μCMM

Version c

Technical Specifications

Document Version 2.5

Initiative **Fair Data Sheet**

The following specifications conform to the guidelines of the *Initiative Fair Datasheet*. Specifications in blue mark Alicona specific values.

Initiative Fair Datasheet

The "Fair Datasheet" considers itself a quality label to encourage manufacturers of measurement instruments to provide practice-oriented and comparable specifications. The initiative is supported by various manufacturers of measurement instruments, users such as Audi, Bosch and Daimler as well as by the Kaiserslautern University of Technology, with PTB, ZVEI and VDI considerably contributing to its operation.

Initiative **Fair Data Sheet**

Specifications in blue mark Alicona specific values.

Technical Specifications

GENERAL SPECIFICATIONS

Measurement principle	non-contact, optical, three-dimensional technologies: Focus-Variation with Smart Flash 2., Vertical Focus Probing and Real3D
Number of measurement points	single measurement: X: 1720, Y: 1720, X x Y: 2.95 million multi measurement: up to 500 million
Positioning volume (X x Y x Z)	310mm x 310mm x 310mm = 29,791,000mm³
Compressed air (*)	maintenance-free with compressed air according to specification, 7 bar consumption: 80 Nl/min (continuous)
Travel speed of axes	up to 100mm/s
Coaxial illumination	LED coaxial illumination (color), high-power, electronically controllable
3D data	monochrome; optional color data available
Objective changer	automatic pneumatic four-place objective changer rack
System monitoring	9 temperature sensors (accuracy: ± 0.1 K), internal current and voltage monitoring, incl. long-term logging, retrievable
ControlServerSF	6 Core, 32 GB DDR4, SSD 500 GB, Windows 10 IoT Enterprise 64bit, 2x 27" Full HD monitor
IP code	IP20
Noise emission	≤ 70 dB(A) during normal operation

DIMENSIONS AND ENVIRONMENTAL CONDITIONS

Dimensions (W x D x H)	measurement instrument: 960 x 1109 x 1958 mm (up to 2288mm); ControlServerSF: 177 x 483 x 480 mm	
Mass	measurement instrument: 1250 kg (incl. steel stand); ControlServerSF: <20 kg	
Temperature requirements	setpoint temperature range: extended setpoint temperature range (on request): ControlServerSF (possible):	20 - 25 °C 19 - 29 °C 0 - 30 °C
Ambient temperature range A (high-precision measurement, VDI 2627 class 2)	permissible limit deviation of setpoint temperature: temperature change rate: permissible linear temperature difference:	+/- 0.8 K 0.8 K/d 0.4 K/h 0.3 K/m
Ambient temperature range B (VDI 2627 class 3)	permissible limit deviation of setpoint temperature: temperature change rate: permissible linear temperature difference:	+/- 2 K 2 K/d 1 K/h 0.5 K/m
Ambient temperature range C (reduced accuracy, VDI 2627 class 4) *(larger range possible on request)*	permissible limit deviation of setpoint temperature: temperature change rate: permissible linear temperature difference:	+/- 3 K 3 K/d 2 K/h 1 K/m
Permissible relative humidity	recommended: 45 % (+/- 5 %); possible: 45 % (+/- 15 %)	
Vibrations	Recommended: < 50µg (RMS values of spectrum between 3 and 100 Hz)	
Supply voltage, current, electric power	1000 W; 100 – 240 VAC; 50 - 60 Hz	

(*) ISO 8573

solid particles	*max. number of particles per m³*	*< 10,000; < 5 µm*	*class 4*
water	*max. pressure dew point*	*+ 3 °C*	*class 4*
oil	*max. total oil content*	*5 mg/m³*	*class 4*

Fair Data Sheet
Initiative

Specifications in blue mark Alicona specific values.

MEASUREMENT OBJECT

Surface texture	any surface, including polished metals
Max. mass	30 kg, more on request
Max. dimensions	width: 680 mm height: 375 mm
Sample preparation	none

OBJECTIVE SPECIFIC FEATURES

Objective		3000 WD8	1900 WD30	1500 WD130	1500 WD23*	1500 WD70	800 WD17	800 WD37	400 WD19	150 WD11
Numerical aperture		0.075	0.12	0.14	0.15	0.14	0.3	0.2	0.4	0.6
Working distance	mm	8.8	30	130	23.5	69.4	17.5	37	19	11
Lateral measurement range (X, Y)	mm	5.26	3.23	2.63	2.63	2.63	1.32	1.32	0.66	0.26
(X x Y)	mm²	27.64	10.43	6.91	6.91	6.91	1.71	1.71	0.43	0.06
Measurement point distance	µm	3.06	1.88	1.53	1.53	1.53	0.76	0.76	0.38	0.15
Calculated lateral optical limiting resolution	µm	4.28	2.68	2.28	2.14	2.14	1.07	1.6	0.80	0.53
Finest lateral topographic resolution	µm	6.2	3.8	3.1	3.1	3.3	1.5	1.6	0.8	0.6
Measurement noise (**)	nm	500	30	180	80	100	4	25	2	1
Vertical resolution (***)	nm	1400	85	510	230	500	30	71	20	10
Vertical measurement range	mm	8	29	125	22.5	65	16.5	36	18	10
Vertical scanning speed	µm/s	3000	3000	3000	3000	3000	1000-3000	1000-3000	500-3000	200-2000
Measurement speed		≤ 1.7 million measurement points/sec.								
Accessibility (angle)	°	47	65	77	63	76	63	70	57	46

(*) Product discontinued, availability not guaranteed.
(**) Measurement noise N_M: Evaluation conforming to ISO 25178-700: 2019 (under development) and Fair Datasheet V1.2
(***) Vertical Resolution: Defined in ‚Optical Measurement of Surface Topography' (ISBN 978-3-642-12012-1) and the Fair Datasheet V1.2 as √8 (square root of 8) x measurement noise. However, the vertical resolution values of Bruker Alicona are much more conservative.

