RAYLASE

APPLICATION SOFTWARE

Original manual

RAYBOARD

MULTI POINT EDITOR

MULTI POINT EDITOR

USER MANUAL

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CONTENTS

1 INTRODUCTION

1.1 About MULTI POINT EDITOR

The MULTI POINT EDITOR (MPE) is a Windows based utility, which allows the user to open, view, edit and save field correction files (*.fc3 or *.gcd) and power correction files (*.pc3) in order to adapt them to the individual opto-mechanical situation of each laser system.

The functionality of the MULTI POINT EDITOR can also be used programmatically at API level, but this would require the installation of the RAYGUIDE SDK, as the MULTI POINT EDITOR is also an integral part of the RAYGUIDE Laser Process Software.

The goal of the MPE is mainly to edit the correction data of the axes of a deflection unit, responsible for the XY position of the laser beam as well as the Z-axis of a prefocusing unit or FOCUSSHIFTER to control the focus position. Other possible axes that are controlled by a *.fc3 correction file, such as SensorZ of an RAYSPECTOR, ZoomZ of an AM-MODULE and Aux-axis of a RAYDIME METER are not calibrated by the MPE.

1.2 Compatibility

The MULTI POINT EDITOR software tool is compatible with the RAYLASE SP-ICE-3 scan controller.

Please note that the software can be used without the connected scan controller if only correction values are applied to a correction file.

1.3 Features

- Calibration of the xy correction values of RAYLASE *.fc3 or *.gcd correction files
- Calibration of the Z-correction values for the third optical axis (if available)
- Creation of a correction table for field position dependent power correction
- Direct marking of the calibration pattern (in connection with the use of a SP-ICE-3 control card)
- Definition of a sub field (if only a subarea of the scan field is usable)
- Selection of different calibration patterns
- Direct input of scaling, rotation, offset and trapezoidal deviations
- Import function of measured values
- Various visualization options of the calibration data for validation of the measured values
- Creation of correction files that map the surface of a three-dimensional body
- Calculation of maximum process speed values

1.4 Scope of delivery

A typical bundle delivered to the customer includes the following items:

- MULTI POINT EDITOR software installation file to install all necessary program and library files required for the MULTI POINT EDITOR.
- MULTI POINT EDITOR user manual as PDF file.
- License agreement as PDF file.

1.5 Laser Safety

The user is responsible for safe operation and for protecting the area around the device from hazards caused by laser radiation. OEM customers must ensure compliance with all local and national regulations.

⚠ WARNING

Avoid unsafe laser operation

Always switch on the PC before switching on the laser system. This prevents the laser from behaving in an uncontrolled and unforeseen manner when the PC is switched on. Check your application carefully before using the laser system. Damaged software can block the entire system and lead to uncontrolled operation of the laser or deflection unit.

Safety instructions for these components can be found in the manuals for the laser system and deflection unit.

1.6 About this Manual

This manual describes the entire functionality and performance features of the MULTI POINT EDITOR software when used with the graphical user interface (GUI).

Conventions

- Emphasized phrases are printed in **bold**.
- Important notes and remarks are introduced with **NOTE:**, **RULE:**, etc.
- Folder and file names are printed in *italics*.
- The names of windows, dialogs and tabs are given as normal text: On the Settings tab.
- Menu options are shown in bold and italics: Select ***File > Save as....***
- The names of dialog options (function buttons, checkboxes) are specified in italics: Select *Fixed*, if you ...
- Buttons are bold and in italics and shown in brackets: Click on ***[Apply]***.
- Buttons labeled with graphic icons are described in words.

  Example:  is a ***[Zoom]*** button.
- References to other pages in the manual are indicated by italics: See *page 22, Setup*.
- Links to web addresses are underlined: Visit RAYLASE**.**

1.7 Legal Information

Copyright

License agreement

The text of the license agreement is delivered as a PDF file together with the software.

Warranty

The rights of the customer in case of material or legal defects of the product are listed in the General Terms and Conditions of RAYLASE. These can be viewed at: https://www.raylase.de/en/terms-and-conditions.html.

No implied warranty or guarantee is given as to fitness for a particular purpose. RAYLASE is not responsible for any damage caused by using the application. Custom assemblies or other assemblies manufactured by RAYLASE may be subject to different warranty terms. Further information can be found in the respective manuals.

1.8 Addresses

Manufacturer

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Phone:	+49 8153 9999 699
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E-mail:	info@raylase.de

Customer Service

RAYLASE customer service will be happy to help you at any time if you have any problems with the software or this manual.

Availability:	Monday to Friday, 9:00 a.m. to 5:00 p.m.
	UTC+1 (April to October: UTC+2)
Phone:	+49 8153 9999 297
E-mail:	support@raylase.de

2 INSTALLATION AND LICENSE

2.1 Installation process

NOTE: Once using the RAYGUIDE application software, the MULTI POINT EDITOR feature is embedded per default and does not need to be installed additionally.

For installation of all RAYLASE software products (therefore also the MULTI POINT EDITOR application), RAYLASE provides the so-called RAYBOARD PRODUCT INSTALLER (RBPI) free of charge as a central tool on its website.

First install (RAYBOARD PRODUCT INSTALLER)

https://www.raylase.de/en/products/software/rayboard/product-installer.html

Here in the “Select the targeted software configuration” menu item, select MULTI POINT EDITOR with the most current version.

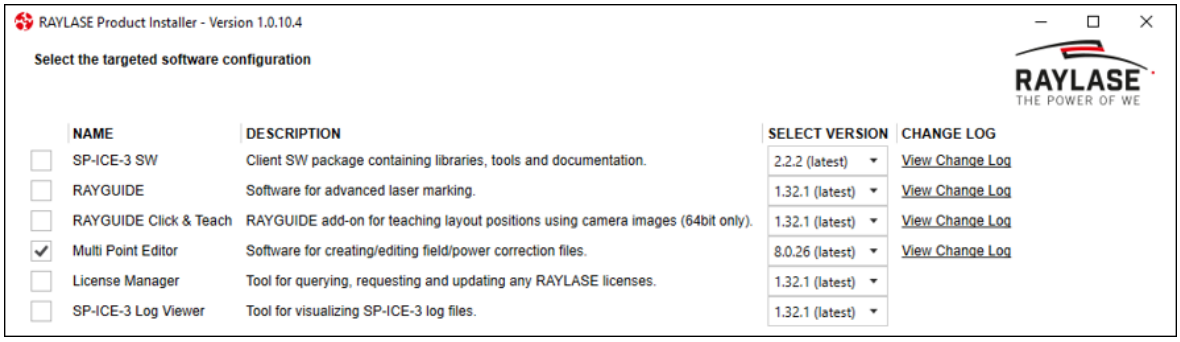


Fig. 2.1: S-AAA

You can use the direct link to the change log to get an overview of the latest changes to the previous version. The RBPI will then download the MULTI POINT EDITOR installation file and the installation options will be displayed.

Accept the license agreement.

After successful installation, you will receive the following information in the RAYBOARD PRODUCT INSTALLER.

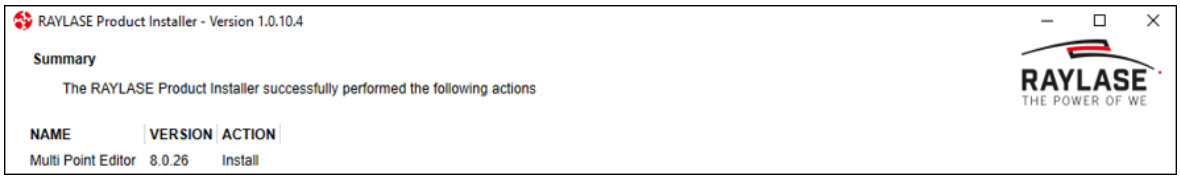


Fig. 2.2: S-AAB

A symbol for starting the MULTI POINT EDITOR application directly on the desktop of the computer is created:

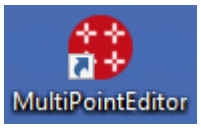


Fig. 2.3: MPE-AAC

Starting software

For instance, use the MULTI POINT EDITOR desktop icon ton start the software.

2.2 License

The MULTI POINT EDITOR is basically a freeware tool. Only the use of the creation of 3D surface correction files requires a MPE Professional license.

The license is distributed in two ways:

- A hardware dongle (hardware license key), to be inserted into a USB port of the computer running the software. This variant allows you to install the software on more than one computer and use the same dongle on each of them in turn. When the software is installed or started with the dongle attached, the license is found and activated automatically.
- A software key (activation license key), which is valid only for a specific computer. To use a software key, a "fingerprint" of the designated computer has to be generated. In the menu, select RAYGUIDE ***Help > License > Generate license request...***, and send the generated file to RAYLASE (license@raylase.de). RAYLASE will return an activation file which can be imported by selecting ***Help > License > Activate license***.

NOTE: The MPE Professional license can also be added to an existing ***RAYGUIDE*** license via push-update, also using the menu option ***Help > License*** > ***Activate license***.

As soon the MPE recognizes the Professional license, it will be mentioned in the top bar.

3 INTRODUCTION TO THE USER INTERFACE

By default, the tab ***Marking*** is shown after the start of the application.

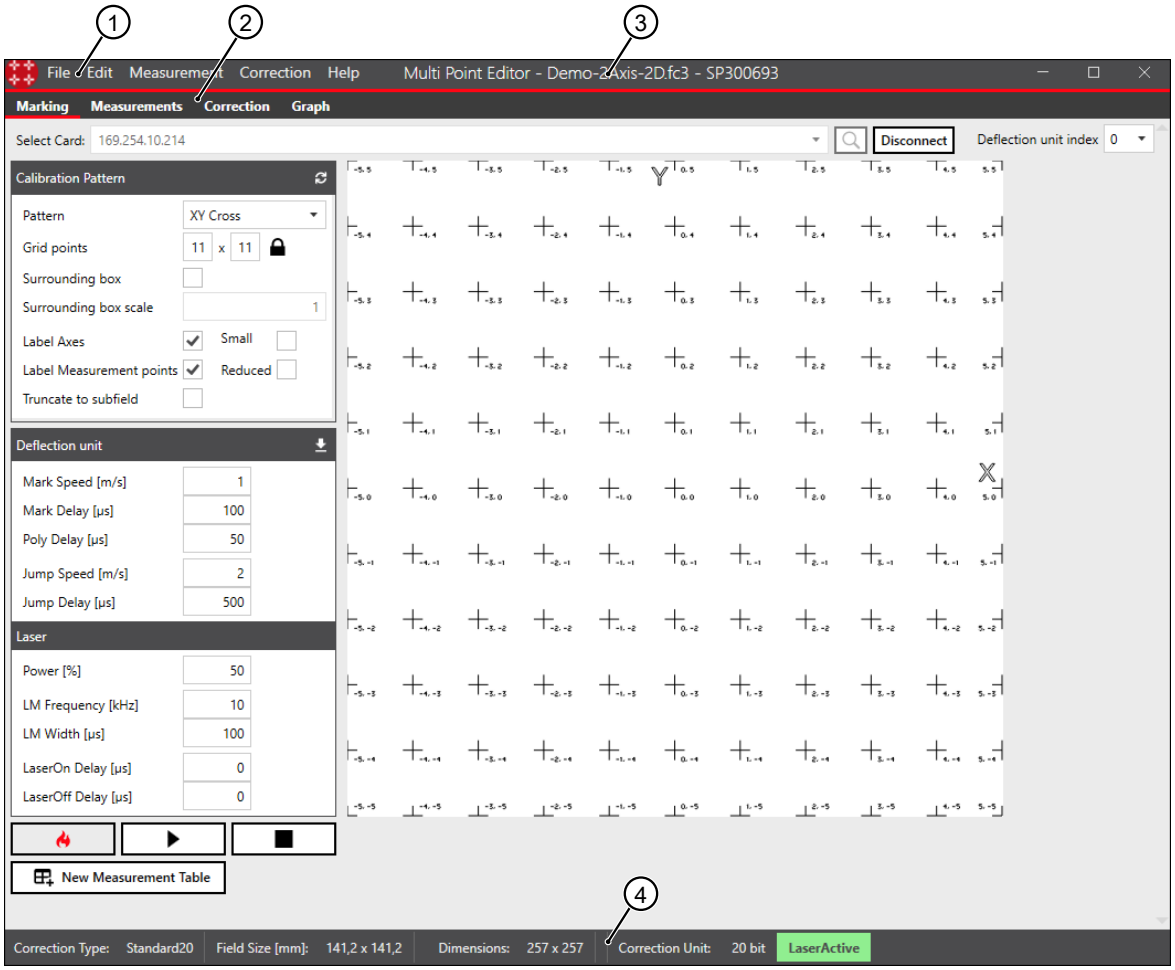


Fig. 3.1: MPE-AAD

1 Menu
2 Main tabs
3 Loaded file name and possible license
4 Info bar

The ***File*** menu refers to common job file tasks. It also provides the option to generate or power correction files (see *page 63, Position dependent power correction file*).

The ***Edit*** menu provides options for changing field size and defining sub fields, changing the resolution of the lookup tables and header information. There is also an option to convert a 3D correction file to a 2D correction file hosted here.

The ***Measurement*** menu provides the option to define the measurement table and to transfer measurements either by loading them in the same table format as defined (see *page 41, Loading measurement values from a file*) or by importing a list of freely defined coordinates (see *page 50, Importing a list of measurement values*).

In the ***Correction*** menu, global field corrections such as scale, offset, rotation, and trapezoid can be applied. An analysis option provides some statistical information as well as options to copy the correction values from the lookup table in either table or list format. The options for creating 3D-Surface correction files are also available from this menu.

The ***Help*** menu provides shortcuts to this manual, log files, and version information.

Applicable keyboard shortcuts are shown after most menu items.

4 GENERAL PREPARATIONS

4.1 Loading a correction file

Go to ***File > Open*** and browse for the desired correction file (RAYGUIDE usually stores its correction files usually under *C:\ProgramData\RAYLASE\Correction Files*).

Alternative: you can simply drag & drop the file from the folder into the MPE application window, or simply double-click on the file, and the file will start the MPE application if it is available.

For *.gcd files (used on SP-ICE-1 PCI/e PRO control card):

- If in the same directory the description file with a *.txt extension exists, it will also be loaded as well and important parameters such as the field size will be extracted.
- If no such *.txt file exists, you will need to set the field size manually.

When the MPE is started from the RAYGUIDE application, the associated correction file is automatically selected and loaded.

4.2 Type of field calibration

The MPE offers two basic ways to calibrate a scan field:

1. If the scan field requires global adjustments such as scaling, offset, rotation or trapezoidal distortion correction, these can be done directly. This could also mean a global focus adjustment that defines a bias / offset for the (all available) Z-axes.
2. If you need a very precisely calibrated scan field and also want to correct inhomogeneous distortions, then a true multi-point correction, which includes global adjustments, is the way to go.

Therefore, you will usually choose either option 1 (see *page 15, Global field corrections*) or option 2 (see *page 18, System dependent considerations* and *page 22, Multipoint calibration*).

5 GLOBAL FIELD CORRECTIONS

NOTE: In the case of a 3D correction file, any of the following global corrections will be applied to all Z-layers.

5.1 Apply scale

To scale the marking result globally, you can apply scaling factors for X and Y to the entire field correction table.

It is recommended to mark a square of ¾ field size, to measure the dimensional error.

Go to the menu ***Correction > Apply scale*** to open the following dialog:

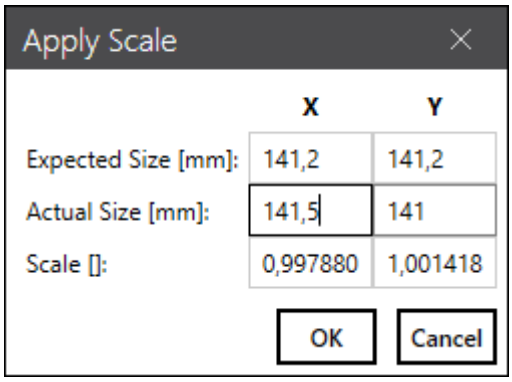


Fig. 5.1: MPE-AAE

Since the scaling is applied to the field correction table, only small scale errors should be applied.

NOTE: Larger scale deviations may result from incorrect working distance adjustments. They should not necessarily be corrected by mechanical adjustment.

5.2 Apply offset

To shift the X- / Y-position of the field center, you can apply an offset to the entire field correction table.

It is recommended to mark a large center cross to evaluate the offset.

In case of a prefocusing deflection unit (AXIALSCAN, AS FIBER, FOCUSSHIFTER) an offset can also be applied to the Z dimension to shift the focus globally.

To access the Z offset field, the units must be selected as either 16 bit, 20 bit or percentage.

Go to the menu ***Correction > Apply offset*** to open the following dialog:

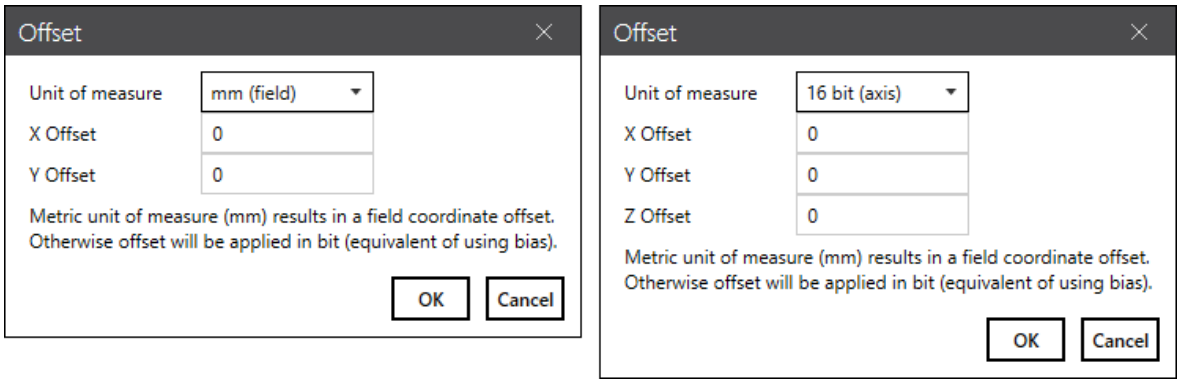


Fig. 5.2: MPE-AAF

Unit of measure controls whether the offset is applied in field coordinates (mm) or control value (20 bit).

5.3 Apply rotation

To rotate the marking result globally, one can apply a rotation to the entire field correction table.

It is recommended that only small (single digit) rotations be compensated.

It is recommended to mark a large center cross, to evaluate the rotation.

Go to the menu ***Correction > Apply rotation*** to open the following dialog:

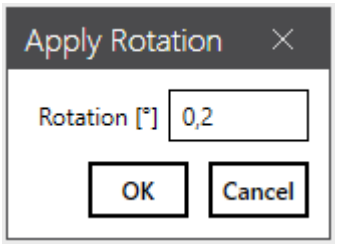


Fig. 5.3: MPE-AAG

5.4 Apply trapezoid

You can use this option to correct a global trapezoidal distortion of the marking result.

It is recommended to mark a square to measure the trapezoidal distortion.

