SIEMENS

D 5000 X-ray Diffractometer

Manual

Order No. C79000-G3476-C137-11

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Order No.: C79000-G3476-C137-11
Order from: Gerätewerk Karlsruhe
Printed in Germany

SIEMENS

D 5000 Diffractometer

Room Planning and Preassembly

Installation Instructions Order No. C79000-M3476-C139-02

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The final installation and commissioning of the measuring equipment can only be carried out quickly by a Siemens specialist if the room has been carefully planned and the preassembly has been terminated. For planning the room and preassembly consult the responsible Siemens branch.

1 Room Planning

1.1 Area of Installation

The installation of the units should be planned in such a way that the diffractometer is accessible from all sides and the cooling air can enter and leave without any obstruction.

Observe the safe floor load (Table 1).

Unit	Width (mm)	Height (mm)	Depth (mm)	Weight (kg)
Radiation protection housing with D 5000 diffractometer	1028	992	1018	280
Free standing housing with KRISTALLOFLEX® 710/710H X-ray generator and electronics	1028	980	860	350

Table 1 Dimensions and weights

Avoid direct sunlight onto the diffractometer.

The cooling water unit, if planned, is usually installed in a separate room (see Section 2.2).

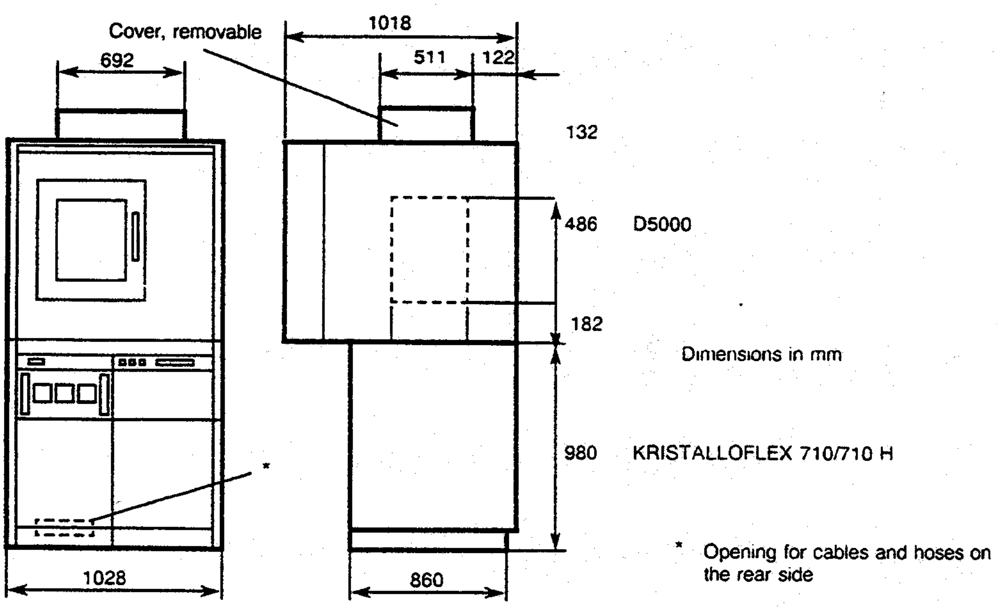


Fig. 1 Dimensions

1.2 Room Temperature and Humidity

Room temperature	24°C
Maximum temperature fluctuation	±10°C
Relative humidity	≤80 %, no condensation

1.3 Heat Dissipation

The heat dissipated into the ambient air (Table 2) must be compensated by a ventilation or air conditioning system.

Unit	Maximum heat dissipation
D 5000 diffractomter	0.05 kW
KRISTALLOFLEX 710/710H	0.20 kW
Control and measuring electronics	0.20 kW

Table 2 Heat dissipation into the ambient air

1.4 Dust Content of the Room Air

Dust content	max. 6 mg/m^3
Diameter of particles	max. 5 µm

If necessary fit dust filters to the room ventilators.

1.5 Vibrations

The maximum permissible deflection amplitude is 0.15 mm up to 20 Hz.

The maximum permissible acceleration amplitude is 2.45 m/s^2 at 20 Hz.

2 Preassembly

2.1 Mains Connection and Grounding

The diffractometer measuring instrument is designed for a mains voltage of 220 V ± 10 %, 50/60 Hz.

If a mains voltage of 208 V or 240 V is specified in the order, a mains transformer to adapt the voltages of 208 V or 240 V to 220 V is installed.

With mains voltages other than 208 V, 220 V or 240 V the X-ray generator and the measuring instrument must be operated via a transformer connected in series.

Unit	Maximum power consumption in kVA	Mains voltage (± 10 %), mains frequency
Electronics	0.2	220 V, 50/60 Hz
Kristalloflex 710	4.5	208 V, 60 Hz; 220/240 V, 50/60 Hz
Kristalloflex 710H	5.5	208 V, 60 Hz; 220/240 V, 50/60 Hz
Cooling water unit PCSI-100, PCSI-200	3.4 6.8	3 x 220/380 V, 50/60 Hz 3 x 220/380 V, 50/60 Hz
Electronics with mains adaptor		208 V, 220 V, 240 V, 50/60 Hz

Table 3

The mains connection is to be led from the mains supply to a switchbox close to the measuring equipment. Furthermore, according to the local regulations, an additional protective ground bar is to be provided (grounding resistance < 0.5 Ω). Fig. 2 shows an example of the mains connection, without cooling water unit.

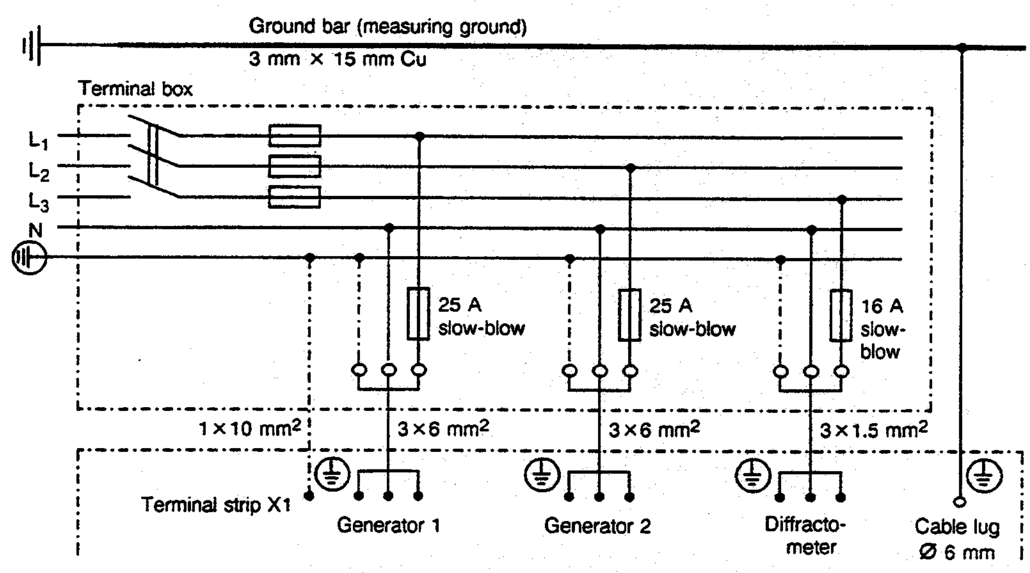


Fig. 2 Mains connection and grounding (with 1 or 2 X-ray generators)

Due to the size of the radio interference suppression capacitors the X-ray generator must not be connected via a socket.

If a fault current switch is used, it should be designed to be triggered by a current of at least 70 mA.

In order to make service work easier, several mains sockets should be installed in the vicinity of the measuring equipment.

2.2 Cooling Water Supply

The cooling water supply of the X-ray generator requires a connection to the mains water supply with drainage system (Fig. 3) or a cooling water unit.

Flow rate	min. 3.6 l/min
Water pressure	5 bis 8 bar
Water temperature	10 bis 25°C

Depending on humidity and room temperature, the cooling water temperature must be selected in such a way that no formation of condensation can occur.

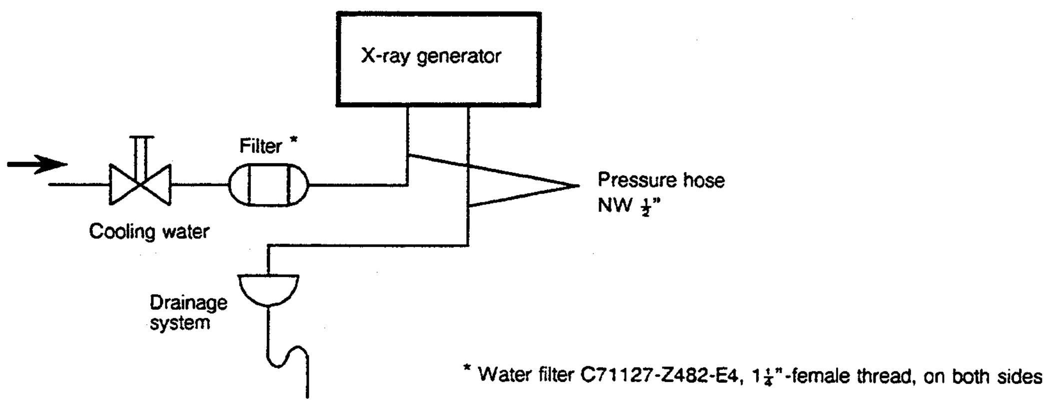


Fig. 3 Cooling water connection

The cooling water should have a low concentration of suspended matter. A suitable water filter should be installed in the supply pipe. If the water has a high concentration of suspended matter, then two water filters should be connected in parallel. This allows one filter to be cleaned without the units having to be switched off.

The hardness of the water should not exceed 30° on the German scale (300 mg CaO in 1 l water); this corresponds to 53.7° on the French scale and 37.5° on the English scale.

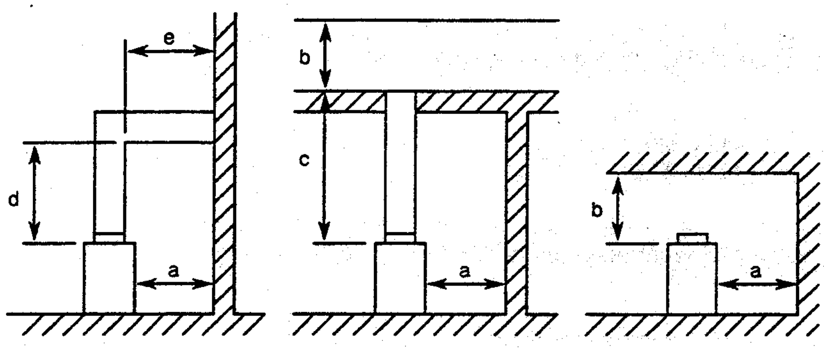
It is often more economical to use a closed cooling water system for the cooling water supply, e.g. a **cooling water unit PCSI.**

Due to the high air flow rate the cooling water unit PCSI should not be installed in the same room as the measuring equipment.

Two NW 1/2" hoses are required to connect the cooling water unit to the X-ray generator. The hoses should not exceed a length of 10 m each and should be fastened using hose clamps.

If a greater distance than 10 m has to be covered, 3/4" copper or galvanized steel pipes should be used. The maximum length is 20 m per pipe. The ends should be fitted with hose connections. In order to connect the X-ray generator and the cooling water unit to the pipes, short NW 1/2" hoses are recommended. The maximum permissible difference in height between the cooling water unit and the X-ray generator is 6 m.

When operating the cooling water unit it is advisable to add an anticorrosion agent (e.g. ANTIROST, manufactured by Alfa-Laval) to the water, in order to avoid corrosion and the formation of algae.



		PCSI-100
a	min.	0.5m
b	min.	0.5m
c	max.	10 m
d+e	max.	5 m

Cross-sectional Ø of ducts 500 mm

Fig. 4 Installation of the cooling water unit

2.3 Counter Tube Gas Supply (for Operation with Position Sensitive Detector)

In order to supply the flow counter tubes a counter tube gas bottle with a pressure reducer is to be installed. It is advisible to provide additional space for a reserve bottle.

The distance from the counter tube gas bottle to the diffractometer should be kept as short as possible. Only a Viton hose may be used.

For longer distances a copper or stainless steel pipe can be installed up to the diffractometer. The pipe must be clean, free of water and solvent and must not contain any solids such as scale and sand.

The counter tube supply hoses must not be installed close to radiators, to ensure that the counter tube gas is not heated up.

In order to stabilize the gas flow a precision pressure controller for test gases should be fitted behind the pressure reducer. Permissible operation pressure: 5 to 8 bar for metal-wire detectors and 10 to 11 bar for quartz-wire detectors. Permissible gas flow: 0.1 to 2 l/h.

Flow counter tubes are usually operated with a commercial counter tube gas mixture of 90 % argon and 10 % methane.

Counter tube gases must be pure to a technical standard (impurities max. 0.5 % by vol.). 50-l gas bottles with 200 bar filling pressure are recommended. The bottles should be secured to prevent them from being knocked over. The safety regulations for inflammable gases must be observed.

The waste counter tube gases should be led into the open air via a separate opening in the wall.

Further details can be found in the instructions for the position sensitive detector.

2.4 Low-temperature and High-temperature Cell

The necessary equipment and preparations for the commissioning of the low-temperature and high-temperature cell are described in the instructions supplied.

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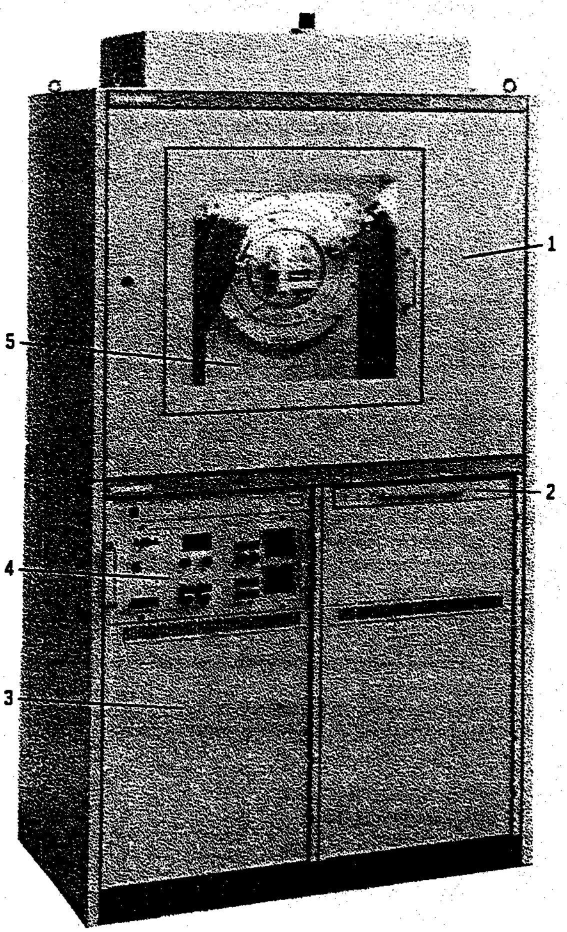
Order No.: C79000-M3476-C139-02
Order from: Gerätewerk Karlsruhe
Printed in the Federal Republic of Germany
AG 0489 0.1 SR 8 En

SIEMENS

D 5000 X-ray Diffractometer

Instructions C79000-B3476-C138-08



1 Radiation protection box
2 Drawer with terminal
3 Cabinet
4 KRISTALLOFLEX® X-ray generator
5 Diffractometer

Fig. 1 D 5000 X-ray diffractometer in radiation protection box, mounted on a cabinet

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1 Application

The D 5000 diffractometer can be used for nearly all X-ray diffraction applications, such as structure research, phase analysis, stress and texture measurements.

Various supplements may be used together with the D 5000 diffractometer; these include

- extended diaphragm systems
- primary and diffracted beam monochromators
- sample holder, sample changer and center gauge
- detectors (scintillation counter, proportional counter, position sensitive detector, Si(Li) semiconductor detector)
- θ/θ design
- texture
- flux analysis
- grazing incidence
- high and low temperature chambers.

The standard model of the D 5000 diffractometer is used for powder examinations.

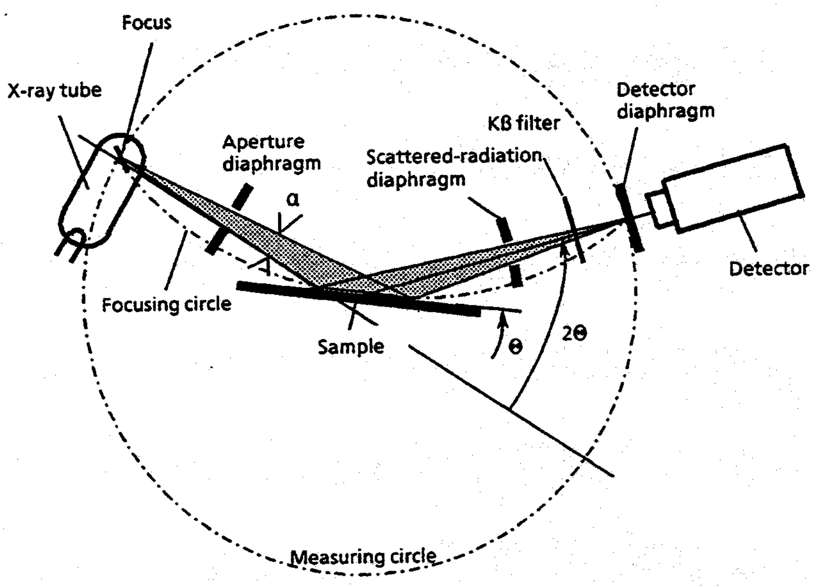
The D 5000 diffractometer can be computer-controlled and thus used for automatic operation.

The D 5000 diffractometer is equipped with separate drives which may be coupled electronically or used independently from one another.

8

2 Method of Operation

The radiation emanating from the line focus of the X-ray tube is diffracted at the sample and recorded by the detector. The sample rotates at a constant angular velocity such that the angle of incidence of the primary beam changes whilst the detector rotates at double angular velocity around the sample. The diffraction angle (2θ) is thus always equal to twice the glancing angle (θ). The diffractometer beam path is shown in Fig. 2-1.



θ Glancing angle
2θ Diffraction angle
α Aperture angle

Fig. 2-1 Diffractometer beam path in θ/2θ mode

Each time the Bragg condition is satisfied, the primary beam is reflected from the sample to the detector. The detector and the connected measuring electronics measure the intensity of the reflected radiation; the angular position of the reflections is displayed at the controller.

Pulse counts or diffraction patterns are obtained in this way.

For clearer representation, the Kβ reflections may be suppressed using a filter or a monochromator.

The Bragg-Brentano law is used for focussing. Focus, sample and detector diaphragm are on the focussing circle; focus and detector diaphragm are also located on the measuring circle. In order that the diffracted radiation can be focused when it hits the detector, the whole effective sample surface should actually be on the focussing circle. In a practical system, however, it is sufficient to place the surface of the plane sample tangentially at the focussing circle.

An aperture diaphragm between tube and sample delimits the irradiated sample area.

Undesired scattered radiation is suppressed by the scattered radiation diaphragm.

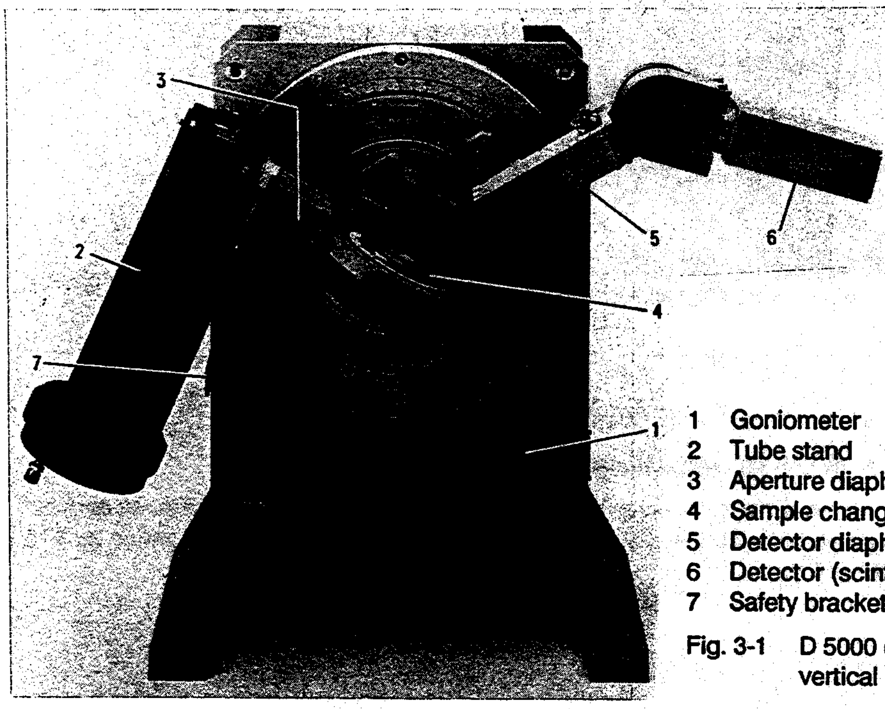
The resolution of the diffractometer depends on the detector diaphragm setting.

Soller slits with an opening angle of 2.3° may be placed before detector diaphragm and aperture diaphragm in order to delimit the vertical divergence.

3 Design of the $\Theta/2\Theta$ Diffractometer

The diffractometer (Fig. 3-1 and 3-2) consists of the goniometer (1), the tube, the tube stand (2), the diaphragm system required for the measurement and the sample changer (4).

The unit is installed horizontally or vertically in a radiation protection housing or on a separate table. When installed in a radiation protection housing, the unit meets the requirements for fully protected instruments, as laid down in the German X-ray regulations of 1.3.1973. A lead glass window at the front of the radiation protection housing enables the samples to be changed or the diffractometer mounts to be modified. The window shutter of the tube stand closes automatically when this window is opened.



1 Goniometer
2 Tube stand
3 Aperture diaphragm holder
4 Sample changer
5 Detector diaphragm holder
6 Detector (scintillation counter)
7 Safety bracket

Fig. 3-1 D 5000 diffractometer, vertical installation

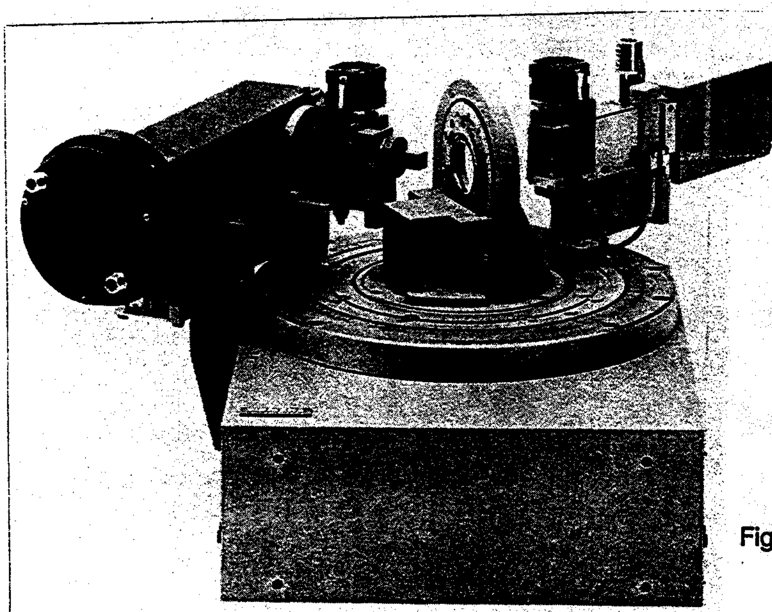
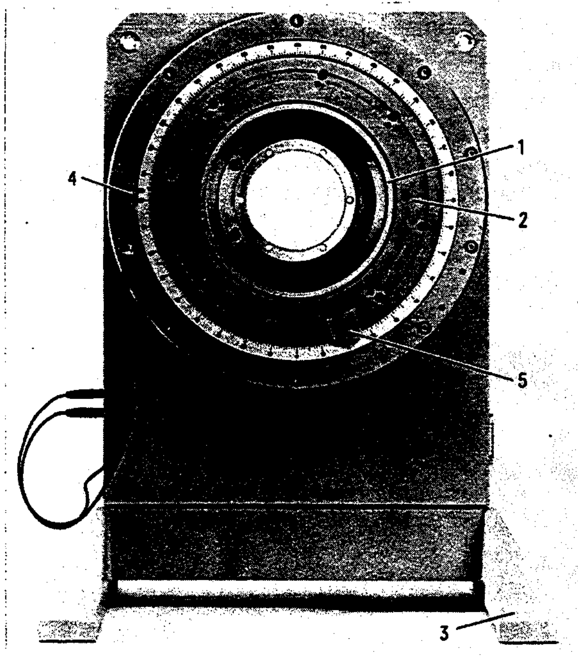


Fig. 3-2 D 5000 diffractometer, horizontal installation

3.1 Goniometer



The goniometer (Fig. 3-1.1 and 3-3) consists of a housing which accepts the sample changer ring (1), the detector holder ring (2) and the drive.

Sample changer ring (1) and detector holder ring (2) are driven by one stepper motor each.

1 Sample changer ring
2 Detector holder ring
3 Foot for vertical installation
4 Limit switch
5 Cam for actuating the limit switch

Fig. 3-3 Goniometer

A foot (3) is provided for vertical installation.

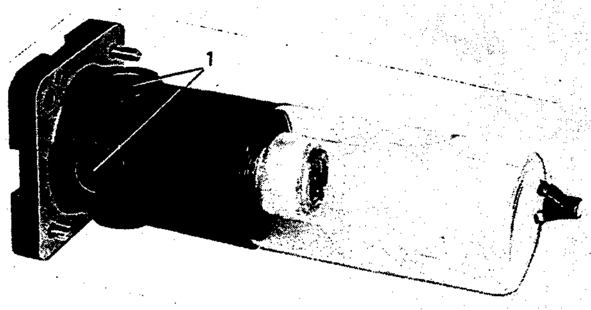
Cam (5) and limit switch (4) delimit the angular range of the goniometer.

The goniometer does not require any electronic supply. A 1° engraving can be used as angular reference. The goniometer contains opto-electronic definitions of the reference position for θ at 30° and 2θ circle at 60°.

3.2 Tube Stand and X-Ray Tube

An X-ray tube with lateral radiation outlet window is used in the D5000 diffractometer. This X-ray tube with earthed anode is supplied by a KRISTALLOFLEX 710 or 710H X-ray generator which is installed in a console-type housing.

3.2.1 X-Ray Tube



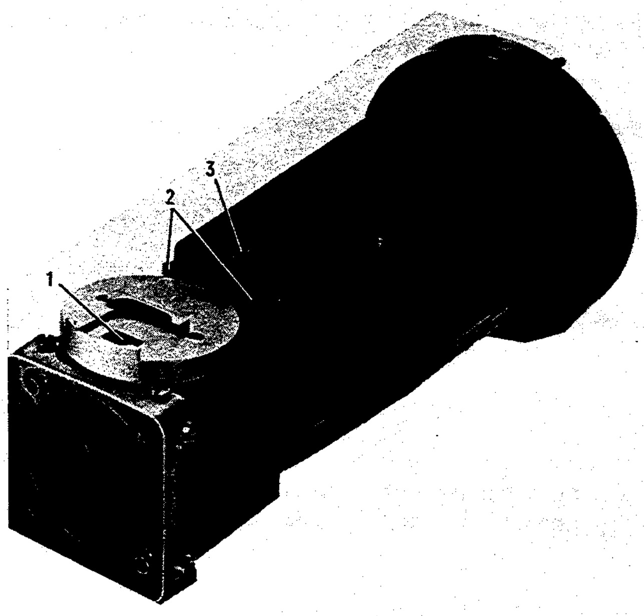
1 Radiation outlet window

Fig. 3-4 F...4KE X-ray diffraction tube

An F...4KE air-insulated X-ray diffraction tube is available with Cr, Fe, Co, Cu, Mo, Ag or W anode. The optical focus can be modified by changing the emission angle. A normal emission angle of 6° reduces the projection of the focus to 1/10 of its length.

3.2.2 Tube Stand

Radiation protection requires that the X-ray tube be housed in a tube stand (Fig. 3-1.2 and 3-5).



1 Radiation outlet
2 Radiation alarm lamps
3 Safety switch for window shutter

Fig. 3-5 Tube stand

The tube stand of the $\theta/2\theta$ diffractometer is mounted on a flange at the side of the goniometer.

The air-insulated X-ray diffraction tubes (Fig. 3-4) used in the diffractometer feature two line focuses and two square focuses, the radiation outlets (1) of which are closed by the tube holder.

An electro-mechanically operated shutter can be opened in a window with line focus (Fig. 3-5.1), used for the powder diffractometer. The other three windows are firmly closed.

Radiation alarm lamps (Fig. 3-5.2) light up when the window shutter is open. The safety switch for the window shutter (Fig. 3-5.3) is pressed down by the diffractometer safety bracket (Fig. 3-1.7).

A 300 V opening pulse and the holding current to hold the tube window open are transmitted from the window control module in the control unit to the K701 window magnet in the tube stand. The fail safe circuitry (C79458-L2234-B10) in the tube stand closes the tube window after the opening pulse if the SI701 switch indicating an open window does not respond or if the E701 or E702 (window open) alarm lamps are defective. The SM701 switch in the tube stand is only closed if the tube stand has been installed properly. Only then can the window be opened.

If the generator high voltage is switched off, the tube window can neither be opened nor held open

If the generator high voltage is switched on, the X-ray generator supplies a +14 V voltage which is used as excitation voltage for the K1 and K2 relays on the window control (C79458-L2234-B4). The K1 relay provides the opening pulse; the K2 relay feeds the opening pulse to the window magnet and switches on the holding current.

Once the X-ray generator is switched off, all window commands are cleared and no new ones accepted

Window control modes

The S618/2 service switch signals the mode to the window control.

Analysis mode (service switch off)

Using the software commands "open window" and "close window", the tube window can be manipulated either from the control panel or from the computer. A pending opening command is deactivated when the lead glass door is opened and activated when the door is closed.

Service mode (service switch on)

Pending software opening commands are cancelled and no new ones accepted in this mode. Pressing the S616 key ("open window") on the radiation protection housing opens the tube window; pressing S617 ("close window") closes the window. Opening or closing the lead glass door has no effect on the tube window.

Fail safe device

The fail safe module (C79458-L2234-B10) in the tube holder monitors both the E701 and E702 alarm lamps which indicate that the tube window is open, and the SI701 switch.

The MOSFET transistor V8 in the K701 window magnet circuit becomes conducting by the +300 V opening pulse via R2, V3 and R3. The opening pulse can then open the tube window. After the pulse has disappeared, a +14 V holding voltage is applied to the magnet. The Zener diode V3 (33 V9) would prevent this voltage from making the V8 transistor conducting if the optocoupler U1 was not made conducting by the lamp current and the Zener diode V3 thus shunted out.

The tube window therefore only remains open when the holding voltage is applied and the E701 and E702 alarm lamps are functioning properly and are activated via the SI701 switch.

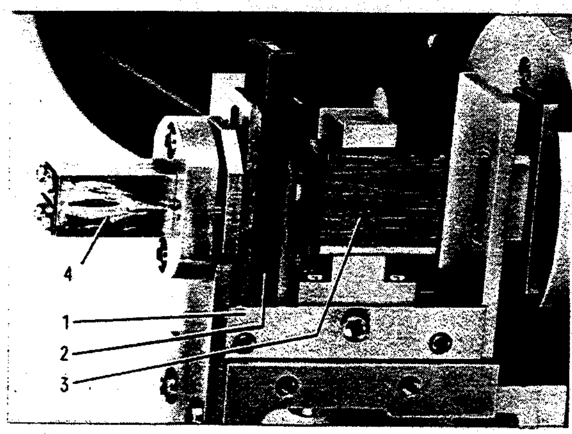
3.3 Diaphragm System

3.3.1 Aperture Diaphragm Holder

The diaphragms of the aperture diaphragm holder are perpendicular to the goniometer level.

3.3.1.1 Version with a Fixed Diaphragm

The aperture diaphragm holder (Fig. 3-6) is fixed on the tube stand flange from the bottom by a screw and can accept a fixed divergence diaphragm (2).



1 Baseplate for the version with fixed diaphragm
2 Divergence diaphragm
3 Primary Soller slit
4 Divergence diaphragm next to the sample

Fig. 3-6 Aperture diaphragm holder for fixed diaphragm (without screening cover)

A primary Soller slit (3) may be inserted before the plug-in divergence diaphragm (2).

A Kβ filter, an absorber or a micro diaphragm may be installed instead of the divergence diaphragm (4).

A scattered-radiation diaphragm (Fig. 3-7.5) or a divergence diaphragm (4) next to the sample may be installed at the tube stand flange.

A cover is installed on the baseplate (1) in order to screen off the scattered radiation.

3.3.1.2 Version with a Variable Diaphragm

The aperture diaphragm holder with variable diaphragm (Fig. 3-7) is fixed on the tube stand flange from below by a screw. It contains a variable divergence diaphragm (2) and a plug-in divergence diaphragm (4).

A $K\beta$ filter, an absorber or a micro diaphragm may be installed instead of the divergence diaphragm (4).

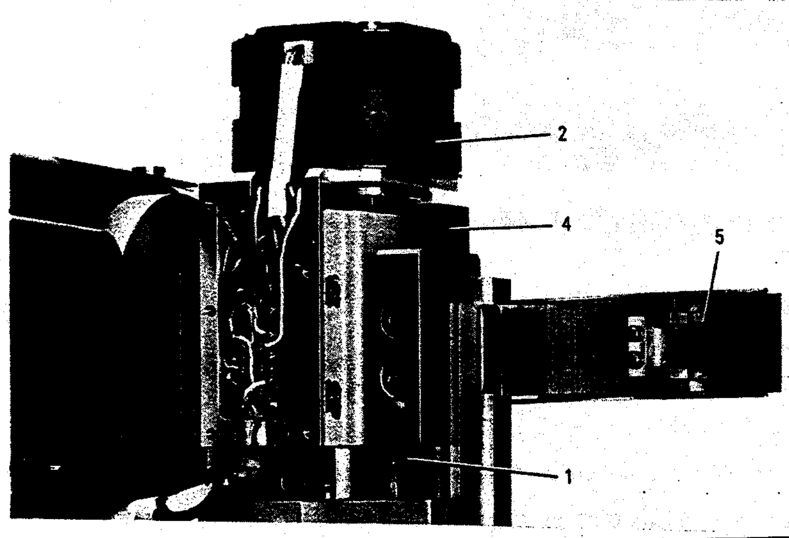
A cover (3) is provided in order to reduce the scattered radiation.

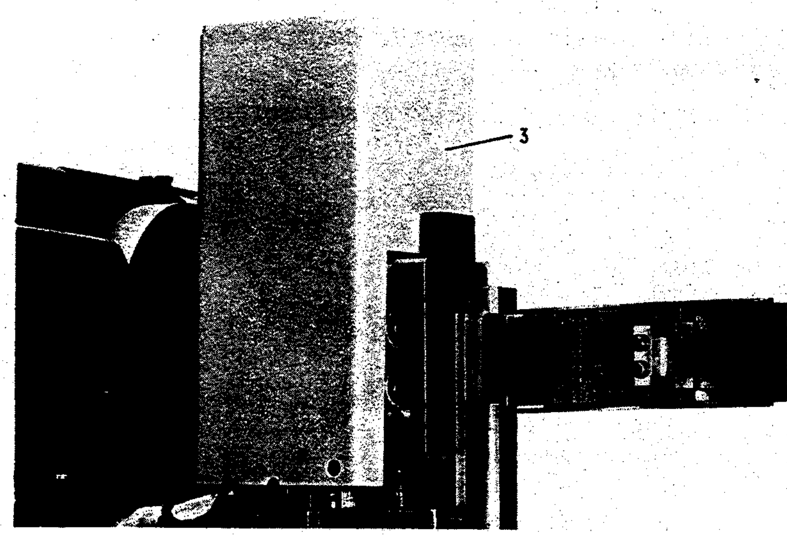
The variable diaphragm has a range of 400 steps corresponding to one rotation of the patented controller. The diaphragm is fitted such that it is wide open at the reference point and that the control range commences with the 55th step following the reference point. With – 55 as the reference value, the following relationship thus applies to the diaphragm width w over 342 steps:

$w_i = 0.1° \cdot 1.01^i$

where i = number of steps

Caution: the variable diaphragm is oriented according to its mounting on the base plate. The position and orientation of the diaphragm must remain the same for all manipulations.





1 Base plate for the version with variable diaphragm
2 Variable divergence diaphragm
3 Screening cover
4 Divergence diaphragm
5 Scattered-radiation diaphragm next to the sample

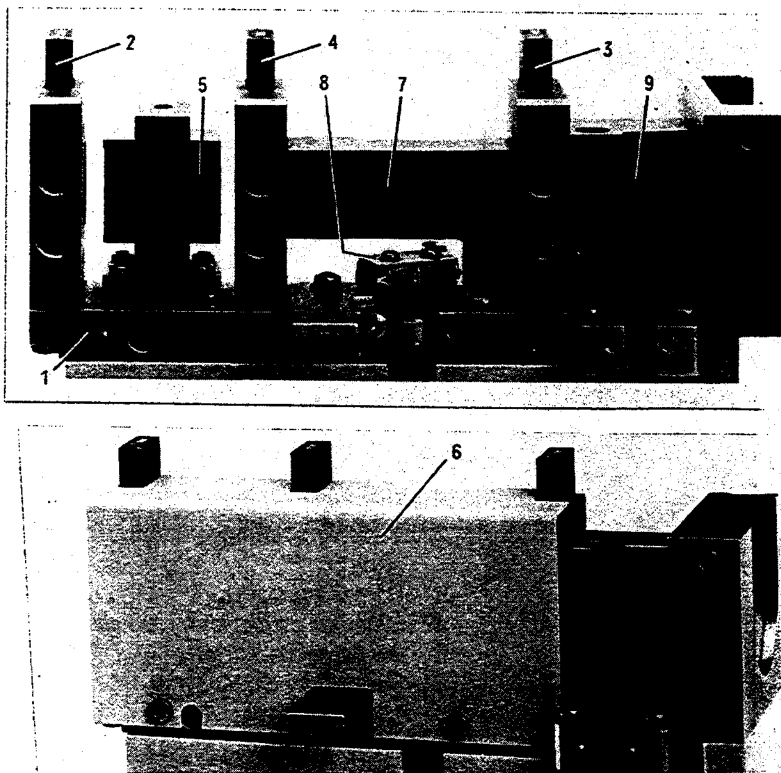
Fig. 3-7 Aperture diaphragm holder for variable diaphragm

3.3.2 Detector Diaphragm Holder

The diaphragms of the detector diaphragm holder are perpendicular to the goniometer level.

3.3.2.1 Version with Fixed Diaphragms

The detector diaphragm holder (Fig. 3-8) is installed on the detector holder ring (Fig. 3-3.2) and accepts the scattered-radiation diaphragm (2) and the detector diaphragm (3).



1 Baseplate for the version with fixed diaphragm
2 Scattered-radiation diaphragm
3 Detector diaphragm
4 Kβ filter
5 Secondary Soller slit
6 Screening cover
7 Screening tube
8 Limit switch
9 Screening element

Fig. 3-8 Detector diaphragm holder for fixed diaphragms

Two set-pins fix the position of the detector holder on the detector.

An absorber may be installed instead of the Kβ filter (4).

A secondary Soller slit (5) may be inserted between the two diaphragm positions (2) and (4).

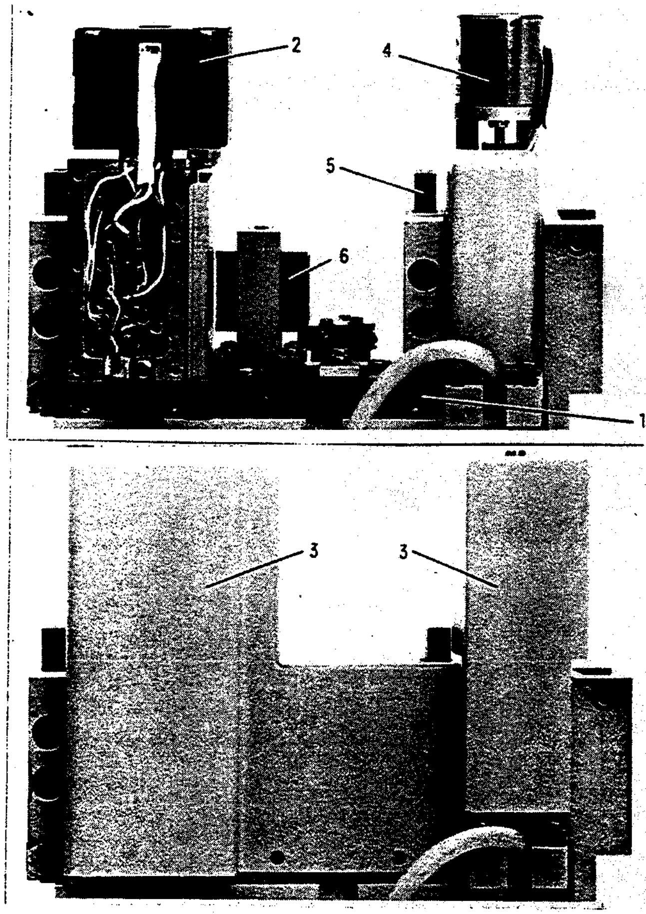
A detector diaphragm changer (Fig. 3-9.4) can be installed before the detector (Fig. 3-1.6) in addition to the plug-in detector diaphragm (3).

A cover (6) and a tube (7) are installed in order to screen off the scattered radiation.

The limit switch (8) delimits the upper angular range of the goniometer.

3.3.2.2 Version with a Variable Diaphragm

The detector diaphragm holder for variable diaphragms (Fig. 3-9) contains a variable scattered-radiation diaphragm (2) and a detector diaphragm (5).



1 Base plate for the version with variable diaphragm
2 Variable scattered-radiation diaphragm
3 Screening cover
4 Detector diaphragm changer
5 Detector diaphragm
6 Secondary Soller slit

Fig. 3-9 Detector diaphragm holder for variable diaphragms

A secondary Soller slit (6) may be inserted between the variable scattered-radiation diaphragm and the detector diaphragm.

A detector diaphragm changer (4) may be inserted between detector diaphragm (5) and detector. A screening element (Fig. 3-8.9) must be installed if detector diaphragm changer is not used.

Two screening covers (3) fixed on the baseplate (1) screen out scattered radiation.

The variable diaphragm has a range of 400 steps corresponding to one rotation of the patented controller. The diaphragm is fitted such that it is wide open at the reference point and that the control range commences with the 55th step following the reference point. With – 55 as the reference value, the following relationship thus applies to the diaphragm width w over 342 steps:

$$w_i = 0.1° \cdot 1.01^i$$

where i = number of steps

Caution: the variable diaphragm is oriented according to its mounting on the base plate. The position and orientation of the diaphragm must remain the same for all manipulations.

Fig. 3-10 shows possible installations on the primary and secondary side of the goniometer. Absorber, Kβ filter or micro diaphragm can be inserted into the adjustable diaphragm positions.

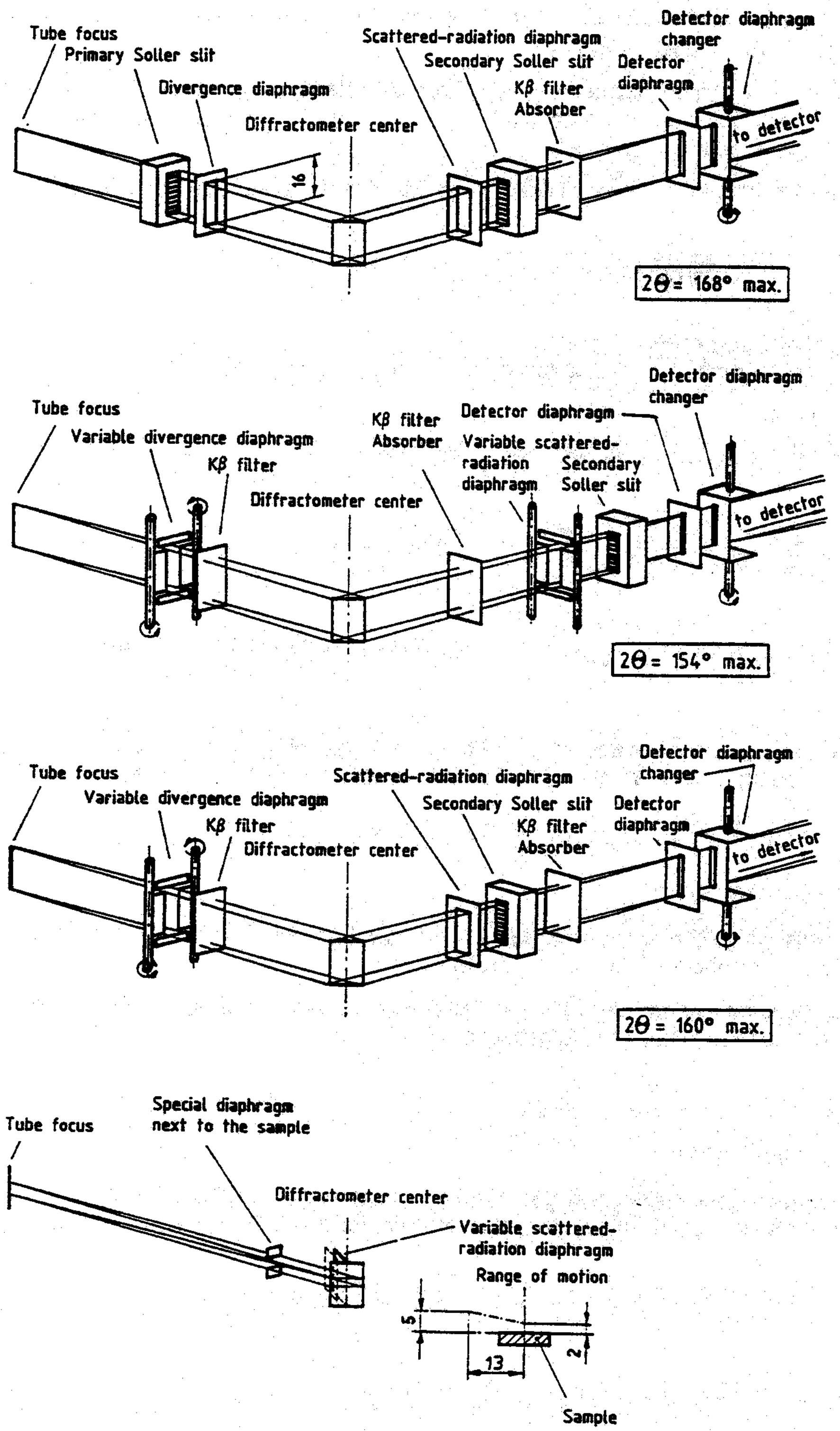


Fig. 3-10 Goniometer mounts

3.3.3 Fixed Diaphragms

The diaphragm width is marked in millimeters on the fixed diaphragms.

The diaphragms are held magnetically.

Always insert the fixed diaphragms such that the bevelled surface is inside (towards the holding magnets). The inscription must be visible.

The diffractometer is supplied together with two 1 mm wide slit diaphragms used as divergence and as scattered-radiation diaphragm (opening angle 0.5°) and a 0.1 mm slit diaphragm used as detector diaphragm (opening angle 0.03°).

Width and opening angle for the various fixed diaphragm positions are specified in Table 3-1.

	Opening angle for	
Diaphragm width	aperture and scattered-radiation diaphragms	detector diaphragms
0,05 mm	0,025°	0,015°
0,1 mm	0,05°	0,03°
0,2 mm	0,1°	0,06°
0,6 mm	0,3°	0,18°
1 mm	0,5°	0,3°
2 mm	1°	0,6°
6 mm	3°	1,8°

Table 3-1 Width and opening angle for the fixed diaphragms

Approximate values are: aperture and scattered radiation angle (in degrees) are equal to 1/2 diaphragm width (in mm); detector angle (in degrees) is equal to 1/3 diaphragm width (in mm).

3.3.4 Micro Diaphragms

Micro diaphragms with a diameter of 0.3, 0.5 or 1 mm may be inserted into the aperture diaphragm position for irradiating small sample surfaces.

A stop screw is used for vertical adjustment. A 1 mm wide diagonal diaphragm (57b) in the detector diaphragm position is used for adjustment.

3.3.5 Diaphragm Changer

A controllable detector diaphragm changer (Fig. 3-9.4) facilitates automatic selection of a fine slit diaphragm (0.06 mm wide, opening angle 0.018°) for high resolution and any plug-in diaphragm as required.

3.3.6 Varialble Slit Diaphragm

The variable divergence diaphragm (Fig. 3-7.2), which is controlled via a stepping motor, facilitates selection of the optimum aperture angle. A patented controller permits the diaphragm to be adjusted in 342 steps between 0.1° and 3°. Here the aperture angle follows the equation

$\alpha_i = 0.1 \cdot 1.01^i$ degrees

with i = number of steps.

Using a second variable slit diaphragm as scattered radiation diaphragm (Fig. 3-9.2) provides optimum scattered radiation suppression, in particular in the range of small angles, and facilitates automatic measurements from $2\theta = 0.3°$ to larger angles, always ensuring a maximum sample irradiation.

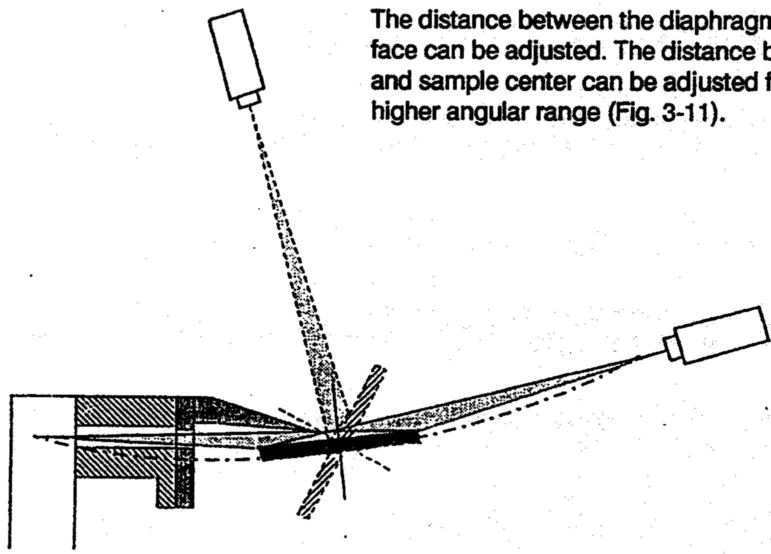
Apart from a selective adjustment of a specific diaphragm width, a microprocessor control command can be used for creating a sinusoidal forced coupling between angle of incidence and diaphragm width. This means that the same sample length of 6.6 or 20 mm is irradiated at any angle of incidence.

3.3.7 Divergence Diaphragm Next to the Sample

For measuring small surfaces, we recommend installing the divergence diaphragm next to the sample (Fig. 3-7.5) to the tube holder flange. The radiation height is delimited by slit diaphragms set to a width of 0.25 mm. This width may be increased up to 0.8 mm. Two pulling and two pressing screws are used for aligning the divergence diaphragm which bears the slit and lies next to the sample to the beam center. A pinhole diaphragm of 5 mm diameter may be used instead of the slit diaphragm in order to delimit the irradiated sample height to approximately 5 mm. Two different versions of the divergence diaphragm next to the sample are provided: one for the 401 mm and one for the 500 mm measuring circle (texture).

3.3.8 Scattered-Radiation Diaphragm Next to the Sample

The scattered-radiation diaphragm next to the sample (Fig. 3-6.4) is a simple aid for measuring in the range of small angles, in particular when a position sensitive detector is used. This diaphragm is fixed to the tube holder flange and screens out scattered radiation of the primary radiation beam.



The distance between the diaphragm edge and the sample surface can be adjusted. The distance between diaphragm edge and sample center can be adjusted for measurements up to a higher angular range (Fig. 3-11).

Fig. 3-11 Scattered-radiation diaphragm next to the sample

3.3.9 Kβ Filter

Radiation (Kα, Kβ)	Filter material	Thickness
Cu	Ni	12 µm
Cr	V	10 µm
Fe	Mn *	10 µm
Co	Fe	10 µm
Mo	Zr	65 µm

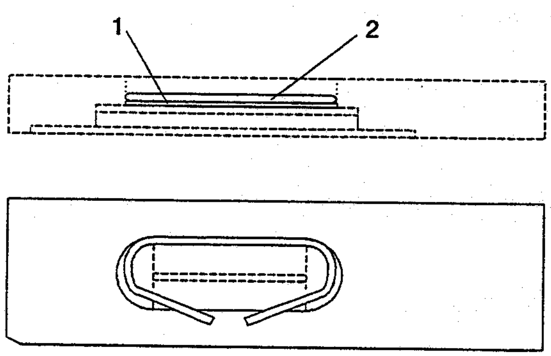
* Manganese in compound (150 µm thickness)

A Kβ filter may be used for suppressing the characteristic Kβ radiation.

Table 3-2 lists the various filter values used for attenuating the Kβ line intensity to 1% of the intensity of the Kα doublet. The Kα line intensity is thus attenuated to a value between half and two thirds of the original value.

Table 3-2 Kβ filter

3.3.10 Absorber



1 Plate 2 Clasp

Fig. 3-12 Plug-in diaphragm with Cu absorber

One or two Cu absorbers of 0.1 mm thickness may be inserted into a slit diaphragm in order to delimit the pulse rate at the detector during adjustment (to 10^5 pulses/second for a scintillation counter, for example).

The Cu absorber can be inserted in any plug-in diaphragm of the aperture or detector diaphragm holder.

Plate (1) and clasp (2) are inserted in the slot of the plug-in diaphragm, as shown in Fig. 3-12.

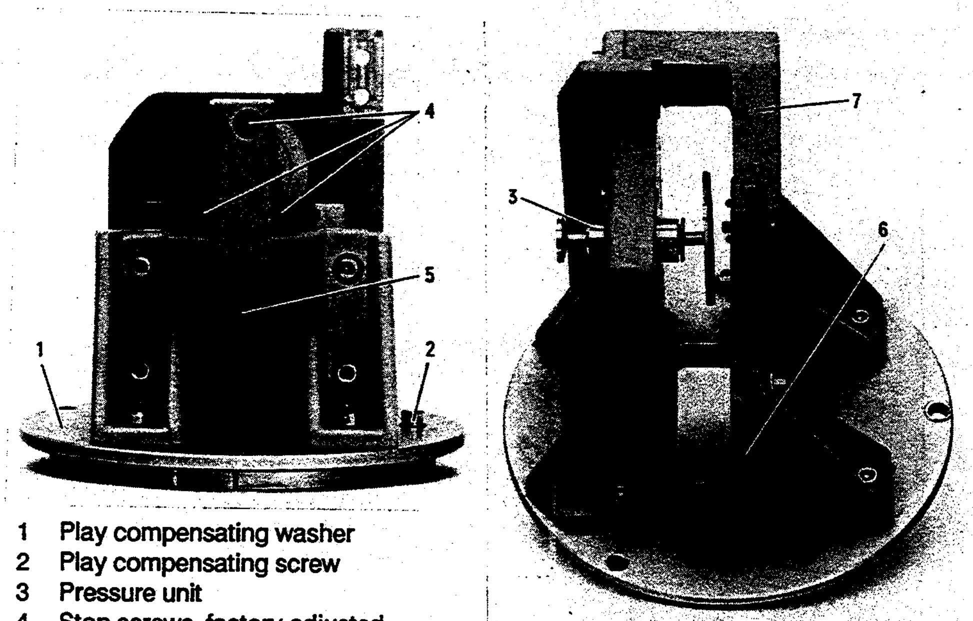
3.4 Sample Changer

The sample changer (Fig. 3-1.4) is adjusted in the factory such that the goniometer rotary axis is on the sample surface. Together with a play compensating washer (1) it is mounted on the sample changer ring (Fig. 3-2.1) and accepts the sample to be examined. The play compensating washer permits sample changer replacement without play and thus ensures reproducibility. Tightening the play compensating screw (2) reduces the fit play between play compensating washer and sample changer ring to zero. Once the play compensating washer (1) has been tightened to the goniometer, the play compensating screw should be loosened and only re-tightened slightly (see Section 8.8).

Caution: The play compensating screw (2) may not be tightened once the equipment has been removed.

3.4.1 Standard Sample Changer

A pressure unit (3) with quick-release lock presses the sample in the standard sample changer (Fig. 3-13) against the stop screw, which can be adjusted without play. The three stop screws (5) are factory-adjusted and secured. The screw (6) may be carefully tightened and adjusted without play.

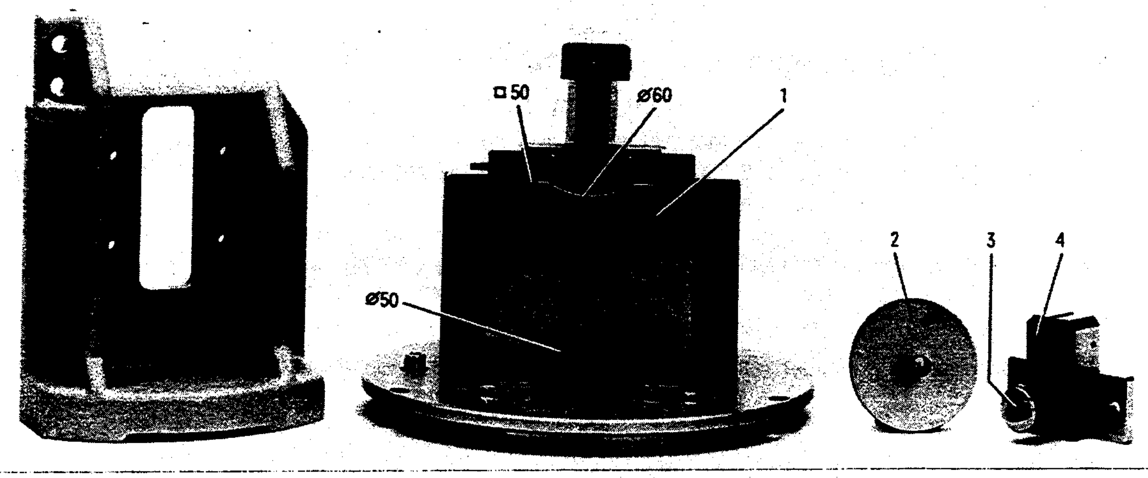


1 Play compensating washer
2 Play compensating screw
3 Pressure unit
4 Stop screws, factory-adjusted
5 Stop screw
6 Screw
7 Bracket
8 Front stop bracket

Fig.3-13 Standard sample changer

Samples up to a thickness of 20 mm may be inserted. An insertion aid (Fig. 3-14.1) is available for samples of 50 x 50 mm and with 50 or 60 mm diameter.

The swivel disk (Fig. 3-14.2) permits unshaped samples to be held tight. It may be removed from the pressure pin (Fig. 3-14.3) and replaced by a sample-specific disk shape.

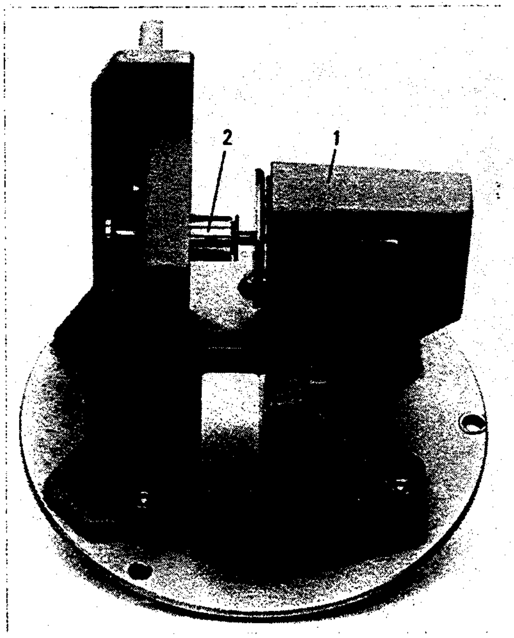


1 Insertion aid
2 Pressure disk
3 Pressure pin
4 Pressure unit

Fig. 3-14 Insertion aid and pressure unit

Setting the pressure unit (Fig. 3-14.4) to the lower position enables alignment of large and uneven samples to the goniometer center using the fourth stop screw (Fig. 3-13.5). The insertion aid must be removed in this case.

The front stop bracket (Fig. 3-13.8 and 3-15.1) permits large-surface insertion of samples; angle 2θ is then limited to 150.



1 Front stop bracket
2 Pressure unit

Fig. 3-15 Standard sample changer with front stop bracket

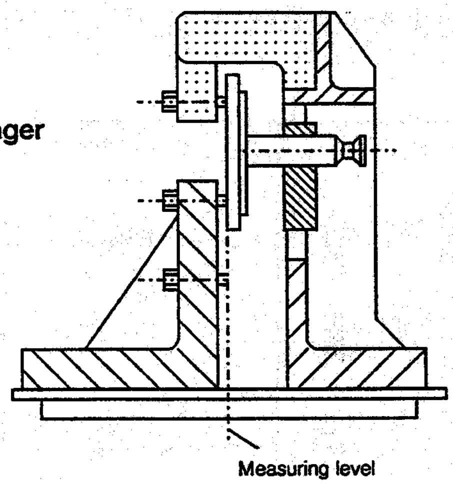
Bracket (Fig. 3-13.7) and front stop bracket (Fig. 3-13.8 and 3-15.1) may be removed and re-installed in a reproducible manner.

Fig. 3-16 shows the two possible installations for the standard sample changer.

Standard sample changer
(basic equipment)

Preferably for samples:
50 dia, 60 dia, 50 x 50
max. 20 thick

Measuring range
$2\Theta = 0...168°$



Bracket
(optional)

Preferably for big samples;
max. 20 thick

Measuring range
2Θ up to 150°

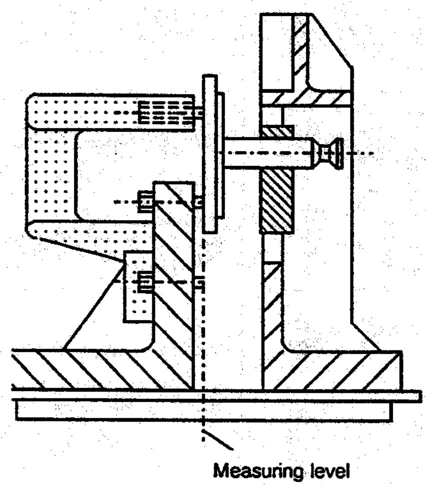


Fig. 3-16 Standard sample changer mounts

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Accessories: Sample holders for powder measurements, quartz sample for check measurements, calibration slit for 0° adjustment and a silicon single crystal holder for examination of very small samples (Fig. 3-17) are provided for use with the standard sample changer. These accessories are also used with the general-purpose cup for the rotating and transmission sample changers (see Chapter 3.4.2).