RESOLUTION AND APPLICATION SPECIFICATIONS

Objective		3000 WD8	1900 WD30	1500 WD130	1500 WD23*	1500 WD70	800 WD17	800 WD37	400 WD19	150 WD11
Min. measurable height	µm	1.4	0.1	0.51	0.1	0.5	0.03	0.07	0.02	0.01
Max. measurable height	mm	8	29	125	22.5	65	16.5	36	18	10
Min. measurable roughness (Ra)	µm	n.a.	n.a.	n.a.	1.2	n.a.	0.1	0.6	0.06	0.03
Min. measurable roughness (Sa)	µm	n.a.	n.a.	n.a.	0.6	n.a.	0.05	0.3	0.03	0.02
Min. measurable radius	µm	20	12	10	10	10	5	5	3	2
Min. measurable wedge angle	°	20								
Max. measurable slope angle, standard measurement	°	87								
Max. measurable slope angle, Vertical Focus Probing	°	>90 (depending on application)								

(*) Product discontinued, availability not guaranteed.

ACCURACY

3D Accuracy 10360-8 (*)

Ambient temperature range A (VDI 2627 class 2)	$E_{Uni:Tr:ODS,MPE}$ = (0.8 + L/600) µm (L in mm) (**) $E_{UniZ:St:ODS,MPE}$ = (0.15 + L/50) µm (L in mm) (***)
Ambient temperature range B (VDI 2627 class 3)	$E_{Uni:Tr:ODS,MPE}$ = (0.8 + L/200) µm (L in mm) (**)
Ambient temperature range C (VDI 2627 class 4)	$E_{Uni:Tr:ODS,MPE}$ = (0.8 + L/100) µm (L in mm) (**)

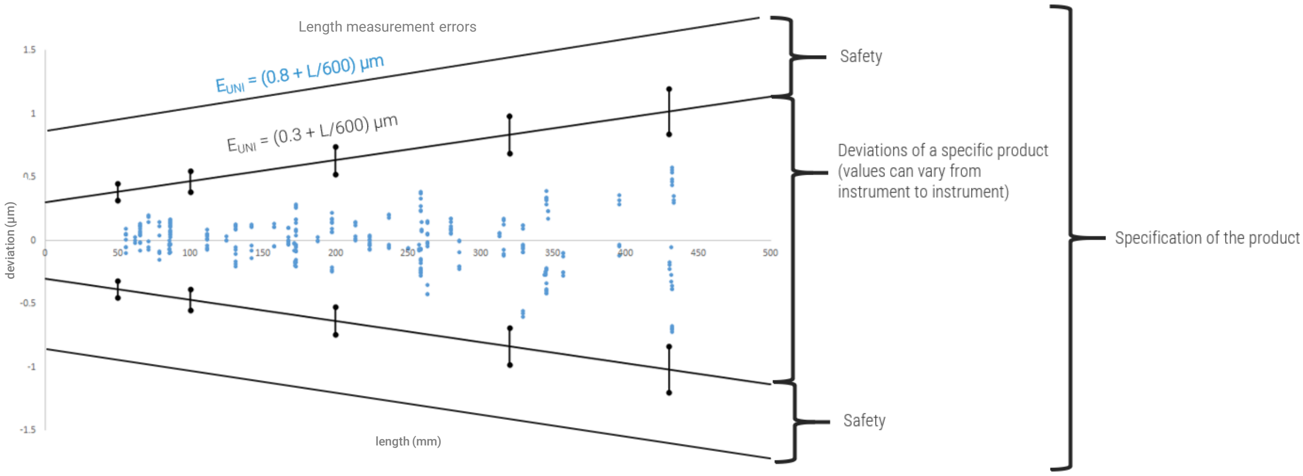
(*) The values given are based on ISO 10360-8 and VDI 2617.
(**) Accuracy of axes based on ISO 10360-8, appendix B.4.3.4.
(***) Valid for single measurements, height step measurement.