Go to the menu ***Correction > Apply trapezoid*** to open the following dialog:

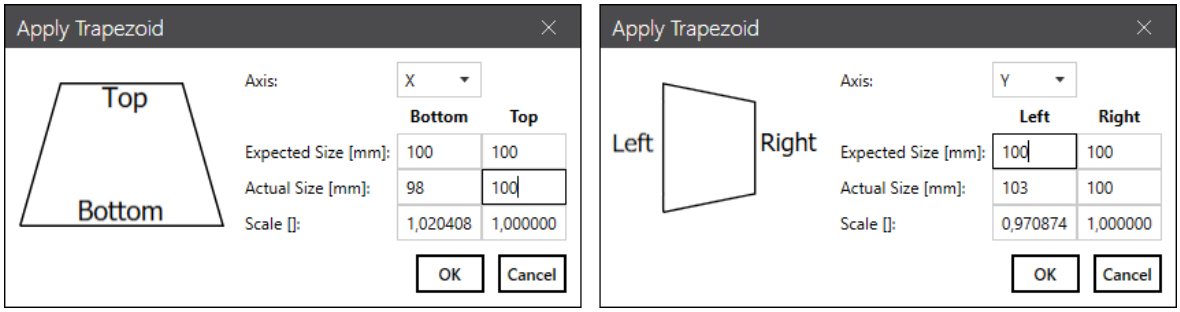


Fig. 5.4: MPE-AAH

After selecting the axis to be compensated, the measured sizes can be set.

NOTE: A trapezoidal distortion can only be corrected along one field axis.

For the X-axis, measure and enter the top and the bottom sides, and for the Y-axis, measure and enter the left and the right side dimensions.

5.5 Apply barrel distortion

Use this option to correct a global barrel distortion of the marking result. It is recommended to mark a square to measure the barrel distortion.

The distortion is usually along a coordinate axis, either the X-axis (width) or the Y-axis (height).

Go to the menu ***Correction > Apply barrel distortion*** to open the following dialog:

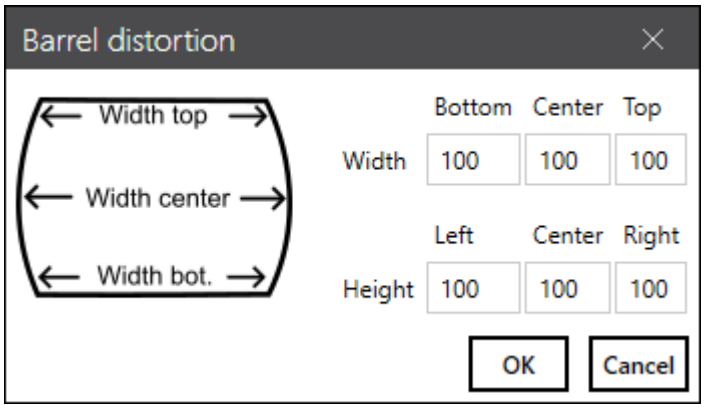


Fig. 5.5: MPE-ABT

6 SYSTEM DEPENDENT CONSIDERATIONS

6.1 Deflection units with f-theta lenses

For all deflection units with f-theta lenses (2-axis deflection unit or FOCUSSHIFTER) only the scan field needs to be calibrated.

6.2 Prefocusing units (AXIALSCAN, AS FIBER)

For prefocusing deflection units, it is recommended that you start with the focus calibration and then continue with the scan field calibration.

6.3 Correction files that provide a 3D volume

If the selected correction file provides a 3D volume, both the focus calibration and the scan field calibration can be performed at multiple focus layers. It is recommended to calibrate at least the top and bottom layers, so that all layers in between are interpolated.

Select *Multi Layer* as *3D Mode*, see *page 23, Definition of calibration job layout, using predefined pattern styles*.

6.4 Correction files with spot magnification

Correction files for the RAYLASE AM-MODULE contain multiple data layers with respect to spot magnification. Similar to a 3D volume correction file, it is recommended to perform the scan field calibration at least at the min and max spot magnification layers, so that all layers in between will be interpolated.

Select *Multi Magnification* as *Magnification Mode*, see *page 23, Definition of calibration job layout, using predefined pattern styles*.

NOTE: It is not recommended to calibrate the focus, as this would only affect the Z axis correction data, but during the process, both axes (Z and ZoomZ) perform a correlated movement.

6.5 Optional field range limitation for calibration (sub field)

Customers who do not want to or are unable to use the entire scan field can define a smaller section – hereafter referred to as “sub field”.

This option can be used for correction files that represent a flat field or a 3D volume. Calibration data for additional axes such as ZoomZ, SensorZ, Aux-axis will also be cropped by a sub field.

NOTE: Only the measurement area is reduced. Correction data outside the sub field is retained.

Go to ***Edit > Change field*** to open below dialog:

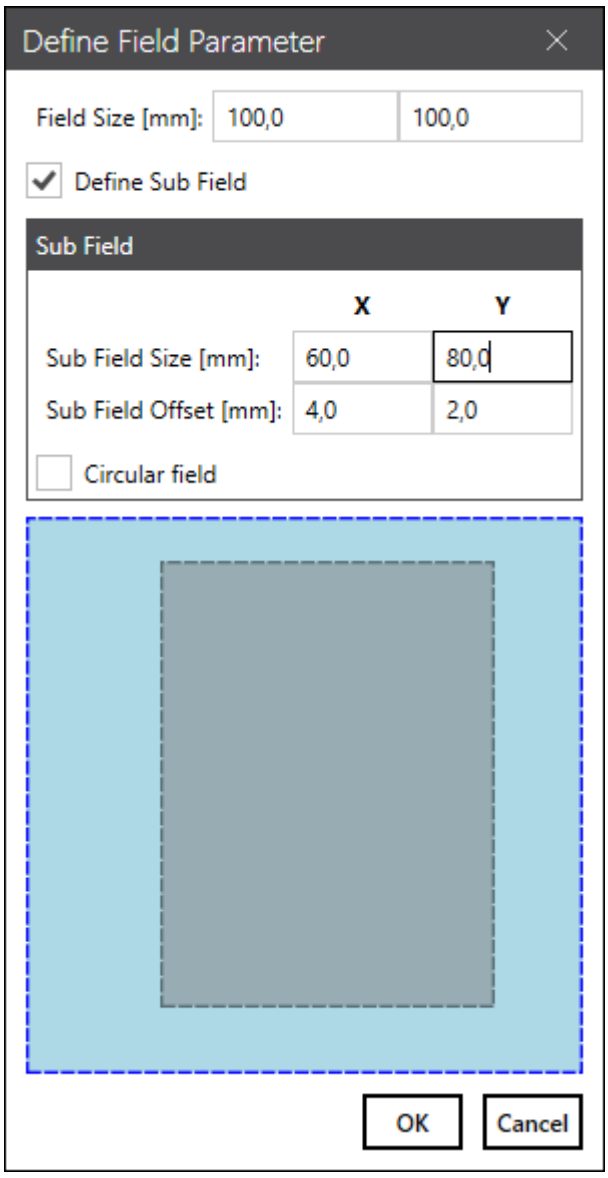
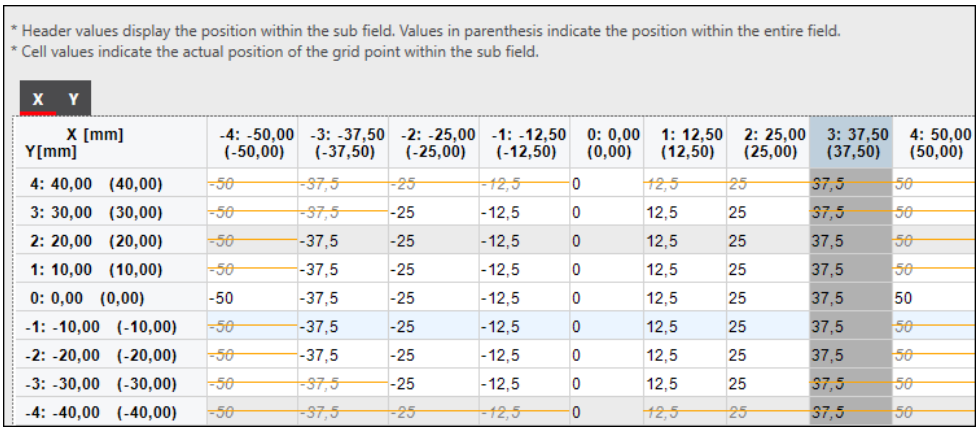


Fig. 6.1: MPE-AAI

Element	Explanation
Define field parameter	
Field size [mm]	Displays the field size per X- and Y-dimension as defined by the loaded correction file.
Define sub field	Select the check box if you want to define a sub field.
Sub field	
Sub field size [mm]	Enter the X- and Y-dimensions of the required sub field.
Sub field offset [mm]	Enter the X- and Y-offsets if the sub field is not centered to scan field.
Circular sub field	Select whether the sub field should be circular instead of rectangular. **NOTE:** The size of the circular sub field defined in this way can exceed the size of the original field. Combined with the offset, this can result in a circular sector. This can be useful for a circular field covered by several deflection units.

Table. 6.1: MPE-001



* Header values display the position within the sub field. Values in parenthesis indicate the position within the entire field.
* Cell values indicate the actual position of the grid point within the sub field.

X Y

X [mm] Y[mm]	-4: -50,00 (-50,00)	-3: -37,50 (-37,50)	-2: -25,00 (-25,00)	-1: -12,50 (-12,50)	0: 0,00 (0,00)	1: 12,50 (12,50)	2: 25,00 (25,00)	3: 37,50 (37,50)	4: 50,00 (50,00)
4: 40,00 (40,00)	~~-50~~	~~-37,5~~	~~-25~~	~~-12,5~~	0	~~12,5~~	~~25~~	~~37,5~~	~~50~~
3: 30,00 (30,00)	~~-50~~	~~-37,5~~	-25	-12,5	0	12,5	25	~~37,5~~	~~50~~
2: 20,00 (20,00)	~~-50~~	-37,5	-25	-12,5	0	12,5	25	37,5	~~50~~
1: 10,00 (10,00)	~~-50~~	-37,5	-25	-12,5	0	12,5	25	37,5	~~50~~
0: 0,00 (0,00)	-50	-37,5	-25	-12,5	0	12,5	25	37,5	50
-1: -10,00 (-10,00)	~~-50~~	-37,5	-25	-12,5	0	12,5	25	37,5	~~50~~
-2: -20,00 (-20,00)	~~-50~~	-37,5	-25	-12,5	0	12,5	25	37,5	~~50~~
-3: -30,00 (-30,00)	~~-50~~	~~-37,5~~	-25	-12,5	0	12,5	25	~~37,5~~	~~50~~
-4: -40,00 (-40,00)	~~-50~~	~~-37,5~~	~~-25~~	~~-12,5~~	0	~~12,5~~	~~25~~	37,5	~~50~~

Example 1: Circular sub field

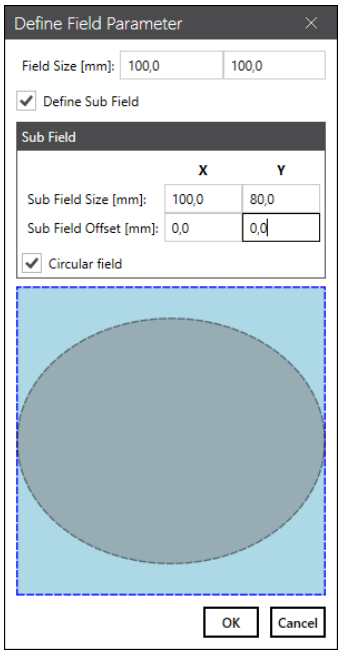


Table. 6.2: MPE-025

Because the measurement table is always rectangular, not all values need to be filled in. All cells corresponding to grid points outside the circle are crossed out and extrapolated.

* Header values display the position within the sub field. Values in parenthesis indicate the position within the entire field.
* Cell values indicate the actual position of the grid point within the sub field.

X Y

X [mm] Y[mm]	1: 12,50 (-47,50)	2: 25,00 (-35,00)	3: 37,50 (-22,50)	4: 50,00 (-10,00)	5: 62,50 (2,50)	6: 75,00 (15,00)	7: 87,50 (27,50)
7: 87,50 (27,50)	12,5	25	37,5	~~50~~	~~62,5~~	~~75~~	~~87,5~~
6: 75,00 (15,00)	12,5	25	37,5	50	62,5	~~75~~	~~87,5~~
5: 62,50 (2,50)	12,5	25	37,5	50	62,5	75	~~87,5~~
4: 50,00 (-10,00)	12,5	25	37,5	50	62,5	75	~~87,5~~
3: 37,50 (-22,50)	12,5	25	37,5	50	62,5	75	87,5
2: 25,00 (-35,00)	12,5	25	37,5	50	62,5	75	87,5
1: 12,50 (-47,50)	12,5	25	37,5	50	62,5	75	87,5

Example2: Circular sub field

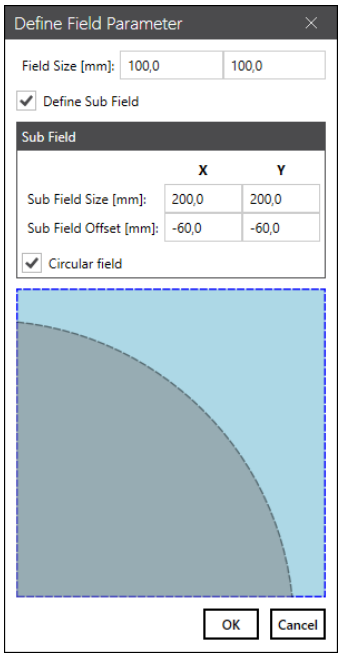


Table. 6.3: MPE-026

The measurement table shows only those cells of the sub field that are inside the original field. Since much of the circle is outside the original field, the table is reduced from 8 x 8 to 7 x 7 points.

NOTES:

- A sub field affects both the marking grid, which is truncated accordingly, and the measurement points which need to be entered.
- Correction points outside the sub field will also be updated, but because the correction values are extrapolated, the accuracy may suffer.
- Correction file data sent to a control card will not be truncated by a sub field definition.

7 MULTIPOINT CALIBRATION

7.1 Marking of the calibration pattern

7.1.1 Preparing the marking pattern “Job”

Using the MPE in combination with RAYLASE SP-ICE-3 control card, you can define and execute a calibration pattern and then measure the grid points afterwards. This requires a connection to an SP-ICE-3 control card. This task is managed in the ***Marking*** tab.

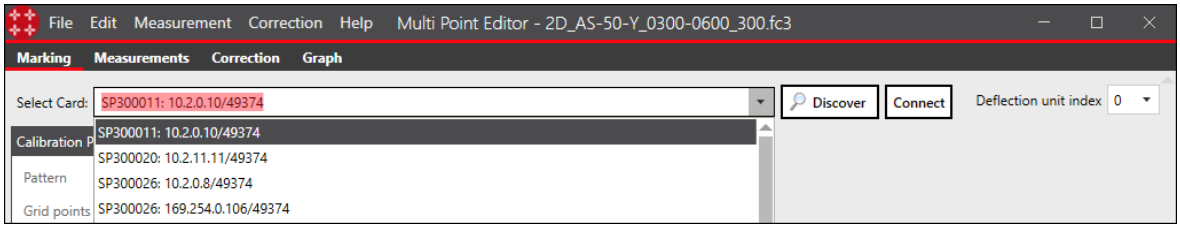


Fig. 7.1: MPE-AAN

The following sections explain all the options on the ***Marking*** tab.

7.1.1.1 Connect to a control card

Card connection	
Selected card	Displays the connected control card with its serial number and IP address. After a detection, all available control cards are listed, and the desired one can be selected.
Discover	Click to start discovering of all available control cards on the network.
[Connect] / [Disconnect]	Press ***[Connect]*** to connect to the selected control card and send the active correction file to the card. Press ***[Disconnect]*** to release the current connection, e.g. for rediscovering or to connect to another card.
Deflection unit index	If the control card uses the *dual scan head mode* to control two deflection units in master-slave mode, the index of the head to be calibrated can be selected. **NOTE:** If index 1 is selected, the same correction file will be stored on the card for both heads. Once both heads have completed their multipoint calibration, the configuration must be set up again.

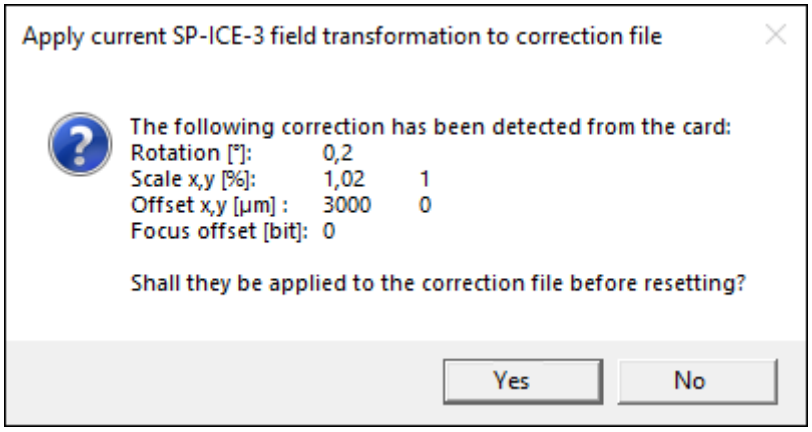
Card connection
NOTES: If another correction file is loaded after the control card is connected, the file is automatically uploaded to the card. In case the MPE is started from the RAYGUIDE application, the connection is already established and the correction file as assigned in RAYGUIDE is selected. Once the MPE is connected to the card, it reads the actual field transformation values from the scan controller. This transformation may include gain, offset and rotation correction previously set by another application (e.g. RAYGUIDE). It is displayed in a pop-up dialog:    Select ***[Yes]*** or ***[No]*** if you want to embed or not to embed the transformation in the correction file. ***IMPORTANT NOTES:*** ***In any case, the transformation is deleted from the control card, since it would otherwise affect the execution of the pattern. In addition, the process transformation is also deleted.*** ***If you have decided not to embed the values after completing the multipoint correction task, be sure to set the values again.*** **NOTE:** If MPE is started from RAYGUIDE and you decide to embed the transformation, the field transformation values for will also be reset in the RAYGUIDE deflection unit configuration.

Table. 7.1: MPE-022

7.1.1.2 Definition of calibration job layout, using predefined pattern styles

For prefocusing systems, it is recommended to start with the focus calibration, see pattern option “Focus calibration”.

Click the ***[Refresh]*** icon to refresh the marking pattern display.

Calibration Pattern	
Pattern	Scan field multipoint calibration ■ *XY Grid* The XY Grid is the best choice for manual measurements. ■ *XY Drill* Compared to the XY Grid, each grid point is represented by a drill point. ■ *XY Circle* Compared to the XY Grid, each grid point is represented by a small circle. **NOTE:** It is not possible to mark complete circles at the edge of the field. To overcome this limitation, you can define a sub field (see *page 19, Optional field range limitation for calibration (sub field)*) that is one circle diameter smaller than the field. ■ *XY Cross* Compared to the XY Grid, each grid point is represented by a cross. **NOTE:** It is not possible to mark complete crosses at the edge of the field. To overcome this cut-off, you can define a sub field (see *page 19, Optional field range limitation for calibration (sub field)*) that is one cross size smaller than the field.
	Focus calibration (only for correction files for prefocusing deflection units) ■ *Z Lines* Each grid position is represented by a line array, where the focus position is incremented per line to identify the best-in-focus line.
Grid Points	Number of grid points for complete X- and Y-axis range. The fields for X and Y are interlocked. Click the ***lock*** button to unlock the two fields. **Recommendation:** The measurement grid should have its grid points on the grid points of the correction file. This can be achieved with the following number of columns / rows (only if no sub field is set): 3, 5, 9, 17, 33, 65, 129, 257. **Application Note:** Typically, a grid of 9 x 9 points provides sufficient position accuracy.
Pulses [1]	Enter the number of pulses for drill points.
Highlight center [1]	Check to add four more drill points around the center of the grid.
Radius [mm] [2]	Enter the radius of the pattern circles.

