VLM

Supplement of Software Description
Marking on the Fly

Version 4.4

ROFIN-SINAR LASER

THE MARK OF EXCELLENCE

CONTENTS

1 Introduction 1
1.1 Background the manual assumes 1
1.2 General 1
1.3 Modes 1
2 Operating instructions 3
2.1 General 3
2.2 Marking on the fly using VLM or VMC2 4
3 Setup 5
3.1 Configurator settings 5
3.2 Marking on the fly parameters 7
3.3 To set the moving direction: 9
3.4 To mark efficiently: 9
3.5 To calibrate encoder step: 10
3.6 To validate conveyor belt velocity: 11
3.7 To setup a long drawing: 12
3.8 To set height of work pieces: 16

1 Introduction

1.1 Background the manual assumes

The user is recommended to read ***VLM*** and ***VMC2*** manuals, the latter one is optional.
Service personnel is assumed to be well-versed with ***Laser Console***, in particular, ***Configurator*** settings.

1.2 General

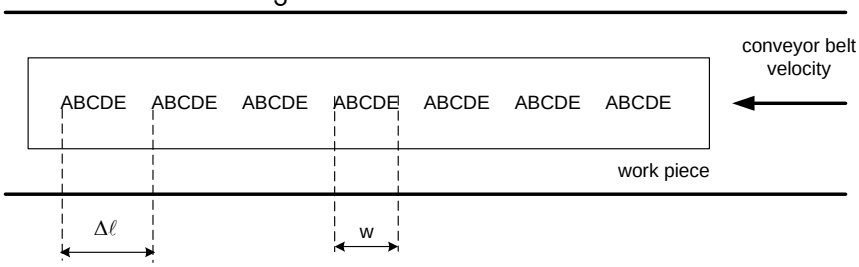
VLM can mark a series of work pieces moving on a conveyor belt. The velocity v [mm/s] of the conveyor belt does not need to be constant. ***VLM*** keeps track of velocity changes in real time using a rotation encoder, i.e. a rotary transducer records the angular velocity of the roller driving the conveyor belt. The belt is assumed not to slip on the roller, of course. ***VLM*** takes into account the conveyor belt velocity v when controlling galvo mirrors.
A work piece passing the light barrier before the galvo field initiates laser marking after moving an appropriate distance called start offset Δs.
Laser marking is possible only while a work piece is within the galvo field, of course. However, ***VLM*** can mark drawings whose length greatly exceeds the length of the galvo field, for instance, a long line of text on tubes or cables.
A work piece must not move out of the galvo field while laser marking is in progress, otherwise, ***VLM*** will cancel marking. There is no simple formula for calculating maximum conveyor belt velocity, its numerical value depends on how much details a drawing comprises. Hence conveyor belt velocity has to be validated during setup.

1.3 Modes

VLM offers several modes for marking on the fly:

- Index trigger (standard)
  - With repetition (loop):
    This mode is the most common.
    The laser marks a selected drawing on a series of work pieces passing the light barrier successively. The number of work pieces to be marked is not limited. Variables such as current date and time as well as serial numbers are an optional feature. ***VLM*** queues up to 16 marking events, i.e. up to 16 work pieces might be between light barrier and the galvo field. The user has to set the loop feature for a selected drawing in ***VLM***.
  - Without repetition (no loop):
    The laser only marks one work piece.

- Length trigger (long work pieces, e.g. tubes or cables). To acquire the length of a work piece, this mode requires an external stop signal of a second light barrier or a stop key.
    - External loop:
      Same procedure as index trigger with loop, but a long work piece passing the light barrier triggers laser marking of a series of drawings on the current work piece at a spacing Δl called repetition gap. More precisely, Δl denotes the periodicity length, which has to exceed the width w of any drawing to be marked.
    - Internal loop:
      Same procedure as described above, but ***VLM*** does not refresh drawings while marking a series of work pieces. To mark a cable continuously, set Δl to the width w of the selected drawing.