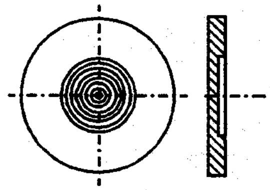
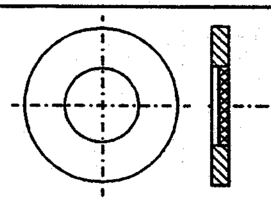
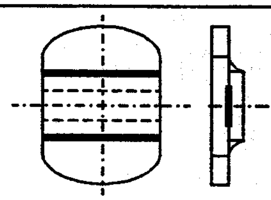
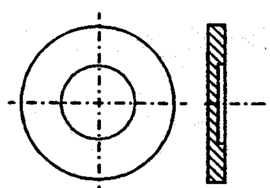
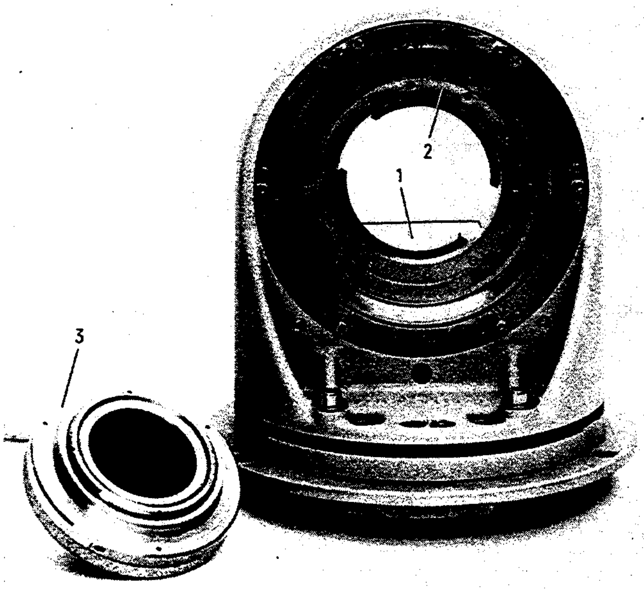
		Used with	Application
Sample holder 50 dia		Standard sample changer General-purpose cup for rotating sample changer	Powder measurement
Quartz sample 50 dia		Standard sample changer General-purpose cup for rotating sample changer	Test measurement
Calibration slit 50 dia, 38 long		Standard sample changer General-purpose cup (with diaphragm cap 20°/0° or diaphragm ring + clamping ring 20°/0°) for rotating sample changer	0° adjustment
Silicon single crystal holder 50 dia		Standard sample changer General-purpose cup for rotating sample changer	Very small samples

Fig. 3-17 Accessories for the standard sample changer

3.4.2 Rotating and Transmission Sample Changers

Instead of the standard sample changer, sample changers with stepper motor drive (Fig. 3-18) may be used in one of two designs: rotating/transmission sample changer or 0° rotating sample changer.



1 Drive motor
2 Seating ring for sample cup
3 Sample cup

Fig. 3-18 Rotating/transmission and 0° rotating sample changer

The sample is inserted in a sample cup which is held by permanent magnets on a pivotable seating ring. A spring in the cup lid presses the sample against the cup diaphragm.

The sample cup's design guarantees that the sample surface is in the cup seat level; different diaphragm thicknesses are thus not significant for the measuring result. Diaphragms of 42 mm diameter are available.

The maximum sample thickness is 50 mm. Plastic centering rings may be used for centering small samples.

The maximum sample thickness for rotating sample holders is 40 mm and 4 mm for transmission sample holders.

3.4.2.1 Rotating/transmission Sample Changer

The requirements for preparation are drastically reduced if the sample changer is used as rotating sample changer. Rotating the sample around its surface normal eliminates the influence of particle size and orientation to a great extent.

The sample changer is used as a transmission sample changer if the crystallite orientation of transmittable objects is to be obtained.

The sample may be rotated around its surface normal.

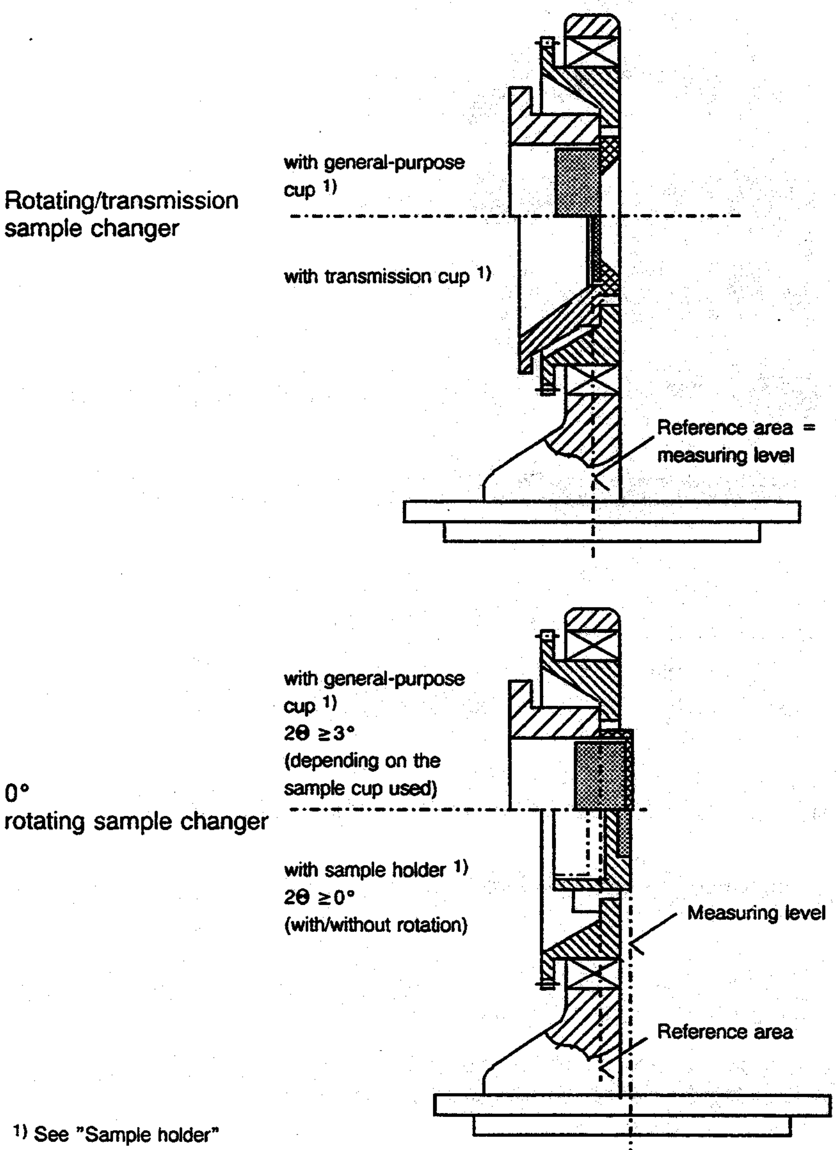
A scale ring with 15° division is applied to the rotary seat and to the sample cup.

In reflection measurements, measurement of a rotating sample is possible from $2\theta = 20°$. If the sample cup is still, measurement is possible from $2\theta = 0°$. Transmission technique permits measurement up to $2\theta = 120°$. Rotational speed can be adjusted continuously between 15 and 120 rpm.

The angular positions can be selected in steps of 0.28°. Reference marks at 0° (mechanical) permit electronic angle correction.

3.4.2.2 0° Rotating Sample Changer

Compared with the rotating/transmission sample changer, the 0° rotating sample changer features a sample holder contact surface which is offset by 6 mm from the goniometer center. The measuring level remains in the goniometer center. With or without rotation, the 0° sample holder permits measurements from $2\theta = 0°$. Transmission measurements are not possible.



1) See "Sample holder"

Fig. 3-19 Design of the rotating/transmission and the 0° rotating sample changer

3.4.2.3 Accessories

A general-purpose cup permits measurement of samples up to 50 mm diameter and 40 mm thickness (Fig. 3-20).

Small samples may be supported using an intermediate ring in the general-purpose cup.

The accessories for the standard sample changer (sample holders, quartz sample, calibration slit and silicon single crystal sample) may also be used with the general-purpose cup.

A transmission cup for samples of up to 50 mm diameter and 4 mm thickness is provided for transmission measurements.

A sample holder (Fig. 3-21) which may be used at both sides permits measurements with rotating samples from $2\theta = 0°$. Powder samples can be inserted in one side, while samples of up to 50 mm diameter and 15 mm thickness can be accepted in the other side. A rupture joint permits the sample holder to be broken easily in order to remove the thick sample. The sample holder may be reused for thick samples.

Further accessories (Fig. 3-21) are sample holders for measuring fibres or threads which can be used with the general-purpose cup or the transmission cup.

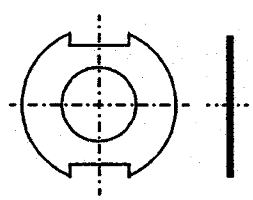
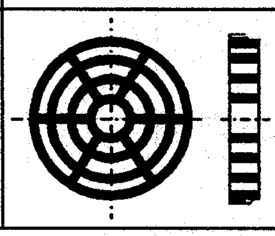
		Used with	Application
Holder 50 dia		General-purpose cup for rotating sample changer Transmission cup for transmission sample changer	Examination of fibres or threads
Intermediate ring 50 dia		General-purpose cup for rotating sample changer	Smaller samples

Fig. 3-20 Accessories for the general-purpose and transmission cup

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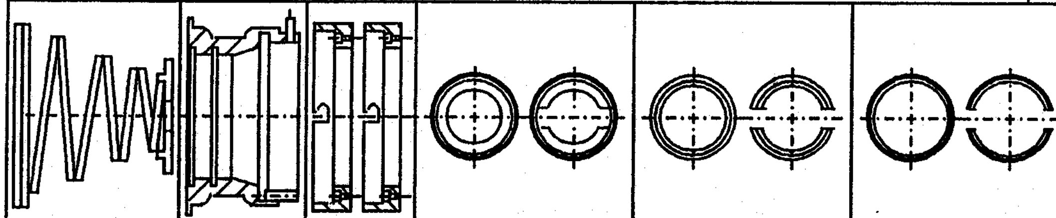
General-purpose components										Used with		Application	Remarks
													1) MRS/SRS diaphragms may be used instead (different diameters and materials).
Pressure unit	Cup Upper part	Cup Lower part	Cup Lower part 0°	Diaphragm cap 3° 42 dia	Diaphragm cap 20°/0° 42 dia	Diaphragm ring 20° 42 dia	Diaphragm ring 20°/0° 42 dia	Clamping ring 20°	Clamping ring 20°/0°	Rotating/transmission sample changer	0° rotating sample changer		
X	X	X			X						X	0° adjustment with calibration slit Measurement: $2\Theta \geq 0°$ without rotation $2\Theta \geq 20°$ with rotation	Sample size: max. 50 dia, max. 40 thick
X	X	X		X							X	Measurement: $2\Theta \geq 3°$ with/without rotation	Sample size: max. 50 dia, max. 40 thick
X	X	X				X		X		X		Measurement: $2\Theta \geq 20°$ with/without rotation	Sample size: max. 50 dia, max. 35 thick
X	X		X				X		X	X		0° adjustment with calibration slit Measurement: $2\Theta \geq 0°$ without rotation $2\Theta \geq 20°$ with rotation	Sample size: max. 50 dia, max. 35 thick

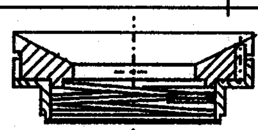
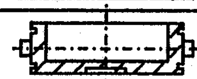
General-purpose components		Used with		Application	Remarks
Transmission cup		X		Transmission	Sample size: max. 50 dia, max. 4 thick
Sample holder			X	Measurement with/without rotation	Both sides can be used, preferably for powders, max. 50 dia, max. 15 thick

Fig. 3-21 Accessories for the rotating/transmission and the 0° rotating sample changer (general-purpose cup)

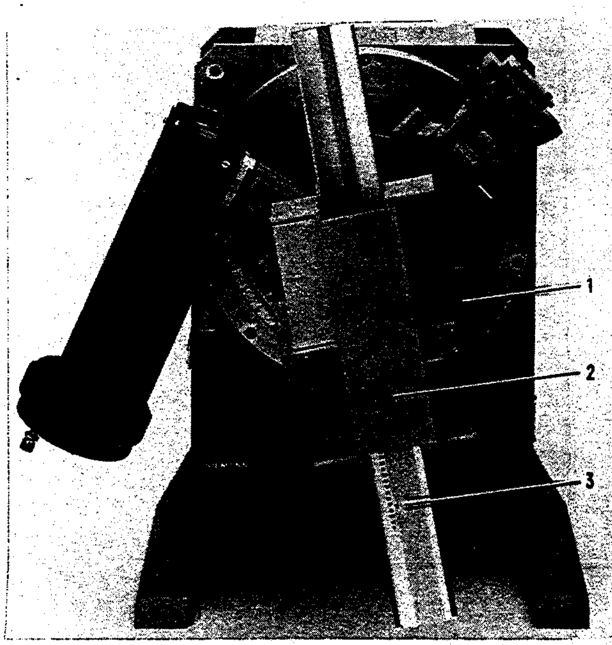
3.4.3 Automatic Changer for 40 Samples

The automatic changer for 40 samples is particularly suitable for routine analysis of a large number of samples. It facilitates automatic measurement of up to 40 samples in a linear magazine.

The sample changer (Fig. 3-22) consists of a support (1) and a deck (2) with the magazine (3). Up to 40 special sample holders (see accessories) can be inserted in the linear magazine used.

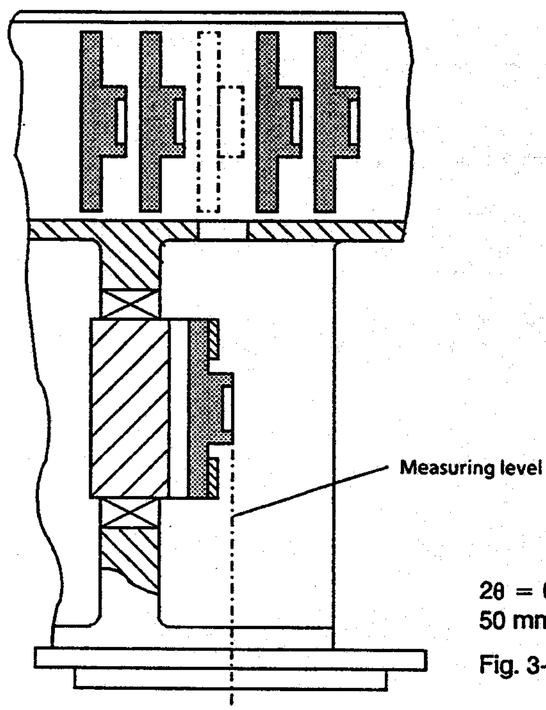
The samples can be up to 5 mm thick and may be rotated at 30 rpm from $2\theta = 0°$ (Fig. 3-23).

Process computer software is used to control the changer via a microprocessor.



1 Support
2 Deck
3 Linear magazine

Fig. 3-22 Automatic changer for 40 samples



$2\theta = 0°$ (with/without rotation) for sample holder 50 mm x 50 mm, 3/5 mm thick

Fig. 3-23 Cross section of the sample changer for 40 samples

Accessories: Sample holders for powder measurement and flux analysis, quartz sample, calibration slit and silicone single crystal sample (Fig. 3-24) are provided for the automatic changer for 40 samples for measurements from $2\theta = 0°$. The analysis level is offset by 3 mm compared with the measuring level.

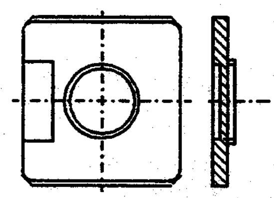
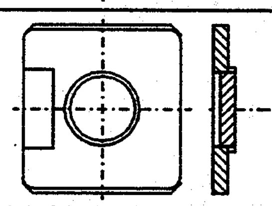
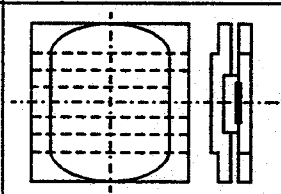
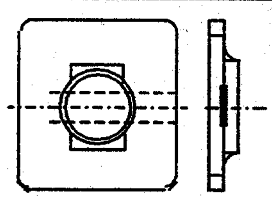
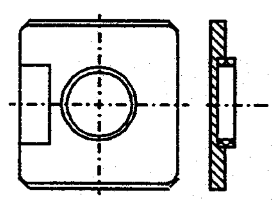
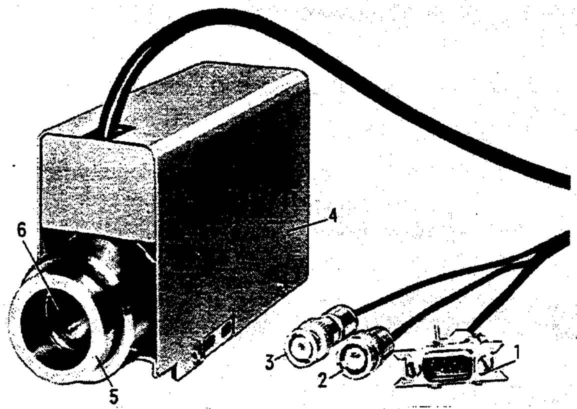
		Application
Sample holder 50 x 50		Powder measurement
Quartz sample 50 x 50		Test measurement
Calibration slit 50 x 50		0° adjustment
Silicon single crystal sample 50 x 50		Very small samples
Sample holder 50 x 50		Flux analysis

Fig. 3-24 Accessories for the changer for 40 samples

3.5 Detector

3.5.1 Scintillation Counter



1 9-pin connector (voltage supply for the pre-amplifier)
2 Signal line BNC connector
3 High-voltage supply MHV connector (red ring)
4 Removable cover
5 Socket for inserting the scintillation counter into the detector holder
6 Radiation inlet window

Fig. 3-25 Scintillation counter

Normally, a scintillation counter (Fig. 3-1.6 and 3-25) which enables X-ray measurement in the wavelength range between 0.05 and 0.3 nm is used as a detector (Fig. 3-26).

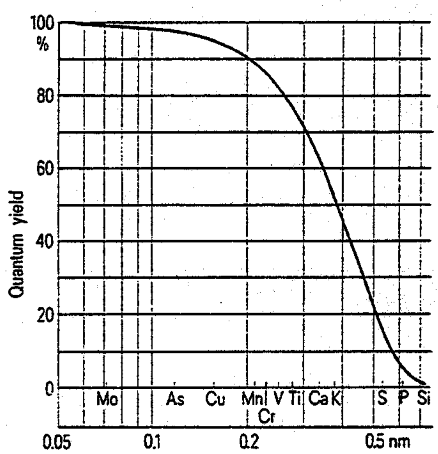
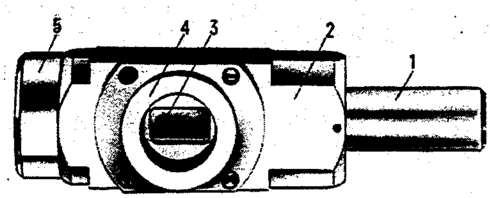


Fig. 3-26 Quantum yield of the scintillation counter

3.5.2 Proportional Counter

The type E proportional counter (Figs. 3-27 and 3-28) may also be used for measuring low-energy X-rays with a wavelength between 0.1 and 0.3 nm. In contrast to the scintillation counter which has a virtually unlimited service life, the proportional counter shows aging phenomena from approximately 10^{10} pulses.

The proportional counter requires a pre-amplifier (Fig. 3-29) which is plugged onto the counter.



1 Protective sleeve on the coaxial connector for the pre-amplifier
2 Counter body
3 Radiation inlet window
4 Socket
5 Protective sleeve on the counter filler nozzle

Fig. 3-27 Type E proportional counter

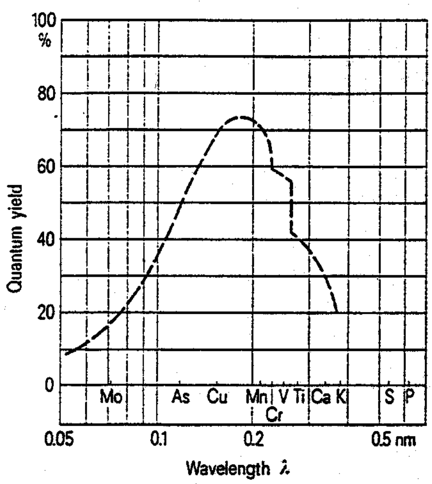
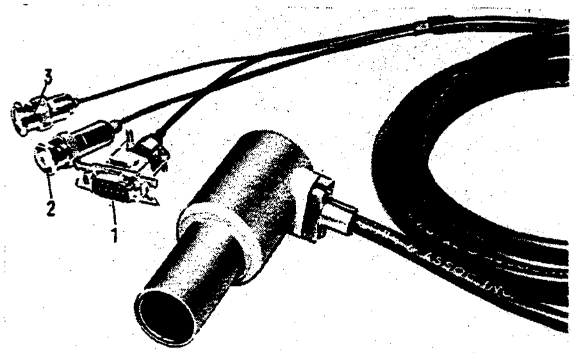


Fig. 3-28 Quantum yield of the type E proportional counter



1 9-pin connector (voltage supply for the pre-amplifier)
2 High-voltage supply MHV connector (red ring)
3 Signal line BNC connector

Fig. 3-29 Charge-sensitive pre-amplifier for the proportional counter

3.5.3 Si(Li) Semiconductor Detector

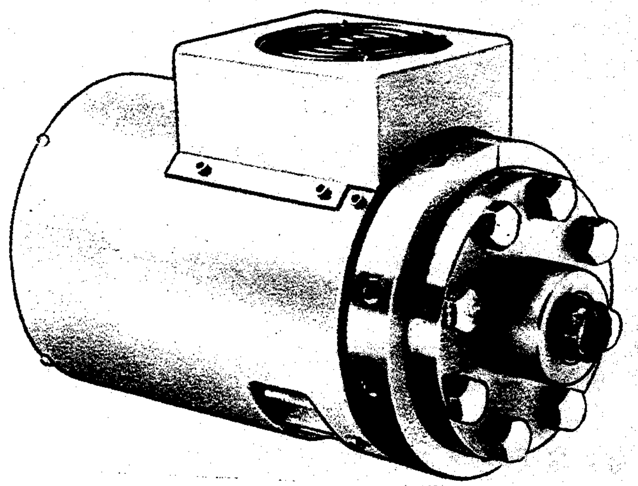


Fig. 3-30 Si(Li) semiconductor detector with Peltier cooling

A Si(Li) semiconductor detector with Peltier cooling can be set up (Fig. 3-30) using the standard detector diaphragm holder (see Chapter 3.3.2).

The Si(Li) semiconductor detector is an X-ray detector with a high energy resolution. It is suitable for X-ray diffractometers and a wavelength range between 0.05 and 0.3 nm (Fig. 3-31).

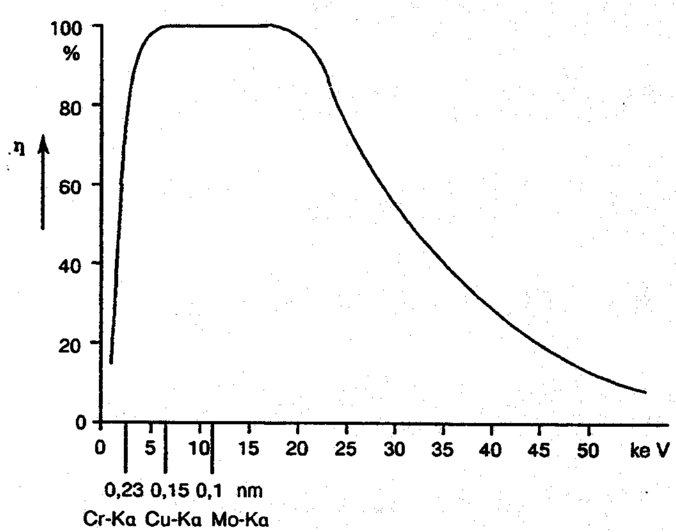
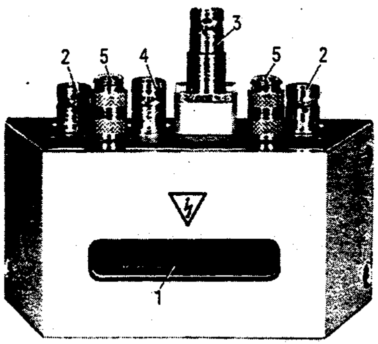


Fig. 3-31 Quantum yield of a typical Si(Li) semiconductor detector (3 mm detector thickness; 25 μm beryllium window thickness)

In contrast to a conventional dispersive diffraction arrangement this detector permits an energy-dispersive diffraction arrangement where sample and detector remain stationary. An X-ray source with continuous radiation is used as excitation.

3.5.4 Position Sensitive Detector

The position sensitive detector (Fig. 3-32) is a special flow counter which detects all reflections within a specific angular range. The angular positions of the detected reflections are determined from the X-ray quanta impact points.



1 Radiation inlet window
2 Signal line
3 High voltage connector
4 Pre-amplifier connector
5 Gas connector

Fig. 3-32 Position sensitive detector

The position sensitive detector is especially suitable for stress measurements, tracking of phase transformations and quick recording of voluminous diffraction patterns.

The position sensitive detector is available in two different versions: with a metal or a quartz counter tube wire. The service life of the metal wire is 100 times greater than that of the quartz wire; the quartz wire has a better position resolution.

The position sensitive detector is suitable for measuring in a wavelength range between 0.05 and 0.5 nm (Fig. 3-33).

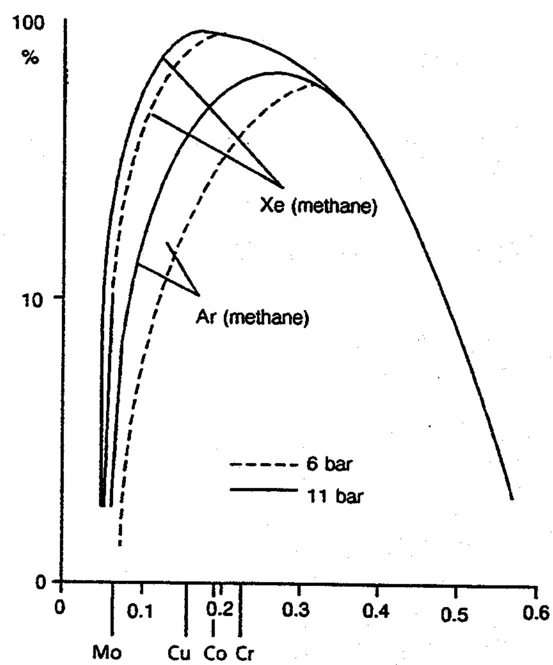


Fig. 3-33 Quantum yield of the position sensitive detector

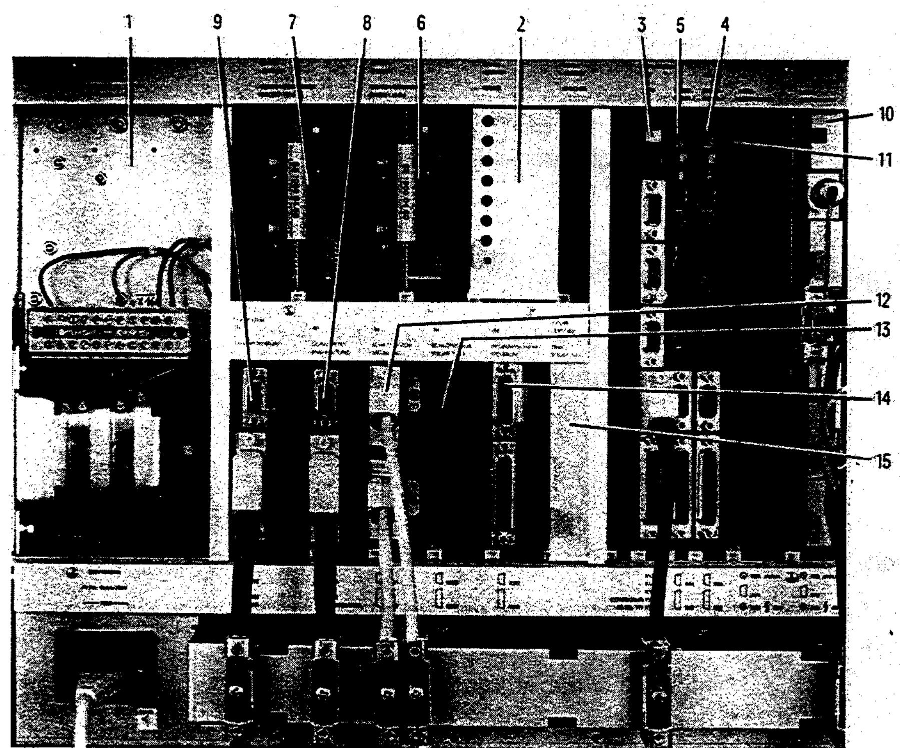
3.6 Measuring and Control Electronics

3.6.1 Control Unit

The control unit (Fig. 3-34) is a subrack which accepts the whole measuring position electronics (see overall circuit diagram, C79298-A3160-X1-*-12).

The subrack is in the lower right-hand part of the cabinet and may be accessed from the front after a cover has been removed.

The control unit consists of the following elements, which are interconnected in wire-wrap technique on the rear of the subrack:



1 Power supply unit
2 Controller
3 CPU
4 Control electronics 1
5 Control electronics 2
6 Goniometer drive circuit 1
7 Goniometer drive circuit 2
8 Interface
9 Window control
10 Measuring electronics 1
11 Measuring electronics 2
12 Stepper motor control 1
13 Stepper motor control 2
14 Sample changer control
15 Triac control

Fig. 3-34 Control unit

3.6.1.1 Power Supply Unit (C79298-A3157-A1-*-11)

The control unit power supply is in the left-hand side of the subrack. It provides all d.c. and a.c. voltages required in the electronics.

Mains connection

The X350 appliance plug is at the front of the subrack.

Mains voltage	220 V AC + 15 %, 50/60 Hz
Maximum current consumption	1 A (N = 220 VA)

A mains cable (Order no. W79079-N2025-A3) connects the X350 appliance plug with the X3 mains socket in the cabinet.

Cf. circuit diagrams C79298-A3136-A101-*-11 and C79298-A3160-X1-*-12.

Mains fuse	In the upper part of the X350 plug, may be accessed using a screwdriver; F7: 1.6 A time-lag F8: 1.6 A time-lag
Service note	A fuse (or fuses) may be defective if there is no control lamp ON on the controller module (C79458-L2234-B9) when the device is switched on.

+60 V output voltage

This voltage feeds the power amplifier of the goniometer stepper motors.

Check	+60 V on interface module (C79458-L2234-B5)
Pilot lamp	"+60 V" on controller module (C79458-L2234-B9)
No fuse	

+5 V output voltage

Power supply for the logic elements on all modules; generated from +11 V in the controller C79458-L2234-B9.

Pilot lamp	"+5 V" on controller module (C79458-L2234-B9)
F1 fuse	6.3 A semi-delay, on interface module (C79458-L2234-B5)

+24 V output voltage

Power supply for all stepper motors except circle 1 and 2, automatic changer for 40 samples detector high voltage 1 and 2, window control.

Check	+24 V on interface module (C79458-L2234-B5)
Pilot lamp	"+24 V" on controller module (C79458-L2234-B9)
F5 fuse	6.3 A semi-delay, on interface module (C79458-L2234-B5)

+12 V output voltage

Power supply for analog elements, impulse amplifier, V.24 computer interface; generated from 17 V AC on the controller module (C79458-L2234-B9).

Pilot lamp	"+12 V" on controller module (C79458-L2234-B9)
F2 fuse	1.6 A semi-delay, on interface module (C79458-L2234-B5)

–12 V output voltage

Power supply for analog elements, impulse amplifier, V.24 computer interface; generated from 17 V AC on the controller module (C79458-L2234-B9).

Pilot lamp	"–12 V" on controller module (C79458-L2234-B9)
F3 fuse	1.6 A semi-delay, on interface module (C79458-L2234-B5)

24-V AC output voltage

Power supply for all a.c. motors.

Check	24 V AC on interface module (C79458-L2234-B5)
Pilot lamp	"24 V AC" on controller module (C79458-L2234-B9)
F4 fuse	1.6 A quick-acting, on interface module (C79458-L2234-B5)

+300-V output voltage

Power supply for the window magnet.

Check	+300 V on window control module (C79458-L2234-B4)
Pilot lamp	"+300 V" on controller module (C79458-L2234-B9)
F6 fuse	0.032 A semi-delay, on window control module (C79458-L2234-B4)

3.6.1.2 Control Module (C79458-L2234-B9)

The module has the following functions:

- Generating a stabilized +5 V supply from +11 V; adjustable via R7 at the front panel using a screwdriver (not marked); factory setting: U = +5.1 V for I = 4 A.
- Generating a stabilized +12 V supply from 17 V AC.
- Generating a stabilized –12 V supply from 17 V AC.
- Front panel pilot lamps for: +5 V, +12 V, –12 V, +24 V, 24 V AC, +300 V, +60 V.

3.6.1.3 CPU Module (C79458-L2234-B1)

The module has the following functions:

- 8032 microprocessor with 64 K PROM and 8 K RAM (battery-backed), interrupt control.
- Serial interface (V.24 and TTY) for connecting a computer (X53).
- Serial interface for connecting the operator panel, C79298-A3157-B4 (X54).
- Serial interface for connecting a display (X55).
- Generating the control signals for goniometer circuit 1.
- Generating the control signals for goniometer circuit 2.
- Control signals for follow-up operation of the position sensitive detector.
- Control of a D5000 bus system which allows connecting the control electronics 1 and 2.
- +5-V voltage monitoring.

Program selector switch

S1 = open/closed	Without/with serial interface X56 to generator
S2 = sense of rotation	Circle 1
S3 = sense of rotation	Circle 1
S4 = open/closed	Backup battery on/off

Connector pin assignment (see C79458-L2234-B1-*-11, sheet 15) [1])

X53 Computer connection

X54 Operator panel (red dot), C79298-A3157-B4

X55 Display

X56 Generator remote control via serial interface (not implemented)

X57 Position sensitive detector

R11 potentiometer

Factory setting: Mains-dependent RAM supply changeover at

$U < 4.9$ V

G2 backup battery (C79458-L212-B5)

If the mains connection is switched off, the backup battery lasts for approximately 2 years and should be replaced within this time. The installation date should be written on a label at the rear of the control unit front panel.

The device configuration must be re-entered after the battery has been replaced.

Test connector

Closed in normal operation:	X58, X59, X60
Open in normal operation:	X61
Program memory EPROM	The program memory EPROM is installed in location D2. Standard equipment: S79610-G18-A900. If an Euler's cradle is used (phi, chi, x, y): S79610-G17-A900. Caution: Note orientation when inserting the EPROM. The side mark of the EPROM must match the print on the board.

1) Not part of this manual.

3.6.1.4 Control Electronics 1 (C79458-L2234-B2)

The control electronics 1 is connected with the CPU via the D5000 bus system. It monitors and controls the following modules:

- Module "Measuring Electronics 1" (C79458-L2234-B3)
- Module "Window Control" (C79458-L2234-B4)
- Module "Interface" (C79458-L2234-B5)
- Module "Stepper Motor Control 1" (C79458-L2234-B6)

Program selector switch

S1	0°mark polarity changeover of circle 3
S2	360°mark polarity changeover of circle 3
S3	0°mark polarity changeover of circle 4
S4	360° mark polarity changeover of circle 4
S5	Sense of rotation of circle 4
S6	Sense of rotation of circle 3

Connector pin assignment (see C79458-L2234-B2-*-11, sheet 15) [1])

X33	External binary input 1: 8 bits External binary output 1: 8 bits External command "tube window open"
X34	Analog mean value for the KOMPENSOGRAPH

Potentiometers

R106	Setting the maximum output voltage at X34; Factory setting: $U_{max} = 1$ V
R120	Setting the offset voltage for the lower discriminator limit of the measuring electronics 1; Factory setting: selection U = 0.00 V, U (X31, b28): –0.01 V
R126	Setting the offset voltage for the window width of the discriminator of measuring electronics 1; Factory setting: selection U = 0.00 V, TP4 test point: –0.01 V
R109	Setting the upper limit of the discriminator of the measuring electronics 1; Factory setting: lower limit selection U = 4.99 V, window width selection U = 0.00 V; $\|U\|$ (X31, b30, – $\|U\|$ (X31), b28) = 0.01 V (negative voltages)

1) Not part of this manual.

TP3 reference voltage

U (REF) = – 4.87 to – 4.95 V

3.6.1.5 Control Electronics 2 (C79458-L2234-B2)

The control electronics 2 is connected with the CPU via the D5000 bus system. It monitors and controls the following modules:

- Module "Measuring Electronics 2" (C79458-L2234-B3)
- Module "Stepper Motor Control 2" (C79458-L2234-B6)
- Module "Sample Changer Control" (C79458-L2234-B8)

Program selector switch

S1	Fine mark polarity changeover of circle 5
S2	Coarse mark polarity changeover of circle 5
S3	Fine mark polarity changeover of circle 6
S4	Coarse mark polarity changeover of circle 6
S5	Sense of rotation of circle 6
S6	Sense of rotation of circle 5

Connector pin assignment (see C79458-L2234-B2-*-11, sheet 15) [1])

X43	External binary input 2: 8 bits External binary output 2: 8 bits
X44	Analog output (not used)

Potentiometers

R106	Setting the maximum output voltage at X44; factory setting: Umax = 1 V
R120	Setting the offset voltage for the lower discriminator limit of the measuring electronics 2; Factory setting: selection U = 0.00 V, U (X41, b28): – 0.01 V
R126	Setting the offset voltage for the window width of the discriminator of measuring electronics 2; Factory setting: selection U = 0.00 V, TP4 test point: – 0.01 V
R109	Setting the upper limit of the discriminator of the measuring electronics 2; Factory setting: lower limit selection U = 4.99 V, window width selection U = 0.00 V; |U| (X41, b30, – |U| (X41, b28) = 0.01 V (negative voltages)

1) Not part of this manual.

TP3 reference voltage

U(REF) = −4.87 V to −4.95 V

3.6.1.6 Goniometer Drive Circle 1 (C79451-Z1188-U1)

The circle 1 stepper motor of the goniometer drive has a resolution of 200 full steps per revolution. The ratio of the worm gear between motor and circle 1 is U = 360 : 1 (1° worm). This results in a goniometer angle of $2\theta = 0.005°$ per full step for circle 1.

An angular resolution of $2\theta = 0.001°$ can be achieved if the stepper motor is operated in microstep mode. Each full step of the motor is then subdivided into five sub-steps. This can be achieved by applying intermediate current values to both motor windings instead of the maximum current for full step operation. These intermediate current values change from clock pulse to clock pulse up to the maximum value for full step operation according to a sine function.

The goniometer drive circle 1 consists of a logic section and a power section which drives the stepper motor of circle 1 in the goniometer.

Logic section

The logic section receives clock pulses and signals for selecting the sense of rotation and the mode from the CPU module (C79458-L2234-B1). It generates the bit patterns and analog current setpoint values required for the power section control.

Power section

The power section consists of two bridge amplifiers, each impressing a controllable constant current to a stepper motor winding. The current control operates in chopper mode. The pulse width controlled switched-mode current controller uses the motor winding inductivity as storage inductivity.

Potentiometers on the module front panel

Factory setting:	Motion	I_{max} = 3.6 A
	Stop	I_{max} = 1.8 A

LED indicators on the module front panel

Four red LEDs indicate the bit pattern of the power amplifier control signals.

The yellow LED is ON if a short-circuit or overtemperature condition has occurred on the module.

3.6.1.7 Goniometer Drive Circle 2 (C79451-Z1188-U1)

The stepper motor of goniometer drive circle 2 is fed by the module "Goniometer Drive Circle 2". Function and programming are identical to circle 1.

3.6.1.8 Interface Module (C79458-L2234-B5)

The interface module has three different functions:

X242 goniometer interface, yellow dot

The goniometer connects to the X242 connector. Therefore the leads from the motor output amplifiers to the motor windings run via the module. The module also contains filter circuits which pass on the status information from the goniometer to the control electronics 1.

Diaphragm changer (X243)

The DETS diaphragm changer (C79298-A3158-B18) connects to the X243 connector.

The diaphragm changer magnet control and a receiver circuit for diaphragm changer status messages are also contained on the module.

Fuses

The module contains five fuses. The associated pilot lamp on the controller module (C79458-L2234-B9) lights up if a fuse is defective.

F1 = 6.3 A / 250 V semi-delay: protecting +5 V

F2 = 1.6 A / 250 V semi-delay: protecting +12 V

F3 = 1.6 A / 250 V semi-delay: protecting –12 V

F4 = 1.6 A / 250 V semi-delay: protecting 24 V AC

F5 = 6.3 A / 250 V semi-delay: protecting +24 V

3.6.1.9 Window Control (C79458-L2234-B4)

The window control module has three different functions:

Closing delay

This circuit contains the R46 NTC thermistor which is used as closing delay for the T1 power supply transformer (see C79298-A3157-A1-*-11).

Synchronous motor

Physical components with a 24 V a.c. synchronous motor, such as "translation" may be connected to the X253 connector of the module (see C79298-A3160-X1-*-12). The function is triggered via "control electronics 1".

Window control

The cable from the radiation protection box (code: X252, blue dot) connects to the S252 connector of the module.

The module contains the electronic circuitry for

- the shutdown circuit (see Chapter 4.2.3).
- the tube window (see Chapter 4.3).
- monitoring and controlling the E604 (X-ray ON) and E605 (window open) alarm lamps (see Chapter 4.2.4).

These elements are monitored and controlled via the control electronics 1 module.

3.6.1.10 Measuring Electronics 1 (C79458-L2234-B3)

This modules feeds detector 1 with the required supply voltages: +12 V, –12 V and detector high voltage. It receives, differentiates and amplifies the measuring pulses from the detector preamplifier. The amplified pulses are fed to a window discriminator which only accepts pulses of a certain amplitude. These pulses are then transformed into "standardized pulses".

Measuring electronics 1 corresponds with control electronics 1. It receives the analog setpoint value for the detector high voltage, the analog value of the upper and lower discriminator limit and the amplifier selection from there.

The control electronics module 1 also contains the associated timer/counter which accumulates the standardized pulses.

Detector high voltage

The detector high voltage is generated out of +24 V via a switched-mode controller with voltage multiplier. The N5 controller amplifier receives the analog setpoint and actual values and triggers the V12 transistor used as variable series resistance.

Three different events stop the clock generator and attenuate the detector high voltage:

- Command input "detector high voltage 0 V": the binary signal HVEIN-N = high switches off the clock pulses; the detector high voltage becomes zero.
- The current limiting circuit in the detector high voltage stage has responded at I > 1 mA.
- The high voltage monitoring circuit in the detector high voltage stage has responded at >1300 V (S1 switch = open).

An LED indicator on the module front panel is ON when the detector high voltage is OK.

Potentiometers (factory settings)

R13	With setpoint value U = +10.000 V: detector high voltage U = 2048 V
R99	The LED indicator is OFF if the control voltage is at its maximum
R17	The high voltage limiting circuit responds for increasing detector high voltage at U > 1500 V
R70	Offset for lower discriminator limit: U = –0.01 V
R69	Offset for upper discriminator limit: U = –0.01 V

S1 switch

S1 = open: high voltage limit for scintillation counter.

Impulse amplifier: the measuring pulses (X15) from the detector pre-amplifier are differentiated at C40, R60 and amplified in N7. The gain can be selected in three levels by the control electronics 1.

Gain: 100, 50, 33.

Connector pin assignment (see C79458-L2234-B3-*-11) [1])

X13	Detector high voltage U = 0 to 2047 V
X14	+12 V, –12 V for pre-amplifier
X15	Impulse input

1) Not part of this manual.

3.6.1.11 Measuring Electronics 2 (C79458-L2234-B3)

Measuring electronics 2 is identical to measuring electronics 1.

It feeds detector 2 with the required supply voltages and receives the measuring pulses from there. Measuring electronics 2 corresponds with control electronics 2.

3.6.1.12 Stepper Motor Control 1 (C79458-L2234-B6)

Two physical components with stepper motor drive (two-phase stepper motor) can be connected to the stepper motor control 1. The module corresponds with the control electronics 1, i.e. it receives clock pulses and information regarding the sense of rotation and the mode selected from the control electronics 1 module and transmits status data of the physical components to this module. The two windings of the two-phase stepper motors are in the diagonal of bridge amplifiers which provide constant current supply according to the bipolar constant current chopper technique.

Two status data items and two limit switch states can be received and conditioned for each physical element.

X233 connector (see C79458-L2234-B6-*-11) [1])

Connection of the physical element with the system code "circuit 3".

Alternatives:

- Euler's cradle circuit χ
- Variable diaphragm 1, divergence slit, DIVS

X232 connector (see C79458-L2234-B6-*-11) [1])

Connection of the physical element with the system code "circuit 4".

Alternatives:

- Euler's cradle circuit φ
- Rotating sample changer

Switch programming

S1, S2 = closed/open	Current circle 4 = 1 A / 0.06 A
S3, S4 = closed/open	Current circle 3 = 1 A / 0.06 A
S5 = 2	Factory setting: half step mode for circles 3 and 4
S6 = open	Factory setting: no external synchronization
S7, S8 = closed/open	Without/with limit switch circle 3
S9, S10 = closed/open	Without/with limit switch circle 4

1) Not part of this manual.

3.6.1.13 Stepper Motor Control 2 (C79458-L2234-B6)

The stepper motor control 2 is identical to the stepper motor control 1, and corresponds with the control electronics 2.

X223 connector (see C79458-L2234-B6-*-11) [1])

Connection of the physical element with the system code "circuit 5".

Alternatives:

- Euler's cradle "translation x"
- Variable diaphragm 2, anti-scatter slit, ASCS

X222 connector (see C79458-L2234-B6-*-11) [1])

Connection of the physical element with the system code:

Euler's cradle "translation y".

3.6.1.14 Sample Changer Control (C79458-L2234-B8)

The sample changer control is used for controlling the automatic sample changer for 40 samples. It provides status information and receives control commands from the control electronics 2.

X212 connector (see C79458-L2234-B8-*-11) [1])

The status information from the sample changer is received via the X212 connector, filtered, transferred to the control electronics 2 and used for interlocking the motor logic of the module.

X213 connector (see C79458-L2234-B8-*-11) [1])

The four sample changer motors connect to the X213 connector. The associated power-factor correction capacitors are on the module.

Program selector switch

S1 = open/closed 50/60 Hz

Set the switch to line frequency when the diffractometer is installed.

1) Not part of this manual.

3.6.1.15 Triac Control (C79298-A3117-B41)

Triac control and sample changer control together control the automatic sample changer for 40 samples.

The triac control contains the four triacs used for switching the four motors.

When the mains voltage is switched on, the 24 V AC voltage for the motors is switched on via the K1 relay contact after a time delay.

3.6.2 Terminal (C79298-A3157-B4)

The terminal enables installation and service work to be performed at the diffractometer measuring position, independently from the computer.

The terminal features a display with four lines and a keyboard, which permits status information display and control of each physical element of the measuring position.

The terminal is designed as a drawer in the top right of the cabinet, below the radiation protection box. An integrated microprocessor controls display and keyboard and corresponds with the CPU C79458-L2234-B1 via a serial interface. The connecting cable of the terminal is connected to the X54 connector (red dot) on the CPU module.

Incorrect input and alarms are signalled by an audible indicator.

Three indicator lamps at the terminal front provide status information for the whole system, even when the drawer is pushed in:

- Green "READY" lamp:
  This lamp is ON if the system is operational and the logic supply voltage U > 4.9 V and the CPU watchdog signals proper software execution.
- Red "ALARM" lamp:
  This lamp indicates an alarm status of the system (together with an audible alarm).
- Yellow "BUSY" lamp:
  This lamp indicates that a measurement is in progress.

The display contrast may be adjusted using the R20 potentiometer on the C79458-L2234-B12 module. It may only be set using a non-conductive screwdriver as the potentiometer wiper may be connected to +5 V (potential danger of a short-circuit to earth).

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3.6.3 Computer Interface

A V.24 and a TTY current interface are provided for connecting a computer at the X53 connector. The various computer connections possible are shown in the assignment plan C79298-A3160-X1-*-17.

- V.24 interface without qualifiers RTS, CTS, DSR, DTR
  X53 (2) TXD...RXD, computer (normally pin 3)
  X53 (2) RXD...TXD, computer (normally pin 2)
  X53 (7) earth..earth, computer (normally pin 7)
  X53 (1) zero..zero, computer (normally pin 1)

  The qualifier connections are not connected.

- V.24 interface with qualifiers RTS, CTS, DSR, DTR
  X53 (5) CTS...DTR or RTS computer
  X53 (20) DTR...CTS computer

- TTY interface

  The constant current for transmission and reception may either be drained from the computer or from the D 5000 controller. See C79298-A3160-X1-*-17.

3.6.4 Limit Switch

A limit switch system prevents the controller from driving the diffractometer co-ordinates to mechanically illegal values.

Circles 1 and 2 (Θ/2Θ)

Both circles have a common axis.

The mounts of both circles may therefore travel against each other or against external fixed elements. This is prevented by a system of limit switches at the mounts and by the 2 range limit switch which is actuated via adjustable cams. The associated cables are connected to the colored pairs of sockets at the goniometer side. Unused sockets must be jumpered as an open circuit feigns a malfunction.

If, despite these measures, one of the circles still travels against an obstacle, the drive presses the worm out of its engagement and actuates an internal limit switch. All these switches are connected in series and have the same effect.

Both goniometer drives stop immediately.

The controller changes to coarse angle state; the diagnosis display shows F200 D0 = 1.

The limit switch position can only be left by entering the "Tuning" command using the terminal. Only the inverse travel direction is permitted for the circle(s) (1; 2; 1 and 2 coupled) which move when the limit switch responds. All other travel commands are illegal and are therefore rejected.

If the goniometer leaves the limit switch, F200 D0 = 0 and the goniometer can be controlled in a normal manner.

Circles 3 to 6 (Euler's cradle; x, y)

The co-ordinates 3 to 6 are orthogonal; the limit switches are assigned to the individual circles. If one of the limit switches for the co-ordinates 3 to 6 responds, all circles stop and assume coarse angle status.

The common reaction shows F200 D1 = 1; F049 and F088 indicate the states of the individual switches.

The limit switch position can only be left by entering the "Tuning" command using the terminal. Only the inverse travel direction is permitted for the circle which moves when the limit switch responds and to which the activated limit switch is allocated.

If a limit switch responds without a motor being active (e.g. during installation, due to a broken wire or a missing jumper at the goniometer), all travel commands of the respective groups 1, 2 or 3 to 6 are rejected. The malfunction must be eliminated manually.

In order to locate the activated limit switch of circle 1 and 2, jumper the four pairs of sockets at the goniometer and observe F200 D0. When D0 becomes 0, then the triggering limit switch was connected to the pair of sockets. This delimitation is normally sufficient for detecting the triggering limit switch. If the limit switch cannot be mechanically released, then the system must be jumpered and travelled backwards.

The following table indicates the direction of motion.

Goniometer type	θ/2θ		θ/θ	
Circle no.	1	2	1	2
Circle	outer	inner	inner	outer
Angle	2θ	θ, ω	emission angle	angle of incidence
Mounts	detector	sample changer	detector	tube
◁ Tuning ▶	anti-clockwise increases	anti-clockwise increases	anti-clockwise increases	clockwise increases
◀ Tuning ▷	clockwise decreases	clockwise decreases	clockwise decreases	anti-clockwise decreases

◀ = selected direction key

If jumpering the pairs of sockets proves unsuccessful, either one of the internal limit switches has responded or the cable connections are defective.

4 Protection Against Radiation

Radiation protection box and tube stand provide the radiation screening measures for the D 5000 measuring position. Controller and monitoring circuits ensure that one screen is always closed and radiation-proof when the X-ray generator is switched on. Alarm lamps indicate when the X-ray generator is switched on ("X-ray ON") and the tube window is open ("shutter open"). The alarm lamps are monitored to check that they are functioning properly.

The D 5000 diffractometer is approved as a fully protected device and has been tested. The approval applies to the configurations and operating values recorded in the certificate BW/360/90/R. Observation of the installation guideline C79298-A3128-A10-*-28 is part of the configuration.

If other configurations or operating modes are used or if radiation protection components are removed or modified, the approval is cancelled and 3 of the X-ray decree on the licensed operation of X-ray equipment then applies.

The safety functions may be eliminated via a keyswitch if required during calibration work in an open beam path. In this case the approval as a fully protected device no longer applies.

The safety functions may not be eliminated in any way other than using the keyswitch.

The key for eliminating the safety functions must only be given to the person responsible for radiation protection measures and must be safely guarded by him or someone appointed by him. Abuse of the key must be prevented.

Caution: Working with an unprotected diffractometer is dangerous. Calibration work with an unprotected unit may only be performed by personnel who are subject to personal dose measurements and medical surveillance.

Only the lowest values for high voltage and tube current may be used.

Use long calibration tools. Never hold your hand in the primary beam.

4.1 Radiation Protection Box

The radiation protection box encloses the measuring position, and is constructed of 2.5 mm iron plate. It screens out scattered radiation from strongly scattering samples of any size even if the aperture of the direct beam is only delimited by the holder of the aperture diaphragm.

The right-hand partition is coated with 2 mm lead and screens out the direct beam.

Additional direct beam screening measures are required if the direct beam of a diffractometer measuring position does not hit the right-hand side partition, such as in the case of the θ/θ diffractometer.

An effective radiation protection thus requires that all items specified in the installation guidelines C79298-A3128-A10-*-28 are installed.

The left-hand partition and the front door may be opened for installation and adjustment work. The maximum length of a side is reduced to 86 cm if the top unit is removed. The diffractometer measuring position is accessed for operation through the lead glass door. These parts of the radiation protection box are monitored.

No further parts may be removed.

4.2 Tube Stand

The tube stand is an essential part of the radiation protection facilities. It has an outlet window for the working beam which can be closed with a 2.4 mm thick W/Cu shutter. Manipulation of the shutter and the surrounding flange plate is not permitted. The SM701 switch in the tube stand is only closed when the tube stand is installed properly. Only then can the shutter be opened. See Section 3.2.2.

4.3 X-ray Safety Circuit and Shutdown Circuit (Overall diagram C79298-A3160-X2-*-12)

- **X-ray safety circuit**

The X-ray safety circuit is an electric circuit of the X-ray generator which supplies earth potential to a safety circuit of the X-ray generator. The safety circuit consists of a power supply, with the negative side connected to earth and the positive pole which feeds the X-ray safety circuit via a relay. The relay picks up and enables the high voltage when the circuit is earthed.

The X-ray safety circuit consists of a series connection of five partial functions:

If the X-ray safety circuit is closed, the radiation alarm lamp E603 ("X-ray ON") on the radiation protection box indicates that the generator high voltage is switched on. The X-ray generator is switched off if the lamp is defective.

The switches S601 to S604 monitor correct installation of goniometer and right-hand partition of the radiation protection box. This monitoring function is also fully active during service operation. It guarantees that the direct beam is directed on the right-hand partition and screened out by it.

The switches S605 to S612 monitor all other screening partitions of the radiation protection box. In service operation they are shortened by the S618 switch. The partitions may thus be removed for service work without switching off the X-ray generator.

The switches S613 and S614 in the radiation protection box are connected in parallel to the switches SK701 and SK702 in the tube stand. The switches S613 and S614 open when the lead glass door of the radiation protection box is opened. The switches SK701 and SK702 open when the tube window is opened. The switches connected in parallel guarantee that the X-ray safety circuit is interrupted and the X-ray generator switched off when lead glass door and tube window are open at the same time. For service purposes, this part of the X-ray safety circuit may be shortened by the S618/1 service switch.

The rip cord connects the X-ray safety circuit to earth potential. It is used to monitor proper installation of the high voltage cable.

- **Shutdown circuit**

The shutdown circuit is an electric circuit of the X-ray generator which supplies the safety circuit of the X-ray generator via the K4 relay. The K4 relay is on the window control module in the control unit. The X-ray generator does not generate high-voltage when the shutdown circuit is open.

The shutdown circuit is opened and the X-ray generator switched off if the X-ray safety function (i.e. lead glass door and tube window open simultaneously) fails. The window control in the control unit uses the S615 switch for monitoring the lead glass door. The SL701 switch in the tube stand supplies the information that the tube window is open. The shutdown circuit fulfills the task of a second independent X-ray safety circuit. This safety function is de-activated during service operation.

The K4 relay can be switched off by a computer command. This enables the computer to switch off the X-ray generator.

- **Alarm lamp monitoring**

E603 alarm lamp ("X-rays ON")

The X-ray safety circuit is opened and the X-ray generator switched off if the E603 alarm lamp is defective.

E604 alarm lamp ("X-rays ON")

The window control module in the control unit monitors the E604 alarm lamp when the X-ray generator high voltage is switched on. The shutdown circuit is opened when this lamp is defective. If the S1 switch is open, a connected E604 lamp remains OFF even if the X-ray generator is switched on.

E605 alarm lamp ("window open")

The window control module in the control unit monitors the E605 alarm lamp when the tube window in the tube stand is open. The shutdown circuit is opened when this lamp is defective.

The S2 switch on the window control module can be opened in systems without the E605 alarm lamp in order to switch off the monitoring function. If the S2 switch is open, a connected E605 lamp remains OFF even if the tube window is open.

E701 and E702 alarm lamps on the tube stand

The U1 optocoupler is activated via the E701 and E702 alarm lamps and the SI701 contact if the tube window is open. The connected fail safe circuit then switches on the holding current for the window magnet. The holding current in the fail safe circuit is interrupted if one of the lamps is defective. The tube window is closed again immediately after it has been opened briefly.

5 Specifications

Weight	630 kg
Cooling-water requirements	
- Flow rate	Min. 3.6 l/min
- Water pressure	5 to 8 bar
- Water temperature	10 to 25 °C
Relative humidity	≤80 %, no condensation

Goniometer

Measuring circle diameter	401 mm; optional 435, 500, 600 mm
Operating position	Horizontal or vertical
Angular range θ and 2θ (without diffractometer mounts)	360°
Step width	0.001°
Angular range with standard mounts	
- with fixed slit diaphragm	$-100° \leq 2\theta \leq +168°$
- with variable divergence diaphragm	$-100° \leq 2\theta \leq +160°$
- with varable divergence and scattered-radiation diaphragm	$-100° \leq 2\theta \leq +154°$
Reproducibility of the angle setting (θ and 2θ)	$\leq \pm 0.0005°$
Absolute accuracy (θ and 2θ)	$\leq \pm 0.005°$
Central clearance in θ ring	155 mm diameter
$\theta/2\theta$ drive	Separately, via 2 stepper motors
Velocity	Max. 1000 °/min
Scanning velocity	Max. 200 °/min
Rotating ring stress capacity	
- Axial thrust	500 N
- Torque perpending to axis	1000 Ncm

Tube stand

X-ray tube	Type F...4KE (air-insulated)
Alignment	Can be tilted and shifted in longitudinal direction
Emission angle	Adjustable between 2° and 8°
Radiation outlet window	Line focus for diffractometer; displaced by 90° for square focus

Diffractometer mounts

Aperture and scattered-radiation diaphragms	Fixed plug-in diaphragms or variable diaphragms
Detector diaphragms	Fixed plug-in diaphragm and diaphragm changer
Collimator (Soller slit)	Primary and secondary: 2.3°
Filter	Plug-in type: V, Mn, Fe, Ni, Zr
Applicable detectors	Scintillation counter, type E proportional counter, position sensitive detector, semiconductor detector

Standard sample changer

Max. sample size with stop bracket, without angle restriction	130 mm x 130 mm x 20 mm; insertion aid for 50 mm x 50 mm, 50 mm and 60 mm diameter and other formats
Max. sample size with stop bracket for symmetrical $\theta/2\theta$ operation	130 mm x 250 mm x 20 mm; can be adapted to various sample shapes: insertion aid for 50 mm x 50 mm, 50 mm and 60 mm diameter and other formats

Rotating/transmission and 0° rotating sample changer

Rotational speed	15, 30, 60, 120 rpm
Scanning velocity	Max. 5400 °/min
Angle positioning	0.28°/step
Sample size	Max. 50 mm diameter
Sample thickness for reflection technique	Max. 40 mm
Sample thickness for transmission technique	Max. 4 mm

Rotating/transmission sample changer

Angular range (2θ) in Reflection technique	
- without sample rotation	0° to 168°
- with sample rotation	20° to 168°
Angular range (2θ) in transmission technique	–100° to 120°

0° rotating sample changer

Angular range (2θ) with or without sample rotation	0° to 168°

Measuring electronics

High-voltage generator	
- High voltage.	0 to 2047 V, selectable in steps of 1 V
Linear amplifier	
- Gain	33, 50, 100
Discriminator	
- Basis	0 to 5 V, selectable in steps of 19.6 mV
- Channel width	0 to 5 V, selectable in steps of 19.6 mV

6 Terminal Operation

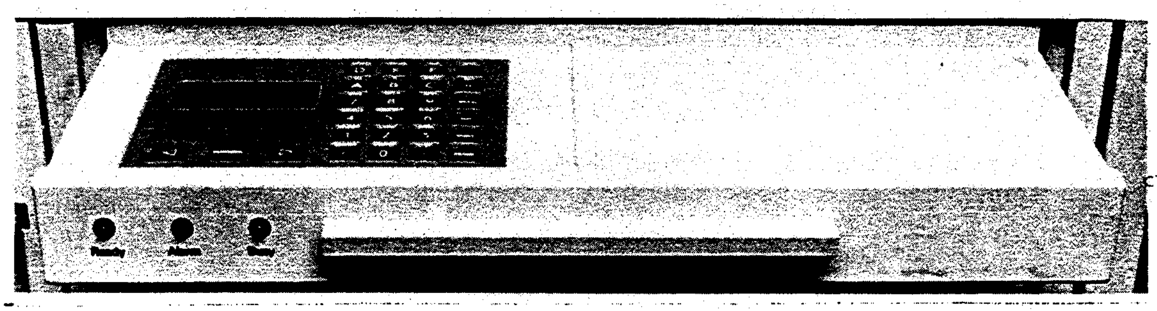

Fig. 6-1 Drawer with terminal

The terminal is used for the following tasks:

- Display of actual values
- Support of device calibration
- Support of device service

6.1 Terminal Design

The terminal consists of an LCD display with 4 lines of 16 characters each and a keyboard. Most keys have a second function.

First key assignment

The key functions inscribed on the keys are valid for the first key assignment.

Second key assignment

The key functions printed above the keys are valid for the second key assignment. The second key assignment becomes active after the SHIFT key has been selected. Pressing the SHIFT key only effects the next key selection.

