



KOHZU

**X-RAY
EXPERIMENTAL
INSTRUMENTS**

P R O D U C T S G U I D E



Founded in 1945, KOHZU Precision Co., Ltd. (KOHZU Seiki Co., Ltd. in Japanese) has been making endless efforts to design and manufacture high precision mechanical instruments in order to meet demanding requirements from clients in various fields of science and technology.

In recent years, KOHZU Precision Co., Ltd. has produced a number of hard X-ray monochromators, diffractometers, spectrometers and other devices for use at modern synchrotron radiation sources around the world. We are proud to know, that our products successfully contribute to the continuing progress of this intensively growing field of science and technology.

In this brochure, we present information on some of our products which are currently being used at synchrotron radiation facilities mainly in Japan, and some in the United States and Europe.

We, at KOHZU, hope that our accumulated experience and technology will support you in your scientific challenges.

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FROM THE HISTORY

More than 30 years ago, KOHZU commenced to develop a ultra-high precision goniometer in response to inquiries from Prof. Kohra and his assistant Dr. Kikuta, who were at that time doing high resolution asymmetric Bragg reflection measurements at University of Tokyo. Resolution at 1/100 part of angular second was the request, and in order to accomplish this challenging task, we developed an original proposal. This became the beginning of our rich experience in developing ultra-high precision goniometers for cutting-edge X-ray experiments.

Based on the successful design of this first device, many excellent goniometers were manufactured later, and the high technology capability of KOHZU Seiki was widely recognized. Most of these goniometers were delivered to beamlines at Photon Factory, KEK (Tsukuba), and recently, to SPring-8, the worlds largest synchrotron radiation facility. This success and constant efforts towards technical improvements led to the fact that nowadays our company is also delivering high precision mechanical devices for synchrotron radiation experimental communities throughout the world. Some of our recent products are presented in this brochure.



This is the first KOHZU ultra-high precision goniometer fabricated in 1962. It was designed by the late chief executive Kazuo KOHZU in his young days, and it is now exhibited in the science museum at SPring-8 (Japanese 3rd generation synchrotron radiation facility) site.

ULTRA HIGH PRECISION GONIOMETERS

We use term “ Ultra High Precision Goniometer ” for a device which is capable of rotating a sample with resolution 0.01" (arc seconds) or better, and accuracy of the rotation axis better than 0.1". Several variations of such goniometers, such as two axis type, heavy duty type, a unit incorporating angular encoder etc., are being manufactured.

However, design concept of these devices (a tangent bar mechanism) is the same for all variations.

Model KTG-11P

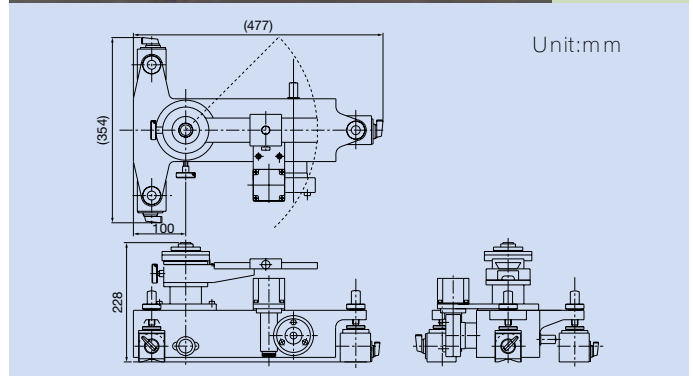
This is an older model of a ultra high precision goniometer designed for use with light samples and rotation axis in vertical orientation. Because of light design, high load cannot be applied to the axis shaft, especially perpendicularly. This goniometer can be quickly installed on any steel base table by using four magnets. The counter arm for a detector or analyzer is driven manually, its fixing is possible by a lock.

Specifications

Fine motion drive	Tangent bar mechanism
Fine motion actuator	5-phase stepping motor
Rotation axis wobble	0.1" / 360 °
Resolution	0.01" / step *
Fine motion range	±2 °
Coarse motion range	360 °
Load capacity	5kg **
Self weight	29kg

* - In full step mode.

** - In axial direction.



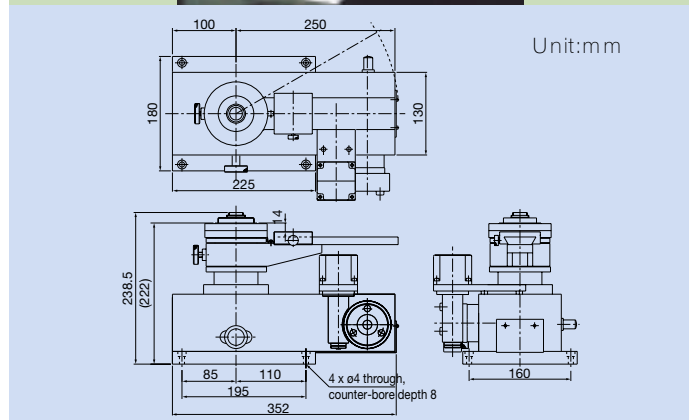
Model KTG-15D

This is our general purpose goniometer which is being used mostly at synchrotron radiation facilities. The axis shaft and bearings are reinforced in order to permit higher load in both axial and radial directions without degrading the goniometer performance. The manually rotated detector arm with a linear slide is provided as a standard. It is possible to achieve higher resolution (0.005" / step) by optional changing of the gear ratio. The angular encoder can be mounted as another option.

Specifications

Fine motion drive	Tangent bar mechanism
Fine motion actuator	5-phase stepping motor
Rotation axis wobble	0.1" / 360 °
Resolution	0.01" / step *
Fine motion range	±2 °
Coarse motion range	360 °
Load capacity	20kg (axis vertically) 10kg (axis horizontally)
Self weight	26kg

* - In full step mode; higher resolution as an option.



ULTRA HIGH PRECISION GONIOMETERS

Extremely high resolution of angular motion is achieved by pushing a bar mounted on a high precision spindle by a micrometer head. The micrometer head itself is actuated by stepping the motor through the worm and worm wheel mechanism. The name of the tangent bar mechanism comes from the formula for calculation of angular motion θ : $\tan\theta = x / L$, where L is length of the bar and x linear displacement of the micrometer. Angular range for this ultra fine motion is limited to approximately 4° for typical bar length L=206mm, while coarse motion over 360° can be made manually after releasing a lock.

Model KTG-15D (AP)

This modification of KTG-15D goniometer has provisions for mounting Heidenhain ROD800 incremental encoder. Resolution of this model is enhanced due to increased gear reduction ratio. There is no detector arm for this modification. The adaptor on the rotation table allows mounting miniature goniometers for sample positioning (Huber Diffractionstechnik GmbH). First two units of this type were supplied together with vertical translation stages and air pad tables to Advanced Photon Source (Argonne National Lab.) as a high resolution 4-bounce nested geometry monochromator assembly (see photo here and p.22 of this brochure).

Specifications

Fine motion drive	Tangent bar mechanism
Fine motion actuator	5-phase stepping motor
Rotation axis wobble	0.1" / 360 °
Resolution	0.005" / step *
Encoder readout	0.1" **
Fine motion range	±2 °
Coarse motion range	360 °
Load capacity	20 kg (axis vertically) 10 kg (axis horizontally)
Self weight	29kg

* - In full step mode

** - With interpolation module.

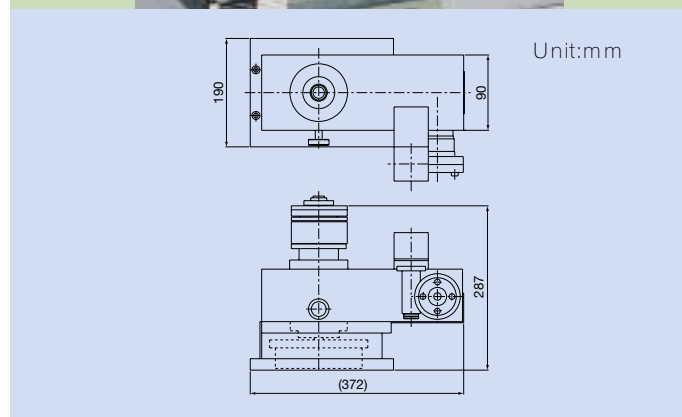
Model KTG-15D (APG)

This is a modification of KTG-15(AP) goniometer equipped with Phytron ZSS type 2-phase stepping motor (can be used with 4-phase driver) and D-sub connector in order to meet the control system standards of synchrotron radiation facilities in Europe (ESRF, DESY). Photo shows the device with small motorized swivel stage (KOHZU SA05-11) for sample tilt adjustment is mounted on the top of the rotation table.

Specifications

Fine motion drive	Tangent bar mechanism
Fine motion actuator	2(4)-phase stepping motor
Rotation axis wobble	0.1" / 360 °
Resolution	0.005" / step *
Fine motion range	±2 °
Coarse motion range	360 °
Load capacity	20 kg (axis vertically) 10 kg (axis horizontally)
Self weight	29kg

* - In full step mode of 500 step / revolution motor.



ULTRA HIGH PRECISION GONIOMETERS

Positioning of these ultrahigh precision goniometers with respect to the X-ray beam can be done by using specially designed heavy duty translation stages of the KHI series. Some examples of these stages are represented on pp.12-14 of this brochure.

Model KTG-15DH

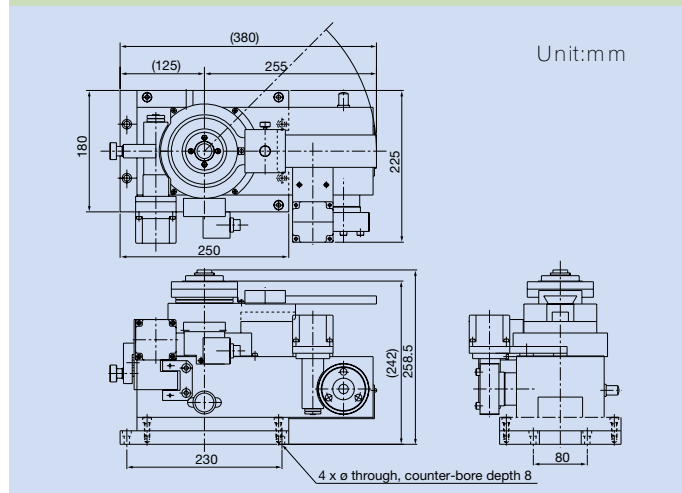
This is a modification of KTG-15D goniometer with motorized detector arm rotation. Detector arm rotation is driven by worm and worm wheel mechanisms actuated by a stepping motor. The detector arm can also be rotated freely by hand after releasing and turning away a block with the worm and the motor. Hinge and lock allows returning the worm to its position with good reproducibility. High resolution (0.005"/step) and encoder options are possible.

Specifications

Fine motion drive	Tangent bar mechanism
Fine motion actuator	5-phase stepping motor
Rotation axis wobble	0.1" / 360 °
Resolution	0.01" / step *
Fine motion range	±2 °
Coarse motion range	360 °
Load capacity	20kg (axis vertically) 10 kg (axis horizontally)
Detector arm drive	Worm and worm wheel
Detector arm actuator	5-phase stepping motor
Detector arm resolution	0.001°/ step **
Self weight	30kg

* - In full step mode; higher resolution as an option.

** - With interpolation module.



Model KED-8T

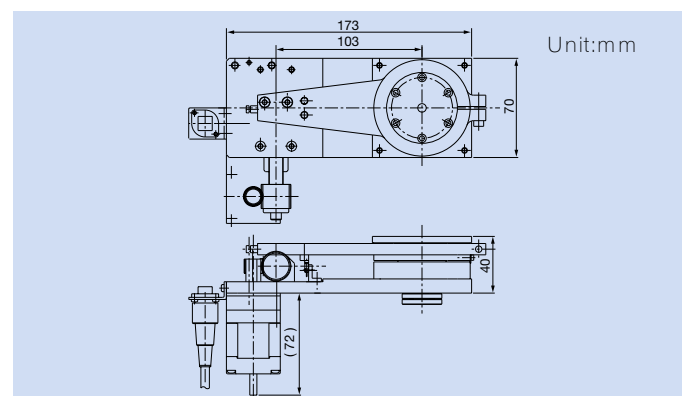
This scaled down and simplified version of tangent bar type goniometer is suitable for angular adjustment of various small X-ray optical elements such as mirrors etc. Because of its compactness and light weight, this goniometer can be used in various experimental arrangements. However, rotation axis accuracy and resolution cannot achieve the values of the KTG series goniometers.