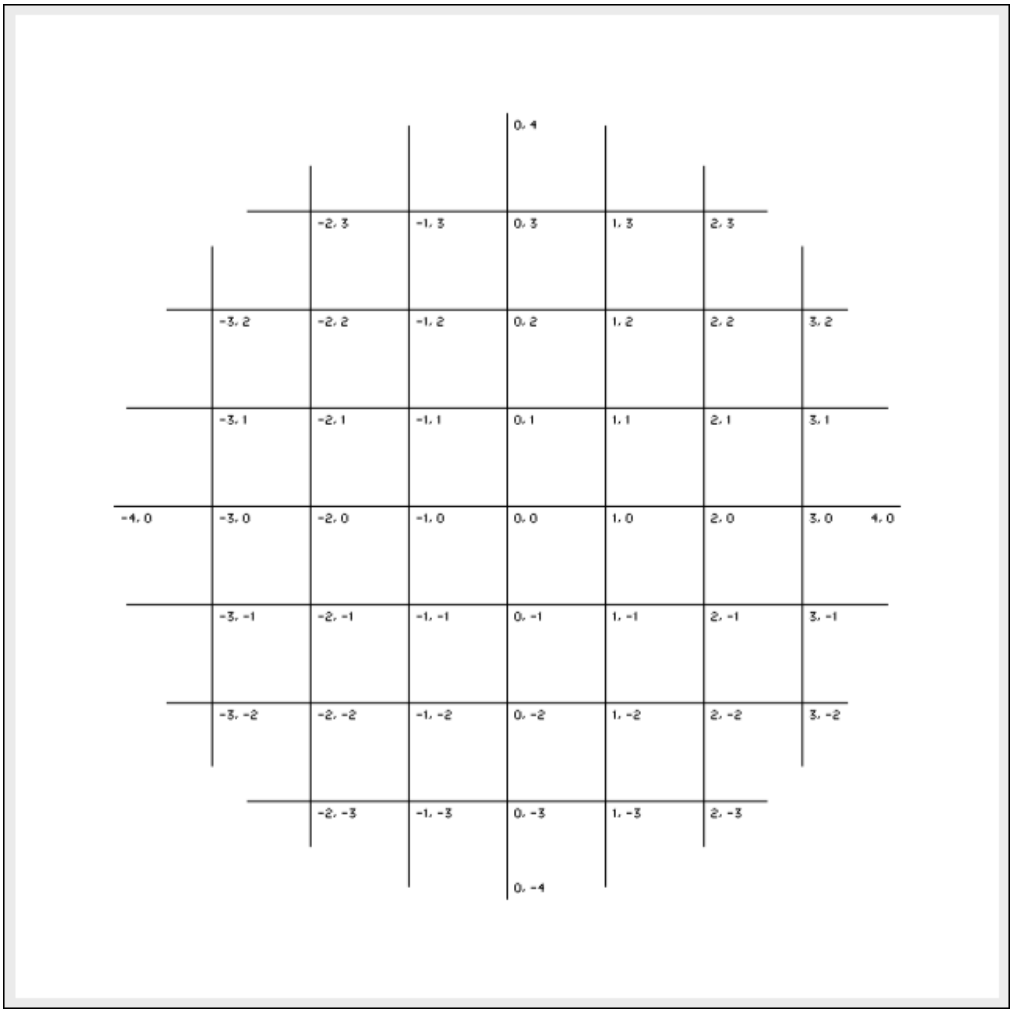
[1] Available only when the pattern *XY Drill* is selected.

[2] Available only when the pattern *XY Circle* is selected.

Calibration Pattern	
Surrounding box [3]	Adds a square around the crosses.
Surrounding box scale [3]	Scales the squares relative to the size of the crosses.
Lines per point [4]	Enter an odd number of lines to be marked at each grid point position. The lines (vertical by default) are arranged symmetrically, with every 5th line drawn slightly longer.
Line spacing [mm] [4]	Enter the line spacing between the parallel Z-lines.
Delta Z [mm] [4]	Select whether the Delta Z value applies to the *Z-lens* or to the *focus*. **NOTES:** ■ When *Z-lens* is selected, the value refers to the range of movement of the axis. A delta value of about 100 µm can cause a noticeable change in the focus position. ■ When *focus* is selected, the value refers to the field domain. The MPE internally converts the value to a lens offset using a special algorithm to control the Z-axis.
Line length scale [4]	Enter the value by which each line is shifted relatively in Z-position, while the center line is marked at the nominal Z-position. The length of the lines can be reduced to avoid possible overlapping of line-groups. The value is 0,66.
Horizontal [4]	Switches the orientation of the lines from vertical to horizontal lines.
Label Axis	Select this check box to additionally mark labels to identify the X- and Y-axes.
Small	Select to force the axis label to fit the label size to the free space between the grid marking instead of overlapping, and to use a single stroke font instead of true type font
Label measurement points	Select to additionally mark the X/Y index at each grid position. **NOTE:** In the same cases, two labels may overlap.
Reduced	Select to limit the number of grid labels to 9 x 9 to avoid overcrowding the pattern being marked.

[3] Available only when the pattern *XY Cross* is selected.

[4] Available only when the pattern *Z Lines* is selected.

Calibration Pattern	
Truncate to sub field	**NOTE:** If a sub field is used, the grid points of the markup are adjusted to fit the rectangular bounding box of the sub field. If this option is checked, the marking pattern will also be cut off at the sub field edge (see *page 19, Optional field range limitation for calibration (sub field)*). Useful mainly for circular sub fields: 

Calibration Pattern	
3D Mode [5] / Magnification Mode [6]	Select, if the pattern is marked ■ just in a *SINGLE* Z position / *SINGLE* magnification level **NOTE:** If only a single Z / magnification position is calibrated, the correction values for all other Z layers / magnification-levels will be extrapolated. ■ or in *MULTIPLE* Z positions / *MULTIPLE* magnification levels. **NOTE:** When calibrating multiple Z positions / magnification levels, the MPE will interpolate the correction values for layers in between.
Z position [mm] [7] / Magnification Level [7]	■ *SINGLE layer:* Enter the Z position / magnification level relative to the working distance for the pattern to be marked. ■ *MULTIPLE layer:* A list of all layers / levels, as defined in the correction file, will appear. Simply check from the offered indexes which focus layer / magnification level should be used to perform the calibration marking. If the predefined layers cannot be used to place a material, additional custom Z-layers can be added. Click ***[Add custom]*** to add an additional layer and define its Z position. **NOTE:** When the pattern has been marked in the first selected Z position / magnification level, a pop-up dialog appears, waiting for your confirmation to continue ■ to mark the pattern again at the next Z position / ■ with the next magnification factor until all selected Z positions / magnification factors have been processed.
	Example: 3D CF - Single Layer selection 

[5] Available only when a 3D correction file is loaded.

[6] Available only when a correction file is loaded, that supports an additional zoom lens.

[7] Depending on the mode selection (3D Mode, Magnification Mode)

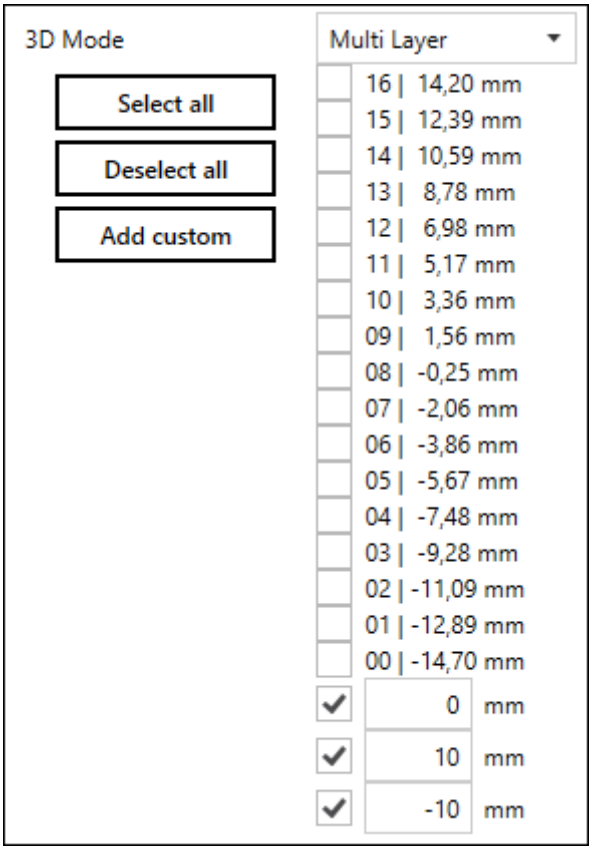
Calibration Pattern	
	Example: 3D CF - Multi Layer selection with custom layers (FOCUSSHIFTER correction file e.g. does not have a Z-Layer for Z = 0 by default) 

Table. 7.2: MPE-023

Example pattern layouts with 9 x 9 grid points

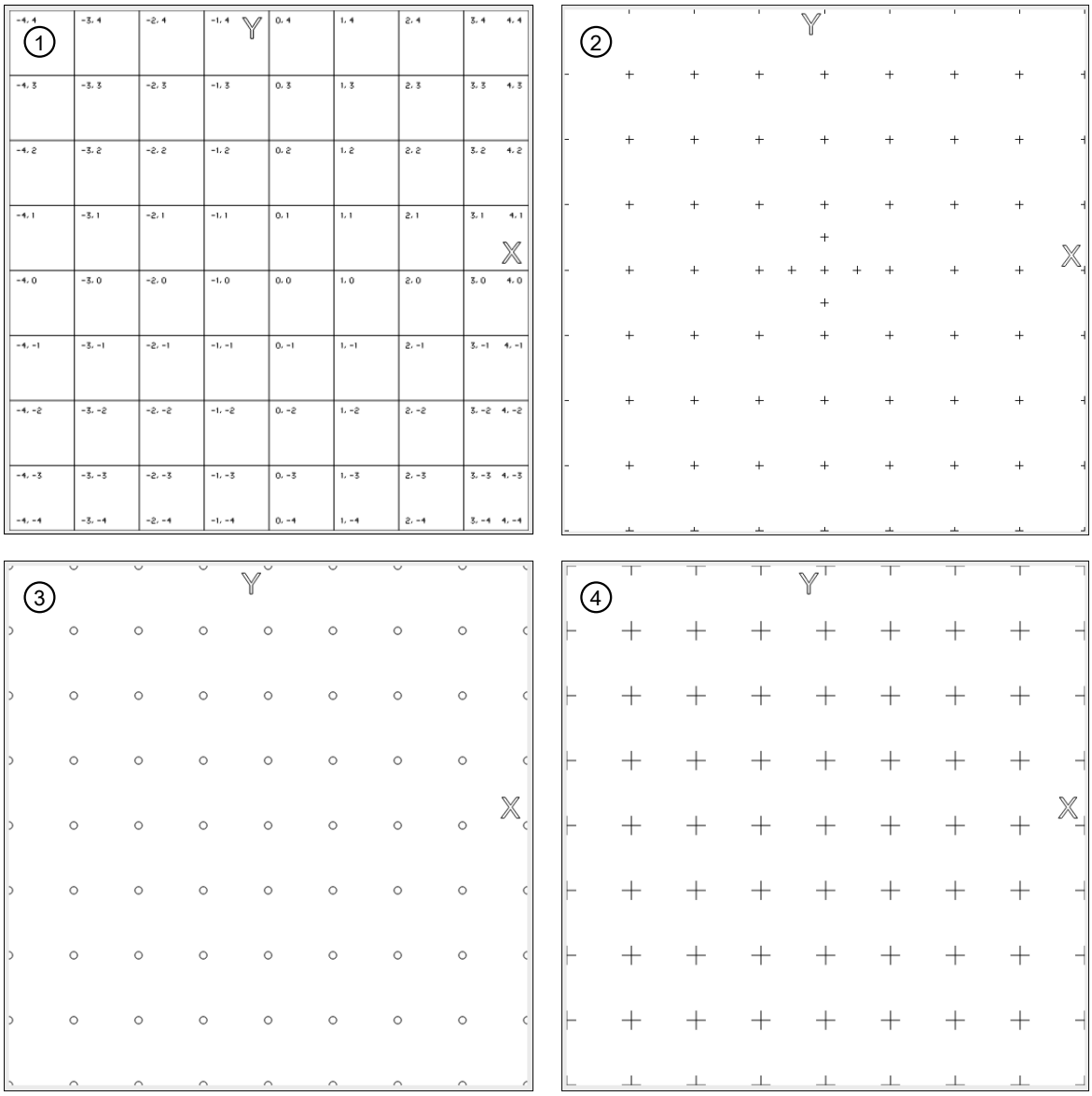


Fig. 7.2: MPE-AAO

1 Grid style (with labels)
2 Drill style (with highlighted center)
3 Circle style
4 Cross style

Z-lines (for focus calibration of prefocusing deflection units)

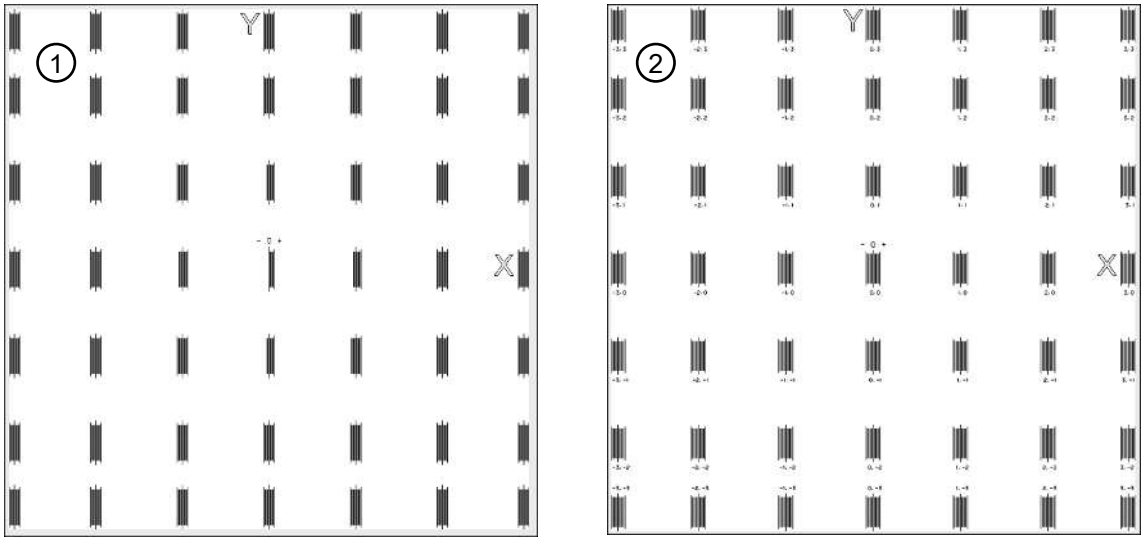


Fig. 7.3: MPE-AAP

1 Z-lines (none-Z-lens-offset CF)

2 Z-lines (predefined Z-lens-offset CF)

- Correction file without Z-lens offset:

  The center positioned line-arrays miss some lines, because the focus positions of those lines would be beyond what the Z-lens can reach.

- Correction file with predefined Z-lens offset:

  Usually every focus position of the pattern can be reached. Therefore, all grid positions show their defined number of lines.

7.1.1.3 Defining the process parameters, used to mark the pattern

Pen	Select a pen to define the process parameters for marking the pattern This option is only available when MPE is started from the RAYGUIDE application.

Table. 7.3: MPE-002

Scanner	
Click the ***[Download]*** button to download the current process parameters for the deflection unit and laser from the connected control card: 	
Mark Speed [m/s]	Speed of the laser spot on the material
Mark delay [µs]	This value is applied after a mark vector, often before a subsequent jump vector. The value refers to the dynamics of the deflection unit.
Poly Delay [µs]	The value refers to the dynamics of the deflection unit. The delay is applied at the transition point between two consecutive mark vectors.
Jump Speed [m/s]	Relative speed, when the deflection unit changes position without laser emission.
Jump Delay [µs]	The delay is applied after a position jump, often before a subsequent mark vector. The value refers to the dynamics of the deflection unit.

Table. 7.4: MPE-003

Laser	
Power [%]	Power value to set emitted laser power. The percentage always refers to a 100 % scale.
LM Frequency [kHz]	Value to define the pulse rate of the laser modulation (LM) signal.
LM Width [µs]	Value to define the pulse width of the laser modulation (LM) signal.
Laser-On Delay [µs]	Values to synchronize the laser activity with the mirror position at the start and end of a laser path. It can also be set with a negative sign.
Laser-Off Delay [µs]	

Table. 7.5: MPE-004

IMPORTANT NOTES when the MPE is not started from the RAYGUIDE application:

The MPE only allows the most important process parameters to be set. All other process parameters must be set using the control card **config tool**.

All system configuration settings, such as the laser configuration, must also to be set using the control card **config tool**.

7.2 Executing the marking pattern “job”

Main controls for execution:

Fig. 7.4: MPE-AAQ

To execute the pattern with the laser, the ***[Arm]***-Button must be turned ***ON*** (red).

Otherwise, the control card won´t request laser emission.

NOTE: When the laser is disarmed, the MPE commands the pointer signal to be on.

To start the execution, press the ***[Play]*** button.

In each case, a pop-up dialog will first display the Z position for the marking.

Example:

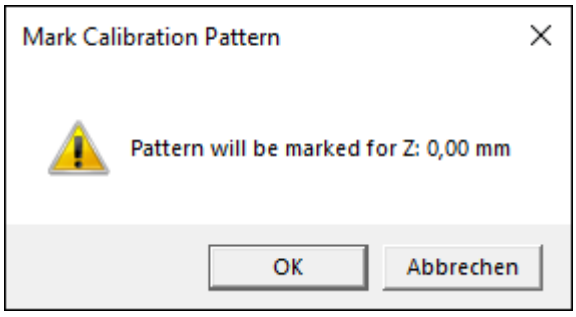


Fig. 7.5: MPE-AAR

NOTE for 3D calibration: If the marking is to be performed in a multi Z level selection, the popup will reappear for each selected Z position until all positions have been processed. In this way, the popup pauses the execution loop to give you time to place the marker material at the new focus position.

Only after confirming this message, the execution will start.

The status bar indicates whether the laser job running:

Fig. 7.6: MPE-AAS

Use the ***[Abort]*** button to stop the execution at any time.

7.3 Entering the measurements

7.3.1 Creating a new measurement table

The best practice is to use the ***[New table]*** button right below the execution buttons:

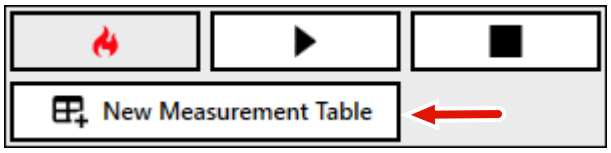


Fig. 7.7: MPE-AAT

This way, the table will already appear with the correct number of cells according to the previously selected grid points, and all cells that are not in the optionally defined sub field will be crossed out.

Alternatively, you can use the menu item ***Measurement > New table***. This can be used when the grid has been marked without using the MPE.