6.2 Key Assignment

6.2.1 First Key Assignment

The first key assignment consists of

- hexadecimal keys (0 ... F),
- special keys (. , - :),
- function keys (RSTO, DEL, SHIFT, ENTER) and
- manual drive control keys (TUNING, UP [1]), DOWN [2])).

RSTO (Restore)

The previous display is repeated.

DEL (Delete)

The last displayed character to have been entered is deleted. Key legend = triangle pointing to the right

SHIFT

This key selects the second key assignment: the second assignment is available for the following keystroke after the SHIFT key has been pressed.

ENTER

A parameter input is terminated.

TUNING

Enabling the manual drive control (tuning) which has been switched over to this mode by the control word "manual control". Manual control is only active as long as this key is depressed. The selected drive starts only after the direction of motion has been entered using the "UP" or "DOWN" key.

UP, DOWN

Direction of motion and speed in the "TUNING" drive mode. Each keystroke in the same direction increases the speed of the selected drive from the initial speed of 1 pulse/s by a factor of 10 up to the highest possible start/stop speed. The speed is maintained when the direction of motion is reversed.

The drive is stopped and the manual control command cleared when the unit runs in a limit switch allocated to the drive. Subsequently, only the last active drive can be travelled out of the limit switch position. This can only be performed after it has been selected again and is only possible in reverse direction.

If the selected drive has not be calibrated, the coarse angle (= full angular degrees of the programmed reference value) will be accepted as actual value when the reference is driven over in positive direction.

1) Key legend = triangle pointing to the right.

2) Key legend = triangle pointing to the left.

6.2.2 Second Key Assignment

Function:

- Drive control commands
- Input of device parameters
- Display parameterization

CIRCLE

Calibrates, positions and stops goniometer circles 1 to 4, and switches over to manual control (= tuning).

Entry:

<circID>:<controlcommand>(,<targetangle>)

<circID>: integer value

circID	meaning
1	Circle 1
2	Circle 2
3	Circle 3 (Euler, χ)
4	Circle 4 (Euler, ϕ)
12	Circle 2, electronically linked with circle 1

With coupled circles, the following route results according to the diffractometer type for circle 2:

Diffractometer type	Circle 1	Circle 2	Route circle 2
$\theta/2\theta$	Detector circle	Sample circle	$\Delta 1/2$
θ/θ	Detector circle	Tube circle	$\Delta 1$

$\Delta 1$ = route of circle 1

<controlcommand>: integer value

Control commands for circuits 1 to 4:

controlcommand	Meaning
0	Stop, without parameters
1	Calibration, without parameters
2	Position, with parameters
3	Manual control (tuning), without parameters

Note: Control command 1 (calibration) is only accepted if at least the coarse angle (= full angular degrees) of the selected circle is known (angle display = coarse angle) and the drive has not run in an allocated limit switch.

Circles 1 and 2 are always calibrated together.

The parameter <targetangle> is required for <controlcommand> = 2 (position).

<targetangle>: real value

This parameter specifies the target angle for the positioning command. The target value must be inside the valid travel range since limit values of the entry are not checked.

The control command is only accepted if the selected circle has been calibrated (angle display = coarse angle + fine angle) and the drive has not run in an allocated limit switch.

TRANS (Translation)

Calibrates linear drives X and Y, stops and switches over to manual control (= tuning).

Entry:

<translID>:<controlcommand>(,<targetpos>)

<translID>: integer value

translID	Meaning
1	Linear drive X
2	Linear drive Y

<controlcommand>: integer value

controlcommand	Meaning
0	Stop drive, without parameters
1	Calibrate drive, without parameters
2	Position drive, with parameters
3	Manual control (tuning), without parameters

Note: Control command 1 (calibration) is only accepted if the drive has not run in an allocated limit switch.

The parameter <targetangle> is required for <control-command> = 2 (position).

<targetangle>: real value

This parameter specifies the target angle for the positioning command. The target value must be inside the valid travel range since the limit values of the entry are not checked. The control command is only accepted if the selected drive has been calibrated (angle display = coarse angle + fine angle) and has not run in an allocated limit switch.

O/R (Oscillation/Rotation)

Switches sample oscillation or rotation with synchronous motor on and off.

Entry:

<controlcommand>

<controlcommand>: integer value

controlcommand	Meaning
0	Oscillation/rotation off
1	Oscillation/rotation on

ROT (Rotation sample changer)

Controls rotating/transmission sample changer with stepper motor

Entry:

<controlcommand> (, <parameter>)

<controlcommand>: integer value

controlcommand	Meaning
0	Stop drive, without parameters
1	Calibrate drive, without parameters
2	Position drive, with parameters
3	Manual control (tuning), without parameters
4	Rotate drive, with parameters

Control command 2 (= position) is only accepted if the rotating/transmission sample changer is calibrated.

An addition parameter is required for control commands 2 (position) and 4 (rotate). This parameter is dependent on the control command and has the following meaning:

controlcommand = 2: position

<parameter>: integer value

Setpoint value of rotating/transmission sample changer in degrees
Resolution: 0.028°

The control command is only accepted if the drive is calibrated.

controlcommand = 4: rotate

<parameter>: integer value

Coded rotation velocity selection:

parameter	Meaning
1	15 rpm
2	30 rpm
3	60 rpm
4	120 rpm

After this command the drive is uncalibrated.

HV (Detector high voltage)

Displays and selects a high voltage value (in volts) for measuring electronics 1 or 2.

Entry:

<target>:<hv-value>

<target>: integer value

Selects the measuring electronics for the subsequent high voltage value:

target	Meaning
1	Measuring electronics 1
2	Measuring electronics 2

<hv-value>: integer value

High voltage value in volts;
range: $0 \leq$ hv-value ≤ 2047,
resolution: 1 V

LL (Low-level discriminator)

Displays and selects the lower discriminator threshold (in volts) for measuring electronics 1 and 2.

Entry:

<target>:<lld>

<target>: integer value

Selects the measuring electronics for the subsequent discriminator threshold value:

target	Meaning
1	Measuring electronics 1
2	Measuring electronics 2

<lld>: real value

Setting of the lower discriminator threshold (in volts);
range: $0 \leq lld \leq 5$,
resolution: 19.6 mV

WDTH (Discriminator width)

Displays and selects the discriminator window width (in volts) for measuring electronics 1 or 2.

Entry:

<target>:<width>

<target>: integer value

Selects the measuring electronics for the subsequent discriminator window width value:

target	Meaning
1	Measuring electronics 1
2	Measuring electronics 2

<width>: real value

Setting of the discriminator window width (in volts);
range: $0 \leq width \leq 5$,
resolution: 19.6 mV

AG (Amplifier gain)

Displays and selects coded amplifier gain for measuring electronics 1 or 2.

Entry:

<target>:<gain>

<target>: integer value

Selects the measuring electronics for the subsequent gain value:

target	Meaning
1	Measuring electronics 1
2	Measuring electronics 2

<gain>: integer value

Coded gain selection:

gain	Meaning
1	Gain approx. 33
2	Gain approx. 50
3	Gain approx. 100

DIVS (Divergence slit)

Control command for the variable diaphragm 1 (= divergence slit: calibrate, position, stop, follow-up with circle 2)

Entry:

<controlcommand> (, <parameter>)

<controlcommand>: integer value

controlcommand	Meaning
0	Stop drive, without parameters
1	Calibrate drive, without parameters
2	Position drive, with parameters
3	Reserved
4	Automatic follow-up with circuit 2, with parameters

The control commands 2 and 4 are only accepted if the diaphragm has been calibrated.

<parameter>:

An additional parameter is required for control commands 2 and 4. This parameter depends on the control command and has the following significance:

Control command = 2: position

<parameter>: integer value

Setpoint value of the variable diaphragm 1 in steps:
Range: 1 number of steps 400

Control command = 4: automatic diaphragm follow-up with circle 2

(See Section 3.3.2.2 for correlation between irradiated sample surface, diaphragm opening and number of steps for variable diaphragm.)

<parameter>: integer value

Selects an allocation of diaphragm positions to the actual value of circle 2 in order to implement a sample surface with constant irradiation:

param	Meaning
1	Selects allocation for a sample length of 20 mm
2	Selects allocation for a sample length of 6.6 mm

ASCS (Antiscatter slit)

Control command for the variable diaphragm 2 (= antiscatter slit: calibrate,position, stop, follow-up with circle 2)

Entry: <controlcommand> (, <parameter>)

<controlcommand>: integer value

controlcommand	Meaning
0	Stop drive, without parameters
1	Calibrate drive, without parameters
2	Position drive, with parameters
3	Reserved
4	Automatic follow-up with circuit 2, with parameters

The control commands 2 and 4 are only accepted if the diaphragm has been calibrated.

<parameter>:

An additional parameter is required for control commands 2 and 4. This parameter is dependent on the control command and has the following significance:

Control command = 2: position

<parameter>: integer value

Setpoint value of the variable diaphragm 2 in steps:
Range: 1 number of steps 400

Control command = 4: automatic diaphragm follow-up with circle 2

(See Section 3.3.2.2 for correlation between irradiated sample surface, diaphragm opening and number of steps for variable diaphragm.)

<parameter>: integer value

Selects an allocation of diaphragm positions to the actual value of circle 2 in order to implement a sample surface with constant irradiation:

param	Meaning
1	Selects allocation for a sample length of 20 mm
2	Selects allocation for a sample length of 6.6 mm

Note: If automatic follow-up operation has been selected for diaphragm 1 and 2, the last parameter to have been entered determines the allocation between diaphragm position and actual value of circle 2.

DETS (Detector slit)

Control command for the diaphragm changer

Entry: <controlcommand>

<controlcommand>: integer value

controlcommand	Meaning
0	Extend diaphragm
1	Retract diaphragm

SAMPLE

Control command for the automatic sample changer for 40 samples

Entry: <controlcommand> (, <position>)

<controlcommand>: integer value

controlcommand	Meaning
0	Stop, without parameters
1	Calibrate, without parameters
2	Set sample to measuring position, with parameter

Control command 2 is only accepted if the sample changer has been calibrated.

<position>:

The additional parameter <position> (= specification of the magazine position containing the sample) is required for control command 2.

Range: 0 position 40

The sample in the measuring position is moved back to its magazine position when <position> = 0 is entered.

WINDOW (Tube window)

Control command for the tube window

Entry: <controlcommand>

<controlcommand>: integer value

controlcommand	Meaning
0	Close tube window
1	Open tube window

XRAY

Control command for the X-ray generator shutdown circuit

Entry: <controlcommand>

<controlcommand>: integer value

controlcommand	Meaning
0	Open shutdown circuit
1	Close shutdown circuit

INTEGR (Integrator)

Defines the parameters "time constant" for the integrator and "full scale" for the analog output.

Entry: <electr-ID>:<tcosnt>,<fscale>

<electr-ID>:

Selects the measuring electronics for the following parameters:

electr-ID	Meaning
1	Selects measuring electronics 1
2	Selects measuring electronics 2

<tconst>: integer value

Time constant (= measuring time) of the integrator (in seconds);
range: 1 tconst 65535

<fscale>: integer value

Dynamic limit of the analog output in pulses per second;
range: 1 fscale 8388607

CONF (Configure)

Input of unit configuration, drive and interface parameters

Entry: <param-ID>:<param-value1>(,<param-value2>)(,<param-value3>)

<param-ID>: integer value

Selection of the parameter to be entered according to the following allocation:

1 = Reference angle of circle 1

2 = Reference angle of circle 2

3 = Reference angle of circle 3 (Euler χ)

4 = Reference angle of circle 4 (Euler φ)

5 = Reference position of the x co-ordinate

6 = Reference position of the y co-ordinate

7 = Reference angle of the rotation/transmission sample changer

8 = Reference value of the variable diaphragm 1 (divergence slit)

9 = Reference value of the variable diaphragm 2 (antiscatter slit)

10 = Reserved

11 = Drive parameter of circle 1

12 = Drive parameter of circle 2

13 = Drive parameter of circle 3 (Euler χ)

14 = Drive parameter of circle 4 (Euler φ)

15 = Drive parameter of the linear co-ordinate x

16 = Drive parameter of the linear co-ordinate y

17 = Drive parameter of the rotation/transmission sample changer

18 = Reserved

19 = Reserved

20 = Type of unit

21 = System configuration

22 = Baud rate, character length, parity and number of stop bits for the asynchronous serial interface to the external computer

23 = Control parameters for communication between the diffractometer and an external computer

Caution: Very important!

Enter drive parameters before reference values.

A calibration run of the affected drive is required after new reference values (param-ID 1 to 9) have been entered. The reference value is accepted as a new reference point at the end of the calibration run.

The reference values must be entered again and updated by a calibration run of the affected drive after new drive parameters (param-ID 11 to 17) have been entered.

<param-value1>(,<param-value2>)

These values are dependent on <param-ID and have the following significance:

<param-ID> = 1 to 4: reference angle of the circles 1 to 4

Entry: <param-ID>:<param-value>

<param-value>: real value

Reference angle of goniometer circles 1 and 2 and Euler circles χ and φ (in degrees).

<param-ID> = 5 to 6: reference values of the X and Y linear drives

Entry: <param-ID>:<param-value>

<param-value>: real value

Reference value of the x and y linear co-ordinates (in mm)

<param-ID> = 7: reference angle of the rotation/transmission sample changer

Entry: <param-ID>:<param-value>

<param-value>: real value

Reference angle of the rotation/transmission sample changer (in degrees)

<param-ID> = 8 to 9: reference values of the variable diaphragms 1 and 2

Entry: <param-ID>:<param-value>

<param-value>: integer value

Reference value of the variable diaphragm 1 (= divergence slit) or the variable diaphragm 2 (0 antiscatter slit) (in steps)

<param-ID> = 11 to 14: drive parameters of the circles 1 to 4

Entry: <param-ID>:<ratio>,<max-velocity>,<mod>

<ratio>: real value

Drive transmission ratio (in steps/degree)

<max-velocity>: real value

Maximum drive velocity (in degrees/min)

<mod>: real value

Modulus value (periodicity) of the circles 2 to 4 (circle 1 ignores <mod>)

<mod> = 0: drive without modulus function

<param-ID> = 15 to 16: linear drive parameters

Entry: <param-ID>:<ratio>,<max-velocity>,

<ratio>: real value

Drive transmission ratio (in steps/mm)

<max-velocity>: real value

Maximum drive velocity (in mm/s)

<param-ID> = 17: drive parameter of the rotation/transmission sample changer

Entry: <param-ID>:<ratio>,<max-velocity>,<mod>

<ratio>: real value

Drive transmission ratio in steps/degree
(3.57142 for type B8 and B9; 4 for type B123 and B124)

<max-velocity>: real value

Maximum positioning velocity in degrees/min (recommended value: 5400)

<mod>: real value

Modulus value (periodicity) of the rotation/transmission sample changer in degrees

<mod> = 0: rotation/transmission sample changer without modulus function (0 must always be entered with types B8 and B9)

<param-ID> = 20: type of unit

Entry: <param-ID>:<param-value>

<param-value>: integer value

param-value	Meaning
1	θ/θ diffractometer
2	$\theta/2\theta$ diffractometer

Note: Circles 1 and 2 have the following significance, depending on the diffractometer type:

Diffractometer	Circuit 1	Circuit 2
$\theta/2\theta$	Detector circle	Sample circle
θ/θ	Detector circle	Tube circle

<param-ID> = 21: system configuration

Entry: <param-ID>:<param-value>

<param-value>: real value

Sum of the bit significance values of a 16-bit word specifying the existing system configuration, according to the following table:

Value	Meaning
1	Closed Euler's cradle
2	Open Euler's cradle
4	Euler translation with synchronous motor
8	Linear co-ordinate x
16	Linear co-ordinate y
32	Rotation/transmission sample changer with stepper motor
64	Variable diaphragm 1

Value	Meaning
128	Variable diaphragm 2
256	Diaphragm changer
512	Automatic sample changer for 40 samples
1024	Rotation/transmission sample changer with synchronous motor
2048	Measuring electronics 1
4096	Measuring electronics 2

The following table contains the (maximum) system configurations possible:

System element	Possible combinations (maximum)					
Closed or open Euler's cradle	x		x			
Euler translation with synchronous motor	x					
Linear coordinate x			x			x
Linear coordinate y			x			x
Rotation/transmission sample changer with stepper motor		x				
Variable diaphragm 1		x		x	x	x
Variable diaphragm 2		x		x	x	
Diaphragm changer		x		x	x	x
Automatic sample changer for 40 samples					x	
Rotation/transmission sample changerwith synchronous motor				x		x
Measuring electronics 1	x	x	x	x	x	x
Measuring electronics 2		x		x	x	x

<param-ID> = 22:

Baud rate, character length, parity and number of stop bits for the asynchronous serial interface to the external computer

Entry: <param-ID>:<baudr>,<length>,<parity>,<stop-bits>

<baudr>: baudrate

Value	Meaning
6	600 bits/s
12	1200 bits/s
24	2400 bits/s
48	4800 bits/s
96	9600 bits/s

<length>: character length

Value	Meaning
5	5 bits character length
6	6 bits character length
7	7 bits character length
8	8 bits character length

<parity>: parity

Value	Meaning
0	No parity
1	Odd parity
2	Even parity

<stop-bits>: number of stop bits

Value	Meaning
1	1 stop bit
2	2 stop bits

<param-ID> = 23:

Control parameters for communication between the diffractometer and an external computer via an asynchronous serial interface

Entry: <param-ID>:<start>,<out>,<checksum>

<start>: ASCII control character for start of string

Range: 1 start < 20_{16}

<out>: ASCII control character, request to send from external computer to diffractometer

Range: 1 out < 20_{16}

<checksum>: communication with or without string checksum

Value	Meaning
0	Without checksum
1	With checksum

DISPL (Display)

Configuration of status and diagnosis display on the terminal

The configuration of the status/diagnosis display is retained after the diffractometer is switched off.

Entry: <displ-ID>:<line-ID1>(,line-ID2>,...)

<displ-ID>: integer value

Coded display selection:

displ-ID	Meaning
1	Status display
2	Diagnosis display

<line-IDx>:

Is dependent on the display selection and has the following meaning:

displ-ID = 1: status display

<line-ID1>(,line-ID2>,...):

List of up to four integer numbers, separated by a comma. The integer numbers are the code numbers of the status information to be displayed, which is updated every 500 ms. The following table lists the code numbers of the status lines:

Code	Meaning
1	Actual value of circle 1 in degrees
2	Actual value of circle 2 in degrees
3	Actual value of circle 3 (χ) in degrees
4	Actual value of circle 4 (ϕ) in degrees
5	Actual value of the linear co-ordinate x (in mm)
6	Actual value of the linear co-ordinate y (in mm)
7	Actual value of the rotation/transmission sample changer with stepper motor (in degrees)
8	Actual value of the variable diaphragm 1 (in steps)
9	Actual value of the variable diaphragm 2 (in steps)
10	Actual value of the diaphragm changer
11	Actual position of the sample changer for 40 samples
12	Count rate in measuring electronics 1
13	Measuring time in measuring electronics 1
14	Pulse counter in measuring electronics 1
15	Count rate in measuring electronics 2
16	Measuring time in measuring electronics 2
17	Pulse counter in measuring electronics 2
18	Ready messages
19	Warnings
20	Alarms
21	Trap register for generator alarms when the X-ray generator is switched off
22	Mode control word
23	Measuring sequence control word
24	Number of rest steps in step scan mode
25	Number of stored measured values
26	Cause for abortion of a measurement
27	Missing ready messages upon abortion of a measurement
28	Pending alarms upon abortion of a measurement

<line-ID> = 18: ready message from the diffractometer

Hexadecimal display of the sum of the following bit significance values:

Significance	Meaning
0001	Circle 1 in desired position
0002	Circle 2 in desired position
0004	Circle 3 (Euler χ) in desired position
0008	Circle 4 (Euler ϕ) in desired position
0010	Translation x in desired position
0020	Translation y in desired position
0040	Rotation/transmission sample changer with stepper motor in desired position
0080	Variable diaphragm 1 in desired position
0100	Variable diaphragm 2 in desired position
0200	Diaphragm changer in desired position
0400	Automatic sample changer for 40 samples in desired position
0800	High voltage 1 selected
1000	High voltage 2 selected
2000	X-ray generator set
4000	Tube window in desired position
8000	Reserved

<line-ID> = 19: warnings from the diffractometer

Hexadecimal display of the warnings with the following bit significance values:

Significance	Meaning
0001	X-ray generator switched off
0002	X-ray generator shutdown circuit open
0004	Tube window closed
0008	Lead glass door open
0010	High voltage 1 switched off
0020	High voltage 2 switched off
0040	No sample in selected magazine position
0080	Service switch in SERVICE position
0100	Level of de-ionized water
0200	Goniometer temperature > 50 °C
0400	Reserved
0800	Reserved
1000	Reserved
2000	Reserved
4000	Reserved
8000	Reserved

Note: The warnings with significance 0001 to 0080 are pending alarms which are masked (= ineffective) by the external computer.

<line-ID> = 20: effective alarms from the diffractometer

Hexadecimal display of the effective alarms from the diffractometer with the following bit significance values:

Significance	Meaning
0001	X-ray generator switched off
0002	X-ray generator shutdown circuit open
0004	Tube window closed
0008	Lead glass door open
0010	High voltage 1 switched off
0020	High voltage 2 switched off
0040	No sample in selected magazine position
0080	Service switch in SERVICE position
0100	Circuit 1 or 2 in limit switch position
0200	At least one of the circuits 3, 4 or TX, TY in limit switch position
0400	300 V DC for tube window missing
0800	+24 V DC missing
1000	24 V AC missing
2000	+12 V DC missing
4000	–12 V DC missing
8000	Sample changer malfunction (automatic sample changer for 40 samples)

Note: The pending alarms masked by the external computer (= ineffective) are displayed as warnings (see "<line-ID> = 19").

<line-ID> = 21: trap register for generator alarms when the X-ray generator is switched off

Hexadecimal display of the trap register for generator alarms when the X-ray generator is switched off (reserved for future applications)

<line-ID> = 22: mode control word

Decimal display of the mode control word with the following bit significance values:

Significance	Meaning
1	0 = normal mode
	1 = set up mode
2	0 = manually controlled
	1 = remote controlled

<line-ID> = 23: measuring sequence control word

Decimal display of the measuring sequence control word with the following meaning:

Value	Meaning
0	No measuring task in progress
1	Initialization of measuring task
2	Measuring sequence control
3	Wait until diffractometer is ready for measurement
4	Measurement in progress
5	Wait until measuring value memory is free
6	Measuring task aborted

<line-ID> = 26:

Cause for abortion of a measurement with the following code:

Display	Meaning
0	External abortion (= abort command)
1	Abortion due to a pending effective alarm
2	Abortion due to the fact that the unit setting time has been exceeded
3	Abortion due to unsatisfied measuring conditions

<line-ID> = 27:

Missing ready message when a measurement is being aborted

Hexadecimal display of the sum of the following bit significance values:

Significance	Meaning
0001	Circle 1 not in desired position
0002	Circle 2 not in desired position
0004	Circle 3 (Euler χ) not in desired position
0008	Circle 4 (Euler ϕ) not in desired position
0010	Translation x not in desired position
0020	Translation y not in desired position
0040	Rotation/transmission sample changer with stepper motor not in desired position
0080	Variable diaphragm 1 not in desired position
0100	Variable diaphragm 2 not in desired position
0200	Diaphragm changer not in desired position
0400	Automatic sample changer for 40 samples not in desired position
0800	High voltage 1 has not been set
1000	High voltage 2 has not been set
2000	X-ray generator has not been set
4000	Tube window closed
8000	Reserved

<line-ID> = 28:

Pending effective (= unmasked) alarms upon abortion of a measurement

Hexadecimal display with the following bit significance values:

Significance	Meaning
0001	X-ray generator switched off
0002	X-ray generator shutdown circuit open
0004	Tube window closed
0008	Lead glass door open
0010	High voltage 1 switched off
0020	High voltage 2 switched off
0040	No sample in selected magazine position
0080	Service switch in SERVICE position
0100	Circle 1 or 2 in limit switch position
0200	At least one of the circles 3, 4 or TX, TY in limit switch position
0400	300 V DC for tube window missing
0800	+24 V DC missing
1000	24 V AC missing
2000	+12 V DC missing
4000	–12 V DC missing
8000	Sample changer malfunction (automatic sample changer for 40 samples)

<displ-ID> = 2: diagnosis display

<line-ID1>(,<line-ID2>,...):

Coded selection of a maximum of four diagnosis messages which are separated by commas and have the following allocation:

line-ID	Meaning
1	Input register $F048_{16}$
2	Input register $F049_{16}$
3	Input register $F04A_{16}$
4	Input register $F04B_{16}$
5	Input register $F04C_{16}$
6	Input register $F088_{16}$
7	Input register $F089_{16}$
8	Input register $F08A_{16}$
9	Input register $F08B_{16}$
10	Input register $F08C_{16}$
11	Input register $F200_{16}$
12	Fault indication SCEr for the automatic sample changer for 40 samples
13	Program version

The display is updated every 500 ms.

<line-ID> = 1 ... 11:

The 8-bit contents of the input registers with the addresses between F04816 and F20016 are displayed in binary representation.

The meaning of the individual register bits is discussed in Section 6.3.

<line-ID> = 12: Error display for the automatic sample changer for 40 samples with the following code:

Display	Meaning
0	Sample changer free from defects
1	Magazine position 0 (S1) has not been reached
2	Reserved
3	Magazine switch position S3 has not been reached
4	Selected magazine position (S4) has not been reached
5	Sample arm position "magazine" (S5) has not been reached
6	Sample arm position "empty field inquiry" has not been reached
7	Sample arm position "measuring position" has not been reached
8	Sample arm position "magazine feed" has not been reached
9	Reserved
10	Reserved
11	Reserved
12	Rocker position "magazine feed" (S13) has not been reached
13	Rocker position "sample feed" (S13) has not been reached
14	Sample rotation "0° position" (L2) has not been reached
15	Sample rotation "90° position" (L1) has not been reached
16	Reserved
17	Magazine feed travelled in limit switch S1
18	Magazine feed travelled in limit switch S11
19	Illegal magazine feed position
20	Illegal sample arm position
21	Illegal rocker position
22	Illegal sample rotation position

<line-ID> = 13:

Program number and version of the diffractometer control software

STATUS

Retrieves the status displays specified by display code 1 under "DISPL". The display is updated approximately every 500 ms.

DIAGN (Diagnosis)

Retrieves the data storage display specified by display code 1 under "DISPL". The display is updated approximately every 500 ms.

HALT

Stop command for all diffractometer drives and measuring sequences

6.3 Register Assignment

6.3.1 Registers on the "Control Logic 1" Module

Register address F048$_{16}$

D7 D0		
1xxx xxxx	Reference circle 4 [1]	
x1xx xxxx	Angle mark circle 4 [1]	
xx1x xxxx	Reference circle 3 [1]	
xxx1 xxxx	Angle mark circle 3 [1]	
xxxx 1xxx	Reference circle 2 [2]	
xxxx x1xx	Angle mark circle 2 [2]	
xxxx xx1x	Reference circle 1 [2]	
xxxx xxx1	Angle mark circle 1 [2]	x = irrelevant

Register address F049$_{16}$

D7 D0		
0xxx xxxx	Generator shutdown circuit closed	
x1xx xxxx	Upper limit switch circle 4 [1]	
xx1x xxxx	Upper limit switch circle 3 [1]	
xxx1 xxxx	Lower limit switch circle 4 [1]	
xxxx 1xxx	Lower limit switch circle 3 [1]	
xxxx x0xx	Tube window open	
xxxx xx1x	Tube window lamp defective	
xxxx xxx0	Service switch in "SERVICE" position	x = irrelevant

Register address F04A$_{16}$

D7 D0		
1xxx xxxx	HV not set on measuring electronics 1	
x1xx xxxx	24 V AC defective	
xx1x xxxx	+60 V DC defective	
xxx1 xxxx	+24 V DC defective	
xxxx 1xxx	Generator high voltage missing	
xxxx x1xx	Diaphragm changer in position "wide"	
xxxx xx1x	Lead glass door is open	
xxxx xxx1	Goniometer temperature > 50 °C	x = irrelevant

1) Meaning of the circles is dependent on system configuration.

2) Meaning of goniometer circles 1 and 2 is dependent on goniometer type.

Register address F04B16

D7 D0	
0xxx xxxx	Circle 3 in fast motion [1])
x1xx xxxx	Circle 3: Actual value = desired value [1])
xx1x xxxx	Circle 4: Actual value = desired value [1])
xxx0 xxxx	Circle 4 in fast motion [1])
xxxx 1xxx	"X-ray" lamp defective
xxxx x1xx	300 V for tube window defective
xxxx xx1x	Reserved
xxxx xxx1	Reserved

x = irrelevant

Register address F04C16 (X33 front connector)

D7 D0	Bit	Pin no.
1xxx xxxx	7	5
x1xx xxxx	6	4
xx1x xxxx	5	3
xxx1 xxxx	4	2
xxxx 1xxx	3	1
xxxx x1xx	2	15
xxxx xx1x	1	16
xxxx xxx1	0	17

x = irrelevant

1) Meaning of the circles is dependent on system configuration.

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6.3.2 Registers on the "Control Logic 2" Module

Register address $F088_{16}$

D7 D0		
1xxx xxxx	Circle 6 reference [1])	
x1xx xxxx	Circle 6 angle mark [1])	
xx1x xxxx	Circle 5 reference[1])	
xxx1 xxxx	Circle 5 angle mark [1])	
xxxx 0xxx	Circle 6, upper limit switch [1])	
xxxx x1xx	Circle 5, upper limit switch [1])	
xxxx xx0x	Circle 6, lower limit switch [1])	
xxxx xxx1	Circle 5, lower limit switch [1])	x = irrelevant

Register address $F089_{16}$

D7 D0		
0xxx xxxx	S11 (automatic sample changer for 40 samples)	
x0xx xxxx	S12 (automatic sample changer for 40 samples)	
xx0x xxxx	S13 (automatic sample changer for 40 samples)	
xxx1 xxxx	L34 (empty field scanning, sample changer for 40 samples)	
xxxx 1xxx	L2 (automatic sample changer for 40 samples)	
xxxx x1xx	L1 (automatic sample changer for 40 samples)	
xxxx xx1x	Reserved	
xxxx xxx0	S8 (automatic sample changer for 40 samples)	x = irrelevant

Register address F08A16

D7 D0		
1xxx xxxx	High voltage not set on meas. electronics 2	
x0xx xxxx	S7 (automatic sample changer for 40 samples)	
xx0x xxxx	S6 (automatic sample changer for 40 samples)	
xxx0 xxxx	S5 (automatic sample changer for 40 samples)	
xxxx 0xxx	S4 (automatic sample changer for 40 samples)	
xxxx x0xx	S3 (automatic sample changer for 40 samples)	
xxxx xx0x	S2 (automatic sample changer for 40 samples)	
xxxx xxx1	S1 (automatic sample changer for 40 samples)	x = irrelevant

1) Meaning of the circles is dependent on system configuration.

Register address F08B16

D7 D0	
0xxx xxxx	Circle 5 in fast motion [1])
x1xx xxxx	Circle 5: Actual value = desired value [1])
xx1x xxxx	Circle 6: Actual value = desired value [1])
xxx0 xxxx	Circle 6 in fast motion [1])
xxxx 1xxx	Reserved
xxxx x1xx	Reserved
xxxx xx1x	Reserved
xxxx xxx1	Reserved

x = irrelevant

Register address F08C16 (X43 front connector)

D7 D0	Bit	Pin no.
1xxx xxxx	7	5
x1xx xxxx	6	4
xx1x xxxx	5	3
xxx1 xxxx	4	2
xxxx 1xxx	3	1
xxxx x1xx	2	15
xxxx xx1x	1	16
xxxx xxx1	0	17

x = irrelevant

6.3.3 Registers on the "CPU" Module

Register address F20016

D7 D0	
0xxx xxxx	Circle 1: Actual value = desired value [2])
x0xx xxxx	Circle 2: Actual value = desired value [2])
xx0x xxxx	+12 V DC defective
xxx1 xxxx	–12 V DC defective
xxxx 0xxx	Circle 2 in fast motion [2])
xxxx x0xx	Circle 1 in fast motion [2])
xxxx xx1x	Limit switch circle 3 and/or 4, 5, 6 [1])
xxxx xxx1	Limit switch circle 1 and/or 2 [2])

1) Meaning of the circles is dependent on system configuration.
2) Meaning of goniometer circles 1 and 2 is dependent on goniometer type.

7 Interface Between Diffractometer and External Computer

7.1 Hardware

Communication between diffractometer and an external computer uses an asynchronous serial interface in full duplex mode (RS 232C) with programmable baud rate (default value 2400 bits/s) and programmable data format (default: 7 data bits, no parity, 1 stop bit).

See diffractometer computer interface for pin assignment.

7.2 Communication

7.2.1 Communications protocol

Start	Start character (programmable)
DAT1	Data string
DAT2	Data string
...	Data string
...	Data string
DATn	Data string
SUM1	Checksum (option)
SUM2	Checksum (option)
CR	ASCII control character "carriage return"

Start	Programmable ASCII control character (default: ENQ).
Data string	String of printable ASCII characters, contains the information for the receiving end.
Checksum	Option default: with checksum. Character combination of two printable ASCII characters, derived from the sum of the characters from START to DATn modulo 4096. The first character is the result of the addition of the six higher order bits of the sum $+20_{16}$. The second character of the addition of the six lower order bits of the sum $+20_{16}$.

The string including the control characters at the beginnong and end of a data transfer may not be longer than 256 characters.

Data transfer can be interrupted at any time if the receiving end issues the ASCII control character DC3 (X-OFF) and can be re-enabled by the control character DC1 (X-ON).

An incorrect string (character, checksum) causes transmission of the ASCII control character NAK (negative acknowledgement). The transmitting end then repeats data transfer.

7.2.2 Data Transfer from the External Computer to the Diffractometer

Each command sent from the external computer to the diffractometer consists of a command code (two letters) and - if required - one or several arguments, separated by commas.

The external computer sends a command to the diffractometer and checks its acceptance without delay by interpreting the command acknowledgement from the diffractometer. Command acknowledgement is initiated when the external computer sends the programmable transmission request character <OUT>. If the command has been accepted, the command acknowledgement merely consists of the start character, the checksum (option) and the string termination character CR. If the command is rejected, an error message (string code "?") with error number is sent to the computer.

7.2.3 Data Transfer from the Diffractometer to the External Computer

The following types of error messages are sent from the diffractometer to the external computer:

- Error messages
- Parameters
- Measuring results
- Status messages
- Diagnosis data

An **error message** is coded with "?" and is the response of the diffractometer to an illegal command. A 2-digit figure is used in the error message to notify the computer of the reason for rejecting the command.

Error code	Meaning
1	Illegal command
2	Arguments required
3	Incorrect argument(s)
4	Command only permitted in computer mode
5	Command only permitted in set up mode
6	Set up mode active
7	No argument permitted
8	Elements cannot be found
9	Drive position not known
10	Drive not calibrated
11	Drive in limit switch
12	Measuring task in progress
13	High-voltage of x-ray generator switched off
14	Power limit of X-ray generator exceeded
15	No response from x-ray generator

Parameters, measuring results, status messages and **diagnosis data** are transferred to the computer after a command has been issued and authorization for transmission has been given by issuing the request-to-send character <OUT> and the command code (two letters).

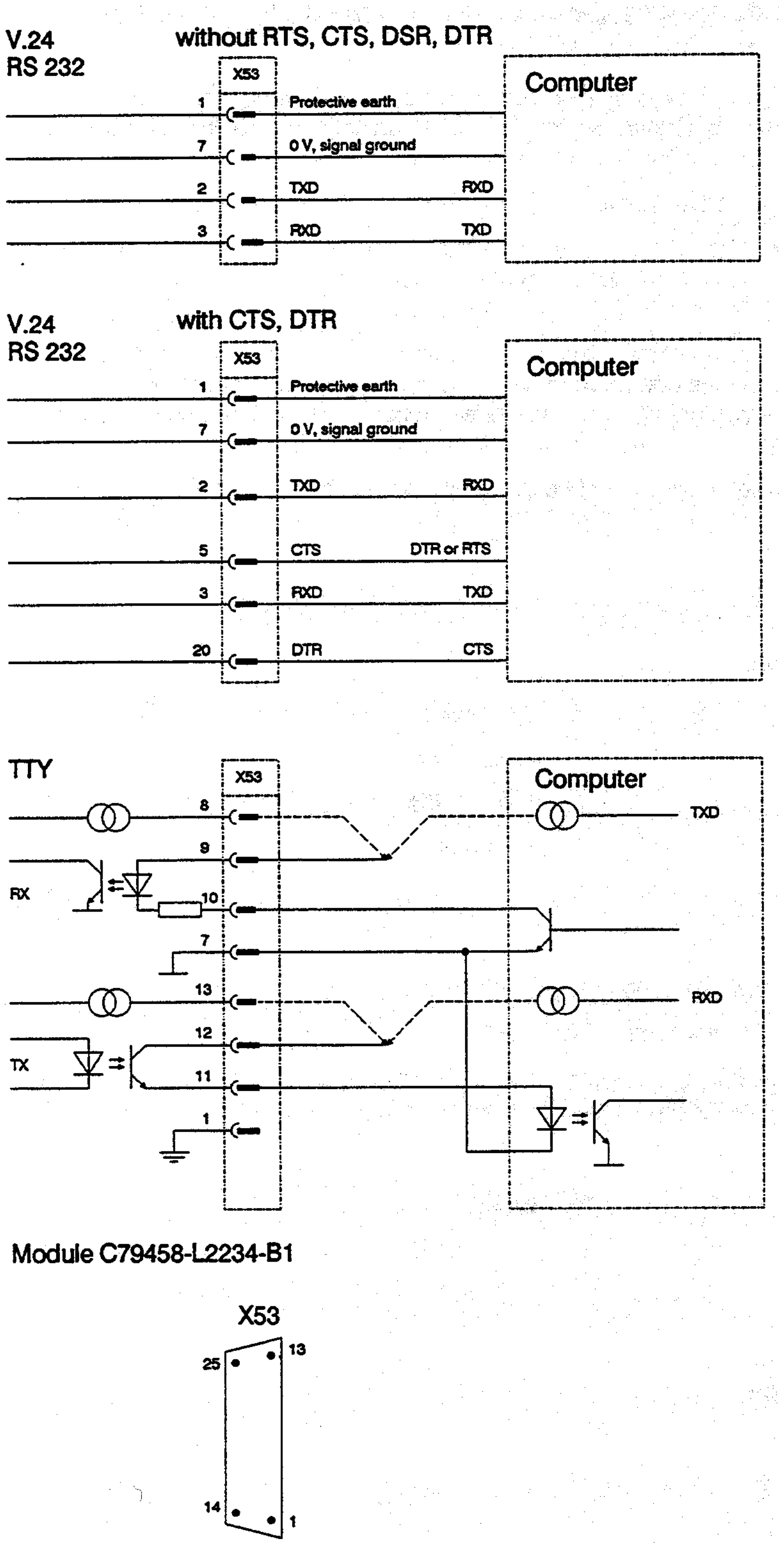

Fig. 7-1 Diffractometer computer interface assignment

7.3 Description of the interface commands from the evaluation computer to the diffractometer

The diffractometer can be controlled by an external computer using a variety of commands. Using the RC1 initialization command, the diffractometer must then be set in "computer control" mode. Status and diagnosis inquiries are permitted in each mode.

The commands are processed in parallel.

Exception: Commands for the same drive and commands regarding measuring sequence control. The previous command is then aborted and the last command to have been entered executed.

A maximum time of 200 ms can elapse between the point in time when an element control command or a measuring sequence control command is given and the start of the execution of this command. The computer can then monitor proper execution by reading the corresponding status information (ready message or measuring sequence control word).

Important: The diffractometer does not check the plausibility and limit values of the received command parameters.

7.3.1 Device definition commands

CN(<type>,<conf>)	**Configure**
PA(<trans>,<speed>,<drive>)	**Parameters**
ZI(<zi-value>,<drive>)	**Zeros Initial**
MO <mod>,<drive>	**Modulus**

Caution: Very important!

These commands are permitted in set up mode only.

Enter drive parameters before reference values.

A calibration run of the affected drive is required after reference values have been altered. The reference value is accepted as a new reference point at the end of the calibration run.

CN<type>,<conf> Configure

Definition of the diffractometer type and the system configuration

<type>: integer value

Value	Diffractometer type
1	θ/θ-diffractometer
2	$\theta/2\theta$-diffractometer

<conf>: integer value

Sum of the bit significance values of a 16-bit word specifying the existing system configuration according to the following table:

Value	Meaning
1	Closed Euler's cradle
2	Open Euler's cradle
4	Euler translation with synchronous motor
8	Linear coordinate x
16	Linear coordinate y
32	Rotation/transmission sample changer with stepper motor
64	Variable diaphragm 1
128	Variable diaphragm 2
256	Diaphragm changer
512	Automatic sample changer for 40 samples
1024	Rotation/transmission sample changer with synchronous motor
2048	Measuring electronics 1
4096	Measuring electronics 2
8192	X-ray generator with remote control

System element	Possible combinations (maximum)					
Closed or open Euler's cradle	x	x				
Euler translation with synchronous motor	x					
Linear coordinate x		x				x
Linear coordinate y		x				x
Rotation/transmission sample changerwith stepper motor			x			
Variable diaphragm 1			x	x	x	x
Variable diaphragm 2			x	x	x	
Diaphragm changer			x	x	x	x
Automatic sample changer for 40 samples					x	
Rotation/transmission sample changer with synchronous motor				x		x
Measuring electronics 1	x	x	x	x	x	x
Measuring electronics 2			x	x	x	x

The following table contains the (maximum) system configurations possible:

CN commands without arguments initiate transfer of the stored system configuration to the external computer.

PA(<trans>,<speed>,<drive>) **Parameters**

Transmission ratio and maximum velocity of the drive <drive>

<trans>: real value

Number of steps per unit (in steps/degree for goniometer circles 1 to 4 and for the rotation/transmission sample changer, in steps/mm for the linear co-ordinates x and y)

<speed>: real value

Maximum velocity (in degrees/min for the goniometer circles 1 to 4, in mm/s for the linear co-ordinates x and y)

Maximum positioning velocity for the rotation/transmission sample changer (in degrees/min)

<drive>: integer value

Coded selection of the drive for which the above parameters apply:

Drive	Meaning
1	Circle 1
2	Circle 2
3	Circle 3 (Euler χ)
4	Circle 4 (Euler ϕ)
5	Linear coordinate x
6	Linear coordinate y
7	Rotation/transmission sample changer

PA commands without parameters initiate transfer of the stored drive parameters to the external computer.

ZI(<zi-value>,<drive>) Zeros Initial

Reference values of the stepper motor drive <drive>

<zi-value>: real value

Drive reference value (in degrees for the goniometer circles 1 to 4 and the rotation/transmission sample changer, in mm for the linear co-ordinates x and y, in steps for the variable diaphragms 1 and 2)

<drive>: integer value

Coded selection of the drive for which the above reference value applies:

Drive	Meaning
1	Circle 1
2	Circle 2
3	Circle 3 (Euler χ)
4	Circle 4 (Euler ϕ)
5	Linear coordinate x
6	Linear coordinate y
7	Rotation/transmission sample changer
8	Variable diaphragm 1
9	Variable diaphragm 2

A calibration run of the affected drive is required after reference values have been altered. The reference value is accepted as a new reference point at the end of the calibration run.

ZI commands without parameters initiate transfer of the stored reference values to the external computer.

MO <mod>,<drive> **Modulus**

Modulus values for the stepper motor drive <drive>

If a modulus value has been entered for a drive, the shortest distance from the starting angle to the target angle will be travelled when a GO command is issued.

<mod>: real value

Drive modulus value (in degrees for the goniometer circles 2 to 4 and the rotation/transmission sample changer with stepper motor)

<mod> = 0: drive without modulus function

<drive>: integer value

Coded selection of the drive for which the above modulus value applies:

Drive	Meaning
1	Reserved
2	Circle 2
3	Circle 3 (Euler χ)
4	Circle 4 (Euler ϕ)
5	Reserved
6	Reserved
7	Rotation/transmission sample changer with stepper motor

7.3.2 Mode selection commands

SU	**Set up**
QU	**Quit**
RC<code>	**Remote Control**

SU **Set up**

Sets the diffractometer to set up mode in order to initialize the commands required specifying the device parameters. This command remains effective until the QU command is issued.

QU **Quit**

Terminates set up mode.

RC<code> **Remote Control**

Sets the diffractometer to "computer control" mode or to the "terminal control" mode, depending on the value of <code>.

<code>: integer value

Control command for selecting the mode:

code	Meaning
0	Terminal control mode
1	Computer control mode

The terminal functions (except display functions) are ineffective in computer control mode.

7.3.3 Commands for setting the measuring parameters

HV <hv-value> (, <electr>)	**High voltage**
AG <gain> (, <electr>)	**Amplifier Gain**
DI(lld>)(, <width>)(, <electr>)	**Discriminator**
IG <tconst> (, <fscale>)(, <electr>)	**Integrator**

HV <hv-value> (, <electr>) **High voltage**

High-voltage value for the measuring electronics selected with <electr>

<hv-value>: integer value

High voltage value in volts;
range: $0 \leq$ hv-value ≤ 2047,
resolution: 1 V

<electr>: integer value

Selects the measuring electronics for the above parameter according to the following code:

electr	Meaning
1	Measuring elekctronics 1 (default)
2	Measuring electronics 2

AG <gain> (, <electr>) **Amplifier Gain**

Gain factor of the measuring electronics selected with <electr>

<gain>: integer value

Coded gain selection:

gain	Meaning
1	Gain approx. 33
2	Gain approx. 50
3	Gain approx. 100

<electr>: integer value

Selects the measuring electronics for the above parameter according to the following code:

electr	Meaning
1	Measuring electronics 1 (default)
2	Measuring electronics 2

DI(lld>)(,<width>)(,<electr>) Discriminator

Values for the lower discriminator threshold and the discriminator width for the measuring electronics selected with <electr>

<lld>: real value

Setting of the lower discriminator threshold (in volts);
range: $0 \leq lld \leq 5$,
resolution: 19.6 mV

<width>: real value

Setting of the discriminator window width (in volts);
range: $0 \leq window \leq 5$,
resolution: 19.6 mV

Without limitation: $5 \leq window \leq 65536$

<electr>: integer value

Selects the measuring electronics for the above parameter:

electr	Meaning
1	Measuring electronics 1 (default)
2	Measuring electronics 2

IG<tconst>(,<fscale>)(,<electr>) Integrator

Defines the parameters "time constant" for the integrator (mean value meter) and "full scale" for the analog output of the measuring electronics <electr>.

<tconst>: real value

Time constant (= measuring time) of the integrator (in seconds);
range: $1 \leq tconst \leq 65535$,
resolution: 0.01 s

<fscale>: integer value

<fscale> is the dynamic limit of the analog output;
range: $1 \leq fscale < 8388607$

<electr>: integer value

Selects the measuring electronics for the above parameter:

electr	Meaning
1	Measuring electronics 1 (default)
2	Measuring electronics 2

Comment: The time constant parameter here has the significance of a measuring time. After the time value "time constant" has elapsed, the mean value is calculated as quotient (counter value/time constant), applied to the analog output as a voltage $0 \leq V \leq 5$ V, displayed or transferred to the computer, if required.

7.3.4 Element control commands

HT(<drive>)	Halt
IN(<drive>)	Initialization
GO<target>,<drive>	Go
OS<ampl>,<speed>,<drive>	Oscillation
RO<rspeed>	Rotation sample changer
SL<scode>	Slit
FD<slcode>	Follow-up Divergence slit
FA<slcode>	Follow-up Antiscatter slit
OR<scode>	Oscillation/rotation
SA<sample>	Sample
TW<scode>	Tube window
XR<scode>	X-ray
OC<mask>,<value>	Output contact

HT(<drive>) **Halt**

Stop command for the drive selected with <drive>

<drive>: integer value

Selecting the drive to be stopped:

Value	Meaning
1	Circle 1
2	Circle 2
3	Circle 3 (Euler χ)
4	Circle 4 (Euler ϕ)
5	Linear coordinate x
6	Linear co-ordinate y
7	Rotation/transmission sample changer with stepper motor
8	Variable diaphragm 1
9	Variable diaphragm 2
10	Automatic sample changer for 40 samples

The drive selected with <drive> must exist.

An **HT** command without parameter stops all drives and measuring sequences.

IN(<drive>) **Initialization**

Calibration of the drive selected with <drive>

<drive>: integer value

Selecting the drive to be calibrated[1]):

Drive	Meaning
1	Circle 1 [1])
2	Circle 2 [1])
3	Circle 3 (Euler χ)
4	Circle 4 (Euler ϕ)
5	Linear coordinate x
6	Linear coordinate y
7	Rotation/transmission sample changer with stepper motor
8	Variable diaphragm 1
9	Variable diaphragm 2
10	Automatic sample changer for 40 samples

An **IN** command without parameters causes calibration of all stepper motor drives, except automatic sample changer for 40 samples, which must be initialized using the separate command **IN10**.

OS<ampl>,<speed>,<drive> **Oscillation**

Control command for software-controlled oscillation of the drive selected with <drive> at a velocity <speed> and a displacement <ampl> from the momentaneous position into the direction specified by <ampl>

<ampl>: real value

Amplitude of the oscillation in the drive unit (in degrees for goniometer circles 1 to 4 and the rotation/transmission sample changer with stepper motor, in mm for the linear coordinates x and y)

<speed>: real value

Velocity of the oscillation (in degrees/min for goniometer circles 1 to 4 and the rotation/transmission sample changer with stepper motor, in mm/s for the linear coordinates x and y)

1) Circles 1 and 2 are always calibrated together.

<drive>: integer value

Selects the drive to oscillate:

Drive	Meaning
1	Circle 1
2	Circle 2
3	Circle 3 (Euler χ)
4	Circle 4 (Euler ϕ)
5	Linear coordinate x
6	Linear coordinate y
7	Rotation/transmission sample changer with stepper motor
8	Reserved
9	Reserved
10	Circles 1 and 2; circle 2 coupled in the same sense [1])
11	Circles 1 and 2; circle 2 coupled in opposite sense [1])

The drive selected with <drive> must exist and be calibrated.

[1]) The following routes result for circles 1 and 2 according to the diffractometer type specified in the **CN** command:

	Circle 2 coupled in the same sense			
Diffractometer type	Circle 1	Circle 2	Routes circle 1	Routes circle 2
$\theta/2\theta$	Detector circle	Sample circle	S1 – I1	(S1 – I1)/2
θ/θ	Detector circle	Tube circle	S1 – I1	S1 – I1

	Circle 2 coupled in opposite sense			
Diffractometer type	Circle 1	Circle 2	Routes circle 1	Routes circle 2
$\theta/2\theta$	Detector circle	Sample circle	S1 – I1	– (S1 – I1)/2
θ/θ	Detector circle	Tube circle	S1 – I1	– (S1 – I1)

S1 = desired angle for circle 1

I1 = actual angle for circle 1

GO<target>,<drive> **Go**

Position drive <drive> to desired value <target>

<target>: real value

Desired position in the drive unit (in degrees for goniometer circles 1 to 4 and the rotation/transmission sample changer with stepper motor, in mm for the linear co-ordinates x and y, in steps for the variable diaphragms)

<drive>: integer value

Coded selection of the drive to be positioned:

Drive	Meaning
1	Circle 1
2	Circle 2
3	Circle 3 (Euler χ)
4	Circle 4 (Euler ϕ)
5	Linear coordinate x
6	Linear coordinate y
7	Rotation/transmission sample changer with stepper motor
8	Variable diaphragm 1
9	Variable diaphragm 2
10	Circles 1 and 2; circle 2 coupled in the same sense [1])
11	Circles 1 and 2; circle 2 coupled in opposite sense [1])

[1]) The following routes result for circles 1 and 2 according to the diffractometer type specified in the **CN** command:

	Circle 2 coupled in the same sense			
Diffractometer type	Circle 1	Circle 2	Routes	
			circle 1	circle 2
θ/2θ	Detector circle	Sample circle	S1 – I1	(S1 – I1)/2
θ/θ	Detector circle	Tube circle	S1 – I1	S1 – I1

	Circle 2 coupled in opposite sense			
Diffractometer type	Circle 1	Circle 2	Routes	
			circle 1	circle 2
θ/2θ	Detector circle	Sample circle	S1 – I1	– (S1 – I1)/2
θ/θ	Detector circle	Tube circle	S1 – I1	– (S1 – I1)

S1 = desired angle for circle 1

I1 = actual angle for circle 1

RO < rspeed > **Rotation sample changer**

Rotation of the rotation/transmission sample changer with stepper motor at velocity < rspeed >

< rspeed > : integer value

Coded selection of the rotation velocity:

rspeed	Meaning
0	Rotation off (default)
1	15 rpm
2	30 rpm
3	60 rpm
4	120 rpm

FD < slcode > **Follow-up divergence slit**

Control command for follow-up operation of the variable diaphragm 1 (divergence slit) with goniometer circle 1

slcode	Meaning
0	Automatic follow-up mode off (default)
1	Selects allocation for a sample length of 20 mm [1])
2	Selects allocation for a sample length of 6 mm [1])

[1]) Allocation between diaphragm position and actual value of circle 2 must be selected in order to achieve a constantly irradiated sample surface.

The diaphragm must be calibrated.

FA < slcode > **Follow-up antiscatter slit**

Control command for follow-up operation of the variable diaphragm 2 (antiscatter slit) with goniometer circle 2

slcode	Meaning
0	Automatic follow-up mode off (default)
1	Selects allocation for a sample length of 20 mm [1])
2	Selects allocation for a sample length of 6 mm [1])

[1]) Allocation between diaphragm position and actual value of circle 2 must be selected in order to achieve a constantly irradiated sample surface.

The diaphragm must be calibrated.

SL<scode> **Slit**

Control command for the diaphragm changer

<scode>: integer value

Control word for the diaphragm changer to extend/retract the diaphragm:

scode	Meaning
0	Extend diaphragm
1	Retract diaphragm

OR<scode> **Oscillation/rotation**

Switching on or off the mechanical sample oscillation (mechanical transformation of a rotational motion with a synchronous motor into an oscillating translatory movement) or the sample rotation using a synchronous motor

<scode>: integer value

Code word for switching on/off oscillation/translatory movement:

scode	Meaning
0	Oscillation/translatory movement off (default)
1	Oscillation/translatory movement on

SA<sample> **Sample**

Control command for the automatic sample changer for 40 samples

<sample>: integer value

Number of the sample to be set in measurement position;
Range: $0 \leq$ sample ≤ 40

<sample> = 0: returns sample from measuring position to magazine.

The sample changer must be calibrated.

TW<scode> **Tube window**

Control command for the tube window

<scode>: integer value

Control word for the tube window:

scode	Meaning
0	Close tube window (default)
1	Open tube window

XR<scode> **X-ray**

Control command for the X-ray generator shutdown circuit

<scode>: integer value

Control word for opening/closing the shutdown circuit

scode	Meaning
0	Open shutdown circuit (default)
1	Close shutdown circuit

OC<mask>,<value> **Output contact**

Sets all binary outputs selected by <mask> to <value>.

<mask>: integer value

Sum of the bit significance values of the binary outputs 1 to 8 according to the following table:

Significance	Binary output number
1	1
2	2
4	3
8	4
16	5
32	6
64	7
128	8

<value>: integer value

Value of the binary outputs selected by <mask>:

value	Meaning
0	High impedance of binary output (inhibited)
1	Low impedance of binary output (conducting)

7.3.5 Commands controlling the measuring sequence

AF<mask>	**Alarm flags**
SS<nstep>,<time>,<size>,<drive>,<mode>(,electr>)	**Step Scan**
SC<nstep>,<time>,<size>,<drive>(,electr>)	**Scan**
HP<hvmin>,<hvmax>,<time>(,electr>)	**High voltage plot**
DP<dimin>,<dimax>,<time>(,electr>)	**Discriminator plot**

AF<mask> **Alarm flags**

<mask>: integer value

Sum of the following bit significance values of alarms to the effect that all subsequent alarms are

Significance	Meaning
1	X-ray generator switched off
2	X-ray generator shutdown circuit open
4	Tube window closed
8	Lead glass door open
16	High voltage 1 not available
32	High voltage 2 not available
64	No sample in magazine
128	Service switch in SERVICE position

ignored. The occurrence of at least one unmasked alarm inhibits measurement or aborts a measurement in progress.

SS<nstep>,<time>,<size>,<drive>,<mode>(,electr>) **Step scan**

Step scan of the stepper motor drive defined by <drive> in <mode> starting at the current position with <nstep> steps of the increment <size>

<nstep>: integer value

Number of steps

<time>: real value

Measuring time/step in seconds;
range: 0.1 ≤ time ≤ 655.35,
resolution: 0.01 s

<size>: real value

Increment in the drive-related unit (in degrees for goniometer circles 1 to 4 and the rotation/transmission sample changer with stepper motor, in mm for the linear co-ordinates x and y, in steps for the variable diaphragms)

<drive>: integer value

Coded selection of the drive to be positioned:

Drive	Meaning
1	Circle 1
2	Circle 2
3	Circle 3 (Euler χ)
4	Circle 4 (Euler ϕ)
5	Linear coordinate x
6	Linear coordinate y
7	Rotation/transmission sample changer with stepper motor
8	Reserved
9	Reserved
10	Circles 1 and 2; circle 2 coupled in the same sense [1])
11	Circles 1 and 2; circle 2 coupled in opposite sense [1])

The drive selected with <drive> must exist and be calibrated.

[1]) The following routes result for circles 1 and 2 according to the diffractometer type specified in the **CN** command:

	Circle 2 coupled in the same sense			
Diffractometer type	Circle 1	Circle 2	Routes circle 1	Routes circle 2
θ/2θ	Detector circle	Sample circle	S1 – I1	(S1 – I1)/2
θ/θ	Detector circle	Tube circle	S1 – I1	S1 – I1

	Circle 2 coupled in opposite sense			
Diffractometer type	Circle 1	Circle 2	Routes circle 1	Routes circle 2
θ/2θ	Detector circle	Sample circle	S1 – I1	– (S1 – I1)/2
θ/θ	Detector circle	Tube circle	S1 – I1	– (S1 – I1)

S1 = desired angle for circle 1

I1 = actual angle for circle 1

<mode>: integer value

Specifies the measuring mode:

mode	Meaning
0	Measuring with drive stopped (step scan)
1	Measuring with drive running (continue step scan)

Addendum to Operating Instructions C79000-B3476-C138:

Warning! The following moving parts of the D 5000 / D 5000 D diffractometer present a risk of injury during installation, start-up and operation and during maintenance and calibration:

Theta circle, 2-theta circle and goniometer mounts.

In step-scan mode, the number of measuring values equals the number of steps +1.

In continue step-scan mode, the travel velocity is <size>/<time> and the number of measuring values equals the number of steps.

<electr>: integer value

Coded selection of the measuring electronics:

electr	Meaning
1	Measuring electronics 1 (default)
2	Measuring electronics 2

SC<nstep>,<time>,<size>,<drive>(,electr>) Scan

Starts the selected drive and counts, during the movement, the pulses which occur within an interval of selectable length. A speed profile is activated at the beginning and end of the path if the drive speed is greater than the start/stop speed of the drive. This means that the measured values in the range

$s_{start} \leq s \leq s_{start} + ((ds/t)/2) \cdot 0{,}5$

where

s_{start} = start position

ds = measuring interval

t = measuring time/interval

must be rejected at the beginning.

In addition, the drive overshoots the calculated end position

$s_{end} = s_{start} + n \cdot ds$ where n = number of measuring intervals

by the distance

$s = ((ds/t)/2) \cdot 0{,}5.$

<nstep>: integer value

Number of steps

<time>: real value

Measuring time/step in seconds;
range: 0.1 ≤ time ≤ 655.35,
resolution: 0.01 s

<size>: real value

Increment in the drive-related unit (in degrees for goniometer circles 1 to 4 and the rotation/transmission sample changer with stepper motor, in mm for the linear co-ordinates x and y)

The quotient <size>/<time> is the travel velocity.

<drive>: integer value

Coded selection of the drive to be positioned:

Drive	Meaning
1	Circle 1
2	Circle 2
3	Circle 3 (Euler χ)
4	Circle 4 (Euler ϕ)
5	Linear coordinate x
6	Linear coordinate y
7	Rotation/transmission sample changer with stepper motor
8	Reserved
9	Reserved
10	Circles 1 and 2; circle 2 coupled in the same sense [1])
11	Circles 1 and 2; circle 2 coupled in opposite sense [1])

The drive selected with <drive> must exist and be calibrated.

[1]) The following routes result for circles 1 and 2 according to the diffractometer type specified in the **CN** command:

	Circle 2 coupled in the same sense			
Diffractometer type	Circle 1	Circle 2	Routes	
			circle 1	circle 2
$\theta/2\theta$	Detector circle	Sample circle	S1 – I1	(S1 – I1)/2
θ/θ	Detector circle	Tube circle	S1 – I1	S1 – I1

	Circle 2 coupled in opposite sense			
Diffractometer type	Circle 1	Circle 2	Routes	
			circle 1	circle 2
$\theta/2\theta$	Detector circle	Sample circle	S1 – I1	– (S1 – I1)/2
θ/θ	Detector circle	Tube circle	S1 – I1	– (S1 – I1)

S1 = desired angle for circle 1

I1 = actual angle for circle 1

<electr>: integer value

Coded selection of the measuring electronics:

mode	Meaning
0	Measuring with drive stopped (step scan)
1	Measuring with drive running (continue step scan)

HP <hvmin>,<hvmax>,<time>(,electr>) **High-voltage plot**

Measuring counting rates as a function of the detector high voltage with the detector high voltage incremented in 5-V steps from <hvmin> to <hvmax>

<hvmin>: integer value

Starting value of the high voltage (in volts);
range: $1 \leq hvmin \leq 2047$,
resolution: 1 V

<hvmax>: integer value

End value of the high voltage (in volts);
range: $hvmin \leq hvmax \leq 2047$,
resolution: 1 V

<time>: real value

Measuring time in seconds;
range: $0.01 \leq time \leq 655.35$

<electr>: integer value

Selects the measuring electronics for the above parameters:

electr	Meaning
1	Measuring electronics 1 (default)
2	Measuring electronics 2

DP <dimin>, <dimax>, <time> (,electr>) **Discriminator plot**

Measuring counting rates as a function of the discriminator position with the lower discriminator threshold incremented in one step at a time (of approximately 0.02 V) from <dimin> to <dimax>. The window width is 1 step (approximately 0.02 V).