Specifications

Fine motion drive	Tangent bar mechanism
Fine motion actuator	5-phase stepping motor
Rotation axis wobble	10" / 360 °
Resolution	0.04" / step *
Fine motion range	±2 °
Coarse motion range	360 °
Self weight	2kg

* - In full step mode.



ULTRA HIGH PRECISION GONIOMETERS

In various experiments, it is necessary to keep the relative position of two rotation axes with high stability. The best stability is achieved, when both rotation axes are mounted inside the same rigid goniometer body. Here we show some examples of two such axis ultrahigh precision goniometers.

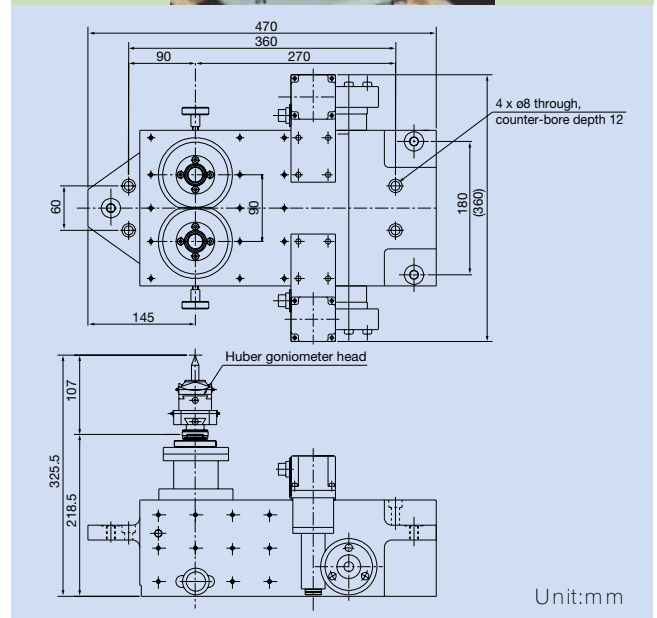
Model KTG-11KW

This goniometer has two parallel ultra high resolution rotation axes driven independently by two tangent bar mechanisms. Distance between the axes is made as small as possible (90 mm). The goniometer was manufactured for use in high precision two crystal topograph set-up.

Specifications (Both Axes)

Fine motion drive	Tangent bar mechanism
Fine motion actuator	5-phase stepping motor
Rotation axis wobble	0.1" / 360 °
Resolution	0.01" / step *
Fine motion range	±2 °
Self weight	50kg

* - In full step mode.



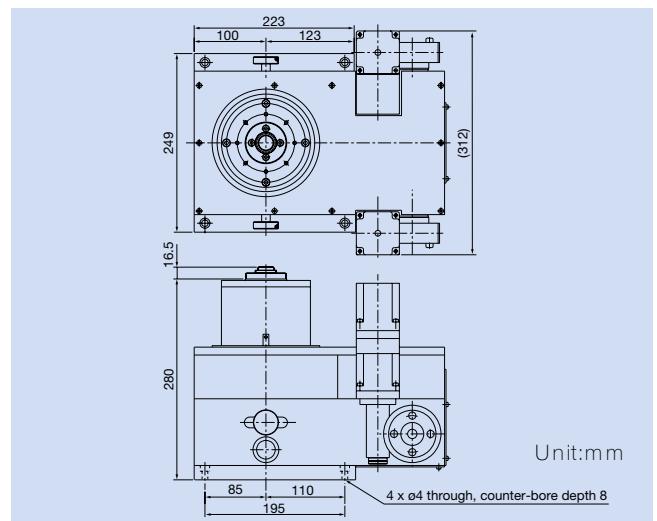
Model KTG-16W

This goniometer has two rotation tables with common rotation axis. Both tables are driven independently by tangent bar mechanisms. The device was manufactured for use as a high resolution 4-crystal asymmetric reflection monochromator.

Specifications (Both Axes)

Fine motion drive	Tangent bar mechanism
Fine motion actuator	5-phase stepping motor
Rotation axis wobble	0.1" / 360 °
Resolution	0.005" / step *
Fine motion range	±2 °
Self weight	50kg

* - In full step mode.



ULTRA HIGH PRECISION GONIOMETERS

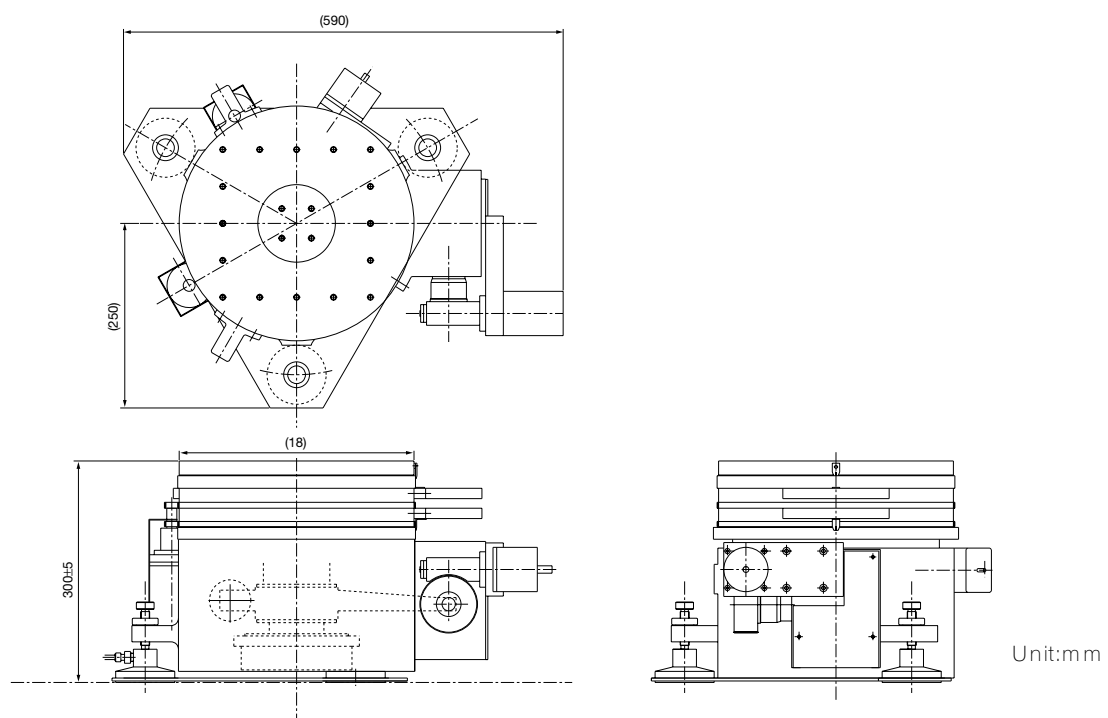
Ultra high precision goniometers which are presented on pp. 2-5 of this brochure have one common disadvantage. They have a rather limited travel range of motorized motion. The goniometer which is presented here offers a solution to this problem.

Model RST-3A2

This goniometer has primary axis θ with coarse and fine drive, and two detector arm axes. All these axes are motorized. Coarse motion of θ is driven by the gear mechanism, while fine motion by the tangent bar. Switching between coarse and fine drive mode is being done remotely by a patented electromagnetic clutch. In addition, a high precision Heidenhain rotary encoder is directly coupled to the θ axis. With this arrangement, angular position of the θ axis can be read precisely for both coarse and fine drive modes. Air pads are provided beneath the device, permitting very smooth horizontal motion over flat surfaces.

Specifications

Travel ranges	θ coarse - 360 ° θ fine - $\pm 2^\circ$ upper arm - 260 ° lower arm - 240 °
Resolutions	coarse - 3.24" / step fine - 0.01" / step upper arm - 0.035 ° / step lower arm - 0.036 ° / step
θ axis encoder	Heidenhain < ROD-800 >
Load capacity	40 kg
Self weight	105 kg
Patent registration No.	SHO 63-7730



HIGH PRECISION GONIOMETERS

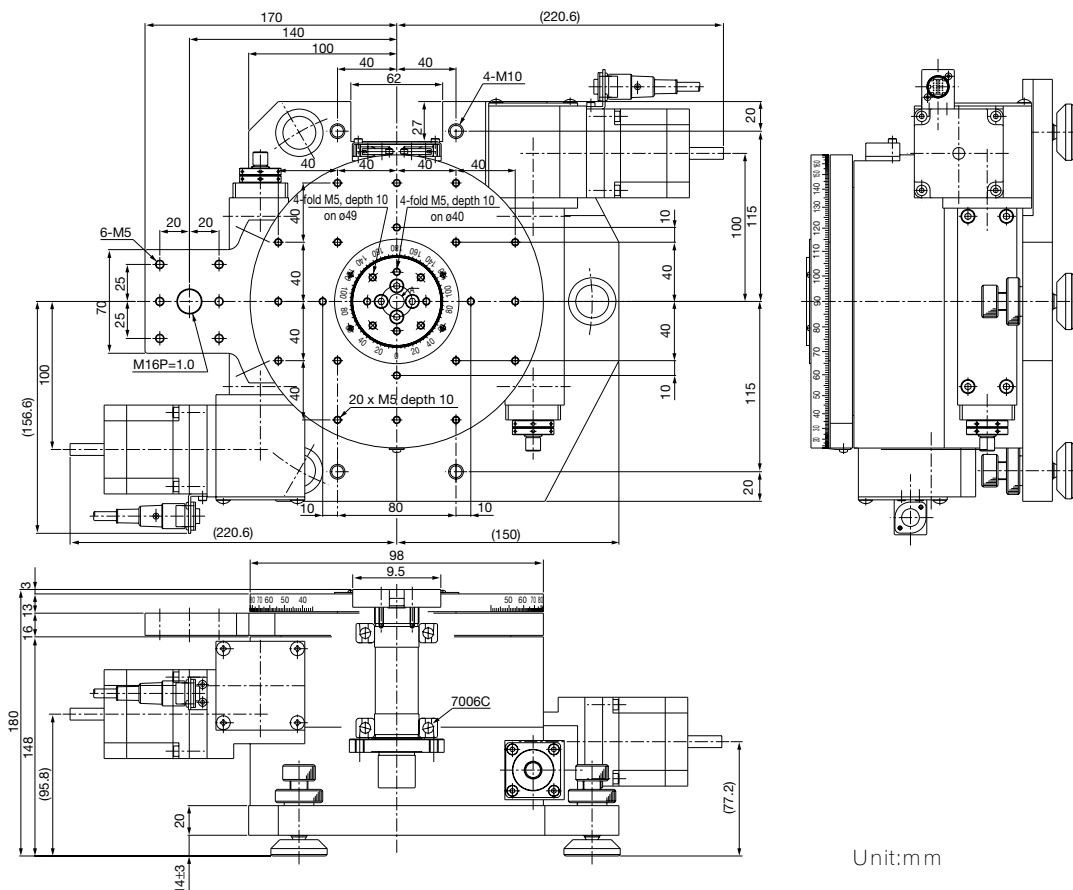
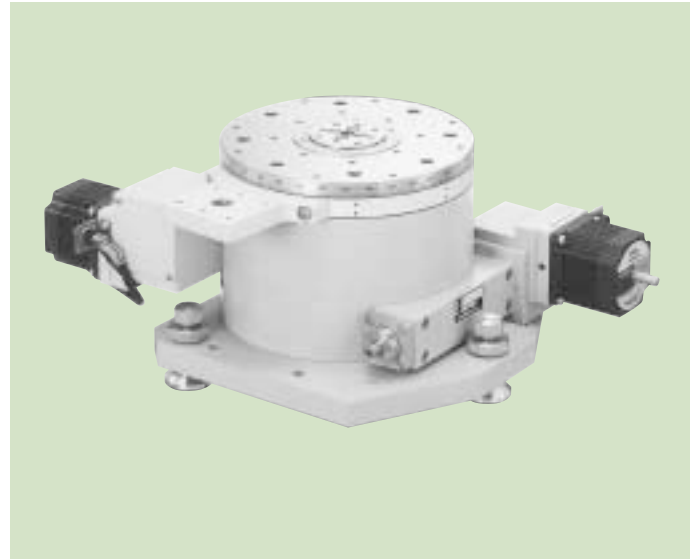
KOHZU Precision is manufacturing a wide range of high precision rotation stages with table diameters varying from the smallest ϕ 50 mm to the largest ϕ 300 mm. There are different types such as single axis, two axis and circle type goniometers. All these stages are driven by precise worm and worm wheel mechanism. In order to assure the best performance, worm wheels for all KOHZU stages are being machined by a custom-made precise gear cutting machine in our factory. For complete description of KOHZU rotations, swivels, as well as translation stages please refer to our catalogues “ Standard Precision Positioning Stages 1999-2000 ” or “ Air-Side Precision Stages and Goniometers ”. Here we give only one example of two axis rotation stage model RA20-21 which is being used for X-ray diffraction experiments most extensively.