Measurement parameters

Flatness deviation	1.3mm x 1.3mm with 800 WD17	U = 0.1µm
Profile roughness	Ra = 0.1µm Ra = 0.5µm	U = 0.012µm, σ = 0.001µm U = 0.02µm, σ = 0.001µm
Areal roughness	Sa = 0.1µm Sa = 0.5µm	U = 0.01µm, σ = 0.001µm U = 0.015µm, σ = 0.001µm
Wedge angle	β = 70° - 110°	U = 0.075°, σ = 0.01°
Edge radius	R = 5µm - 20µm R > 20µm	U = 1.5µm, σ = 0.15µm U = 2µm, σ = 0.3µm

Appendix: Accuracy

µCMM ACCURACY OF AXES: $E_{Uni:Tr:ODS,MPE}$



- » Each point represents a distance measurement of a specific length.
- » 5 lengths, 3 times, 7 directions, according to ISO 10360-8
- » Test uncertainty according to ISO 23165: U(k=2) = 0.05 µm + 0.3 µm/m (laser interferometer)

Relation between E_{Bi} and E_{Uni}

ISO 10360 deals with the acceptance and reverification tests for coordinate measuring systems (CMS). In part 8, CMMs with optical distance sensors are discussed*, using the length measurement errors E_{Bi} and E_{Uni} for verification. In case of optical measuring instruments, the relevant parameter for real measurement application is E_{Uni} due to the measuring direction. Using method B (see ISO 10360-8, section 6.3.5.3), E_{Bi} can be calculated from the measured and the calibrated length measurement errors as well as the probing form and size errors P_{Form} and P_{Size}.

Assuming:
- E_{Uni} = (0.3 + L/600)µm
- $P_{Form.Sph.1x25:St:ODS}$ = 0.405µm
- $P_{Size.Sph.All:St:ODS}$ = 0.12µm

Using method B, $E_{Bi:j:ODS}$ can be calculated based on the 105 measured and calibrated values $L_{Uni.meas}$ and $L_{Uni.cal}$:
- $L_{Uni.meas} - L_{Uni.cal} + P_{Size.Sph.1x25:j:ODS} > 0 \rightarrow \mathbf{E_{Bi:j:ODS}} < L_{Uni.meas} - L_{Uni.cal} + P_{Size.Sph.1x25:j:ODS} + P_{Form.Sph.1x25:j:ODS}$
- $L_{Uni.meas} - L_{Uni.cal} + P_{Size.Sph.1x25:j:ODS} < 0 \rightarrow \mathbf{E_{Bi:j:ODS}} > L_{Uni.meas} - L_{Uni.cal} + P_{Size.Sph.1x25:j:ODS} - P_{Form.Sph.1x25:j:ODS}$

Plot all errors → results in $\mathbf{E_{Bi:j:ODS}}$ = (0.65 + L/600)µm

**Note that ISO 10360-8 has limited applicability to an optical micro-coordinate measuring machine such as the µCMM. Reasons for this are:*

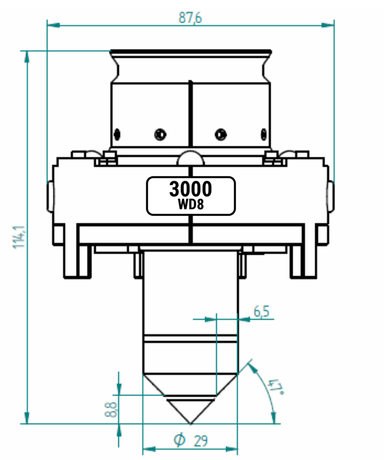
- *The standard specifies that the spheres to be measured have a diameter of 10-51mm. This is not possible with a single field measurement on a microcoordinate measuring machine like the µCMM. It requires an image field measurement, which necessitates moving the sensor head and the stitching of several single field measurements. This is not covered by ISO 10360-8. The spheres on the calibration standards used by Bruker Alicona therefore have a diameter of 1mm.*
- *A bidirectional length measurement (E_{Bi}) is stipulated in the standard for historical reasons, as it was established when using tactile measuring methods. Optical measuring instruments typically measure unidirectional, which means that a requirement for bidirectional evaluation is far from practice.*
- *The standard is designed for point measurements as known from tactile measuring devices. The extension to point clouds is only marginally provided for in ISO 10360-8. However, due to the small tolerances, optical measuring devices for microcoordinate metrology measure small dimensions using geometry elements based on point clouds. This means that a requirement for point measurements is neither viable nor suitable for application.*

Currently, the guideline VDI/VDE 2617 Sheet 12.2 is being developed according to ISO 10360-8 in the VDI/VDE Technical Committee 3.31, which deals in detail with the topic of acceptance and reverification testing for coordinate measuring machines for the optical measurement of micro-geometries.

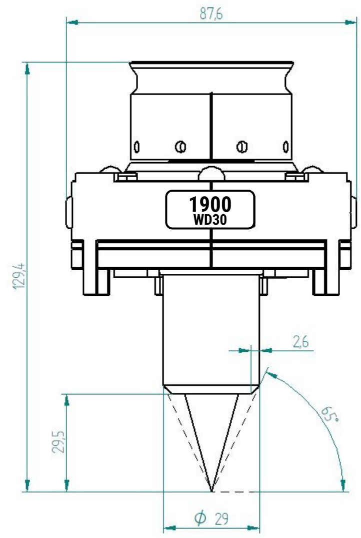
Relation between E_{UniZ} and uncertainty of profile roughness

Since the Rz value is typically 6 times as high as the Ra value, the uncertainty of the Rz value is also 6 times as high as the uncertainty of the Ra value. If the influence of the λ_c filter is considered as well, the result is E_{UniZ}