<dimin>: real value

Starting value of the lower discriminator threshold (in volts);
range: $0 \leq$ dimin ≤ 5,
resolution: 19.6 mV

<dimax>: real value

End value of the lower discriminator threshold (in volts);
range: dimin $\leq$ dimax ≤ 5,
resolution: 19.6 mV

<time>: real value

Total measuring time in seconds per step;
range: $0.01 \leq$ measuring time per step $\leq$ 655.35,
resolution: 0.01 s

<electr>: integer value

Selects the measuring electronics for the above parameters:

electr	Meaning
1	Measuring electronics 1 (default)
2	Measuring electronics 2

7.3.6 Terminal control commands

DS<displ-ID(,<option)	**Display**
BE(<scode)	**Bell**

DS<displ-ID(,<option) **Display**

Retrieves a display specified by <displ-ID> on the terminal CRT:

<displ-ID: integer value

Coded display selection:

displ-ID	Meaning
1	Status display
2	Diagnosis display
3	Text display

<option>:

Is dependent on the display selection and has the following meaning:

displ-ID = 1: status display

<option>:

List of up to four integer numbers, separated by a comma. The integer numbers are the code numbers of the status information to be displayed, which is updated every 500 ms. The following table lists the code numbers of the status lines:

Code	Meaning
0	Control software version
1	Actual value of circle 1 in degrees
2	Actual value of circle 2 in degrees
3	Actual value of circle 3 (χ) in degrees
4	Actual value of circle 4 (φ) in degrees
5	Actual value of the linear co-ordinate x (in mm)
6	Actual value of the linear co-ordinate y (in mm)
7	Actual value of the rotation/transmission sample changer with stepper motor (in degrees)
8	Actual value of the variable diaphragm 1 (in steps)
9	Actual value of the variable diaphragm 2 (in steps)
10	Actual value of the diaphragm changer
11	Actual position of the sample changer for 40 samples
12	Count rate in measuring electronics 1
13	Measuring time in measuring electronics 1
14	Pulse counter in measuring electronics 1
15	Count rate in measuring electronics 2
16	Measuring time in measuring electronics 2
17	Pulse counter in measuring electronics 2
18	Ready messages
19	Warnings
20	Alarms
21	Trap register for generator alarms when the X-ray generator is switched off
22	Mode control word
23	Measuring sequence control word
24	Number of rest steps in step scan mode
25	Number of stored measured values
26	Cause for abortion of a measurement
27	Missing ready messages upon abortion of a measurement
28	Pending alarms upon abortion of a measurement

The display is discussed in Section 6.2.2.

displ-ID = 2: diagnosis display

<option>:

List of up to four integer numbers, separated by a comma. The integer numbers are the code numbers of the diagnosis data to be displayed, which is updated every 500 ms. The following table lists the code numbers of the diagnosis lines:

line-ID	Meaning
1	Input register $F048_{16}$
2	Input register $F049_{16}$
3	Input register $F04A_{16}$
4	Input register $F04B_{16}$
5	Input register $F04C_{16}$
6	Input register $F088_{16}$
7	Input register $F089_{16}$
8	Input register $F08A_{16}$
9	Input register $F08B_{16}$
10	Input register $F08C_{16}$
11	Input register $F200_{16}$
12	Fault indication SCEr for the automatic sample changer for 40 samples
13	Program version

The display is discussed in Section 6.2.2.

displ-ID = 3: text display

String of any printable ASCII characters (text). The text is displayed on the terminal and may not exceed 64 characters. <CR,LF> is automatically inserted after every 16 characters when the text is output via the terminal.

Note: The display remains on the screen until the next DS command is issued or the display is changed via a terminal input.

A DS command without additional <option> specification causes the display selected by <displ-ID> in the stored configuration to be generated.

BE(<scode>) **Bell**

Switches an audible signal on or off, according to <code>.

<code>: integer value

Control word for an audible signal, according to the following code:

code	Meaning
0	Audible signal off (default)
1	Single sound (duration approx. 0.5 s)
2	Permanent sound (on/off frequency

7.3.7 Commands for reading device status, registers and measured values

ST(<avcd>)	**Status**
RI(<mask>)	**Read input**
RR(<reg-code>)	**Read register(s)**
MV(<nval>)	**Read measured values**

ST(<avcd>) **Status**

Request for transferring status data from the diffractometer to the external computer.

<avcd>: integer value

Selects the status information to be transferred to the external computer

Status messages between diffractometer and external computer

avcd	Meaning
1	Actual value of circle 1 in degrees
2	Actual value of circle 2 in degrees
3	Actual value of circle 3 (χ) in degrees
4	Actual value of circle 4 (ϕ) in degrees
5	Actual value of the linear coordinate x (in mm)
6	Actual value of the linear coordinate y (in mm)
7	Actual value of the rotation/transmission sample changer with stepper motor (in degrees)
8	Actual value of the variable diaphragm 1 (in steps)
9	Actual value of the variable diaphragm 2 (in steps)
10	Actual value of the diaphragm changer
11	Actual position of the sample changer for 40 samples
12	Count rate in measuring electronics 1
13	Measuring time in measuring electronics 1
14	Pulse counter in measuring electronics 1
15	Count rate in measuring electronics 2
16	Measuring time in measuring electronics 2
17	Pulse counter in measuring electronics 2
18	Ready messages
19	Warnings
20	Alarms
21	Trap register for generator alarms when the X-ray generator is switched off
22	Mode control word
23	Measuring sequence control word
24	Number of rest steps in step scan mode
25	Number of stored measured values
26	Cause for abortion of a measurement
27	Missing ready messages upon abortion of a measurement
28	Pending alarms upon abortion of a measurement

ST without argument causes transmission of the complete status information. The individual status information items are separated by commas and transferred to the computer in the order of ascending code numbers. Missing items are replaced by commas.

Status information items with codes between 18 and 28 are decimal figures ≤ 65535 with up to 5 digits. They are the sum of significance values of the following allocation:

Ready messages from the diffractometer

Significance	Meaning
1	Circle 1 in desired position
2	Circle 2 in desired position
4	Circle 3 (Euler χ) in desired position
8	Circle 4 (Euler ϕ) in desired position
16	Translation x in desired position
32	Translation y in desired position
64	Rotation/transmission sample changer with stepper motor in desired position
128	Variable diaphragm 1 in desired position
256	Variable diaphragm 2 in desired position
512	
1024	Automatic sample changer for 40 samples in desired position
2048	High voltage 1 selected
4096	High voltage 2 selected
8192	X-ray generator set
16384	Tube window in desired position
32768	Reserved

Warnings from the diffractometer

Significance	Meaning
1	X-ray generator switched off
2	X-ray generator shutdown circuit open
4	Tube window closed
8	Lead glass door open
16	High voltage 1 switched off
32	High voltage 2 switched off
64	No sample in magazine position
128	Service switch in SERVICE position
256	Water level
512	Goniometer temperature > 50 °C
1024	Reserved
2048	Reserved
4096	Reserved
8192	Reserved
16384	Reserved
32768	Reserved

Note: The warnings with significance 1 ... 128 are pending alarms which are masked (= ineffective) by the external computer.

Alarms from the diffractometer (which can be masked with the AF command)

Significance	Meaning
1	X-ray generator switched off
2	X-ray generator shutdown circuit open
4	Tube window closed
8	Lead glass door open
16	High voltage 1 missing
32	High voltage 2 missing
64	No sample in magazine
128	Service switch in SERVICE position

Note: The pending alarms masked by the computer with the AF command (= ineffective) are displayed as warnings and not as alarms.

Alarms from the diffractometer (which cannot be masked with the AF command)

Significance	Meaning
256	Circle 1 or 2 in limit switch position
512	At least one of the circuits 3, 4 or TX, TY in limit switch position
1024	300 V DC missing
2048	+24 V DC missing
4096	24 V AC missing
8192	±12 V DC missing
16384	60 V DC missing
32768	Sample changer malfunction (automatic 40-sample changer)

Trap register for generator alarms when the X-ray generator is switched off

Significance	Meaning
1	Power limit of X-ray generator exceeded
2	Level of de-ionized water
4	Town water
8	Safety loop
16	X-ray lamp
32	Window lamp
64	Reserved
128	Reserved

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Mode control word

Significance	Meaning
1	0 = diffractometer control active
	1 = set up mode
2	0 = terminal control
	1 = computer control

Measuring sequence control word

Value	Meaning
0	No measuring task in progress
1	Initialization of measuring task
2	Measuring sequence control
3	Wait until diffractometer is ready for measurement
4	Measurement in progress
5	Wait until measuring value memory is free
6	Measuring task aborted

Cause for abortion of a measurement

Display	Meaning
0	External abortion (= abort command)
1	Abortion due to a pending effective alarm
2	Abortion due to the fact that the unit setting time has been exceeded
3	Abortion due to unsatisfied measuring conditions
4	Measured-value memory overflow
5	Measuring task cannot be executed

Missing ready message when a measurement is being aborted

Significance	Meaning
1	Circle 1 not in desired position
2	Circle 2 not in desired position
4	Circle 3 (Euler χ) not in desired position
8	Circle 4 (Euler ϕ) not in desired position
16	Translation x not in desired position
32	Translation y not in desired position
64	Rotation/transmission sample changer with stepper motor not in desired position
128	Variable diaphragm 1 not in desired position
256	Variable diaphragm 2 not in desired position
512	Diaphragm changer not in desired position
1024	Automatic sample changer for 40 samples not in desired position
2048	High voltage 1 has not been set
4096	High voltage 2 has not been set
8192	X-ray generator has not been set
16384	Tube window not in desired position
32768	Reserved

Effective alarms upon abortion of a measurement

Significance	Meaning
1	X-ray generator switched off
2	X-ray generator shutdown circuit open
4	Tube window closed
8	Lead glass door open
16	High voltage 1 switched off
32	High voltage 2 switched off
64	No sample in selected magazine position
128	Service switch in SERVICE position
256	Circle 1 or 2 in limit switch position
512	At least one of the circuits 3, 4 or TX, Ty in limit switch position
1024	300 V DC missing
2048	+24 V DC missing
4096	24 V AC missing
8192	+12 V DC missing
16384	–12 V DC missing
32768	Sample changer malfunction (automatic sample changer for 40 samples)

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RI(<mask>) **Read input**

Reads all binary TTL inputs selected by <mask> and transfers the figure 0 for TTL LOW input levels and the figure 1 for TTL HIGH input levels to the external computer in the order of ascending significance.

<mask>: integer value

Sum of the bit significance values of the binary inputs 1 to 8:

Significance	Number of the binary output
1	1
2	2
4	3
8	4
16	5
32	6
64	7
128	8

An **RI** command without parameters causes transfer of all binary inputs.

Unconnected binary inputs are terminated with 1-kΩ resistors to +5 V and supply TTL HIGH level.

RR(<reg-code>) **Read register(s)**

Command for reading diagnosis data

<reg-code>: integer value

Code number of diagnosis data items with the following allocation:

reg-code	Meaning
1	Input register $F048_{16}$
2	Input register $F049_{16}$
3	Input register $F04A_{16}$
4	Input register $F04B_{16}$
5	Input register $F04C_{16}$
6	Input register $F088_{16}$
7	Input register $F089_{16}$
8	Input register $F08A_{16}$
9	Input register $F08B_{16}$
10	Input register $F08C_{16}$
11	Input register $F200_{16}$
12	Fault indication SCEr for the automatic sample changer for 40 samples
13	Program version
14	Code of the key, that has been actuated at the diffractometer terminal last

<reg-code> = 1 to 11

Sum of bit significance values which are discussed in the Chapter "Register Assignment" and are output as a 3-digit decimal figure ≤ 255

<reg-code> = 12

Error code for the automatic sample changer for 40 samples with the following meaning:

Display	Meaning
0	Sample changer free from defects
1	Magazine position 0 (S1) has not been reached
2	Reserved
3	Magazine switch position S3 has not been reached
4	Selected magazine position (S4) has not been reached
5	Sample arm position "magazine" (S5) has not been reached
6	Sample arm position "empty field inquiry" has not been reached
7	Sample arm position "measuring position" has not been reached
8	Sample arm position "magazine feed" has not been reached
9	Reserved
10	Reserved
11	Reserved
12	Rocker position "magazine feed" (S13) has not been reached
13	Rocker position "sample feed" (S13) has not been reached
14	Sample rotation "0 degree position" (L2) has not been reached
15	Sample rotation "90 degree position" (L1) has not been reached
16	Reserved
17	Magazine feed travelled in limit switch S1
18	Magazine feed travelled in limit switch S11
19	Illegal magazine feed position
20	Illegal sample arm position
21	Illegal rocker position
22	Illegal sample rotation position

<reg-code> = 13

String with program number and version of the internal control software

<reg-code> = 14

Code of the key, that has been actuated at the diffractometer terminal last (maximum 3 digits). If no key has been actuated at the diffractometer terminal after the command **RR14** has been entered last, zero is output

An **RR** command without parameters causes output of all diagnosis data.

MV(<nval>)	**Read measured values**

Command for reading stored measured values

<nval>: integer value

Number of measured values to be transferred in one block to the computer (default = 1)

Measured values are transferred to the computer as integer numbers (range $0 \leq MV \leq 8388607$) together with the code MV. An overflow of the measured value range is displayed by 99 999 999. Only those measured values available will be output if there are less than required.

7.3.8 List of the interface commands

Device definition commands (Section 7.3.1)

CN(<type>,<conf>)	**Configure**
PA(<trans>,<speed>,<drive>)	**Parameters**
ZI(<zi-value>,<drive>)	**Zeros Initial**
MO(<mod>,<drive>)	**Modulus**

Mode selection commands (Section 7.3.2)

SU	**Set up**
QU	**Quit**
RC<code>	**Remote Control**

Commands for setting the measuring parameters (Section 7.3.3)

HV<hv-value>(,<electr>)	**High voltage**
AG<gain>(,<electr>)	**Amplifier Gain**
DI(lld>)(,<width>)(,<electr>)	**Discriminator**
IG<tconst>(,<fscale>)(,<electr>)	**Integrator**

Element control commands (Section 7.3.4)

HT(<drive>)	**Halt**
IN(<drive>)	**Initialization**
GO<target>,<drive>	**Go**
OS<ampl>,<speed>,<drive>	**Oscillation**
RO<rspeed>	**Rotation sample changer**
SL<scode>	**Slit**
FD<slcode>	**Follow-up divergence slit**
FA<slcode>	**Follow-up antiscatter slit**
OR<scode>	**Oscillation/rotation**

SA<sample>,<code>	**Sample**
TW<scode>	**Tube window**
XR<scode>	**X-ray**
OC<mask>,<value>	**Output contact**

Commands controlling the measuring sequence (Section 7.3.5)

AF<mask>	**Alarm flags**
SS<nstep>,<time>,<size>,<drive>,<mode>(,electr>)	**Step scan**
SS<nstep>,<time>,<size>,<drive>(,electr>)	**Scan**
HP<hvmin>,<hvmax>,<time>(,electr>)	**High voltage plot**
DP<dimin>,<dimax>,<time>(,electr>)	**Discriminator plot**

Terminal control commands (Section 7.3.6)

DS<displ-ID>(,<option>)	**Display**
BE(<scode>)	**Bell**

Commands for reading device status, registers and measured values (Section 7.3.7)

ST(<avcd>)	**Status**
RI(<mask>)	**Read input**
RR(<reg-code>)	**Read register(s)**
MV(<nval>)	**Read measured values**

8 Installation

8.1 Installation of Cabinet and Radiation Protection Box

Please follow the Room Planning (C79000-M3476-C139) and Installation Guidelines (C79298--A3128-A10-*-31) when installing the diffractometer system.

The safety switches on the radiation protection box table top must comply with the planned diffractometer configuration according to the Installation Guidelines C79298-A3128-A10-*-28.

8.2 Installing Earth, Mains and Water Connections

The earth and mains connections must comply with the circuit diagram C79298-A3136-A101-*--11.

In order to guarantee faultless operation of the measuring position, all earth connections between

- X-ray generator,
- goniometer,
- tube stand,
- radiation protection box,
- terminal,
- control unit and
- side panels

must be installed as shown in the circuit diagram C79298-A3136-A101-*-11, using cables with cross sections as indicated in the diagram.

All cables leading to the control unit connectors must be fixed with special cable clamps to a clamping rail next to the connector location.

The screen insulation material must be removed in the cable clamp area and the screens pressed against the cabinet by the cable clamps.

If the screen insulation of a cable cannot be removed (e.g. computer cables), the cable is also fixed using a cable clamp. M3 threaded holes below the clamping rail permit the screens of these cables to be connected to earth using an M3 screw.

Water connections are established according to the diagram C79298-A3136-A101-*-12. Refer to the Operating Instructions of X-ray generator and tube stand for connecting these units to the water supply.

8.3 Activating the X-ray Generator Shutdown Circuit

The jumper between 5a and 8a in the X4 generator plug (see circuit diagram C79249-A3028-X1-*--11) must be removed in order to enable the control unit to switch off the X-ray generator in the event of a hazardous situation or on command. This jumper is removed in the factory if the X-ray generator is part of a D 5000 measuring equipment.

8.4 Programming the Control Unit

Caution: Switch off mains before manipulating electronics modules or cables.

The electronics modules contain electrostatically sensitive components. An earthed object should be touched before handling these components or modules.

Before the D5000 measuring position can be commissioned, the control unit modules must be programmed using the programming switches provided, and its configuration and operating parameters entered.

The corresponding program memory must be installed in the CPU.

The above steps have already been performed in an D5000 measuring position. They only require updating if the configuration is changed or control modules are replaced.

Follow the instructions in C79298-A3160-X1-*-37 to set the programming switches and select the program memory (see also module description).

Configuration and operation parameters are entered via the terminal using the CONF command (see Chapter 6).

8.5 Cabling of the Measuring Position

Caution: Switch off mains before manipulating electronics modules or cables.

Plugged connections must be secured by means of screws to ensure durable contact. Poor connections can be destroyed by the stepper motor currents.

The overview circuit diagram C79298-A3160-X1-*-12 shows the D5000 measuring position including all physical components which may be connected, except the position sensitive detector and the high temperature attachment.

All information required for hardware planning and installation can be found in this diagram:

Connection of physical elements, such as automatic sample changer (X212, X213).

Connection of various physical elements to a connector, which only allows one element to be connected. For example: rotation sample changer with stepper motor or Euler cradle circle phi (broken line representation of X232 connecting cable).

Connecting cable type specification for physical elements which are to be connected via a separate cable. For example: goniometer cable C79195-A3533-H400 (X242).

The control unit modules required for element operation. These are the modules featuring the connector of the physical element and the modules which are shown in the overview diagram between these connecting modules and the bus system.

The plug-in location of the modules are shown on the inscription strips on the control unit subrack.

The connector specification "X..." on the control unit for connecting an element.

Caution: The connectors of some elements are identical and may therefore be confused. In addition to the specification "X...", some of these connectors have coloured dots:

X252 (blue dot): box connector to control unit window control (C79458-L2234-B4).

X242 (yellow dot): connection of the goniometer cable to the control unit interface (C79458--L2234-B5).

X54 (red dot): connection of the operator panel to the control unit CPU (C79458-L2234-B1).

In order to prevent damage to the electronics due to incorrect connector installation, the connector specification should be checked against the inscriptions on the control unit before the unit is switched on.

8.6 Elapsed Time Counter and Additional Alarm Lamps

Follow the Installation Guidelines C79298-A3136-A101-*-28 when installing the elapsed time counter.

Follow the Installation Guidelines C79298-A3128-D15...D16-*-31 for connecting the additional alarm lamps.

8.7 Initializing the Goniometer Angle

First, a coarse synchronization of control unit and goniometer is required. Select "tuning" mode on the terminal and set both circles, coming from smaller angles, above the reference point (inner circle 30°, outer circle 60°).

The sample tangent is used as a pointer for the inner circle, the detector direction as a pointer for the outer circle (see Fig. 8-1).

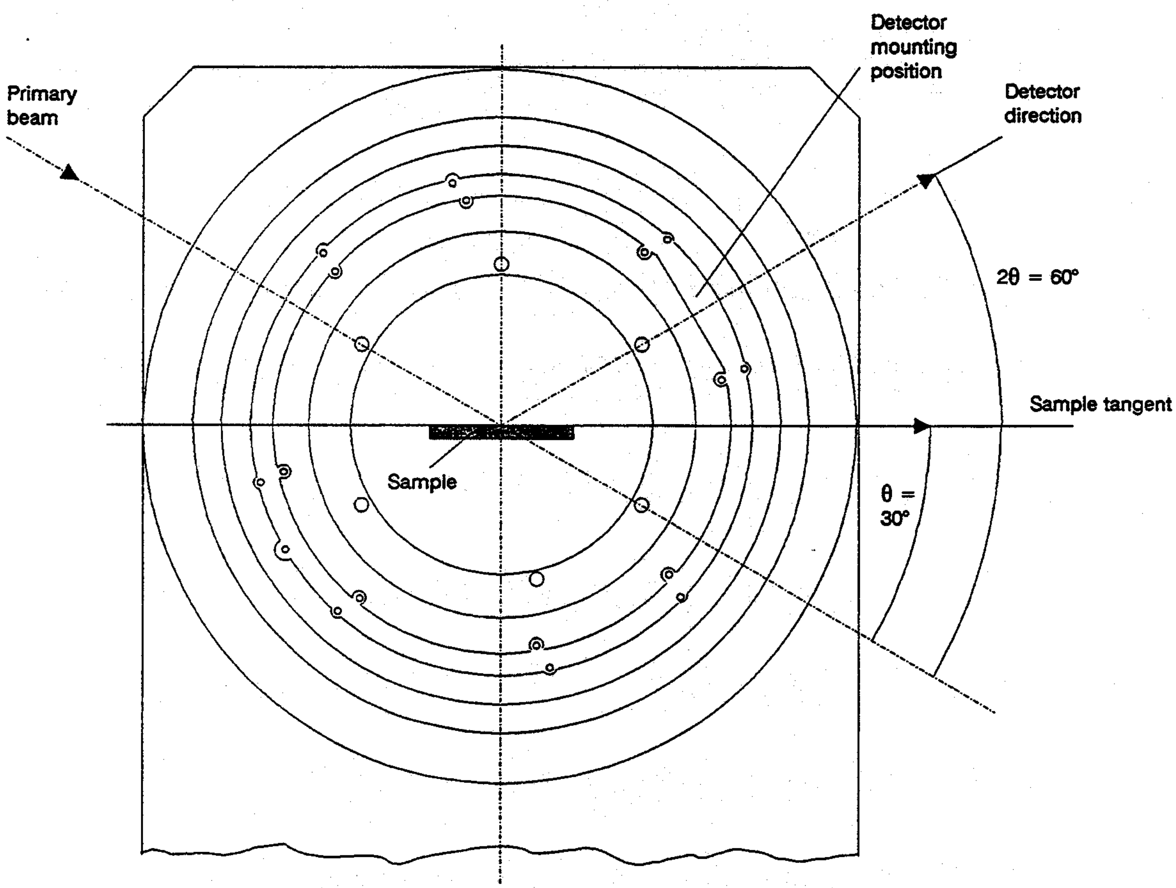


Fig. 8-1 Detector mounting position and sample surface oriented to the drilling pattern of the inner circle as pointer for the reference point position

The coarse angle (without digits after the decimal point) is displayed on the terminal with the reference angle as a reference angle at the reference point.

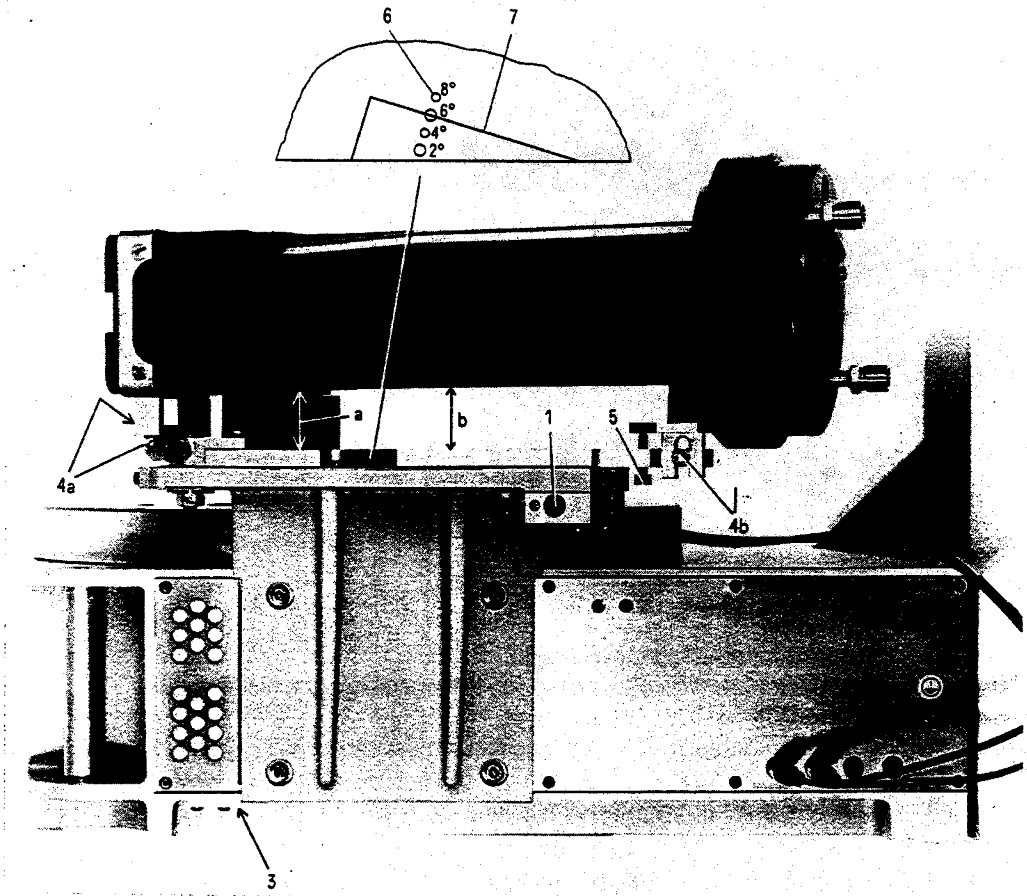
This procedure must always be performed when a coarse angle is stored but, because of alterations, the coarse angle might not be identical to the actual angular position.

The angle is then calibrated in a set run. The fine angle with all decimal digits is then displayed. If the initial coarse angle shows an error of more than 2° in a set run, the latter cannot find the reference point and coarse synchronization is required.

8.8 Install Goniometer and Mounts

Follow the Installation Instructions C79298-A3128-A10-*-28 to install the safety switches, which monitor the goniometer positioning in the radiation protection box according to the model. The diffractometer is to be shifted evenly into the installation fixture.

The goniometer is in a horizontal position when the tube flange and the tube stand are installed.



1 Adjusting screw for take-off angle
3 Stop
4a Front mounting screws of tube stand
4b Rear mounting screw of tube stand
5 Adjusting screw for longitudinal axis
6 Markings for the take-off angle
7 Edge for setting the take-off angle

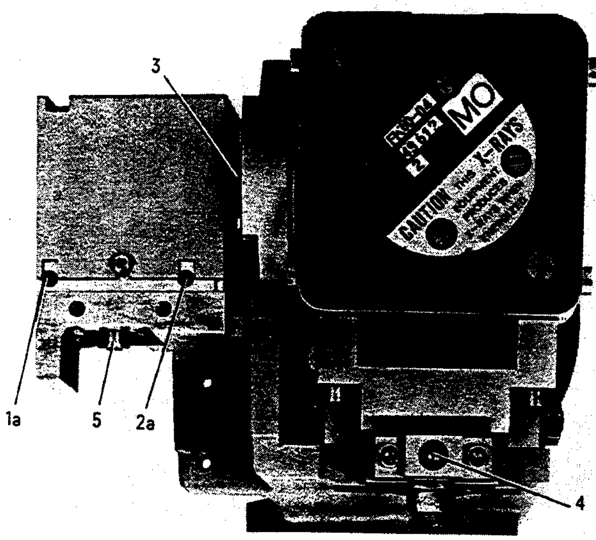
Fig. 8-2 Flange with tube stand

8.8.1 Tube stand and aperture diaphragms

First fix the tube flange to the goniometer using four hexagon socket screws such that it is firmly pressed against the stop (Fig. 8-2.3).

The aperture diaphragm system is fixed from below on the stand at the tube flange using a screw (Fig. 8-3.5) and a spring washer. The adjustment screws (Fig. 8-3.1a/1b and 8-3.2a/2b) of uncalibrated diaphragms are set to the middle of the total calibration travel.

With uncalibrated stop, mount the sample flange at the center of the free space and move the stop to it.



1a Front adjusting screw for aperture diaphragm
1b Rear adjusting screw for aperture diaphragm (on the opposite side, not shown)
2a Front adjusting screw for radiation outlet flange
2b Rear adjusting screw for radiation outlet flange (on the opposite side, not shown)
32 Adapter ring
4 Front adjusting screw
5 Mounting screw for aperture diaphragm holder

Fig. 8-3 Tube stand with aperture diaphragm holder

The tube stand is set onto the tube flange such that the adapter ring (Fig. 8-3.3) of the aperture diaphragm stand projects freely into the opening at the radiation outlet window and is fixed by three screws (Fig. 8-2.4).

It should be noted that the heavy tube stand does not apply any force on the adapter ring. Tube stand and aperture diaphragm system may also be installed in inverse sequence. The front adjustment screw (Fig. 8-3.4 and 8-4.1) is used to set the desired dimension according to Fig. 8-4 if the tube flange has not been calibrated.

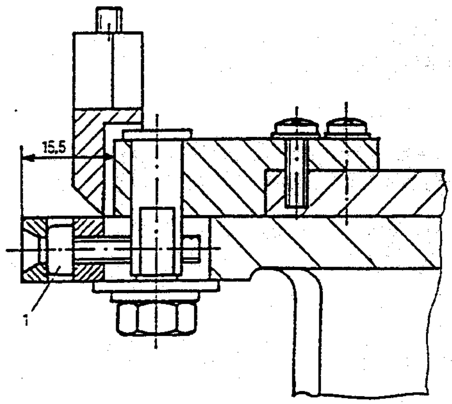
Set the take-off angle.

Set the edge (Fig. 8-2.7) by means of the adjusting screw (Fig. 8-2.1) to the center of the marking (FIg. 8-2.6) which corresponds to the desired take-off angle.

Usually a take-off angle of 6° is used. The focus then appears smaller by a factor of 10.

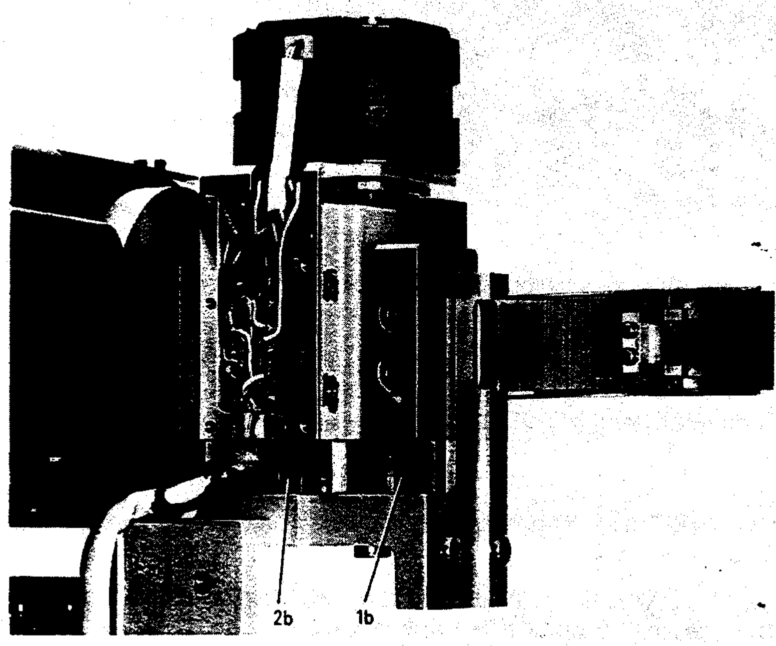
Using the adjustment screw (Fig. 8-2.5) tube axis is aligned in parallel to the goniometer level. The distances a and b must be equal (approximately 40 mm).

Mount the safety bracket (Fig. 3-1.7) with two screws.



1 Front adjusting screw

Fig. 8-4 Desired dimension



1a Front adjusting screw for aperture diaphragm (on the opposite side, not shown)
1b Rear adjusting screw for aperture diaphragm
2a Front adjusting screw for variable aperture diaphragm (on the opposite side, not shown)
2b Rear adjusting screw for variable aperture diaphragm

Fig. 8-5 Aperture diaphragm holder with variable aperture diaphragm

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8.8.2 Sample changer

The angle control must be initialized before the sample changer can be installed.

The circles are travelled to non-critical mechanical values, e.g. 60°/30° in a set run.

When delivered, the sample changer is centred, i.e. the sample level tangents to the mid-vertical of the installation circle and thus the rotary axis of the θ circle.

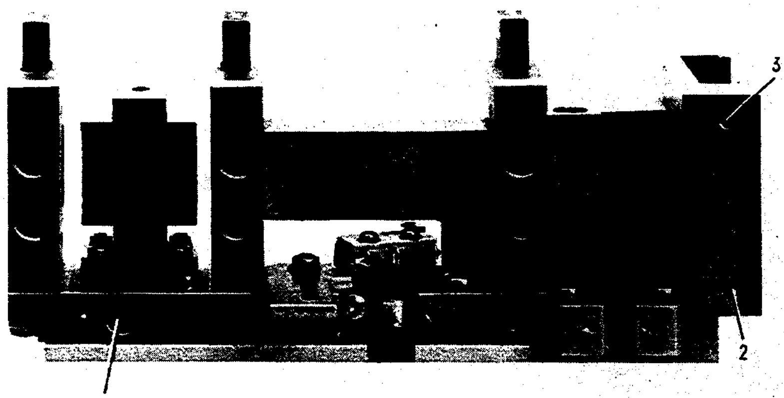
Play-free installation is achieved by proceeding as follows:

Verify that the tensioning screw (Fig. 3-13.2) is relieved of tension.

The sample changer is fixed using three hexagonal socket screws and spring washers. These screws are then each unscrewed by a quarter turn before the tensioning screw is tightened.

The sample changer is then fixed in this position and the tensioning screw loosened.

8.8.3 Detector diaphragm and detector



1a Front adjusting screw for scattered-radiation diaphragm (on the opposite side, not shown)
1b Rear adjusting screw for scattered-radiation diaphragm
2 Detector suppert
3 Securing screw

Fig. 8-6 Detector diaphragm holder with fixed diaphragms

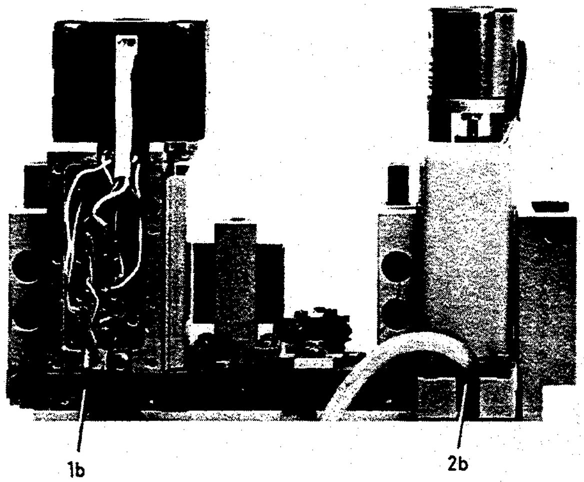
The detector diaphragm holder is fixed in its position using two fit pins and fixed on the detector ring using two hexagonal socket screws.

The limit switch cams must be installed before the detector foot is installed, since the latter covers the opening in which the limit switch cams are to be inserted.

If you wish to bring the diffractometer into a vertical position, it has be done at the latest before mounting the detector.

Insert the detector with socket (Fig. 3-25.5) into the holder (Fig. 8-6.2) of the detector diaphragm holder.

Tighten the locking screw (Fig. 8-6.3).



1a Front adjusting screw for variable scattered-radiation diaphragm (on the opposite side, not shown)
1b Rear adjusting screw for variable scattered-radiation diaphragm
2a Front adjusting screw for detector diaphragm changer (on the opposite side, not shown)
2b Rear adjusting screw for detector diaphragm changer

Fig. 8-7 Detector diaphragm holder with variable scattered-radiation diaphragm and detector diaphragm changer

8.9 Insert X-ray Tube

See Operating Instructions for type S tube stand.

Connect the rip line to the ground plug at the high-voltage plug.

Connect the cable of the tube stand to the multipoint connector X700 in the radiation protection box.

8.10 Set Limit Switch

The limit switches must be set before the diffractometer can be used for measurements. Please verify that all possible collisions have been provided for. All limit switches are connected in series, individually or in groups to the sockets on the goniometer side. Unused socket pairs must be jumpered. The limit switch function is discussed in Section 3.6.4.

9 Parameterizing the Measuring Electronics

Before the unit is calibrated under radiation or before measuring reflections, the electronics parameters must be selected such that all direct beam pulses and/or all pulses from the diffracted beam are recorded.

A scattering body is irradiated with $\theta/2\theta$ of approximately 65°/130° at a setting of 20 kV / 5 mA. The rear of a plastic sample holder, a piece of perspex or the rear of the calibration glass slit may be used as a scattering body. All diaphragms, absorbers or Kβ filters must be removed or opened. Soller slits may remain in the beam path. The scintillation counter must be installed directly behind the detector diaphragm location without any monochromators.

Select the required gain (e.g. 2).

Select the lower threshold as value for the required line position (e.g. 1).

Select the integral channel width.

Starting at 800 V, increase detector high voltage in steps of approximately 50 V until the pulse rate is nearly constant (changes less than 5 % per 50 V).

Select the tube current such that the pulse rate is approximately $4 \cdot 10^4$ pulses/s.

Reduce detector high voltage until half the intensity has been reached.

Set lower threshold to half the value (e.g. 0.5).

The channel width remains integral for measurements using the direct beam.

Set the channel width to twice the lower threshold (e.g. 1) for measurements using the diffracted beam. This setting can be optimized with a strong reflection and a discriminator plot.

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10 Calibrating the Diffractometer

Calibration is performed in order to align all diaphragm centers to the zero direction and to define the zero position of the θ and 2θ scales.

The diffractometer has been calibrated before delivery. The adjustment screw settings should therefore not be altered during commissioning.

The diffractometer is installed with its mounts (see Section 8) and control unit and measuring electronics are initialized (see Section 9).

First-time calibration is limited to defining the zero points of the θ and 2θ scales and checking the diaphragm positions. The adjustment screw settings are only altered if this is required for corrections.

An adjustment screw need therefore not be touched if the control values of all calibration steps are within tolerance.

Calibration is split up into the procedures “measuring check” using the goniometer drives and “selective correction” using the adjustment screws. This enables calibration work to be performed under full protection conditions.

A bell-shaped curve results if beam aperture and detector aperture are approximately equal. The beam direction is identical to the maximum intensity and can be determined using the usual peak value detecting methods. In a different arrangement, the correlation between control angle and intensity shows more squared characteristics without specific maximum. The beam direction in this case is then the edge mean value at 80 % of the maximum value.

If in doubt, the mean value method should be used. Measurements can be computer-controlled or manually performed.

All measurements should start at the small angular values in order to eliminate the gear box influence when changing direction.

The maximum counting rate should be between 1×10^5 and 5×10^5 pulses/s in order to ensure the statistic accuracy of the measured values. The intensity can be adjusted accordingly by setting the X-ray generator and inserting the absorber.

Calibration without glas slit described Section 10.1.5, 10.1.6, 10.2.5 and 10.2.6 (sample: none) presuppose that there is no shadowing of the direct beam in the sample changer. This is not always completely guaranteed with the rotating sample changers. Therefore, for these calibration steps, the sample changer must be turned (90°), so that the direct beam can pass through the cleared center.

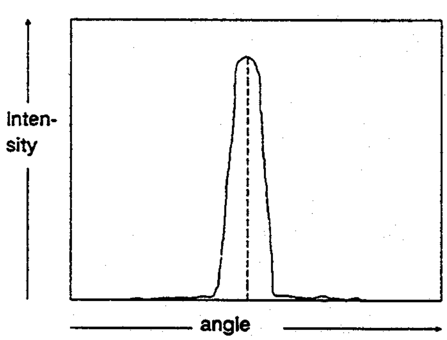

Fig. 10-1 Beam direction according to the maximan

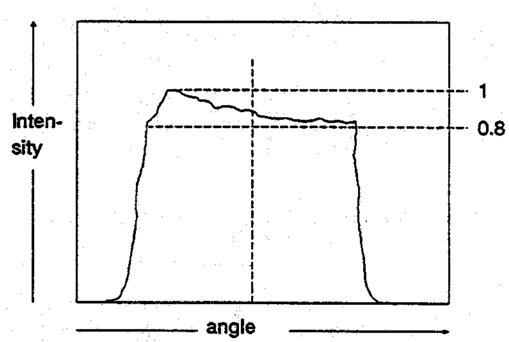

Fig. 10-2 Beam direction according to the mean value of the 80% edges

10.1 Adjustment of the fixed diaphragms

10.1.1 Zero Point Definition of the Θ Scale

Constellation

Variable aperture diaphragm	Not available
Fixed aperture diaphragm	6 mm + absorber
Sample	Glass slit
Fixed scattered-radiation diaphragm	Open
Variable scattered-radiation diaphragm	Not available
Kβ filter	As required
Detector diaphragm	Open
θ without correction	$-1° < \theta < +1°$
2θ without correction	0°

Measures

Search maximum in the range $-1° < \theta < +1°$ with θ.

Consequence

The calibration is o.k. if the zero angle θ_N lies within the range $-1° < \theta_N < +1°$; if not, check sample changer and its installation.

Result

The angle of the fine zero beam on the uncorrected θ scale is θ_N.

10.1.2 Zero Point Definition of the 2Θ Scale

Constellation

Variable aperture diaphragm	Not available
Fixed aperture diaphragm	6 mm + absorber
Sample	Glass slit
Fixed scattered-radiation diaphragm	Open
Variable scattered-radiation diaphragm	Not available
Kβ filter	As required
Detector diaphragm	0,1 mm
θ without correction	Zero angle according to Section 10.1.1
2θ without correction	$-1° < 2\theta < +1°$

Measures

Search maximum in the range $-1° < 2\theta < +1°$ with 2θ.

Consequences

The calibration is o.k. if the zero angle lies within the range $-0.3° < 2\theta_N < +0.3°$.

If $2\theta_N \leq -0.3°$, turn length adjustment screw at the tube flange (Fig. 8-3.4) by $|2\theta_N| \times 70/16$ turns anti-clockwise.

If $2\theta_N \geq +0.3°$, turn length adjustment screw at the tube flange (Fig. 8-3.4) by $|2\theta_N| \times 70/16$ turns clockwise.

Note the play of the adjustment screw.

Calibration steps according to Section 10.1.1 and 10.1.2 must be repeated if tube displacement is necessary.

Result

The zero beam angle on the uncorrected 2θ scale is $2\theta_N$.

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10.1.3 Standardize Angle Scales on the Zero Beam

Measure

Enter $\theta_R = 30° - \theta_N$ as reference angle for θ.

Enter $2\theta_R = 60° - \theta_N$ as reference angle for 2θ.

Execute set run then.

Result

The zero point of the corrected angles is in the zero beam.

Note: This standardization assumes that the zero angles are determined with an uncorrected angle scale (reference angle: 30°/60°). The reference angle $\theta_R = 30° - (\theta_{N1} + \theta_{N2})$ must be entered if the zero angle θ_{N2} is determined with an angle scale corrected with θ_{N1}.

The same applies for 2θ accordingly.

10.1.4 Centering the Scattered-Radiation Diaphragm to the Zero Beam

Constellation

Variable aperture diaphragm	Not available
Fixed aperture diaphragm	6 mm + absorber
Sample	Glass slit
Fixed scattered-radiation diaphragm	0.1 mm
Variable scattered-radiation diaphragm	Not available
$K\beta$ filter	As required
Detector diaphragm	Open
θ without correction	0°
2θ without correction	$-1° < 2\theta < +1°$

Measures

Search maximum in the range $-1° < 2\theta < +1°$ with 2θ.

Consequences

The calibration is o.k. if $|2\theta_{max}| < 0.01°$.

If $2\theta_{max} \geq +0.01°$, turn adjustment screw at the front (Fig. 8-6.1a) by $2\theta_{max} \times 66/16$ turns clockwise and secure using the rear counter screw (Fig. 8-6.1b).

If $2\theta_{max} \leq -0.01°$, turn adjustment screw at the rear (Fig. 8-6.1b) by $2\theta_{max} \times 66/16$ turns clockwise and secure using the front counter screw (Fig. 8-6.1a).

Check with "measures".

Result

The scattered-radiation diaphragm is aligned to the zero beam and thus to the sample center.

10.1.5 Centering the Aperture Diaphragm to the Zero Beam

Constellation

Variable aperture diaphragm	Not available
Fixed aperture diaphragm	0,1 mm
Sample	None
Fixed scattered-radiation diaphragm	6 mm + absorber
Variable scattered-radiation diaphragm	Not available
$K\beta$ filter	As required
Detector diaphragm	1 or 0.1 mm
θ	0° (90° with rotating sample changer)
2θ	$-2° < 2\theta < +2°$

Measures

Activate direct beam in the range $-2° < 2\theta < +2°$ with 2θ and determine the mean value $2\theta_M$ of the 80% edge angles.

Consequences

The calibration is o.k. if $|2\theta_M| < 0.02°$.

If $2\theta_M \geq +0.02°$, turn adjustment screw at the rear (Fig. 8-3.1b) by $2\theta_M \times 47/16$ turns clockwise and secure using the front counter screw (Fig. 8-3.1a).

If $2\theta_M \leq -0.02°$, turn adjustment screw at the front (Fig. 8-3.1a) by $2\theta_M \times 47/16$ turns clockwise and secure using the rear counter screw (Fig. 8-3.1b).

Check with "measures".

Result

The aperture diaphragm is aligned to the zero beam and thus to the sample center.

10.1.6 Centering the Radiation Outlet Flange

Constellation

Variable aperture diaphragm	Not available
Fixed aperture diaphragm	Open
Sample	None
Fixed scattered-radiation diaphragm	Open
Variable scattered-radiation diaphragm	Not available
Kβ filter	As required
Detector diaphragm	0.1 mm + absorber
θ	0° (90° with rotating sample changer)
2θ	$-4° < 2\theta < +4°$

Measures

Activate direct beam in the range $-4° < 2\theta < +4°$ with 2θ and determine the mean value $2\theta_{F1,2}$ of the 80% edge angles.

Consequences

The calibration is o.k. if both $|2\theta_{F1,2}| \geq 3.5°$.

If the absolute value of an edge angle is less than 3.5°and positive, turn adjustment screw at the front (Fig. 8-3.2a) by $(3.5° - |2\theta_F|) \times 16/16$ turns clockwise and secure using the rear counter screw (Fig. 8-3.2b).

If the smaller edge angle is negative, turn adjustment screw at the rear (Fig. 8-3.2b) by $(3.5° - |2\theta_F|) \times 16/16$ turns clockwise and secure using the front counter screw (Fig. 8-3.2a).

Check with "measures".

Result

The radiation outlet flange permits a beam of an aperture angle of 3° to emerge without shading.

10.2 Adjustment of the Variable Diaphragms

10.2.1 Zero Definition of the Θ Scale

Constellation

Variable aperture diaphragm	342 (open)
Fixed aperture diaphragm	6 mm + absorber
Sample	Glass slit
Fixed scattered-radiation diaphragm	Not available
Variable scattered-radiation diaphragm	342 (open)
$K\beta$ filter	As required
Detector diaphragm	Open
θ without correction	$-1° < \theta < +1°$
2θ without correction	0°

Measures

Search maximum in the range $-1° < \theta < +1°$ with θ.

Consequence

The calibration is o.k. if the zero angle θ_N lies within the range $-1° < \theta_N < +1°$; if not check sample changer and its installation.

Result

The angle of the fine zero beam on the uncorrected θ scale θ_N.

10.2.2 Zero Definition of the 2Θ Scale

Constellation

Variable aperture diaphragm	342 (open)
Fixed aperture diaphragm	6 mm + absorber
Sample	Glass slit
Fixed scattered-radiation diaphragm	Not available
Variable scattered-radiation diaphragm	342 (open)
Kβ filter	As required
Detector diaphragm	0,1 mm
θ without correction	Zero angle according to Section 10.2.1
2θ without correction	$-1° < 2\theta < +1°$

Measures

Search maximum in the range $-1° < 2\theta < +1°$ with 2θ.

Consequence

The calibration is o.k. if the zero angle lies within the range $-0.3° < 2\,\theta_N < +0.3°$.

If $2\theta_N \leq -0.3°$, turn length adjustment screw at the tube flange (Fig. 8-3.4) by $|2\,\theta_N| \times 70/16$ turns anti-clockwise.

If $2\theta_N \geq +0.3°$, turn length adjustment screw at the tube flange (Fig. 8-3.4) by $|2\,\theta_N| \times 70/16$ turns clockwise.

Note the play of the adjustment screw.

Calibration steps according to Section 10.2.1 and 10.2.2 must be repeated if tube displacement is necessary.

Result

The zero beam angle on the uncorrected 2θ scale is $2\theta_N$.

10.2.3 Standardize Angle Scales on the Zero Beam

Measure

Enter $\theta_R = 30° - q_N$ as reference angle for θ.

Enter $2\theta_R = 60° - 2\theta_N$ as reference angle for $2\theta_N$..

Execute set run.

Result

The zero point of the corrected angles is in the zero beam.

Note: This standardization assumes that the zero angles are determined with an uncorrected angle scale (reference angle: 30°/60°). If the zero angle θ_{N2} is determined with an angle scale corrected with θ_{N1} the reference angle $\theta_R = 30° - (\theta_{N1} + \theta_{N2})$ must be entered.

The same applies for 2θ accordingly.

10.2.4 Centering the Variable Scattered-Radiation Diaphragm to the Zero Beam

Constellation

Variable aperture diaphragm	342 (open)
Fixed aperture diaphragm	6 mm + absorber
Sample	Glass slit
Fixed scattered-radiation diaphragm	Not available
Variable scattered-radiation diaphragm	10 (closed)
$K\beta$ filter	As required
Detector diaphragm	Open
θ	0°
2θ	$-1° < 2\theta < +1°$

Measures

Search maximum in the range $-1° < 2\theta < +1°$ with 2θ.

Consequences

The calibration is o.k. if $|2\theta_{max}| < 0.01°$

If $2\theta_{max} \geq +0.01°$, turn adjustment screw at the front (Fig. 8-7.1a) by $2\theta_{max}$ x 109/16 turns clockwise and secure using the rear counter screw (Fig. 8-7.1b).

If $2\theta_{max} \leq -0.01°$, turn adjustment screw at the rear (Fig. 8-7.1b) by $2\theta_{max}$ x 109/16 turns clockwise and secure using the front counter screw (Fig. 8-7.1a).

Check with "measures".

Result

The variable scattered-radiation diaphragm is aligned to the zero beam and thus to the sample center.

10.2.5 Centering the Variable Aperture Diaphragm to the Zero Beam

Constellation

Variable aperture diaphragm Fixed	10 (closed) 6 mm + absorber
Sample	None
Fixed scattered-radiation diaphragm Variable	Not available 342 (open)
$K\beta$ filter	As required
Detector diaphragm	1 or 0,1mm
θ	0° (90° with rotating sample changer)
2θ	$-2° < 2\theta < +2°$

Measures

Activate direct beam in the range $-2° < 2\theta < +2°$ with 2θ and determine the mean value $2\theta_M$ of the 80% edge angles.

Consequences

The calibration is o.k. if $|2\theta_M| < 0.02°$.

If $2\theta_M \geq +0.02°$, turn adjustment screw at the rear (Fig. 8-5.2b) by $2\theta_M \times 35/16$ turns clockwise and secure using the front counter screw (Fig. 8-5.2a).

If $2\theta_M \leq -0.02°$, turn adjustment screw at the front (Fig. 8-5.2a) by $2\theta_M \times 35/16$ turns clockwise and secure using the rear counter screw (Fig. 8-5.2b).

Check with "measures".

Result

The variable aperture diaphragm is aligned to the zero beam and thus to the sample center.

10.2.6 Centering the Aperture Plug-in Diaphragm to the Zero Beam

Constellation

Variable aperture diaphragm	342 (open)
Fixed aperture diaphragm	0.1 mm + absorber
Sample	None
Fixed scattered-radiation diaphragm	Not available
Variable scattered-radiation diaphragm	342 (open)
$K\beta$ filter	As required
Detector diaphragm	1 or 0.1 mm
θ	0° (90° with rotating sample changer)
2θ	$-2° < 2\theta < +2°$

Measures

Activate direct beam in the range $-2° < 2\theta < +2°$ with 2θ and determine the mean value $2\theta_M$ of the 80% edge angles.

Consequences

The calibration is o.k. if $|2\theta_M| < 0.02°$.

If $2\theta_M \geq +0.02°$, turn adjustment screw at the rear (Fig. 8-5.1b) by $2\theta_M \times 47/16$ turns clockwise and secure using the front counter screw (Fig. 8-5.1a).

If $2\theta_M \leq -0.02°$, turn adjustment screw at the front (Fig. 8-5.1a) by $2\theta_M \times 47/16$ turns clockwise and secure using the rear counter screw (Fig. 8-5.1b).

Check with "measures".

Result

The aperture diaphragm is aligned to the zero beam and thus to the sample centre.

10.3 Calibrating the Detector Diaphragm Changer

For the basic calibration, it is assumed that the detector diaphragm changer is open or has not been inserted.

The detector diaphragm changer is calibrated after basic calibration. The diaphragm changer is aligned to the zero beam such that the zero angles of the fixed diaphragm and the detector diaphragm changer are the same.

Constellation

The constellation is the same as in Section 10.1.2.

Measures

Determine the zero angle of the plug-in diaphragm ($2\theta_{NS}$) with open detector diaphragm changer according to Chapter 10.1.2. Remove detector plug-in diaphragm and select the diaphragm changer. Determine the zero angle with diaphragm changer ($2\theta_{NW}$) in the same manner as with the plug-in diaphragm.

Consequence

The calibration is o.k. if $|2\theta_{NW} - 2\theta_{NS}| < 0.01°$.

If $2\theta_{NW} - 2\theta_{NS} \leq -0.01°$, turn adjustment screw at the front (Fig. 8-7.2a) by $|2\theta_{NW} - 2\theta_{NS}| \times 173/16$ turns clockwise and secure using the rear counter screw (Fig. 8-7.2b).

If $2\theta_{NW} - 2\theta_{NS} \geq +0.01°$, turn adjustment screw at the rear (Fig. 8-7.2b) by $|2\theta_{NW} - 2\theta_{NS}| \times 173/16$ turns clockwise and secure using the front counter screw (Fig. 8-7.2a).

Check with "measures".

Result

The angular values of plug-in diaphragm and diaphragm changer are identical.

10.4 Adjustment with Open Eulerian Cradle

The objective of the adjustment is to align the zero beam on the fulcrum of the Eulerian cradle, the alignment of all diaphragm centres to the zero direction and determination of the zero of the θ and the 2θ scales.

The general remarks on adjustment of the diffractometer (page 10-1) must also be observed.

The correct horizontal position of the focal spot should be guaranteed by carrying out an adjustment with a standard sample changer according to Sections 10.1.1 and 10.1.2.

Adjustment of the Eulerian coordinates x and y must be carried out using a mandrel and telescope. x, y and z should be adjusted such that the movement of the mandrel tip becomes as small as possible when χ and ϕ are varied. If nothing is specified with all subsequent adjustments, the x and y coordinates remain at these adjusted values x_N and y_N.

The value 0° must be set for the Eulerian coordinate ϕ with all subsequent adjustments, if ϕ is not specified.

10.4.1 Adjustment of Focal Spot Height, Determination of Zero Angle $2\theta_0$

Constellation

Fixed aperture diaphragm	Open
Diaphragm close to sample	Not fitted
Sample	Diaphram holder with 0.05-mm diaphragm
Fixed scattered-radiation diaphragm	Open
Soller slit	Not fitted
Detector diaphragm	0.3-mm aperture hole [1])
χ	+45° / 0° / – 45°
θ	0°
2θ	$-1° < 2\theta < +1°$

[1]) Aperture hole at rated height, not corrected for height!

Measures

With 2θ in the range $-1° < 2\theta < +1°$, search for the maximum for $\chi = +45°$, 0° and – 45°:

$A = 2\theta_{max}$ ($\chi = +45°$), $B = 2\theta_{max}$ ($\chi = 0°$) and $C = 2\theta_{max}$ ($\chi = -45°$).

Consequences

The adjustment is correct if $|C - A| < 0.03°$.

If $(C - A) \geq 0.03°$, reduce the distance from the focal spot to the goniometer plane by
h (in mm) = $2.18 \cdot (C - A)$ (in degrees).

If $(C - A) \leq -0.03°$, increase the distance from the focal spot to the goniometer plane by
h (in mm) = $2.18 \cdot (A - C)$ (in degrees).

Check with “Measures”.

Result

The focal spot, fulcrum of the Eulerian cradle and the detector aperture at $2\theta_0$ are in a straight line. Thus the zero beam passes through the fulcrum of the Eulerian cradle.

$2\theta_0 = 3.41\ B - 1.21 \cdot (C + A)$

10.4.2 Adjustment of Long Aperture Slit Close to the Sample

Constellation

Fixed aperture diaphragm	Open
Aperture slit close to the sample	Fitted
Sample	Diaphram holder with 0.05-mm diaphragm
Fixed scattered-radiation diaphragm	Open
Soller slit	Not fitted
Detector diaphragm	0.1 mm
χ	$+45° / -45°$
θ	0°
2θ	$-1° < 2\theta < +1°$

Measures

With 2θ in the range $1° < 2\theta < +1°$, search for the maximum for $\chi = +45°$ and $-45°$:

$S = 2\theta_{max.}$ ($\chi = +45°$), $P = 2\theta_{max}$ ($\chi = -45°$).

Consequences

The adjustment is correct if $|S - P| < 0.01°$.

If $(S - P) \geq +0.01°$, turn the bottom screw on the aperture close to the sample by $20 \cdot (S - P)/16$ turns counterclockwise, and the top screw clockwise by the same amount.

If $(S - P) \leq -0.01°$, turn the top screw on the aperture close to the sample by $20 \cdot (P - S)/16$ turns counterclockwise, and the bottom screw clockwise by the same amount.

Check with "Measures".

Result

The aperture slit close to the sample is aligned to the Eulerian fulcrum.

10.4.3 Adjustment of Long Aperture Hole Close to the Sample

Constellation

Fixed aperture diaphragm	Open or 6-mm diaphragm + absorber
Aperture hole close to the sample	Fitted
Sample	Sample holder with 45° diaphragm
Fixed scattered-radiation diaphragm	Open
Soller slit	Not fitted
Detector diaphragm	Open
χ	90° / 0°
φ	0° / 180°
θ	0°
2θ	0°
x	27 mm < x < 33 mm

Measures

With x in the range 27 mm < x < 33 mm for χ = 90° and 0° with ϕ = 0° and 180°, search the maximum:

$L = x_{max}$ (χ = 90° / ϕ = 0°); $M = x_{max}$ (χ = 0° / ϕ = 0°); $Q = x_{max}$ (χ = 90° / ϕ = 180°); $R = x_{max}$ (χ = 0° / ϕ = 180°).

Consequences

The adjustment is correct If $|Q - R| < 0{,}05$ mm and $|L - M| < 0.02$ mm.

If $(Q - R) \geq 0.05$ mm, turn the front screw on the aperture hole close to the sample $16 \cdot (Q - R)/16$ turns counterclockwise and the rear screw clockwise by the same amount.

If $(Q - R) \leq -0.05$ mm, turn the rear screw on the aperture hole close to sample the by $16 \cdot (R - Q)/16$ turns counterclockwise and the front screw clockwise by the same amount.

If $(L - M) \geq 0.02$ mm, turn the bottom screw on the aperture hole close to sample the by $14 \cdot (L - M)/16$ turns counterclockwise and the top screw clockwise by the same amount.

If $(L - M) \leq -0.02$ mm, turn the top screw on the aperture hole close to sample the by $14 \cdot (M - L)/16$ turns counterclockwise and the bottom screw clockwise by the same amount.

Check with “Measures”.

Result

The aperture hole close to the sample is aligned to the Eulerian fulcrum.

10.4.4 Adjustment of Sample Height of Eulerian Cradle (z Coordinate)

a) θ scan

Constellation

Fixed aperture diaphragm	Open
Aperture slit close to sample	Any
Sample	Sample holder with glass slit
Fixed scattered-radiation diaphragm	Open
Soller slit	Not fitted
Detector diaphragm	Open
χ	0°
θ	$-1° < \theta < +1°$
2θ	0°

Measures

With θ in the range $-1° < \theta < +1°$, search the maximum (θ_N).

Consequences

If the zero angle θ_N is in the range $-1° < \theta_N < 1°$, normalize the θ angle scale onto the zero beam according to Section 10.1.3; otherwise check the Eulerian cradle and its assembly, and repeat the complete adjustment according to Section 10.4.

Result

The angle of the zero beam on the newly normalized θ scale is 0°.

b) 2θ scan

Constellation

Fixed aperture diaphragm	Open
Aperture slit close to sample	Any (as with Section 10.4.4a)
Sample	Sample holder with glass slit
Fixed scattered-radiation diaphragm	Open
Soller slit	Not fitted
Detector diaphragm	0.1 mm
χ	0°
θ	0°
2θ	$-1° < 2\theta + 1°$

Measures

With 2θ in the range $-1° < 2\theta < +1°$, search the maximum ($2\theta_N$).

Consequences

If $|2\theta_N - 2\theta_0| < 0.003°$, normalize the 2θ scale to the zero beam according to Section 10.1.3 ($2\theta_0 = 3.41B - 1.21 \cdot (C + A)$; see Section 10.4.1).

If $2\theta_N - 2\theta_0 \geq 0.003°$, reduce the sample height z of the Eulerian cradle by Δz (in mm) $= 2.18 \cdot (2\theta_N - 2\theta_0)$ (in degrees).

If $2\theta_N - 2\theta_0 \leq -0.003°$, increase the sample height z of the Eulerian cradle by Δz (in mm) $= 2.18 \cdot (2\theta_0 - 2\theta_N)$ (in degrees).

Check the adjustments with "Measures" as in Sections 10.4.4a and 10.4.4b.

Result

The angle of the zero beam on the newly normalized 2θ scale is 0°.

10.4.5 Centering the Scattered Radiation Diaphragm, Aperture Diaphragm and Radiation Outlet Flange to the Zero Beam

With $\chi = 0°$, proceed according to Sections 10.1.4, 10.1.5 and 10.1.6.