Model RA20-21

This two axis (θ - 2θ) motorized rotation stage allows rotation independently of a sample with either a detector or analyzer mounted on a side arm. Resolution of both axes is enhanced mechanically by using additional worm and worm wheel mechanism. The stage can be used in either horizontal or vertical orientation of the common rotation axis. More detailed specifications can be found on p.240 of either catalogue (see above).

Basic Specifications

Resolution (θ axis)	0.0002 ° / step (half step mode)
Resolution (2θ axis)	0.0004 ° / step (half step mode)
Absolute accuracy (both axes)	10"
Self weight	26 kg



HIGH PRECISION GONIOMETERS

If our catalogues products do not satisfy the customer's needs, we are ready to customize the design of the standard goniometer. Options such as motor, limit switches or connector exchange (in order to meet the control system standards of the facility where our products will be used), strong radiation, vacuum and baking compatibility are routinely being done for various products.

Model RA20-21 options

Here we show some examples of the RA20-21 stage modifications and accessories which are being manufactured frequently.

TIS-3Cl : Lang Camera

This assembly is a Lang camera set-up which consists of RA20-21, translation stage and other accessories. The set-up is being used for surface analysis of 2-inch wafers.



RST-6K : 2θ Counter Arm

This is an arm with extended length and slide mounts in order to install and position various optical elements such as slits, collimators etc.



PWT-20CH : Goniometer with 2θ Free Drive

This is a modification of RA20-21 which permits manual rotation of the detector arm by detaching the worm and motor assembly.

Encoder Option

Incremental rotary encoder can be installed on the worm and motor axis.

RA20-21V : High Vacuum Compatibility

This is a modification of RA20-21 for use in high vacuum at pressures down to 10^{-7} mbar (no baking). Modifications for use in vacuum down to 10^{-9} mbar with baking compatibility can be supplied.

HIGH PRECISION GONIOMETERS

Our standard positioning stages can be assembled in various combinations. Here we show some examples of multi-axis goniometers which can be easily combined out of our standard positioning stages. Since alignment of individual components may be critical, we recommend that customers let us do the assembly work in the

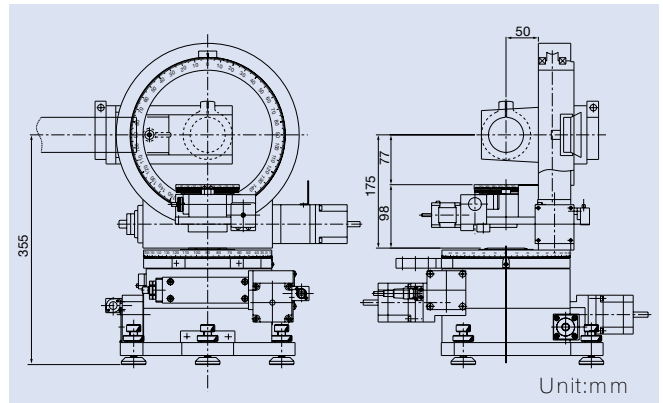
Model RSG-7B

This is simple 4-axis circle type goniometer (ϕ , χ -circle, θ , Z from the top to the bottom) assembled out of RA07-02 with additional worm gear, RA20-51 and RA20-21 (please refer to the catalogue). Detector mount (see the drawing) can be supplied together with the goniometer.



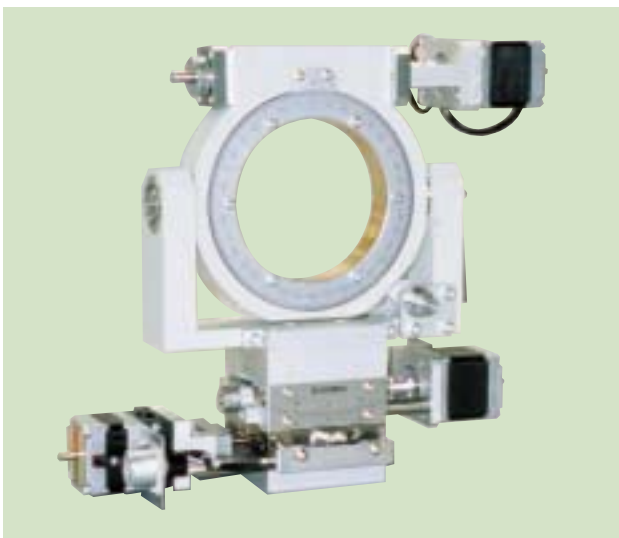
Specifications

ϕ -axis (RA07-02)	Travel range : 360 ° Absolute accuracy : 0.02 ° Resolution : 0.000025 ° / step (enhanced, half step mode)
χ -circle (RA20-51)	Travel range : 2000 ° Absolute accuracy : 0.01° Resolution : 0.001° / step (half step mode)
Sphere of confusion	50 μ m



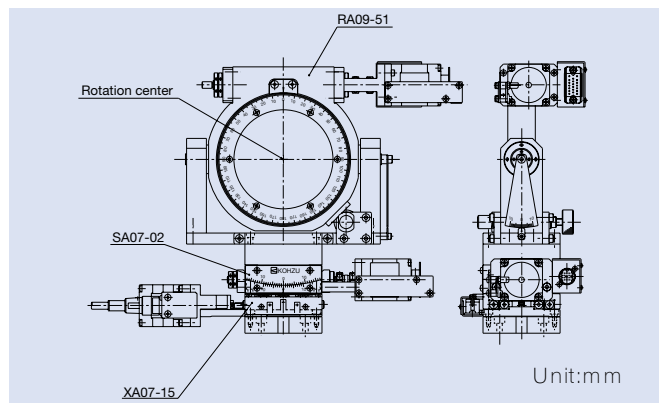
Model SPI-3

This is small sized goniometer with 3 motorized motion axes (χ circle with manual θ_y tilting, θ_x swivel and Y translation) for adjustment of optical elements. The device consists of RA09-51 circle, SA07-02 swivel and XA07-15 translation stage.



Specifications

Resolutions (half step mode)	χ circle : 0.0012 ° / step θ_x swivel : 0.0006 ° / step Y translation : 0.25 μ m / step
Travel Ranges	χ circle : ± 155 ° θ_y tilt : ± 10 ° θ_x swivel : ± 10 ° Y translation
Self weight	5 kg



HIGH PRECISION GONIOMETERS

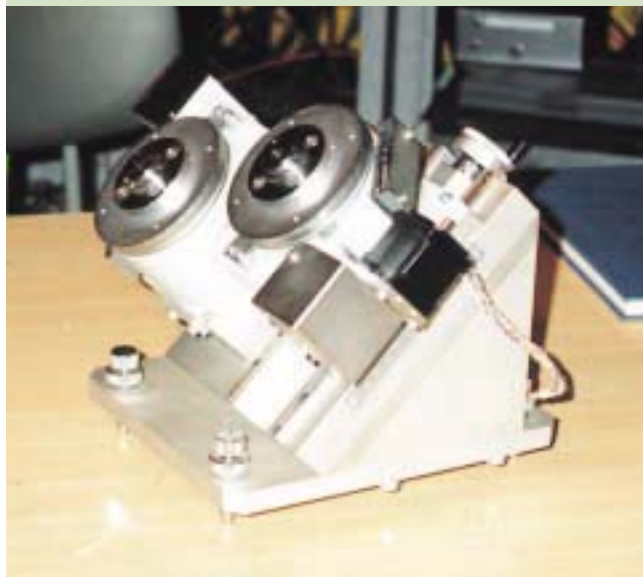
These examples of high precision goniometers consist of rotation stages with axis tilted 45° in the plane perpendicular to the X-ray beam and translation stages for position adjustment. Typical applications of such arrangement are experiments with X-ray polarization conversion.

One such goniometer is installed at SPring-8 X-ray undulator beamline BL-39XU. It is being used with piezoactuator driven oscillator holding diamond crystal atop the rotation stage as a phase retarder in polarization modulation set-up (see for example M.Suzuki et al., Jpn. J. Appl. Phys. vol.37, 1998, pp.L1488-L1490).

Model KHI-3



Model TIS-3



This goniometer has two parallel rotation axes tilted at 45° in the plane perpendicular to the optical axis. The position of one axis with respect to another can be adjusted by manual translation stage.

ACCESSORIES

For all goniometers presented in this brochure, we are supplying a wide spectrum of sample, detector and optical element holders, conversion spacers, handles for manual rotation of motor shafts etc. These are some examples of frequently used accessories.

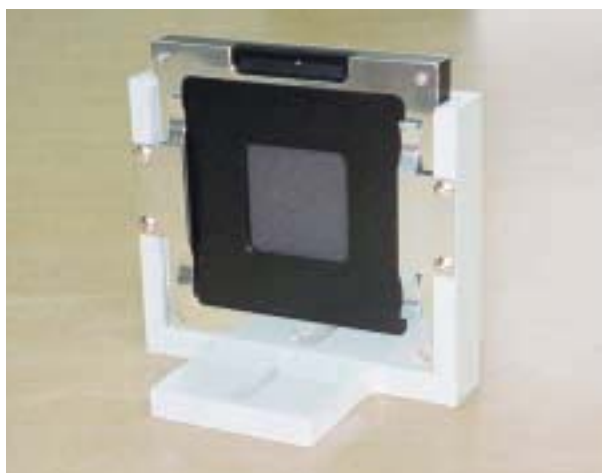
KTG-15DA Goniometer Head Mount

This spacer is for mounting of miniature goniometer heads (Huber Diffraktionstechnik GmbH) atop the KTG-15D goniometer table.



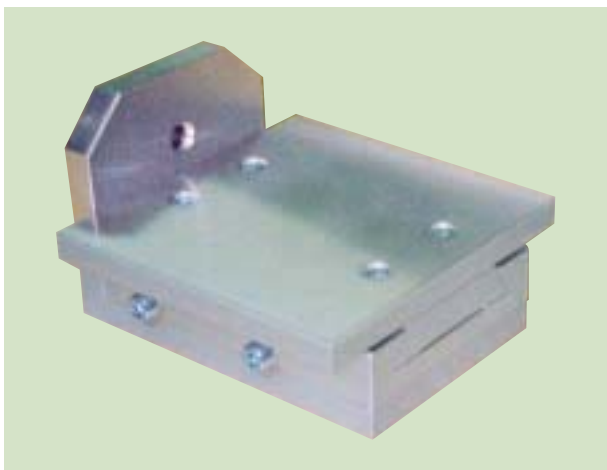
KEI-10FG 3 Inch Film Holder

This holder is for fast fixing of the frame with a 3 inch optical element (film, filter etc.).



KIS-9 Sample Holder

This is a holder for fixing the sample to the goniometer. The holder has a translation slide for manual sample position adjustment. Sample mounting or removal can be done easily with use of this holder.



KES-52P Slit Holder

This holder is designed for all models of KOHZU slits. It has four magnets on the bottom for easy fixing to any steel base table. There is a clamp which allows vertical positioning of the device.