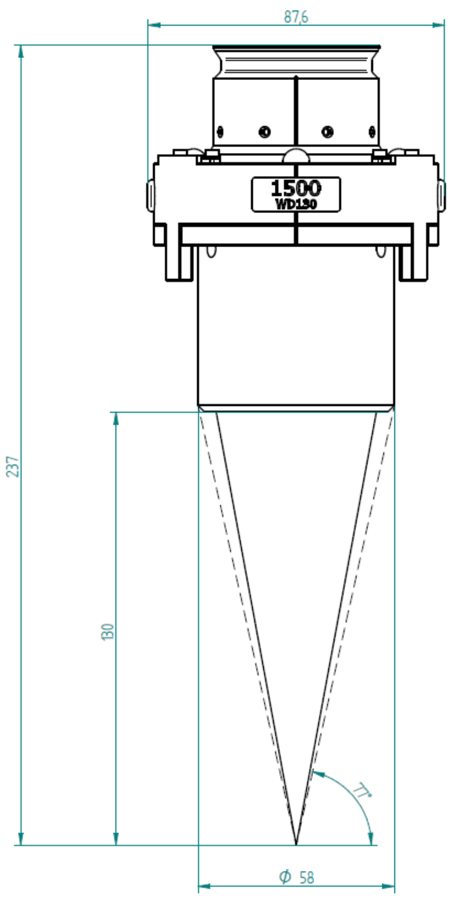
Objectives: Accessibility and Dimensions



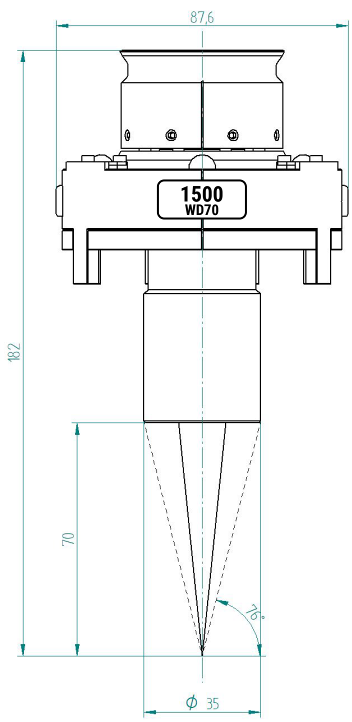
µCMMObjective3000 WD8
accessibility: 47°



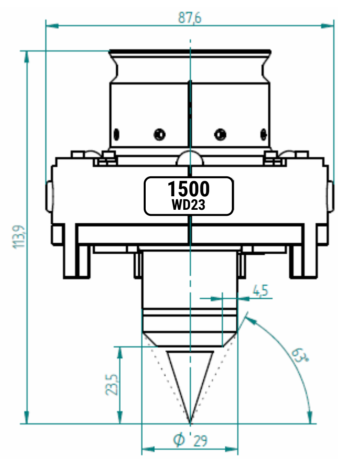
µCMMObjective1900 WD30
accessibility: 65°



µCMMObjective1500 WD130
accessibility: 77°



µCMMObjective1500 WD70
accessibility: 76°



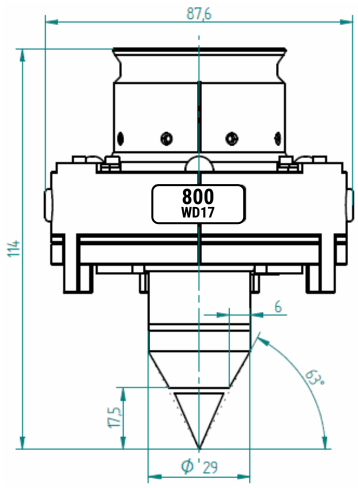
µCMMObjective1500 WD23*
accessibility: 63°
* product discontinued, availability not guaranteed.

Notice About Objective Names:
To enable a more precise differentiation, objective names have been expanded to include the working distance in their name.

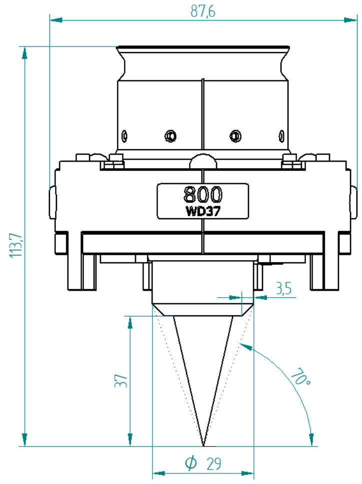
Formerly	New name	Formerly	New name
3000A	3000 WD8	800A	800 WD17
1500B	1500 WD70	400A	400 WD19
1500A	1500 WD23	150A	150 WD11

Bruker alicona
That's metrology!

