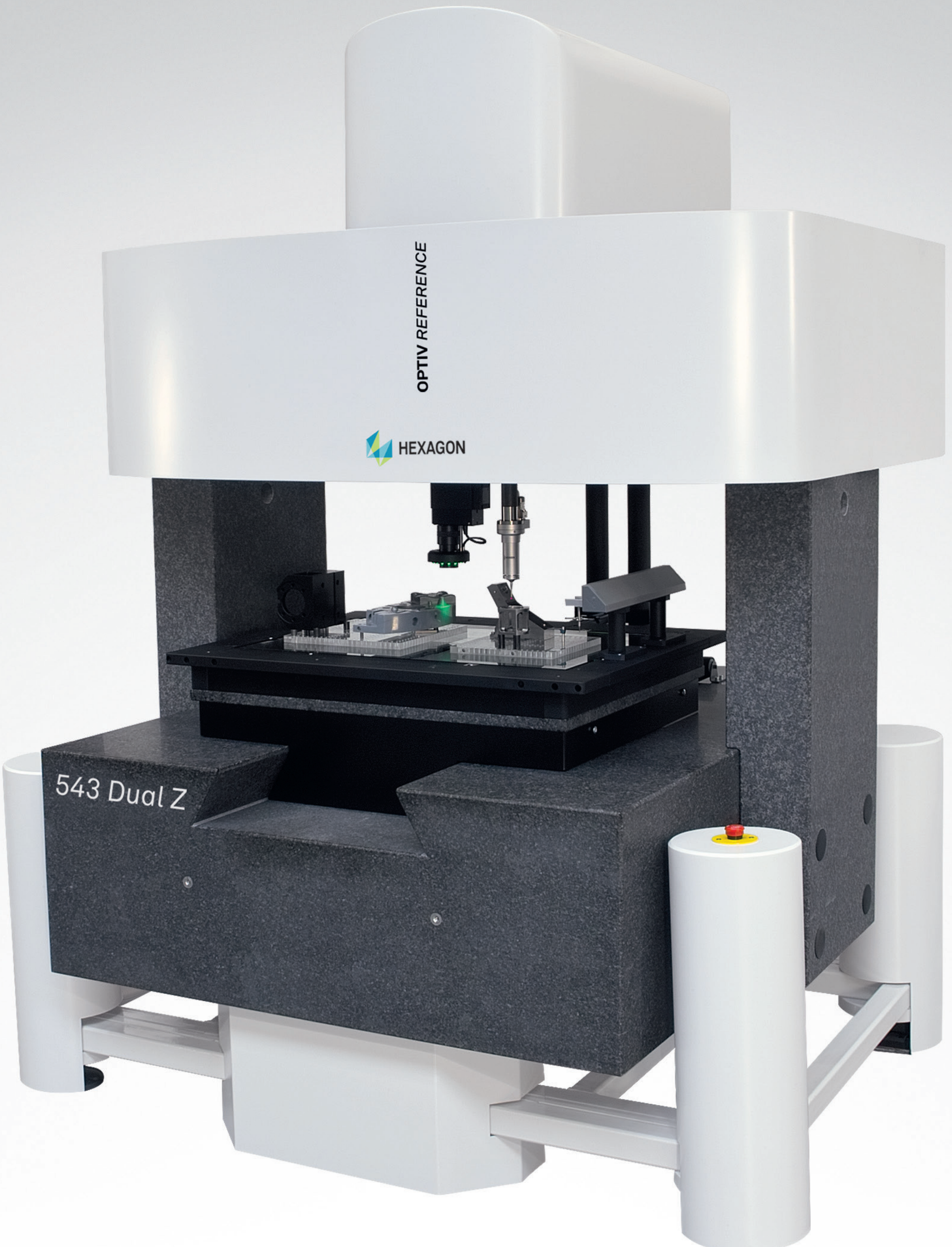
HEXAGON
MANUFACTURING INTELLIGENCE

TECHNICAL DATA

OPTIV REFERENCE 543 DUAL Z



Product description

The Optiv Reference 543 Dual Z combines optical and tactile measurement in one system. The system supports multi-sensor measurements using the Vision sensor, the touch-trigger and scanning probe, the TTL laser (Through-The-Lens) as well as the innovative Chromatic White Light Sensor (CWS). The basic machine with Vision sensor can be expanded with all the available sensors on a modular basis. Measurement software is PC-DMIS Vision.