Appendix

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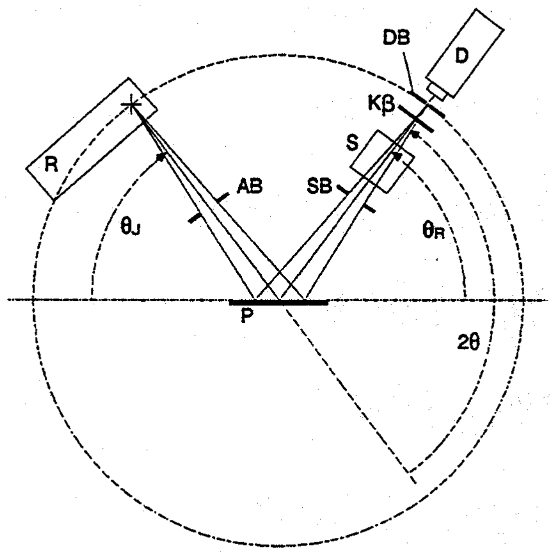
A Θ/Θ Diffractometer

A.1 Method of Operation

The θ/θ diffractometer is used for diffraction measurements of a fixed horizontal sample. For this purpose, both the X-ray tube with aperture diaphragms and the detector with its aperture system are rotated on a circle around the sample surface centre and the angle of incidence θ_J and the angle of reflection θ_R set. The diffraction angle follows the equation $2\theta = \theta_J + \theta_R$. Fig. A-1 shows the beam path.



θ_J	Angle of incidence	P	Sample
θ_R	Angle of reflection	R	X-ray tube
AB	Aperture diaphragm	S	Soller slit
D	Detector	SB	Scattered-radiation diaphragm
DB	Detector diaphragm		
Kβ	Kβ filter		

Fig. A-1 θ/θ diffractometer beam path

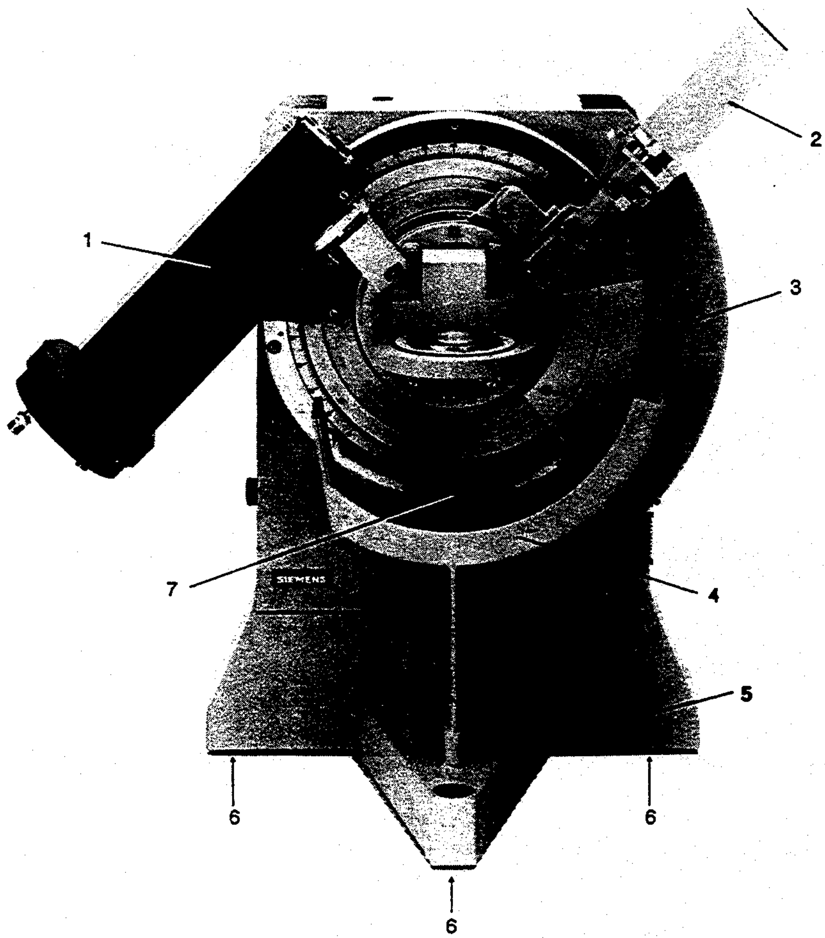
A.2 Application

A permanently horizontally fixed sample surface enables investigations to be performed on samples which would be destroyed when tilted (liquids, liquid-solid junctions, sensitive powders) and with samples which do not allow any movement due to their weight or shape (rail sections, turbine blades, archaeological samples etc.). As the required aggregates can be installed at fixed locations, the θ/θ diffractometer is particularly suitable for all types of investigation where a specific medium is applied to the sample (evacuated sample rooms, inert gas conditions, high and low temperatures etc.). The large X-ray tube range of up to 168° enables stress measurements of stationary samples according to the ω method.

A.3 Design

The θ/θ diffractometer uses the same basic structure as the θ/2θ diffractometer: tube stand, controller and X-ray generator, radiation protection box, goniometer and superstructure. The individual components are described in Chapter 3.

A sturdy foot (5) provides a solid stand, even for heavy superstructures. The three resting points (6) can be adjusted in height which enables the sample surface to be horizontally aligned. The one-sided weight of the tube stand is compensated by a counter weight (3). Both tube stand (1) and counter weight are fixed to the outer ring. A clip at the tube stand end provides for proper cable guidance during the motion.



1 Tube stand and X-ray tube
2 Detector
3 Counter weight
4 Primary-beam trap
5 Foot
6 Height-adjustable resting points
7 Angle limit stop at $\theta_J = 87°$

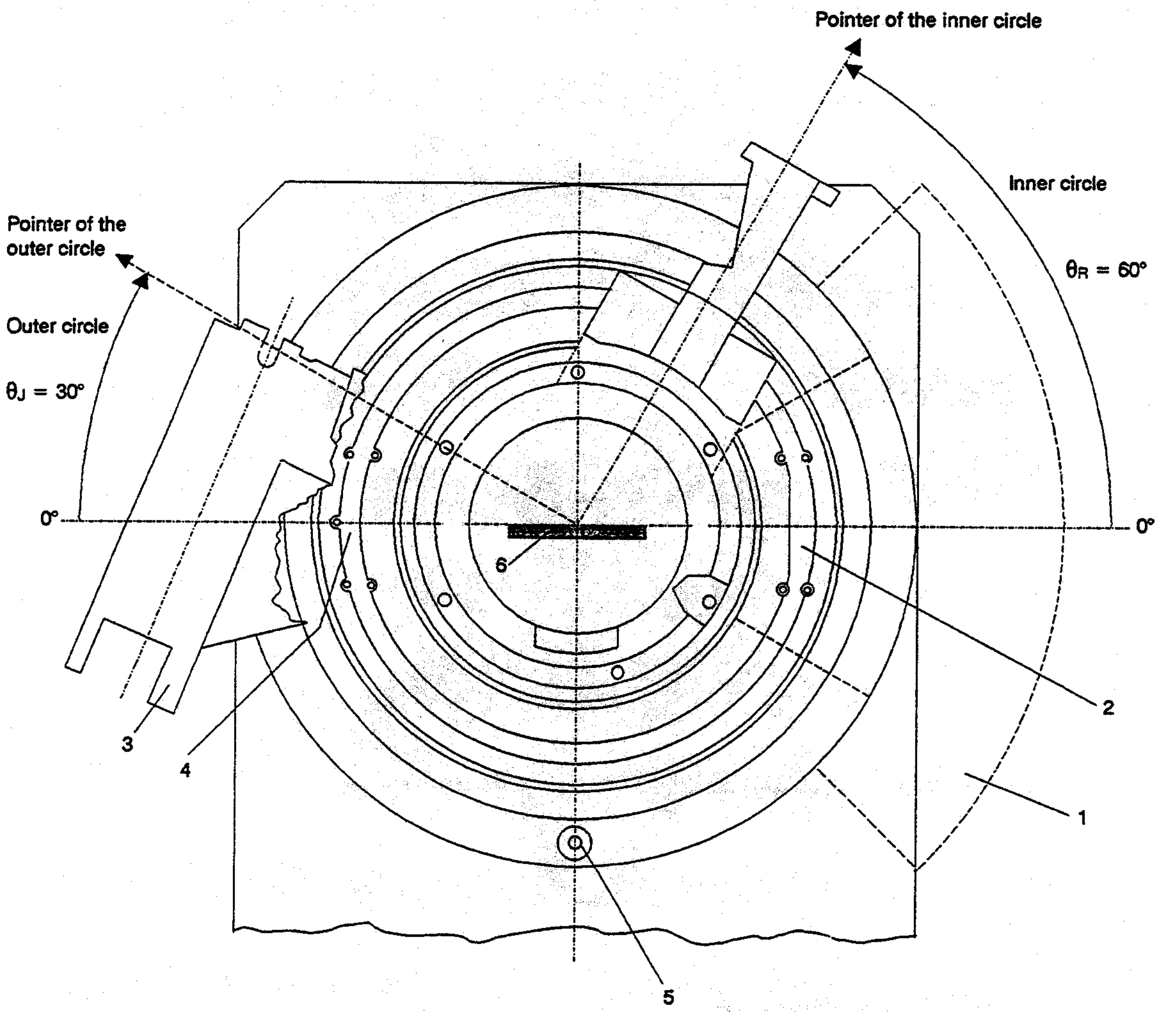
Fig. A-2 θ/θ diffractometer

A flange on the inner ring supports the detector and its diaphragm system.

The sample changer can be fixed to a cylindrical part which is attached concentrically at the goniometer. The open centre of this part allows supply cables to be led to the sample. Guide pins between this cylinder and the goniometer allow its position to be reproduced if required.

A primary-beam trap lined with lead (Fig. A-2.4) screens the primary beam over the full range of the X-ray tube, regardless of the sample changer type.

Due to the modular structure of the D 5000, a θ/2θ diffractometer with a fixed tube can be converted into a θ/θ diffractometer with fixed sample, using the appropriate accessories.



1 Counter weight
2 Counter weight flange installation location on outer ring
3 Tube flange
4 Tube flange installation location on outer ring
5 Angle limit stop at $\theta_J = 87°$
6 Sample

Fig. A-3 θ/θ diffractometer (schematic)

A.4 Radiation Protection

The statements made in Chapter 4 also apply for the θ/θ diffractometer.

An exceptional feature is the motion of the tube stand with variable primary-beam direction. The corresponding screening is guaranteed by a trough-shaped primary-beam trap. It should be noted that this trap must be installed at the installation points for the beam path level used.

The θ/θ diffractometer has been designed as a fully protected unit for operation up to an angle of incidence of 87° and any sample type. A stop at this angle (Figs. A-2.7 and A-3.5) provides a limitation. The unit no longer complies with the model conformity and needs a special permit for operation if this limit stop is removed. The same applies if the primary-beam trap is removed in order to enable special sample changers to be installed.

A.5 Installation

The installation steps according to Sections 8.1 to 8.6 are identical to those of the θ/2θ diffractometer. In addition, the primary-beam trap must be installed at the lying goniometer.

A.5.1 Initializing the Goniometer Angle

First of all controller and goniometer are synchronized. Select "Tuning" mode and use the terminal for moving both circles from smaller angles across the reference points (inner circle: 60°, outer circle: 30°).

The centre of the detector installation flange is used as a pointer for the inner circle; the uppermost of the three fixing screws for the tube flange is used as a pointer for the outer flange (Fig. A-3).

The coarse angle (without digits after the decimal point) is displayed on the terminal with the reference angle as a reference angle at the reference point.

This procedure must always be performed when a coarse angle is stored but, because of alterations, the coarse angle might not be identical to the actual angular position.

The angle is then calibrated in a set run. The fine angle with all decimal digits is then displayed. If the initial coarse angle shows an error of more than 2° in a set run, the latter cannot find the reference point and coarse synchronization is required.

Install goniometer and superstructure.

A.5.2 Tube Stand and Counter Weight

Caution! Please note when installing tube stand and counter weight that no part on its own applies a full torque load to the outer circle, as this would lead to the disengagement of the worm gear and the wheel spinning.

Move the outer circle to 85°.

Install the cams for the upper and lower range limit of the outer circle before installing the counter weight.

Fix counter weight (Figs. A-2.3 and A-3.1) now.

Retain this position and install the tube stand and flange. Only then may the outer circle be moved.

Aperture diaphragms, sample changer and the detector superstructure are installed as for the θ/2θ diffractometer.

A.6 Adjustment of the Fixed Diaphragms

A.6.1 Zero Point Definition of the Θ_J Scale

Constellation

Variable aperture diaphragm	Not available
Fixed aperture diaphragm	6 mm + absorber
Sample	Glass slit
Fixed scattered-radiation diaphragm	Open
Variable scattered-radiation diaphragm	Not available
Kβ filter	As required
Detector diaphragm	Open
θ_J without correction	$-1° < \theta_J < +1°$
θ_R without correction	0°

Measures

Search maximum in the range $-1° < \theta_{JN} < +1°$ with θ_J.

Consequence

The calibration is o.k. if the zero angle θ_N lies within the range $-0.6° < \theta_{JN} < +0.6°$.

If $\theta_{JN} < -0.6°$, turn front adjustment screw (Fig. 8-3.4) at the tube flange by $|\theta_{JN}| \times 70/16$ turns anti-clockwise.

If $\theta_{JN} > +0.6°$, turn front adjustment screw (Fig. 8-3.4) at the tube flange by $|\theta_{JN}| \times 70/16$ turns clockwise.

Note the play of the adjustment screw.

Result

The angle of the fine zero beam on the uncorrected θ_J scale is θ_{JN}.

A.6.2 Zero Point Definition of the θ_R Scale

Constellation

Variable aperture diaphragm	Not available
Fixed aperture diaphragm	6 mm + absorber
Sample	Glass slit
Fixed scattered-radiation diaphragm	Open
Variable scattered-radiation diaphragm	Not available
Kβ filter	As required
Detector diaphragm	0,1 mm
θ_J without correction	Zero angle according to Section A.6.1
θ_R without correction	$-1° < \theta_R < +1°$

Measures

Search maximum in the range $-1° < \theta_R < +1°$ with θ_R

Consequences

The calibration is o.k. if the zero angle lies within the range $-0.6° < \theta_{RN} < +0.6°$.

If $|\theta_{RN}| \geq 0.6°$, check if the sample surface is vertical within $\pm 0.5°$ with respect to the goniometer edge. If this is the case, $|\theta_{RN}| > 0.6°$ can also be used.

If this is not the case, check the sample changer and the installation.

If the sample changer installation has been manipulated, the adjustments according to Section A.6.1 and A.6.2 must be repeated.

Result

The zero beam angle on the uncorrected θ_R scale is θ_{RN}.

A.6.3 Standardize Angle Scales on the Zero Beam

<u>Measure</u>

Enter $\theta_{JR} = 30° - \theta\vartheta_{JN}$ as reference angle for θ_J.

Enter $\theta_{RR} = 60° - \theta_{RN}$ as reference angle for θ_R.

Execute set run then.

<u>Result</u>

The zero point of the corrected angles is in the zero beam.

Note: This standardization assumes that the zero angles are determined with an uncorrected angle scale (reference angle: 30°/60°). The reference angle $\theta_{JR} = 30° - (\theta_{JN1} + \theta_{JN2})$ must be entered if the zero angle θ_{JN2} is determined with an angle scale corrected with θ_{JN1}.

The same applies for θ_R accordingly.

A.6.4 Centring the Scattered-Radiation Diaphragm to the Zero Beam

Constellation

Variable aperture diaphragm	Not available
Fixed aperture diaphragm	6 mm + absorber
Sample	Glass slit
Fixed scattered-radiation diaphragm	0.1 mm
Variable scattered-radiation diaphragm	Not available
Kβ filter	As required
Detector diaphragm	Open
θ_J without correction	0°
θ_R without correction	$-1° < \theta_R < +1°$

Measures

Search maximum in the range $-1° < \theta_R < +1°$ with θ_R.

Consequences

The calibration is o.k. if $|\theta_{Rmax}| < 0.01°$.

If $\theta_{Rmax} \geq +0.01°$, turn adjustment screw at the front (Fig. 8-6.1a) by θ_{Rmax} x 66/16 turns clockwise and secure using the rear counter screw (Fig. 8-6.1b).

If $\theta_{Rmax} \leq -0.01°$, turn adjustment screw at the rear (Fig. 8-6.1b) by θ_{Rmax} x 66/16 turns clockwise and secure using the front counter screw (Fig. 8-6.1a).

Check with "measures".

Result

The scattered-radiation diaphragm is aligned to the zero beam and thus to the sample centre.

A.6.5 Centring the Aperture Diaphragm to the Zero Beam

Constellation

Variable	aperture diaphragm	Not available
Fixed		0,1 mm
Sample		None
Fixed	scattered-radiation diaphragm	6 mm + absorber
Variable		Not available
Kβ filter		As required
Detector diaphragm		1 or 0.1 mm
θ_J		0°
θ_R		$-2° < \theta_R < +2°$

Measures

Activate primary beam in the range $-2° < \theta_R < +2°$ with θ_R and determine the mean value θ_{RM} of the 80% edge angles.

Consequences

The calibration is o.k. if $|\theta_{RM}| < 0.02°$.

If $\theta_{RM} \geq +0.02°$, turn adjustment screw at the rear (Fig. 8-3.1b) by θ_{RM} x 47/16 turns clockwise and secure using the front counter screw (Fig. 8-3.1a).

If $\theta_{RM} \leq -0.02°$, turn adjustment screw at the front (Fig. 8-3.1a) by θ_{RM} x 47/16 turns clockwise and secure using the rear counter screw (Fig. 8-3.1b).

Check with "measures".

Result

The aperture diaphragm is aligned to the zero beam and thus to the sample centre.

A.6.6 Centring the Radiation Outlet Flange

Constellation

Variable / Fixed	aperture diaphragm	Not available / Open
Sample		None
Fixed / Variable	scattered-radiation diaphragm	Open / Not available
Kβ filter		As required
Detector diaphragm		0.1 mm + absorber
θ_J		0°
θ_R		$-4° < \theta_R < +4°$

Measures

Activate primary beam in the range $-4° < \theta_R < +4°$ with θ_R and determine the mean value $\theta_{RF1,2}$ of the 80 % edge angles.

Consequences

The adjustment is correct if both $|\theta_{RF1,2}| \geq 3.5°$.

If the absolute value of an edge angle is less than 3.5° and positive, turn adjustment screw at the front (Fig. 8-3.2a) by $(3.5° - |\theta_{RF}|) \cdot 16/16$ turns clockwise and secure using the rear counter screw (Fig. 8-3.2b).

If the smaller edge angle is negative, turn adjustment screw at the rear (Fig. 8-3.2b) by $(3.5° - |\theta_{RF}|) \cdot 16/16$ turns clockwise and secure using the front counter screw (Fig. 8-3.2a).

Check with "measures".

Result

The radiation outlet flange permits a beam of an aperture angle of 3° to emerge without shading.

A.7 Adjustment of the Variable Diaphragms

Adjustment with variable diaphragms is performed similarly. See θ/2θ diffractometer calibration (Section 10.2).

SIEMENS

KRISTALLOFLEX 760 X-ray Generator

C79249-A3054-A3, -A4
for Supplying Diffraction Tubes and Side-Window Spectrometer Tubes

Operating Instuctions C79000-B3476-C182-05

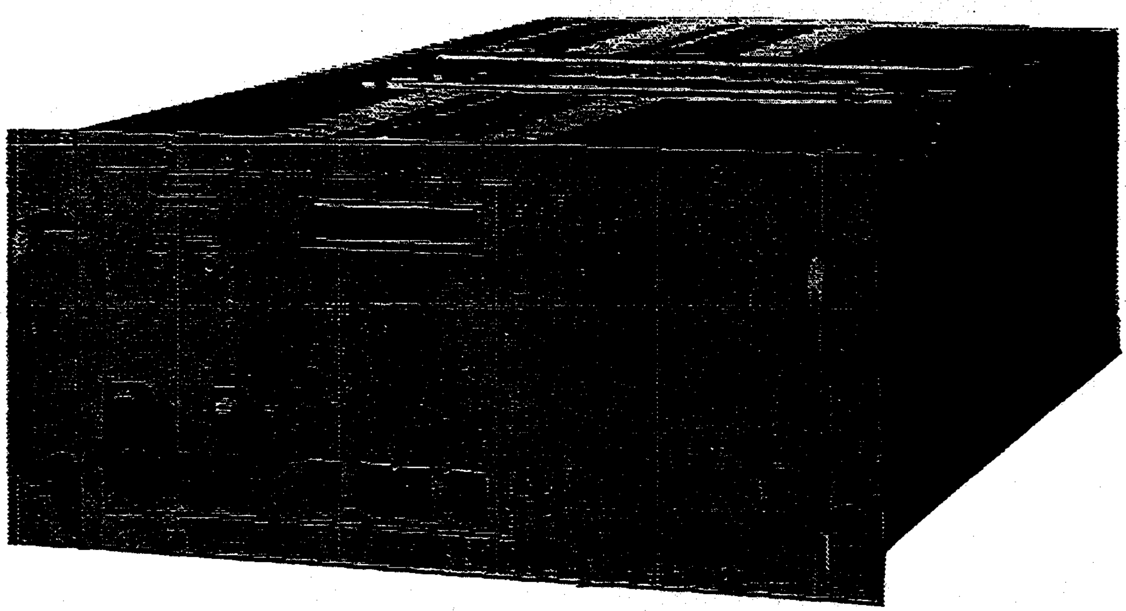


Fig. 1 KRISTALLOFLEX® 760 X-ray generator

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1 Description

1.1 Application

The KRISTALLOFLEX 760 X-ray generator is a highly-stable device for supplying diffraction tubes and side-window spectrometer tubes (high voltage applied to cathode).

1.2 Control

The X-ray generator has a processor control. The green "Ready" LED on the front panel signals that the X-ray generator is ready for operation. This readiness is established if the key switch is in the "I" or "II" position. The key switch should be positioned to "0" during extended pauses in operation.

Reference values can be set using a local control panel, and status and diagnostic information can be read.

The generator can be connected to a computer via a serial V.24 interface.

The X-ray generator has an operating-hours counter.

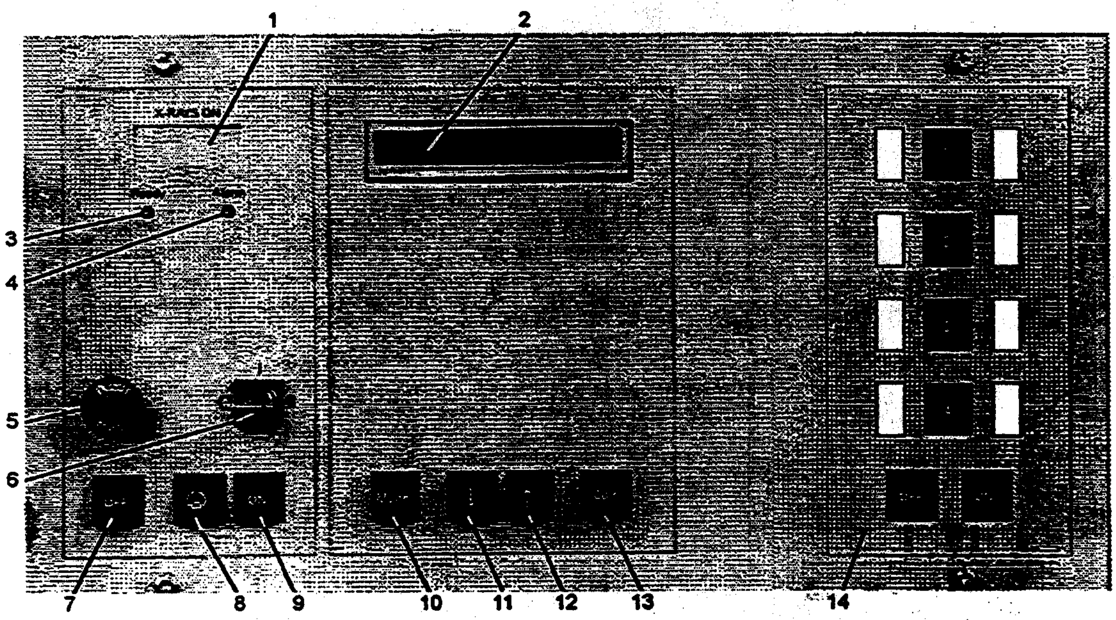
2 Design

The design of the X-ray generator makes it easy to service. All parts are accessible from above and are fitted into a 19-inch wide, U-shaped chassis. The front control panel is hinge-mounted. The rear panel includes connections for the cooling water supply, the V.24 interface and connectors for the X-ray instrument and its internal cooling water unit.

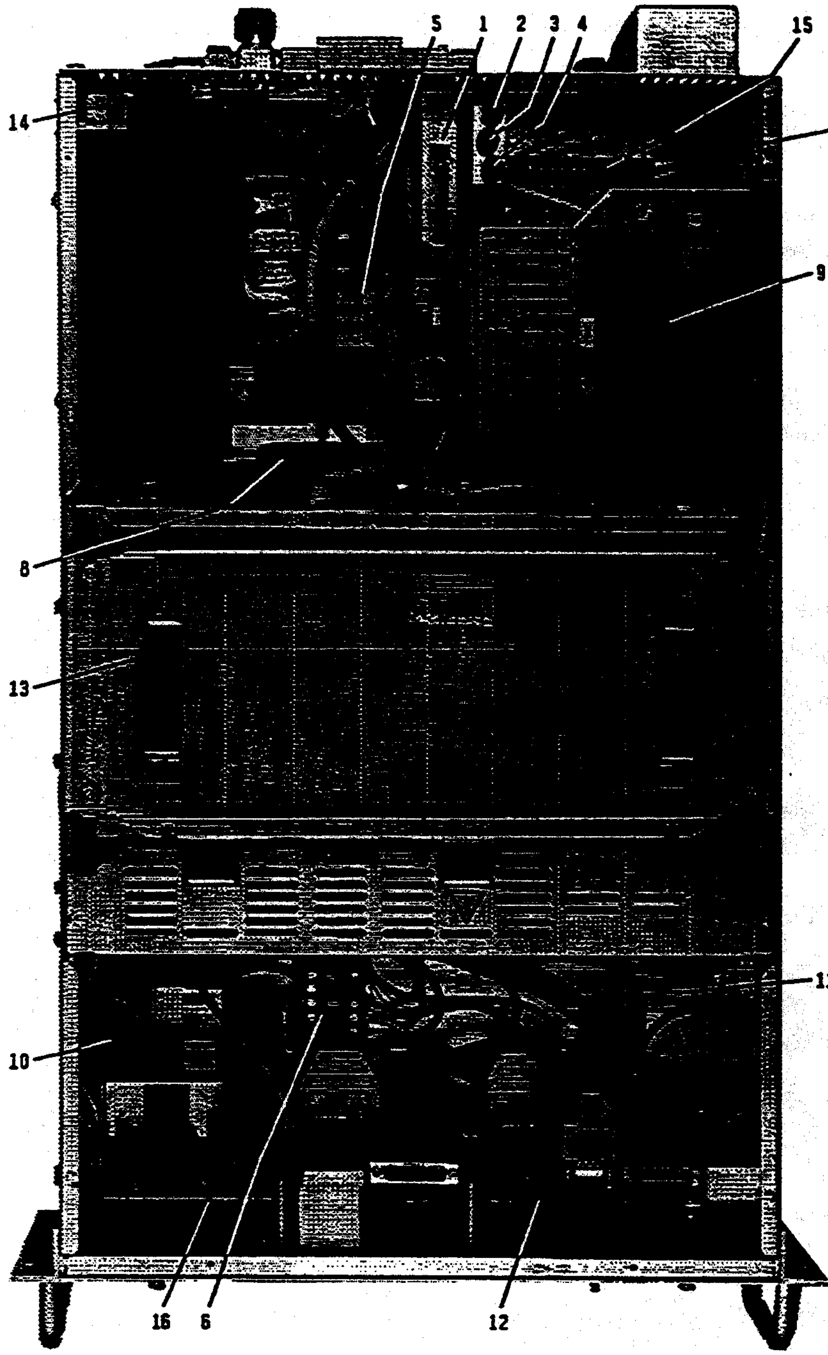
The following components are fitted:

- Interference suppression unit
- Rectifier
- Inverter
- High-voltage module
- PCBs with the electronic regulators, control and protection circuits
- Cooling water supply

The X-ray generator can be built into 19-inch racks.



1 Signal lamp "X-RAYS ON
2 Display panel
3 LED "Ready"
4 LED "Alarm"
5 Red button (emergency-off)
6 Key switch
7 Key "OFF"
8 Key "Heater"
9 Key "ON"
10 Key "Mode"
11 Key "↓"
12 Key "↑"
13 Key "Edit"
14 Window control



1 Circuit breaker, 32 A
2 Fuse F2, T 1.6 A
3 Fuse F7, T 4 A
4 Fuse F6, T 4 A
5 Contactor K52
6 Contactor K51
7 Mains connection terminals X13
8 High-voltage socket
9 Inverter
10 Transformer T51
11 Thyodul with voltage regulator
12 Integral board (-B20)
13 High-voltage tank
14 Terminal X10 for mains frequency adaptation
15 Terminal block X3
16 Fuse F1 on integral board (-B20), F 1 A

Fig. 3 Top view

3 Method of Operation

3.1 High-Voltage Generation and Regulation

The medium-frequency AC voltage from the inverter is transformed to high-voltage, then rectified and smoothened by a special circuit. The DC voltage is applied to the high-voltage socket (8, Fig. 3) via a series resistor, which is necessary to protect the X-ray tube. The electrical connection to the X-ray tube is made by a double-screened high-voltage cable (1, Fig. 5).

The high-voltage is measured via a precision voltage divider. The voltage with respect to ground is used for the high-voltage display and as the actual value for the high-voltage regulator.

The high-voltage regulator on PCB -B20 amplifies the difference between the setpoint and the actual value and applies this to the voltage control element -B4. This adjusts the primary voltage of the high-voltage transformer by means of the thyristor control element and the inverter such that the high-voltage is maintained constant to ± 0.01 %.

3.2 Regulation of Tube Current

Tube current is regulated by the cathode heater. The actual value of the tube current is measured by a resistor on the ground side of the high-voltage circuit. The tube current regulator is on PCB -B20. The difference between the setpoint and the actual value of the tube current is amplified there and applied to the control element -B255. This alters the heater current so that the tube current is maintained constant to ± 0.01 %. The control element -B255 has a current transformer which allows the heater current to be displayed (2, Fig. 2).

3.3 Protection Circuits

The X-ray generator has the following protection circuits for the X-ray generator and tube:

- An overcurrent and an undercurrent relay in the heater circuit of the X-ray tube.
- An overcurrent and an overvoltage monitoring circuit in the high-voltage circuit.
- A fast-acting short-circuit protection in the high-voltage circuit. This switches off the high-voltage in less than 10 µs if there is a tube flashover (impacts), preventing damage to the tube and X-ray generator. The high-voltage automatically returns to the setpoint after the short-circuit has been tripped. The correct value is reached via a slow ramp to spare the tube. The X-ray generator switches off if the short-circuit is constant, e.g. with a defective tube.
- A temperature monitor in the high-voltage module which trips at approx. 60 °C.
- A temperature monitor in the power section of the inverter which trips at approx. 100 °C.
- A level monitor in the high-voltage generator which trips if the oil level falls by approx. 10 mm.
- A switch-off circuit which allows the X-ray generator to be switched to zero power via connected devices (external warning lamp, cooling-water unit); see Section 6.7.

3.4 Radiation Protection

The radiation protection circuit is provided for the safety of operating personnel and to meet the prerequisites for a fully-protected device. The protection circuit switches the X-ray generator off if a safety switch on the connected equipment is open, or if the high-voltage cable is not connected (ripcord not inserted).

3.5 Technical Data

Continuous output power	Max. 3000 W
High-voltage	10 to 60 kV
Tube current	5 to 80 mA
Frequency	20 kHz
Stability of high-voltage and tube current with mains fluctuations up to ± 10 %	< 0.01 %
High-voltage ripple	< 5 %
Regulation time constant	< 100 ms
Tube heating current	2 to 4.5 A
Tube heating voltage	5 to 12 V
Power supply	230 V, 50/60 Hz
Power consumption	5.5 kVA
Mains fuse	25 A, slow-blow
Cooling-water connection	½"
Cooling-water flow rate	Min. 3.5 l/min
Water pressure	5 to 8 bar
Water temperature	10 to 35 °C
Degree of protection to DIN 40050	IP 20
Dimensions (w x h x d)	
Desk-top version	483 mm x 266 mm x 761 mm
Rack-mounted version	483 mm x 222 mm x 761 mm
Weight	
Desk-top version	76 kg
Rack-mounted version	65 kg

4 Installation

4.1 Set-up

The rack-mounted version is fitted on telescopic rails in the electronics cabinet of the X-rax instrument.

4.2 Mains Connection

Note: An additional ground connection (10 mm^2) must be made in addition to the protective earth conductor of the mains cable. The connection point is the M6 ground terminal on the rear panel (10, Fig. 6).

The X-ray generator is factory-set to the required mains frequency. The set value is shown on the rating plate.

If changes are made on-site, the rating plate must be altered accordingly.

The mains frequency is selected at terminal X10 (14, Fig. 3).

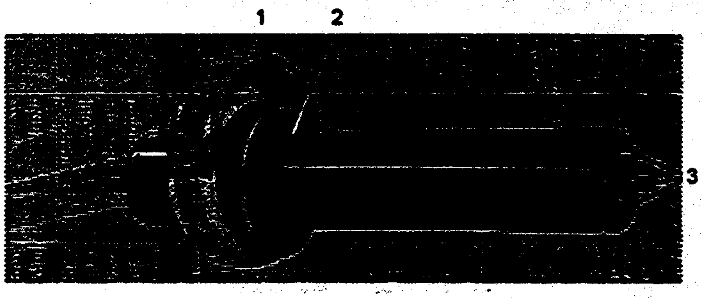
4.3 Terminal Block X3

The terminal block X3 must be connected in accordance with the reqirements of the X-ray analysis instrument.

Terminals	Connection	Remarks
1-2	Radiation warning lamp	A jumper must be inserted if the X-ray generator is mounted in a D 500 or D 5000 diffractometer or in a film camera measuring station
3-4	Additional radiation warning lamp (24 V, 4 W)	This function is activated by setting the jumper from X515.1-2 to X516.1-2 on the integral board (12, Fig. 3).
5	Jumper to ground	This jumper must be inserted for X-ray generators with window control to terminate the shut-off circuit.
5-6	Jumper for shut-off circuit	This jumper must be removed if an internal cooling-water unit is connected.
6-7	Jumper for shut-off circuit	
9-10	Warning lamp (24 V, 2 ... 8 W) with the function "All window cutters closed"	For X-ray generators with window control, this warning lamp can be connected. Otherwise a resistor (1 kΩ, 2 W) must be connected.
11-12	Warning lamp (24 V, 2 ... 8 W) with the function "At least one window cutter open"	For X-ray generators with window control, this warning lamp can be connected. Otherwise a resistor (1 kΩ, 2 W) must be

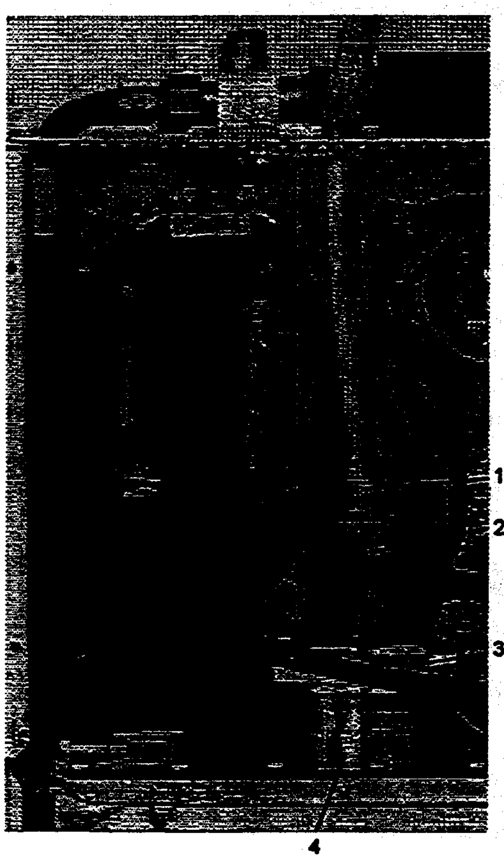
4.4 Connection of High-Voltage Cable

The high-voltage sockets and plugs must be clean. If necessary, clean and dry using a lint-free cloth and alcohol.



1 Union nut
2 Guide lug
3 Contact pins

Fig. 4 High-voltage plug



1 High-voltage cable
2 High-voltage plug
3 Union nut
4 High-voltage socket

Fig. 5 Connection of the high-voltage cable

Push the gasket onto the high-voltage plug (Fig 4; 2, Fig. 5) ensuring that the slot in the gasket slides over the guide lug (2, Fig. 4) on the plug.

Smear enough vaseline (approx. 2 cm^3) onto the end of the plug to completely cover the pins.

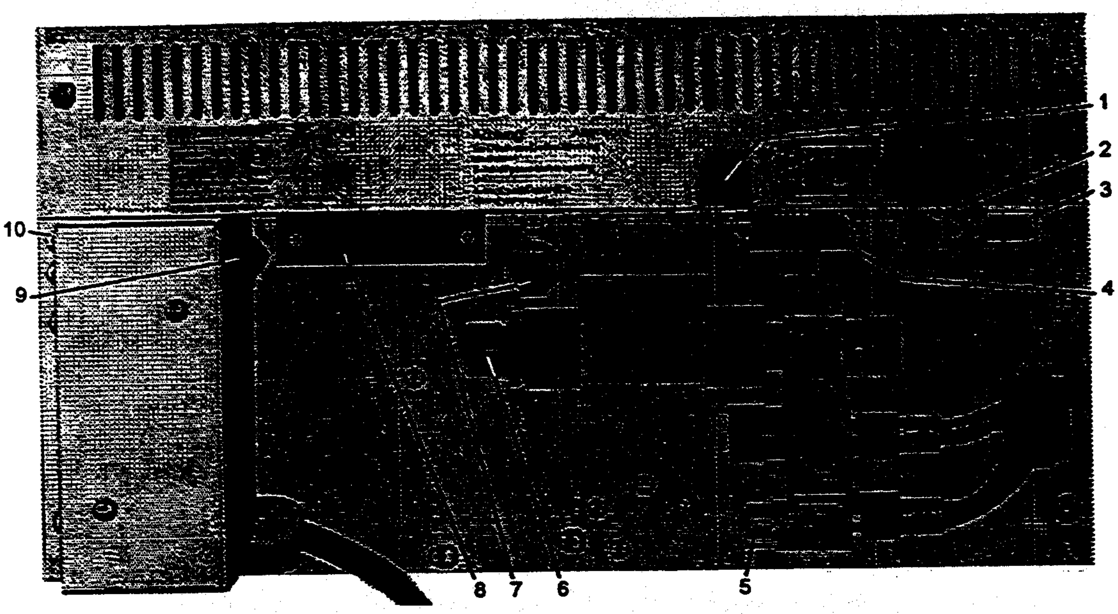
Push the plug into the high-voltage socket (4, Fig. 5) until the vaseline makes contact.

Carefully press the plug home until the contact pins (3, Fig. 4) engage.

Tighten the union nut (3, Fig. 5) securely and tighten again after 30 minutes of operation.

4.5 Cooling-Water Connections

See connection diagram.



1 Inlet for high-voltage cable
2 Connector X541 for X-ray instrument
3 Connector X540 for computer interface
4 Connector X542 for internal cooling-water unit C79298-A3179-A1 or solenoid valve V0
5 Cooling-water inlet from external cooling-water unit or municipal water supply respectively, M18 x 1.5 thread
6 Cooling-water outlet to external cooling-water unit or water sink respectively, $^3/_8$" thread
7 Circuit breaker (shown in "Off" position)
8 Connector X543 for tube stand
9 Cable inlet for connection of an additional radiation warning lamp (to special order)
10 Ground (earth conductor) connection, M6

Fig. 6 Rear view

4.6 External Warning Lamps (in Connection with a Window Control)

Two fail-safe warning lamps (24 V, 2 ... 8 W) with the functions "All window shutters closed" and "At least one window shutter open" can be connected to terminal block X3 (15, Fig. 3) in the X-ray generator:

- Terminals 9-10: "All window shutters closed"
- Terminals 11-12: "At least one window shutter open"

5 Commissioning and Start-up

Open external cooling-water tap or switch on external cooling-water unit respectively.

Switch on external power switch (master switch).

Pull the red emergency-off button (5, Fig. 2).

Set key switch (6, Fig. 2) to the "I" position.

The most recent cause for shut-off is shown on the display (2, Fig. 2): "Error-Code: xy" or "kV= 0 mA= 0". The green "Ready" LED (3, Fig. 2) lights. The limit values of the X-ray tube are set to maximum (60 kV, 80 mA, 3000 W, see Section 6.3).

Press the "Heater" key (8, Fig. 2) for approx. 2 s. The setpoint values are shown on the display: "kV 20, mA: 5". Data are sent to the internal cooling-water unit [1]. If the LED in the "Heater" key flashes, the conductivity of the cooling water is too high (actual value of conductivity > 2,5 µS; see Section 6.1). After some time the LED is lit continuously, and the X-ray generator can be switched on.

Press the "ON" key (9, Fig. 2). The "X-RAYS ON" signal lamp (1, Fig. 2) and the radiation warning lamp at the X-ray instrument light up. The X-ray generator is switched on. The LED in the "Heater" key goes off; the LED in the "ON" key lights up. On the display the actual values are shown: "kV= 20 mA= 5".

Adjust the voltage and current setpoints. First adjust the voltage setpoint, and then the current setpoint.

When using new X-ray tubes or tubes which have been out of operation for longer than 12 hours, observe the following start-up instructions unless other values have been specified by the manufacturer:

Pause in operation (days)	High-voltage / duration								Total time for 55 kV
	20 kV	25 kV	30 kV	35 kV	40 kV	45 kV	50 kV	55 kV	
0.5 to 3	30 s	30 s	30 s	30 s	30 s	30 s	1 min	2 min	6 min
3 to 30	30 s	30 s	2 min	2 min	5 min	5 min	10 min	10 min	35 min
> 30 or new X-ray tube	30 s	30 s	2 min	2 min	5 min	10 min	15 min	15 min	50 min

An automatic start-up routine can be selected for new tubes (see Section 6.6).

The maximum high-voltage is 60 kV.

The X-ray generator is switched off by pressing the "OFF" key (7, Fig. 2). To protect the tube (very small thermal load of filament and anode), reduce the tube current to 5 mA before switching off. The high-voltage may remain at the operating value.

During initial commissioning, check the function of the water flow monitor and the radiation protection circuit.

1) X-ray instruments with internal cooling-water unit C79298-A3179-A1.

6 Operation

The X-ray generator is equipped with a local control panel for entering parameter values and a 16-digit LCD for displaying entered values and status and diagnostic information.

6.1 Local Operation and Display

A keypad with 4 keys is used for local operation. The keys have an auto-repeat function. These keys are used to select input values or desired status and diagnostic information or to enter parameter values.

Select parameters to be entered or status and diagnostic information to be output by simultaneously pressing the "Mode" (10, Fig. 2) and "↑" (12, Fig. 2) or "↓" (11, Fig. 2) keys. The display then changes accordingly to one of the following possible messages:

kV= mA=	Actual values of high-voltage in kV and tube current in mA
kV: kV=	Setpoint and actual value of high-voltage
mA: mA=	Setpoint and actual value of tube current
Hcu=	Actual value of heater current in A
Flow=	Actual value of cooling-water flow in l/min 1)
Temp=	Actual value of cooling-water temperature in °C 1)
Conduct=	Actual value of conductivity in µS 1)
U-AK=	Actual value of voltage at the thyodul in V
I-input=	Mains current consumption in A
Warn:	Warning
STATUS:	Generator status register
Relay=	Relay status
Error-Code:	Shut-off cause
DIAG:	Operating-voltages status register
MODE:	Generator operating-mode register
RTi=	Operating hours
kV min:	Minimum high-voltage in kV
mA min:	Minimum tube current in mA
kV max:	Maximum high-voltage in kV
mA max:	Maximum tube current in mA
P abs:	Absolute limiting power in W
BdR:	Baud rate for V.24 interface
Release version of firmware and software	
Automatic?	Start-up routine
counts	Counter for tube surging

All actual values are identified by the index "=", setpoints and status informations by the index ":".

1) X-ray instruments with internal cooling-water unit C79298-A3179-A1.

The display cycles in increasingly shorter intervals if the "↑" or "↓" key is pressed for longer than approx. 1 second (auto-repeat function). Actual-value and status displays are updated at intervals of 200 ms.

In order to modify parameters, press the "Edit" key (13, Fig. 2) together with the "↑" or "↓" key. The parameter value is then increased or decreased by a fixed amount. The value is changed at shorter intervals in the corresponding direction if the "↑" or "↓" key is pressed for longer than approx. 1 second (auto-repeat function).

Parameter input on the local control panel is disabled if the X-ray generator is remote-controlled.

6.2 Setpoints for High-Voltage and Tube Current

The setpoints can be adjusted using the functions "kV: kV=" and "mA: mA=". The step size is 1 kV or 1 mA respectively. Setpoint values must not be smaller than the minimum values (10 kV, 5 mA) and not be larger than the definable maximum values.

Limiting is also carried out if the defined maximum power is exceeded.

Setpoints are at the minimum values when the X-ray generator is switched on.

When modifying the setpoints in the "Operation" position, the actual values are adjusted to the setpoints when the "Edit" key is released.

6.3 Maximum Values for High-Voltage, Tube Current and Power

The maximum values can be set using the functions "kV max:", "mA max:" and "P abs:". Step sizes for the power are from 100 W up to a maximum of 3000 W.

Preset values are 60 kV, 80 mA and 3000 W. The maximum values can only be changed if the key switch is in the "II" position.

6.4 Baud Rate

The baud rate can be adjusted using the "BdR" function. The adjustable baud rates are: 1200, 2400, 4800 and 9600 bd (preset value: 9600 bd).

The baud rate can only be changed if the key switch is in the "II" position.

The new baud rate is first activated after a generator reset.

6.5 Explanation of Status and Diagnostic Information

Status information is constantly regenerated and can be displayed using the "MODE", "STATUS", "Error-Code", "DIAG" and "Relay" functions. Status and diagnostic informations "Error-Code", "DIAG" and "Relay" are explained in Section 8.

"MODE" (generator operating-mode register) is a decimal number resulting from the following bit significances:

Significance	Meaning
1	Heating mode
2	High-voltage on
4	kV actual value = kV setpoint
8	mA actual value = mA setpoint
16	Remote control on
32	High-voltage flashover
64	Generator warning
128	Generator stand-by

6.6 Start-up Routine for New X-ray Tubes

A start-up routine (total duration 50 minutes) can be selected using the "Automatic?" function.

Switch on high-voltage.

Set key switch to the "II" position.

Select the "Automatic?" function.

Start automatic routine by operating the "Edit" key together with the "Up" key.

The display alternates between "Automatic run" and "kV =   min =" (kV = current value of high-voltage, min = expired time in minutes). "Automatic end" appears on the display after 50 minutes if the program is completely executed without errors.

If an error occurs during the routine, "Error at kV = " appears on the display (kV = actual value of high-voltage at which the error occurred).

The routine can be aborted at any time by selecting another function.

6.7 Generator Stand-by

In stand-by mode the X-ray generator remains switched on, but does not generate high-voltage.

The setpoint values of kV and mA are set to zero.

Generator stand-by can be activated via the serial interface (see Section 7.2.3).

Generator stand-by is activated by opening the switch-off circuit.

Generator stand-by can only be disabled via the serial interface. For this purpose the switch-off circuit must be closed and permitted setpoint values of kV and mA be set.

Stand-by mode is ended by switching off the generator.

To avoid condensation, instruments without internal cooling-water unit C79298-A3179-A1 or solenoid valve V0 are switched off, when they have been in standby mode for more than 15 min.

6.8 Window Control

The window shutters in the tube stand are operated using the window control keypad.

An opening time from 1 s to 99 h can be entered for each window.

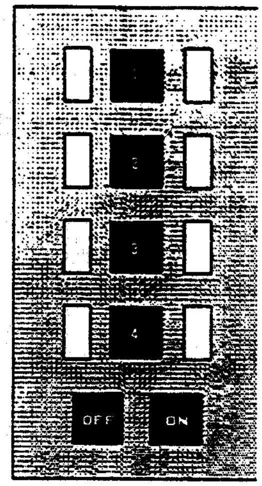


Fig. 7 window control

Setting the opening time

The opening time for each window can be modified as long as the associated window shutter is closed. The opening time can be entered in hours, minutes and seconds.

- Select the required window by presssing key "1", "2", "3" or "4" until the green LED in the key flashes.

  The last opening time entered appears on the display.

  The time is displayed in the format "min: yy sec: zz" if the opening time is less than 1 h, otherwise in the format " h: xx min: yy ".

  The setpoint of the parameter h, min or sec which is output flashing on the display can be modified using the keys "Edit" and "↑" or "↓".

  The parameter can be selected using the keys "Mode" and "↑" or "↓".

Open window shutter

The window shutters can only be opened if the X-ray generator is in the "Operation" position.

- Select the required window by presssing key "1", "2", "3" or "4" until the green LED in the key flashes.

  The set opening time appears in the display.

- Press key "ON" at the window control.

  The green illuminated field assigned to the window is extinguished; the red field lights up.

  The opening time is counted down to zero on the display.

Close window shutter

The window shutters close when the opening time has expired or if the X-ray generator is not in the "Operation" position.

The window shutters can also be closed using the keypad:

- Select the required window by presssing key "1", "2", "3" or "4" until the green LED in the key flashes.

- Press key "OFF" at the window control.

  The red illuminated field assigned to the window is extinguished; the green field lights up.

7 Interface between X-ray Generator and External Computer

7.1 Hardware

Data transfer between the X-ray generator and an external computer is via an asynchronous serial interface in full-duplex mode (RS 232 C) at 9600 Bd, and with 8 data bits, no parity, 1 stop bit.

Pin assignments of computer interface of X-ray generator

9-pin connector (Cannon)

2	TxD	Transmitted data
3	RxD	Received data
7	Signal ground	

7.2 Data Transmission

Transmission protocol

Start	Start character (programmable)
DAT1	
DAT2	
...	Data string
...	
DATn	
CR	ASCII control character "Carriage Return"

Data string: string with representable ASCII characters, contains information for receiver.

The string may be up to 8 characters long including the control characters at the beginning and end of a data transmission.

Data transmission can be interrupted at any time by the receiver using the ASCII control character DC3 (X-OFF) and restarted using the control character DC1 (X-ON).

A faulty string is acknowledged by the ASCII control character NAK (negative acknowledge). The transmitter then repeats the data transmission.

7.2.1 Data transmission from external computer to X-ray generator

Each command from an external computer to the X-ray generator consists of a command identifier (2 letters) and an argument.

The external computer transmits a command to the X-ray generator and immediately checks that it has been received by evaluating the command acknowledgement from the X-ray generator. The command acknowledgement is made on the initiative of the computer by transmitting the polling character ENQ. If the command has been accepted, the acknowledgement consists of only the start character SOH and the string terminator CR. If the command has been rejected, an error message (string identifier "?") with error number is transmitted to the computer.

7.2.2 Data transmission from X-ray generator to external computer

Messages from the X-ray generator to the external computer include:

- Error messages
- Parameters of X-ray generator
- Status messages
- Diagnostic information

An **error message** is the response of the X-ray generator to an illegal command and has the identifier "?". The reason for rejection of the command is passed in the error message to the computer in a 2-digit error code.

Error code	Meaning
1	Illegal command
2	Arguments required
3	Incorrect argument(s)
4	Command only permissible in computer mode
20	Generator switched off
21	Generator power limited
22	Switch-off circuit open

Parameters, status messages and diagnostic information of the X-ray generator are transmitted to the computer on command and following the authorization to transmit by output of the polling character ENQ with the command code (2 letters).

The X-ray generator outputs the following message without being requested every time there is a change in the operating mode control word:

<BEL>
<G>
<S>
<Operating-mode control word>
<CR>
<ENQ>

This message is sent every second, until the computer sends the following acknowledgement:

<ACK>

Note: ASCII control character BEL = 07_{16} instead of SOH = 41_{16} as start character.

7.2.3 Description of interface commands RC → X-ray generator

The X-ray generator can be controlled by an external computer via a number of commands. The X-ray generator must be set to the "computer control" operating mode by the preparatory command RC1. Parameter, status and diagnostic scans are permissible in every mode.

Commands are processed in parallel.

The maximum delay between a command for generator control and the commencement of its execution is 200 ms. Correct execution can then be monitored by the computer by reading the corresponding status information (ready message or operating-mode control word).

- Command for mode switch-over of X-ray generator

RC<code> **Remote control**

Switches the X-ray generator to the "remote control" mode and back to the "local" mode depending on the <code> value.

<code>: integer

code	Meaning
0	"Local" mode
1	"Remote control" mode

- Commands for selection of voltage and current [1])

GV<value> **Generator voltage**

GC<value> **Generator current**

GV<value> **Generator voltage**

Setpoint for generator high-voltage

<value>: integer

Generator high-voltage in kV

Value range: kVmin ≤ value ≤ kVmax; 0: select generator stand-by

GC<value> **Generator current**

Setpoint for generator current

<value>: integer

Generator current in mA

Value range: mAmin ≤ value ≤ mAmax; 0: select generator stand-by

1) Commands for selection of voltage and current are ignored with error message "?13" if the service switch is in "SERVICE" position.

- Commands for reading parameters, status and diagnostic information of the X-ray generator

GP<code>	**Generator parameter**
GS<code>	**Generator status**
GR<code>	**Generator register**

GP<code> **Generator parameter**

Request to transmit parameters of the X-ray generator to the external computer

<code>: integer

Selection of parameters to be transmitted to the external computer

code	Meaning
1	Minimum voltage in kV (kVmin)
2	Maximum voltage in kV (kVmax)
3	Minimum current in mA (mAmin)
4	Maximum current in mA (mAmax)
5	Limiting power

These parameters are device-specific limits which can only be entered on the local control panel of the X-ray generator.

GS<code> **Generator status**

Request to transmit status information of the X-ray generator to the external computer

<code>: integer

Selection of status information to be transmitted to the external computer

code	Meaning
1	Operating mode control word (see "MODE" in Section 6.5)
2	Actual voltage
3	Actual current
4	Heater current
5	Cooling-water flow [1])
6	Voltage at thyodul
7	Cooling-water temperature [1])
8	Cooling-water conductivity [1])
9	Power consumption
10	Operating hours

1) X-ray instruments with internal cooling-water unit C79298-A3179-A1.

GR<code> **Generator register**

Command to read diagnostic information of the X-ray generator

<code>: Integer

Selection of diagnostic information with the following assignment:

code	Meaning	Display
1	Program version	
2	Instrument status	STATUS
3	Switch-off cause	Error-Code
4	Relay status	Relay
5	Voltage diagnosis	DIAG
6	Generator warning	Warn

<code> = 1:

String with program No. and release version of installed control software of the X-ray generator

<code> = 2 ... 6:

Total of bit significances whose meaning is explained in Section 8. These are output as a decimal number ≤ 255.

8 Maintenance and Repair

8.1 Routine Maintenance

Check water filter (if fitted) for contamination according to manufacturer's instructions.

Check the X-ray protection circuit following each shut-down or maintenance operation:
Switch the X-ray generator to "Operate". Disconnect the ripcord from the high-voltage plug. The X-ray generator must switch off.

8.2 Troubleshooting

The power supply of the digital section is not in order, if the green "Ready" LED (3, Fig. 2) is not lit and the display panel (2, Fig. 2) remains dark. The following reasons are possible:

External power switch open or fuse defective.

Key switch (6, Fig. 2) in the "0" position or red button (5, Fig. 2) has been operated.

Fuse F6 (4, Fig. 3) or F7 (3, Fig. 3) defective.

Plug X506 on pushbutton board -B1 not connected.

Plug X511 on integral board (12, Fig. 3) not connected.

Transformer T51 (10, Fig. 3) defective.

If the X-ray generator cannot be switched to the "Heating" position, the following reasons can be indentified by the status and diagnosis bytes:

Fuse F2 defective or tube heating cable not connected (Error-Code: 1).

Heating current controller defective (Error-Code: 2).

High-voltage cable not connected correctly (Error-Code: 5).

Circuit breaker F1 switched off (Error-Code: 22).

If "STATUS: " remains at a value < 8, the integral board (-B20) is defective.

If the LED in the "Heater" key (8, Fig. 2) flashes, the switch-off circuit is open, "STATUS= 8".

Switch-off circuit of X-ray instrument open (see Instructions of X-ray instrument for troubleshooting).

If the "Alarm" LED flashes in addition, "Warn" is displayed and warnings can be read. The following reasons are possible [1]):

Conductivity > 2,5 µS ("Conduct= ").

Water level too low (dry sensor) or sensor broken, conductivity < 0,1 µS ("Level= ").

Cooling water temperature > 50 °C ("Temp= ").

Cooling water flow < 3.6 l/min ("Flow= ").

If the "ON" key (9, Fig. 2) has been operated, "Error code: " is indicated after switching-off.

This information is displayed approx. 3 s after the "X-RAYS ON" signal lamp (1, Fig. 2) is extinguished. The X-ray generator is in swiched-off status.

1) X-ray instruments with internal cooling-water unit C79298-A3179-A1.

Status and diagnosis informations are described in the following:

Error-Code

Heating current too small	1
Heating current too large	2
kV actual value > 110 % of setpoint	3
mA actual value > 110 % of setpoint	4
Temperature monitoring of inverter	5
High-voltage > 68 kV	6
Voltage at thyodul > 480 V	7
Oil volume in high-voltage tank too small	8
Temperature monitoring of high-voltage generator	9
Shut-off circuit in spectrometer open	10
Water temperature > 50 °C 1)	12
Sensor broken, conductivity < 0,1 µS 1)	13
Water flow < 4 l/min	14
Generator stand-by longer than 15 min	16
Temperature of deionized water > 56 °C 1)	17
Level of deionized water too low 1)	18
Aquastop	19
Generator switched off via "OFF" button	20
Power cut	21
Circuit breaker F1 switched off	22
Mains current too large	23
Supply voltage out of range	24
Additional radiation warning lamp defective	25
Short circuit to ground in shut-off circuit	29
Safety circuit open	30
Short circuit to ground in safety circuit or radiation warning lamp defective	31
Relay K11 open	33
Relay K3 open	34
Relay K5 open	35
Relay K6 open	36
Relay K12 open	37
Relay K13 open	38
Tube surges	40
High-voltage in stand-by mode	41
Vltage at thyodul in stand-by mode	42
Generator not in in stand-by mode	43
Stand-by function not parametrized	50
Generator type not indentified	51
EEPROM type not indentified	52
Warning lamp "At least one window shutter open " defective 2)	60
Control command not executed 2)	61

Make a note of the Error-Code before the X-ray generator is switched on again.

STATUS

Relay contact or actual-value registration defective	0
All inactive relays OK	1
Check relay K3	3
Check relay K12	4
Generator in the "Heating" position	5
Check power supply	6
Check relay K13	7
Check shut-off circuit	8
Shut-off circuit closed	9
Check safety circuit	10
Safety circuit closed	11
Check relay K5 andK6	12
Check short-circuit monitoring to ground	13
Check supply voltage for relay K52	14
Generator ready	15

Warn

Significance	Meaning	Display
1	Flow of deionized water < 4 l/min	Flow 1)
2	Level of deionized water too low	Level 1)
4	Temperature of deionized water > 40 °C	Temp 1)
16	Tube current controller out of controlling range or generator in stand-by mode	Limit_mA Stand-by
32	External green warning lamp defective	ext. Lamp 2)

Several warnings occurring at the same time are displayed cyclically.

DIAG

Significance	Meaning
1	+15 V present
2	– 15 V present
4	– 5 V present
8	+14 V present
16	Contactor K2 on

Relay

Significance	Meaning
1	Relay K3 closed
2	Relay K12 closed
4	Relay K13 closed
8	Relay K11 closed
16	Relay K10 closed
32	Relay K5 closed
64	Relay K14 closed
128	Relay K6 closed

1) X-ray instruments with internal cooling-water unit C79298-A3179-A1.

2) Generators with window control.

Siemens AG
Analytical X-ray Systems AUT 37
D-76181 Karlsruhe

Siemens Aktiengesellschaft

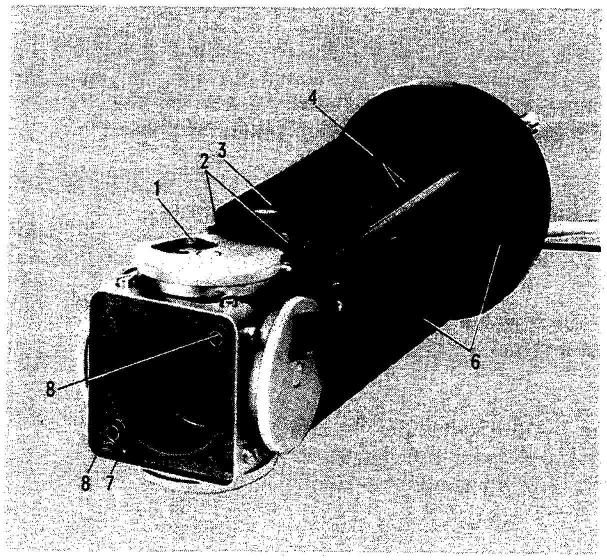
C79000-B3476-C182-05
Printed in Germany

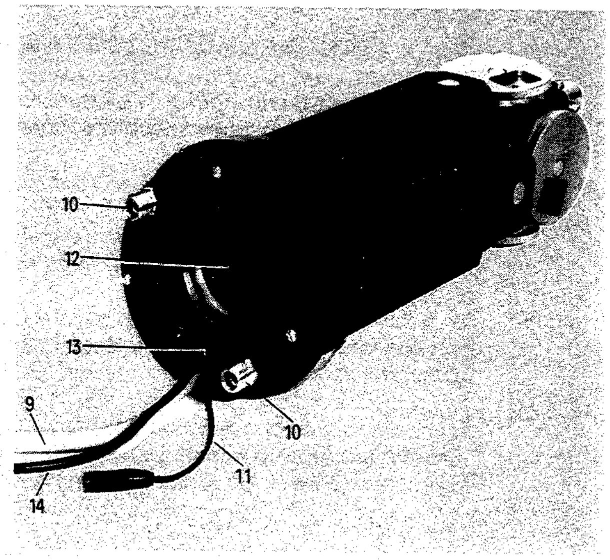
Progress
in Automation.
Siemens

SIEMENS

Röhrenhalterung Typ S
Tube Stand Type S
C79298-A3154-A1, -A3, -A9, -A10

Betriebsanleitung/Instructions Bestell-Nr. / Order No. C79000-B3474-C141-04





1 Schwenkklappe
2 Strahlenwarnlampen; leuchten bei göffnetem Fensterschieber
3 Sicherheitsschalter für Fensterschieber; wird von der aufgesetzten Filmkammer betätigt
4 Buchsenpaar für Sichheitsschaltung der Filmkammer
6 Bohrungen für Paßstifte (42)
7 Stift zur Festlegung der Lage der Röntgenröhre
8 Kühlwasserrohr
9 Anschlußkabel
10 Gewindestutzen M 14 x 1 zum Anschluß der Kühlwasserschläuche
11 Reißleine (Massesteckverbindung)
12 Isolierfolie
13 Erdungsschraube
14 Erdungskabel

Bild 1 Röhrenhalterung Typ S

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1 Verwendung

Die Röhrenhalterung Typ S dient als Halterung für luftisolierte Feinstruktur-Röntgenröhren F...4KE mit vier Strahlenaustrittsfenstern. Sie ist zum Betrieb von Filmkammern und Diffraktometern geeignet und kann waagerecht oder senkrecht auf der Tischplatte des Filmkammermeßplatzes oder eines Arbeitstisches montiert werden.