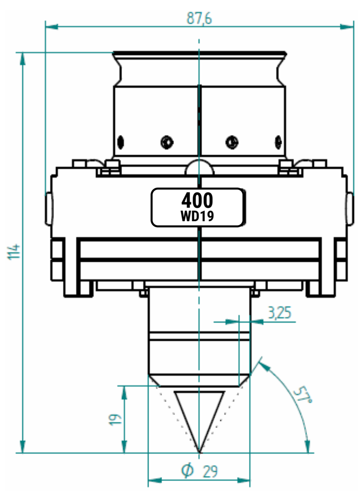
Objectives: Accessibility and Dimensions



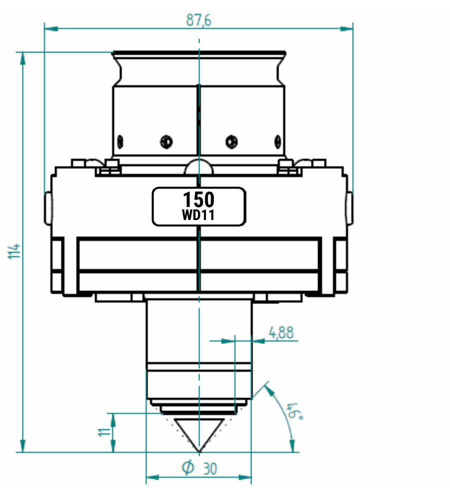
µCMMObjective800 WD17
accessibility: 63°