The dialog that appears requires the following information (depending on the correction file):

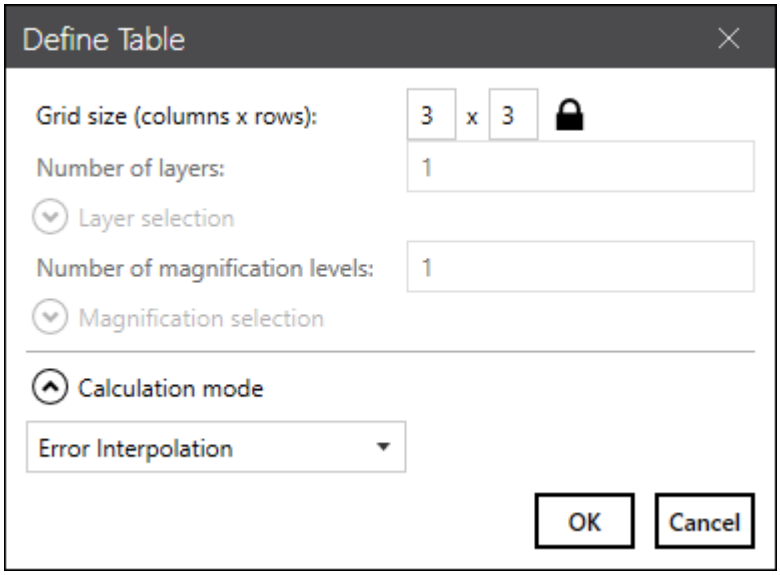


Fig. 7.8: MPE-AAU

Define table	
Grid Size (columns x rows)	It is recommended to use a grid, whose grid points correspond to the grid points of the correction file. This can be achieved with the following number of columns / rows: 3, 5, 9, 17, 33, 65, 129, 257. **NOTE:** The grid size should be the same as the number of grid points which were marked. **APPLICATION NOTE:** A 9 x 9 grid is usually sufficient for position accuracy. Use the [Lock] button to allow different values for columns and rows if necessary.
Number of layers [8]	In the case of a 3D correction file, you can define the number of Z layers in which you have marked and measured pattern to perform the XY field calibration.
Layer selection [8]	Use the expander to view the layer selection: Shows a preselection of the layers (count and Z value) evenly distributed according to the defined number of layers in relation to the available layers of the loaded correction file. If desired, use the drop-down selection to switch to another available layer.
Number of magnification levels [9]	In the case of a correction file that supports a zoom lens (e.g. for RAYLASE AM-MODULE), you can specify the number of marked magnification levels and measured pattern to perform the XY field calibration.
Magnification selection [9]	Use the expander to view the magnification selection: Shows a preselection of the levels (count and magnification factor) evenly distributed according to the defined number of levels in relation to the available levels of the loaded correction file. If desired, use the drop-down selection to change to another available factor

[8] Only accessible if the loaded correction file provides a 3D volume.

[9] Only accessible if the loaded correction file supports the ***ZoomZ***-axis.

Define table	
Calculation Mode	Depending on the correction task, the following calculation modes are available: ■ *Error Interpolation* Default mode for any standard XY field correction ■ *Absolute interpolation* If you want to set the field correction directly. For more details refer to *page 40, Enter measurements for focus calibration using absolute values*. ■ *Z-Line* Default mode for Z-axis (focus) calibration The Delta Z [mm] can be either related either to – the lens or – the focus.

Table. 7.6: MPE-005

When the settings are complete, press ***[OK]*** and the new table appears on the ***Measurements*** tab.

7.3.2 Tab “Measurements“

7.3.2.1 Enter measurements for scan field calibration

The Measurements table by default is divided into two tabs:

- one for the X-values and
- one for the Y-values of the measured grid points.

The displayed values, as well as the values in the column / row header, show the expected X- and Y-coordinate value of the grid points in [mm].

In the case of a sub field that's offset relative to the actual scan field, the expected grid coordinates in the table shown refer to the center of the sub field. The grid points themselves are always evenly spread over the sub field size along the two coordinate axes.

Example:

Original Measurements table with sub field definition

Marking | Measurements | Correction | Graph

* Header values display the position within the sub field. Values in parenthesis indicate the position within the entire field.
* Cell values indicate the actual position of the grid point within the sub field.

X Y

X [mm] Y[mm]	-4: -50,00 (-35,00)	-3: -37,50 (-22,50)	-2: -25,00 (-10,00)	-1: -12,50 (2,50)	0: 0,00 (15,00)	1: 12,50 (27,50)	2: 25,00 (40,00)	3: 37,50 (52,50)	4: 50,00 (65,00)
4: 60,00 (70,00)	-50	-37,5	-25	-12,5	0	12,5	25	37,5	50
3: 45,00 (55,00)	-50	-37,5	-25	-12,5	0	12,5	25	37,5	50
2: 30,00 (40,00)	-50	-37,5	-25	-12,5	0	12,5	25	37,5	50
1: 15,00 (25,00)	-50	-37,5	-25	-12,5	0	12,5	25	37,5	50
0: 0,00 (10,00)	-50	-37,5	-25	-12,5	0	12,5	25	37,5	50
-1: -15,00 (-5,00)	-50	-37,5	-25	-12,5	0	12,5	25	37,5	50
-2: -30,00 (-20,00)	-50	-37,5	-25	-12,5	0	12,5	25	37,5	50
-3: -45,00 (-35,00)	-50	-37,5	-25	-12,5	0	12,5	25	37,5	50
-4: -60,00 (-50,00)	-50	-37,5	-25	-12,5	0	12,5	25	37,5	50

Fig. 7.9: MPE-AAV

Example:

Original Measurements table with 4 selected Z-layers

Marking | Measurements | Correction | Graph

0,00
-12,47
-23,16
-28,50
[mm]
Layer 0

* Header values display the position within the sub field. Values in parenthesis indicate the position within the entire field.
* Cell values indicate the actual position of the grid point within the sub field.

X Y

X [mm] Y[mm]	-4: -125,00	-3: -93,75	-2: -62,50	-1: -31,25	0: 0,00	1: 31,25	2: 62,50	3: 93,75	4: 125,00
4: 125,00	-100	-75	-50	-25	0	25	50	75	100
3: 93,75	-100	-75	-50	-25	0	25	50	75	100
2: 62,50	-100	-75	-50	-25	0	25	50	75	100
1: 31,25	-100	-75	-50	-25	0	25	50	75	100
0: 0,00	-100	-75	-50	-25	0	25	50	75	100
-1: -31,25	-100	-75	-50	-25	0	25	50	75	100
-2: -62,50	-100	-75	-50	-25	0	25	50	75	100
-3: -93,75	-100	-75	-50	-25	0	25	50	75	100
-4: -125,00	-100	-75	-50	-25	0	25	50	75	100

Average correction [µm]: 0,00 Maximal correction [µm]: 0,00

Fig. 7.10: MPE-AAW

The slider position connects the measurement table e.g. with the focus layer / magnification layer of the correction file. Now move the slider to each available layer and enter the measured values in the X- and Y-table.

TIP about useless cells: If the scan field contains areas that could not be marked, and therefore no measurement data is available for these grid points, you can select the corresponding cells in the table (multiple selection possible), use the context menu *Toggle ignored cells*.

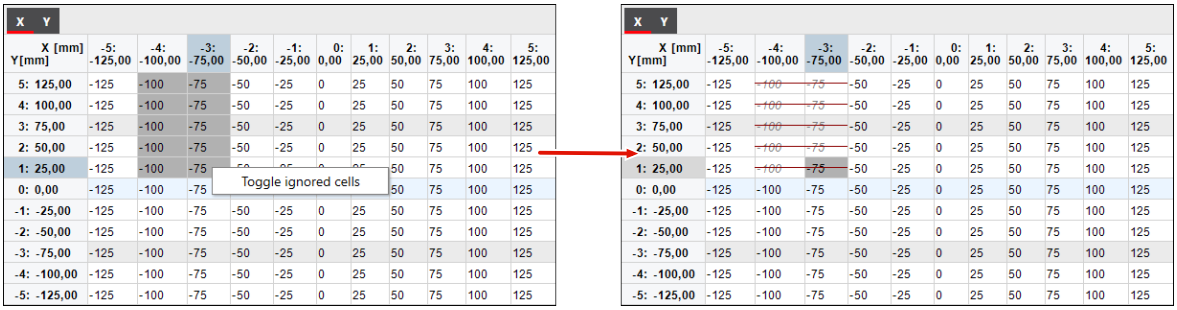


Fig. 7.11: MPE-AAX

The selected cells are then crossed out, just like cells outside a sub field, and are ignored in the error calculation.

NOTE: Note that if too many cells are missing, the calibration result will suffer. This is especially the case if cells are missing at the edge of the sub field, requiring extrapolation..

Below the table, the MPE displays information about the average correction in [µm] and the maximum correction in [µm].

Once all measurement data has been entered, you can use the ***[Show graph]*** option to navigate to the ***Graph*** tab to review the resulting impact of the measurement on the correction file. For more details on the graph, refer to chapter *page 51, Graphical visualization of correction file data*.

Press ***[Apply]*** to calculate the new field correction.

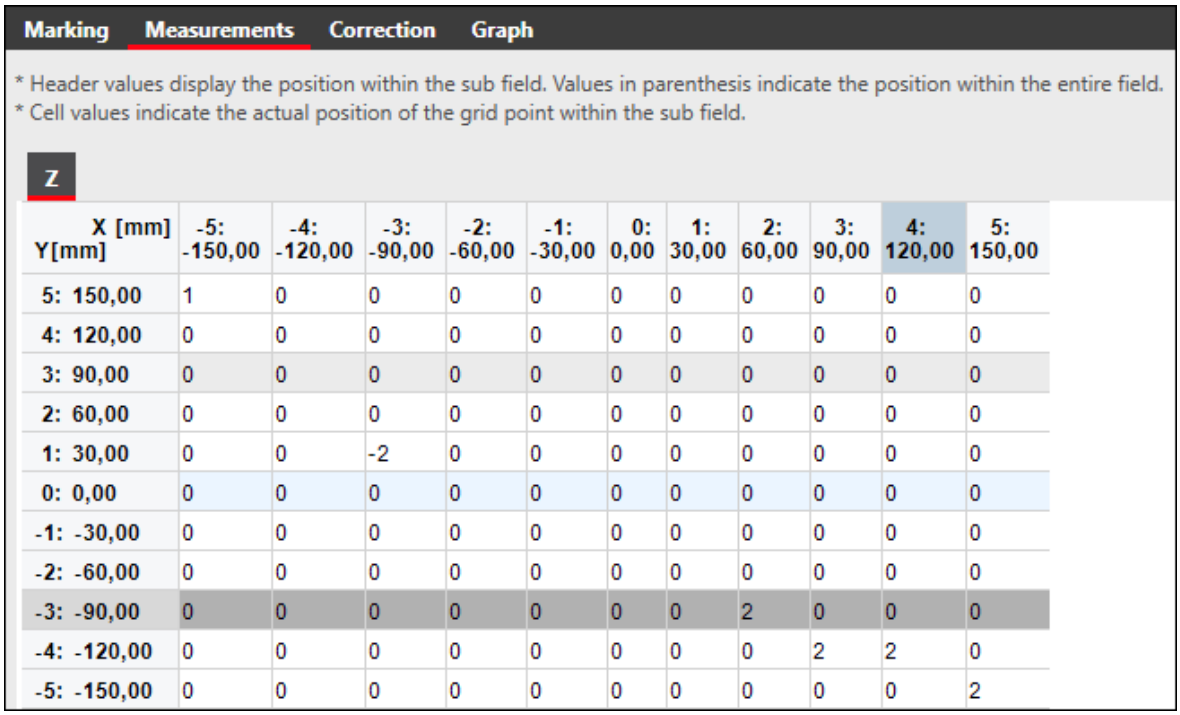
TIP: If you want to save the entered measurement data for further use, e.g. possible re-import or archiving, use the ***Measurement > Save table*** menu.

7.3.2.2 Enter measurements for focus calibration

The Measurements tab only provides one table for the Z-axis.

Different from the field calibration, where you enter the measured grid point coordinate, you have to enter the order number of the "best in focus" line for each grid position. The center line has an order number of zero.

TIP: If the best focus position is not clearly on one line, but between two marked lines, you can also enter a floating point number, e.g. 1,5.



X [mm] Y[mm]	-5: -150,00	-4: -120,00	-3: -90,00	-2: -60,00	-1: -30,00	0: 0,00	1: 30,00	2: 60,00	3: 90,00	4: 120,00	5: 150,00
5: 150,00	1	0	0	0	0	0	0	0	0	0	0
4: 120,00	0	0	0	0	0	0	0	0	0	0	0
3: 90,00	0	0	0	0	0	0	0	0	0	0	0
2: 60,00	0	0	0	0	0	0	0	0	0	0	0
1: 30,00	0	0	-2	0	0	0	0	0	0	0	0
0: 0,00	0	0	0	0	0	0	0	0	0	0	0
-1: -30,00	0	0	0	0	0	0	0	0	0	0	0
-2: -60,00	0	0	0	0	0	0	0	0	0	0	0
-3: -90,00	0	0	0	0	0	0	0	2	0	0	0
-4: -120,00	0	0	0	0	0	0	0	0	2	2	0
-5: -150,00	0	0	0	0	0	0	0	0	0	0	2

Fig. 7.12: MPE-AAY

Move the slider to each layer position and enter the values determined in the tables.

The sign of the order number of the other lines could be noted as follows:

- Left: Vertical line pattern
- Right: Horizontal line pattern

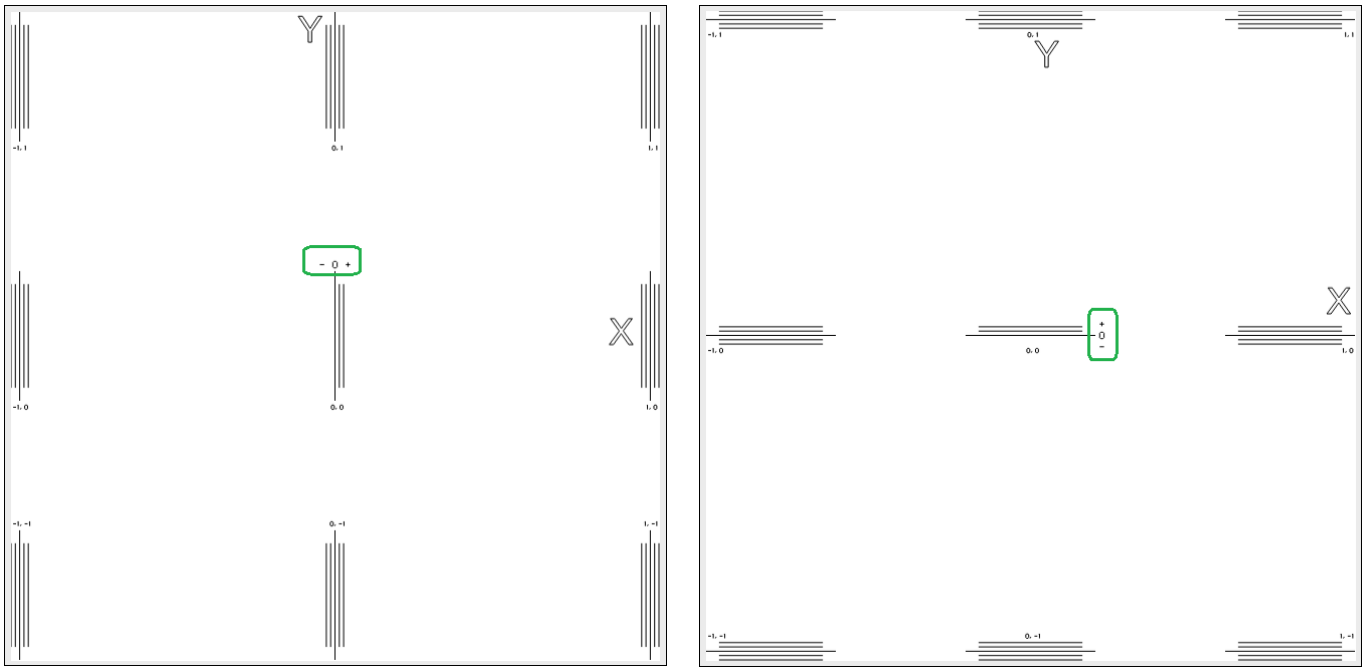
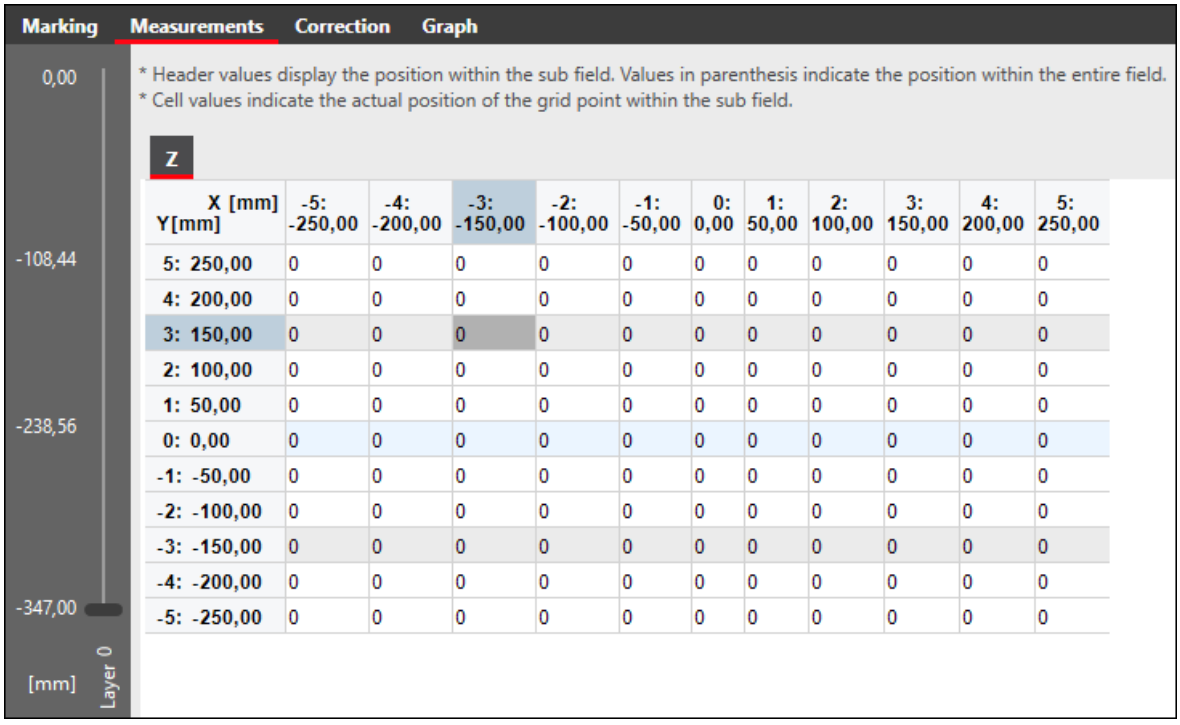


Fig. 7.13: MPE-AAZ

If the focus calibration is to be performed for several focus layers, a layer slider to the left of the table allows you to select the corresponding layer. The layer slider represents your previous done layer selection.