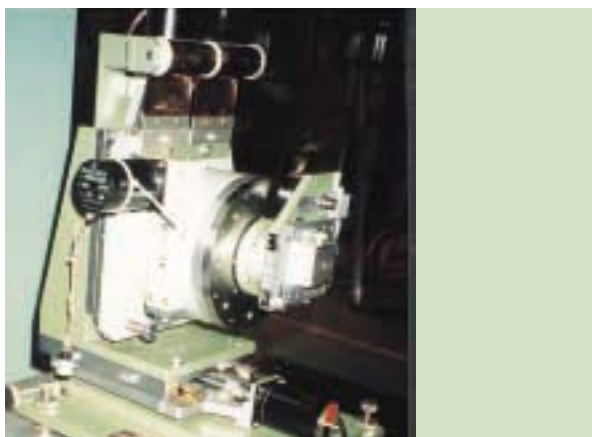


XZ STAGES

Heavy duty translation stages of the KHI series are designed for motorized vertical and horizontal positioning of KGT goniometers (see pp.2-5 of this brochure), heavy rotation stages such as RA20-21 for example (p.7 of this brochure) and other equipment.

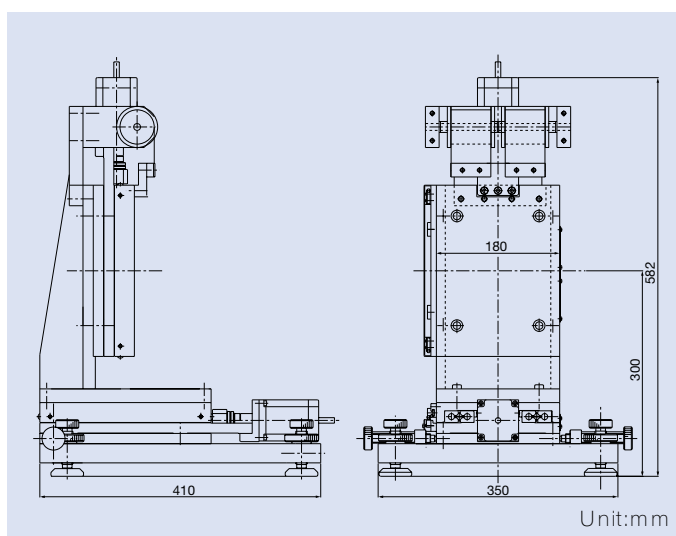
Model KHI-4

This XZ stage is being used for motorized vertical and horizontal positioning of the goniometer in the plane perpendicular to the X-ray beam. A simple load cancel mechanism with constant force springs allows use of the standard motorized translation stage XA25-01 (please refer to the catalogues, p.172) with minor modifications for vertical translation. The same type of stage is being used for horizontal translation as well. Since our standard translation stages has outstanding repeatability and stiffness, precision and stability of goniometer positioning is high.



Specifications (both axes)

Resolution (half step mode)	1 μ m / step
Travel	100 mm
Repeatability	\pm 0.5 μ m
Load capacity	30 kg
Self weight	30 kg



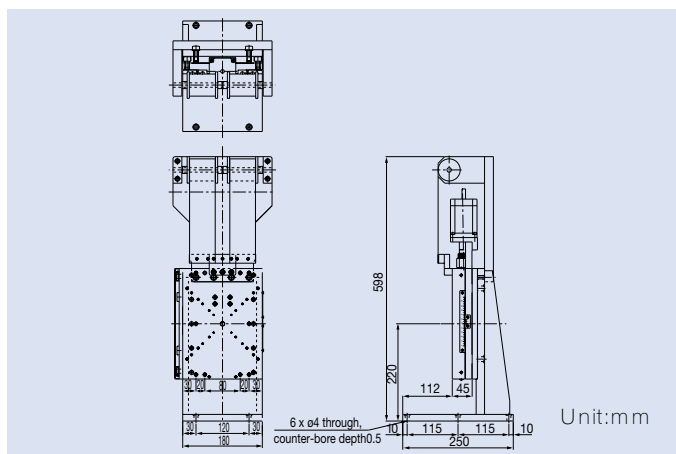
Model KHI-4S

Design of this vertical translation stage is derived from model KHI-4. It has an improved design of L-shape mounting bracket with load cancel springs. This gives better stability to the whole system and enhanced load capacity.



Specifications

Resolution (half step mode)	1 μ m / step
Travel	100 mm
Repeatability	\pm 0.5 μ m
Load capacity	50 kg
Self weight	35 kg



XZ STAGES

Translation stages of the KHI series can be manufactured in various modifications : vertical translation only, vertical and one axis horizontal, vertical and two axis horizontal. These stages are usually placed atop air pad unit which allows smooth horizontal transportation of whole unit across smooth base table (see for example KHI-4SK on this page or pp.18, 21, 22 of this brochure).

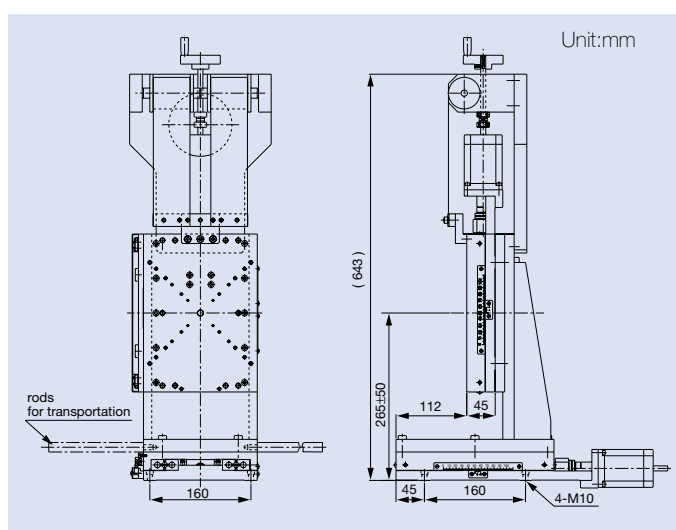
Model KHI-4SK

This XZ stage consists of KHI-4S placed atop horizontal translation stage XA25-01 (refer to the p.172 of the catalogue). Photo shows KHI-4SK mounted on the air pad unit which allows manual coarse XY translations along the guides.



Specifications (both axes)

Resolution (half step mode)	1 μ m / step
Travel	100 mm
Repeatability	\pm 0.5 μ m
Load capacity	50 kg
Self weight	40 kg



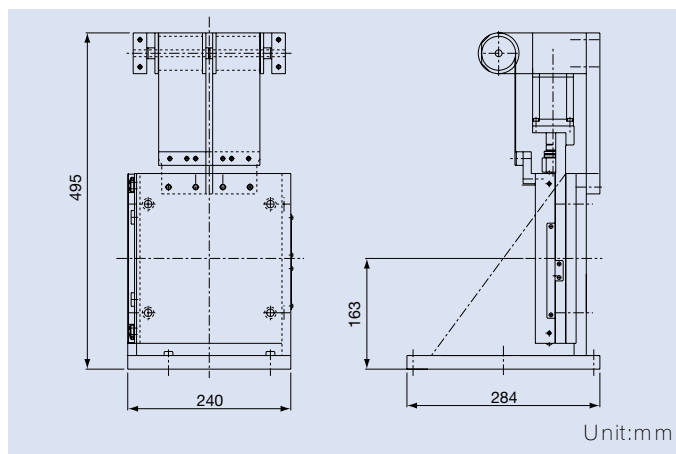
Model KHI-4AP

This vertical translation stage has a stiffer L-shape mounting bracket in comparison to that of the model KHI-4S. This gives better stability against a large momentum load, which is imposed on the stage structure when for example a KTG goniometer with encoder option is mounted. Photo shows KHI-4AP holding KTG-15D (AP) on the top of air pad unit (part of 4 bounce nested geometry monochromator AAG-100, p.22 of this brochure).



Specifications

Resolution (half step mode)	1 μ m / step
Travel	100 mm
Repeatability	\pm 0.5 μ m
Load capacity	30 kg
Self weight	25 kg



XZ STAGES

Longer travel range of the KHI series stages can be achieved by replacing the XA25-01 stage with modification of long travel type XA20-51 (please refer to the catalogue, p.182) and modification of the L-shaped mounting bracket.

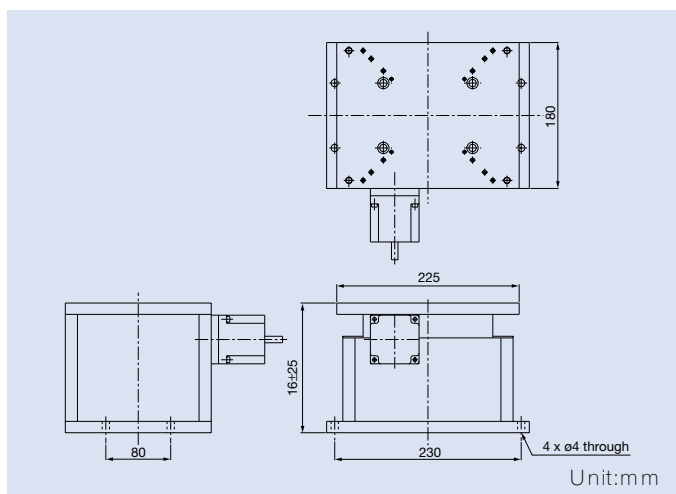
Model KHI-9

This Z stage has the highest load capacity among the KHI series. Another advantage is it's compactness, which allows versatile layout of the experimental set-up.



Specifications

Resolution (half step mode)	1 μ m / step
Travel	50 mm
Load capacity	100 kg
Self weight	25 kg



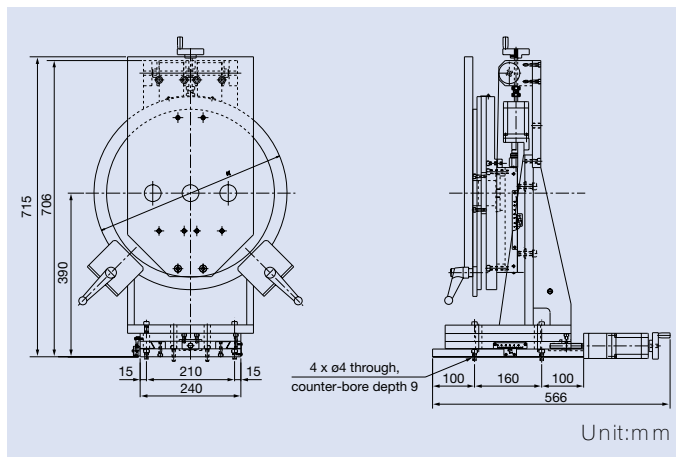
Model KHI-7

This XZ translation stage was designed specially for carrying two axis goniometer KTG-11KW (p.5 of this brochure). The characteristic features are enhanced load capacity and a lockable rotation table which allows axes of the KTG-11KW goniometer to be oriented with respect to the beam in the vertical plane.



Specifications

Resolution (half step mode)	1 μ m / step
Travel	100 mm
Repeatability	\pm 0.5 μ m
Rotation range	\pm 90 °
Load capacity	50 kg
Self weight	50 kg

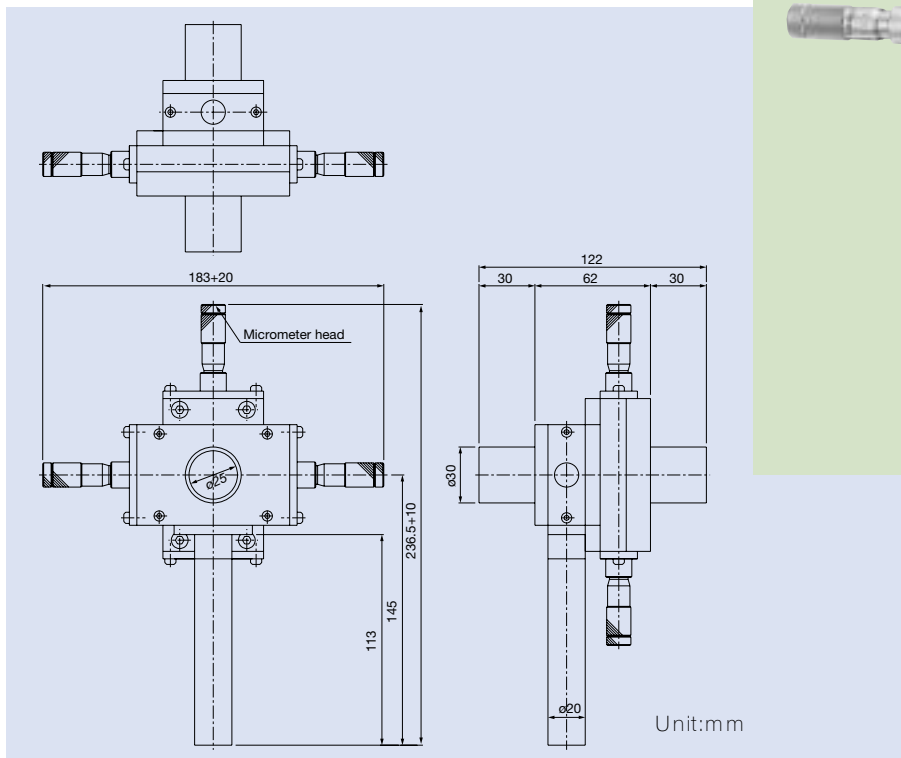


PRECISION SLITS

Manual KOHZU precision slits use simple design with dovetail slides for blade guidance, and micrometer heads as actuators. Optimized design, precise manufacturing and careful adjustment provide excellent performance for such simple devices. There are several modifications of these slits.

