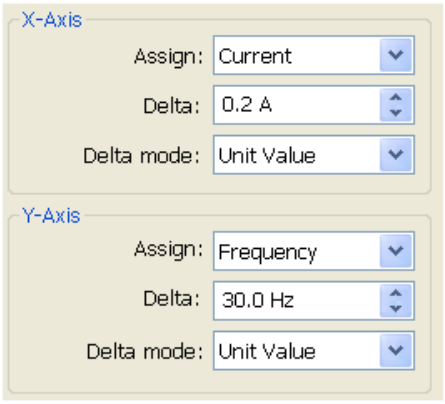
1. Define a new center point:
   Right-click and center the laser parameter set to define another box as the center point of the matrix, so that all other boxes are also in the area that the laser can cover (for more details, see section *'Running a test marking and optimizing the result')*.

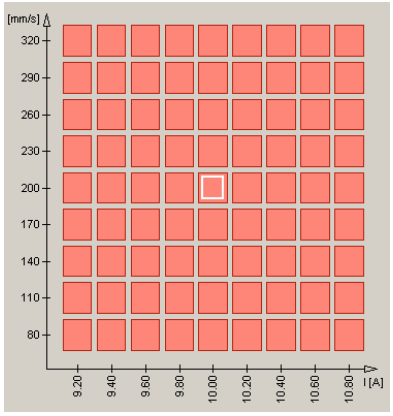



   In this example, the center is at 500 mm/s and 13 A, whereas it was previously at 200 mm/s and 10 A.

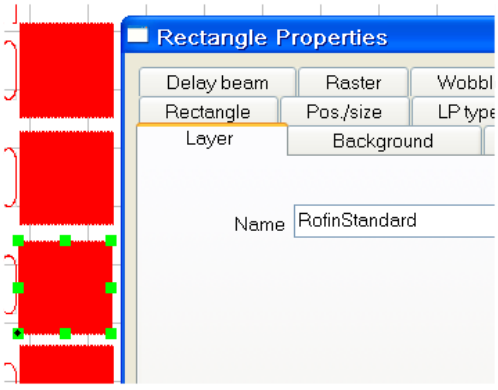
2. Adjust Delta:
   In the **Delta** section, change the steps that specify the difference in the laser parameter value from box to box so that all boxes are in the area that the laser can cover.