Fields of application

- R&D measurements in labs
- Versatile geometry measurements and GD&T analysis with maximum accuracy

Design

(1) Optical and tactile sensors are assigned to two independent vertical axes. When measuring complex 3D workpieces the positioning of the sensors is easier. Makes it possible to use turn/pivot probes.

- Design principle:
  - » Low-vibration granite construction with a fixed bridge and a moving table
  - » Integrated subframe with optional vibration dampers
  - » Dual Z-Design (1) with two vertical axes
- Guides:
  - » Precision air bearings on all axes
- Drives:
  - » DC servo motors, power transmission via backlash free circulating ball screws
- Length measuring system:
  - » Incremental optoelectronic length measuring system
  - » Resolution of the scales 0.05 µm

Measuring range (X x Y x Z1/Z2)

(2) Vision sensor <—> Touch probe (see page 8)

	Optiv Reference 543 Dual Z		
	Vision sensor	**Touch probe**	**Mutual measuring range (2)**
X	530 mm (20.87 in.)	530 mm (20.87 in.)	400 mm (15.75 in.)
Y	400 mm (15.75 in.)	400 mm (15.75 in.)	400 mm (15.75 in.)
Z1/Z2	300 mm (11.81 in.)	300 mm (11.81 in.)	300 mm (11.81 in.)

Loading capacity

- Load-bearing capacity of the table up to 150 kg (of the glass plate up to 50 kg)

Dimensions in mm and weights in kg

- Dimensions see machine layout on page 7
- Machine weight 2300 kg

Measuring accuracy (3)

(3) The conditions of acceptance of Hexagon Metrology Vision apply.

L = measurement length in mm

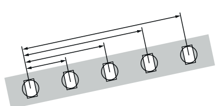
At 20°C, acc. to ISO 10360-7, with Vision sensor, at highest zoom magnification (3)

Length measurement error

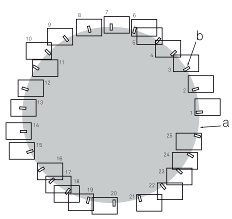
Ex, Ey	= (0.5 + L/600) µm
Exy	= (0.8 + L/600) µm

Probing error

P_{F2D}	= 0.8 µm
P_{FV2D}	= 0.8 µm



Ex, Ey, Exy: On a glass artefact, 5 measurement lengths are measured with 3 repetitions. The distances between the chrome lines on the glass artefact are calibrated to each other. The position of the chrome line in the CMM's coordinate system is recorded using the image sensor. The length is formed from the distance between two chrome lines. The probing direction at each end of the length is opposite.



a Test circle
b Measuring window

P_{F2D} / P_{FV2D}: 25 points are measured, which are equally distributed on a circle. A best-fit circle calculated from these measurements is the basis to determine the range of deviations as a result. The parameter P_{FV2D} is determined at standstill of the CMM, P_{F2D} is determined with movement of the CMM.

At 20°C, acc. to ISO 10360-2 / -4, with the HP-S-X1 probing system (3)

Length measurement error

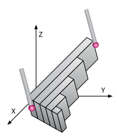
MPE_E (x), MPE_E (y)	= (0.5 + L/300) µm
MPE_E (xy)	= (0.8 + L/300) µm
MPE_E	= (1.3 + L/300) µm

Volumetric probing error

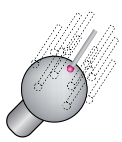
MPE_P = 1.3 µm

Volumetric scanning probing error

MPE_{THP} = 1.9 µm (t = 90 sec)

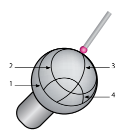


A set of 5 gauges has to be measured 3 times with one probing at each end, in 7 different directions in space. All measuring results must be within "E".