Die Röhrenhalterung ist das Strahlenschutzgehäuse der Röntgenröhre. Sie dient als Montagebasis von Monochromatoren oder kleineren Filmkammern.

2 Aufbau und Arbeitsweise

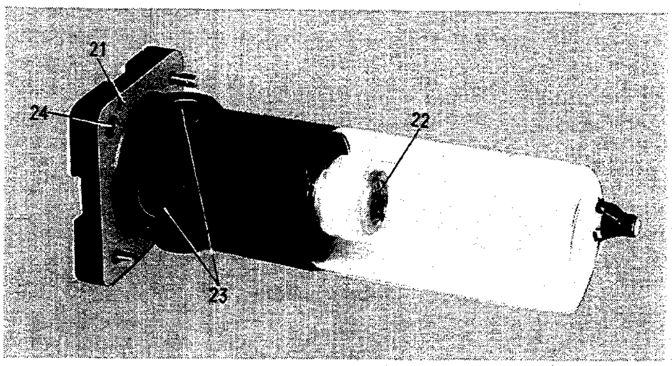
Die Röhrenhalterung (Bild 1) besitzt vier elektromagnetisch betätigte Fensterschieber, die die Strahlenaustrittsfenster der Röntgenröhre verschließen und je nach Bedarf geöffnet werden können.

Die Feinstruktur-Röntgenröhren F...4KE (Bild 2) besitzen zwei Strich- und zwei Quadratbrennflecke. Die Fensterschieber 1 und 3 sind den Strichbrennflecken zugeordnet, die Fensterschieber 2 und 4 den Quadratbrennflecken.

Im Inneren der Röhrenhalterung befindet sich eine Isolierfolie (12), die Hochspannungüberschläge vermeidet und einen Betrieb bis zu 60 kV ermöglicht. Unter der Kunststoffabdeckung befindet sich eine Erdungsschraube (13).

Vor jedem Strahlenaustrittsfenster der Ausführung -A3 und -A10 ist eine drehbare Filterscheibe mit fünf Kβ-Filtern und einer freien Position angebracht. Je nach Anodenmaterial kann eines der Kβ-Filter zur Unterdrückung der Kβ-Strahlung verwendet werden:

Anodenmaterial	Cr	Fe	Co	Cu	Mo
Kβ-Filter	V	Mn	Fe	Ni	Zr



21 Bohrung zur Festlegung der Lage der Röntgenröhre in der Röhrenhalterung
22 Hochspannungsanschluß
23 Strahlenaustrittsfenster
24 Kühlwasserbohrung

Bild 2 Röntgenröhre F...4KE

3 Technische Daten

Röntgenröhre	F...4KE (siehe Datenblatt der Röntgenröhre)
Fensterschieber	
Impuls zum Öffnen der Fensterschieber	durch Kondensatorentladung (C = 2 x 47 µF)
Haltespannung	DC 14 V
Kühlwasserversorgung	
Wasserdruck	5 bis 8 bar für Röntgenröhre, Röntgengenerator, interne Ventile und Schläuche
Durchflußmenge	min. 3,5 l/min
Abschaltverzögerung des Röntgengenerators bei Wassermangel	max. 2 s
Gewindeanschluß für Kühlwasserschläuche	M 14 x 1

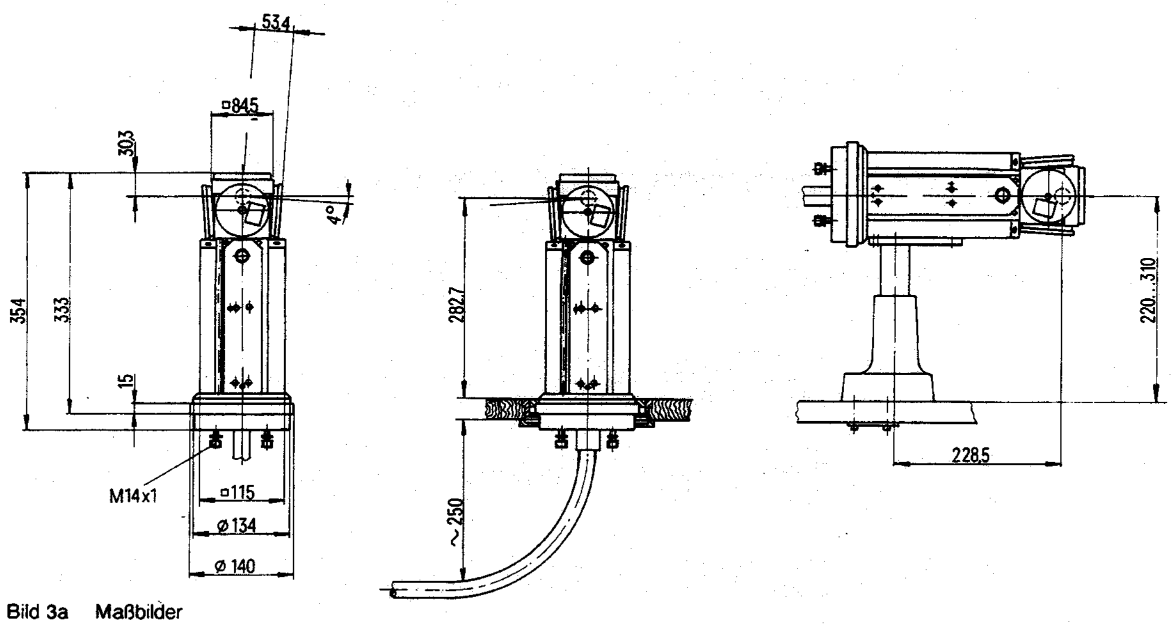
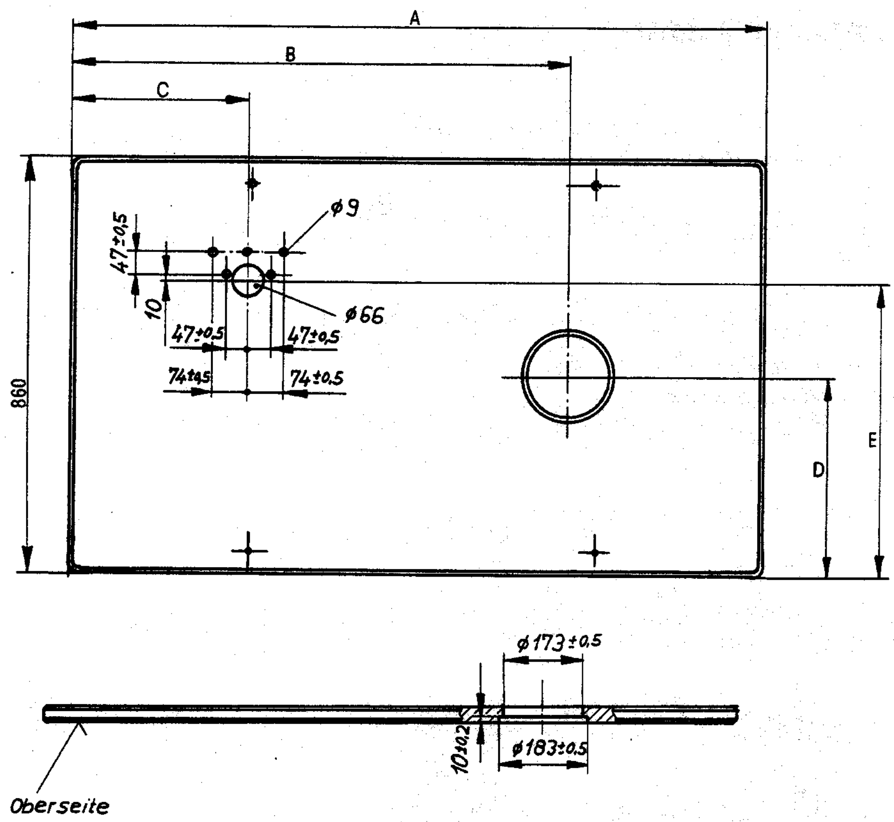


Bild 3a Maßbilder



Anordnung	Maße A	B	C	D	E	Material
□	1028	-	-	-	-	Holz
□ ○	1028	514	-	410	-	Holz
□	1456	-	-	-	-	Stein
□ ○	1456	728	-	410	-	Stein
□ ▽	1456	-	728	-	605	Stein
□ ▽ ○	1456	1044	373	410	605	Stein

▽ Bohrung für waagerechte Röhrenhalterung
○ Bohrung für senkrechte Röhrenhalterung

Bild 3b Bohrungen in der Tischplatte

4 Montage

Die Röhrenhalterung wird mit dem Teilesatz C72298-A224-D3 (für senkrechte Montage) oder C72298-A224-D4 (für waagerechte Montage) auf der Tischplatte montiert. Die Tischplatte ist mit verschiedenen Anordnungen der Bohrungen zur Montage der Röhrenhalterung lieferbar. Wenn eine andere Montageplatte verwendet wird, ist diese entsprechend zu bohren (siehe Bild 3b).

4.1 Senkrechte Montage

Einsatzring (32) in die Bohrung der Tischplatte setzen.

Gegenring (33) von unten anschrauben.

Schutzerde an die Erdungsschraube (13) führen.

Hochspannungskabel, Kühlwasserschläuche und Anschlußkabel anschließen (siehe Abschnitt 4.3).

Röhrenhalterung in den Einsatzring stellen und mit dem Haltering (31) befestigen.

31 Haltering
32 Einsatzring
33 Gegenring

Bild 4a Teilesatz für senkrechte Montage

4.2 Waagerechte Montage

Fuß (44) auf die Bohrung der Tischplatte stellen und mit der Gegenplatte (45) befestigen.

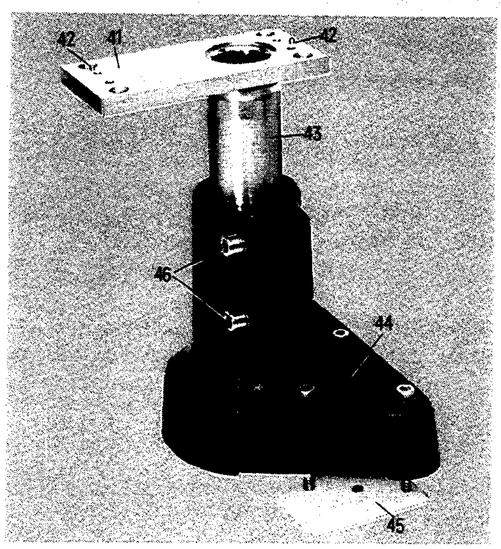
Feststellschrauben (46) lösen. Montageplatte (41) für die Röhrenhalterung ausrichten. Feststellschrauben wieder anziehen.

Röhrenhalterung in einer der vier möglichen Stellungen auf die Montageplatte legen; dabei müssen die Paßstifte (42) in die Bohrungen (6) der Röhrenhalterung eindringen. Röhrenhalterung mit vier mitgelieferten Schrauben M 4 x 12 auf der Montageplatte befestigen.

Schutzerde an die Erdungsschraube (13) führen.

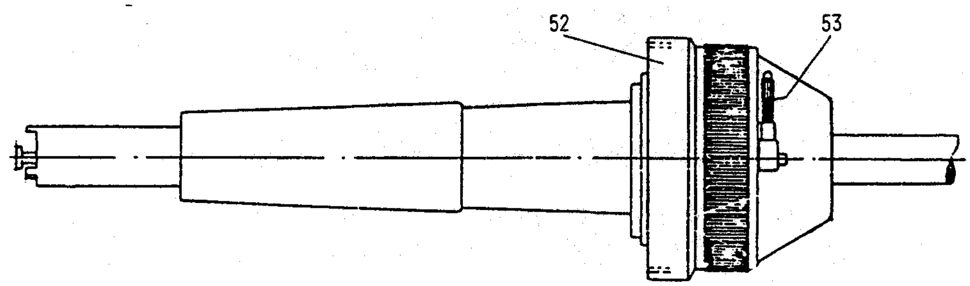
Hochspannungskabel, Kühlwasserschläuche und Anschlußkabel anschließen (siehe Abschnitt 4.3).

Röntgenröhre einsetzen (siehe Abschnitt 4.4).



41 Montageplatte
42 Paßstift
43 Tragrohr
44 Fuß
45 Gegenplatte
46 Feststellschrauben

Bild 4b Teilesatz für waagerechte Montage



52 Überwurfmutter
53 Massestecker

Bild 5 Hochspannungsstecker

4.3 Anschluß an den Röntgengenerator

Mit dem Röntgengenerator wird die Röhrenhalterung über das Hochspannungskabel, das Anschlußkabel und die Kühlwasserschläuche verbunden.

4.3.1 Anschluß des Hochspannungskabels

Achtung! Zur Sicherung vor Hochspannungsunfällen den Röntgengenerator ausschalten, bevor das Hochspannungskabel angeschlossen oder die Röntgenröhre eingesetzt wird. Schlüsselschalter am Röntgengenerator abziehen und Reißleine an der Röhrenhalterung ziehen, um ein Wiedereinschalten des Röntgengenerators zu verhindern. Erst das Kabel an der Röhrenhalterung befestigen, dann am Generator!

Stecker des Hochspannungskabels (Bild 5) in die Röhrenhalterung einführen und mit der Überwurfmutter (52) festschrauben. Der Stecker darf nicht gefettet werden. Hochspannungskabel an den Röntgengenerator anschließen (siehe Betriebsanleitung des Röntgengenerators).

4.3.2 Anschluß der Kühlwasserschläuche

Kühlwasserschläuche an die Gewindestutzen (10) der Röhrenhalterung und an den Röntgengenerator gemäß Zeichnung C79298-A3136-A101-*-12 anschließen. Siehe auch Betriebsanleitung des Röntgengenerators. Dabei die Durchflußrichtung beachten (gekennzeichnet durch Pfeile hinter den Gewindestutzen). Bei der Montage stets zwei Gabelschlüssel gegensinnig verwenden, um den Gewindestutzen zu entlasten.

Achtung! Die Abschaltungverzögerung bei Wassermangel darf höchstens 2 s betragen. Dies ist bei der ersten Inbetriebnahme in Stellung "Heizen" zu kontrollieren (Zuflußschlauch knicken).

4.3.3 Anschlußkabel

Das Anschlußkabel wird direkt am Röntgengenerator (Stecker X4 bei KRISTALLOFLEX 710 und 710H; siehe Bedienungsanleitung des Röntgengenerators) gesteckt. Über das Anschlußkabel laufen der Sicherheitskreis und die Fenstersteuerung.

4.4 Ein- und Ausbau der Röntgenröhre

Achtung! Die Strahlenaustrittsfenster (23) der Röntgenröhre bestehen aus dünnen Beryllium und dürfen nicht berührt werden.

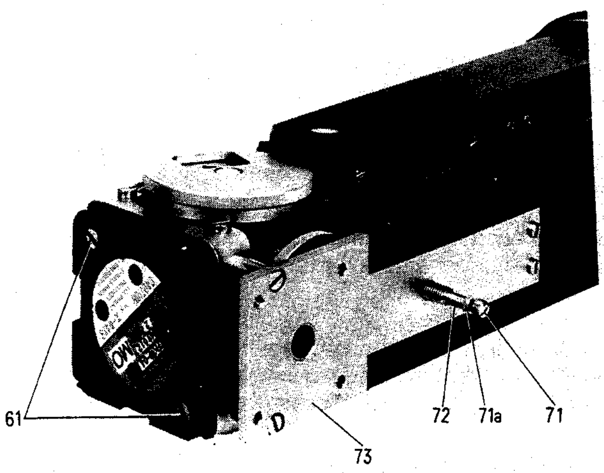
Einbau

Vor dem Einbauen sicherstellen, daß der Röntgengenerator ausgeschaltet und die Reißleine gezogen ist.

Dichtungen an den Wasserrohren (8) auf richtigen Sitz kontrollieren.

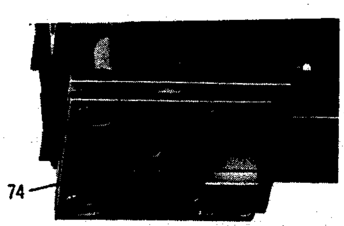
Röntgenröhre in die Röhrenhalterung einsetzen; dabei muß der Stift (7) an der Röhrenhalterung in die Bohrung (21) der Röntgenröhre eindringen.

Befestigungsschrauben (61) der Röntgenröhre wechselweise anziehen; dabei darf die Röntgenröhre nicht verkantet werden.



61 Befestigungsschrauben
71 Schraube für Längenanpassung
71a Kontermutter
72 Stift zum Betätigen des Sicherheitsschalters (3)
73 Adapterplatte

Bild 6 Röhrenhalterung mit Adapterplatte und eingesetzter Röntgenröhre



74 Befestigungsplatte
Bild 7 Montage der Befestigungsplatte

Ausbau

Röntgengenerator ausschalten.

Kühlwasserzufluß absperren.

Kühlwasserschläuche, wenn möglich, mit Preßluft ausblasen, damit beim Ausbauen der Röntgenröhre kein Kühlwasser in die Röhrenhalterung gerät.

Befestigungsschrauben (61) der Röntgenröhre wechselweise lösen; dabei darf die Röntgenröhre nicht verkantet werden.

Röntgenröhre herausnehmen; dabei darf kein auslaufendes Wasser an den Röhrenkörper oder in die Röhrenhalterung gelangen. Zurückgebliebene Wassertropfen abwischen.

4.5 Montage der Filmkammer

Als Basis für die Montage der Filmkammer dient die Adapterplatte (73). Sie wird gemäß Bild 6 in der gewünschten Position an der Röhrenhalterung montiert; dabei muß die Schwenkklappe (1) von Hand geöffnet werden.

Befestigungsplatte (74) gemäß Bild 7 an der Adapterplatte montieren.

Abhängig von der verwendeten Filmkammer wird die kurze oder lange Schraube (71) für den Betätigungsstift (72) verwendet. Die Schraube ist so zu justieren und zu kontern, daß der Sicherheitsschalter (4) von der aufgesetzten Filmkammer betätigt wird.

Sicherheitskabel der Filmkammer (siehe Betriebsanleitung der Filmkammer) mit dem Buchsenpaar (4) der Röhrenhalterung verbinden, das zu der verwendeten Position gehört (siehe Abschnitt 6.3).

5 Betrieb mit der Fenstersteuerung

Die Röhrenfenster werden von der Uhreneinheit des Röntgengenerators gesteuert. Die Uhrenheinheit und ihre Funktion werden in der Bedienungsanleitung des Röntgengenerators eingehend beschrieben. Der Zustand "Fenster offen" wird jeweils durch die zugeordneten Fensterkontrollampen angezeigt. Die Kontrollampen werden überwacht. Brennen diese nicht, so wird das Fenster sofort wieder geschlossen.

6 Strahlenschutz

Die Röhrenhalterung ist in Verbindung mit den Röntgenröhren der F...4KE mit Wolfram als härtestem Anodenmaterial bis zu 60 kV und 3 kW bauartzugelassen und auf Leckstrahlung geprüft.

Achtung! Vor Inbetriebnahme des Röntgenmeßplatzes ist sicherzustellen, daß die Vorschriften bezüglich Strahlenschutz und Umgang mit Röntgenstrahlern erfüllt sind. In der Bundesrepublik Deutschland gilt die Röntgenverordnung (RöV vom 8. Januar 1987).

Zur Vermeidung von ungewollt austretender Direktstrahlung sind folgende Sicherungen vorgesehen:

6.1 Schwenkklappe

Die Schwenkklappe (1) verschließt das Strahlenaustrittsfenster (23), solange nicht eine montierte Kammer die Klappe zwangsweise offenhält. Unbenutzte Fenster sind so doppelt verschlossen.

6.2 Sicherheitsschalter für Fensterschieber

Jedem Fenster ist ein Sicherheitsschalter (3) zugeordnet. Er unterbricht die Ansteuerleitung des Hubmagneten, der den Fensterschieber öffnet, wenn nicht die montierte Kammer mit einem Betätiger den Schalter niederdrückt.

Der Fensterschieber eines unbenutzten Fensters kann infolgedessen nicht geöffnet werden.

6.3 Röntgensicherheitskreis

Der Röntgensicherheitskeis dient zur Überwachung der Vollständigkeit der Abschirmungen und der richtigen Montage des Hochspannungskabels (Erdung der Röhrenhalterung). Nur wenn der Röntgensicherheitskreis Durchgang hat und die Reißleine (11) an der Überwurfmutter des Kabels gesteckt (Erdung) ist, läßt sich die Hochspannung am Röntgengenerator einschalten.

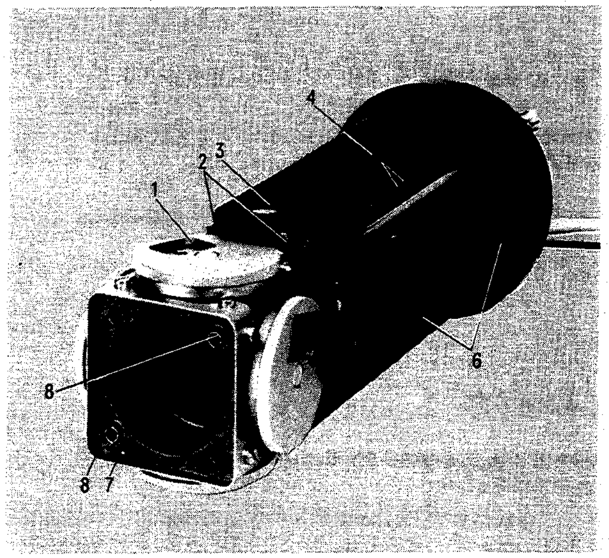
In der Röhrenhalterung öffnet der Fensterschieber je zwei Schalter im Sicherheitskreis, sobald er aufgesteuert wird. Parallel zu diesen Sicherheitsschaltern kann über je zwei Buchsen der Überwachungskreis der Untersuchungseinrichtung geschaltet werden. Dieser ist so auszulegen, daß er nur dann geschlossen ist, wenn die Einrichtung strahlenschutzmäßig komplett und zu ist.

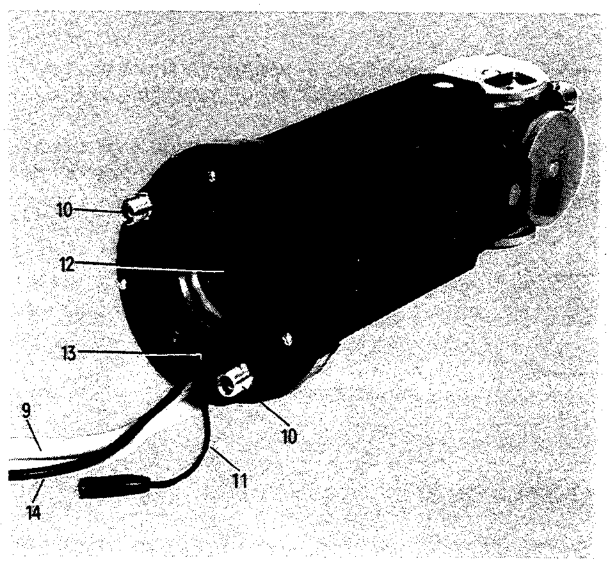
Achtung! Die richtige Funktion des Sicherheitskreises, insbesondere die richtige Zuordnung der Meßeinrichtungen zu den Fensterschaltern ist vor der Inbetriebnahme des Röntgengenerators, nach jedem Umbau und in regelmäßigen Abständen zu überprüfen.

7 Wartung

Nach jeder Außerbetriebnahme und jeder Wartung ist der **Röntgensicherheitskreis** zu kontrollieren: Funktion aller Mikroschalter des Röntgensicherheitskreises und der Massesteckverbindung (Reißleine) an der Röhrenhalterung nacheinander einzeln überprüfen (siehe Abschnitt 6).

Kühler der **Röntgenröhre** regelmäßig reinigen (siehe Datenblatt der Röntgenröhre).





1 Swivelling cover
2 Radiation warning lamps;
lit when window shutter is open
3 Safety switch for window shutter;
is operated by a camera placed in position
4 Pair of sockets for the camera safety circuit
6 Bore holes for locating pins (42)
7 Pin for X-ray tube positioning
8 Cooling water pipe
9 Connection cable
10 Threaded pipe M 14 x 1 for connection of the
cooling water hoses
11 Rip line (ground connector)
12 Insulating foil
13 Grounding screw
14 Grounding cabl

Fig. 1 Tube stand type S

1 Application

The tube stand type S is used as a holder for air-insulated F...4KE X-ray diffraction tubes with four tube windows. It is suitable for operation of X-ray diffraction cameras and diffractometers and can be mounted either horizontally or vertically on the table top of the measuring instrument of the X-ray diffraction camera or on a work bench.

The tube stand provides the radiation-protection housing for the X-ray tube and serves as mounting base for monochromators or smaller diffraction cameras.

2 Design and Mode of Operation

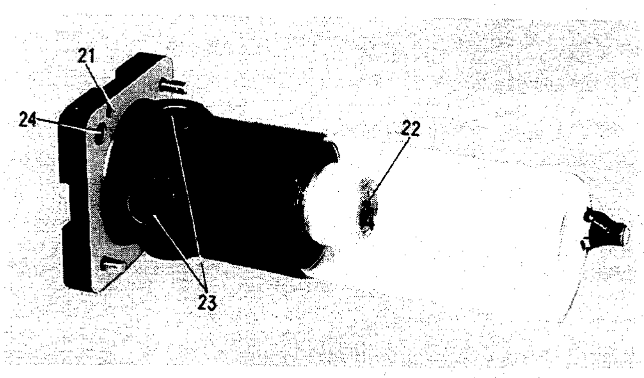
The tube stand (Fig. 1) has four electromagnetically operated shutters which close the windows of the X-ray tube and can be opened as required.

The F...4KE X-ray diffraction tubes (Fig. 2) have two line foci and two square foci. The window shutters 1 and 3 are allocated to the line foci and the window shutters 2 and 4 to the square foci.

Inside the tube stand there is an insulating foil (12) which avoids high-voltage flashovers and allows an operation up to 60 kV. A grounding screw (13) is located under the plastic covering.

In front of each tube window of the versions -A3 and -A10 there is a rotary filter disk with five Kβ filters and one free position. Depending on the anode material of the X-ray tube, one of the Kβ filters can be used to suppress the Kβ radiation:

Anode material	Cr	Fe	Co	Cu	Mo
Kβ filter	V	Mn	Fe	Ni	Zr



21 Bore hole for positioning the X-ray tube in the tube stand
22 High-voltage terminal
23 Tube window
24 Cooling water bore holes

Fig. 2 F...4KE X-ray tube

3 Technical Data

X-ray tube	Type F...4KE (see data sheet of X-ray tube)
Window shutter	
Shutter-opening pulse	by capacitor discharge (C = 2 x 47 µF)
Holding voltage	14 V DC
Cooling water supply	
Water pressure	5 to 8 bar for X-ray tube, X-ray generator, internal valves and hoses
Flow rate	min. 3,5 l/min
Switch-off delay of X-ray generator upon water failure	max. 2 s
Threaded pipe connection for cooling water hoses	M 14 x 1

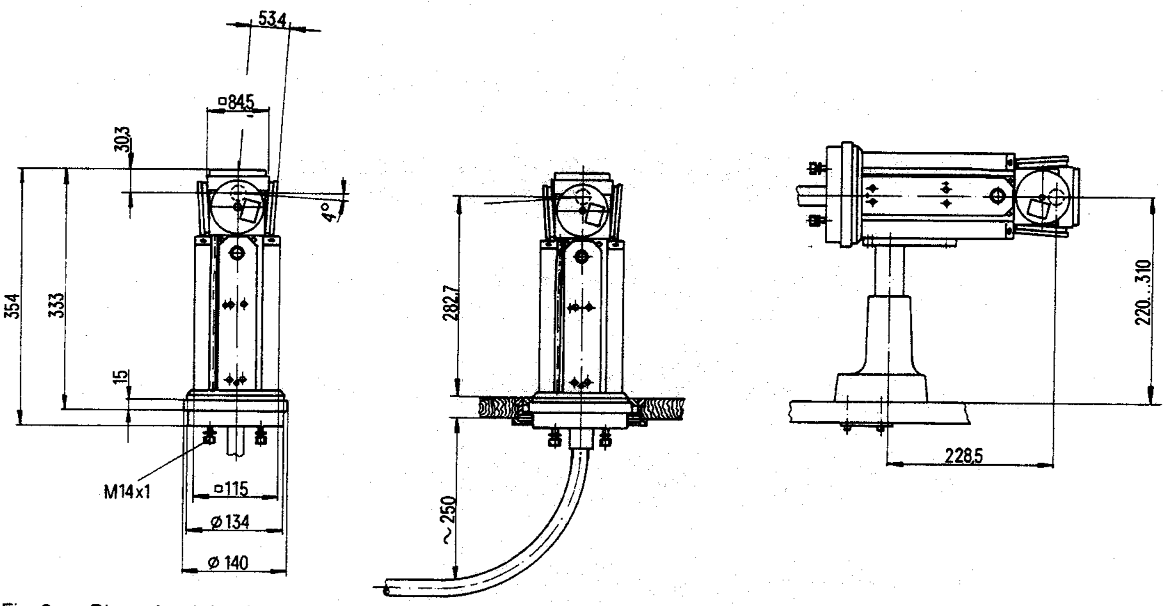
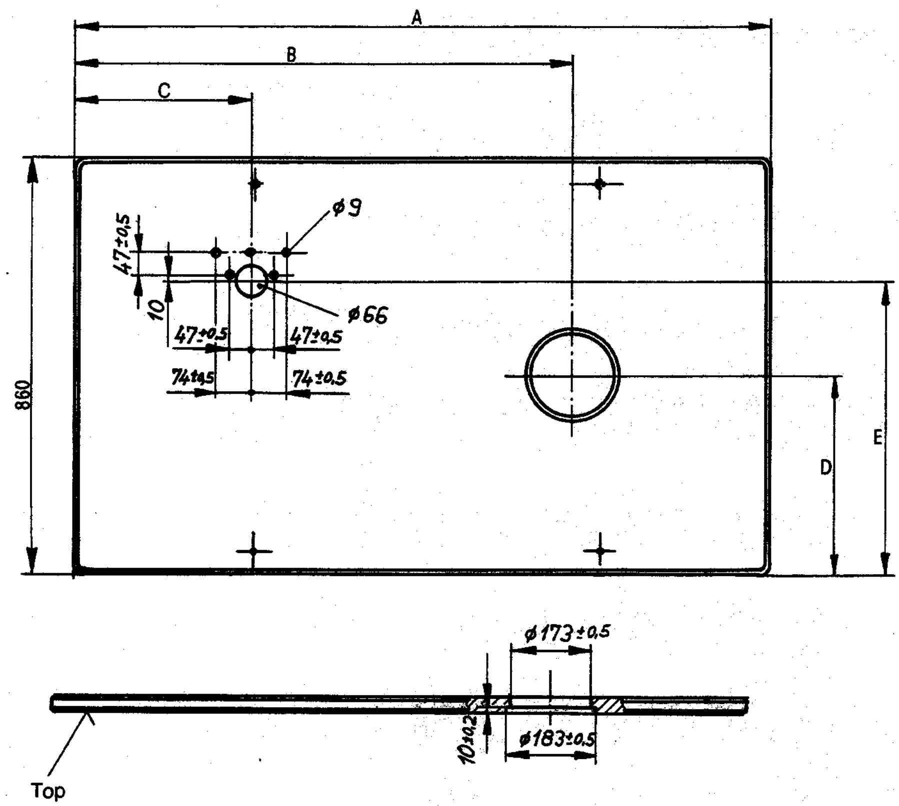


Fig. 3a Dimensional drawings



Arrangement	Dimensions A	B	C	D	E	Material
	1028	-	-	-	-	Wood
○	1028	514	-	410	-	Wood
	1456	-	-	-	-	Stone
○	1456	728	-	410	-	Stone
▽	1456	-	728	-	605	Stone
▽ ○	1456	1044	373	410	605	Stone

▽ Bore hole for horizontal tube stand
○ Bore hole for vertical tube stand

Fig. 3b Bore holes in the table top

4 Mounting

The tube stand is mounted on the table top using the parts kit C72298-A224-D4 (for vertical mounting) or C72298-A224-D4 (for horizontal mounting). The table top is available with various arrangements of the bore holes for mounting the tube stand. When using a different mounting plate, it must be drilled accordingly (see Fig. 3b).

4.1 Vertical Mounting

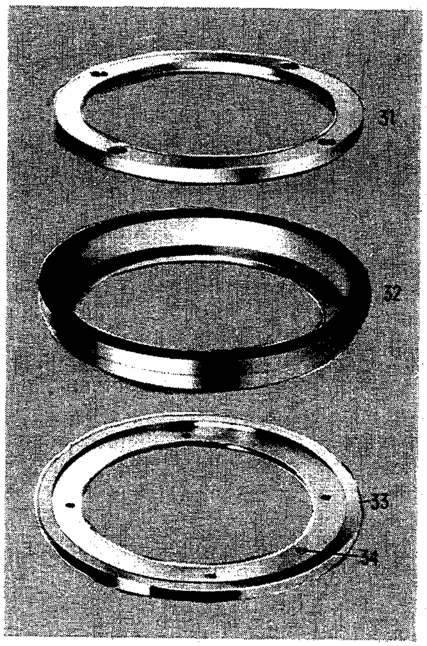
Place the insert ring (32) into the bore holes of the table top.

Screw on the counter ring (33) from underneath.

Connect the protective earth to the grounding screw (13).

Connect high-voltage cable, cooling water hoses and connection cable (see Section 4.3).

Place the tube stand into the insert ring and fasten it with the retaining ring (31).



31 Retaining ring
32 Insert ring
33 Counter ring

Fig. 4a Parts kit for vertical mounting

4.2 Horizontal Mounting

Place the foot (44) on the bore hole in the table top and fasten it with the counter plate (45).

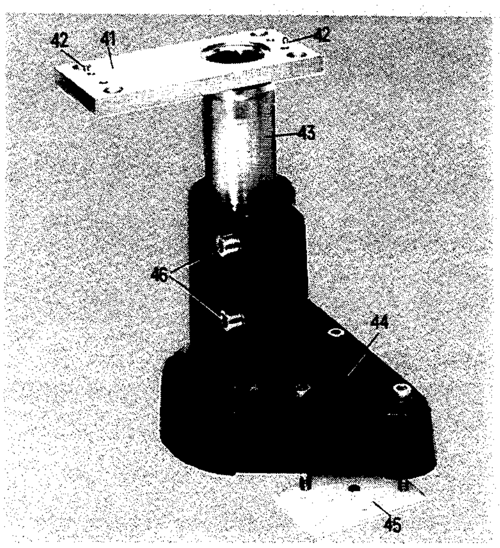
Loosen the set screws (46). Align the mounting plate (41) for the tube stand. Retighten the set screws.

Place the tube stand on the mounting plate in one of the four possible positions and make sure that the locating pins (42) engage in the bore holes (6) of the tube stand. Fasten the tube stand on the mounting plate with four M 4 x 12 screws supplied.

Connect the protective earth to the grounding screw (13).

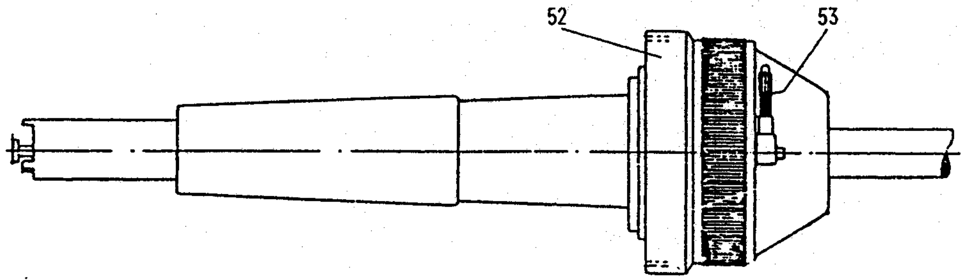
Connect high-voltage cable, cooling water hoses and connection cable (see Section 4.3).

Insert the X-ray tube (see Section 4.4).



41 Mounting plate
42 Locating pin
43 Supporting tube
44 Foot
45 Counter plate
46 Set screws

Fig. 4b Parts kit for horizontal mounting



52 Union nut
53 Ground connector

Fig. 5 High-voltage connector

4.3 Connection to the X-ray Generator

The tube stand is connected to the X-ray generator via the high-voltage cable, the connection cable and the cooling water hoses.

4.3.1 Connection of the High-voltage Cable

Caution! Before the high-voltage cable is connected or the X-ray tube is inserted, switch off the X-ray generator to avoid high-voltage accidents. Remove the key switch from the X-ray generator and pull the rip line to prevent a restart of the X-ray generator. First fasten the cable to the tube stand then to the generator!

Insert the plug of the high-voltage cable (Fig. 5) into the tube stand and fasten it by tightening the union nut (52). The plug must not be greased. Connect the high-voltage cable to the X-ray generator (see instructions for the X-ray generator).

4.3.2 Connection of the Cooling Water Hoses

Connect the cooling water hoses to the threaded pipes (10) of the tube stand and to the X-ray generator according to the drawing C79298-A3136-A101-*-12 (see also the instructions for the X-ray generator). By doing so, observe the flow direction (marked by arrows behind the threaded pipes).For the mounting always use two fork wrenches in opposite direction to relieve the threaded pipe.

Caution! The switch-off delay upon water failure must not exceed 2 s. This must be checked in the "Heating " position when the equipment is first put into operation (bend the water supply hose).

4.3.3 Connection Cable

The connection cable is directly plugged into the X-ray generator (connector X4 for KRISTALLOFLEX 710 and 710H; see instructions for the X-ray generator). The connection cable supplies the safety circuit and the window control.

113

4.4 Fitting and Removal of the X-ray Tube

Caution! The windows (23) of the X-ray tube are made of thin beryllium and must not be touched.

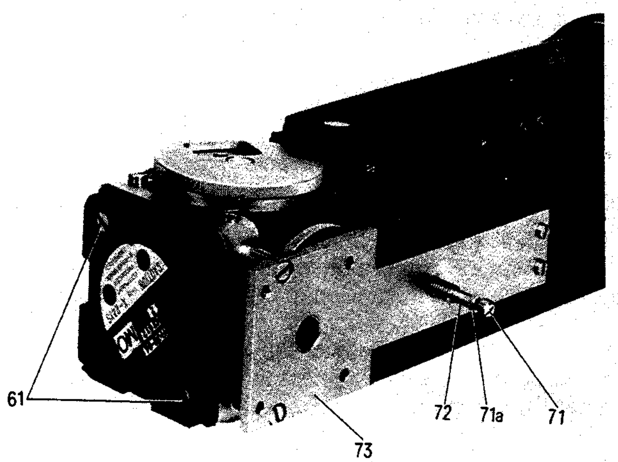
Fitting

Before fitting the X-ray tube make sure that the X-ray generator is switched off and the rip line is pulled.

Check that the seals on the water pipes (8) fit properly.

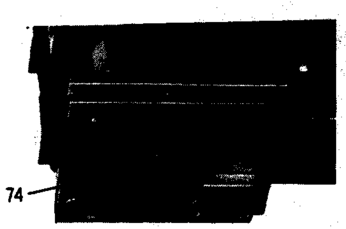
Insert the X-ray tube in the tube stand; the pin (7) at the tube stand must then engage in the bore hole (21) of the X-ray tube.

Tighten the fastening screws (61) of the X-ray tube alternately, taking care not to misalign the X-ray tube.



61 Fastening screws
71 Screw for length adjustment
71a Counter nut
72 Pin for actuating the safety switch (3)
73 Adapter plate

Fig. 6 Tube stand with adapter plate and X-ray tube inserted



74 Fastening plate

Fig. 7 Mounting of the fastening plate

Removal

Switch off the X-ray generator.

Block off the cooling water flow.

If possible, blow out the cooling water hoses with compressed air. This prevents the cooling water from getting into the tube stand when removing the X-ray tube.

Alternately loosen the fastening screws (61) of the X-ray tube and make sure that the X-ray tube is not misaligned.

Remove the X-ray tube; make sure that no water running out gets to the tube or into the tube stand. Wipe off any remaining drops of water.

4.5 Mounting of the X-ray Diffraction Camera

The adapter plate (73) serves as the base for mounting the X-ray diffraction camera. Manually open the swivelling cover (1) to mount the X-ray diffraction camera to the tube stand in the desired position (see Fig. 6).

Mount the securing plate (74) on the adapter plate according to Fig. 7.

Depending on the camera used, the short or long screw (71) will be used for the actuating pin (72). The screw must be adjusted and locked in such a way that the safety switch (4) is operated by the camera when it is attached.

Connect the safety cable of the camera (see operating instructions for the camera) with the pair of sockets (4) at the tube stand belonging to the position used (see Section 6.3).

5 Operation with the Window Control

The tube windows are controlled by the timer unit of the X-ray generator. The timer unit and its function are described in detail in the operating instructions of the X-ray generator. The allocated window pilot lamps indicate the status "window open". The pilot lamps are monitored. If they are not lit the window is closed immediately.

6 Radiation Protection

If the tube stand is used together with the F...4KE X-ray tubes, which have tungsten as hardest anode material, it is approved for operation up to 60 kV and 3 kW and tested for leakage radiation.

Caution! Before commissioning of the X-ray measuring instrument make sure that the regulations regarding radiation protection and handling of the X-ray tubes have been fulfilled. The X-ray regulations (RöV from 08.01.1987) apply for the Federal Republic of Germany.

The following safety equipment is provided to prevent unintentional emission of direct radiation:

6.1 Swivelling Cover

The swivelling cover (1) keeps the tube window (23) closed, as long as the cover is not forced to stay open by a mounted camera. Thus, unused windows are double-locked.

6.2 Safety Switch for Window Shutter

A safety switch is allocated to each window. It interrupts the control line of the solenoid which opens the window shutter, unless the mounted camera depresses the switch using an actuator.

Consequently, the window shutter of an unused window cannot be opened.

6.3 X-ray Safety Circuit

The X-ray safety circuit monitors whether the high-voltage cable is completely shielded and correctly mounted (grounding of the tube stand). The high voltage of the X-ray generator can only be switched on if the X-ray safety circuit is continuous and the rip line (11) is plugged onto the union nut of the grounding cable.

In the tube stand the window shutter opens two switches each in the safety circuit as soon as it is controlled to open. In parallel to these safety switches the monitoring circuit of the test equipment can be switched via two sockets each. The monitoring circuit is to be designed in such a way that it is only then closed if the equipment is closed and fulfills the radiation protection requirements.

Oversized Drawing

(intentionally left out)

Contact the factory Service Dept.
for hardcopy, if needed.

Provide manual number and page
number of missing drawing.

SIEMENS

Diffraktometer D 5000
D 5000 Diffractometer
Diffractomètre D 5000

Ersatzteilliste / Parts List / Liste de pièces de rechange — Bestell-Nr. / Ord. no. / N° de réf. C79000-E3463-C148-02

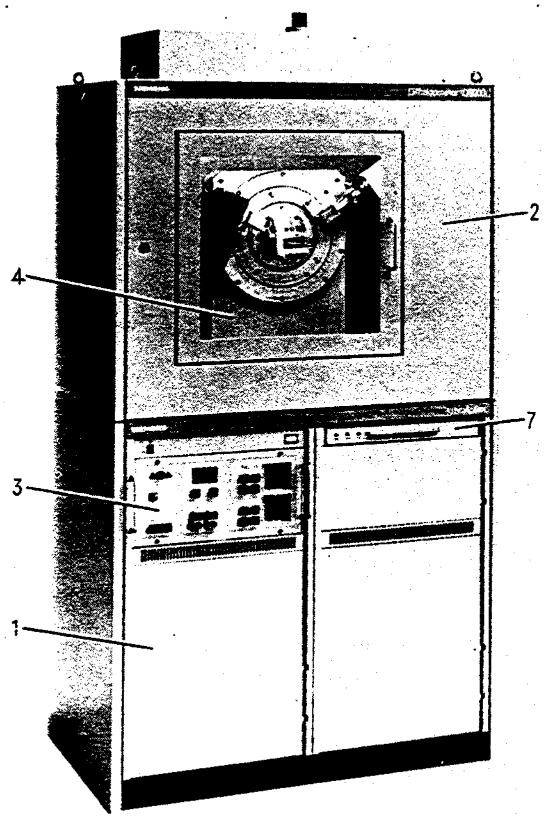


Bild 1 Diffraktometer D 5000
Fig. 1 D 5000 Diffractometer
Fig. 1 Diffractomètre D 5000

1 Standgehäuse
Console
Console

2 Strahlenschutzgehäuse
Radiation protection
Boîtier de protection des radiations

3 Röntgengenerator KRISTALLOFLEX® 710/710 H
KRISTALLOFLEX® 710/710H X-Ray Generator
Genérateur de rayons X KRISTALLOFLEX® 710/710 H

4 Goniometer
Goniometer
Goniomètre

7 Bedienfeld
Control panel
Panneau de commande

Diese Ersatzteilliste entspricht dem technischen Stand Mai 1990

Hinweise für die Bestellung

Die Bestellung muß enthalten:

1. Stückzahl
2. Bezeichnung
3. Bestell-Nr.
4. Bezeichung, Bestell-Nr. und Fabrikations-Nr. (F-Nr.) des Gerätes, zu dem das Ersatzteil gehört.

Bestellbeispiel:

Axiallüfter W74247-L8750-A2 für Steuergerät in Diffraktometer D 5000, Fabr.-Nr.

This parts list represents the technical state of May 1990

Ordering instructions

All orders should specify the following:

1. Quantity
2. Designation
3. Ord.No.
4. Designation, Order no. and Serial no. (F-No.) of the instrument to which the spare part belongs.

Ordering example:

Axial-flow fan W74247-L8750-A2 for control unit in D 5000 Diffractometer, Serial No.

Cette liste de pièces détachées correspond à l'état technique de mai 1990

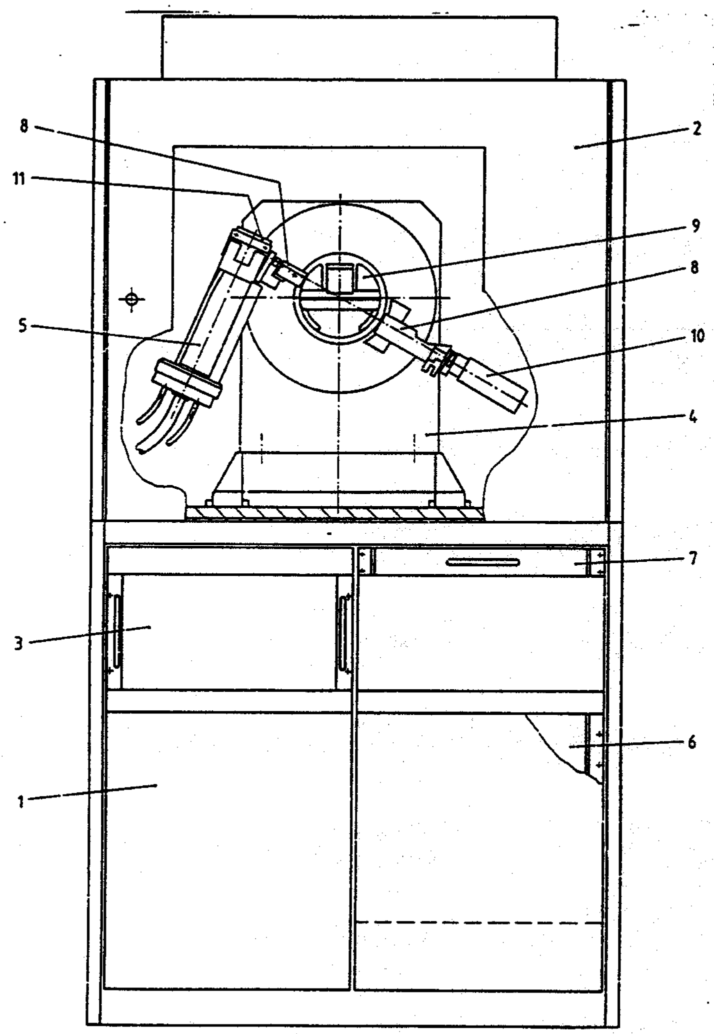
Exemple de commande:

La commande doit comporter:

1 quantité
2. la désignation.
3. le n° de référence
4. la désignation, le n° de réf. et le n° de série (F-N°) de l'appareil auquel est destinée la pièce.

Exemple de commande:

Ventilateur axial W74247-L8750-A2 pour l'unité de commande dans le diffractomètre D 5000, n° de série



1 Standgehäuse
Console
Console

2 Strahlenschutzgehäuse
Radiation protection housing
Boîtier de protection des radiations

3 Röntgengenerator KRISTALLOFLEX 710/710 H
KRISTALLOFLEX 710/710 H X-Ray Generator
Générateur de rayons X KRISTALLOFLEX 710/710 H

4 Goniometer
Goniometer
Goniomètre

5 Röhrenhalterung
Tube stand
Support tube

6 Steuergerät
Control unit
Unité de Commande

7 Bedienfeld
Control panel
Panneau de commande

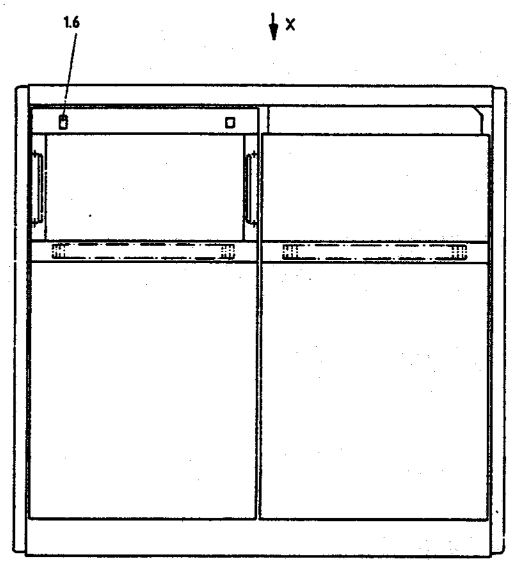
8 Blendensystem
Diaphragm system
Système de diaphragmes

9 Probenwechsler
Specimen Changer
Changeur d'éprouvettes

10 Detektor
Detector
Détecteur

11 Röntgenröhre
X-ray tube
Tube des rayons X

Bild 2 Diffraktometermeßplatz
Fig. 2 Diffractometer measuring station
Fig. 2 Poste de mesure du diffractomètre



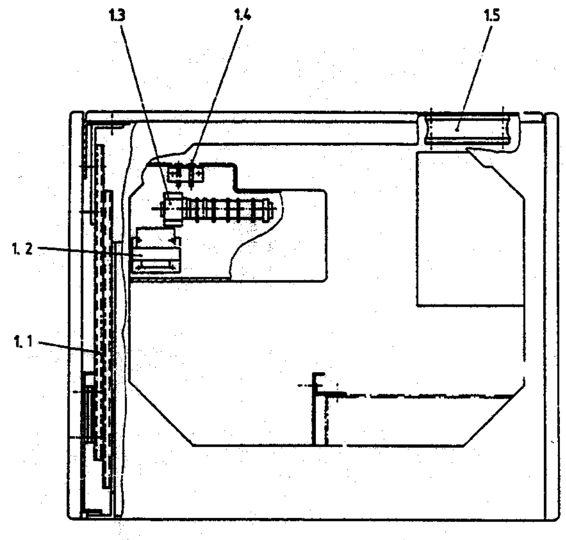


Bild 3 Standgehäuse
Fig. 3 Console
Fig. 3 Console

Teil-Nr. Part no. N° de pièce	Bezeichnung Description Désignation	Bestell-Nr. Order no. Réf. de commande	Bemerkungen Remarks Remarques
1	Standgehäuse Console Console		
1.1	Teleskopschienen Telescopic guide support Rails télescopiques	C79123-Z738-A1	1 Paar 1 pair 1 paire
1.2	Netzanpassungs-Transformator Line adapter transformer Transformateur d'adaptation au réseau	C71198-A210-B43	
1.3	Wechselstrom-Schütz AC contactor Contacteur courant alternatif	3TB4011-OAN1	K1
1.4	Schmelzeinsatz T 6.3 A/250 V Slow-blow fuse Cartouche fusible	W79054-L1011-T630	
1.5	Axiallüfter Axial-flow fan Ventilateur axial	W74247-L8750-A2	M1, M2
1.6	Netzschalter Mains switch Commutateur principal	W79050-W1201-U102	

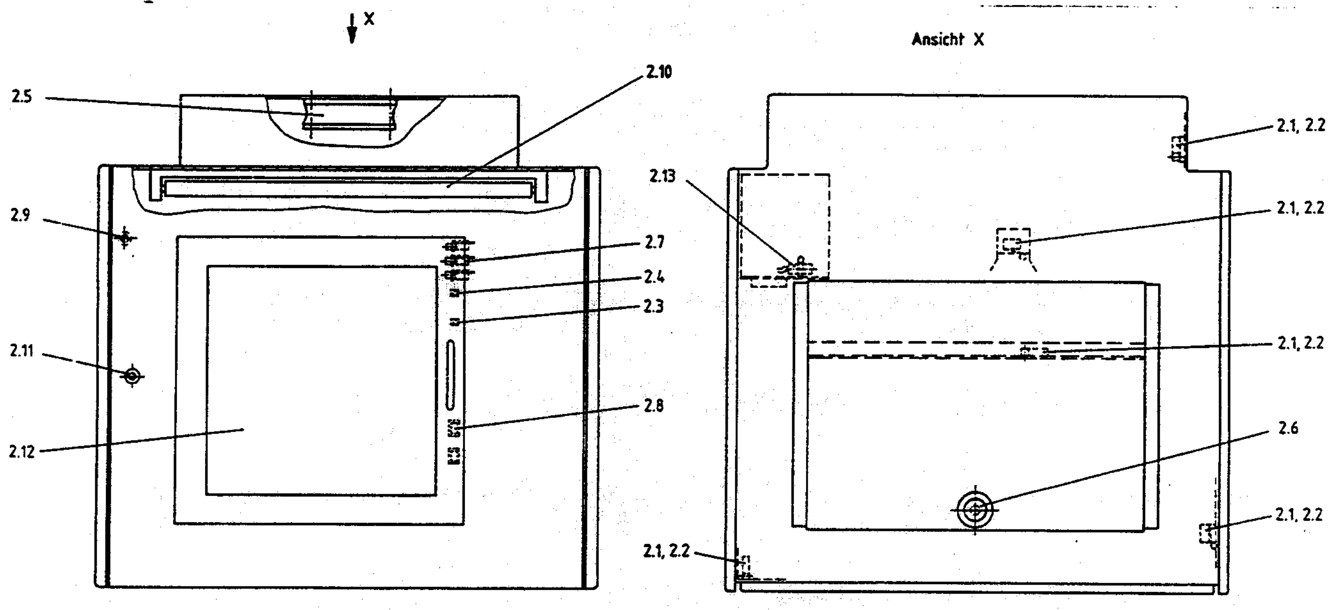


Bild 4 Strahlenschutzgehäuse
Fig. 4 Radiation protection housing
Fig. 4 Boîtier de protection des radiations

Teil-Nr. Part no. N° de pièce	Bezeichnung Description Désignation	Bestell-Nr. Order no. Réf. de commande	Bemerkungen Remarks Remarques
2 2	Strahlenschutzgehäuse Radiation protection housing Boîtier de protection des radiations		
2.1	Mikroschalter Microswitch Microcommutateur	C71315-Z153-C4	S 101 ...S112
2.2	Rollenhebel Ball lever Levier à galet	C71315-Z153-M9	

Teil-Nr. Part no. N° de pièce	Bezeichnung Description Désignation	Bestell-Nr. Order no. Réf. de commande	Bemerkungen Remarks Remarques
2.3	Drucktaste Push-button Bouton poussoir	W79050-T3106-L101	S 617
2.4	Drucktaste Push-button Bouton poussoir	W79050-T3104-L101	S 616
2.5	Axiallüfter Axial-flow fan Ventilateur axial	W74247-L8750-A2	E 601
2.6	Warnlampe Warning lamp Lampe témoin	C79298-A1-A12	
2.6.1	Glühlampe, 12-15 W, 166 mA Lamp Lampe	W79064-A1-A12	E 603
2.7	Mikroschalter Microswitch Microcommutateur	C72315-Z153-C13	S613...S615
2.8	Wippschalter Rocker switch Commutateur à bascule	W79050-W1201-U102	S 619, S 620
2.9	Schlüsselschalter Keyswitch Interrupteur à clé	W79050-X3102-X	S 618
2.10	Leuchtstofflampe Fluorescent lamp Tube fluorescent	5PL1030-2F	E 602
2.11	Zylinderschloß Cylinder lock Serrure à cylindre	C71123-Z466-B11	
2.12	Scheibe Wafer Disque	C72298-A231-C40	
2.13	Entstörkondensator Interferende suppression capacitor Condensateur antiparasitage	B81921-A-B21	RC 600
3	Röntgengenerator KRISTALLOFLEX 710/710H siehe Ersatzteilliste C79000-E3474-C074 KRISTALLOFLEX 710/710H X-Ray Generator see parts list C79000-E3474-C074 Générateur de rayons X KRISTALLOFLEX 710/710 Voir liste des pièces de rechange C79000-E3474-C074		

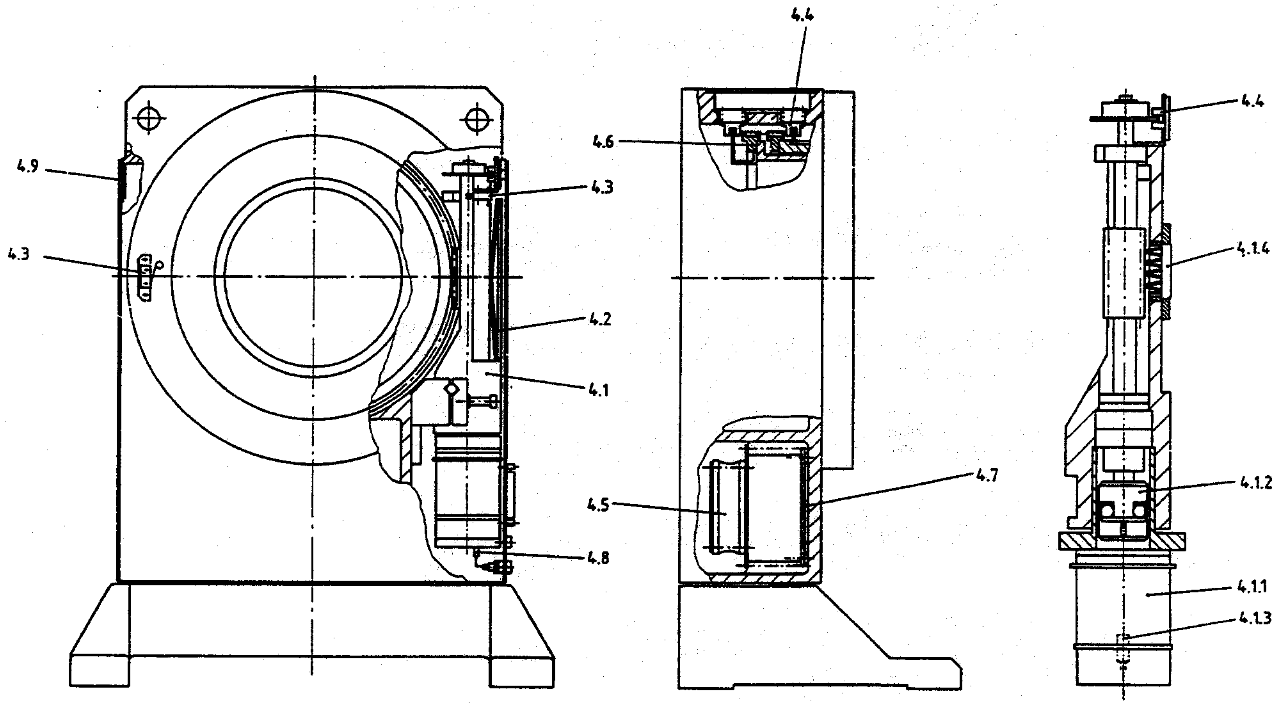


Bild 5 Goniometer
Fig. 5 Goniometer
Fig. 5 Goniomètre

Teil-Nr. Part no. N° de pièce	Bezeichnung Description Désignation	Bestell-Nr. Order no. Réf. de commande	Bemerkungen Remarks Remarques
4.1	Antrieb Drive Entraînement	C79298-A3156-B1	
4.1.1	Schrittmotor Step motor Moteur pas à pas	W79047-A4014-X	M1, M2
4.1.2	Kupplung Coupling Accouplement (embrayage)	C79106-Z1410-A1	
4.1.3	Thermoschalter Thermostatic switch Thermocommutateur	W79086-D2-D70	S3, S4
4.1.4	Schmierbürste Lubrication brush Brosse graisseuse	C79298-A3156-B7	
4.2	Blattfeder Leaf spring Ressort à lames	C79298-A3156-C76	
4.3	Mikroschalter Microswitch Microcommutateur	W79050-X6001	S1, S2
4.3.1	Rollenhebel Bull lever Levier à galet	C71315-Z153-M4	
4.4	Lichtschranke OPB 960 Light barrier OPB 960 Barrage photoélectrique	W79025-G1913-X	H 1...H 4
4.5	Axiallüfter Axial-flow fan Ventilateur axial	C74247-F60-E2	E 1
4.6	Schrägstirnrad Single-helical gear Roue hélicoïdale	C79298-A3156-C2	
4.7	Verdrahtungsplatte Backplane Tableau des connexions	C79458-L2234-B11	
4.8	Diode 1N6267 A Diode 1N6267 A Diode 1N6267 A	W79020-W61-D832	V 1...V 4
4.9	Filterpapier Filter paper Papier filtre	C79298-A3156-D12	1 Satz, 4 Stück 1 Set, 4 pieces 1 Jeu, 4 pièces