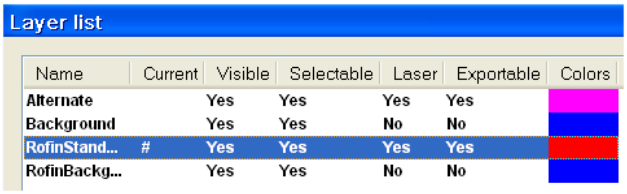


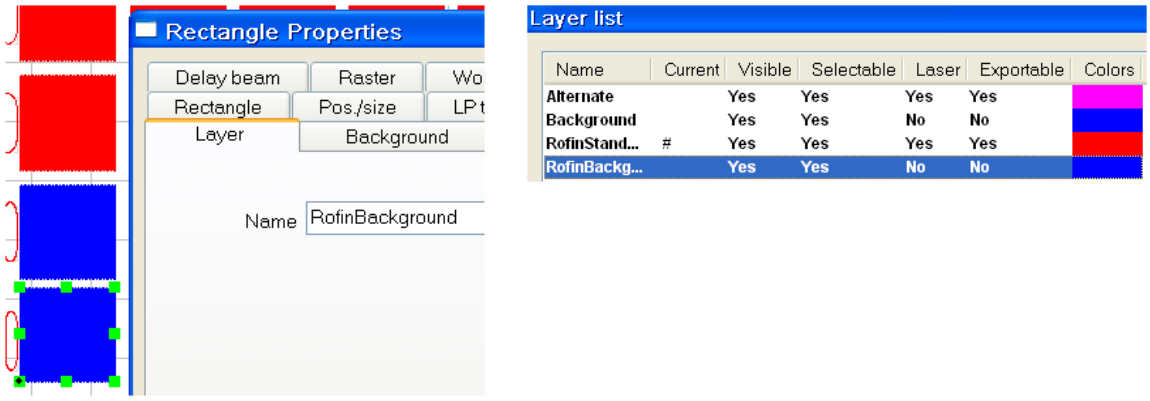




In this example, the middle is still at 200 mm/s and 10 A, but the Deltas for both laser parameters have been reduced considerably to 0.2 A or 30 mm/s so that the matrix instead of originally -200 mm/s to 600 mm/s and from 6 A to 14 A now goes from 80 mm/s to 320 mm/s and from 9.2 A to 10.8 A.

3. Accept matrix unchanged
   The matrix can also be transferred into the drawing unchanged. In this case, all blue boxes, after the object grouping has been removed, are saved on a different layer from the rest of the matrix. Whereas the red box and all other information to be marked (see '*Additional information to be* marked' section for more details) are saved on a laserable layer, the blue boxes are saved on a non-laserable layer and thus skipped when the marking is carried out.






In this example, the red boxes are on the "RofinStandard" layer which is marked in the layer list as laserable. The blue boxes are located on the "RofinBackground" layer which is identified as non-laserable in the layer list.

## 2.5 Application examples

Changes in the laser parameter values affect the marking result. The table below shows several of these effects. As the marking result always depends on the combination of all laser parameters, for example, changing an individual laser parameter value is often not adequate for the optimum marking result.

| Laser parameters | Change | Effect |
|---|---|---|
| Current | increase | The marking is wider and lower in the material. |
| | decrease | The marking becomes thinner and weaker. |
| Frequency | increase | The marking contrast on the material increases. With plastic in particular, a high frequency is recommended. |
| | decrease | The marking is lower contrast. |
| Speed | increase | The marking is completed more quickly. |
| | decrease | The making takes longer. |
| Power | increase | The marking is wider and lower in the material. |
| | decrease | The marking becomes thinner and weaker. |
| Line width | increase | The distance between the individual lines of the hatching decreases. With a very low distance or if the individual lines overlap, the hatching is no longer visible and a surface is produced. |
| | decrease | The distances between the lines in a hatched area become larger. The hatching becomes increasingly clear, the larger the line width. |
| Limit | increase | The proportion of laser power suppressed with the first pulse becomes larger, and the laser output becomes lower. |
| | decrease | The proportion of laser power suppressed with the first pulse becomes lower. Marking is started earlier. |
| Step | increase | The first pulse suppression is removed more quickly. |
| | decrease | The first pulse suppression is removed more slowly. |

### Interrelationship between current, frequency and line width

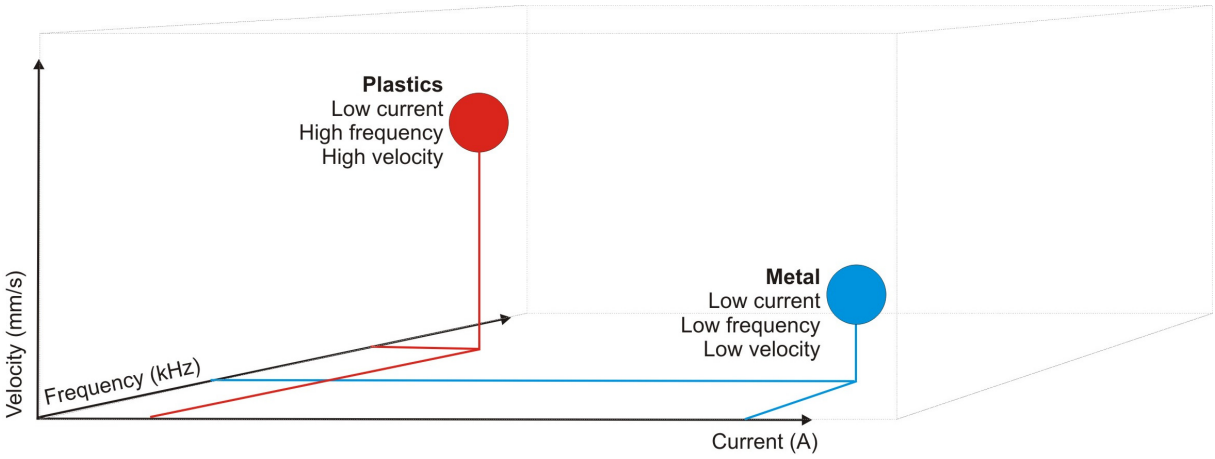
With marking, the contrast is too strong or even slight damage occurs. In this case, the laser parameters for current and/or frequency must be decreased. To find the optimum set of laser parameters, it is therefore advisable to define a matrix with the two parameters of Current and Frequency.