A precision sphere has to be measured with 25 probings. P is the range of all radii.

P = $R_{max} - R_{min}$ = sphere form.



A precision sphere has to be scanned with 4 defined lines. THP is the range of all radii.

THP = $R_{max} - R_{min}$ = sphere form, scanning..

Airborne noise emissions	• The A-weighted emission sound pressure level at operator's position is less than 70 db(A).
Environmental requirements	• Limits of permissible floor vibration < 5 x 10^{-3} m/s^2 corresponds to an amplitude of < 5 µm at 5 Hz • Air humidity 40 % - 70 % RL, non-condensing • Environmental temperature 20 °C ± 0.8 °C • Permissible temperature gradient 0.7 °C/h, 0.9 °C/d, 0.6 °C/m
Throughput	• Max. traversing speed » Per axis 150 mm/s, in a plane 210 mm/s, in space 260 mm/s
Supply data	• Input voltage power supply 115-230 V ± 10% • Frequency 50/60 Hz ± 5% • Power consumption 1500 VA • Air supply system: » Air pressure connection with 1/2-inch quick-connect coupling » Air pressure at least 600000 pascal (Pa), max. 1000000 pascal (Pa) » Air consumption approx. 70 Nl/min (3 axes) » Pre-cleaned air according to ISO 8573-1 class 1
Other optional equipment	• Vibration damping system • Air bearing rotary table • Stylus module changing rack • Motorised indexing probe heads • Periphery: » Worktable » Printers, monitors » Uninterruptible power supply (UPS)
Vision sensor	**Technical description** • Sensor for non-contact measurement of smallest and closely toleranced features » High resolution black-and-white CCD camera, for interference-free, low noise image reproduction » Maximum optical precision due to low distortion optics »» Motorised CNC zoom »» Fixed optics »» Dual Camera optics » Powerful image processing »» Fast, precision video autofocus »» Automatic feature detection, geometry and bad pixel video filters »» Contour scanning mode: Sophisticated set of user-selectable algorithms to setup edge detection, intelligent, automatic selection of the most suitable setting for the measurement »» Best fit routines »» AutoTune: Transferability of measuring programs between machines of the same type »» MultiCapture: MultiCapture allows all 2D features within a field of view to be captured simultaneously, regardless of the feature type. Inspection speeds can be increased by 35 % or more, depending on the feature size and density. The capture sequence for groups of features using MultiCapture is also automatically optimized, creating the most efficient possible path with the fewest number of stage movements. **Illumination for Vision sensor** • Coaxial LED top light • Telecentric LED back light • 12-segment LED ring light (Ø 120 mm) » 2 rings with 2 different angles of incidence (28,21° and 37,88°) » Segments: »» 4 x 90° (inner ring) »» 8 x 45° (outer ring) » White LEDs

CNC zoom

- 10x motorised zoom, for a continuous adjustment of field of view and resolution
- High resolution 1/2-inch CCD camera (H 752 x V 582 pixels)

Magnification variants of the 10x CNC zoom on a 20 inch monitor					
Lens	Magnification	Working distance (mm)	Max. workpiece height (mm)	Max. field of view (mm)	Min. field of view (mm)
Standard	0.65x to 6.5x	86	0 to 300	10.2 x 7.7	1.0 x 0.8

Fixed optics with changeable lenses (optional)

- Fixed focal length, telecentric precision optics
- CCD camera 1/2-inch
  - » H 752 x V 582 pixel
- Available lenses 1x, 3x, 5x, 10x

Magnification variants of the fixed optics				
Optical magnification of the lens	Working distance (mm)	Pixel size (µm/pixel)	Field of view H x V (mm)	Magnification on 22 inch LCD
1x	79	8.50	6.4 x 4.9	69x
3x	75	2.83	2.1 x 1.6	207x
5x	64	1.70	1.3 x 1.0	346x
10x	48	0.85	0.6 x 0.5	691x