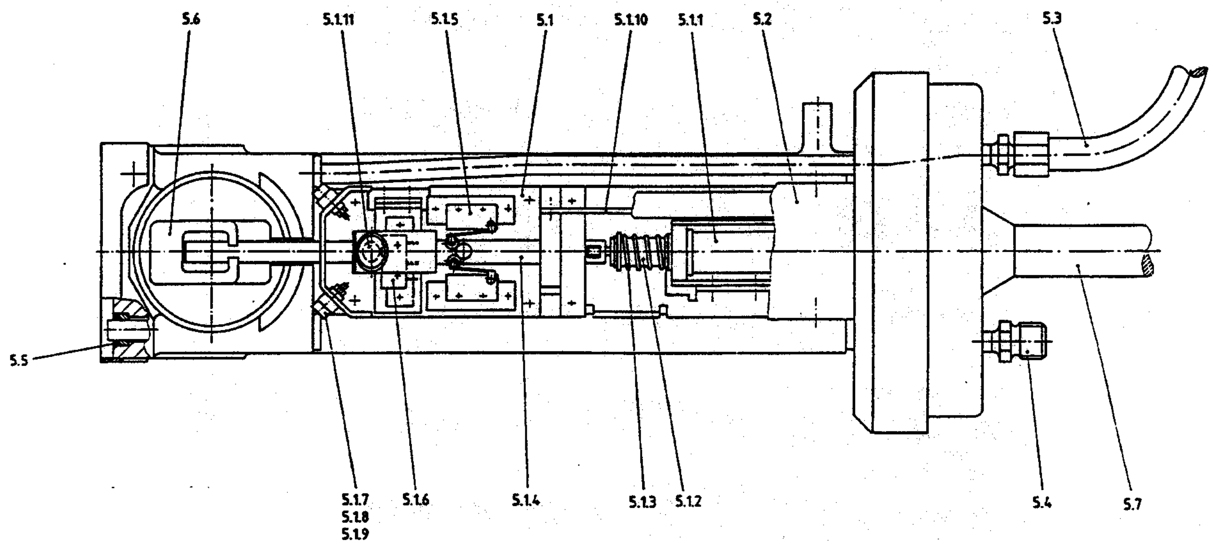


Bild 6 Röhrenhalterung
Fig. 6 Tube stand
Fig. 6 Support tube

Teil-Nr. Part no. N° de pièce	Bezeichnung Description Désignation	Bestell-Nr. Order no. Réf. de commande	Bemerkungen Remarks Remarques
5.1	Verschlußeinheit Loking device Unité de verrouillage	C79298-A3154-B11	
5.1.1	Hubmagnet Lifting solenoid Electroaimant de Levage	C79298-A3154-B3	K701
5.1.2	Anker Armature Systéme d'ancrage	C79298-A3154-C24	

Teil-Nr. Part no. N° de pièce	Bezeichnung Description Désignation	Bestell-Nr. Order no. Réf. de commande	Bemerkungen Remarks Remarques
5.1.3	Druckfeder Pressure spring Ressort de pression	C72298-A224-C3	
5.1.4	Schieber Shutter Curseur	C79298-A3154-B6	
5.1.5	Mikroschalter Microswitch Microcommutateur	W79050-X6021-X	S1 701, SK701, SK702
5.1.6	Mikroschalter Microswitch Microcommutateur	W79050-X6001	SM701
5.1.7	Lampenfassung Lamp socket Douille de lampe	W79064-E2001-A	
5.1.8	Kalotte Collar Calotte	W79064-X8-X	
5.1.9	Glühlampe 12 V, 50 m A Lamp Lampe	W79064-A5002-B12	E701, E702
5.1.10	FBG-Fail-Safe P.C. board Fail-safe Cartes de circuits imprimés à sûreté intégrée	C79458-L2234-B10	
5.1.11	Feder Spring Ressort	C79298-A3154-B7	
5.2	Kappe Cover Couvercle	C79298-A3154-C50	
5.3	Verbindungsschlauch Connection hose Flexible de Liaison	C71402-A4-C12	3 m
5.4	Kühlleitung Cooling pipe Conduite de refroidissement	C72298-A224-B19	
5.5	O-Ring O-ring gasket joint torique	C71121-Z100-A22	
5.6	Verschluß Lock Verrou	C79298-A3154-C10	
5.7	Hochspannungskabel High-voltage cable Câble haute tension	W79079-K2012-A1	3,5 m

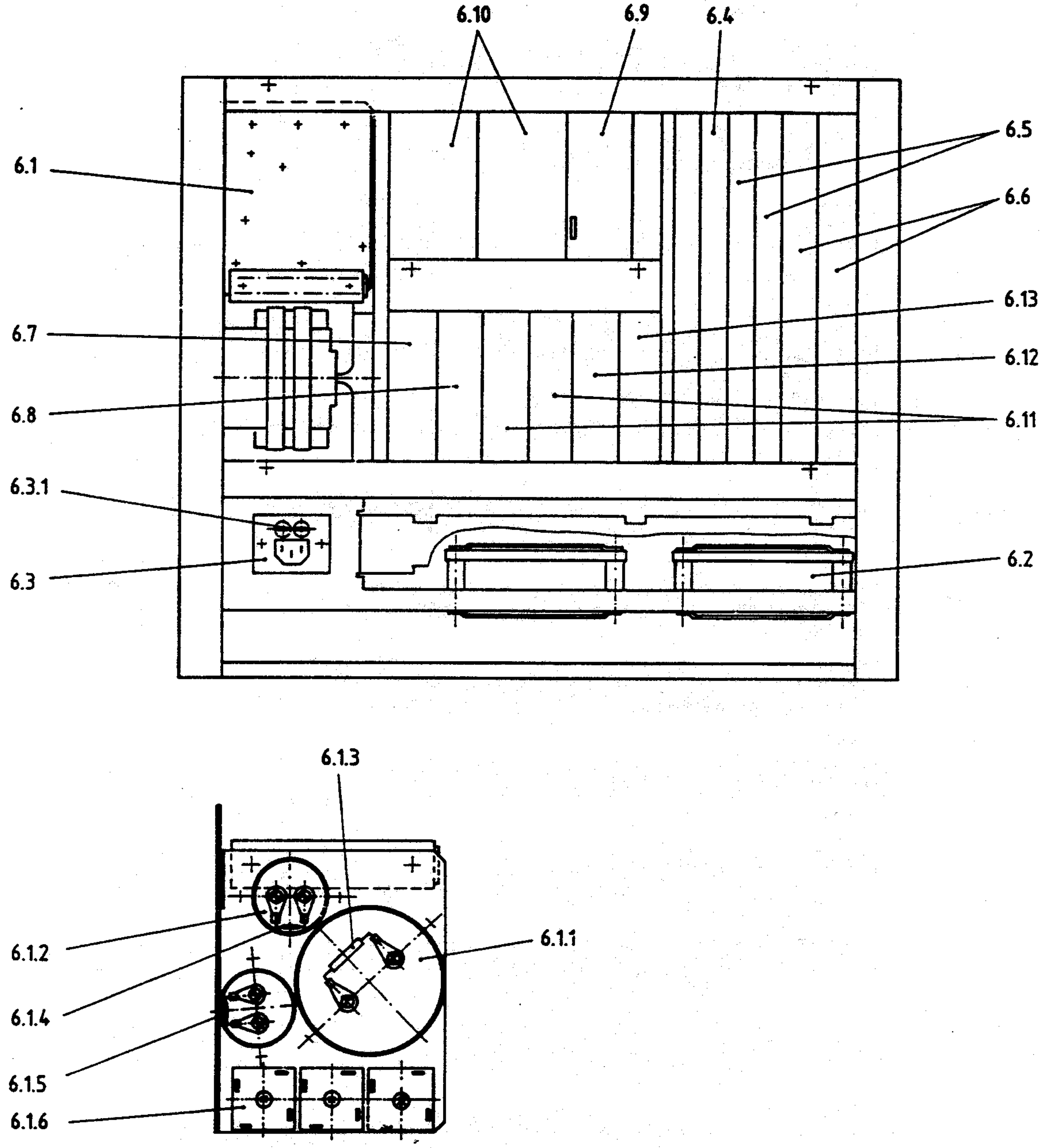


Bild 7 Steuergerät
Fig. 7 Control unit
Fig. 7 Unité de commande

Teil-Nr. Part no. N° de pièce	Bezeichnung Description Désignation	Bestell-Nr. Order no. Réf. de commande	Bemerkungen Remarks Remarques
6.1	Stromversorgung Power supply Alimentation en courant		
6.1.1	Kondensator, 10 000 µF, 100 V Capacitor Condensateur	W79010-M3109-T100	C1
6.1.2	Kondensator, 10 000 µF, 40 V Capacitor Condensateur	W79010-M3109-T40	C2, C3
6.1.3	Widerstand, 10 kΩ, 1,5 W Resistor Résistance	W74004-M303-J97	R1
6.1.4	Widerstand, 1 kΩ Resistor Résistance	W74004-D2102-F2	R2
6.1.5	Widerstand, 4,75 kΩ Resistor Résistance	W74004-D2472-F502	R3
6.1.6	Gleichrichter KB PC 25-02 Rectifier Redresseur	W79023-C1013-A203	V1...V3
6.2	Axiallüfter Axial-flow fan Ventilateur axial	W74247-L8750-A2	E1, E2
6.3	Stecker mit Filter Plug with filter Fiche avec filtre	W79074-B1404-U3	X 350
6.3.1	Schmelzeinsatz, T1, 6 A, 250 V Slow-blow fuse Cartouche fusible	W79054-L1011-T160	F7, F8
6.4	FBG CPU P.C. board CPU Cartes de circuits imprimés CPU	C79458-L2234-B1	

Teil-Nr. Part no. N° de pièce	Bezeichnung Description Désignation	Bestell-Nr. Order no. Réf. de commande	Bemerkungen Remarks Remarques
6.4.1	Festwertspeicher Read-only-memory Mémoire morte	S79610-G61-A900	
6.4.2	Batterie Battery Batterie	C79458-L212-B5	
6.5	FBG Steuerelektronik P.C. board Electronic control system CCI du système électronique de commande	C79458-L2234-B2	
6.6	FBG Meßelektronik P.C. board Electronic measuring system CCI du système électronique de mesur	C79458-L2234-B3	
6.7	FBG Fenstersteuerung P.C. board Window control system CCI du système de commande de la fenêtre de visualisation	C79458-L2234-B4	
6.7.1	Schmelzeinsatz, M0, 032 A/250 V Medium time lag fuse Cartouche fusible	W79054-N1010-M32	F6
6.8	FBG Anschaltung P.C. board interface CCI de l'interface	C79458-L2234-B5	
6.8.1	Schmelzeinsatz, M6, 3 A/250 V Medium time-lag fuse Cartouche fusible	W79054-N1011-M630	F1, F5
6.8.2	Schmelzeinsatz M1, 6 A/250 V Medium time-lag fuse Cartouche fusible	W79054-L1011-M160	F2, F3
6.8.3	Schmelzeinsatz, F1, 6 A/250 V Fast-blow fuse Cartouche fusible	W79054-L1011-F160	F4
6.9	FBG Regler P.C. board Controller CCI du contrôleur	C79458-L2234-B9	
6.10	FBG Ansteuerelektronik P.C. board Electronic trigger system CCI du système de commande de démarrage	C 79451-Z1188-U1	
6.11	Schrittmotorsteuerung Step motor control Commande du moteur pas à pas	C79458-L2234-B6	
6.12	FBG Probenwechslersteuerung P.C. board Specimen changer control CCi de la commande du changeur d'éprouvettes	C79458-L2234-B8	
6.13	FBG Triac-Steuerung P.C. board Triac control CCi de la commande TRIAC	C79298-A3117-B41	

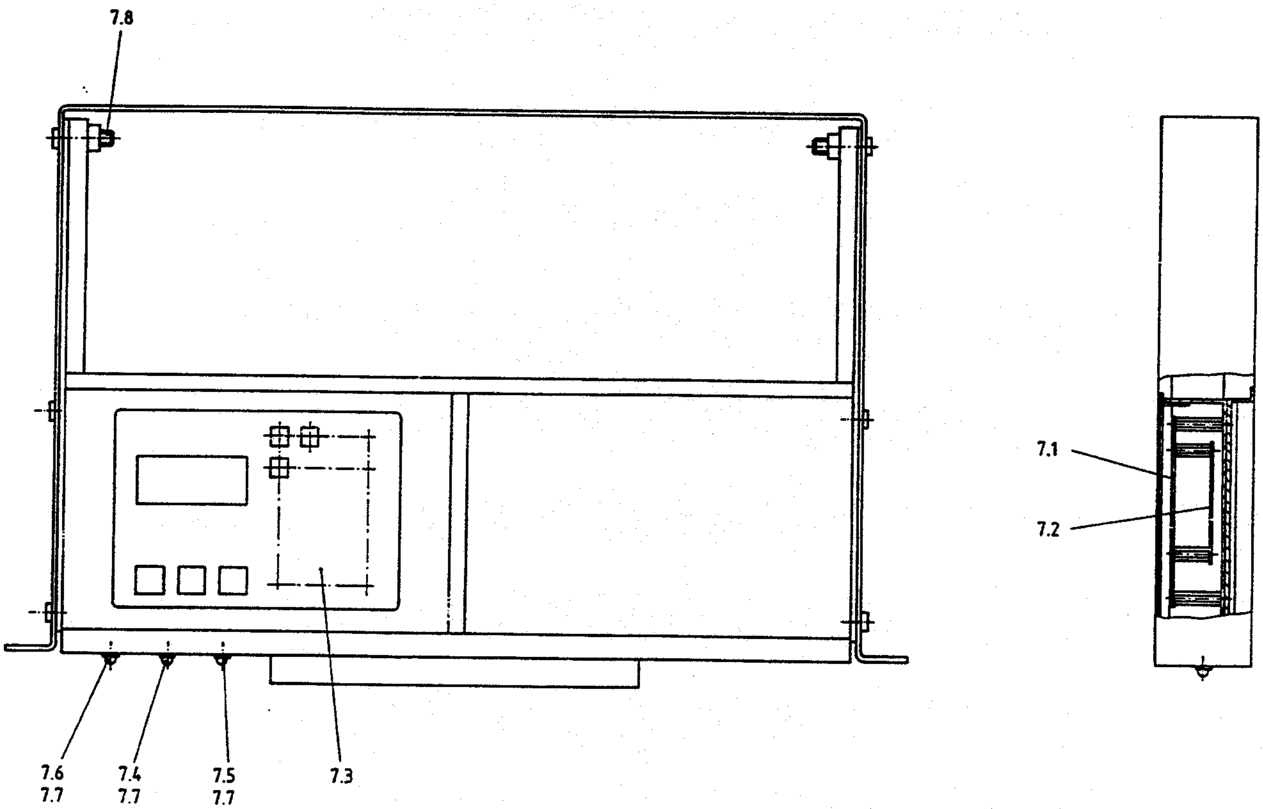


Bild 8 Bedienfeld
Fig. 8 Control panel
Fig. 8 Panneau de commande

Teil-Nr. Part no. N° de pièce	Bezeichnung Description Désignation	Bestell-Nr. Order no. Réf. de commande	Bemerkungen Remarks Remarques
7.1	FBG Control Board P.C. board - CCI de commande	C79458-L2234-B12	
7.1.1	Festwertspeicher Read-only memory Mémoire morte	S79610-G39-A900	
7.2	FBG LCD-Display P.C. board LCD-Display CCI de l'affichage LCD	C79458-L2234-B16	
7.3	Folientastatur Membrane Keyboard Clavier membrane	C79451-Z88-U1	
7.4	Leuchtdiode, rot LED, red DEL, rouge	W79025-L1951-H120	H1
7.5	Leuchtdiode, gelb LED, yellow DEL, jaune	W79025-L3953-H120	H2
7.6	Leuchtdiode, grün LED, green DEL, verte	W79025-L2955-H120	H3
7.7	Befestigungsring Mounting ring Bague de fixation	W79029-X4605	
7.8	Druckstück Snap-on screw Elément de pression	C79123-Z1268-E1	

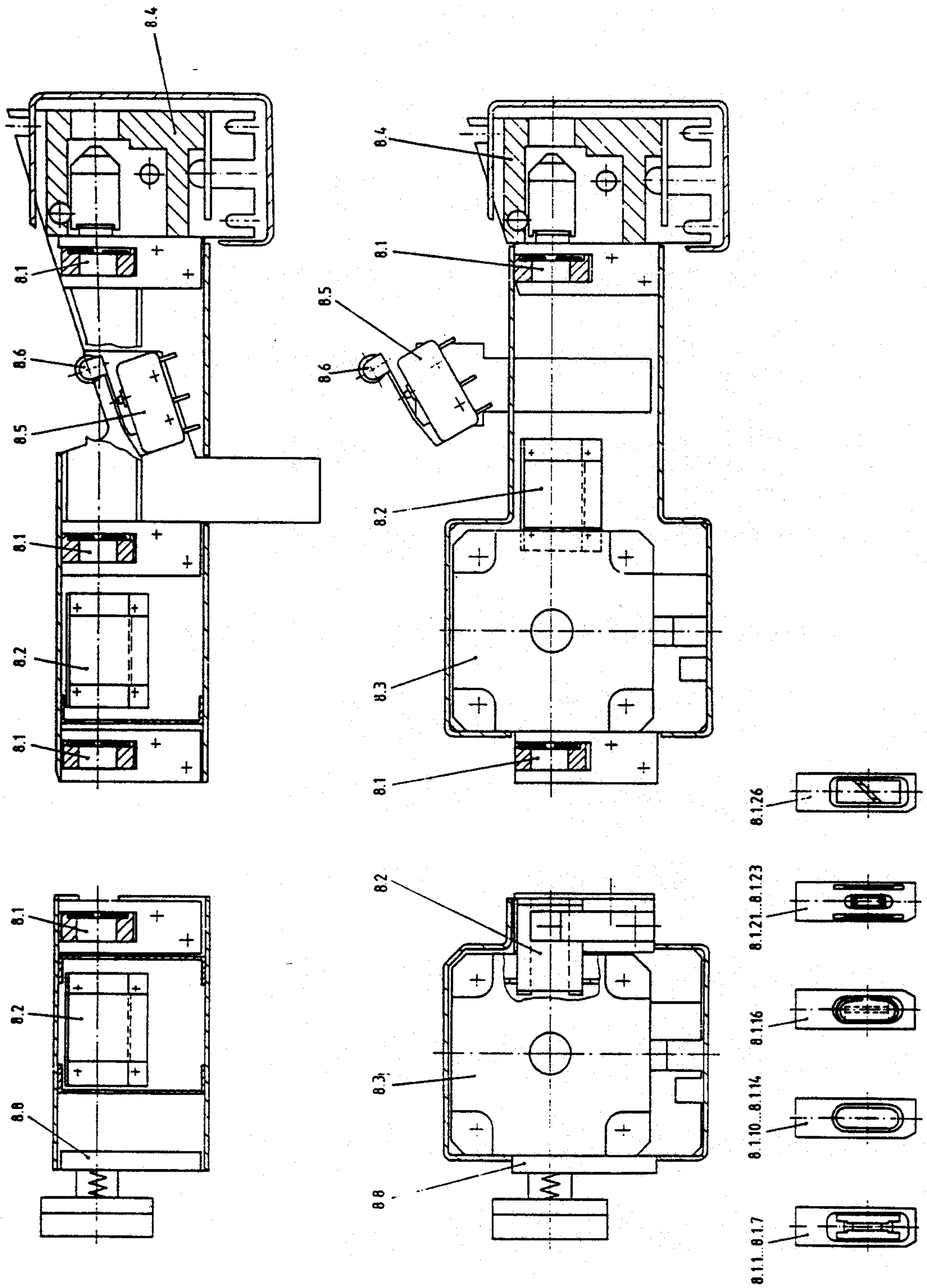


Bild 9a Blendensystem
Fig. 9a Diaphragm system
Fig. 9a Système de diaphragmes

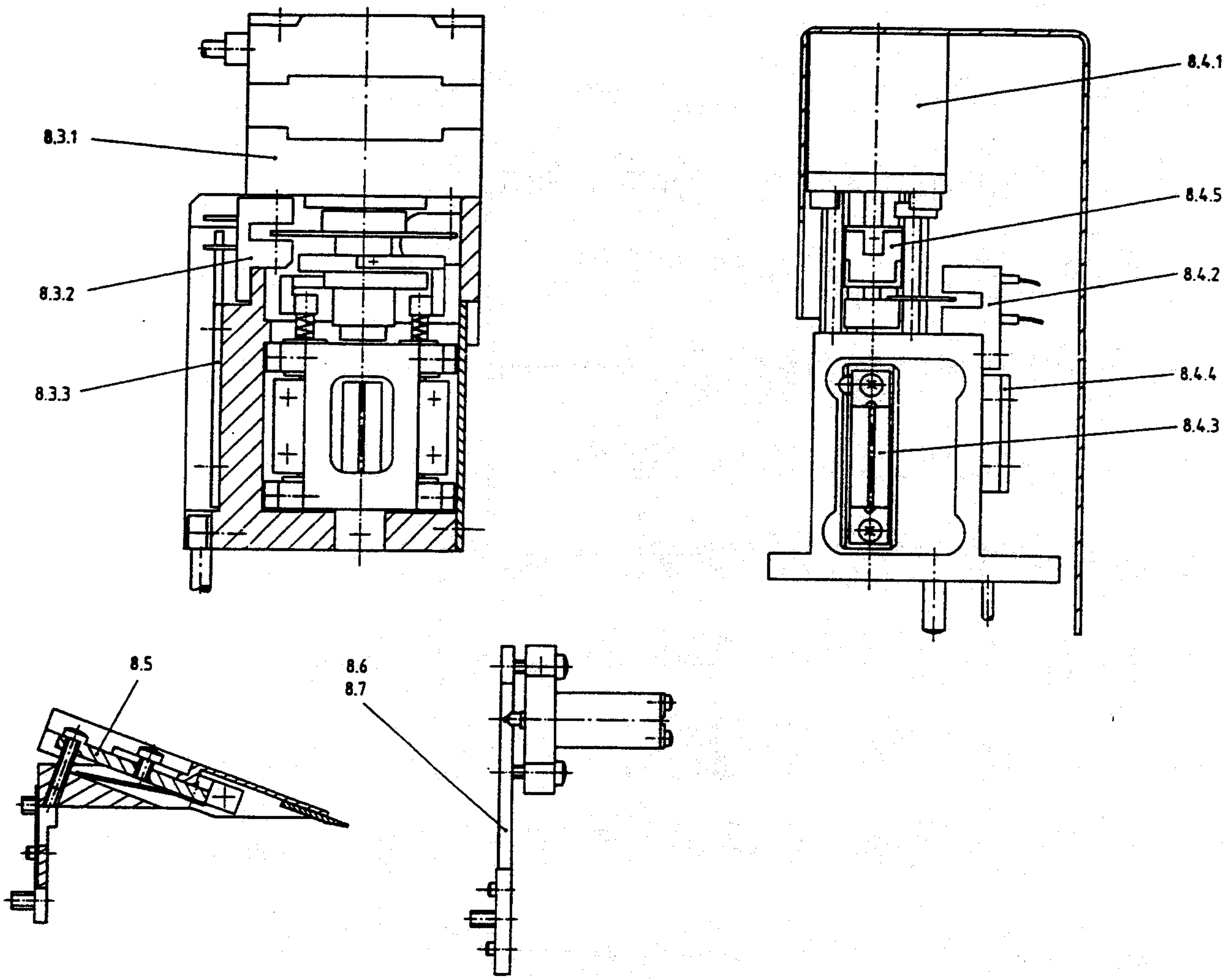


Bild 9b Blendensystem
Fig. 9b Diaphragm system
Fig. 9b Système de diaphragmes

Teil-Nr. Part no. N° de pièce	Bezeichnung Description Désignation	Bestell-Nr. Order no. Réf. de commande	Bemerkungen Remarks Remarques
8.1	Steckblende, Kβ-Filter, Absorber, Detachable diaphragm, Kβ-Filter, absorber Diaphragme enfichable Filtre Kβ, absorbeur		
8.1.1	Steckblende, Spalt 0,05 mm Detachable diaphragm, slit 0.05 Diaphragme enfichable, fente 0,05 mm	C79298-A3158-B40	
8.1.2	Steckblende, Spalt 0,1 mm Detachable diapphragm, slit 0.1 Diaphragme enfichable, fente 0,1 mm	C79298-A3158-B41	
8.1.3	Steckblende, Spalt 0,2 mm Detachable diaphragm, slit 0.2 Diaphragme enfichable, fente 0,2 mm	C79298-A3158-B42	
8.1.4	Steckblende, Spalt 0,6 mm Detachable diaphragm, slit 0.6 Diaphragme enfichable, fente 0,6 mm	C79298-A3158-B43	
8.1.5	Steckblende, Spalt 1,0 mm Detachable diaphragm, slit 1.0 Diaphragme enfichable, fente 1,0 mm	C79298-A3158-B44	
8.1.6	Steckblende, Spalt 2,0 mm Detachable diaphragm, slit 2.0 Diaphragme enfichable, fente 2,0 mm	C79298-A3158-B45	
8.1.7	Steckblende, Spalt 6,0 mm Detachable diaphragm, Slit 6.0 Diaphragme enfichable, fente 6,0 mm	C79298-A3158-B46	
8.1.10	Kβ-Filter, V Kβ-Filter, V Filtre Kβ, V	C79298-A3158-B55	
8.1.11	Kβ-Filter, Mn Kβ-Filter, Mn Filtre Kβ, Mn	C79298-A3158-B56	
8.1.12	Kβ-Filter,Fe Kβ-Filter, Fe Filtre Kβ, Fe	C79298-A3158-B57	
8.1.13	Kβ-Filter, Ni Kβ-Filter, Ni Filtre Kβ, Ni	C79298-A3158-B58	
8.1.14	Kβ-Filter, Zr Kβ-Filter, Zr Filtre Kβ, Zr	C79298-A3158-B59	
8.1.16	Absorber Absorber Absorbeur	C79298-A3158-D25	

Teil-Nr. Part no. N° de pièce	Bezeichnung Description Désignation	Bestell-Nr. Order no. Réf. de commande	Bemerkungen Remarks Remarques
8.1.21	Mikroblende, Ø 0,3 mm Micro-diaphragm, diam. 0.3 Microdiaphragme, 0,3 mm	C79298-A3158-B87	
8.1.22	Mikroblende, Ø 0,5mm Micro-diaphragm, diam. 0,5 Microdiaphragme, 0,5 mm	C79298-A3158-B88	
8.1.23	Mikroblende, Ø 1,0 mm Micro-diaphragm, diam. 1.0 Microdiaphragme, 1,0 mm	C79298-A3158-B89	
8.1.26	Diagonalblende Diagonal diaphragm Diaphragme diagonal	C79298-A3158-B90	
8.2	Sollerspalt Soller slit Fente Soller	C79298-A3158-B122	
8.3	Variable Blende Variable diaphram Diaphragme variable	C79298-A3158-B19	
8.3.1	Antrieb Drive Entraînement	C79298-A3158-B51	M1
8.3.2	Lichtschranke Light barrier Barrage photoélectrique	W79025-G4301-X	V1
8.3.3	Verdrahtungsplatte Backplane Tableau de connexions	C79458-L2234-B15	
8.4	Blendenwechsler Diaphragm changer Changeur de diaphragmes	C79298-A3158-B18	
8.4.1	Drehmagnet Solenoid Solénoïde	W79043-D1080-A3	K1

Teil-Nr. Part no. N° de pièce	Bezeichnung Description Désignation	Bestell-Nr. Order no. Réf. de commande	Bemerkungen Remarks Remarques
8.4.2	Lichtschranke Light barrier Barrage photoélectrique	W79025-G4301-X	U1
8.4.3	Formblech Profiled scheet metal Tôle profilée	C79298-A3158-B35	
8.4.4	Verdrahtungsplatte Backplane Tableau des connexions	C79458-L2234-B14	
8.4.5	Kupplung Coupling Accouplement	C79298-A3158-B131	
8.5	Streustrahlblende Stray radiation diaphragm Diaphragme de diffraction	C79298-A3158-B92	
8.6	Sonderblende, a = 31,5 mm Special diaphragm a = 31,5 mm Diaphragme spécial a = 31,5 mm	C79298-A3158-B83	
8.7	Sonderblende, a = 71.5 mm Special diaphragm a = 71,5 mm Diaphragme spécial a = 71,5 mm	C79298-A3158-B84	
8.8	Strahlenfalle Ray trap Piège à rayons	C79298-A3158-B7	

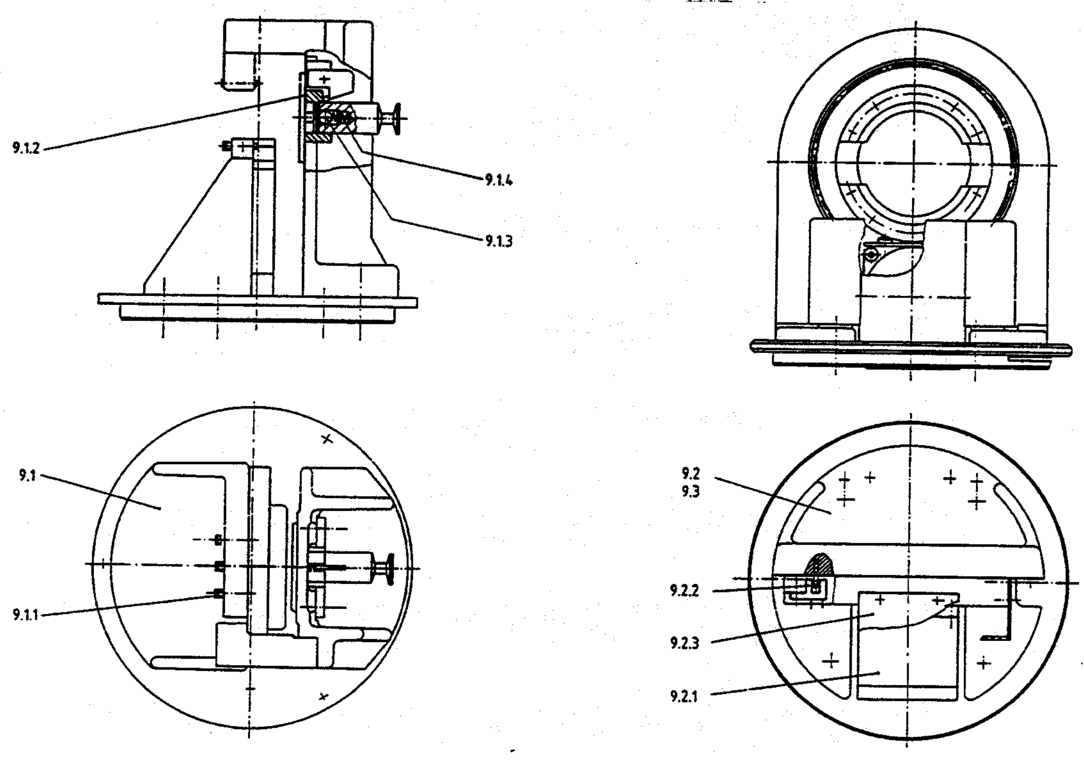


Bild 10 a Probenwechsler
Fig. 10 a Specimen changer
Fig. 10 a Changeur d'éprouvettes

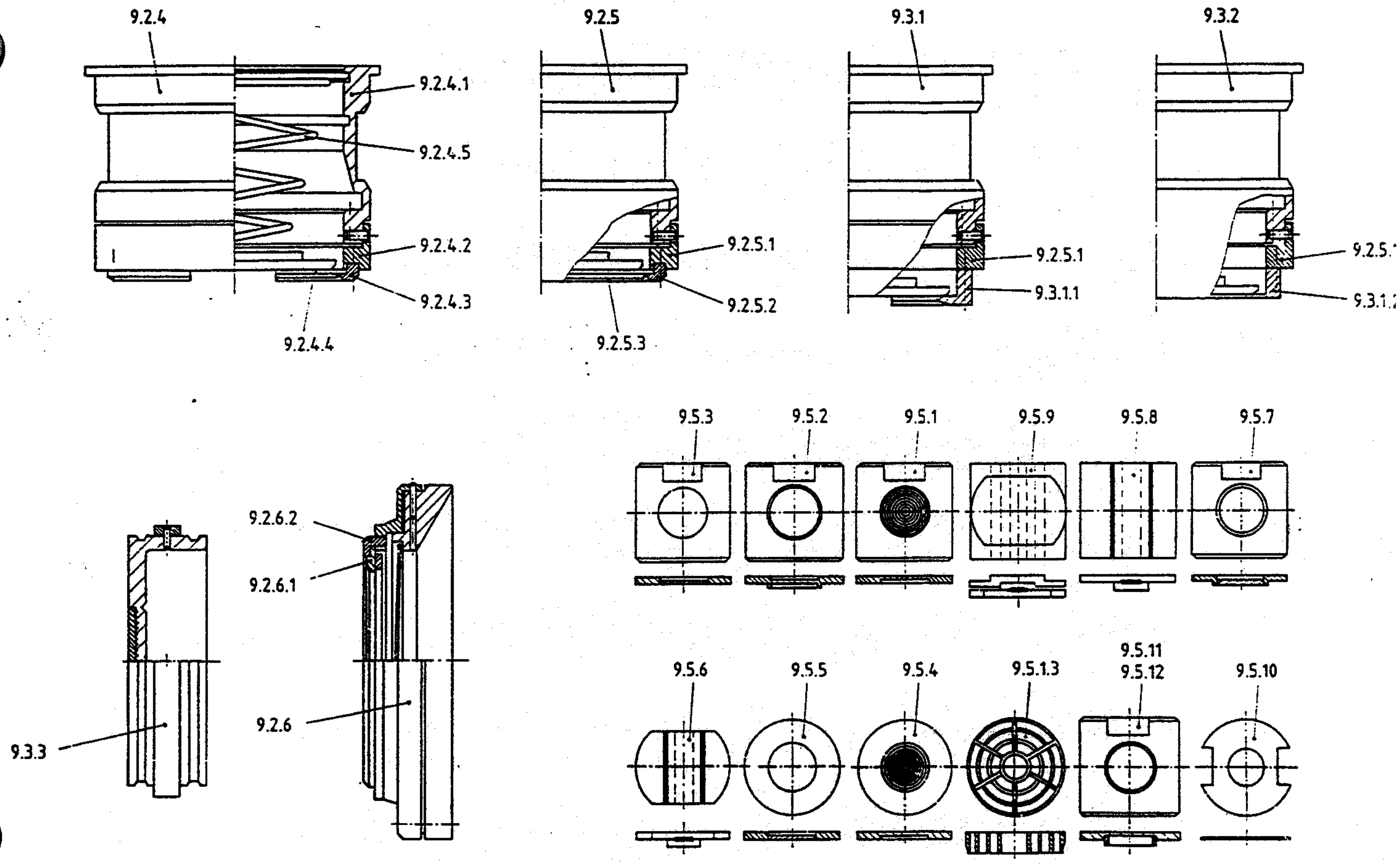


Bild 10 b Probenwechsler
Fig. 10 b Specimen changer
Fig. 10 b Changeur d'éprouvettes

Teil-Nr. Part no. N° de pièce	Bezeichnung Description Désignation	Bestell-Nr. Order no. Réf. de commande	Bemerkungen Remarks Remarques
9.1	Standardprobenwechsler Standard specimen changer Changeur d'échantillon standard	C79298-A315-B20	
9.1.1	Schraube Screw Vis	C79298-A3158-C63	
9.1.2	Teller Plate Plateau	C79298-A3158-C58	
9.1.3	Kugelbolzen Ball pin Boulon à rotule	C79298-A3158-C59	
9.1.4	Druckfeder Pressure spring Ressort de pression	C71451-A128-C33	
9.2	Dreh-Durchstrahl-Probenwechsler Rotation-transmission specimen changer Changeur d'échantillons rotatif à traversée du rayonnement	C79298-A3158-B8	
9.2.1	Motor Motor Moteur	C79298-A3158-B125	M 1
9.2.2	Lichtschranke Light barrier Barrage photoélectrique	W79025-G4301-X	U 1
9.2.3	Verdrahtungsplatte Backplane Tableau des connexions	C79458-L2234-B13	
9.2.4	Probenbecher Specimen cup Gobelet échantillon	C79298-A3158-B67	
9.2.4.1	Becher-Oberteil Upper part of cup Partie supérieur du gobelet	C79298-A3114-B72	
9.2.4.2	Becher-Unterteil Lower part of cup Partie inférieure du gobelet	C79298-A3114-C178	

Teil-Nr. Part no. N° de pièce	Bezeichnung Description Désignation	Bestell-Nr. Order no. Réf. de commande	Bemerkungen Remarks Remarques
9.2.4.3	Spannring, geteilt Clamp ring, divided Bague de serrage, séparée	C79298-A3114-C179	
9.2.4.4	Blendenring, geteilt Diaphragm ring, divided Bague diaphragme, séparée	C79298-A3158-C118	
9.2.4.5	Andruckeinheit Contact unit Patin-presseur	C79298-A3114-B71	
9.2.5	Probenbecher Specimen cup Gobelet échantillon	C79298-A3158-B66	
9.2.5.1	Probenbecher-Unterteil Lower part of cup Partie inférieure du gobelet	C79298-A3114-C171	
9.2.5.2	Spannring Clamp ring Bague de serrage	C79298-A3114-C170	
9.2.5.3	Blende Diaphragm Diaphragme	C79298-A3158-C119	
6	Durchstrahlbecher Cup for transmission specimens Gobelet à traversée de rayonnement	C79298-A3158-D4	
9.2.6.1	Blende Diaphragm Diaphragme	C79298-A3158-C119	
9.2.6.2	Spannring Clamp ring Bague de serrage	C79298-A3114-C170	
9.3	Drehprobenwechsler, 0 Grad Rotation specimen changer, 0 degr. Changeur d'échantillons rotatif, 0 degré	C79298-A3158-B124	
9.3.1	Probenbecher Specimen cup Gobelet d'échantillon	C79298-A3158-B64	

Teil-Nr. Part no. N° de pièce	Bezeichnung Description Désignation	Bestell-Nr. Order no. Réf. de commande	Bemerkungen Remarks Remarques
9.3.1.1	Blendenkappe Cover for diaphragm Cache de diaphragme	C79298-A3158-C129	
9.3.1.2	Blendenkappe Cover for diaphragm Cache de diaphragme	C79298-A3158-C128	
9.3.2	Probenbecher Specimen cup Gobelet d'échantillon	C79298-A3158-B65	
9.3.3	Präparateträger, 0 Grad Specimen carrier, 0 degr. Porte préparations, 0 degré	C79298-A3158-B60	
9.5.1	Präparateträger, 50x50, 12 Grad Specimen carrier 50x50, 12 degr. Porte préparations, 50x50, 12 degrés	C72298-A227-C154	
9.5.2	Präparateträger, 50x50, 0 Grad Specimen carrier, 50x50, 0 degr. Porte préparations, 50x50, 0 degré	C72298-A227-C155	
9.5.3	Quarzprobe, 50x50, 12 Grad Quartz specimen, 50 x 50, 12 degr. Echantillon de quartz, 50x50, 12 degrés	C72298-A227-B35	
9.5.4	Präparateträger, Ø 50 Specimen carrier, diam. 50 Porte préparations, 50	C79298-A3158-C98	
9.5.5	Quarzprobe, Ø 50 Quartz specimen, diam. 50 Echantillon de quartz, 50	C79298-A3158-B61	
9.5.6	Justierspalt, Ø 50 Adjusting slit, diam. 50 Fente d'ajustage, 50	C79298-A3158-B62	
9.5.7	Quarzprobe, 50x50, 0 Grad Quartz specimen, 50x50, 12 degr. Echantillon de quartz, 50x50, 0 degré	C72298-A227-B36	
9.5.8	Justierspalt, 50x50, 12 Grad Adjusting slit, 50x50, 12 degr Fente d'ajustage, 50x50, 12 degrés	C71298-A32-B11	
9.5.9	Justierspalt 50x50, 0 Grad Adjusting slit 50x50, 0 degr. Fente d'ajustage, 50x50, 0 degré	C79298-A3158-B63	
9.5.10	Halter, Ø 50 Holder diam. 50 Support, 50	C72298-A225-C28	
9.5.11	Träger, 50x50, Ofenflußanalyse Carrier, 50x50, pot flux analysis Porte-pièces, 50x50, analyse de fusion de creuset	C72298-A227-C137	
9.5.12	Ring, Ofenflußanalyse Ring pot flux analysis Bague, analyse de fusion de creuset	C72298-A227-C138	
9.5.13	Zwischenring, Ø 50 Intermediate ring, diam. 50 Bague intermédiaire, 50	C79298-A3114-C125	
	Probenwechsler siehe Ersatzteilliste C7900-E3474-C13		
	Position specimen changer see parts List C79000-E3474-C13		
	Changeur d'éprouvettes voir Liste des pièces de rechange C79000-E3474-C13		

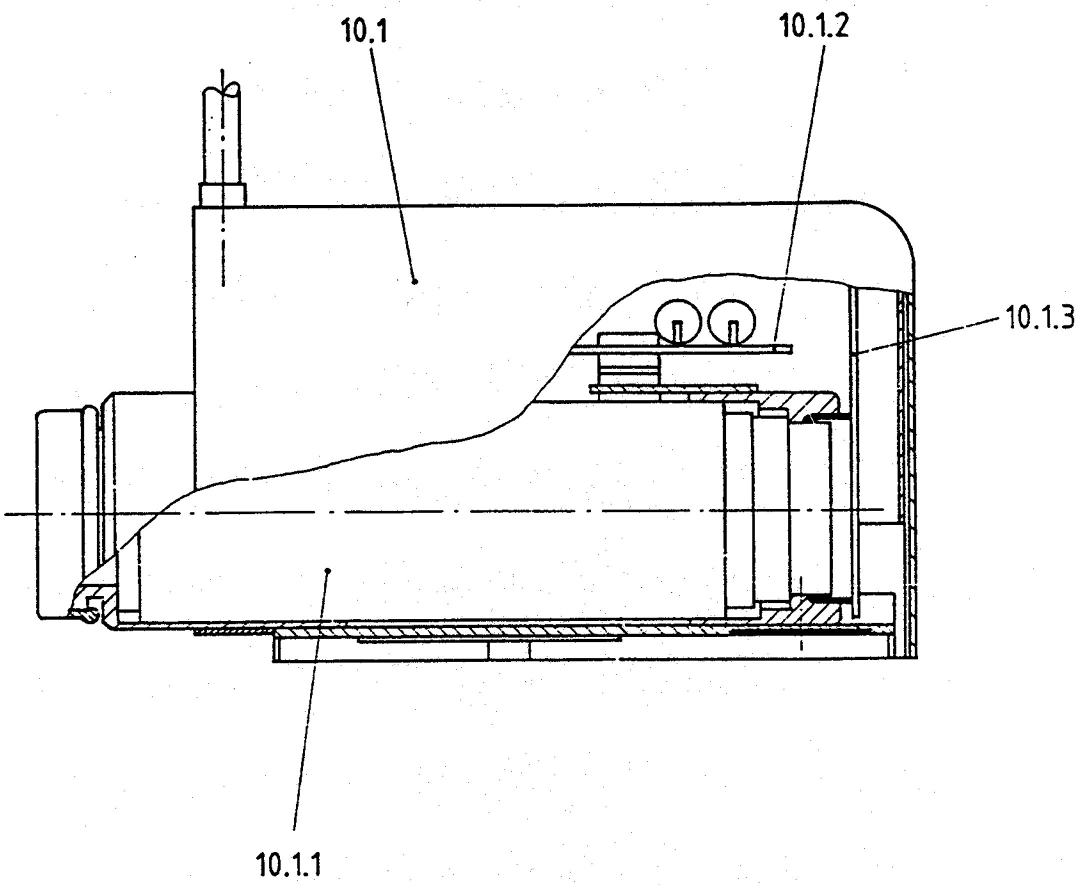


Bild 11 Detektor
Fig. 11 Detector
Fig. 11 Détecteur

Teil-Nr. Part no. N° de pièce	Bezeichnung Description Désignation	Bestell-Nr. Order no. Réf. de commande	Bemerkungen Remarks Remarques
10.1	*Szintillationszähler* Scintillation counter Compteur de scintillations	C79298-A3138-A2	
10.1.1	Szintiblock Scinti block Scintibloc	C71249-Z559-D1	
10.1.2	FBG P, C, board Carte circuit imprimé	C71249-A58-B27	
10.1.3	FBG P, C, board Carte circuit imprimé	C71249-A58-B6	

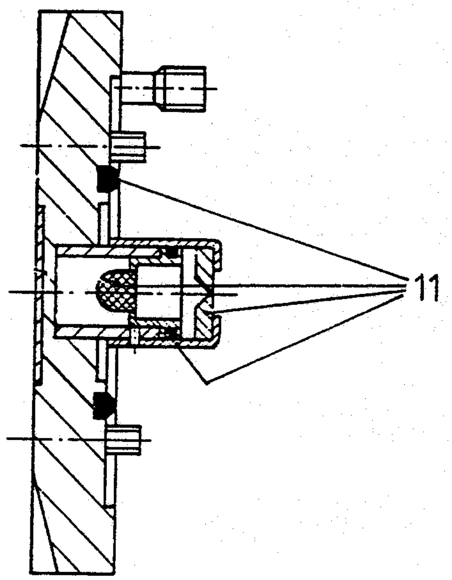


Bild 12 Röntgenröhrenhalterung
Fig. 12 X-ray tube stand
Fig. 12 Support de tubes à rayons X

Teil-Nr. Part no. N° de pièce	Bezeichnung Description Désignation	Bestell-Nr. Order no. Réf. de commande	Bemerkungen Remarks Remarques
1	Satz loser Teile für Röntgenröhre Spare kit for X-ray tube Jeu de rechange pour tubes à rayons X	C79127-Z35-A-1	

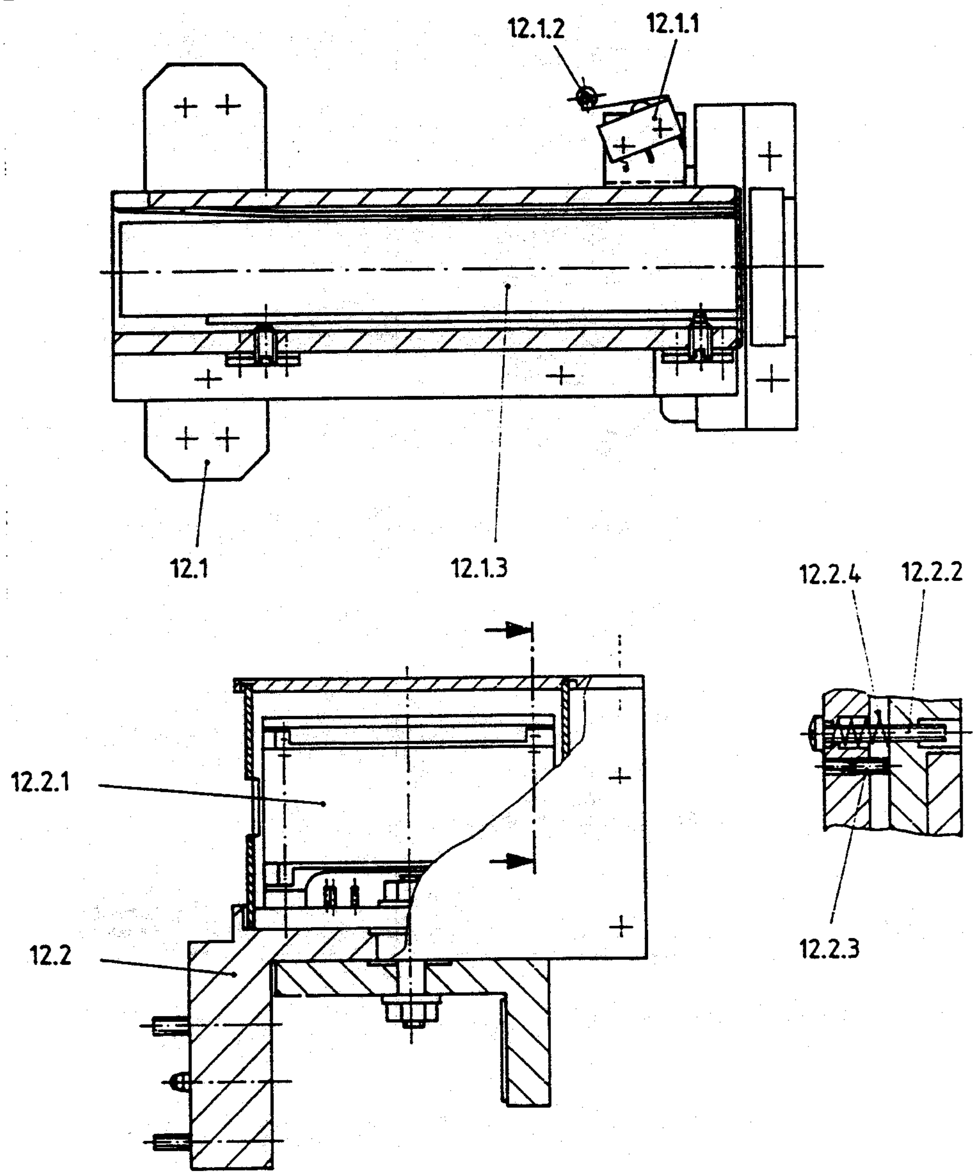


Bild 13 Meßzusatz
Fig. 13 Measuring attachment
Fig. 13 Accessoire de mesurage

Teil-Nr. Part no. N° de pièce	Bezeichnung Description Désignation	Bestell-Nr. Order no. Réf. de commande	Bemerkungen Remarks Remarques
12.1	Grundeinrichtung Basic unit Installation de base	C79298-A3158-B70	
12.1.1	Mikroschalter Microswitch Microcommutateur	W79050-X6001	
12.1.2	Rollenhebel Ball lever Levier à galet	W79050-M2001	
12.1.3	Sollerspalt Soller slit Fente de Soller	C72298-A3158-B76	
12.2	Monochromator Monochromator Monochromateur	C79298-A3158-B71	
12.2.1	Kristall LiF 100 Crystal LIF 100 Cristal LIF 100	C79213-A3000-B50	
12.2.2	Schraube Screw Vis	M2X14SN60511-8.8	
2.2.3	Gewindestift Grub screw Goujon fileté	M2X5DIN914-45H	
12.2.4	Druckfeder Pressure spring Ressort pression	C79298-A3158-C165	

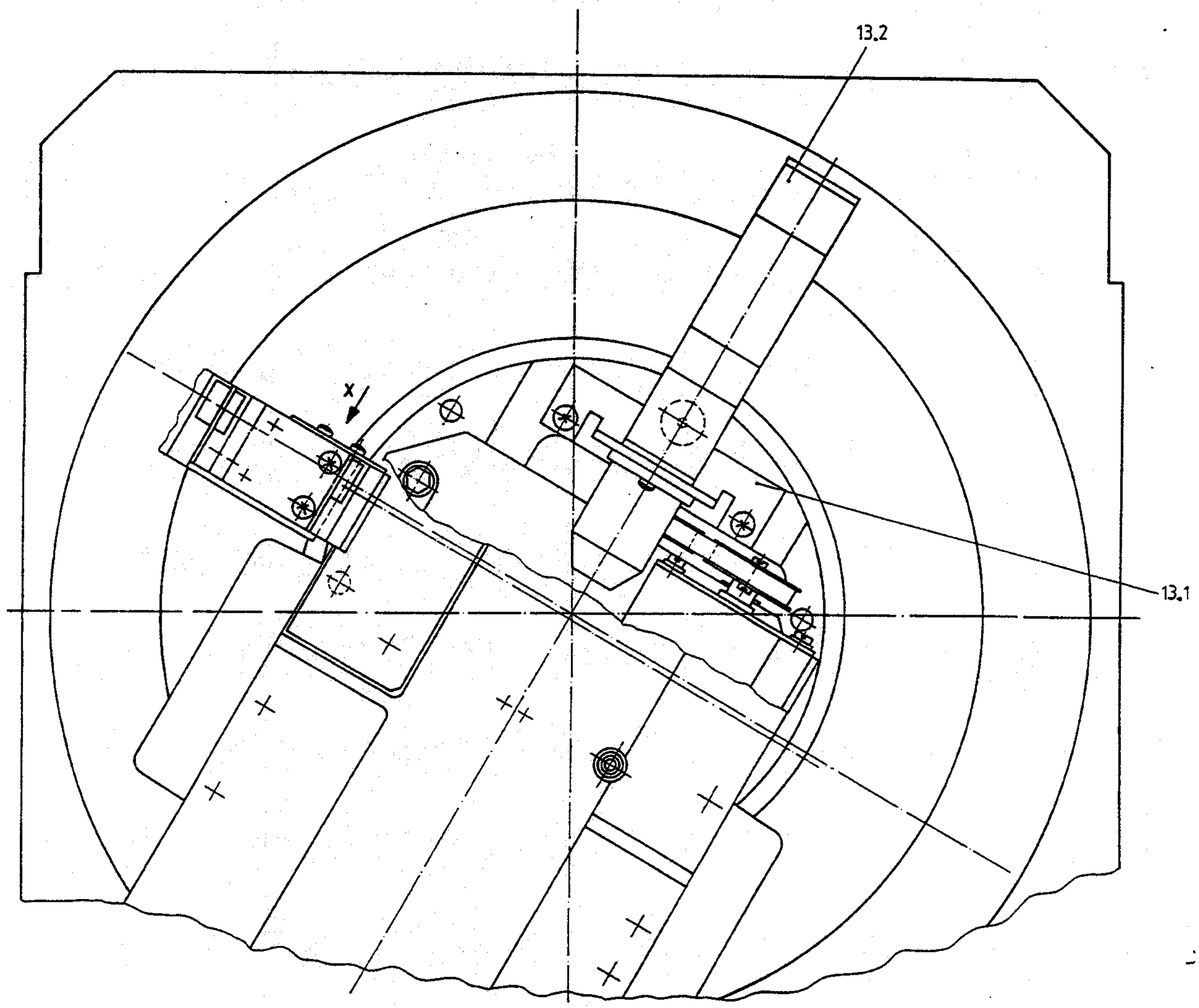


Bild 14 Meßzusatz für Ofenflußanalyse
Fig. 14 Attachment Measuring for pot flux analysis
Fig. 14 Accessoire de mesurage pour analyse de fusion de creuset

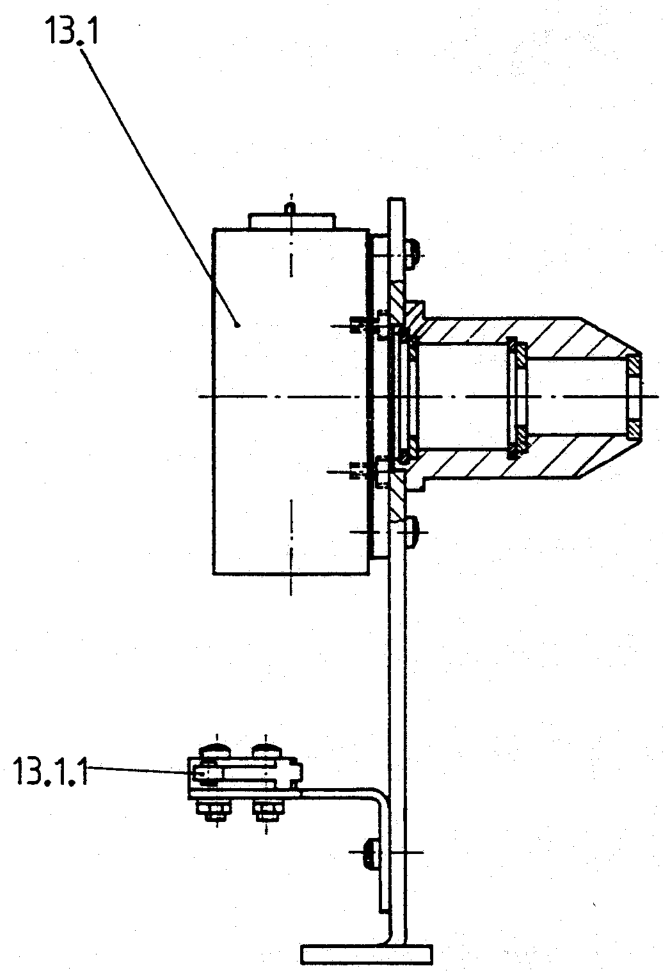


Bild 15 Zählrohr
Fig. 15 Counter tube
Fig. 15 Tube compteur

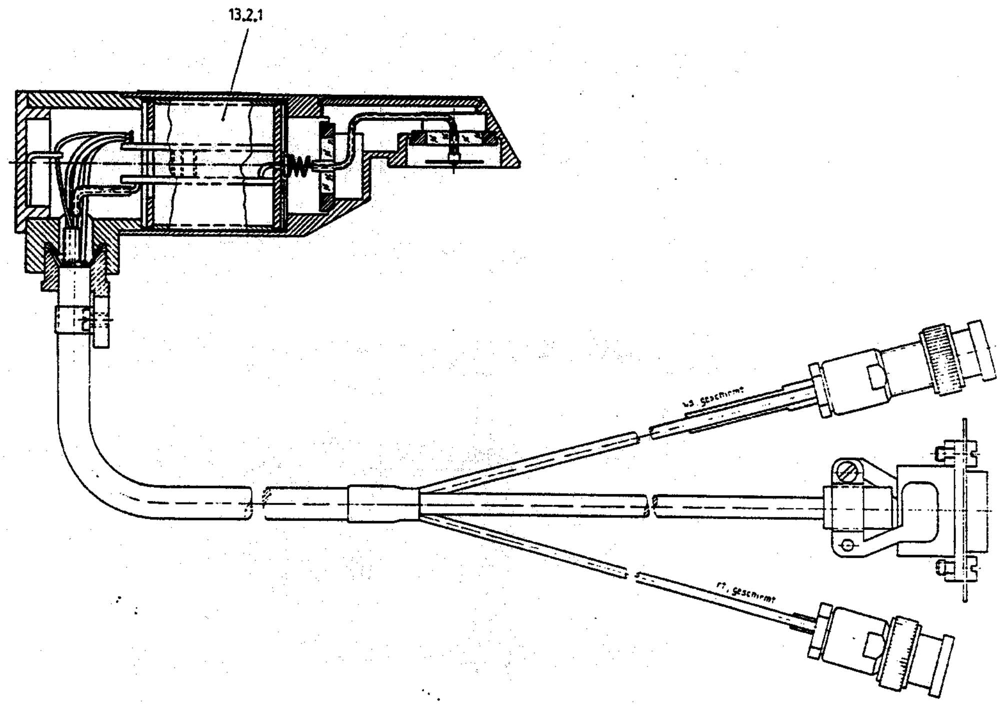


Bild 16 Vorverstärker
Fig. 16 Preamplifier
Fig. 16 Préamplificateur

Teil-Nr. Part no. N° de pièce	Bezeichnung Description Désignation	Bestell-Nr. Order no. Réf. de commande	Bemerkungen Remarks Remarques
13.1	Proportional-Zählrohr Proportional counter tube Tube compteur proportionnel	C72298-A223-B106	
13.1.1	Mikroschalter Microswitch Microcommutator	C71315-Z153-C25	
13.2	Vorverstärker Preamplifier Préamplificateur	C72298-A223-B200	
13.2.1	Verstärker Amplifier Amplificateur	C71428-A4-B53	
13.3	Druckfeder Pressure spring Ressort de pression	C72298-A223-C604	

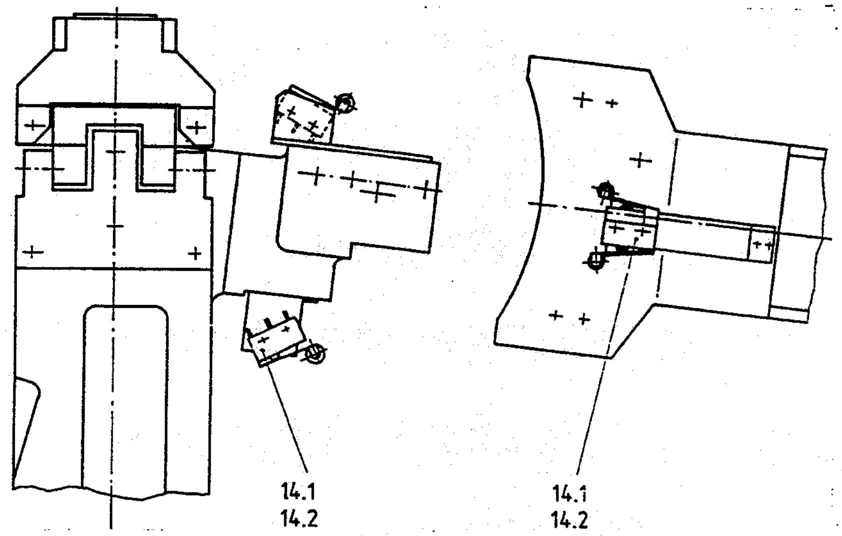


Bild 17 Montageteile für Textur-Diffraktometer
Fig. 17 Assembly parts for texture diffractometer
Fig. 17 Parties d'assemblage pour diffractomètre de texture

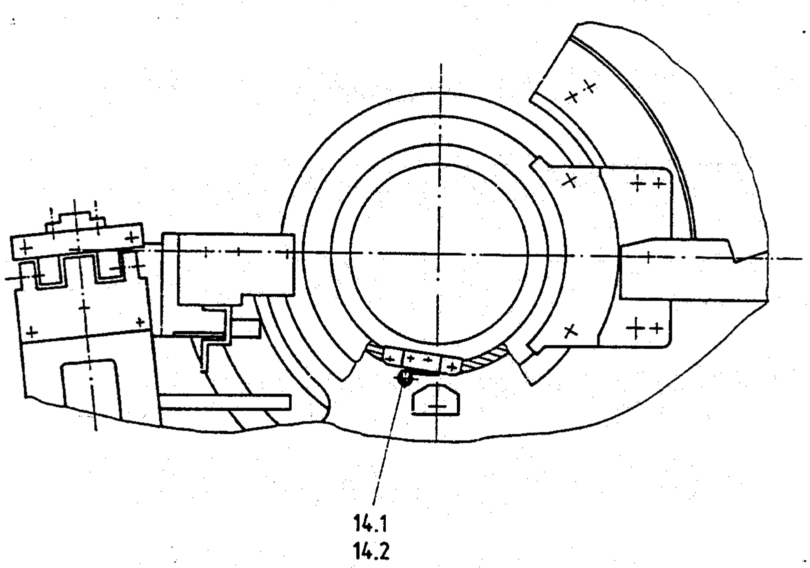


Bild 18 Montageteile für Theta-Theta Diffraktometer
Fig. 18 Assembly parts for theta-theta diffractometer
Fig. 18 Parties d'assemblage pour diffractomètre Theta-Theta

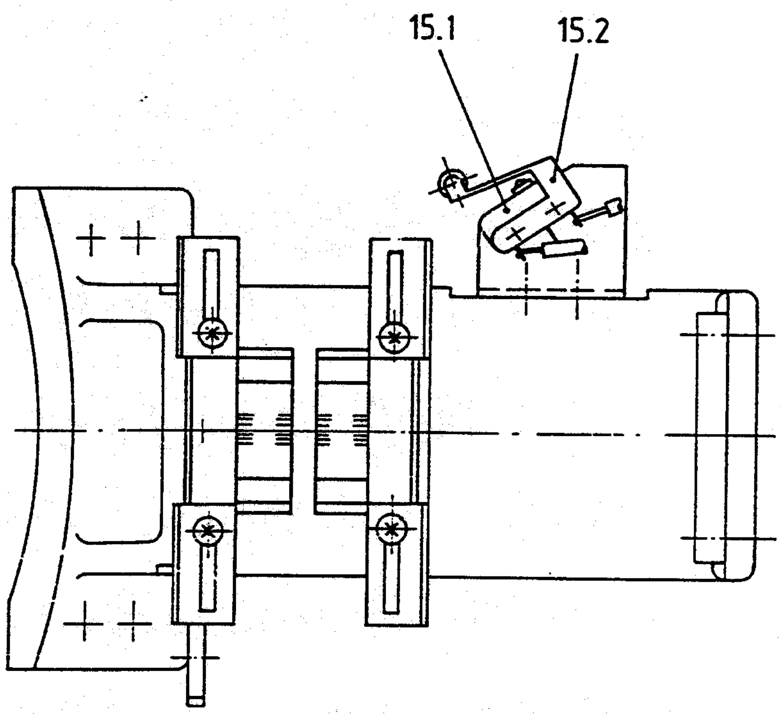


Bild 19 Montageteile für OED
Fig. 19 Assembly parts for PSD
Fig. 19 Parties d'assemblage pour DEO

Teil-Nr. Part no. N° de pièce	Bezeichnung Description Désignation	Bestell-Nr. Order no. Réf. de commande	Bemerkungen Remarks Remarques
14.1 15.1	Mikroschalter Microswitch Microcommutateur	W79050-X6001	
14.2 15.2	Rollenhebel Ball lever Levier à galet	C71315-Z153-M4	

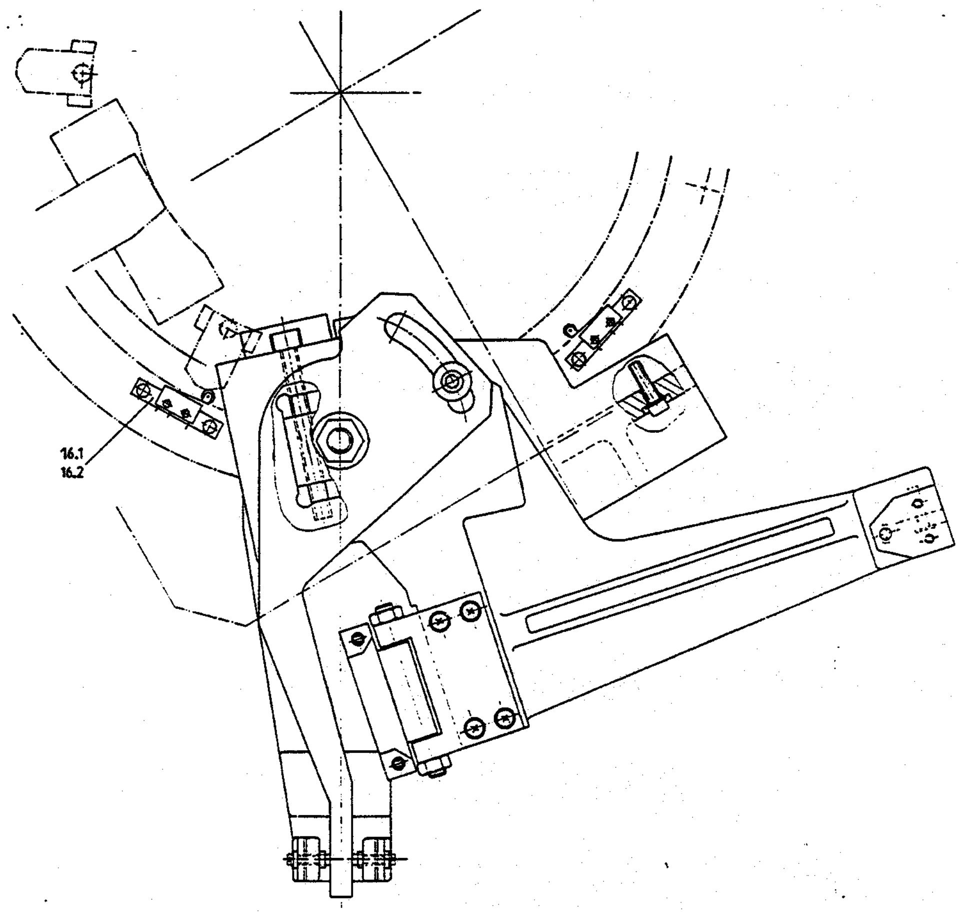


Bild 20 Transmissions-Primärmonochromator
Fig. 20 Transmission primary monochromator
Fig. 20 Transmission monochromateur primaire

Teil-Nr. Part no. N° de pièce	Bezeichnung Description Désignation	Bestell-Nr. Order no. Réf. de commande	Bemerkungen Remarks Remarques
16.1	Mikroschalter Microswitch Microcommutateur	W79050-X6001	
16.2	Rollenhebel Ball lever Levier à galet	C71315-Z153-M4	

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Bestell-Nr. / Order No. / N° de réf: C79000-E3463-C148-02
Bestellung an / Order from / A commander à: Gerätewerk Karlsruhe
Printed in the Federal Republic of Germany
AG 1291 0.2 KI 36 De-En-Fr

SIEMENS

Röntgengenerator KRISTALLOFLEX 760/761
KRISTALLOFLEX 760/761 X-Ray Generator
Générateur de rayons X KRISTALLOFLEX 760/761

C79249-A3054-A3, -A4
C79249-A3053-A1

Ersatzteilliste / Spare Parts List / Liste de pièces de rechange C79000-E3463-C180-03

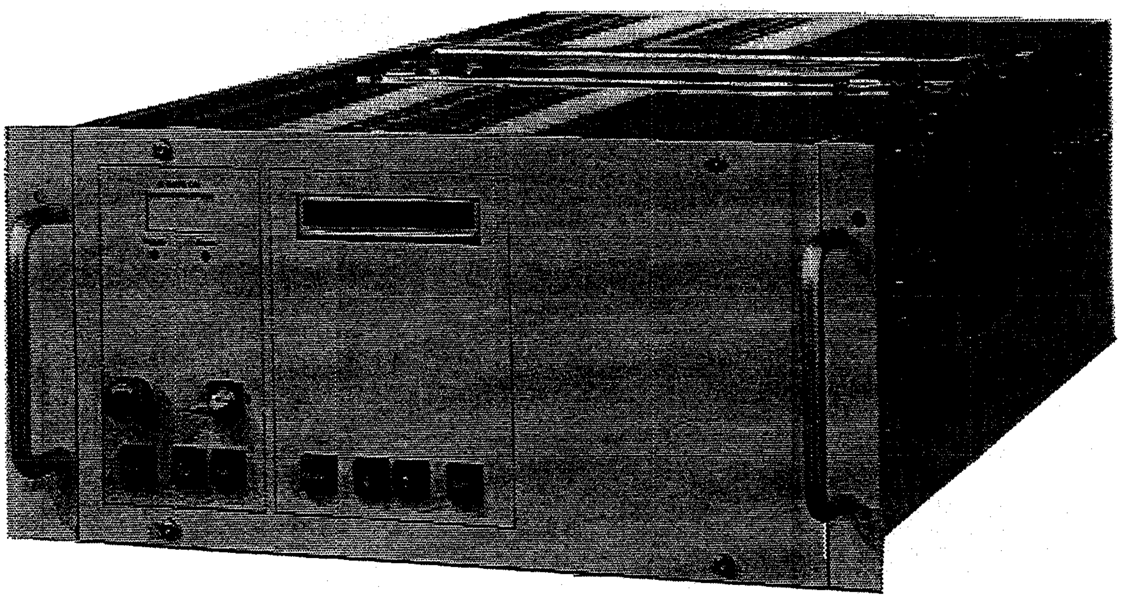


Bild 1 Röntgengenerator KRISTALLOFLEX® 760/761
Fig. 1 KRISTALLOFLEX® 760/761 X-ray generator
Fig. 1 Générateur de rayons X KRISTALLOFLEX 760/761

Diese Ersatzteilliste entspricht dem Stand von Mai 1993.