It is possible that the line width is also set too high, meaning that there are too many overlaps of the individual dots. Another option would therefore be to define a matrix with Line Width and Current or Frequency.

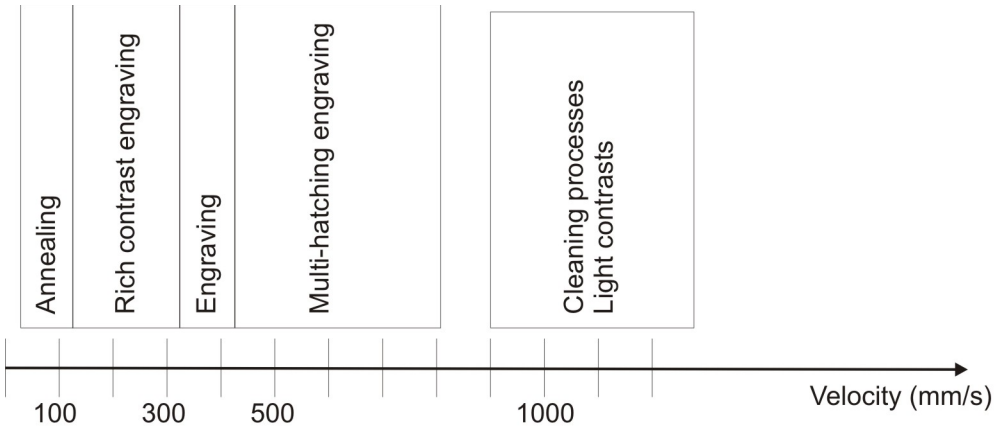
### Interrelationship of current, frequency, speed and material

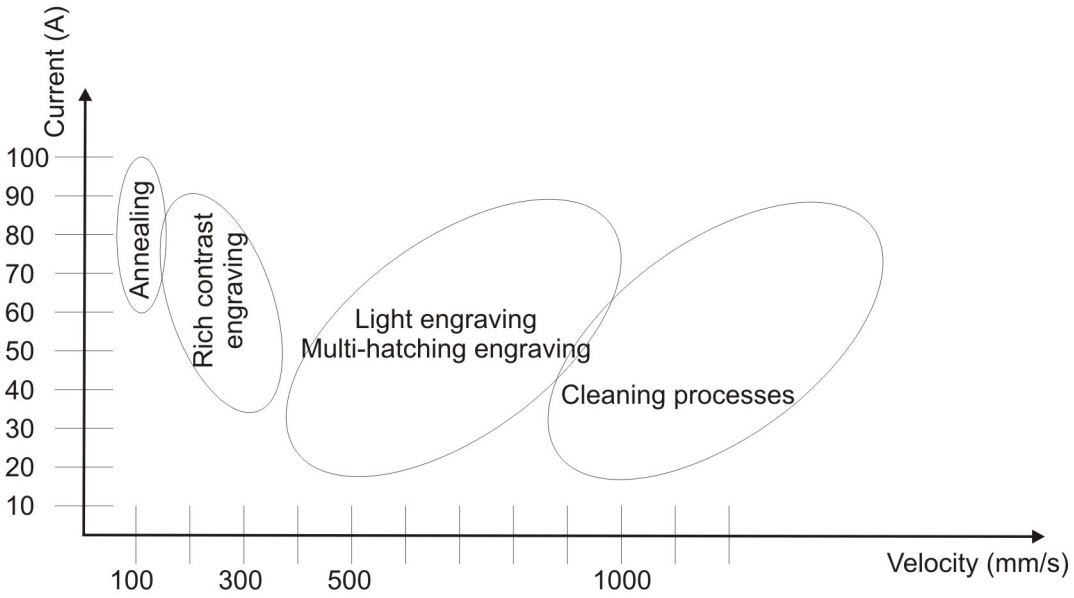
In most cases, the working point of Current, Frequency and Speed are calculated at the start.