Dual Camera optics (optional)

- In two steps electronically switchable magnification by factor 1:3.3
- Camera #1: 1/3-inch CCD camera
  - » H 752 x V 582 pixel
- Camera #2: 2/3-inch CCD camera
  - » H 752 x V 582 pixel
- Available lenses: 3x, 5x, 10x

Magnification variants of the Dual Camera optics (camera #1, detail mode / camera #2, overview mode)				
Optical magnification of the lens	Working distance (mm)	Pixel size (µm/pixel)	Field of view H x V (mm)	Magnification on 22 inch LCD
3x	75	2.12 / 7.03	1.6 x 1.2 / 5.3 x 4.1	278x / 84x
5x	64	1.27 / 4.22	1.0 x 0.7 / 3.2 x 2.5	463x / 138x
10x	48	0.64 / 2.11	0.5 x 0.4 / 1.6 x 1.2	925x / 281x

Chromatic White Light Sensor (CWS) (optional)

[(1)] *Measuring range CWS: see page 8*

Technical description

- Optical sensor for focussing and scanning purposes according to the principle of chromatic length aberration of white light
- Surface independent and robust measurement with a resolution in the nanometer range

CWS measuring head	10 mm [(1)]	3 mm [(1)]	600 µm [(1)]	300 µm [(1)]
Working distance	70 mm	22.5 mm	6.5 mm	4.5 mm
Resolution in Z direction	300 nm	100 nm	20 nm	10 nm
Diameter of the CWS spot	24 µm	12 µm	4 µm	5 µm

Through-The-Lens laser (TTL laser, optional)

Technical description

- Available only for systems equipped with fixed optics or Dual Camera optics
- Available for 5x and 10x lens
- Coaxial reflection into the optical path of the Vision sensor
- Measuring principle: Foucault and triangulation method
- Functionality:
  - » Autofocus sensor for quick focussing of the Vision sensor and measuring heights, bore depths and flatness
  - » Scanning sensor for the contour and surface scanning
- Laser safety class 2, average output < 1 mW
- Red laser, wavelength 650 nm to 680 nm
- Spot size approx. 100 µm at 5x lens and accordingly approx. 50 µm at 10x lens
- Resolution ± 0.1 µm
- Measuring accuracy within E1 (at 10x lens)
- Average focus speed 0.2 s
- Scanning feature in conjunction with PC-DMIS CAD++ Vision

Touch-trigger probes TP200, HP-TM (optional)

[1] Mutual measuring range Vision-Sensor <—> Touch-trigger probe in X direction = 400 mm (see page 8)

TP200 [1]	HP-TM [1]
Technical description	
• 6-way touch-trigger probe using innovative micro strain gauge technology • Allows for small trigger forces and offers advanced triggering accuracy as well as long reliable operation	• 5-way touch-trigger probe: Sensor body and stylus holding module are magnetically connected to each other • Stylus holding modules available in four versions with different trigger forces
Measuring accuracy (at 20°C, according to ISO 10360-2)	
$MPE_E = (1.3 + L/300)$ µm, $MPE_P = 1.3$ µm	
Mounting	
M8 thread (probe body), M2 thread (styli)	
Two stylus holding modules	**Four stylus holding modules**
LF low force SF standard force	LF low force, SF standard force MF medium force, EF extended force
Trigger force	
X, Y: 0.02 N / Z: 0.07 N (all modules)	0.055 N at 10 mm (LF module) 0.08 N at 10 mm (SF module) 0.10 N at 25 mm (MF module) 0.10 N at 50 mm (EF module)
Optional stylus module changing rack	
with 3 or 6 slots	HR-P4 or HR-P6 (with 4 or 6 slots)