- Simulate counter (setup only):
  The laser shutter should be closed and the rotation encoder is switched off. Service personnel can check whether a chosen conveyor belt velocity v is appropriate for a selected drawing.

2 Operating instructions

2.1 General

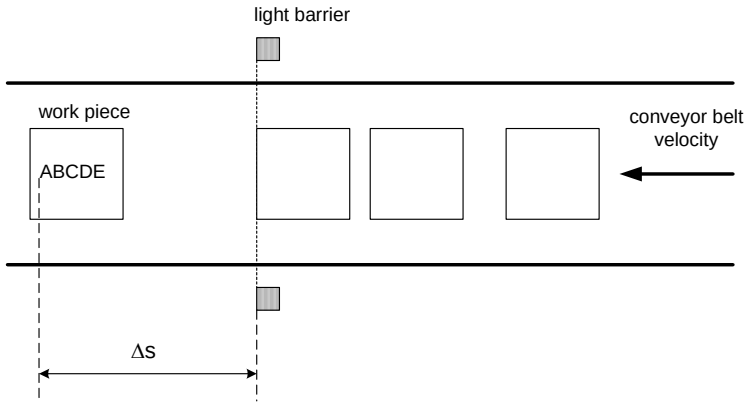
To switch on the marking on the fly mode for a selected drawing:

1. Open the drawing file to be marked in ***VLM***.

The user can import `LOGO` or `XML` drawings. However, he has to save them in `*.VLM` file format to retain their marking on the fly settings.

2. Select **Drawing settings** from the **Options** menu of the main window.
3. Click the **Options** tab.
4. Tick the **On the fly** check box.
5. (Applies to length trigger-external loop and (optional) index trigger) Tick the **Execute drawing in a loop** check box.
6. Click **Apply**.
7. Save the drawing in `*.VLM` file format.

The user can add a serial number or current date and time to a drawing, see ***VLM*** manual, chapter ***Extended functions for object editing***, section ***Working with variables***. Serial numbers require executing drawings in a loop.



During setup, service personnel can stop the conveyor belt and clear the **On the fly** check box to measure the distance Δs between ***VLM's*** starting point of a selected drawing and the light barrier. ***VLM*** marks a work piece being at rest without the OTF feature.

2.2 Marking on the fly using VLM or VMC2

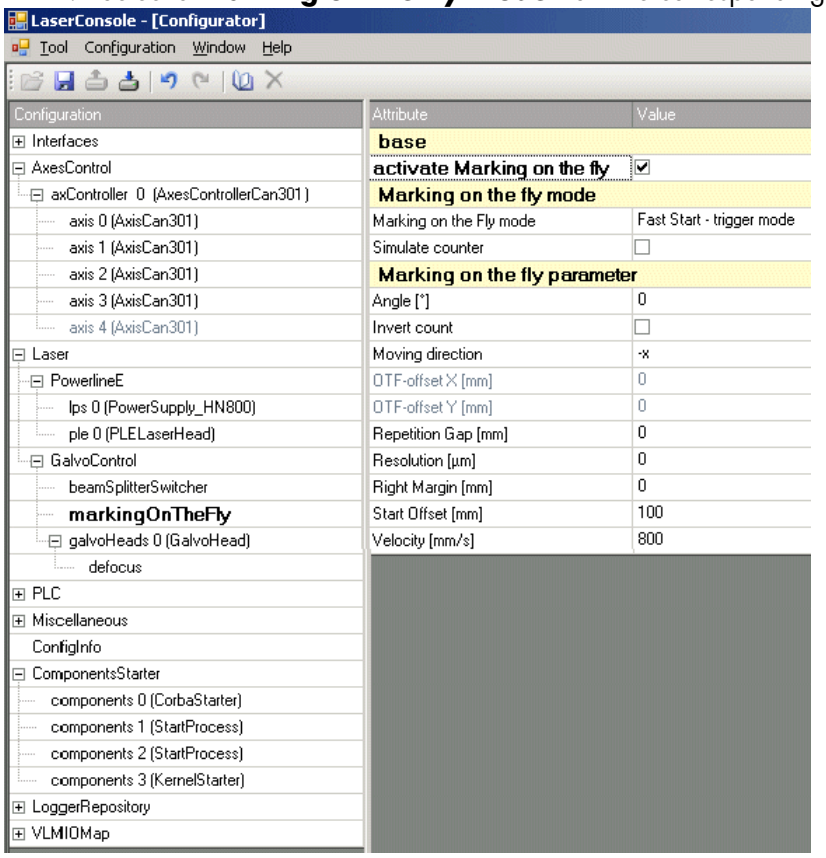
Proceed as described in the corresponding manuals. There are no special settings or instructions, except for exchanging drawing files while marking a series of work pieces using ***VMC2***.