The graphic below indicates approximately how the parameters of Current, Frequency and Speed differ for the plastic and metal materials.



In metal processing in particular, several speed ranges are already known:



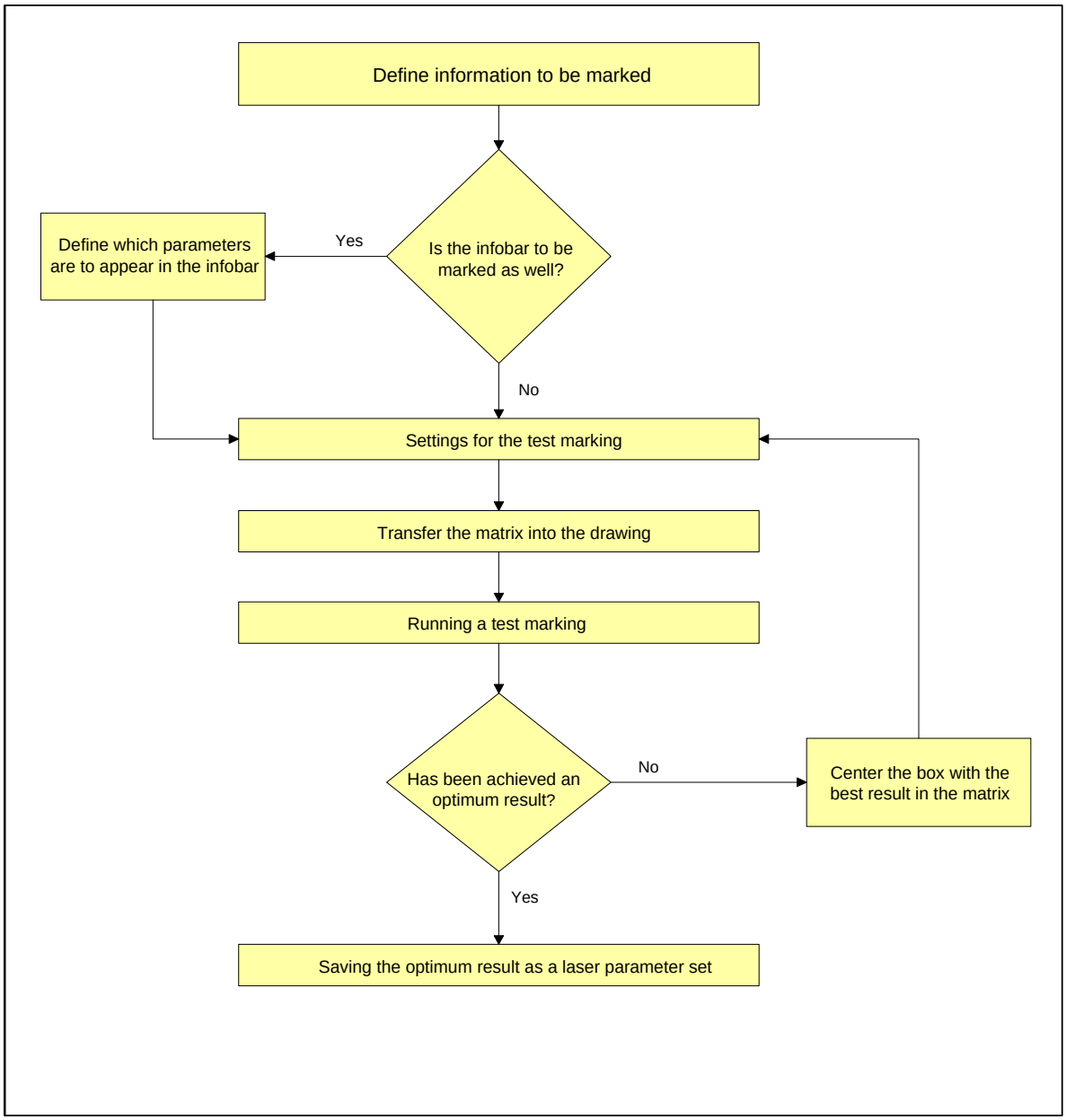

If the speed is to be optimized, select a current value of approx. 80% of the maximum current value and vary the speed and frequency.

If the quality is to be optimised, and the process time is known, select variations of current and frequency for the lowest possible speed.

If the frequency range is known (e.g. for reasons of specific physical properties), select variations of current and speed.

# 3 Finding and saving the optimum set of laser parameters

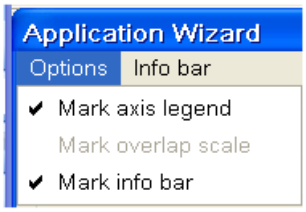
To find the optimum set of laser parameters for the material to be marked, the laser parameters always need to be adjusted and test markings carried out. The graphic below shows the sequence:



## 3.1 Define information to be marked

Use the Options menu to define what information is transferred into the drawing and is thus also marked.
A checkmark in front of the option means that the option is also marked.

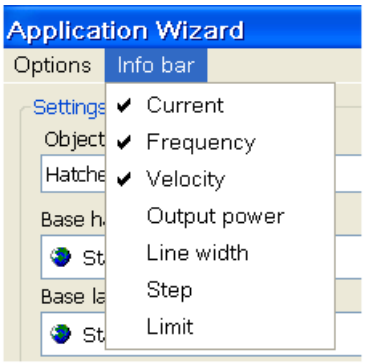