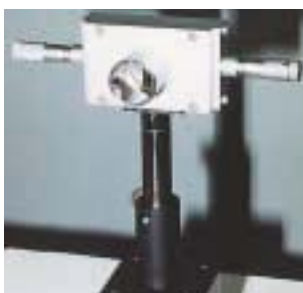
Model KEI-10D2

This is a 4-blade manual slit with upper, lower, left and right blades adjustable independently by 4 micrometer heads. As a standard, blades are made of Tantalum, and the blade edges are cut at angle with respect to the beam axis in order to reduce edge scattering.



Modifications

There exist different versions and modifications of KEI-10D2, for example two blade version KEI-10D, or version with extended travel KEI-12. Photo below shows two blade version KEI-10D.



Specification summary

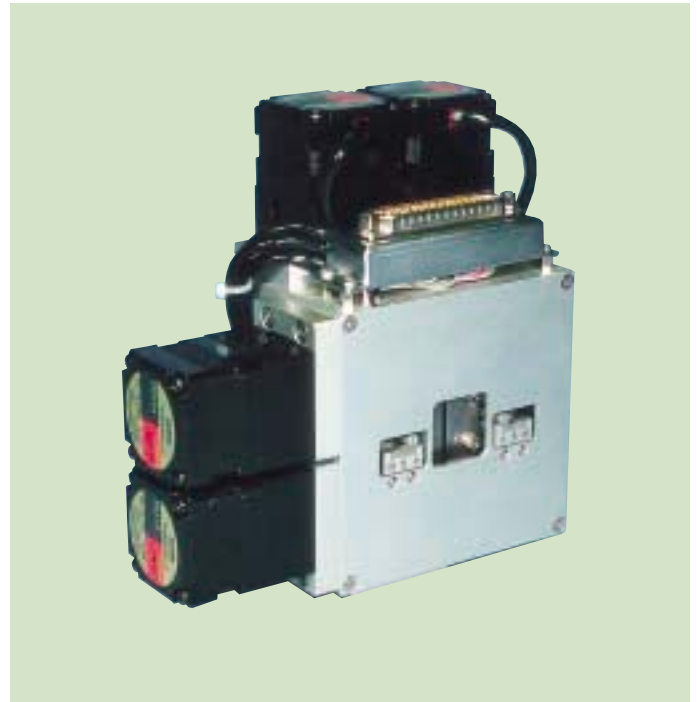
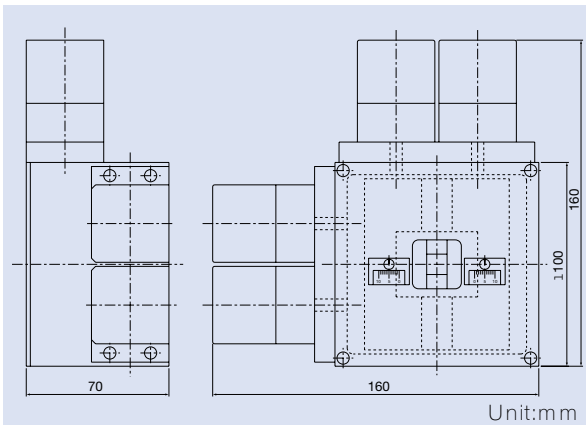
Model	KEI-10D2	KEI-10D	KEI-12
Direction	XY	X	X
Travel	10 mm	10 mm	12 mm
Micrometer readout	10 μ m	10 μ m	10 μ m
Blade material	Tantalum	Tantalum	Tantalum
Blade thickness	3 mm	3 mm	3 mm
Self weight	2.5 kg	1.0 kg	1.5 kg

PRECISION SLITS

Motorized KOHZU precision slits have design features common to our standard translation stages of the XA series (please refer to the catalogue). Motion of the blades is guided by precision cross roller guides, and driven by a precision ground screw mechanism. A stepping motor is being used as an actuator. These features provide outstanding performance of our slits, such as good resolution, high repeatability, straightness and small angular errors of blade motion.

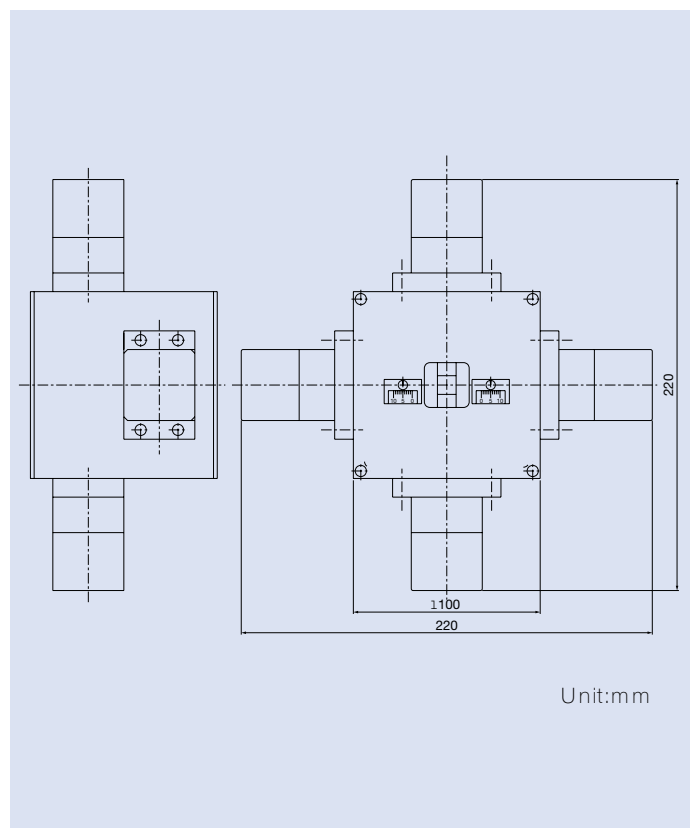
Model GHM-3S

This is the simplest motorized 4-blade slit for general use. Blades in each pair are mounted in the same plane, and motors are placed on the same side for each pair. This design allows us to make the device rather compact. Motions of the blades are independent.



Model GHM-3SP

This high precision slit has a drive mechanism with improved accuracy in comparison to the GHM-3S model. Four linear encoders can be installed in order to monitor independent motion of each blade. Special care is taken during the assembly and adjustment in order to assure the best performance. This unit was used in an X-ray photon correlation experiment with synchrotron radiation from TRISTAN Main Ring at KEK, Tsukuba (S.Kikuta et al., Jpn. J. of Synchrotron Radiation v.10, 1997, p.126 - in Japanese, abstract in English).

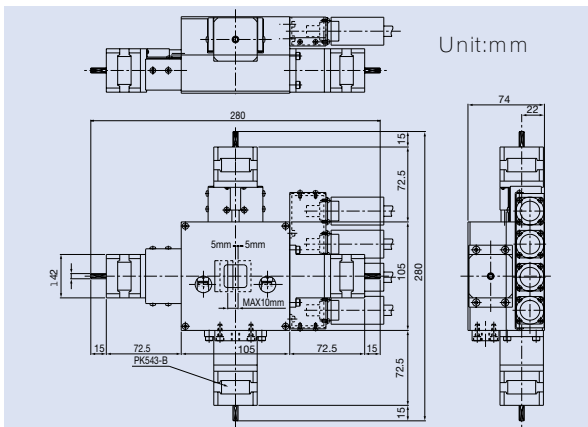


PRECISION SLITS

Motorized precision slits are being manufactured in various modifications which differ in blade drive (coupled or independent), blade mounting, shape, thickness etc. There is also a modification for use in a vacuum. We can adapt our slits for use with a specific control system, where there are required motors or connectors other than our standard.

Model GHM-7

This has two pairs of blades with mechanically coupled drives in each pair. The desired gap can be set by one motor, while the other allows scanning the gap over the whole travel range. This type of slit is convenient for experiments, where horizontal and vertical motion of the beam with constant size is required.



Specification summary

Model	GHM-3S	GHM-3SR	GHM-3SV	GHM-SP	GHM-7
Feature	Independent blades	Overlapping blades	Vacuum option****	High precision	Coupled blades
Blade travel	(0~10) mm	(-5~+5) mm	(0~10) mm	(0~10) mm	(0~10) mm
Minimum gap	10 μ m	0	10 μ m	10 μ m	10 μ m
Resolution*	0.5 μ m / step	0.5 μ m / step	0.5 μ m / step	0.5 μ m / step	0.5 μ m / step
Encoder resolution	-----	-----	-----	0.1 μ m	-----
Repeatability	0.5 μ m	0.5 μ m	0.5 μ m	0.2 μ m	0.5 μ m
Absolute accuracy	10 μ m	10 μ m	10 μ m	5 μ m	10 μ m
Blade motion straightness	1 μ m	1 μ m	1 μ m	0.5 μ m	1 μ m
Blade edge perpendicularity	0.1°	0.1°	0.1°	0.05 °	0.1°
Blade parallelism	20"	20"	20"	10"	20"
Blade material**	Tantalum	Tantalum	Tantalum	Tantalum	Tantalum
Blade thickness***	5 mm 10 mm	5 mm	5 mm	5 mm	5 mm
Environment	Air	Air	>10 ⁻⁵ mbar	Air	Air

* - Microstep drive can be used in order to enhance the resolution.

** - Tungsten or Tungsten alloy can be used as well.

*** - Use of blades thicker than 5mm require increased thickness of the slit body.

**** - Whole slit including motors is placed inside vacuum.

BASE TABLES

Besides precise goniometers, high precision X-ray experiments require rigid and stable supporting structures for these devices. Here we present some examples of base tables which can be used for vertical, horizontal positioning and tilting of goniometers described in this brochure.

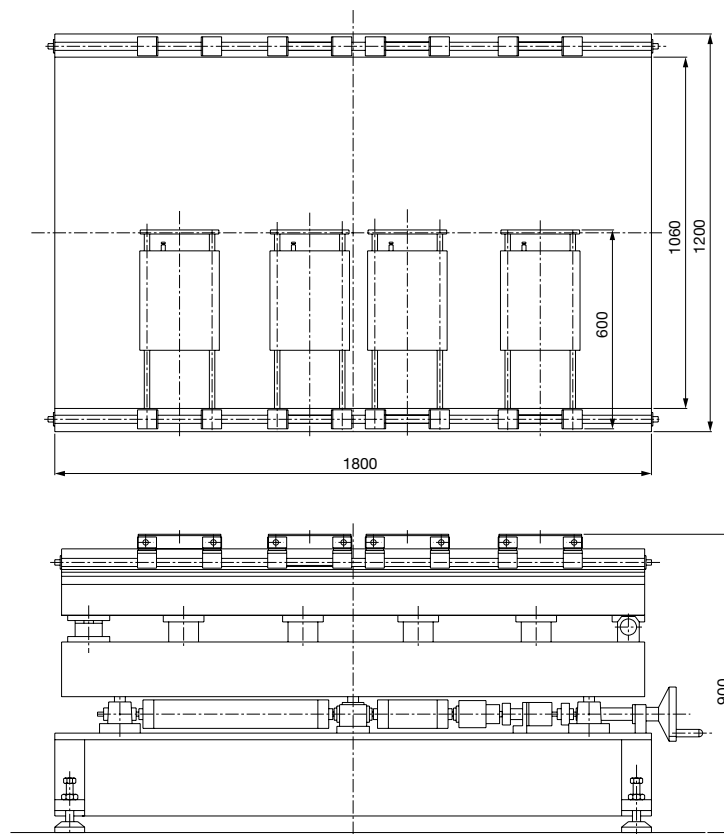
Model KCS-6

This table has a polished upper surface with air pad units which can carry KHI series translation stages with ultra high precision KTG series goniometers described in this brochure (pp. 12-14 and pp. 2-5 respectively), as well as other heavy equipment. Up to 8 air pad units can be placed on the top of the table. Supply of pressurized air allows smooth translation of these pads in a horizontal plane along bar guides. The position of each pad can be locked by magnetic chuck. The base table itself allows motorized vertical adjustment and manual rotation around the vertical axis. Bolts on the bottom allow height and tilt adjustment during beamline installation.