X [mm] Y[mm]	-5: -250,00	-4: -200,00	-3: -150,00	-2: -100,00	-1: -50,00	0: 0,00	1: 50,00	2: 100,00	3: 150,00	4: 200,00	5: 250,00
5: 250,00	0	0	0	0	0	0	0	0	0	0	0
4: 200,00	0	0	0	0	0	0	0	0	0	0	0
3: 150,00	0	0	0	0	0	0	0	0	0	0	0
2: 100,00	0	0	0	0	0	0	0	0	0	0	0
1: 50,00	0	0	0	0	0	0	0	0	0	0	0
0: 0,00	0	0	0	0	0	0	0	0	0	0	0
-1: -50,00	0	0	0	0	0	0	0	0	0	0	0
-2: -100,00	0	0	0	0	0	0	0	0	0	0	0
-3: -150,00	0	0	0	0	0	0	0	0	0	0	0
-4: -200,00	0	0	0	0	0	0	0	0	0	0	0
-5: -250,00	0	0	0	0	0	0	0	0	0	0	0

Fig. 7.14: MPE-ABB

7.3.2.3 Enter measurements for focus calibration using absolute values

As a special approach, you may be able to provide the absolute position of the Z-lens relative to its travel range.

In this case, when defining the measurement table, the calculation mode must be set to “absolute interpolation” and the Z-axis must be selected.

Currently, this mode is only supported for Z-axis.

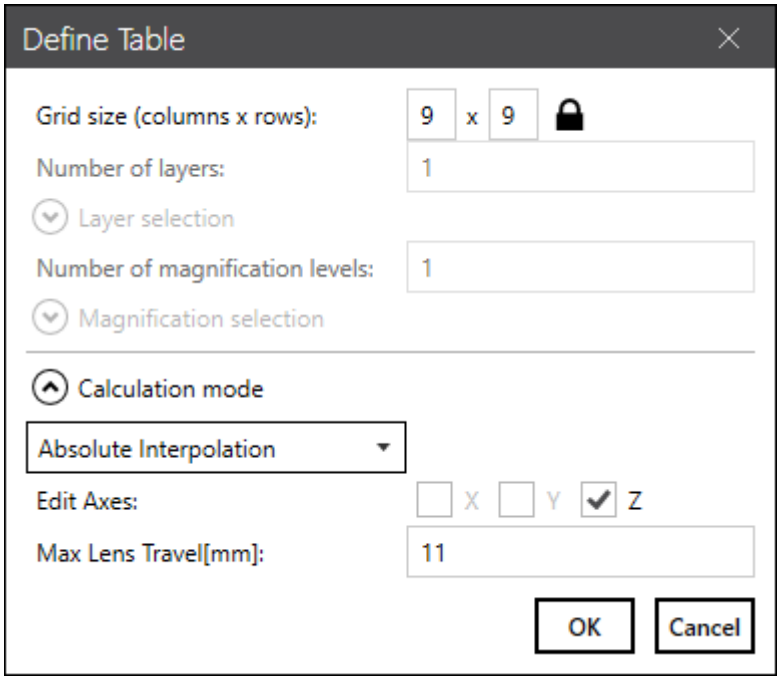


Fig. 7.15: MPE-ABC

The values are now displayed in millimeters and can be edited directly.

When the changes are applied, the values are interpolated to fit the size of the correction table and replace the original correction values of the selected axis.

* Header values display the position within the sub field. Values in parenthesis indicate the position within the entire field.
* Cell values indicate the actual position of the grid point within the sub field.

Z

X [mm] Y[mm]	-4: -75,00	-3: -56,25	-2: -37,50	-1: -18,75	0: 0,00	1: 18,75	2: 37,50	3: 56,25	4: 75,00
4: 75,00	10,956	9,85	9,014	8,493	8,316	8,493	9,014	9,85	10,956
3: 56,25	9,765	8,577	7,677	7,114	6,923	7,114	7,677	8,577	9,765
2: 37,50	8,359	7,606	6,655	6,059	5,856	6,059	6,655	7,606	8,859
1: 18,75	8,291	6,997	6,012	5,395	5,185	5,395	6,012	6,997	8,291
0: 0,00	8,098	6,789	5,793	5,168	4,956	5,168	5,793	6,789	8,098
-1: -18,75	8,291	6,997	6,012	5,395	5,185	5,396	6,012	6,997	8,291
-2: -37,50	8,359	7,606	6,655	6,059	5,856	6,059	6,655	7,606	8,859
-3: -56,25	9,765	8,577	7,677	7,114	6,923	7,114	7,677	8,577	9,765
-4: -75,00	10,956	9,85	9,014	8,493	8,316	8,493	9,014	9,85	10,956

Fig. 7.16: MPE-ABD

7.3.3 Loading measurement values from a file

Loading the measurement from a file can support two main use cases:

- You have saved the previously entered measurements and want to reload them.
- You use a measuring device that automatically measures the marked position and generates a table of values.

The data is entered into a text based file, the application related file name is *.mtf.

The “type= Error” corresponds to the field correction. According to the “Error Interpolation” calculation method these values define the actual marked position.

The “Type = Offset” corresponds to the “Z-Line” calculation mode used when performing the 3rd-axis multi point calibration (see *page 38, Enter measurements for focus calibration*).

If no type is specified, it defaults to Error.

NOTE: The specified field size (in [µm]) must match the field size of the supplied correction file! Otherwise, you will get an exception.

7.3.3.1 Loading the complete measurement data

Go to ***Measurement > Load table*** in order to select the measurement file to load.

This text file must be in the following format:

- Lines to be ignored must begin with '#' or be blank.
- Each row lists one data point.
- All other rows are treated as valid data.
- The coordinates in each valid line must be separated by tab, space, or semicolon.
- The coordinates must follow the US-English numbering style, i.e. '.' (dot) as the decimal point.
- All units (except for row, column etc.) are in microns.

If the header line contains "layer", the first column is interpreted as layer.

If it contains magnification and layer, the first column is magnification, the second is layer.

NOTE: In practice, either the magnification or the layers will have multiple entries, never both.

The header row contains the index of the layer / magnification while the corresponding column contains the count, starting from zero.

If a sub field is defined (`=SubFieldSize`), has an offset (`=SubFieldOffset)`, and if the sub field will be circular (`=IsCircularField`), this information is also mentioned in the header.

NOTE: You may need to save a sample of your specific measurement table to see the format required.

Next are a few examples:

Example 1:

Prefocusing deflection unit, flat field (XY calibration, single layer)

```
# Multipoint FieldCorrection File
# The data contained herein describes the actual positions where the laser fired
# All units (except for row and column etc) are in microns

# Each line lists one data point consisting of
# [Magnification/Layer/]Row/Column: the position where the data point is expected
expressed as [magnification/layer/]row/column
# ActualX/Y/Z: the position where the laser truly fired
# Empty lines and lines that begin with '#' are ignored
# The fields can be separated by <space>, <tab> or <semicolon>
# The floating point values must use '.' as the decimal point

; Type:             Error
; FieldSize:        300000    300000
; Selected layers:
; Selected magnifications:

; Magnification [] Layer [] Row [] Column [] ActualX [um] ActualY [um] ActualZ [um]
0         0         0         0         -150000   -150000   0         0         0
0         0         0         1         -112500   -150000   0         0         0
0         0         0         2         -75000    -150000   0         0         0
0         0         0         3         -37500    -150000   0         0         0
0         0         0         4         0         -150000   0         0         0
0         0         0         5         37500     -150000   0         0         0
0         0         0         6         75000     -150000   0         0         0
0         0         0         7         112500    -150000   0         0         0
0         0         0         8         150000    -150000   0         0         0
0         0         0         0         -150000   -112500   0         0         0
0         0         1         1         -112500   -112500   0         0         0
0         0         1         2         -75000    -112500   0         0         0
0         0         1         3         -37500    -112500   0         0         0
0         0         1         4         0         -112500   0         0         0
0         0         1         5         37500     -112500   0         0         0
0         0         1         6         75000     -112500   0         0         0
0         0         1         7         112500    -112500   0         0         0
0         0         1         8         150000    -112500   0         0         0
0         0         2         0         -150000   -75000    0         0         0
0         0         2         1         -112500   -75000    0         0         0
0         0         2         2         -75000    -75000    0         0         0
```

Table. 7.7: MPE-007

Example 2:

Prefocusing deflection unit, 3D volume (3 focus layers selected for XY calibration)

```
# Multipoint FieldCorrection File
# The data contained herein describes the actual positions where the laser fired
# All units (except for row and column etc) are in microns

# Each line lists one data point consisting of
# [Magnification/Layer/]Row/Column: the position where the data point is expected
expressed as [magnification/layer/]row/column
# ActualX/Y/Z: the position where the laser truly fired
# Empty lines and lines that begin with '#' are ignored
# The fields can be separated by <space>, <tab> or <semicolon>
# The floating point values must use '.' as the decimal point

; Type:                    Error
; FieldSize:               1000000   1000000
; SubFieldSize:            850000    850000
; SubFieldOffset:          0         0
; IsCircularField:         False [10]
```

[10] Example continues on next page.

```
; Selected layers:          0         8         16
; Selected magnifications:

; Magnification [] Layer [] Row [] Column [] ActualX [um] ActualY [um] ActualZ [um]
0         0         0         0         -425000   -425000   0         0         0
0         0         0         1         -318750   -425000   0         0         0
0         0         0         2         -212500   -425000   0         0         0
0         0         0         3         -106250   -425000   0         0         0
0         0         0         4         0         -425000   0         0         0
0         0         0         5         106250    -425000   0         0         0
…
0         1         0         0         -425000   -425000   0         0         0
0         1         0         1         -318750   -425000   0         0         0
0         1         0         2         -212500   -425000   0         0         0
0         1         0         3         -106250   -425000   0         0         0
0         1         0         4         0         -425000   0         0         0
0         1         0         5         106250    -425000   0         0         0
0         1         0         6         212500    -425000   0         0         0
0         1         0         7         318750    -425000   0         0         0
0         1         0         8         425000    -425000   0         0         0
…
0         2         0         0         -425000   -425000   0         0         0
0         2         0         1         -318750   -425000   0         0         0
0         2         0         2         -212500   -425000   0         0         0
0         2         0         3         -106250   -425000   0         0         0
0         2         0         4         0         -425000   0         0         0
0         2         0         5         106250    -425000   0         0         0
0         2         0         6         212500    -425000   0         0         0
0         2         0         7         318750    -425000   0         0         0
```

Table. 7.8: MPE-007

Example 3:

AM-MODULE, flat field (3 magnifications selected for calibration)

```
# Multipoint FieldCorrection File
# The data contained herein describes the actual positions where the laser fired
# All units (except for row and column etc) are in microns

# Each line lists one data point consisting of
# [Magnification/Layer/]Row/Column: the position where the data point is expected
expressed as [magnification/layer/]row/column
# ActualX/Y/Z: the position where the laser truly fired
# Empty lines and lines that begin with '#' are ignored
# The fields can be separated by <space>, <tab> or <semicolon>
# The floating point values must use '.' as the decimal point [11]
```

[11] Example continues on next page.

```
; Type:                       Error
; FieldSize:                  500000    500000
; Selected layers:
; Selected magnifications:    0         4         8

; Magnification []  Layer []  Row []  Column []  ActualX [um]  ActualY [um]  ActualZ [um]
0          0          0          0          -250000    -250000    0          0          0
0          0          0          1          -187500    -250000    0          0          0
0          0          0          2          -125000    -250000    0          0          0
0          0          0          3          -62500     -250000    0          0          0
0          0          0          4          0          -250000    0          0          0
0          0          0          5          62500      -250000    0          0          0
0          0          0          6          125000     -250000    0          0          0
…
1          0          0          0          -250000    -250000    0          0          0
1          0          0          1          -187500    -250000    0          0          0
1          0          0          2          -125000    -250000    0          0          0
1          0          0          3          -62500     -250000    0          0          0
1          0          0          4          0          -250000    0          0          0
1          0          0          5          62500      -250000    0          0          0
1          0          0          6          125000     -250000    0          0          0
1          0          0          7          187500     -250000    0          0          0
1          0          0          8          250000     -250000    0          0          0
…
2          0          0          0          -250000    -250000    0          0          0
2          0          0          1          -187500    -250000    0          0          0
2          0          0          2          -125000    -250000    0          0          0
2          0          0          3          -62500     -250000    0          0          0
2          0          0          4          0          -250000    0          0          0
2          0          0          5          62500      -250000
2          0          0          6          125000     -250000    0          0          0
2          0          0          7          187500     -250000    0          0          0
2          0          0          8          250000     -250000    0          0          0
2          0          0          10         -250000    -187500    0          0          0
```

Table. 7.9: MPE-008

Example 4:

AXIALSCAN, flat field (focus calibration)

```
# The fields can be separated by <space>, <tab> or <semicolon>
# The floating point values must use '.' as the decimal point

; Type:                 Offset
; FieldSize:            500000      500000
; SubFieldSize:         450000      450000
; SubFieldOffset:       0           0
; IsCircularField:      False [12]
```

[12] Example continues on next page.

```
; Selected layers:
; Selected magnifications:

; Magnification [] Layer [] Row [] Column [] OffsetX [bit] OffsetY [bit] OffsetZ
[bit]
0               0               0               1               0               0               0
0               0               0               2               0               0               0
0               0               0               3               0               0               0
0               0               0               4               0               0               0
0               0               0               5               0               0               0
0               0               0               6               0               0               0
0               0               0               7               0               0               0
0               0               0               8               0               0               0
0               0               0               9               0               0               0
0               0               1               0               0               0               0
0               0               1               1               0               0               0
0               0               1               2               0               0               14299
0               0               1               3               0               0               0
0               0               1               4               0               0               0
0               0               1               5               0               0               0
0               0               1               6               0               0               0
0               0               1               7               0               0               0
0               0               1               8               0               0               0
0               0               1               9               0               0               0
0               0               2               0               0               0               0
0               0               2               1               0               0               0
0               0               2               2               0               0               0
0               0               2               3               0               0               0
0               0               2               4               0               0               0
0               0               2               5               0               0               0
0               0               2               6               0               0               0
0               0               2               7               0               0               0
0               0               2               8               0               0               42897
```

Table. 7.10: MPE-009

7.3.3.2 Loading a table for a single layer/magnification

Instead of loading the entire measurement table, a single data grid for a (focus) layer or magnification can be loaded with ***Measurement > Load table layer***.

This will only overwrite the data of the active layer of the measurement table.

The file format is the same as on *page 42, Loading the complete measurement data*, whereby it must be ensured that the number of rows and columns matches the current measurement table.

7.3.3.3 Importing a list of measurement values

If the measured points are not a uniform grid, a list of measured points defined by expected and actual position can be imported.

Magnification and layer indices can be provided optionally. Currently only X/Y errors can be imported, meaning actual Z must be equal to expected Z if provided.

A new measurement table must be created, taking into account the number of measurements in the prepared list that will be imported next. The number of layers and magnifications will be used as specified in the imported list.

For each point in the measurement table, the nearest three points to the imported points are determined. A plane that is fitted through the measured deviation of these three points then defines the error at that position.

The unit of measurement is [µm] and the decimal point is '.'.

Support format:

<expected X>, <expected Y>, <expected Z>, <actual X>, <actual Y>

NOTE: After loading or importing measurement data, it is still necessary to apply the data and save the calibrated correction file.

8 GRAPHICAL VISUALIZATION OF CORRECTION FILE DATA

When loading a correction file and especially after applying measurements, you may want to visually check the original or modified data.

Use the ***Graph*** tab to view the correction file visualization.

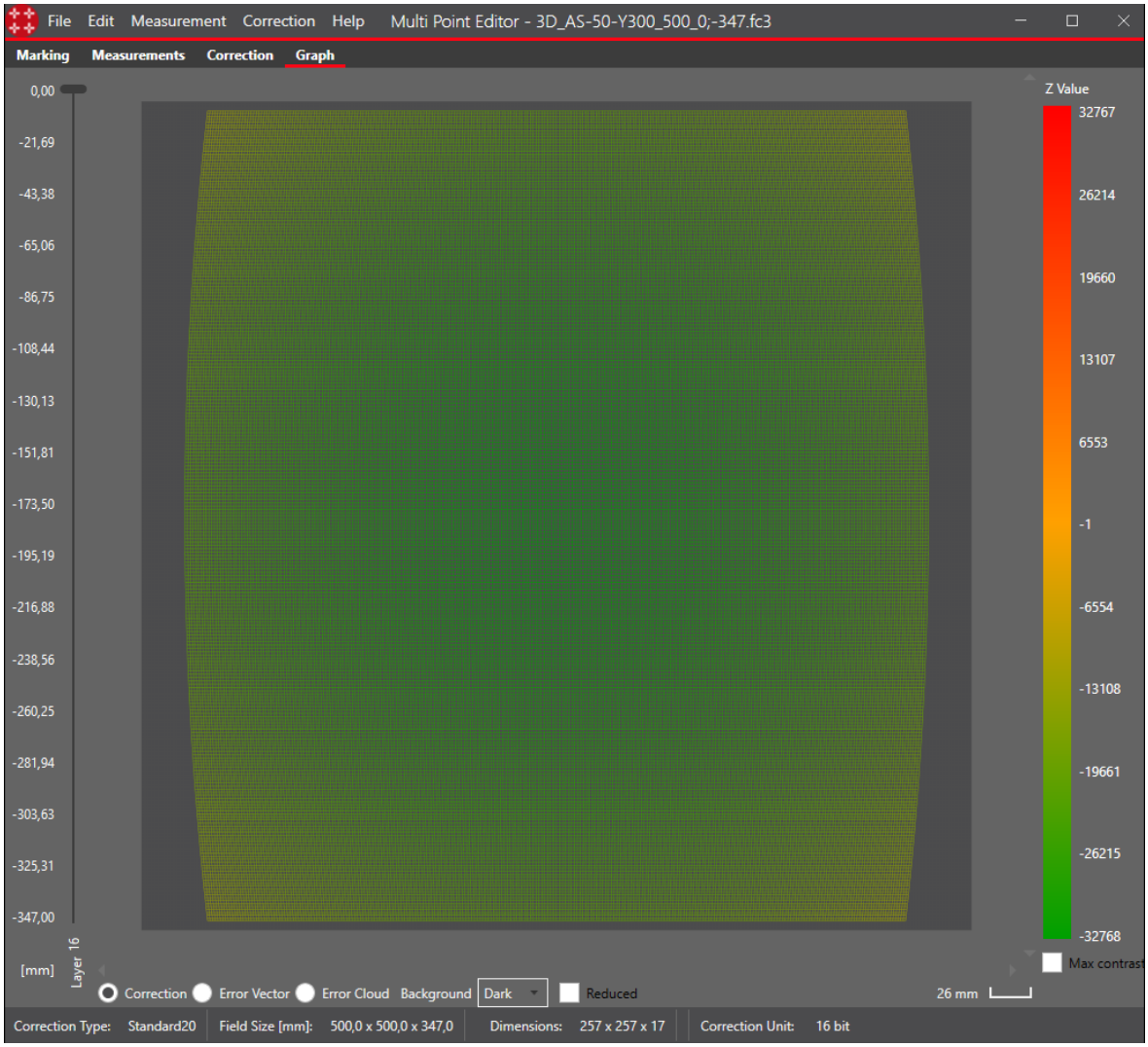


Fig. 8.1: MPE-ABE

NOTE: The background color of the graph can be changed from black to white (dark vs. light) according to the user's preference.

The **color bar** defines the color of the values for the Z-axis over the graph.

The range of values depends on the selected correction unit (refer to *page 75, Settings*):

	16 Bit	20 Bit	Percent
Min. (green)	-32768	-524288	-50
Max. (red)	+32767	+524287	+50

Table. 8.1: MPE-010

The bar can either represent the full range of Z-axis values, or by using the “max contrast” flag, the color range from min to max of the Z-axis will be adjusted to the min/max values of the respective Z-layer.

More than one Z-axis

As soon as a correction file supports more than one Z-axis (linear axis), a selection becomes available (below the checkbox). If the correction file supports an additional Z-axis, select whether the displayed correction data refers to

- Z-axis (focus),
- SensorZ (RAYSPECTOR) or
- Aux-axis (RAYDIME METER).