- Select Options > Mark axis legend to mark the X and Y axes legends as well.




- Select Options > Mark infobar to mark the information on multiple laser parameters used.

If the Infobar is to be marked as well, set in the Infobar menu for which laser parameters the values are to be marked. A maximum of four values can be marked. If more than four laser parameters are selected in the Infobar, only the values for the first four laser parameters are also marked. A checkmark in front of the laser parameter means that the particular laser parameter value is also marked.

- Select Infobar > Current
  to mark the value for the current intensity.
- Select Infobar > Frequency
  to mark the frequency value with which the laser pulses are generated.
- Select Infobar > Speed
  to mark the value for the marking speed on the workpiece as well.



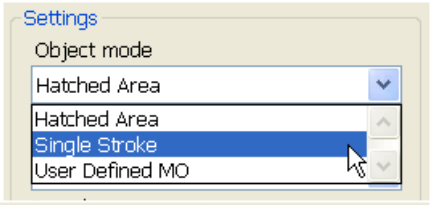

- Select Infobar > Output power
  to mark the value for the power.
- Select Infobar > Line width
  to mark the value for the laser line width.
- Select Infobar > Step
  to mark the value for the steps with which to remove the suppression as well.
- Select Infobar > Limit
  to mark the value for the thickness of the suppression as well.