Specifications

Dimensions	1800 mm X 1200 mm X 900 mm
Vertical travel	±100 mm (motorized)
Resolution	0.11 μm / step
Rotation around vertical axis	±2 ° (manual)
Load capacity (air pad unit)	100 kg



Unit:mm

BASE TABLES

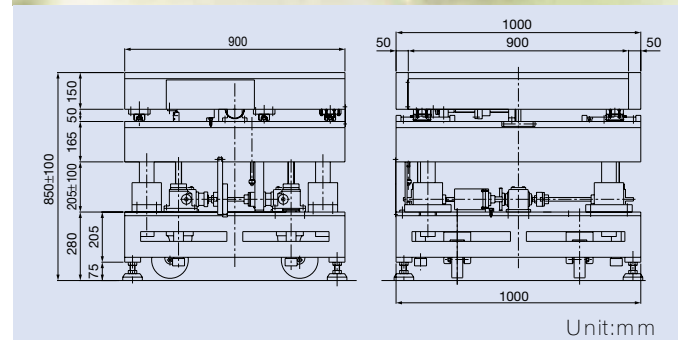
Examples here are a small selection among base tables being produced by KOHZU for various experimental set-ups. Parameters of supporting tables such as table size, height, number of motion axes, number of carrier units etc. can be adapted for customers needs.

Model FKY-16

This is a general purpose XY table with motorized vertical and horizontal adjustment mechanism. The feature of this model is a large travel range in vertical direction. As all KOHZU support structures, this table has bolts on the bottom for height and tilt adjustment during initial installation.

Specifications

Table Size	900 mm × 900 mm × 850 mm
Vertical travel	± 100 mm
Horizontal travel	± 50 mm
Straightness (vertical motion)	20 μm / 100 mm (vertical axis) 10 μm / 100 mm (horizontal axis)
Repeatability	2 μm (both vertical and horizontal)
Actuator	Stepping motor

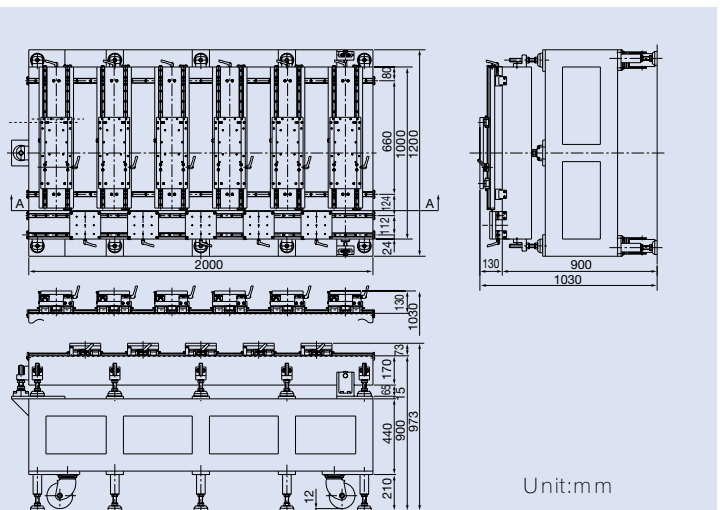


Model KIG-20B

This base table is equipped with XY-carriers which allow smooth translations of heavy goniometers and other equipment in the horizontal plane. There are additional smaller carrier tables for positioning of light equipment such detectors along X-ray beam. The carriers are guided by linear rail guides. The carriers can be locked into desired positions by mechanical clamps. The top table can be rotated in a horizontal plane by pushing screws around the vertical pivot. Tilt and height alignment of the whole structure can be done manually by adjustment bolts at the top. Photo shows KIG-20B with two KTG-11KW & KHI-7 and one RSG-7B & KHI-4SK assemblies mounted on the carriers.

Specifications

Dimensions	2000 mm × 1200 mm × 900 mm
Rotation in horizontal plane	± 2 ° (manual)
Goniometer XY-carriers	6 units (manual)
Detector X-carriers	5 units (manual)



BASE TABLES

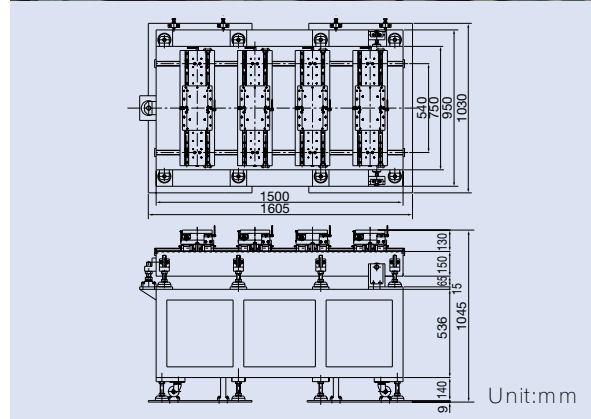
Simple and versatile base tables of the KIG series are being produced in various modifications which differs in sizes, load capacity, number and type of translation carriers. Motion of carriers can be motorized as an option. This can be done later as an upgrade.

Model KIG-20

This base table is a simplified version of KIG-20B with 4 large XY-carriers for translations of goniometers in the horizontal plane. These carriers can be locked into desired positions by mechanical clamps. The top table can be rotated in the horizontal plane by pushing screws around vertical pivot. Tilt and height alignment of the whole structure can be done manually by adjustment bolts at the top. Photo shows KIG-20 with 3 carriers upgraded for motorized motion.

Specifications

Dimensions	1500 mm X 750 mm X 1000 mm
Rotation in horizontal plane	$\pm 2^\circ$ (manual)
Vertical travel	± 20 mm (manual)
Goniometer XY-carriers	4 units (manual)

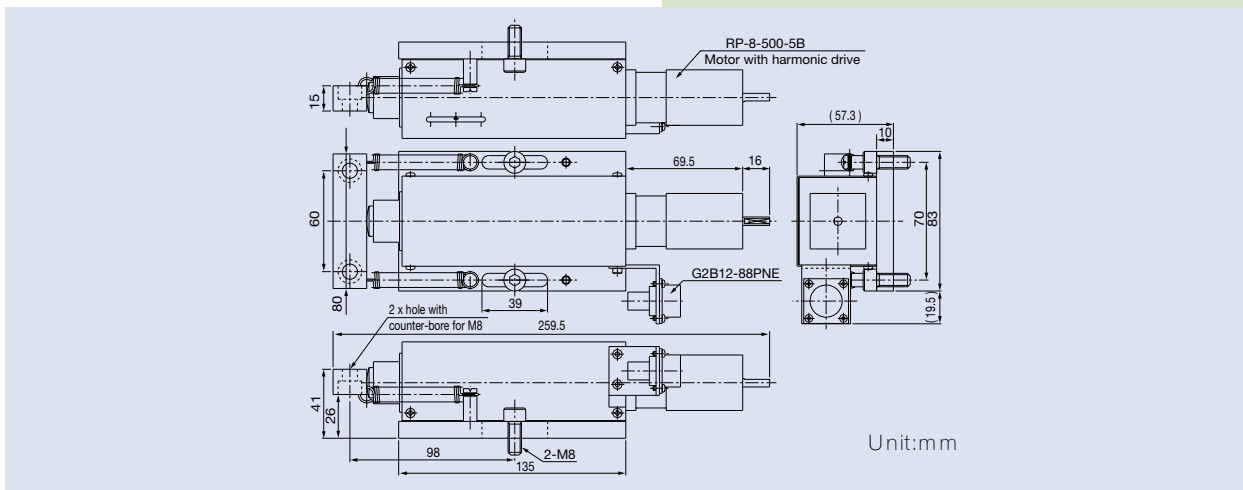


Model KIG-20M

This is a compact motor unit which allows upgrade of KIG series tables with motorized X- and XY-carriers. Unit body which contains motor with harmonic gear reduction and lead screw mechanism should be mounted to the base, while a block which is being pushed by the screw has to be attached to the carrier table. Return springs between the body and the block assure motion in both forward and reverse directions.

Specifications

Travel range	± 15 mm
Resolution	0.04 μm / step (half step mode)



APPLICATIONS

This part of the brochure shows some of our successful special order products. Many of these devices are installed at various beamlines of Japanese synchrotron radiation facilities (Photon Factory, SPring-8) and other research institutions.

Model GOH-1

This particular goniometer system is a combination of four < KHI-4SK > XZ stages (p.13) with two < KTG-15DH > goniometers (p.4) and two < RA20-21 > rotation stages (p.7) mounted on the < KCS-6 > air pad base table (p.18). Other combinations, as for example < KHI-7 > XZ stage (p.14) and < KTG-11KW > two-axis goniometer (p.5) are also available. This system is presently being used for X-ray nuclear resonant scattering experiments at SPring-8 BL09XU beamline (Y.Yoda and T.Harami, SPring-8 Annual Report, 1996, p.40).



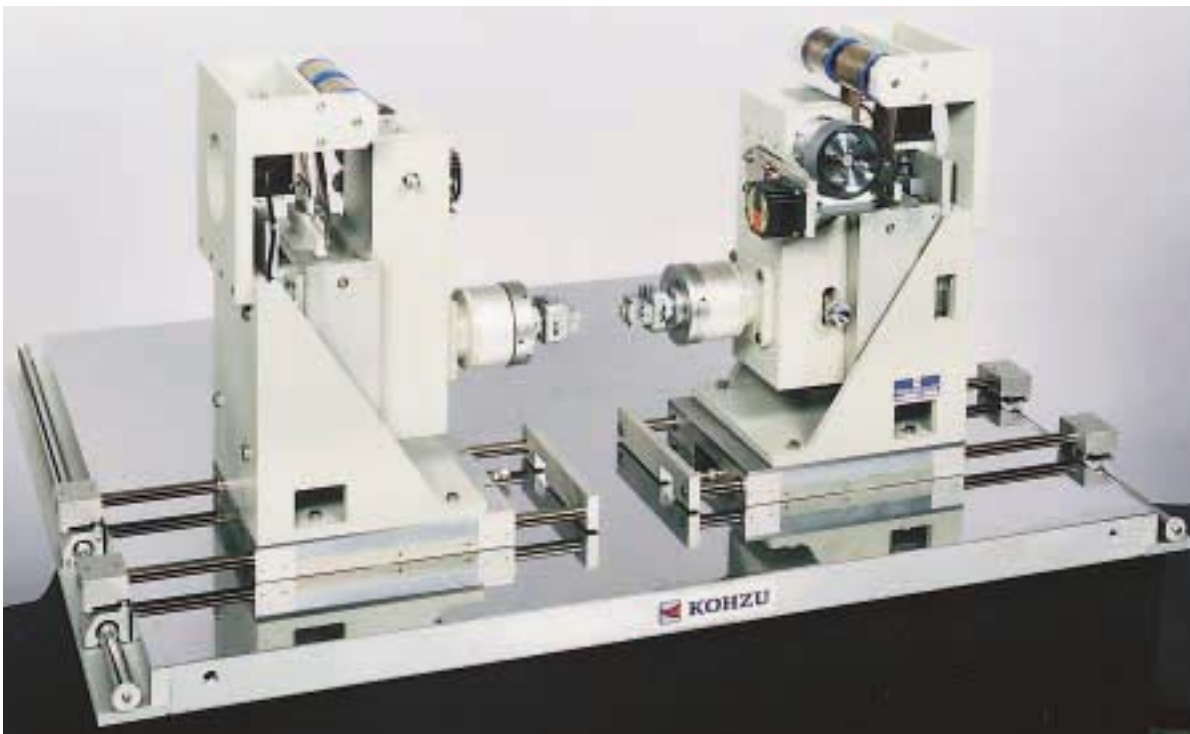
Delivered to : Photon Factory, KEK (Tsukuba),
presently installed at SPring-8 BL09XU beamline.