µCMMObjective800 WD37
accessibility: 70°

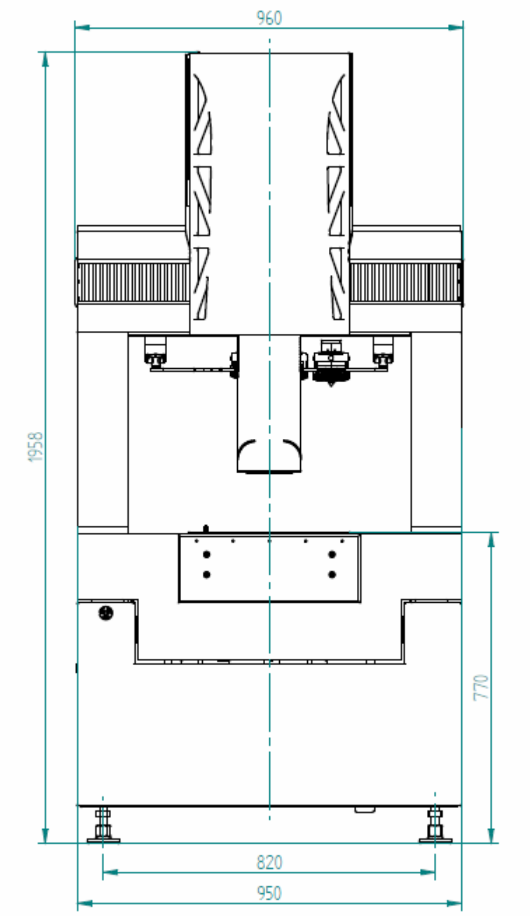


µCMMObjective400 WD19
accessibility: 57°

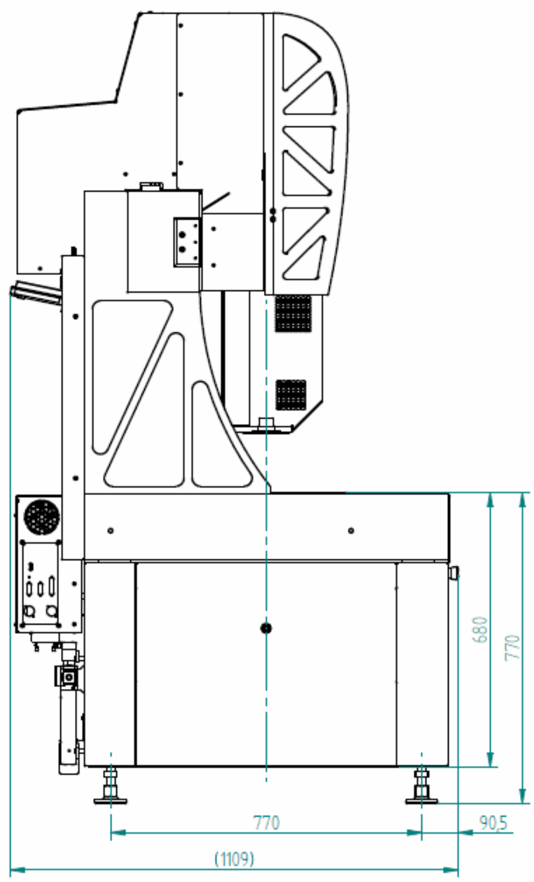


µCMMObjective150 WD11
accessibility: 46°

Technical Drawings

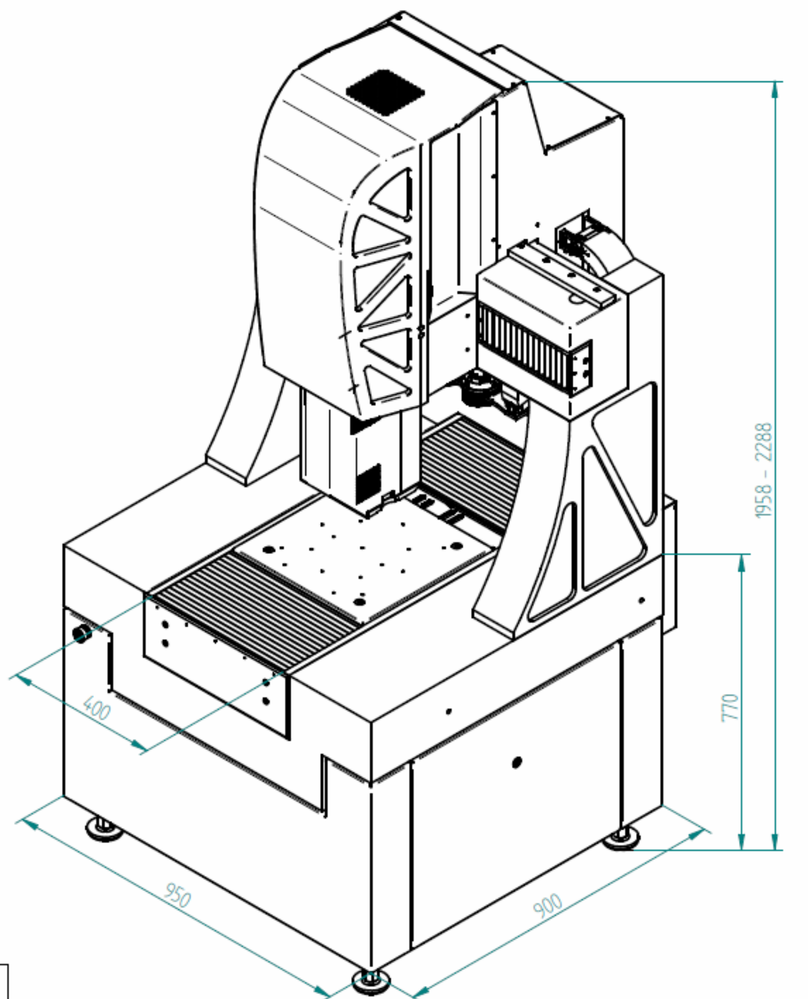


µCMM – front view
(sensor in lowest position)