3 Setup

3.1 Configurator settings

The user is not recommended to modify the settings described in this chapter, rather, service personnel should edit them.
Although the marking on the fly feature has to be switched on for every selected drawing, this feature also has to be switched on in ***Configurator*** settings:

1. Open the **Laser** and then the **Galvo control** section.
2. Click the **Marking on the fly** component.
3. Tick the **Activate marking on the fly** check box.
4. Select a **Marking on the fly mode** from the corresponding list box.

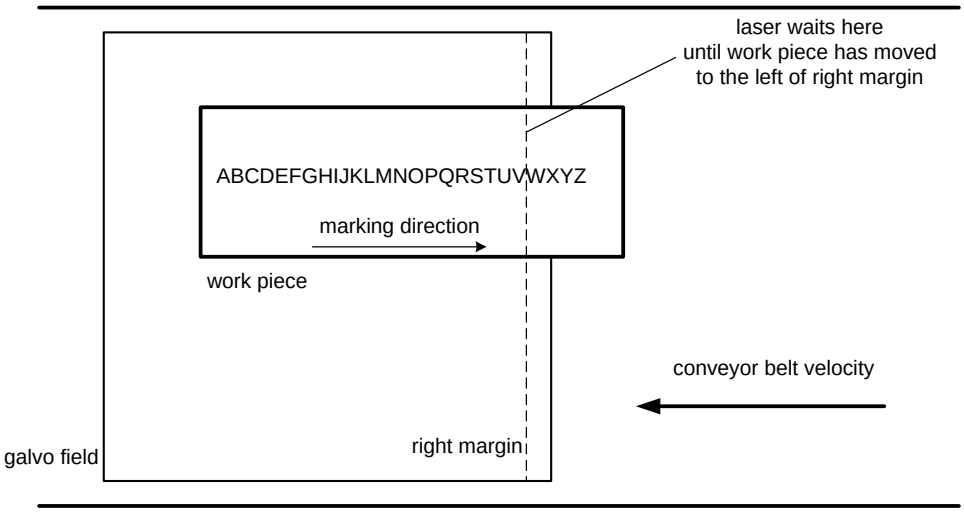


Attribute	Value
base	
activate Marking on the fly	☐
Marking on the fly mode	
Marking on the Fly mode	**Fast Start - trigger mode**
Simulate counter	**Fast Start - trigger mode**
Marking on the fly paramete	**Repetition mode - external program**
Angle [°]	**Repetition mode - internal program**
Invert count	☐
Moving direction	-x
OTF-offset X [mm]	0
OTF-offset Y [mm]	0
Repetition Gap [mm]	0
Resolution [µm]	0
Right Margin [mm]	0
Start Offset [mm]	100
Velocity [mm/s]	800

The **Simulate counter** check box is used for validating conveyor belt velocity as described in a below section of the present chapter.