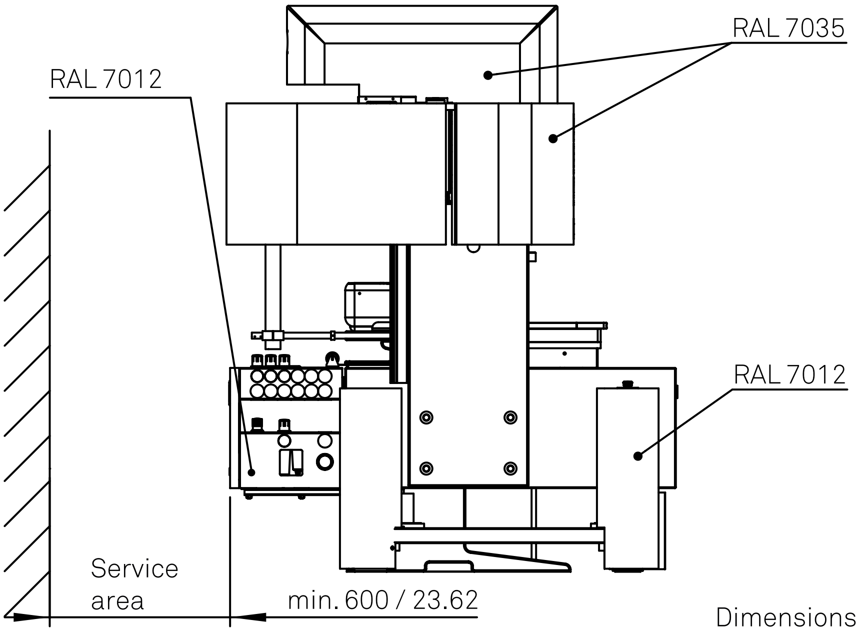
Scanning probe HP-S-X1C (standard), HP-S-X1S/H (optional)

[2] Mutual measuring range Vision-Sensor <—> HP-S-X1 in X direction = 400 mm (see page 8)

HP-S-X1C [2]	HP-S-X1S [2]	HP-S-X1H [2]
	HH-A-T5 motorised indexing probe head (optional)	
Technical description: High accuracy 3D scanning probe head that supports single point probing, self-centering as well as continuous high-speed-scanning for fast and accurate form and profile measurements		
Probe head type: Analog		
Stylus joint: M3		
Resolution: < 0.1 µm		
Measuring range: ± 2 mm in all axes		
Linear stiffness: 1.2 N/mm		
Stylus length range: Vertical: up to 225 mm Horizontal: up to 50 mm	**Stylus length range:** Vertical: up to 115 mm	**Stylus length range:** Vertical: up to 225 mm Horizontal: up to 50 mm
Optional stylus module changing rack: HR-X1 with 3 or 6 slots		