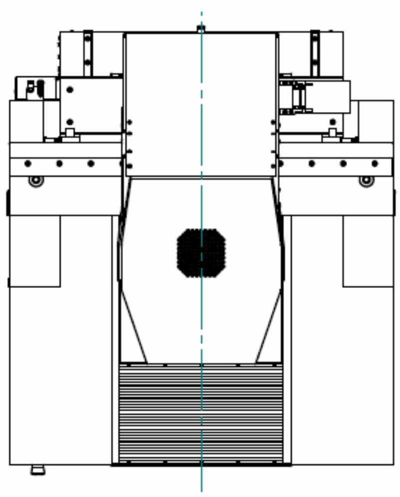


µCMM – side view

Technical Drawings

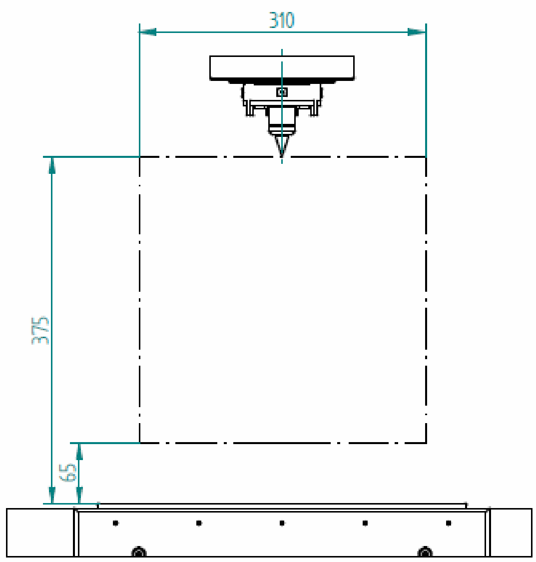


μCMM – isometric view

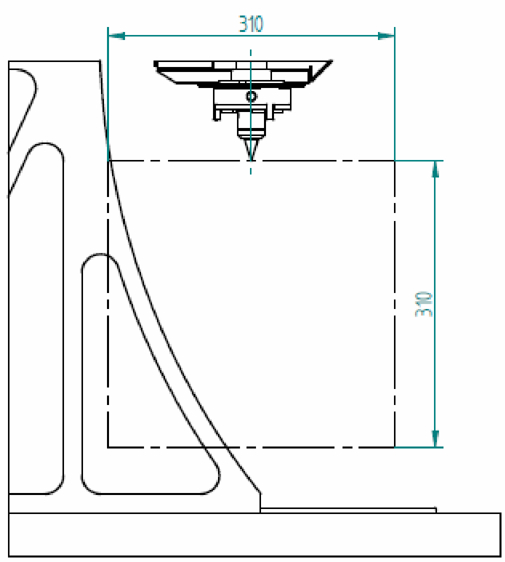


μCMM – top view

Technical Drawings

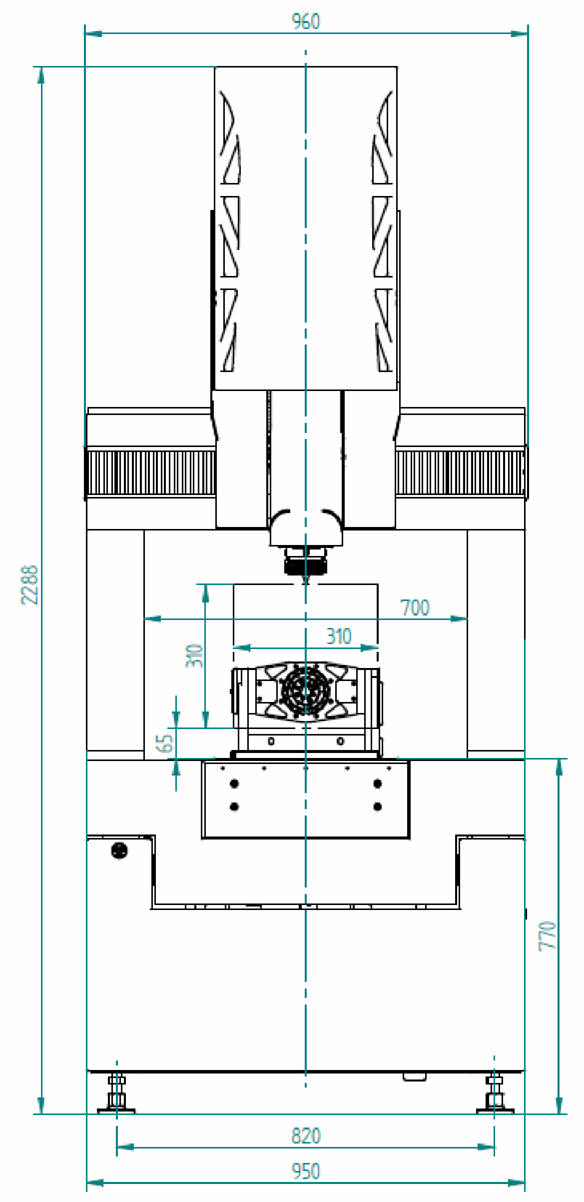


µCMM – positioning volume, front view

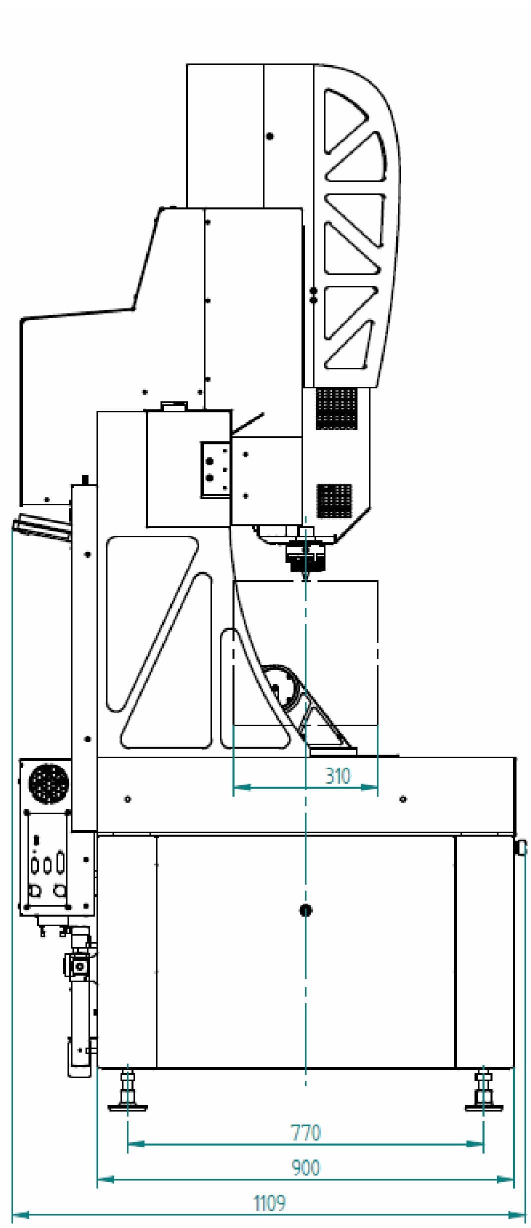


µCMM – positioning volume, side view

Technical Drawings with µCMMReal3D

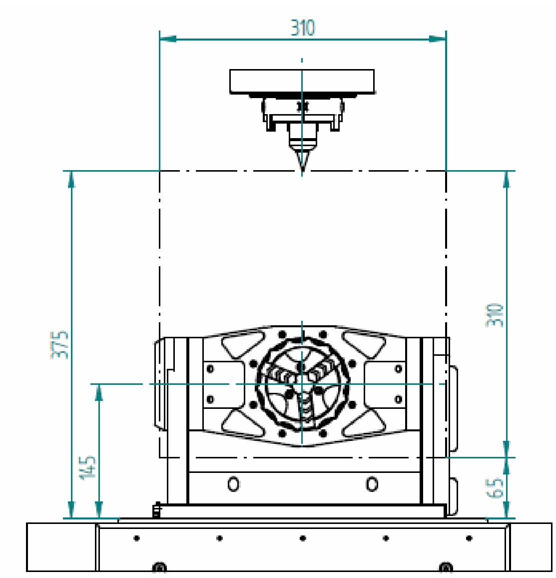


µCMM – front view with µCMMReal3D

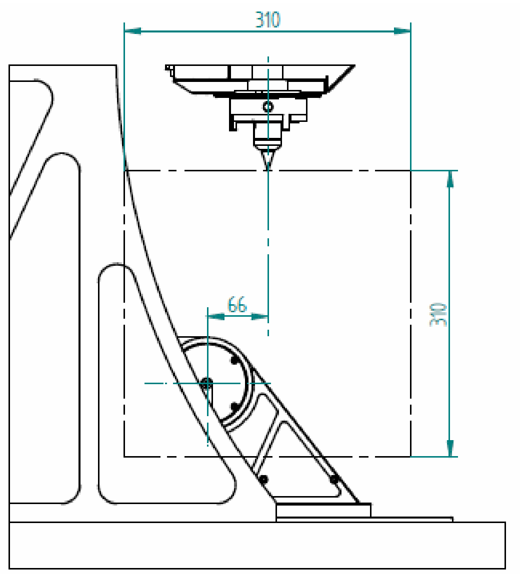


µCMM – side view with µCMMReal3D

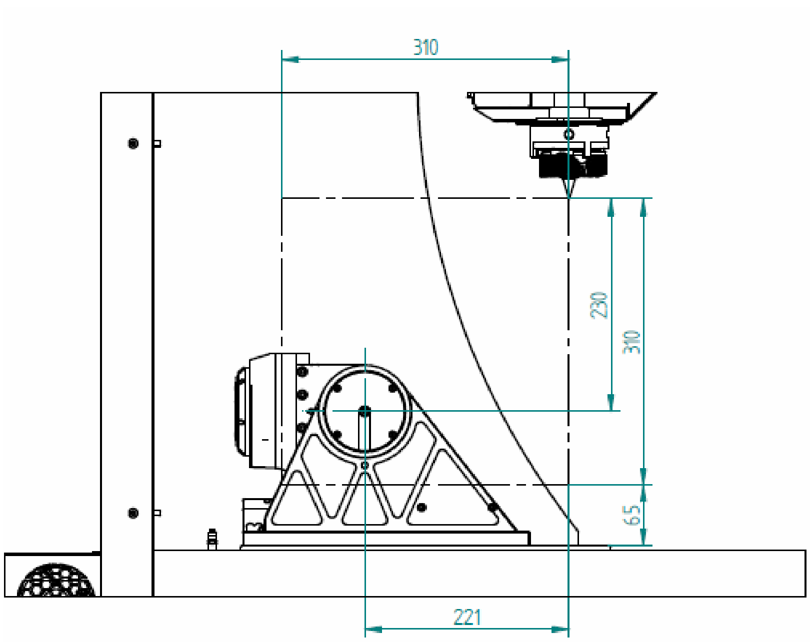
Technical Drawings with µCMMReal3D



µCMM – positioning volume
with µCMMReal3D, front view

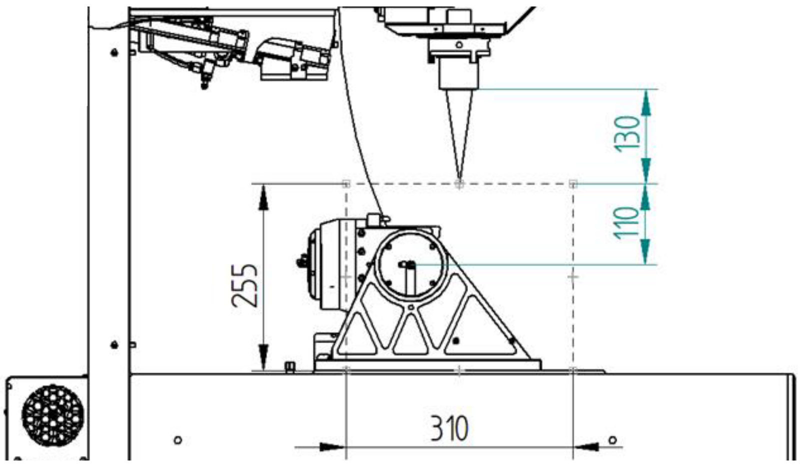


µCMM – positioning volume
with µCMMReal3D, side view,
Y axis in middle position



µCMM – positioning volume with
µCMMReal3D,
side view,
Y axis in rearmost position

Technical Drawings with µCMMReal3D



µCMM – positioning volume with µCMMReal3D
and µCMMObjective 1500 WD130,
side view,
Y axis in middle position

Bruker alicona

That's metrology!

Warranty and Copyrights

Warranty

ALICONA IMAGING GMBH AND ITS SUPPLIERS ACCEPT NO LIABILITY FOR ANY PROBLEMS THAT OCCUR AS A RESULT OF ANY OPERATIONS CARRIED OUT OTHER THAN THOSE STATED IN THE MANUAL THAT COMES WITH THIS PRODUCT. FURTHERMORE WE TAKE NO WARRANTY AT ALL HARDWARE DAMAGES ON UPGRADED MEASUREMENT SYSTEMS THAT RESULT FROM IMPROPER OPTICS, WRONG OR INCOMPLETE CALIBRATION, NOT SUITABLE SPECIMEN OR INCOMPATIBLE HARDWARE COMPONENTS.

Compatibility with other Products
Alicona Imaging GmbH does not guarantee that this product is compatible with any software or hardware product that was not obtained from Alicona Imaging GmbH.

Copyrights