3.2 Marking on the fly parameters

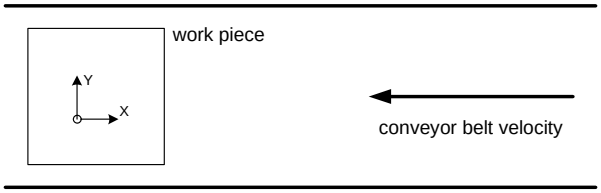
Angle [deg.]	Angle denotes a lateral deviation in the horizontal plane [-45…+45 deg]
Invert count [±1]	Reverses conveyor belt velocity: +v to –v; necessary because encoder step is an unsigned numerical value
Moving direction [±x, ±y]	Sets direction of belt velocity in the galvo head coordinate system
Repetition gap [mm] (length trigger)	Length trigger Δl denotes the periodicity length of consecutive drawings to be marked on one work piece; applies to length trigger mode only. If the time interval (Δl-w)/v is elapsed since last marking and ***VLM*** has not yet loaded or refreshed next drawing, ***VLM*** cancels marking, displaying an error message; w denotes the width of a selected drawing.
Resolution [µm] (encoder step)	Circumference of roller driving conveyor belt (2πr) divided by number of encoder steps per revolution (2π); the encoder step corresponds to the movement of conveyor belt between two encoder signals; Encoder step should not exceed 50 µm.
Right margin [mm]	Setting a right margin prevents an error called "galvo overrun", i.e. ***VLM*** considers in advance that the laser beam is confined to the galvo field, of course. A writing speed, e.g. in (+x) direction, which exceeds belt velocity v, e.g. in (-x) direction, could give rise to a laser beam to try moving out of the galvo field, although ***VLM*** would stop this at the right border. ***VLM*** interrupts marking when laser beam touches right margin and later resumes marking once a work piece has moved a bit. The right margin should at least be set to the width of the largest character to be marked or even a few mm larger. A right margin simplifies adapting writing speed to conveyor belt velocity.
Start offset [mm]	Start offset Δs is the distance a work piece travels after passing the light barrier before laser marking begins.
Simulated belt velocity [mm/s]	(simulation mode only) In simulation mode, i.e. **Simulate counter** check box is ticked, service personnel can validate conveyor belt velocity, considering a drawing to be marked. Without simulation it is difficult to predict, if ***VLM*** keeps up with the conveyor belt velocity.



Writing speed often exceeds conveyor belt velocity. The user can set the first one to maximum because ***VLM*** stops proceeding at the right margin and later resumes marking once a work piece has moved a bit.

3.3 To set the moving direction:

1. Remember ***Configurator's*** **Field rotation [deg.]** set by manufacturer.
2. Enter 0.00 in the **Field rotation [deg.]** input box.
3. Stop the conveyor belt and clear the **On the fly** check box.
4. Mark a drawing, e.g. a coordinate system labeled with x and y, on a sample work piece, such a drawing on a sample work piece reveals the belt direction, e.g. (–x) or (–y).
5. Select one of the four settings [±x, ±y] from the **Moving direction** list box.
6. Enter manufacturer's setting in the **Field rotation [deg.]** input box.



This conveyor belt is running in (-x) direction.

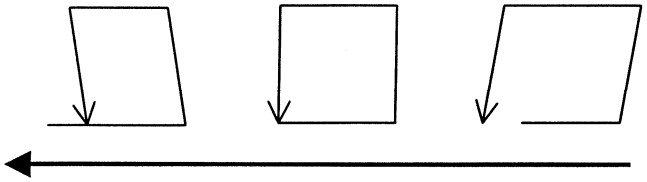
3.4 To mark efficiently:

To mark a line of text, which is written from the left to the right, the opposite direction is appropriate for the conveyor belt. The user should avoid unnecessary movements of the galvo mirrors. For instance, if the conveyor belt direction was from the left to the right, marking a line of text such as "ABCDEFGH" would not start at "H", rather ***VLM*** would begin at "A". If the conveyor belt direction is from the right to the left, however, ***VLM*** marks in an efficient way, starting at "A" and ending at "H". To summarize, writing and belt direction should be opposite. The user cannot change direction of marking for text objects, ***VLM*** determines the order of the characters to be marked.
A drawing comprising several lines of text one upon the other can be marked, yet very slowly, slow down conveyor belt velocity accordingly. To step up writing speed, import text as a LOGO file, though editing text is no longer possible because it's converted into vector graphics.