APPLICATIONS

Besides KOHZU's well known hard X-rays double crystal monochromators, we have delivered some other customized mechanical systems to synchrotron radiation facilities overseas (APS - Argonne, ESRF - Grenoble, DESY - Hamburg, SRRC - Hsinchu). Here is one example of such a system.

Model AAG-100

This combination of two < KTG-15D (AP) > goniometers (p.3), two < KHI-4AP > Z-stages (p.13) and < KCS-8 > air pad base table (1000mm X 1100mm) was delivered to SRI-CAT, Advanced Photon Source (Argonne). It is being used for nuclear resonance scattering and other experiments where ultra high energy resolution (sub-meV range) is required (see E.E.Alp et al, APS Research, v.1, No.1, 1998, pp.9-14). Other variations, as for example AAG-102 with larger base table and longer travel of the Z-stages, or AAG-100G with additional motorized horizontal translation stages under KHI-4AP were delivered to SRI-CAT and ChemMat-CARS beamlines at APS.



Delivered to : SRI-CAT, Advanced Photon Source,
Argonne National Laboratory.

APPLICATIONS

As for our standard positioning stages, vacuum compatibility of the KTG goniometers down to pressures below 10^{-5} mbar can be achieved by simple modifications such as grease exchange. Device presented on this page is one example of such modification. Compatibility with vacuum down to pressures 10^{-9} mbar and eventually baking can be achieved by proper selection of materials, components and surface treatment.

Model SPC-1

This unit is a high resolution monochromator for non-elastic scattering experiments. Mechanics of the < KTG-15D > goniometers is lubricated by vacuum compatible grease. This modification alone allows achievement pressures of the order of 10^{-5} mbar. The unit is being installed in the hutch of BL11XU beamline at SPring-8 facility. It is being used as a high resolution X-ray monochromator for Mosbauer spectroscopy. Typical working conditions are energies around 14.4 Kev with meV resolution (excitation of ^{57}Fe level).



Delivered to : JAERI (Japan Atomic Energy Research Institute)
beamline BL11XU at SPring-8.

APPLICATIONS

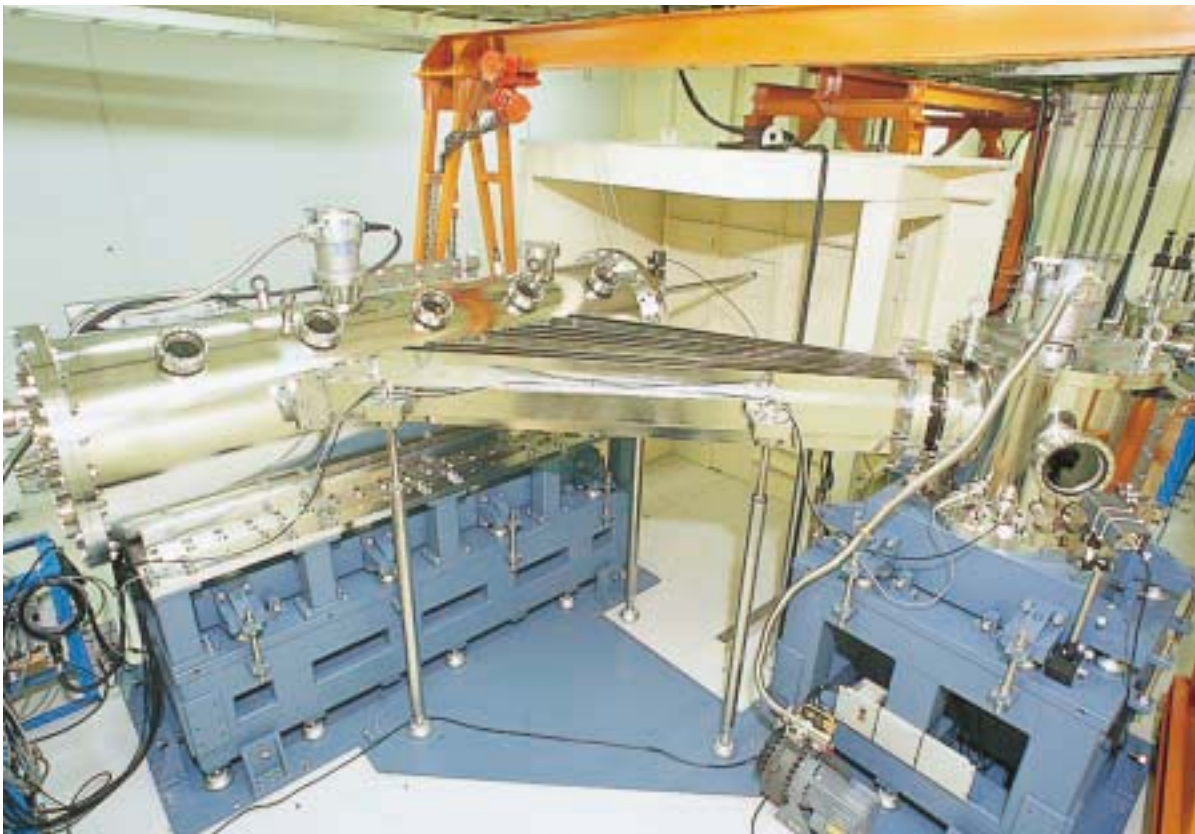
Examples at these two pages show monochromators of the “Troika” - concept beamline which is operated by Hyogo prefecture at SPring-8. Two deflecting diamond double crystal monochromators < HSM-1 > are taking monochromatic X-ray beams to two side hutches, while remaining quasi-white beam passes to the main beamline hutch, where it is monochromatized by Silicon double crystal monochromator < HSM-2 > (refer to J.Matsui et al., SPring-8 Annual Report, 1997, pp.125-130).

Model HSM-1

A diamond double crystal monochromator is deflecting a monochromatic beam with 2 m horizontal offset to a side hutch. This arrangement allows having fixed position of the exit monochromatic beam for Bragg angles in the range (22.5 - 34.1)°. In order to cover whole angular range, water cooled first crystal has to be translated in vacuum 1.2 m along the monochromatic beam axis with minimum pitch, yaw and roll. Our technology allows keeping these angular errors of translation within 15" in the whole travel range.



Inner part of the vacuum chamber of the 1st crystal part



Delivered to : Hyogo prefecture beamline BL24XU at SPring-8.

APPLICATIONS

Apparent advantage of the “Troika” - concept beamline is a possibility to carry out simultaneous experiments in 3 hutches, although at different energies only. Characteristic feature of the BL24XU beamline arrangement is fixed position of the monochromatic beam in side hutches. This gives an advantage in comparison to arrangement of the first beamline of such type at ESRF (ID-10) where sample goniometers in side hutches have to follow deflected beam motion during energy changes because of using diamond one crystal monochromators for the side beamlines.

Model HSM-2

This horizontal 40 mm offset Silicon double crystal monochromator is being used at the main hutch of the BL24XU beamline. The device allows working with quasi-monochromatic beam at energies corresponding to Bragg angles (3.0 - 25.0)°. Horizontal orientation which is rather unusual for double crystal monochromators provides very good performance of the monochromator because of constant load distribution on the main axis rotation mechanism during energy changes.



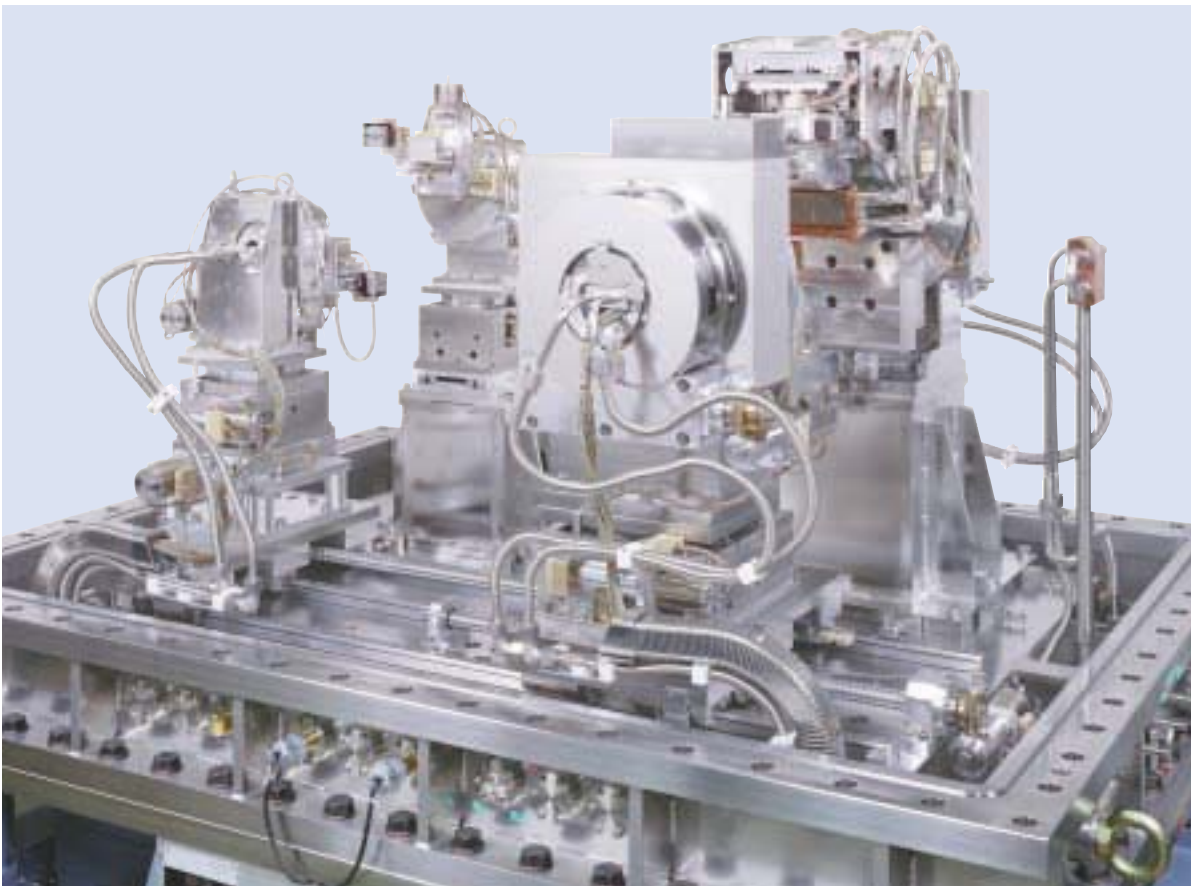
Delivered to : Hyogo prefecture beamline BL24XU at SPring-8.

APPLICATIONS

In addition to well known KOHZU general purpose double crystal monochromators with crystals mounted on common rotation table, we recently manufactured several double crystal monochromators which consist of in-vacuum independent goniometers for each crystal. The example on this page is one of them. These devices are generally more stable and precise. Another advantage is a possibility to work at low Bragg angles below 3° . In this angular range, the common rotation table type monochromators are unstable because of a large momentum load imposed on the rotation axis mechanism.

Model MKZ-4

This is a wide energy range (0.5 keV ~ 60 keV) double crystal monochromator with two pairs of independent in-vacuum goniometers. Pair of larger goniometers is for Si crystals in variable or adjustable inclined geometry (the same arrangement as for SPring-8 standard double crystal monochromator - see M.Yabashi et al., X-ray Optics Design, SPIE Conference on Performance, and Applications, Denver, Colorado, July 1999, Proc. SPIE v.3773). The smaller goniometers are either for multi-layer or YB66 crystals. Depending on the desired energy range, the crystals can be introduced to, or withdrawn from X-ray beam.



Delivered to : Beamline BL15XU (Institute of Inorganic Materials) at SPring-8.

APPLICATION

KOHZU is manufacturing devices which are installed not only at the beamlines of various synchrotron radiation facilities, but also at laboratories where conventional X-ray sources are being used. Some of these systems are for testing of beamline optical elements at synchrotron radiation facilities, and, some for various experimental research at universities and research laboratories.