3D volumes or Zoom-axis

For correction files that support either 3D volumes or a Zoom-axis, a slider is available (to the left of the graph). It can be used to select the layer for which the corresponding correction data should be displayed.

Navigation

Navigating the graph:

- Scroll to zoom in / out,
- Left drag to pan.

Type of data visualization	Description
Correction	Shows the grid of correction values Use the “reduced” flag to change the number of grid lines from original (usually 257 x 257) to 65 x 65
Error vector [13]	The error vector graph shows the measured and the expected locations. The measured points are green and the expected points blue. The resulting correction is shown as a red arrow.
Error cloud [13]	The error cloud displays the necessary XY correction of each measured point. The color is defined by the distance of the measured point from the center, i.e. the color changes from green (center) to red (corner). The scale of the plot is shown as plot size [µm] in the lower right corner. This can be useful for deeper analysis of the nature of the errors (e.g. if the whole field has the same offset, all points would be displayed at the same position).

Table. 8.2: MPE-011

[13] This display option is only useful as long as the deviation between the measured values and the default values can be determined within the MULTI POINT EDITOR. Loading a correction file that has already been edited will no longer provide this information.

9 APPLY MEASUREMENT AND SAVE MODIFIED CORRECTION FILE

After entering the measured values and checking them in the visualization, the values can be applied.

After the values have been applied, a message is displayed informing you of the average and maximum correction:

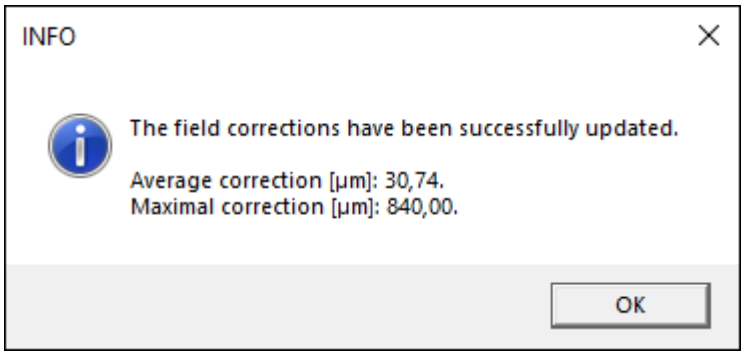


Fig. 9.1: MPE-ABF

Finally, save the modified correction: ***File > Save as... Save as...***.

TIP: It is useful to save the file with the same name as the original, but adding information about the type of correction applied and, if necessary, the number of iterations as a suffix.

NOTES:

- If the resulting field with the applied correction exceeds the field size (e.g. because the field was offset), you are notified that the correction values will be clipped to fit the field size.
- Normally, there is no backup of the original correction file, unless you check the option in the MPE settings (***Edit > Settings...***).
- An index is appended to the filename, if the target file already exists.
- The standalone application will upload the modified correction when saving (if still connected to the scan controller), and the changes to the correction file will become active. The RAYGUIDE application will also have the modified version in its configuration.

10 GENERATING CORRECTION FILES REPRESENTING A 3D SURFACE

When processing on a 3D surface and the vector data is not available as 3D vectors, there is another way to adapt the focus of the laser beam to the surface. Instead of a correction file representing a 3D volume (cuboid), the correction file, which controls the Z-axes anyway, maps the surface shape.

To do so, the MPE offers two features.

These features require starting with a correction file that provides a 3D volume.

The result is a correction file that represents the outer shell, i.e. a single 2D layer that follows the 3D surface.

NOTE: It is recommended to perform regular field and focus corrections on the 3D volume before starting to create a 3D surface correction file.

10.1 Apply wrapped surface

This option allows you to create 3D correction files that not only represent a 3D surface, but also correct the XY position of the incoming layout coordinates so that the layout wraps onto the surface.

To calculate the correction, only certain types of surfaces are supported:

- cylindrical surface,
- inclined plane.

10.1.1 Mode: Cylinder

Select: ***Apply wrapped surface > Mode: Cylinder***

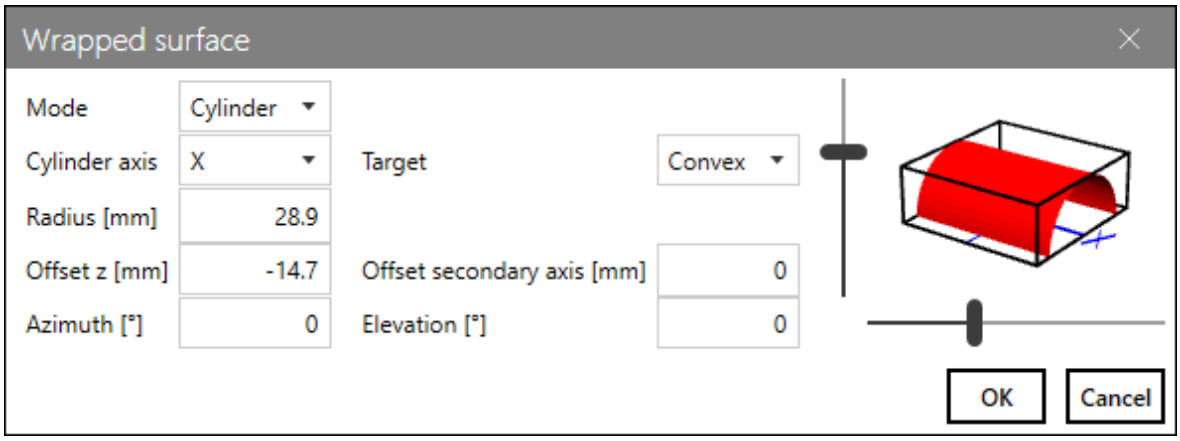


Fig. 10.1: MPE-ABG

Element	Description
Cylinder axis	Specify whether the cylinder axis is placed along the X- or Y-axes.
Target	Select whether the cylinder represents a concave or convex curvature
Radius [mm]	Enter the radius of the cylinder in [mm].
Offset z [mm]	Offset of the cylinder axis relative to the zero plane of the correction file.
Offset secondary axis [mm]	Enter the parallel offset of the cylinder axes to the selected coordinate axes.
Azimuth [°] [14]	Horizontal angle of the cylinder axes relative to the selected coordinate axes.
Elevation [°] [14]	Vertical angle of the cylinder axes relative to the selected coordinate axes.

Table. 10.1: MPE-012

[14] Azimuth and elevation angles are limited to a maximum of ±10 degrees.

10.1.2 Mode: Plane

Select: ***Apply wrapped surface > Mode: Plane***

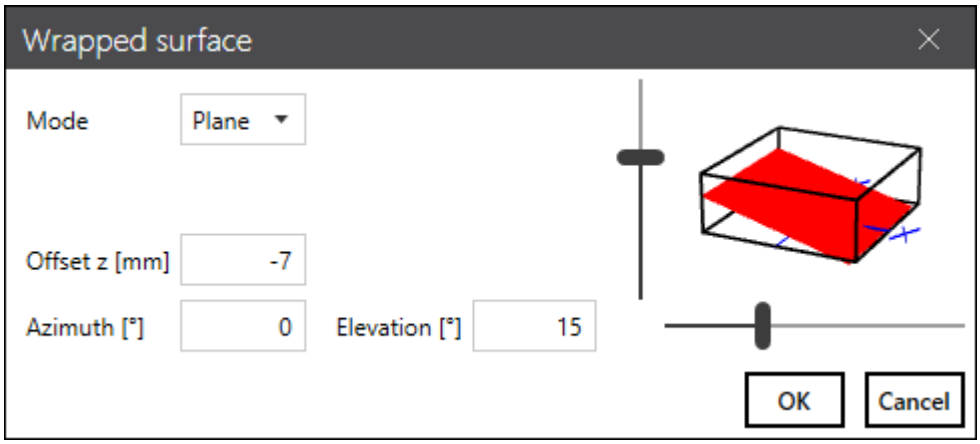


Fig. 10.2: MPE-ABH

Element	Description
Offset z [mm]	Offset of a “flat” plane relative to Z=0.
Azimuth [°] [15]	Horizontal rotation angle of the inclined plane relative to the X-axis.
Elevation [°] [15]	Tilt angle of the inclined plane in vertical perspective.

Table. 10.2: MPE-013

[15] Azimuth and elevation angles are limited to a maximum of ±10 degrees.

10.2 Apply projection

This option allows you to create almost any kind of 3D surface by importing the surface shape from an STL file. With this option, only the Z data of the correction file is matched to the surface, resulting in a projected image of the layout being processed. As an alternative to importing an STL file, you can define a sphere shape by entering its radius and position.

10.2.1 Mode: Sphere

Select: ***Apply projection > Mode: Sphere***

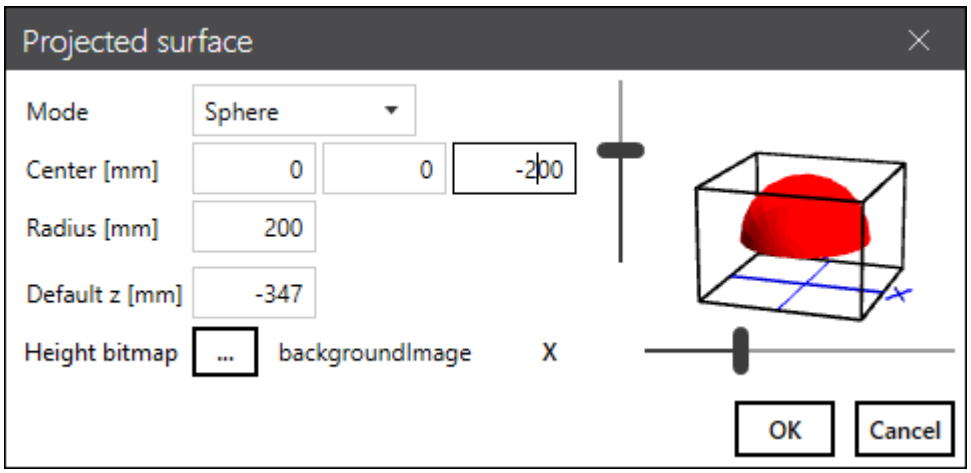


Fig. 10.3: MPE-ABI

Element	Description
Center [mm] (X/Y/Z)	Coordinate of the center of the sphere relative to the origin of working volume.
Radius [mm]	Enter the radius in [mm] of the sphere. A positive radius results in a convex sphere, while a negative radius results in a concave sphere.
Default z [mm]	Defines the Z-position for all XY-positions, that do not meet the surface of the sphere.

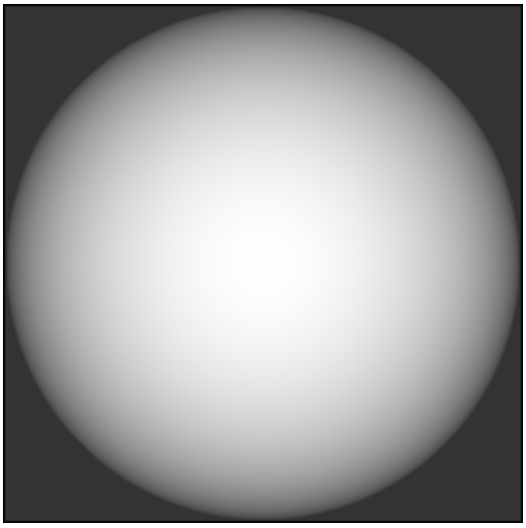
Element	Description
Height bitmap […]	Browse to a folder and specify a file name for a height-representing image. Example:  This image can be e.g. loaded into the background of RAYGUIDE as an orientation for where to place the layout object in order to hit the 3D surface. **NOTE:** The darker the deeper the focus compared to Z = 0.

Table. 10.3: MPE-014

10.2.2 Mode: STL File

Select: ***Apply projection > Mode "STL"***

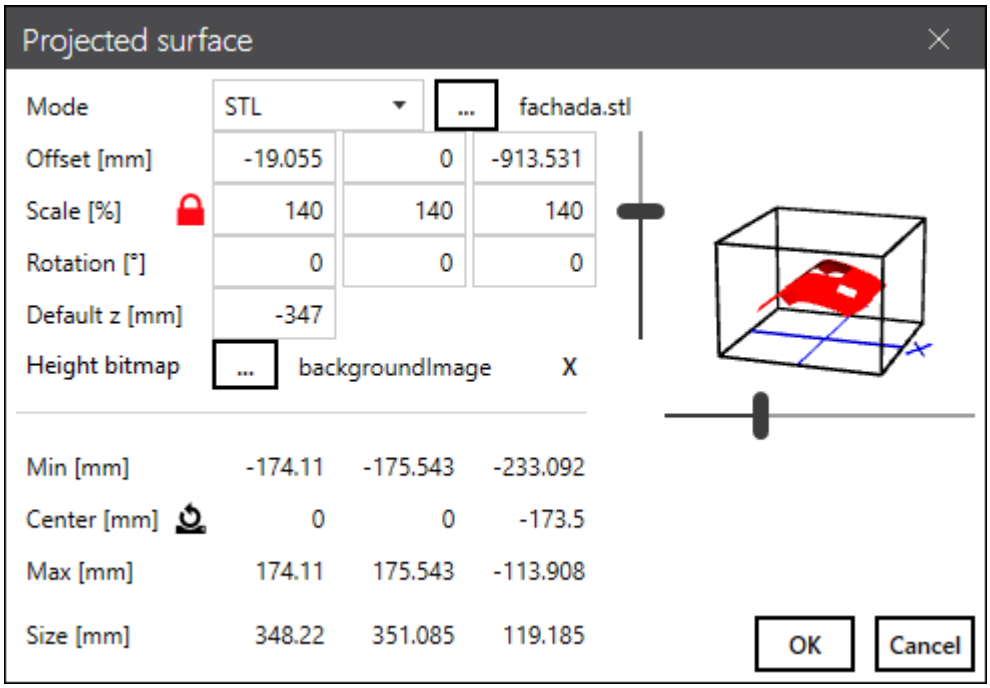


Fig. 10.4: MPE-ABJ

Element	Description
[…] Select file	Browse to the desired STL file and load it.
Offset[mm]	Define the offset from the origin of the STL File to the origin of the working volume given by the correction file.
Scale [%]	Scaling of the STL file dimensions in percent (in X-, Y-, Z-dimension) By default, the dimensions are locked for the same aspect ratio. Unlock if necessary.
Rotation [°]	Enter an angle to rotate the 3D surface relative to the axis of the correction file
Default z]mm]	Defines the Z-position for all XY positions, that do not meet the STL surface.

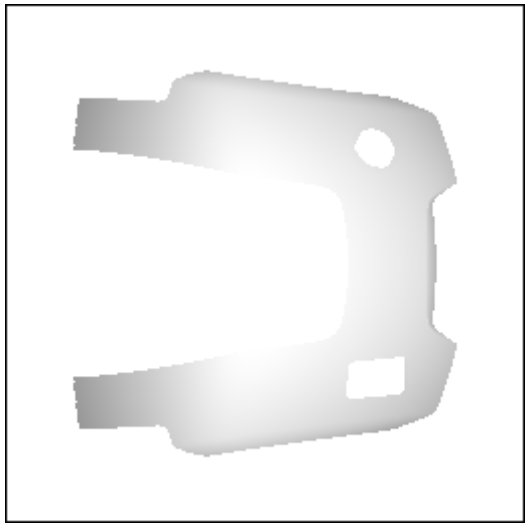
Element	Description
Height bitmap […]	Browse to a folder and specify a file name for a height-representing image. Example:  This image can be e.g. loaded into the background of RAYGUIDE as an orientation, where to place the layout object in order to hit the 3D surface. NOTE: The darker the deeper the focus compared to Z = 0.
Infos	
Min.[mm] (X/Y/Z)	Shows the minimum position of the surface in each axis direction
Center [mm]	Use the ***[Reset]*** button to center the surface inside the volume. This sets the STL origin to the working volume origin. The values show the actual offset between the two origins.
Max.[mm] (X/Y/Z)	Shows the maximum position of the surface in each axes direction.
Size [mm] (X/Y/Z)	Surface size along the three axis dimensions, including scaling.

Table. 10.4: MPE-015

TIP: To avoid cropping the imported surface, make sure all positions are inside the 3D volume.

Next to the value field, a preview shows the actual position of the surface relative to the working volume. Use the two sliders to adjust the point of view.

11 CORRECTION FILE HEADER

The *.fc3 correction file contains a lot of additional information in what is called the "header". This information includes the metadata, too.

Go to ***Edit > Change header***

The only editable value here is the Z-offset, which can be used to set the reference plane (Z = 0) other than the default defined by RAYLASE.

The *Info field* can be used to enter custom information.

NOTE: The header data is used by the control card, while the metadata is just additional information that specifies more detailed information about the optical setup that the correction file applies to.

Example: AM-MODULE header

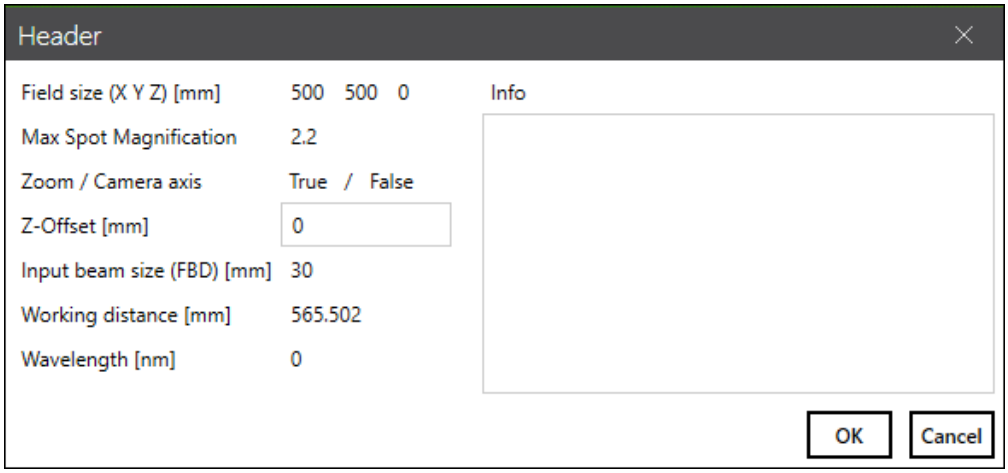


Fig. 11.1: MPE-ABK

Example: Header with additional metadata

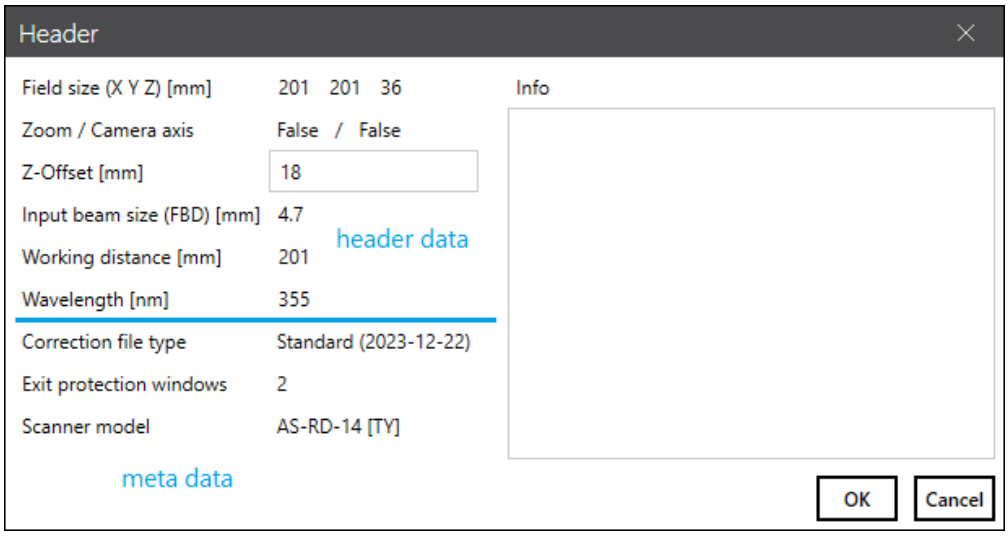


Fig. 11.2: MPE-ABL

12 POSITION DEPENDENT POWER CORRECTION FILE

The MULTI POINT EDITOR software can also be used to create power correction files. These files are uploaded to the control card to adjust the laser power based on the field position.