3.5 To calibrate encoder step:

In production mode, the rotation encoder measures the conveyor belt velocity v in real time.
Precise numerical values prevent distortions of the marked drawings. Encoder step should not exceed 50 µm.
Calibration is done in two steps: coarse and fine adjustment.

1. Measure diameter 2×r of roller including the belt.
2. Calculate the corresponding circumference 2×π×r.
3. To calculate encoder step, divide the circumference by the number of encoder signals per revolution of the roller.
4. Enter this encoder step in the Resolution [µm] text box.
5. Laser mark a few sample squares.
6. The result reveals whether ***VLM*** acquires the conveyor belt velocity properly (center). Otherwise, increase (left) or decrease (right) encoder step (Resolution [µm]).



conveyor belt velocity

3.6 To validate conveyor belt velocity:

Conveyor belt velocity has to be adapted to every layout to be marked.

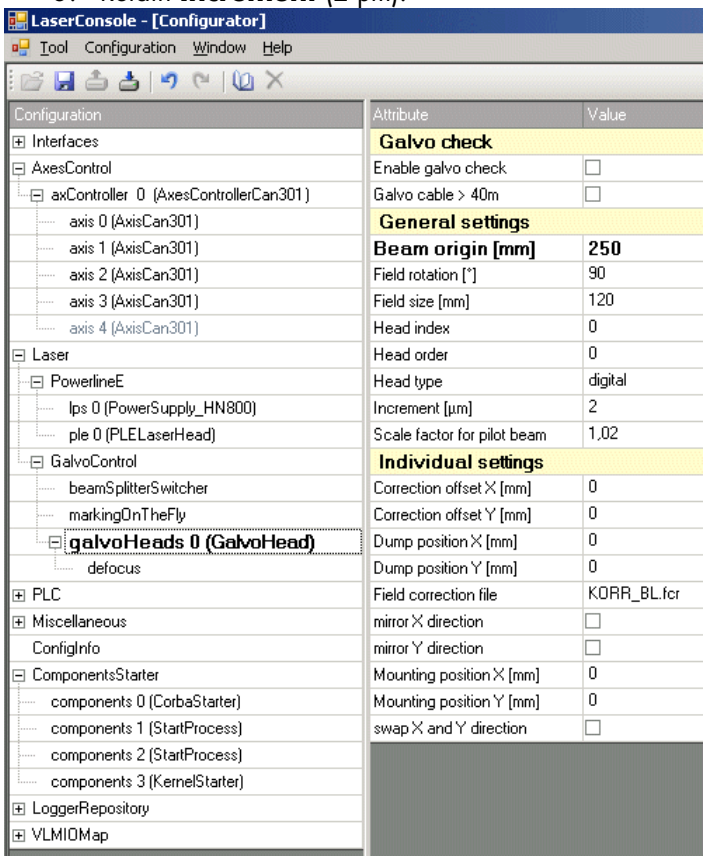
1. Close ***VLM***.
2. Close laser shutter.
3. Set simulation mode, ticking the **Simulate counter** check box in ***Configurator***.
4. Enter desired **Velocity [mm/s]** of the conveyor belt.
5. Launch ***VLM***.
6. Load the selected drawing and start marking.
7. Press the index trigger key (if there is one).
   or
   Interrupt the light barrier, simulating arrival of a work piece (if there is no index trigger key mounted).

Either a message "Layout executed successfully" or "overrun" appears. If the latter message appears, try slowing down the conveyor belt or optimize layout settings, i.e. the order of a drawing's elements to be marked.
This procedure also works, if **Execute drawing in a loop** check box is ticked in the ***Drawing settings*** window.

3.7 To setup a long drawing:

The width of a drawing may exceed the extent of the galvo field.
A long line of text exceeding the width of the galvo field (120 mm) shall be laser marked. In the present example, the galvo field is enlarged form 120 mm×120 mm to 400 mm×400 mm.
The laser installation is not modified at all, only the maximum drawing size is enlarged.