Control system and safety regulations

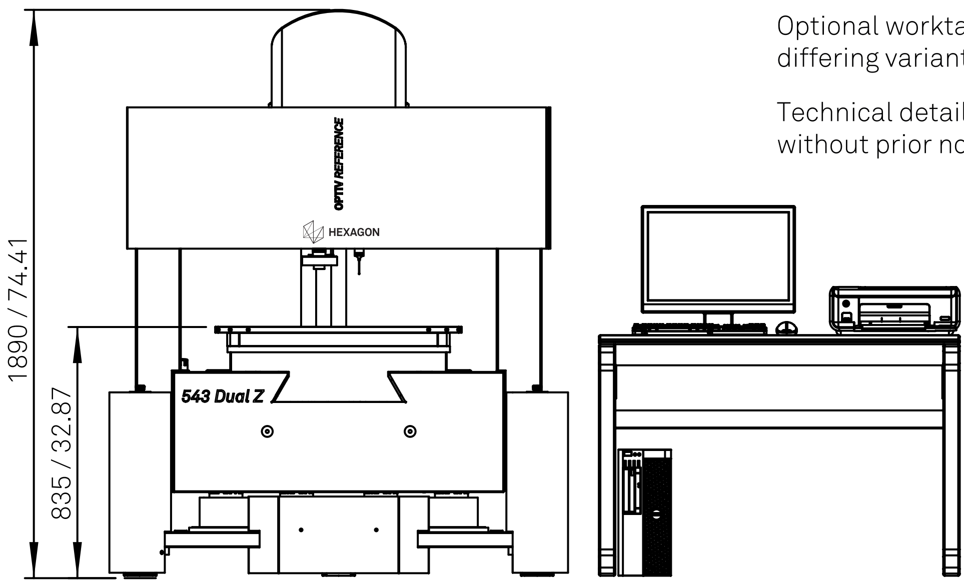
- Machine control unit
  - » DELL computer system with Microsoft Windows 7 Professional (64 bit)
- CNC controller:
  - » 4-5 axes microprocessor CNC with vector path control
- Safety equipment:
  - » Emergency-Stop circuit with Emergency-Stop button
  - » Scale signal monitoring
  - » Safety limit switches
  - » Protective covers for the axes' drives
  - » Collision protection for touch-trigger probes
- Safety regulations:
  - » DIN EN ISO 12100-1 and -2 (Safety of machinery)
  - » DIN EN 60204-1 (Safety of machinery - Electrical equipment of machines)
  - » DIN EN ISO 13849-1 (Safety of machinery - Safety-related parts of control systems)
  - » DIN EN 61000-4-2 and -4 (Electromagnetic compatibility EMC, immunity of machines)
  - » DIN EN 55011 (Industrial, scientific and medical equipment - Radio-frequency disturbance characteristics)

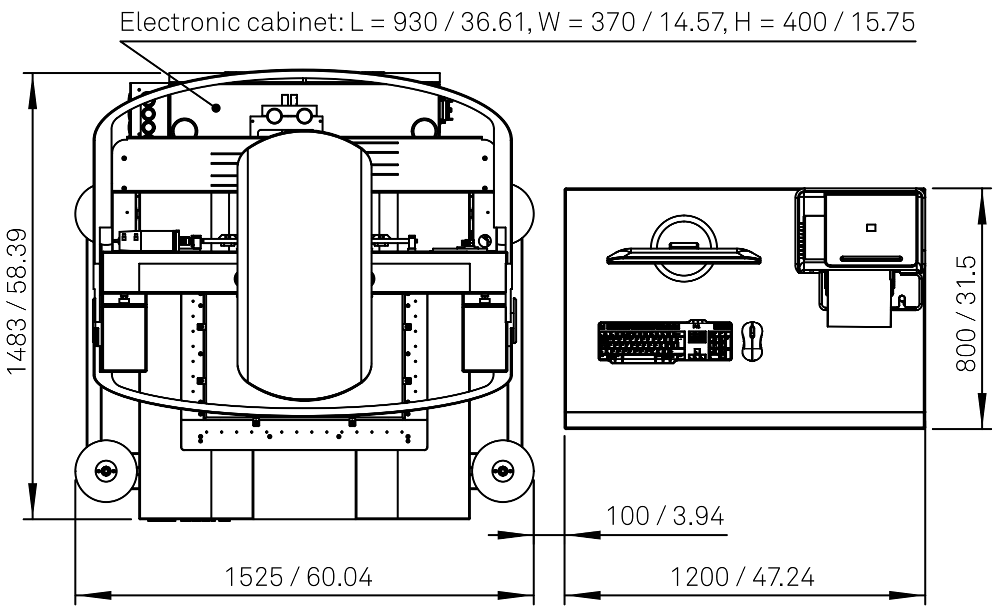


Dimensions in mm / inch

Optional worktable and monitor(s), differing variants possible.

Technical details subject to change without prior notice.