» *For more information on the Options and Infobar menus, read the 2.3 section.*

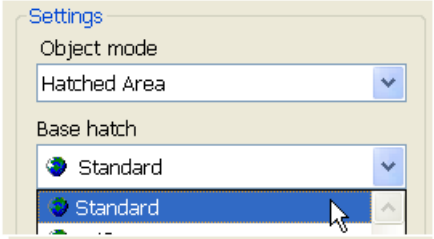
## 3.2 Settings for the test marking

In the application wizard window, you can set how the matrix to be marked is to look, in which two laser parameters are to intersect the matrix boxes and how large the differences are to be in both these laser parameters from box to box.
If a specific drawing object is to appear in the matrix, the drawing object (e.g. a circle) must be inserted into the drawing and selected. Then open the application wizard and select Custom in the object mode section.

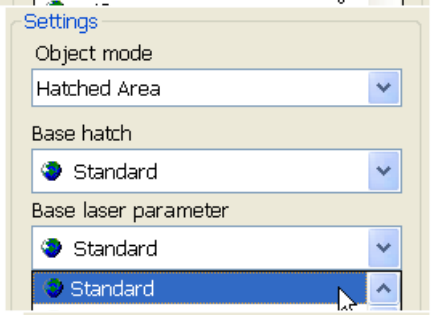
- From the Object mode dropdown list, select whether hatched surfaces, lines or a drawing object are to be marked.
  The matrix view will be updated.




- From the Basic hatching parameters dropdown list, select a hatching parameter set or a line width.
  All hatching parameters available under Options > Hatch parameter settings > Global HP table... are displayed in the dropdown list.

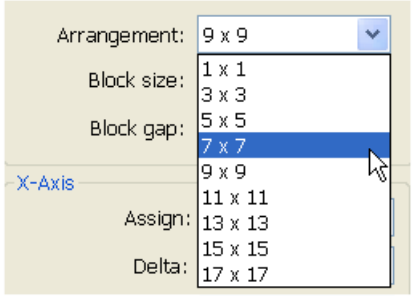



- From the Basic laser parameters dropdown list, select a laser parameter set that has appropriate values for the material to be marked.
  These laser parameters are allocated to the box that is located precisely in the middle of the matrix (identified by a white frame).




- From the Alignment dropdown list, select the number of boxes for the matrix.
  The matrix view will be updated.

  ROFIN recommends a matrix between 5x5 and 9x9 for optimum results.

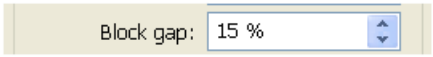



- Change the page length (in mm) for the boxes in the matrix via the arrows or manual input in the Block size field.
  Smaller box sizes save space and thus permit other test markings on the same workpiece.

  The matrix view will be updated.

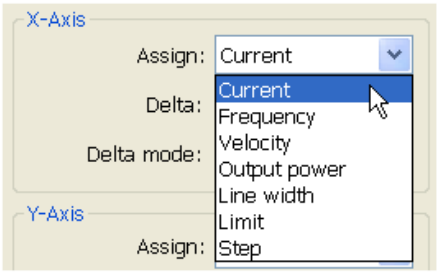
- Change the distance (in % relative to the specified page length) between the boxes via the arrows or manual input in the Block gap field.

  The matrix view will be updated.



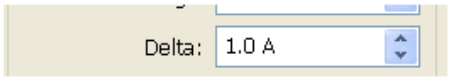

- Select the laser parameter for the X axis.

  The legend will be updated.



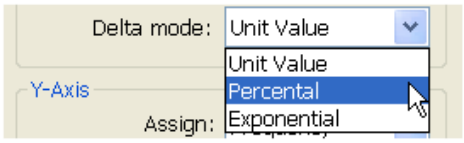

- Define the increments in which the laser parameters are to change on the X axis from box to box.

  The legend will be updated.