1. Set **Width** and **Height** in the ***Drawing settings*** window of ***VLM*** to the extent of the real galvo field, i.e. 120 mm×120 mm in present example.
2. Enter the extent of the enlarged galvo field in the **Field size [mm]** input box, i.e. 400 mm in present example.
3. Retain **Increment** (2 µm).



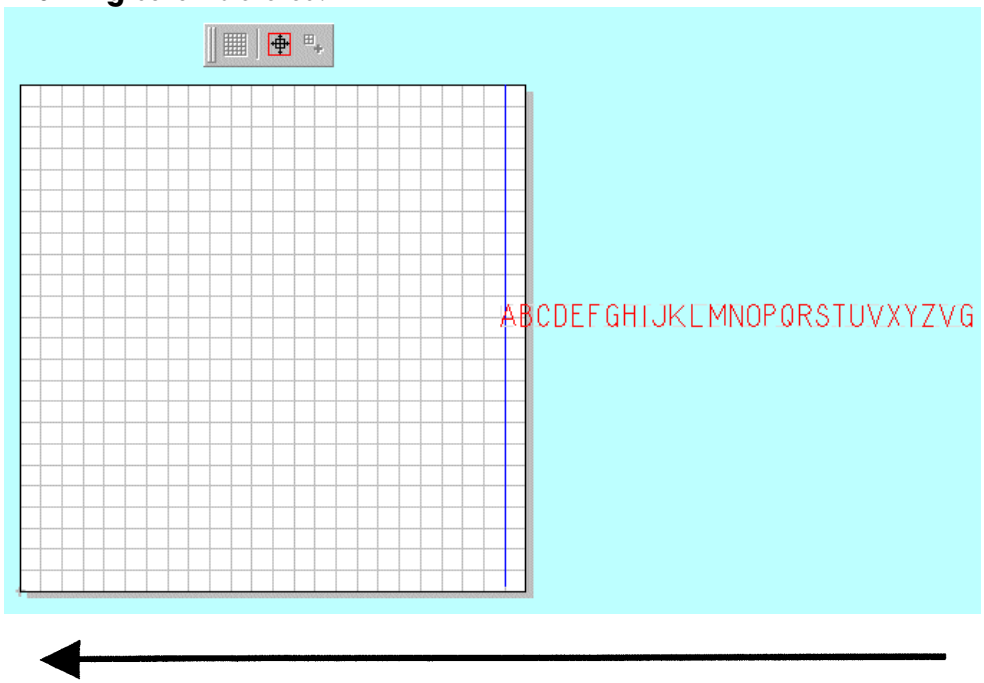
4. Enter x and y offsets in the input boxes in the bottom of the ***VLM*** main window.

In the present example, a real (120 mm×120 mm) and an enlarged galvo field (400 mm×400 mm) result in an offset of:
Offset **X**=140 [mm]
Offset **Y**=140 [mm]
The offset amounts to ½×{extent of enlarged galvo field – extent of real galvo field} in both directions, x and y.

5. Place the beginning of a long text line near the right margin of the real galvo field (x direction) and near center of the real galvo field (y direction), see the below screen shot.

This way, a long line of text which does not fit into the real galvo field can be marked, because ***VLM*** does no longer check whether a drawing is too large to fit into the real galvo field. On the other hand, a right margin prevents any malfunction which might arise from enlarging the galvo field virtually.
The user may draw guiding lines displayed in blue which will not be marked (optional).
The blue guiding line in the below screen shot indicates a right margin.