Reference 543 Dual Z

Dimensions in mm / inch

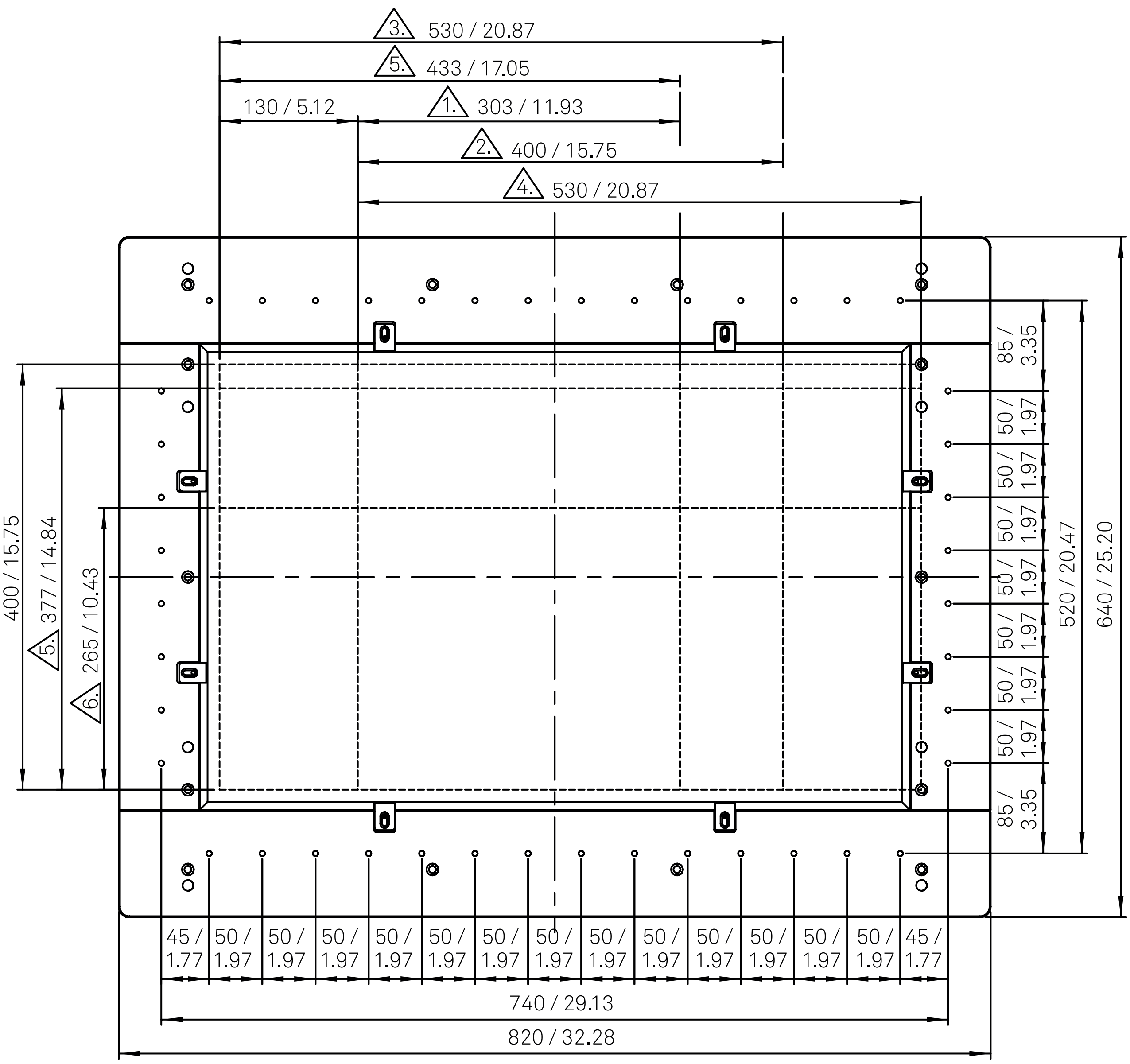
Technical details subject to change
without prior notice.

Size of all threads M6 - 12 deep

Offset camera + touch probe 130 mm / 5.12 inch

Offset camera + CWS 96 mm / 3.78 inch

1. Mutual measuring range of all sensors
2. Mutual measuring range camera + touch probe
3. Measuring range camera
4. Measuring range touch probe
5. Measuring range CWS
6. Measuring range rotary table



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Version 25 November 2015