Model KMK-6

This is device for evaluation of optical elements to be installed at beamlines of Photon Factory, KEK, Tsukuba. Performance of small optical elements such as monochromator crystals etc. can be evaluated off-line in the optical laboratory by X-rays coming from a conventional source.



Delivered to : Photon Factory, KEK, .

APPLICATIONS

Although not very well known outside Japan, there are many models of circle type X-ray diffractometers produced by KOHZU. These custom made devices are mainly installed at beamlines of Photon Factory, KEK, Tsukuba and SPring-8. Characteristic features of our diffractometers are customized design which is not being provided by other manufacturers, high stability and precision.

Model SIN-1

This large 4 axis diffractometer is being used for material analysis. There are several characteristic features of this system. Angle of ω -axis can be read by precise rotary encoder attached directly to the axis. There is special load compensation mechanism at 2ω -axis, which allows to install long detector arm with analyzer and detector adjustment mechanics. Remotely controlled motorized beam collimation system which is placed on the same supporting structure with the diffractometer, allows to form the entrance beam. Fully motorized supporting structure provides a kinematic base with XYZ translation and tilts around X, Y and Z axes. All these functions are making this device useful for variety of applications.



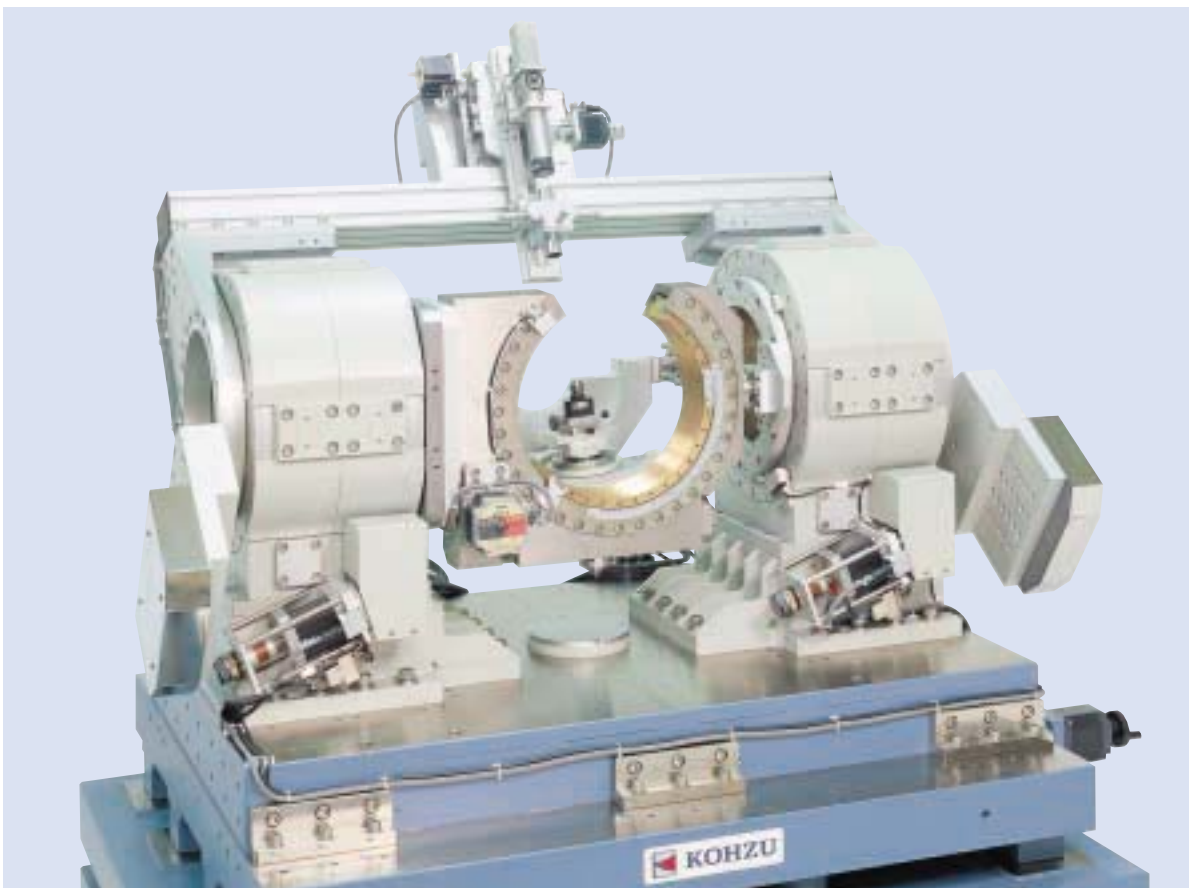
Delivered to : Nippon Steel Company;
installed at BL-3A beamline of Photon Factory, KEK, Tsukuba.

APPLICATIONS

Robust design which is characteristic for many KOHZU diffractometers gives outstanding performance with high stability and precision. Accumulated skills of our designers and technicians, as well as special care during each phase of fabrication and assembly process contribute to high quality of our custom made products.

Model SSY-1

This high precision 4-axis diffractometer with ϕ , χ circles, ω - 2θ goniometer with analyzer and detector adjustment, and fully motorized base table with XZ translations and α rotation around vertical axis. Characteristic feature is split χ circle design which allows to have more flexibility for experimental geometries. The device is being used for metal surface and coating analysis under various conditions such as high temperature, aggressive environment etc..



Delivered to : NIRO (New Industry Research Organization), Kobe;
Installed at Hyogo Prefecture beamline BL24XU, SPring-8.

APPLICATIONS

Many KOHZU diffractometers can carry rather heavy load, which gives reasonable flexibility for installing equipment on the sample circle and the detector arm. There is a variety of KOHZU standard and customized translation and swivel stages (refer to the catalogues of standard positioning stages) which can be used for fine motorized adjustment of both position and angle of samples and optical elements. These stages have outstanding mechanical stability against momentum load. Therefore, parameters such as sphere of confusion of a diffractometer are not degraded by installation of fine adjustment mechanism.

Model TDT-17

This is a multipurpose high precision 4-axis diffractometer with ϕ , χ circles, ω - 2θ goniometer with analyzer and detector adjustment, and fully motorized base table with XZ translations and α rotation around vertical axis. There is a possibility to install motorized XYZ translation and two axis tilting stage on the top of sample ϕ -circle. There is also a variety of optional equipment such as motorized adjustment mechanics, motorized slit etc., which can be installed on the detector arm. Sphere of confusion of all 4 sample rotation axes is kept within 10 μm .



Delivered to : JAERI (Japan Atomic Energy Research Institute) beamline BL09XU at SPring-8.

APPLICATIONS

KOHZU has certain experience in building small and middle size kappa-circle diffractometers. There are several models for use both in atmosphere and in vacuum. These devices are mainly sought for wide open space around sample position. This allows more flexibility in experimental geometry, and installation of various equipment around the sample, such as optical microscope or CCD camera for sample positioning, cryostream for sample cooling etc.

Model HNA-12

This is a diffractometer system which has middle size kappa circle 4 axis goniometer with ϕ , κ , θ and 2θ circles. It is being used with conventional X-ray source for crystal structure analysis. There is Heidenhain rotary encoder directly coupled to θ axis, which allows precise reading of angular position. Sphere of confusion of 3 axes is within 10 μm .



Delivered to : HITACHI Industrial Research Laboratories.

APPLICATIONS

The X-ray phase contrast imaging is a perspective experimental method for biology and medicine, because it allows clear boundaries and interfaces between areas with slightly different refraction index, which cannot be seen by conventional intensity contrast imaging. The phase contrast technique requires highly collimated X-ray beam which covers whole area containing the object of interest. High precision goniometers for positioning and orientation of optical elements are, therefore, important elements of any phase contrast imaging set up.

Model HSM-4

This is beam collimating system for X-ray phase contrast imaging experiments being performed in the BL24XU beamline hutch at SPring-8 facility. The set up consists of < KHI-7 > XZ stage with model < KTG-11KW > goniometer, and other goniometers on the top of KIG-series base table. Excellent X-ray phase contrast images with resolution of the order of 10 μm are being produced with use of this set up.



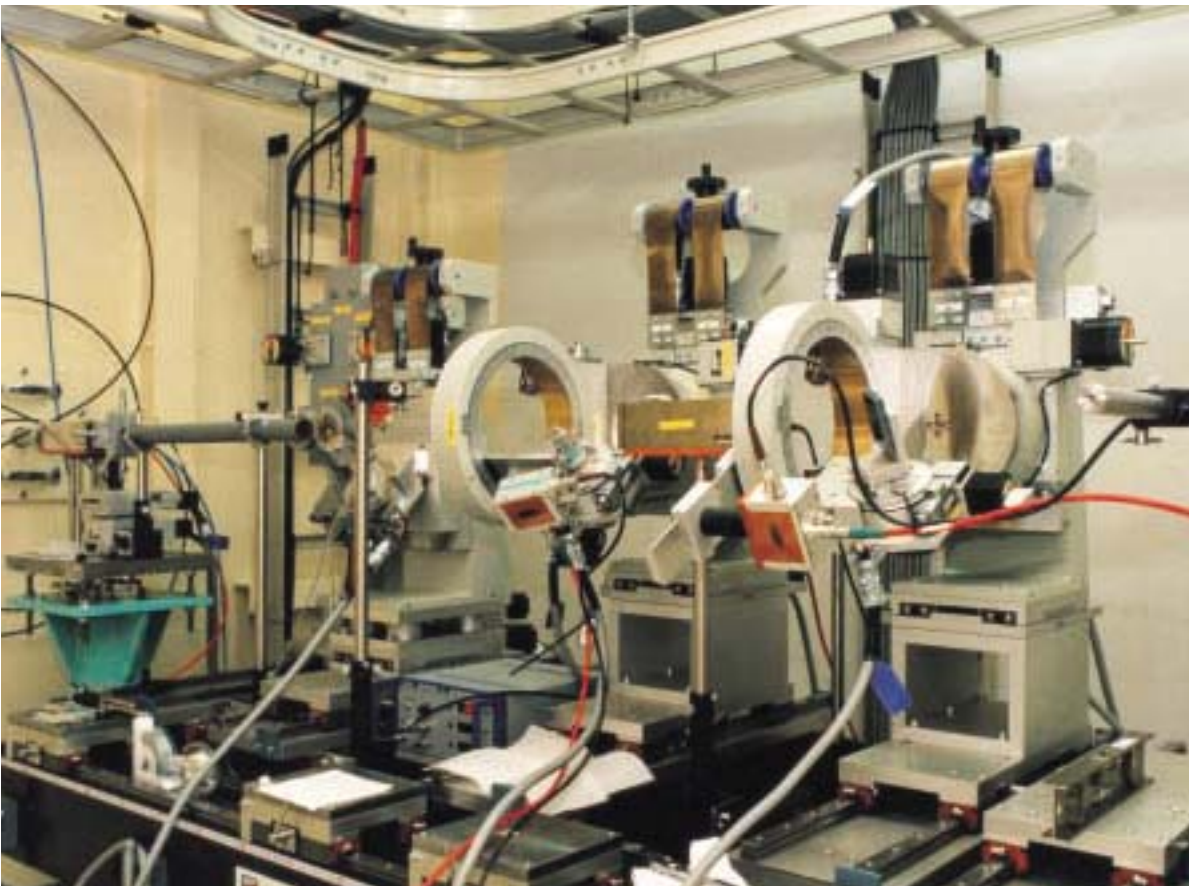
Delivered to : Hyogo Prefecture beamline BL24XU at SPring-8.

APPLICATIONS

X-ray polarization conversion by diamond crystal phase retarder provides polarization state tunability and high polarization purity, which is an advantage in comparison to use of polarization tunable insertion devices. X-ray phase retarder can convert linearly polarized beam into that with right or left hand circular polarization with high efficiency and flexibility (K.Hirano et al., Nuclear Instrum.& Meth. Phys. Res. A336, 1993, p.343). KOHZU has experience of building mechanical part of such phase retarders for SPring-8 synchrotron radiation facility (this page and p.10 of this brochure).

Model RKN-12

This is a combination of KHI type XZ stages with RSG-7B and other type goniometers placed on the top of KIG series base table. The set up allows polarization conversion by X-ray phase retarder, and evaluation of resulting polarization state by analyzers and detectors located downstream.



Delivered to : RIKEN (Institute for Physical and Chemical Research) Beamline BL29XU at SPring-8.

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