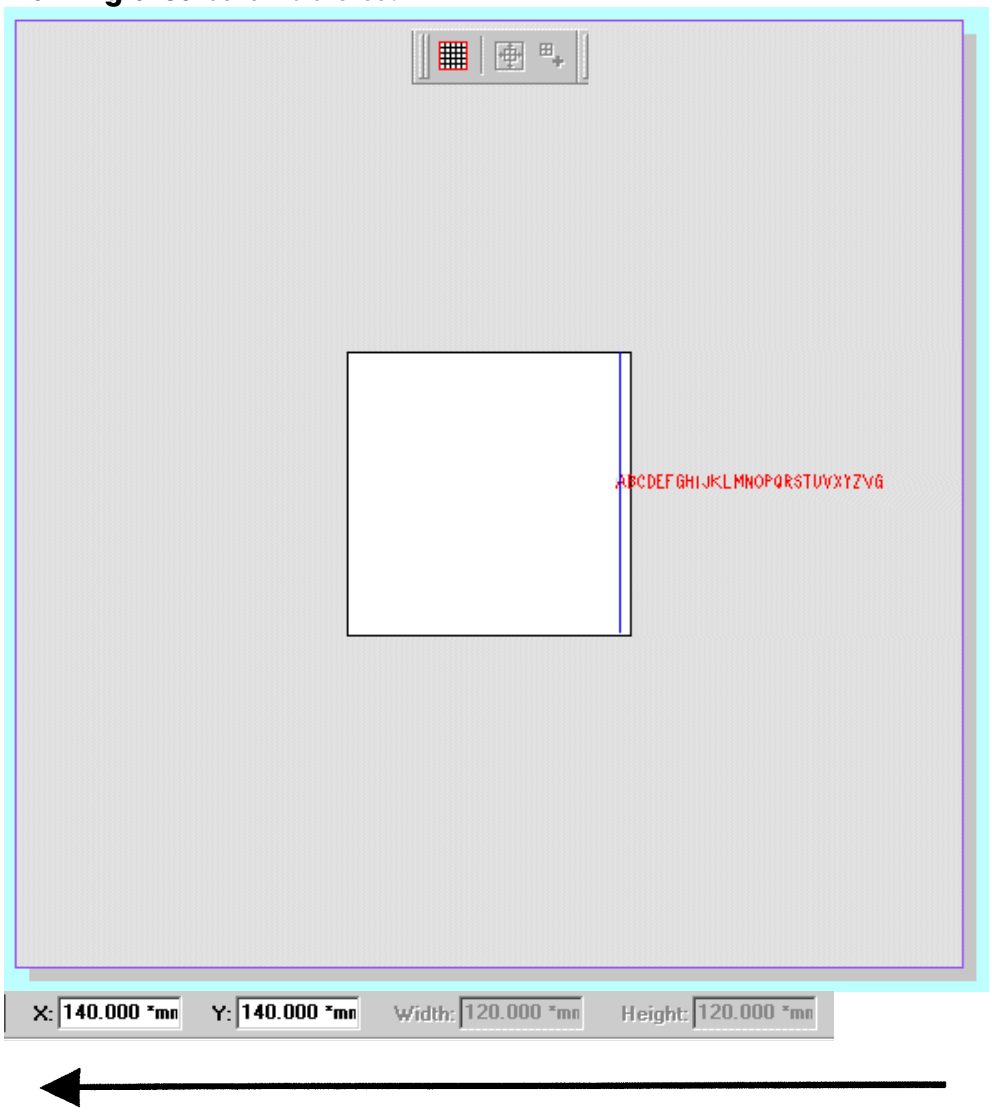
Drawing button is clicked:



Conveyor belt velocity

The checkered area of the above screen shot indicates the extent of the real galvo field (120 mm×120 mm).

Marking area button is clicked:



Conveyor belt velocity

The above screen shot shows the position of the real galvo field along with a drawing in the enlarged galvo field. Galvo field size (400 mm×400 mm) plotted in grey is retrieved from ***Configurator***.

3.8 To set height of work pieces:

To prevent blurred markings, the laser has to be adjusted to the proper height: The region to be marked has to lie within the focus depth interval, which amounts to a few mm.
Set the height in the ***Workpiece and settings*** window of ***VLM***.
Enter the proper height, i.e. the z coordinate, in the **Reference point** input box.