A common use case would be to compensate for the variation in power density caused by variation in spot size due to deflection angle.

To generate a new power correction file, select ***File > Generate power correction.***

NOTE: The power correction is not part of the field correction. Instead, this method creates a special correction file named *.pc3.

In the following dialog, you have to define the number of grid points and layers (in case of a 3D workspace) as well as the field size (according to the used field correction file).

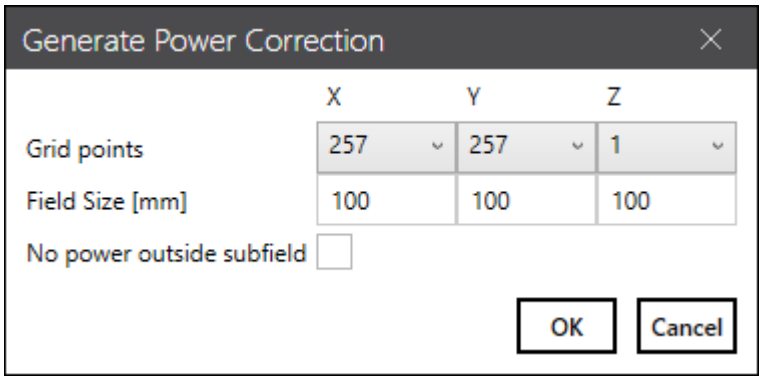


Fig. 12.1: MPE-ABM

In addition, the "No power outside sub field" flag can be checked to force power scaling to zero outside the sub field. This type of power correction is used, for example, to avoid laser power emission when the scanner targets a position outside the defined sub field (see *page 19, Optional field range limitation for calibration (sub field)*.

NOTE: To use the flag, the sub field must first be defined (in a field size that matches the field size of the power correction, or a field correction file with a sub field definition must have been loaded before (refer to *page 19, Optional field range limitation for calibration (sub field)*).

When you click ***[OK]***, the basis for the power correction is created, resulting in a scale factor = 1 for the entire field used.

NOTE: Although you are presented with a measurement table, this 3 x 3 table is not ready for your input.

Next, go to the ***Measurement > New table*** menu to create the table for entering the scaling factors for the power correction required.

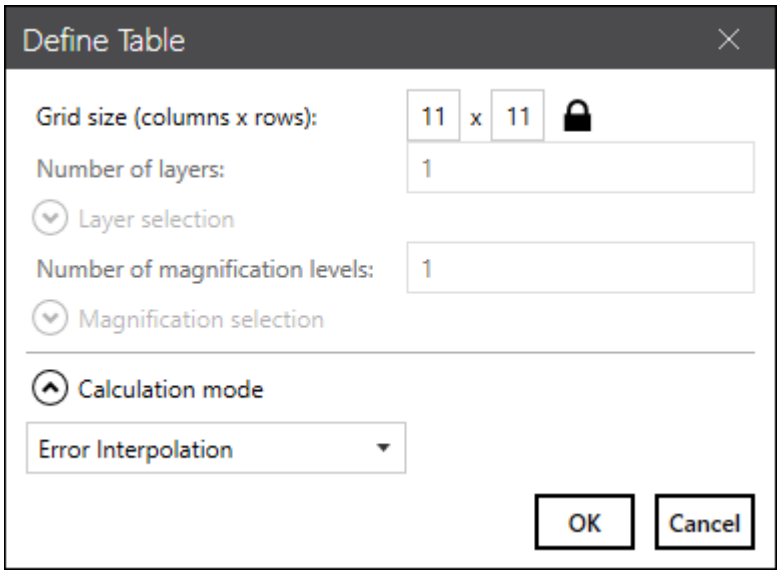
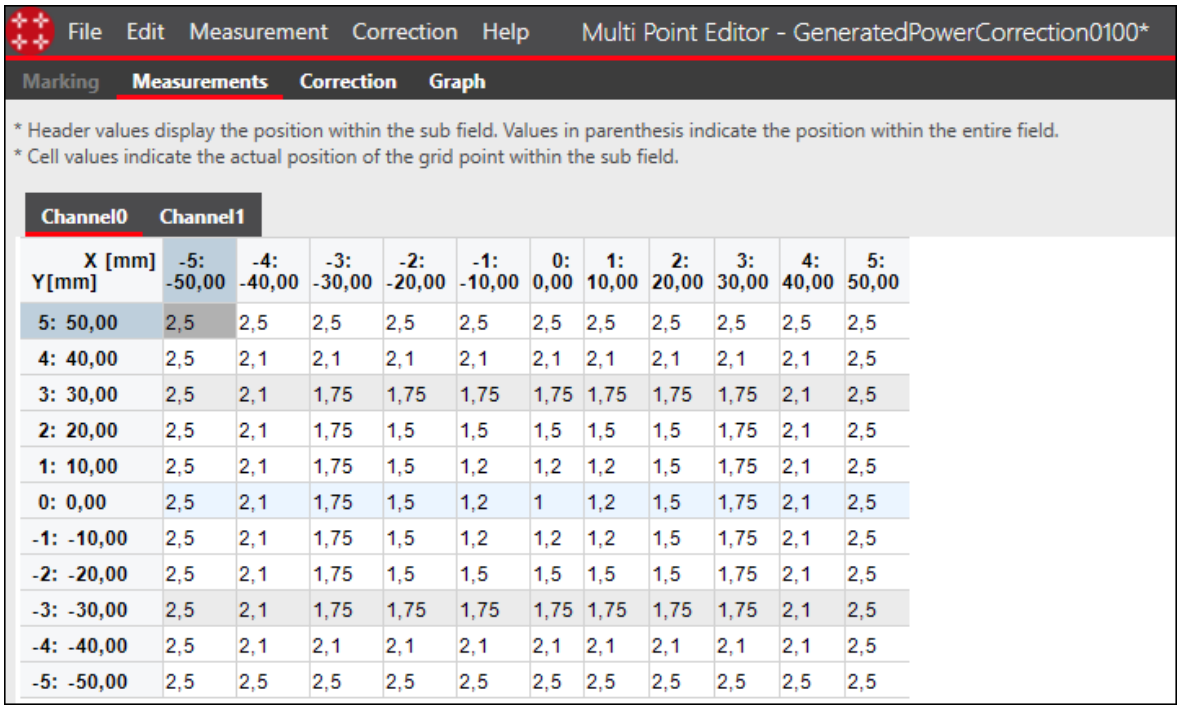


Fig. 12.2: MPE-ABN

The grid with the channel0 tab is used to control the laser power on the main power control card. Channel1 is optional if the laser has defined a secondary power target (usually Dac1).

The range of values to enter can be from factor 0 to factor 4. You can also enter decimal values, the display will just round them to 2 digits.

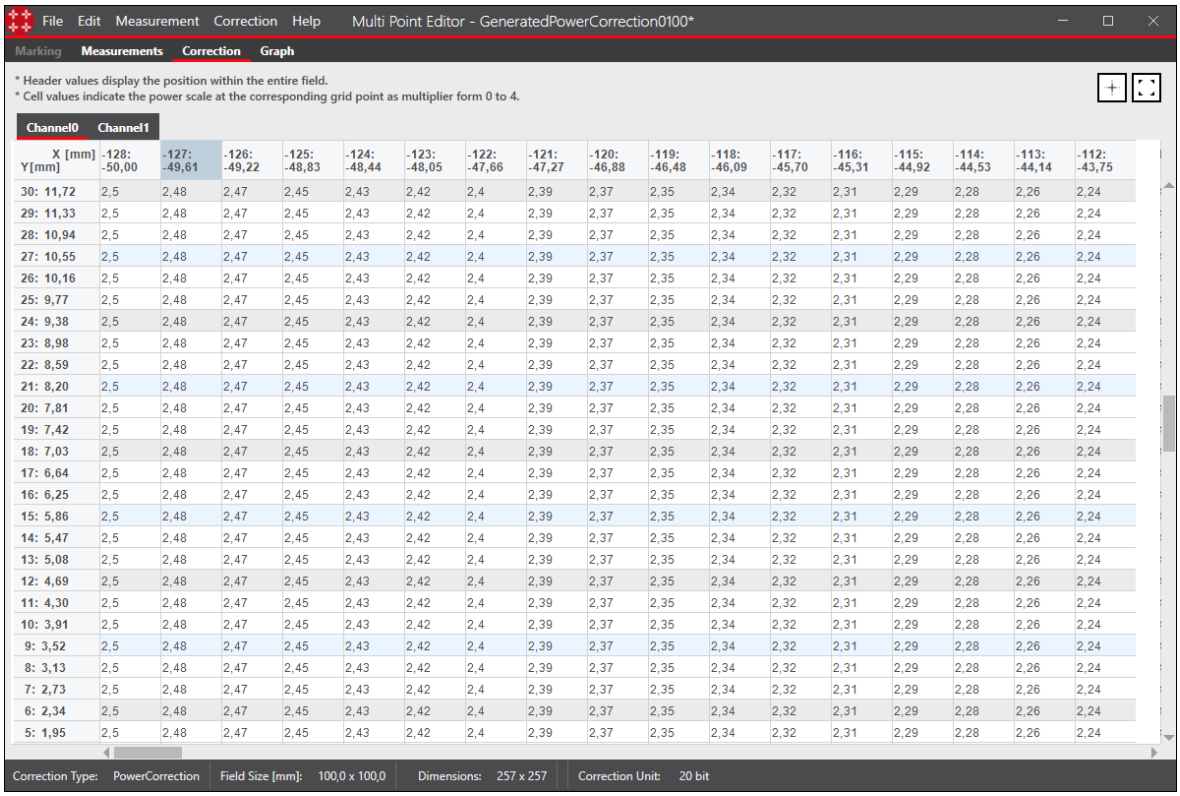


X [mm] Y[mm]	-5: -50,00	-4: -40,00	-3: -30,00	-2: -20,00	-1: -10,00	0: 0,00	1: 10,00	2: 20,00	3: 30,00	4: 40,00	5: 50,00
5: 50,00	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5
4: 40,00	2,5	2,1	2,1	2,1	2,1	2,1	2,1	2,1	2,1	2,1	2,5
3: 30,00	2,5	2,1	1,75	1,75	1,75	1,75	1,75	1,75	1,75	2,1	2,5
2: 20,00	2,5	2,1	1,75	1,5	1,5	1,5	1,5	1,5	1,75	2,1	2,5
1: 10,00	2,5	2,1	1,75	1,5	1,2	1,2	1,2	1,5	1,75	2,1	2,5
0: 0,00	2,5	2,1	1,75	1,5	1,2	1	1,2	1,5	1,75	2,1	2,5
-1: -10,00	2,5	2,1	1,75	1,5	1,2	1,2	1,2	1,5	1,75	2,1	2,5
-2: -20,00	2,5	2,1	1,75	1,5	1,5	1,5	1,5	1,5	1,75	2,1	2,5
-3: -30,00	2,5	2,1	1,75	1,75	1,75	1,75	1,75	1,75	1,75	2,1	2,5
-4: -40,00	2,5	2,1	2,1	2,1	2,1	2,1	2,1	2,1	2,1	2,1	2,5
-5: -50,00	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5

Fig. 12.3: MPE-ABO

On the ***Correction*** tab, you will notice that the scaling factors are again distributed over the array of grid points. Since the number of grid points is likely to be larger than the number of points in the measurement table, the values are interpolated accordingly.

Again, there are two subtabs for channel0 and channel1:



X [mm] Y[mm]	-128: -50,00	-127: -49,61	-126: -49,22	-125: -48,83	-124: -48,44	-123: -48,05	-122: -47,66	-121: -47,27	-120: -46,88	-119: -46,48	-118: -46,09	-117: -45,70	-116: -45,31	-115: -44,92	-114: -44,53	-113: -44,14	-112: -43,75
30: 11,72	2,5	2,48	2,47	2,45	2,43	2,42	2,4	2,39	2,37	2,35	2,34	2,32	2,31	2,29	2,28	2,26	2,24
29: 11,33	2,5	2,48	2,47	2,45	2,43	2,42	2,4	2,39	2,37	2,35	2,34	2,32	2,31	2,29	2,28	2,26	2,24
28: 10,94	2,5	2,48	2,47	2,45	2,43	2,42	2,4	2,39	2,37	2,35	2,34	2,32	2,31	2,29	2,28	2,26	2,24
27: 10,55	2,5	2,48	2,47	2,45	2,43	2,42	2,4	2,39	2,37	2,35	2,34	2,32	2,31	2,29	2,28	2,26	2,24
26: 10,16	2,5	2,48	2,47	2,45	2,43	2,42	2,4	2,39	2,37	2,35	2,34	2,32	2,31	2,29	2,28	2,26	2,24
25: 9,77	2,5	2,48	2,47	2,45	2,43	2,42	2,4	2,39	2,37	2,35	2,34	2,32	2,31	2,29	2,28	2,26	2,24
24: 9,38	2,5	2,48	2,47	2,45	2,43	2,42	2,4	2,39	2,37	2,35	2,34	2,32	2,31	2,29	2,28	2,26	2,24
23: 8,98	2,5	2,48	2,47	2,45	2,43	2,42	2,4	2,39	2,37	2,35	2,34	2,32	2,31	2,29	2,28	2,26	2,24
22: 8,59	2,5	2,48	2,47	2,45	2,43	2,42	2,4	2,39	2,37	2,35	2,34	2,32	2,31	2,29	2,28	2,26	2,24
21: 8,20	2,5	2,48	2,47	2,45	2,43	2,42	2,4	2,39	2,37	2,35	2,34	2,32	2,31	2,29	2,28	2,26	2,24
20: 7,81	2,5	2,48	2,47	2,45	2,43	2,42	2,4	2,39	2,37	2,35	2,34	2,32	2,31	2,29	2,28	2,26	2,24
19: 7,42	2,5	2,48	2,47	2,45	2,43	2,42	2,4	2,39	2,37	2,35	2,34	2,32	2,31	2,29	2,28	2,26	2,24
18: 7,03	2,5	2,48	2,47	2,45	2,43	2,42	2,4	2,39	2,37	2,35	2,34	2,32	2,31	2,29	2,28	2,26	2,24
17: 6,64	2,5	2,48	2,47	2,45	2,43	2,42	2,4	2,39	2,37	2,35	2,34	2,32	2,31	2,29	2,28	2,26	2,24
16: 6,25	2,5	2,48	2,47	2,45	2,43	2,42	2,4	2,39	2,37	2,35	2,34	2,32	2,31	2,29	2,28	2,26	2,24
15: 5,86	2,5	2,48	2,47	2,45	2,43	2,42	2,4	2,39	2,37	2,35	2,34	2,32	2,31	2,29	2,28	2,26	2,24
14: 5,47	2,5	2,48	2,47	2,45	2,43	2,42	2,4	2,39	2,37	2,35	2,34	2,32	2,31	2,29	2,28	2,26	2,24
13: 5,08	2,5	2,48	2,47	2,45	2,43	2,42	2,4	2,39	2,37	2,35	2,34	2,32	2,31	2,29	2,28	2,26	2,24
12: 4,69	2,5	2,48	2,47	2,45	2,43	2,42	2,4	2,39	2,37	2,35	2,34	2,32	2,31	2,29	2,28	2,26	2,24
11: 4,30	2,5	2,48	2,47	2,45	2,43	2,42	2,4	2,39	2,37	2,35	2,34	2,32	2,31	2,29	2,28	2,26	2,24
10: 3,91	2,5	2,48	2,47	2,45	2,43	2,42	2,4	2,39	2,37	2,35	2,34	2,32	2,31	2,29	2,28	2,26	2,24
9: 3,52	2,5	2,48	2,47	2,45	2,43	2,42	2,4	2,39	2,37	2,35	2,34	2,32	2,31	2,29	2,28	2,26	2,24
8: 3,13	2,5	2,48	2,47	2,45	2,43	2,42	2,4	2,39	2,37	2,35	2,34	2,32	2,31	2,29	2,28	2,26	2,24
7: 2,73	2,5	2,48	2,47	2,45	2,43	2,42	2,4	2,39	2,37	2,35	2,34	2,32	2,31	2,29	2,28	2,26	2,24
6: 2,34	2,5	2,48	2,47	2,45	2,43	2,42	2,4	2,39	2,37	2,35	2,34	2,32	2,31	2,29	2,28	2,26	2,24
5: 1,95	2,5	2,48	2,47	2,45	2,43	2,42	2,4	2,39	2,37	2,35	2,34	2,32	2,31	2,29	2,28	2,26	2,24

Fig. 12.4: MPE-ABP

As an alternative to entering the values manually, the values can also be loaded from a file. To load power correction values, the "Type" must be "Scale".

Example:

```
# Multipoint FieldCorrection File
# The data contained herein describes the scale applied to the correction values.
# Scale of 1 equals original value

# Each line lists one data point consisting of
# [Magnification/Layer/]Row/Column: the position where the data point is expected
expressed as [magnification/layer/]row/column
# ScaleX/Y/Z: multiplier
# Empty lines and lines that begin with '#' are ignored
# The fields can be separated by <space>, <tab> or <semicolon>
# The floating point values must use '.' as the decimal point [16]
```

[16] Example continues on next page.

```
; Type:                       Scale
; FieldSize:                  100000    100000
; Selected layers:
; Selected magnifications:

; Magnification [] Layer [] Row [] Column [] ScaleX [] ScaleY [] ScaleZ []
0          0          0          0          2.5        1          1          1          1
0          0          0          1          2.5        1          1          1          1
0          0          0          2          2.5        1          1          1          1
0          0          0          3          2.5        1          1          1          1
0          0          0          4          2.5        1          1          1          1
0          0          0          5          2.5        1          1          1          1
0          0          0          6          2.5        1          1          1          1
0          0          0          7          2.5        1          1          1          1
0          0          0          8          2.5        1          1          1          1
0          0          0          9          2.5        1          1          1          1
0          0          0          10         2.5        1          1          1          1
0          0          1          0          2.5        1          1          1          1
0          0          1          1          2.1        1          1          1          1
0          0          1          2          2.1        1          1          1          1
0          0          1          3          2.1        1          1          1          1
0          0          1          4          2.1        1          1          1          1
0          0          1          5          2.1        1          1          1          1
0          0          1          6          2.1        1          1          1          1
0          0          1          7          2.1        1          1          1          1
0          0          1          8          2.1        1          1          1          1
0          0          1          9          2.1        1          1          1          1
0          0          1          10         2.5        1          1          1          1
0          0          2          0          2.5        1          1          1          1
0          0          2          1          2.1        1          1          1          1
0          0          2          2          1.75       1          1          1          1
0          0          2          3          1.75       1          1          1          1
```

Table. 12.1: MPE-016

After confirming the entered values with the ***[Apply]*** button, similar to the field correction, the entered values can be visualized in a kind of heat map. Clicking the ***[Show graph]*** button switches directly to the ***Graph*** tab to view the power scaling distributed over the scan field.