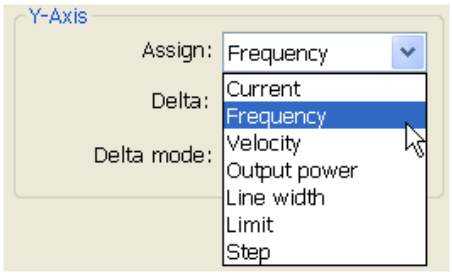

- Define whether the laser parameters are to change from box to box in equally sized steps (unit), percentage, or exponentially.

  The legend will be updated.




- Select the laser parameter for the Y axis.

  The legend will be updated.

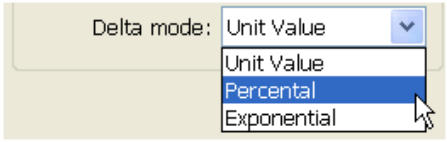



- Define the increments in which the laser parameters are to change on the Y axis from box to box.

  The legend will be updated.


- Define whether the laser parameters are to change from box to box in equally sized steps (unit), percentage, or exponentially.

  The legend will be updated.



## 3.3 Accepting settings into the VLM layout

Once all the settings have been made, transfer the matrix with the laser parameters into the drawing.

- Click on [Accept].

  The matrix with the information to be marked is displayed in the drawing. The laser parameters for the boxes differ in the laser parameters defined for X and Y axes. All other laser parameters are identical for all boxes.

  The application wizard window remains open.

The group of marking objects generated can be edited just like any other group and like any other marking object in VLM, e.g. rotated, moved, reduced or enlarged.

## 3.4 Running a test marking and optimizing the result

Run a test marking, analyze and optimize the result.

- Mark the material with the matrix.
- Analyze the result.
- Select the box with the best result.
- Right-click on this box in the application wizard.
- Select Center laser parameter set.

  The box with the former best marking result is now positioned in the center of the matrix and identified with a white frame.


- Adapt the steps in which the laser parameter is changed from box to box, as described in the '*Settings for the test marking*' section, for both axes to obtain a finer raster.
- Accept the matrix as described in the '*Accepting settings into the* VLM layout' section. The drawing will be updated.

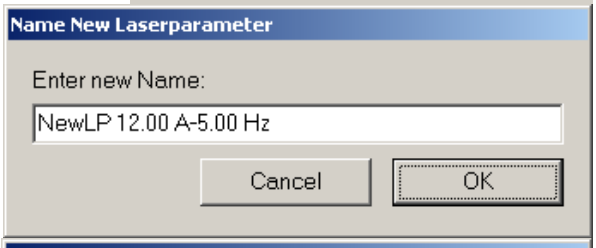
In this section, repeat the steps described until the laser parameter set for a box achieves the optimum result. Also adapt the remaining laser parameter as described in the previous sections.

## 3.5 Saving the optimum result as a laser parameter set

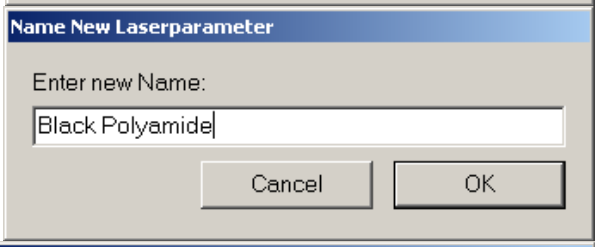
When you have found the optimum laser parameter set for the material, save these parameters, thus making the drawings available.

- Right-click on the box with the optimum laser parameter set.
- Select Generate laser parameter set to save the parameter set as a new global set of parameters.


The software suggests a name containing the values for the laser parameters of the X and Y axes. For example, NewLP 12.00 A-5.00 Hz when the optimum result has been achieved at 12 A and 5 Hz. The name can be edited.




- Enter a name for the laser parameter set, e.g. "Black Polyamide".
- Click on [OK].




The laser parameter set is now available in the global laser parameter table under Options > Laser parameter settings > Global HP table....

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