Example: (corresponds to the values as shown in the previous table)

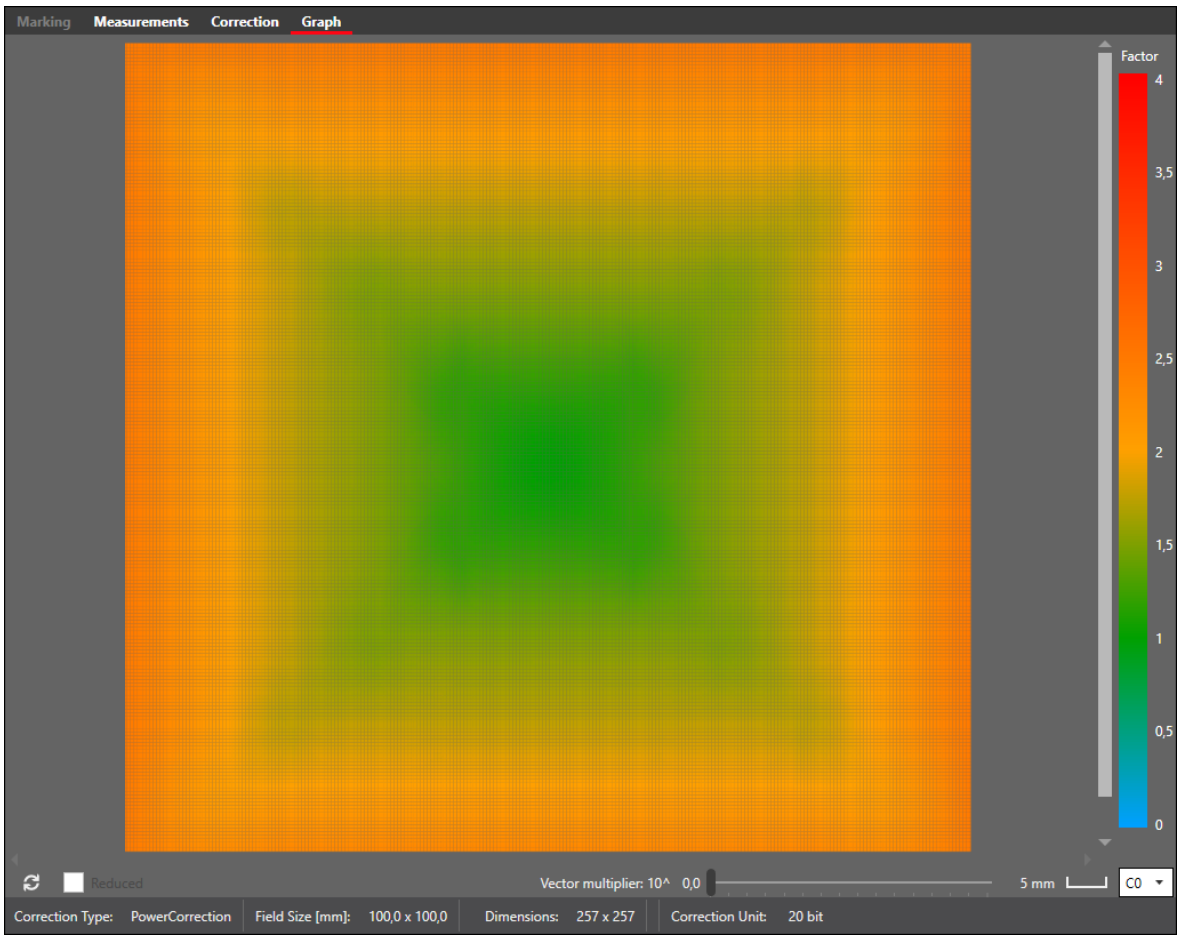


Fig. 12.5: MPE-ABQ

To switch the graph display from channel0 to channel1, use the drop-down menu below the color bar.

Once the power correction is done, you can save the file: ***File > Save / Save as...***

Upload the file to the control card, either directly through API commands or through the RAYGUIDE Laser configuration. The appropriate file type is *.pc3.

13 DETERMINATION OF MAXIMUM PROCESS SPEEDS

On the data sheets of the deflection units, the maximum processing speeds are usually given in [rad/s] and in [mm/s] for the linearly moving Z-axis. These are the speeds at which the lenses move, not, for example, how fast the focus can be moved in the field along the Z-axis.

When working with an AM-MODULE, the magnification speed must also be specified as an application parameter. The speed is given in [1/s], which is the number of magnification change per time.

Information stored in the correction file can be used to convert data sheet values to field domain units. Therefore, the MPE provides a function to analyze and calculate the processing speed.

Go to ***Correction > Analyze***.

The dialog shown below opens and provides the following information and functions:

- Left: Analysis of 3D correction file (example)
- Right: Analysis of an AM-MODULE correction file (example).

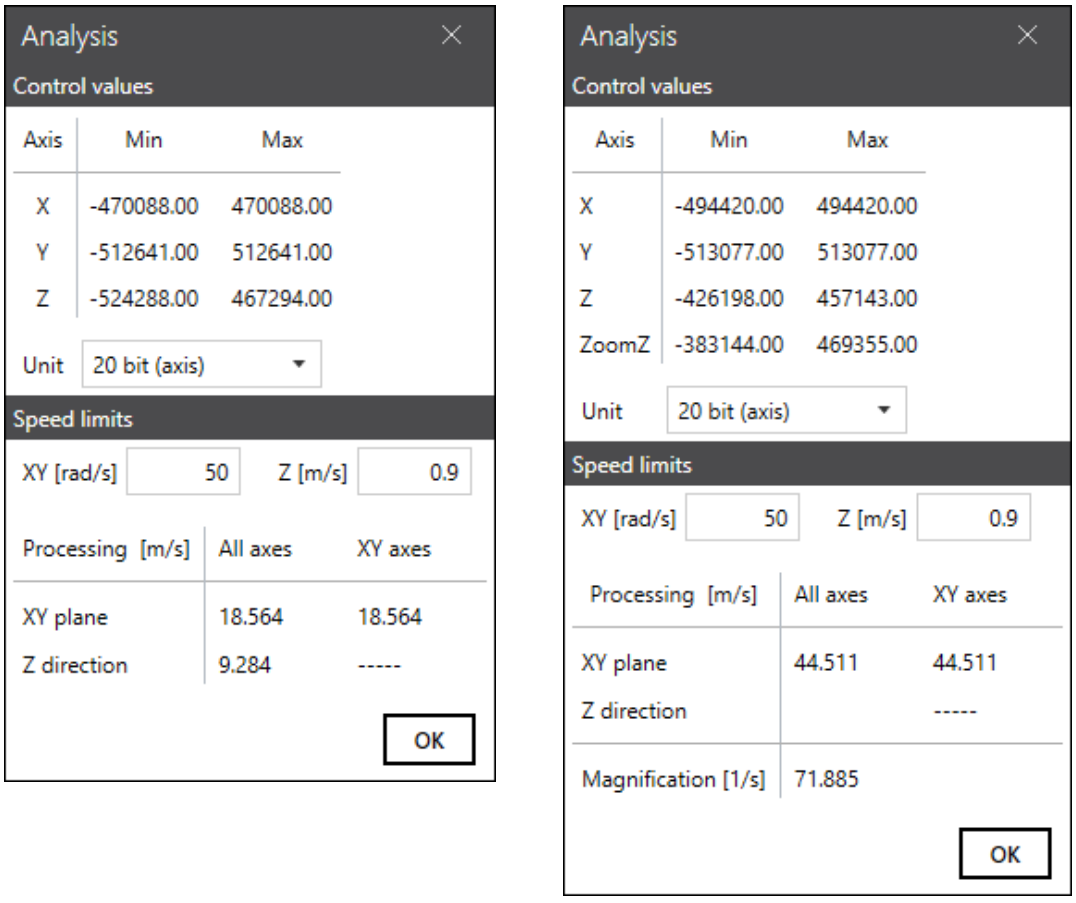


Fig. 13.1: MPE-ABS

13.1 Control values

The table shows the maximum control values used in the correction file per axis depending on the selected units.

You can select the following units:

- 16-bit resolution (valid for XY2-100 protocol),
- 20-bit resolution (valid for SL2-100 or RL3-100 protocol),
- Percent (of axis movement range),
- Percent (margin).

13.2 Speed limits

First, you need to enter the speed limits in [rad/s] as specified in the corresponding deflection unit datasheets.

NOTE: Please be careful to check the value, as it may depend on the aperture size, mirror substrate, and so on.

The Z-axis speed is specified in [mm/s]. The default maximum speed for all common Z-axes is 900 mm/s. If necessary, you can enter a different speed value.

Table explanation	
XY Plane	These values are valid when the scanning trajectory is limited to a XY plane.
Z direction	This value represents the case when the spot moves vertically along the Z direction only.
All axes	This value includes the movement of all axes involved. For example, if the deflection unit is a prefocusing unit, the usually less dynamic Z-axis is also considered to maintain the focus position.
XY axes	This value considers only the movement of the XY mirrors, excluding any possible Z-axis.
Magnification	Value for the maximum possible magnification speed

Table. 13.1: MPE-024

14 COMMAND LINE

14.1 Correction file generation

A command line interface is available to programmatically generate field correction files (*.fc3) or power correction files (*.pc3) using script commands.

The generated file will be saved in the same path as the input file and will have the same name, regardless of the extension. If a file with the same name already exists, it will be overwritten without asking.

If the correction values exceed the field, they are automatically clipped.

14.1.1 Generation of *.fc3 files

For *.fc3 generation the following arguments are expected in this order:

Argument	Default value
fc3	-
txz filename (with path)	-
optional config file name	XYMaxGalvoAngles = 22.5, MaxLensTravel = 11. In case of a focusshifter, MaxLensTravel is calculated as *1048575 / taxiscalfactor.*
optional rows	257
optional columns	257
optional layers	17

Table. 14.1: MPE-027

14.1.2 Generation of *.pc3 files

For *.pc3 generation the following arguments are expected in this order:

Argument	Default value
pc3	-
txz filename (with path)	-
optional rows	257
optional columns	257
optional layers	17

Table. 14.2: MPE-028

14.2 Apply measurement table

The measurement table can be applied to a correction file with or without a sub field.

14.2.1 Without sub field

The following arguments are expected in this order:

Argument	Explanation
applyError	-
correction file name	*.fc3 or *.pc3
measurement table file name	For file format, see *page 41, Loading measurement values from a file*.
optional new correction file name	The original file will be overwritten if the new name is not set. Example including new file name: `MultiPointEditor.exe applyError "correction.fc3" "measurements.mtf" "newFileName.fc3"` Quotes are only necessary if the path contains whitespace.

Table. 14.3: MPE-029

14.2.2 With sub field

The following arguments are expected in this order:

Argument	Explanation
applyErrorSubfield	-
correction file name	*.fc3 or *.pc3
measurement table file name	For file format, see *page 41, Loading measurement values from a file*.
sub field size X [µm]	-
sub field size Y [µm]	-
sub field offset X [µm]	-
sub field offset Y [µm]	-
optional new correction file name	The original file will be overwritten if the new name is not specified.

Table. 14.4: MPE-030

14.3 Apply bit error

A bit error table can be applied to the correction file. The values are interpolated to the dimensions of the correction file and then added to the correction values.

Expected format:

```
; Layer Row Column OffsetX [bit] OffsetY [bit] OffsetZ [bit] Offset4 [bit] Offset5
[bit]
0          0          0          0          0          0          0          297.886
0          0          0          0          0          0          0          500
```

Table. 14.5: MPE-017

The following arguments are expected in this order:

Argument	Explanation
applybiterror	-
correction file name	*.fc3 or *.pc3
bit error table file name	-
optional new correction file name	If the new name is not specified, the original file will be overwritten.

Table. 14.6: MPE-031

14.4 Logging

A log file is created at

%programdata%\RAYLASE\Multi Point Editor\Logs\MultiPointEditorConsole.log

It contains the parameters with which the program was called and any messages.

15 LOG DATA

If MPE is started directly from the RAYGUIDE application, the logging is part of the standard RAYGUIDE logs, see the RAYGUIDE manual.

When the MPE is used as a standalone application, it creates log files in the following path:

C:\ProgramData\RAYLASE\Multi Point Editor\Logs

Two log files are created:

- Application log file: *MultiPointEditor.log*
- SP-ICE-3 log file: *SPICE3Mpe.log*
  It tracks all commands sent to the SP-ICE-3 scan controller.

To navigate to the log files, go to ***Help > Log***

If requested by RAYLASE support, please send these files for troubleshooting to support@raylase.de.

16 SETTINGS

There are two things to define in the ***Settings...*** dialog:

- If and where the backup file of the original correction files is stored.
- Correction display unit: 20 bit / 16 bit / Percent.

To open the dialog, select ***Edit > Settings...***

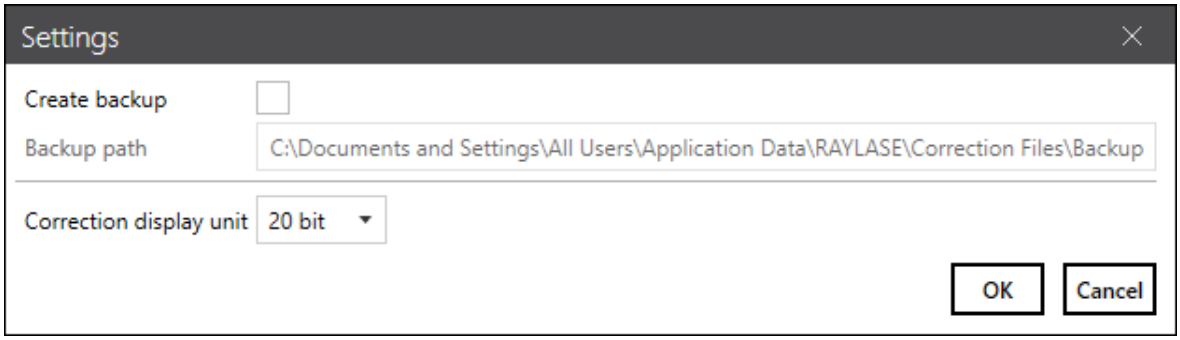


Fig. 16.1: MPE-ABR

17 EXPLANATION OF CORRECTION FILE NAMING

Correction file naming is a continuous improvement process, so you may find it a bit confusing.

The following example should help you to extract the important information from the naming.

Customer specivic correction files may be named differently. The examples below do not cover all possible abbreviations that may be used.

17.1 Correction files for 2-axis deflection units

Correction file name	Explanation
4401-499-000-26_SS-IV-15_LR-20,0-003.fc3	
4401-499-000-26_ SS-IV-15_ LR-20,0-003.fc3	■ Vendor ID F-Theta lens_ ■ SS-IV head model - with 15mm mirror aperture_ ■ Lens ring spec
2407_SS-II-20_4401-508-000-26.fc3	
2407_ SS-II-20_ 4401-508-000-26.fc3	■ RAYLASE list ID_ ■ SS-II to SS-V head model - with 20mm mirror aperture_ ■ Vendor ID F-Theta lens

Table. 17.1: MPE-018

17.2 Correction files for AXIALSCAN, AS FIBER (with or without RAYSPECTOR, RAYDIME METER)

Correction file name	Explanation
2D_AS-F-30-Y_250.0_WD257_off2_PW3+4_SZ2.fc3	
2D_ AS-F-30-Y_ 250.0_ WD257_ off2_ PW3+4_ SZ2.fc3	■ Flat field_ ■ AS FIBER-30mm mirror aperture-YAG wavelength_ ■ 250mm field size_ ■ 257mm working distance_ ■ 2mm Z-Lens offset_ ■ two protective windows_ ■ Support of SensorZ-axis
3D_AS-50-Y_300-1000_WV3917.fc3	
3D_ AS-50-Y_ 300-1000_ WV3917.fc3	■ 3D volume_ ■ AXIALSCAN-50mm mirror aperture-YAG wavelength_ ■ 300mm-1000mm field size_ ■ 3917mm Working Volume
3D_AS-F-30-Y_300_WD318_off2_WV47_PW3+4.fc3	
3D_ AS-F-30-Y_ 300_ WD318_ off2_ WV47_ PW3+4.fc3	■ 3D volume_ ■ AS FIBER-30mm mirror aperture-YAG wavelength_ ■ 300mm field size_ ■ 318mm working distance_ ■ 2mm Z-Lens offset_ ■ 47mm working volume_ ■ two protective windows

Correction file name	Explanation
3D_AS-F-30-633_400_WD447_off5.5_WV10_PW3_SZ2_SZ3.fc3	
3D_	■ 3D volume_
AS-F-30-633_	■ AS FIBER-30mm mirror aperture-633nm special wavelength_
400_	■ 400mm field size_
WD447_	■ 447mm working distance_
off5.5_	■ 5,5mm Z-Lens offset_
WV10_	■ 10mm working volume_
PW3_	■ one protective window_
SZ2_	■ Support of SensorZ-axis_
SZ3.fc3	■ Support of Aux-axis used in RAYDIME METER
2D+M_AS-F-50_370_WD378_off2_def4.0x_NA75_Msq1.1.fc3	
2D+M_	■ Flat field plus magnification_
AS-F-50_	■ AS FIBER-50mm mirror aperture_
370_	■ 370mm field size_
WD378_	■ 378mm working distance_
off2_	■ 2mm Z-Lens Offset_
def4.0x_	■ 4x Defocusing_
NA75_	■ 75mm NA of AS FIBER_
Msq1.1.fc3	■ M^2 of 1.1

Table. 17.2: MPE-019

17.3 Correction files for FOCUSSHIFTER

Correction file name	Explanation
3D_LT-FC3-05-[Y]_4401-301-000-21_MS-14.fc3	
3D_ LT-FC3-05-[Y]_ 4401-301-000-21_ MS-14.fc3	■ 3D volume_ ■ Linear Translator_ ■ FOCUSSHIFTER Compact Size - 3-fold internal beam expansion - 5mm input aperture-YAG wavelength_ ■ Vendor ID F-Theta lens_ ■ MINISCAN - with 14mm mirror aperture
2690_FS-RD-14-Y_017700-025-26.fc3	
2690_ FS-RD-14-Y_ 017700-025-26.fc3	■ MPE List ID_ ■ FOCUSSHIFTER-RAYVOLUTION DRIVE - 14mm mirror aperture – YAG wavelength_ ■ Vendor ID F-Theta lens
2364_FS-L2-05-TY_SS-II-15_4401-481-000-21.gcd	
2364_ FS-L2-05-TY_ SS-II-15_ 4401-481-000-21.gcd	■ MPE List ID_ ■ FOCUSSHIFTER-2-fold beam expansion-5mm input aperture - Triple YAG wavelength_ ■ SS-II to SS-V head models-15mm mirror aperture_ ■ Vendor ID F-Theta lens

Table. 17.3: MPE-020

17.4 Corrections Files for AM MODULE

Correction file name	Explanation
2D_AM-30RD-F085_0500_WD566_off0,5_Z2,2.fc3	
2D_ AM-30RD-F085_ 0500_ WD566_ off0,5_ Z2,2.fc3	■ Flat field_ ■ AM-MODULE-30mm mirror aperture - 85mm focal length collimator_ ■ 500mm field size_ ■ 566mm working distance_ ■ 0,5mm Z-Lens offset_ ■ max. magnification factor = 2.2

Table. 17.4: MPE-021

Head office:
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+49 8153 9999 699
info@raylase.de

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