Hinweise für die Bestellung

Die Bestellung muß enthalten:

1. Stückzahl
2. Bestell-Nr.
3. Bezeichnung
4. Bezeichnung und Fabrikations-Nr. des Gerätes, zu dem das Ersatzteil gehört

Bestellbeispiel

1 Netztransformator W75040-B14-A55 für Röntgengenerator KRISTALLOFLEX 761, Fabr.-Nr. ...

This Spare Parts List represents the technical state as of May 1993.

Ordering instructions

All orders should specify the following:

1. Quantity
2. Order No.
3. Designation
4. Designation and Serial No. of the instruments to which the spare part belongs

Example for ordering

1 mains transformer W75040-B14-A55 for KRISTALLOFLEX 761 X-ray generator, Serial No. ...

Cette liste de pièces de rechange correspond à la situation technique de mai 1993.

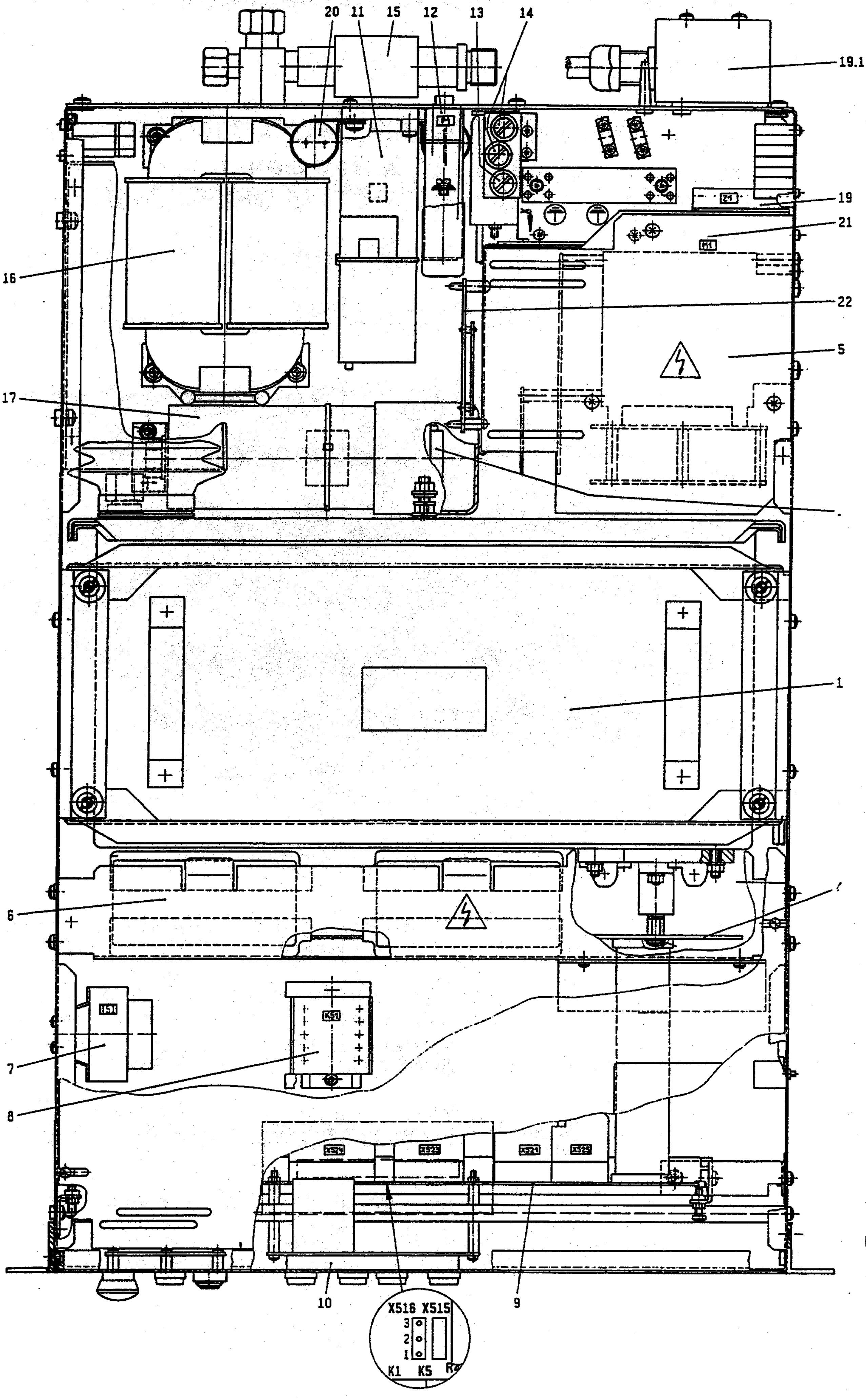
Indications de commande

La commande doit comporter:

1. Quantité
2. N° de référence
3. Désignation
4. Désignation et n° de fabrication de l'appareil auquel est destinée la pièce de rechange

Exemple de commande

1 transformateur secteur W75040-B14-A55 pour générateur de rayons X KRISTALLOFLEX 761, n° de fabrication ...



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X516
X515
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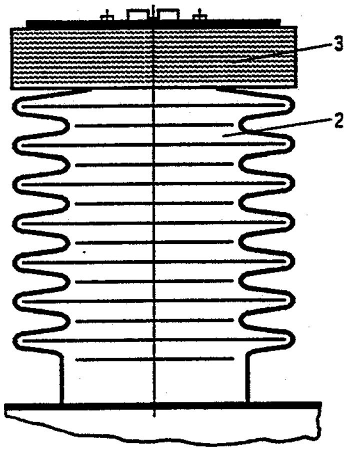
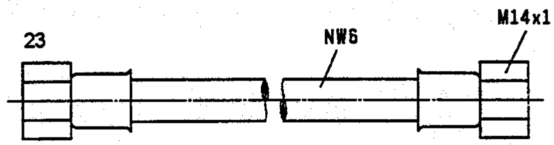
K1
K5

Teil-Nr. Part no. Pièce n°	Bezeichnung Designation Désignation	Bestell-Nr. Order no. No. de réf.	Bemerkungen Remarks Remarques



Bild/Fig. 3



Bild/Fig. 4

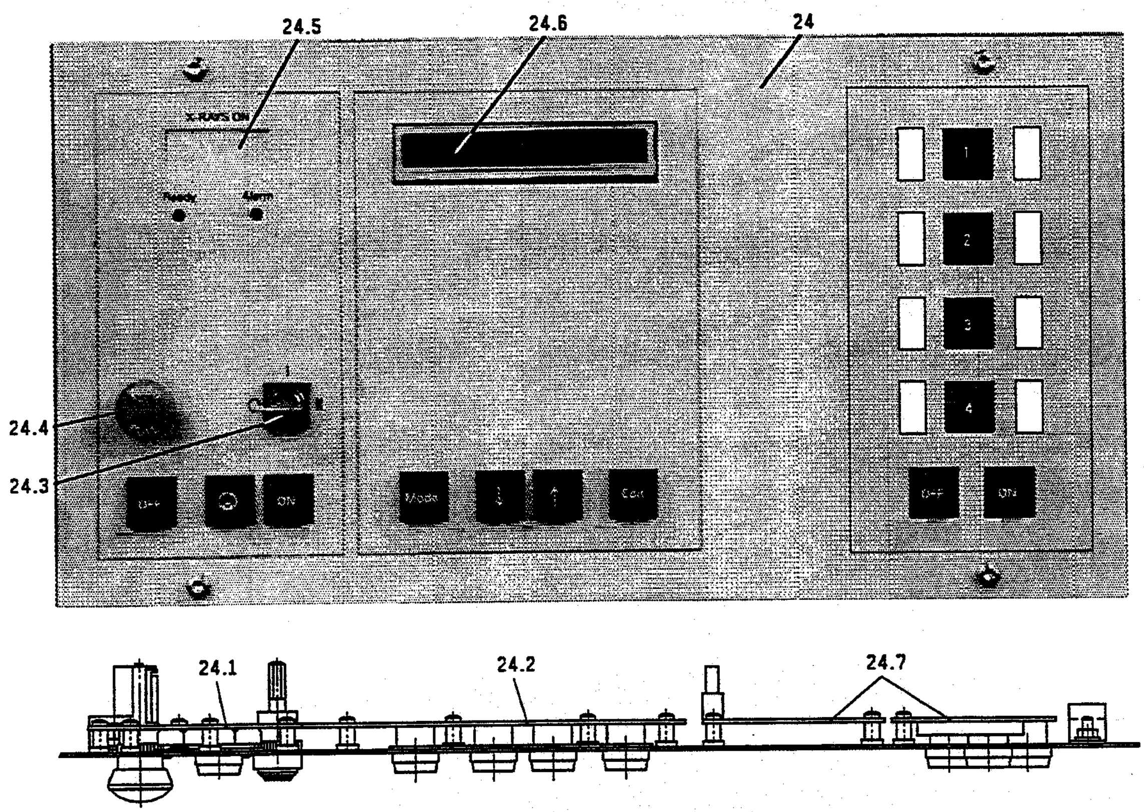
1	Hochspannungskessel High-voltage tank Cuve haute tension	C79249-A3054-B95 1) C79249-A3052-B122 2)	
2	Faltenbalg Bellows Soufflet	C79249-A3028-D10	Austauschsatz Exchange kit Kit d'échange
3	Zwischenstück Spacer Pièce intermédiaire	C79249-A3028-C86	
4	U-Stellglied Voltage regulator Organe de réglage de tension	C79249-A3053-B4	
4.1	Thyristor THY-MTT 40 A 12 N	W79024-A6122-T483	V1
4.2	Drahtwiderstand, 51 Ω, 5 %, 50 W Wire-wound resistor, 51 Ω, 5 %, 50 W Résistance bobinée, 51 Ω, 5 %, 50 W	W79005-F4510-J8	R2, R3
5	Wechselrichter Inverter Onduleur	C79249-A3054-B23 1) C79249-A3052-B183 2)	
5.1	Transistor BUS 98 A	W79022-G4512-P303	V1...V8
6	Kondensator-Batterie Capacitor battery Batterie de condensateurs	C79249-A302 8-B74	
6.1	Elektrolytkondensator, 1000 µF, 350 V Electrolytic capacitor, 1000 µF, 350 V Condensateur électrolytique, 1000 µF, 350 V	W79010-M3108-T350	
6.2	Metallwiderstand, 39 kΩ, 5 %, 4 W Metal-film resistor, 39 kΩ, 5 %, 4 W Résistance à couche métallique, 39 kΩ, 5 %, 4 W	C71004-Z39-A77	
7	Netztransformator Mains transformer Transformateur secteur	W75040-B14-A55	T51
8	Koppelglied, DC 24 V Coupling element, 24 V DC Elément de couplage, DC 24 V	W75053-B1001-N402	K51
9	Integralplatte Integral board Carte intégrale	C79249-A3054-B20 3)	

1) Für/for/pour KRISTALLOFLEX 760.

2) Für/for/pour KRISTALLOFLEX 761.

3) Geräte bis Fabr.-Nr. 15: Brücke X516/2-3 einsetzen (siehe Bild 2).
Instruments with Serial No. up to 15: Insert jumper X516/2-3 (see Fig. 2).
Appareils avec n° de fabrication jusqu'à 15: Insérer le cavalier X516/2-3 (voir fig. 2).

Teil-Nr. Part no. Pièce n°	Bezeichnung Designation Désignation	Bestell-Nr. Order no. No. de réf.	Bemerkungen Remarks Remarques
9.1	Festspeicherpaket ROM package Mémoire morte	S79610-G94-A900	
9.2	G-Schmelzeinsatz, F 1 A, 250 V G-type fuse, F 1 A, 250 V Cartouche fusible, F 1 A, 250 V	W79054-L1021-F100	F1
10	Anzeige, vollständig Display, complete Indicateur à cristaux liquides, complet	C79249-A3053-B54	
11	Schütz, DC 24 V Contactor, 24 V DC Contacteur, DC 24 V	W75053-B1002-N113	K52
12	Schutzschalter, 32 A Protective switch, 32 A Disjoncteur de protection, 32 A	W75051-B3112-A320	F1
13	G-Schmelzeinsatz, T 1,6 A G-type fuse, T 1.6 A Cartouche fusible, T 1,6 A	W79054-L1010-T160	F2
14	G-Schmelzeinsatz, T 4 A G-type fuse, T 4 A Cartouche fusible, T 4 A	W79054-L1011-T400	F6, F7
15	Durchflußmeßzelle Flow meter cell Cellule de mesure du débit		
15.1	Flügelrad, vollständig Impeller, complete Roue de turbine, complet	C79249-A3000-D8	
15.2	Lager Bearing Palier	C79249-A3000-C9	
16	Netzdrossel Mains choke Self de ligne	W79041-A1505-C1	L1
17	Kondensator, 50 µ F, 400 V Capacitor, 50 µ F, 400 V Condensateur, 50 µ F, 400 V	W79012-N1506-K400	C1
18	Metallwiderstand, 39 kΩ, 5 %, 4 W Metal-film resistor, 39 kΩ, 5 %, 4 W Résistance à couche métallique, 39 kΩ, 5 %, 4 W	C71004-Z39-A77	R1
19	Funkentstörfilter Radio interference filter Filtre d'anti-parasitage	W79041-E4253-B1	Z1
19.1	Funkentstördrossel Radio interference choke coil Self d'anti-parasitage	W79041-A3146-B1	L2
20	Kondensator, 100 nF Capacitor, 100 nF Condensateur, 100 nF	B81121-A-B3	C4, C5
21	Radiallüfter Radial fan Ventilateur radial	W79087-R2001-B47	M1
22	Stufenschalter Step switch Commutateur à plots	C79249-A3052-B140	
23	Schlauchleitung, 0,34 m Hose, 0.34 m Tuyau, 0,34 m	C79304-Z127-A1	



Bild/Fig. 4

Teil-Nr. Part no. Pièce n°	Bezeichnung Designation Désignation	Bestell-Nr. Order no. No. de réf.	Bemerkungen Remarks Remarques
24	Frontplatte, vollständig Front panel, complete Plaque frontale, complet		
24.1	Anzeigeplatte Display board Carte d'indicateur	C79249-A3053-B3	
24.2	Tastenplatte Pushbutton board Carte de clavier	C79249-A3053-B1	
24.3	Schlüsselschalter Key-operated switch Interrupteur à clé	W79050-E7552-A922	
24.4	Schalter Switch Interrupteur	W75050-T1101-U102	
24.5	Filterscheibe Filter pane Plat filtrant	C79249-A3028-C209	
24.6	Filterscheibe Filter pane Plat filtrant	C79249-A3028-C208	
24.7	Fenstersteuerung Window controller Commande de fenêtre	C79249-A3054-B21	

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Röntgenanalytik AUT 37
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Technische Änderungen vorbehalten.
Technical data subject to change.
Nous nous réservons le droit de modifier les caractéristiques techniques.

Progress
in Automation.
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C79000-E3463-C180-03
Printed in Germany

Contents of Section 7

C79000-M3474-C146-01

Circuit diagrams

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Goniometer	C79298-A3156-A1-*-11
Control unit	C79298-A3157-A1-*-11
Terminal	C79298-A3157-B4-*-11
Rotating sample changer	C79298-A3158-B9-*-11
Diaphragm changer	C79298-A3158-B18-*-11
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Scintillation counter	C79298-A3178-A10-*-11
KRISTALLOFLEX 760 X-ray generator	C79249-A3054-A1-*-12

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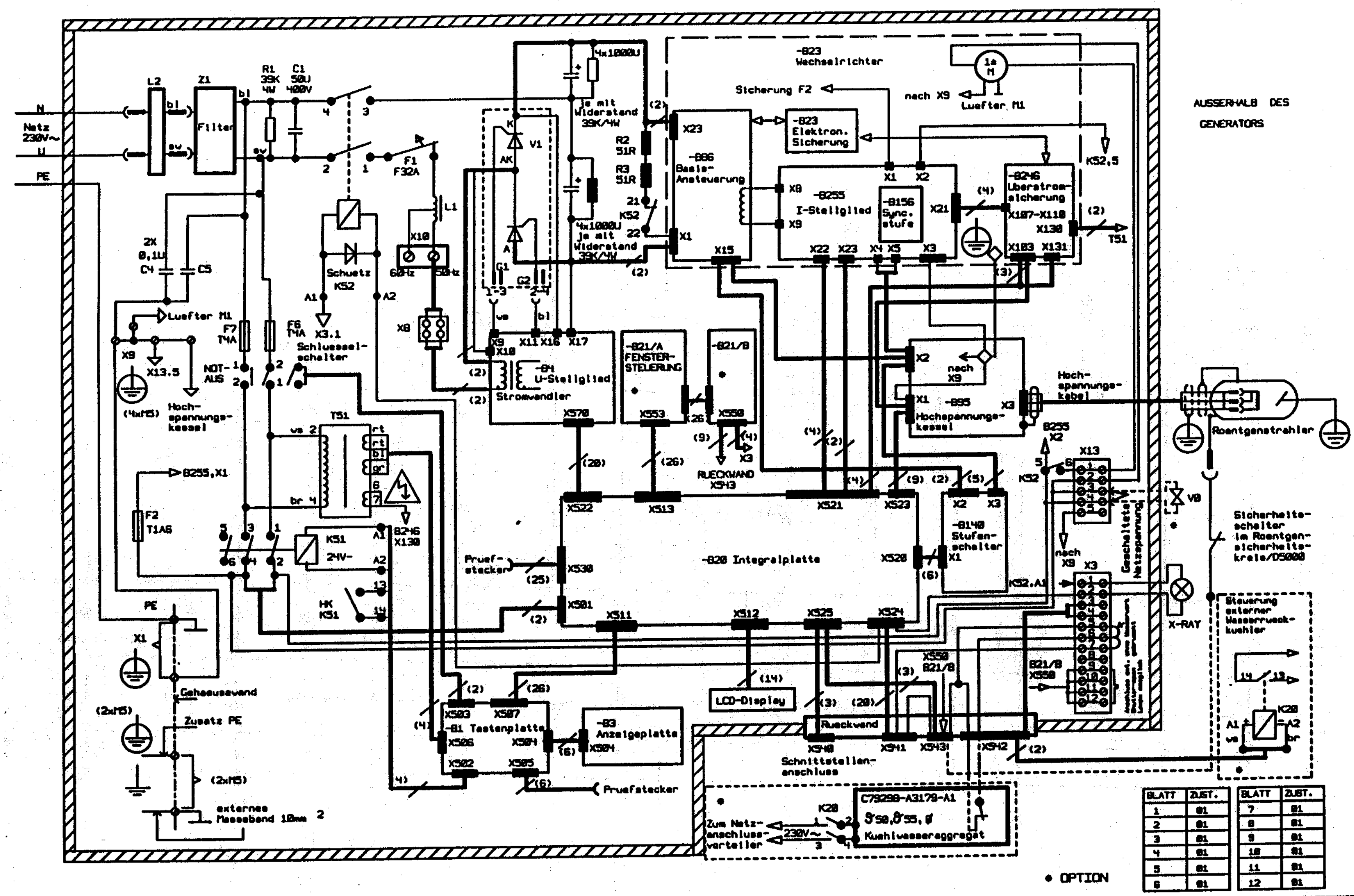

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ROENTGEN-GENERATOR K760

Stromlaufplan/Circuit diagram

C79249-A3054-A1

C79249-A3054-A1-•-12

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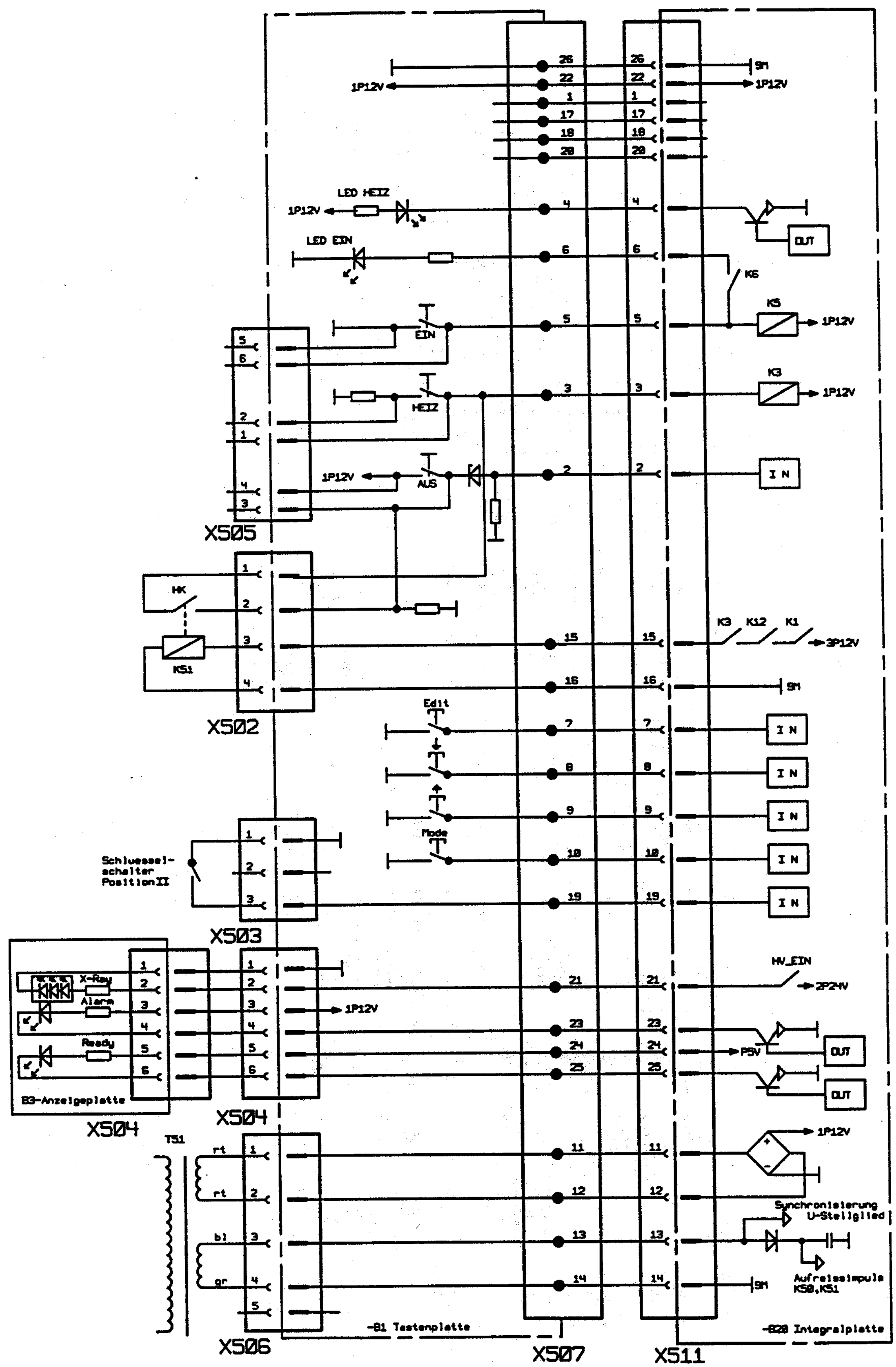

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Stromlaufplan/Circuit diagram

C79249-A3054-A1

C79249-A3054-A1-*-12

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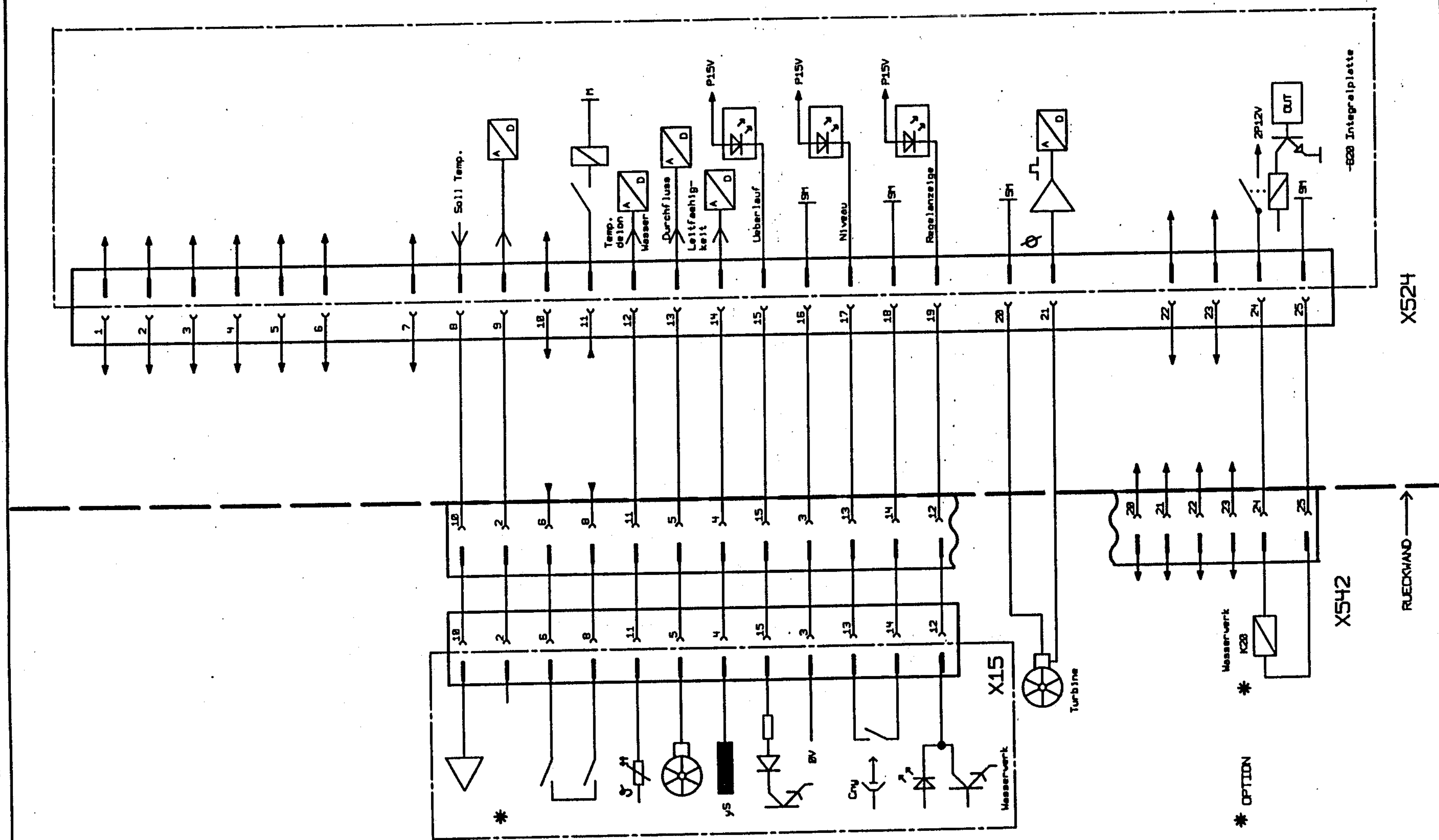

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Stromlaufplan/Circuit diagram

C79249-A3054-A1
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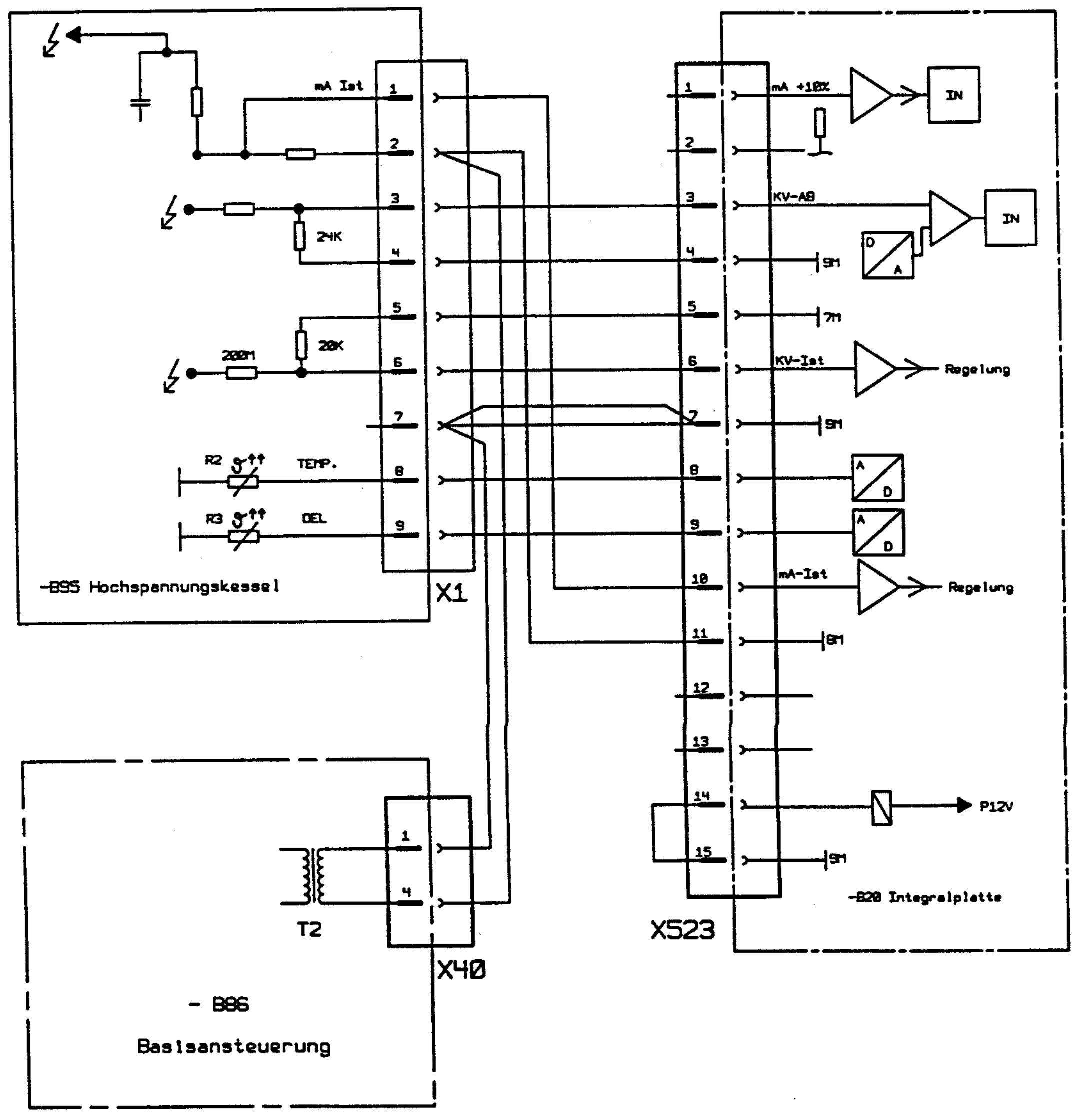

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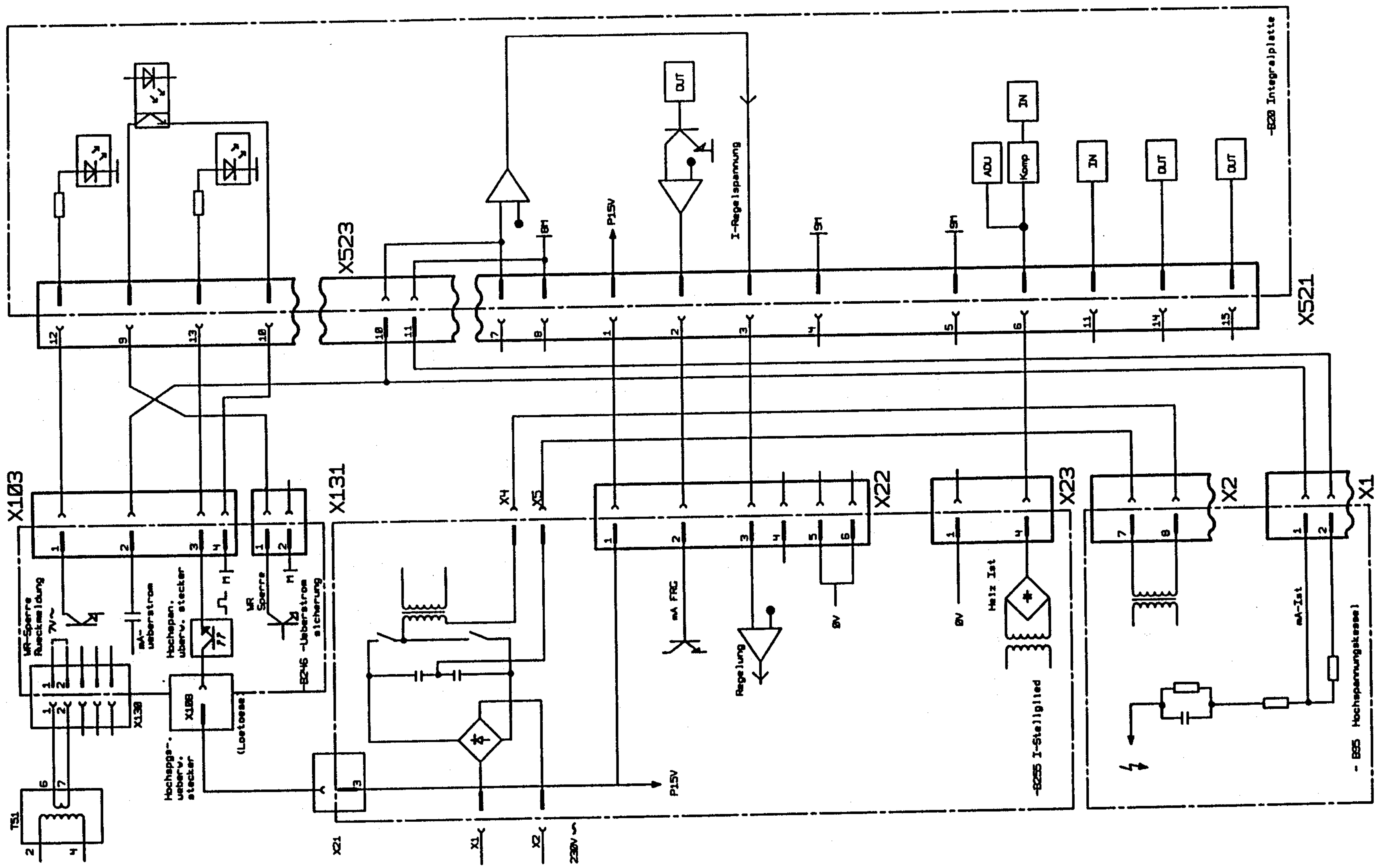

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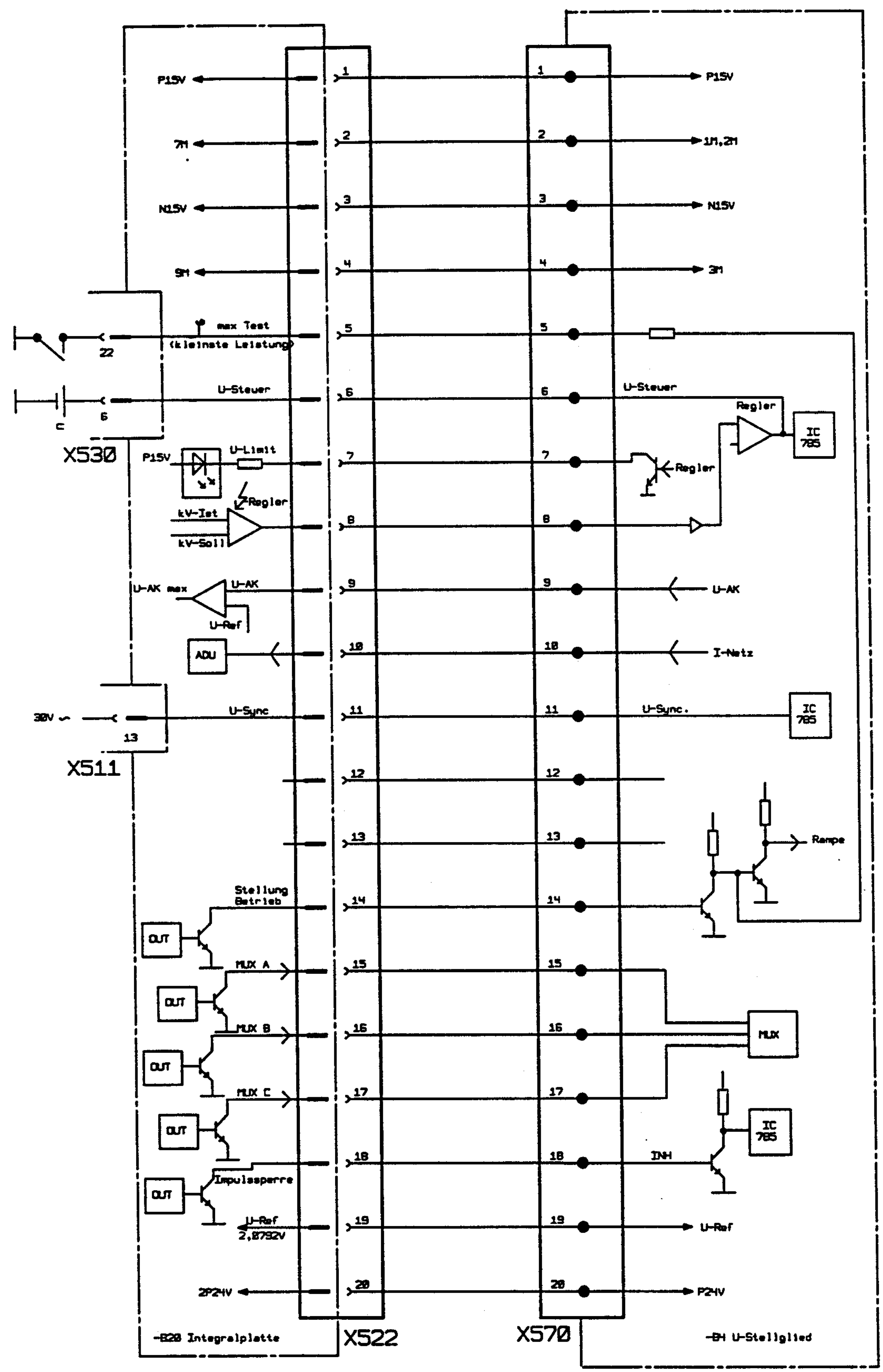

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Stromlaufplan/Circuit diagram

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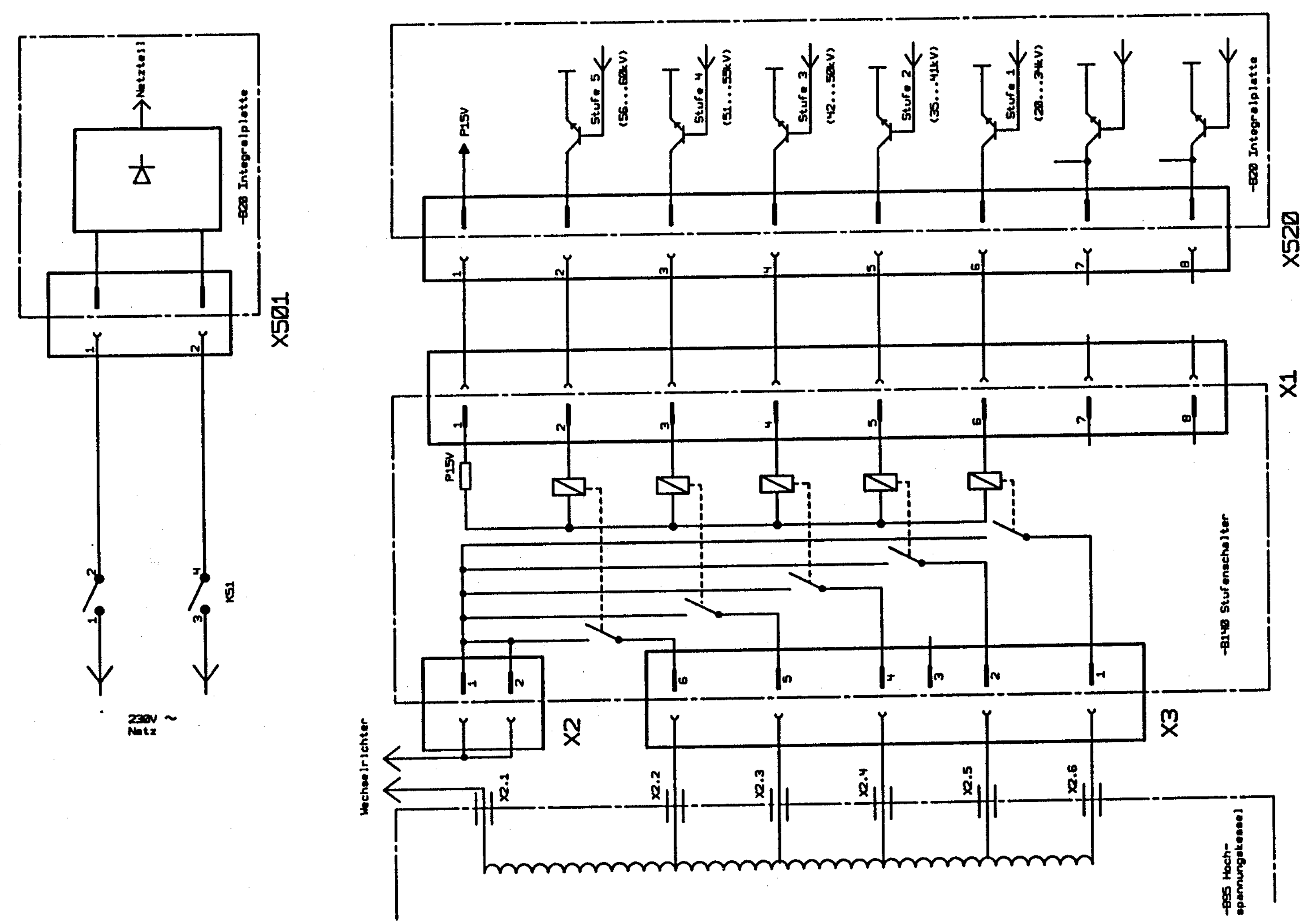

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Stromlaufplan/Circuit diagram

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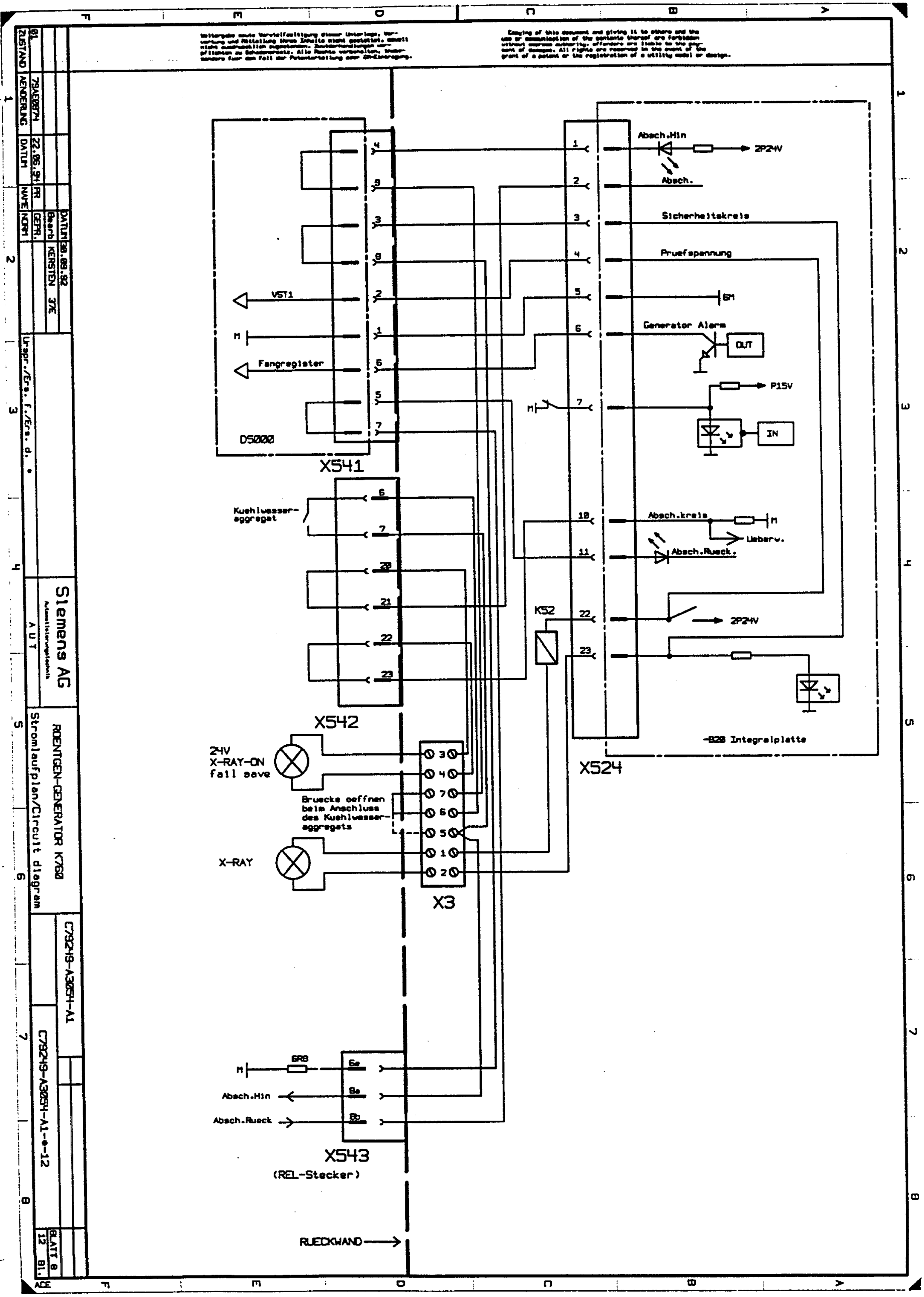

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Fangregister
X542
Kuehlwasser-aggregat
X3
24V X-RAY-ON fail save
Bruecke oeffnen beim Anschluss des Kuehlwasser-aggregats
X-RAY
X543
(REL-Stecker)
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Abach.Hin
Absch.Rueck
RUECKWAND
X524
Absch.Hin
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Absch.
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Pruefspannung
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Generator Alarm
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Absch.kreis
Ueberw.
Absch.Rueck.
K52
-B20 Integralplatte
Siemens AG
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ROENTGEN-GENERATOR K760
Stromlaufplan/Circuit diagram
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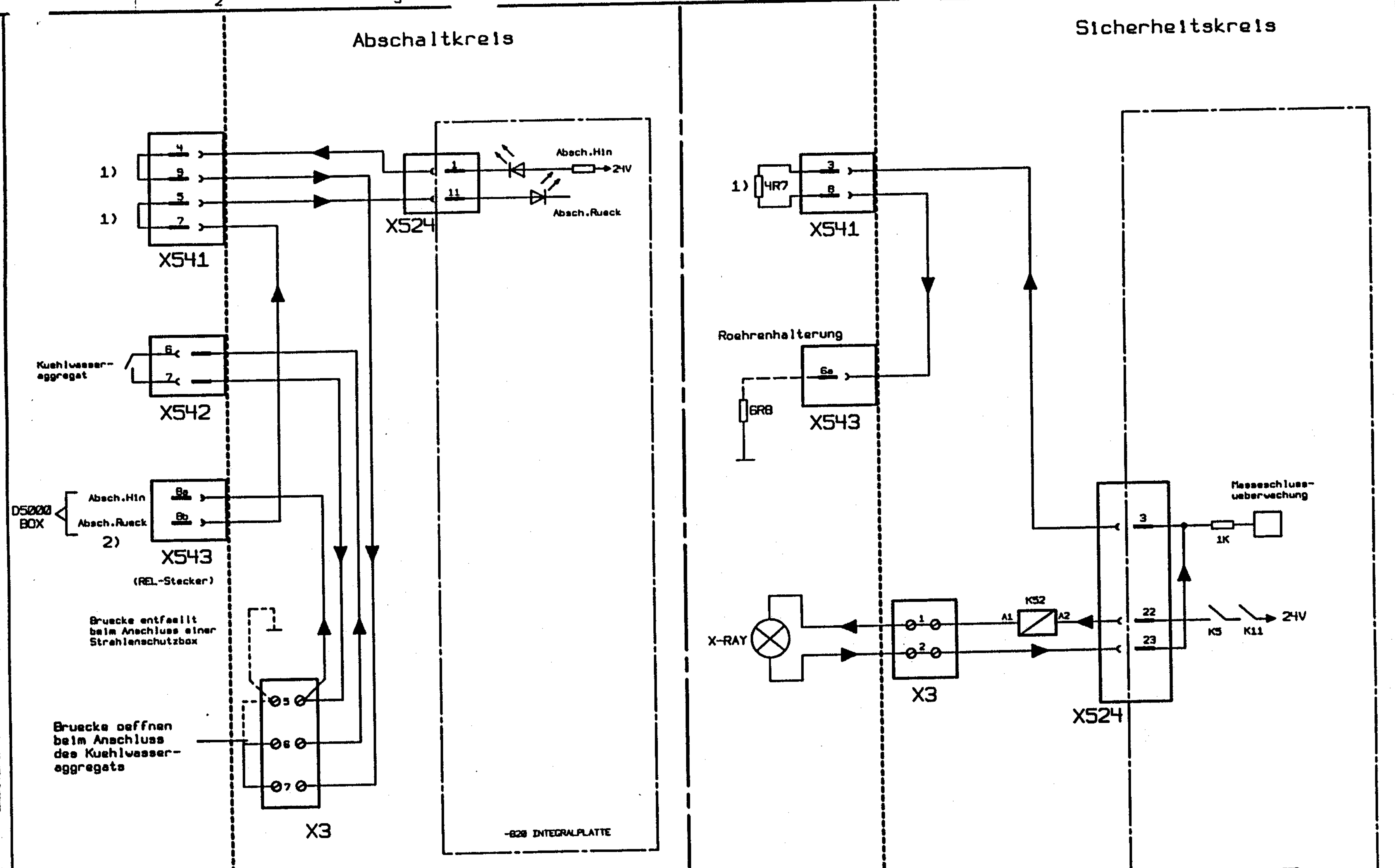

1) Im Steckergehaeuse gebrueckt
2) Absch.Rueck wird mit neuer Box realisiert

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C79249-A3054-A1-*-12

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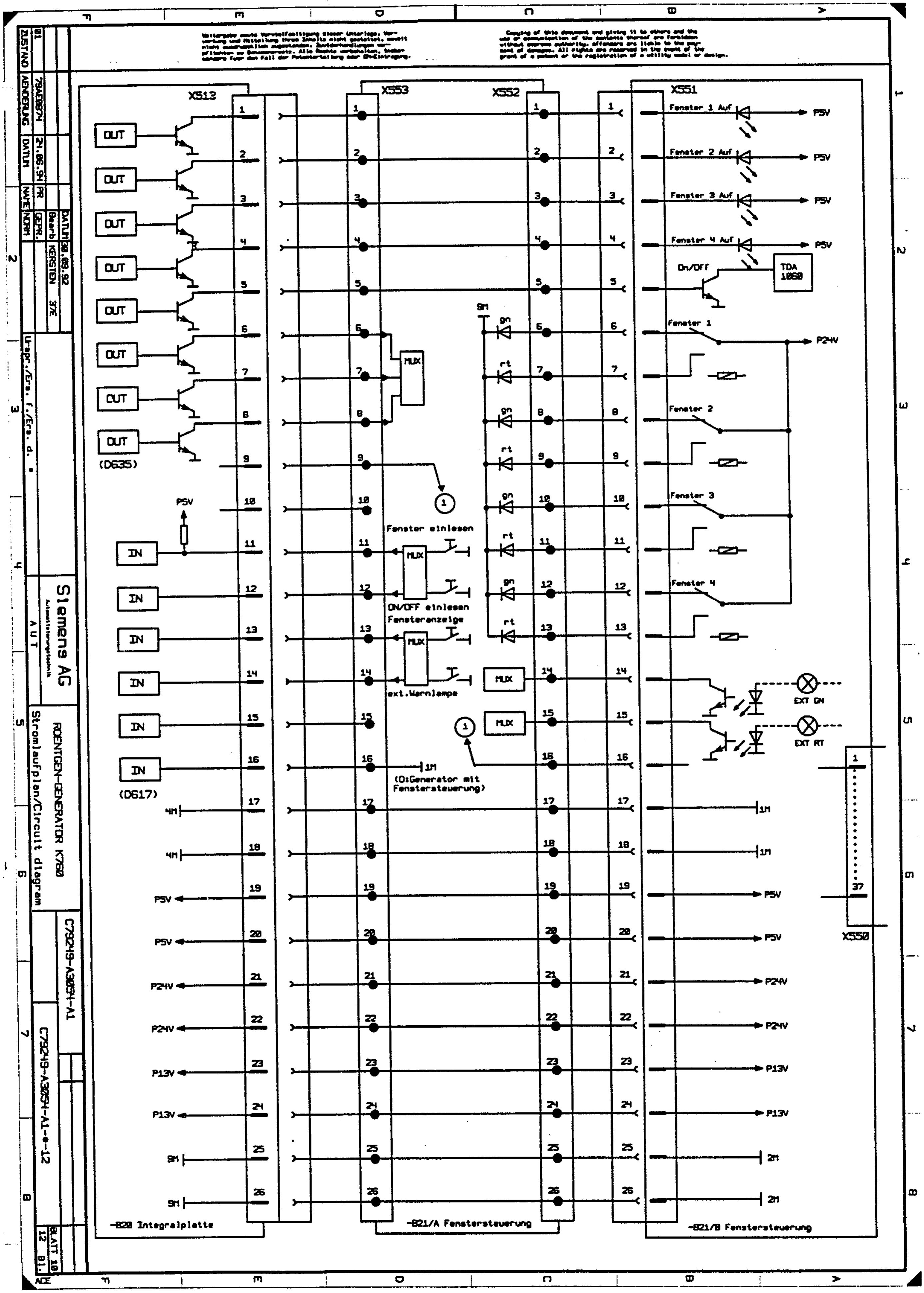
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X551
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IN
(D617)
P5V
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Fensteranzeige
ext.Warnlampe
(D:Generator mit
Fenstersteuerung)
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Fenster 2 Auf
Fenster 3 Auf
Fenster 4 Auf
On/Off
TDA
1060
Fenster 1
Fenster 2
Fenster 3
Fenster 4
P24V
P13V
EXT GN
EXT RT
9M
4M
1M
2M
gn
rt
-B20 Integralplatte
-B21/A Fenstersteuerung
-B21/B Fenstersteuerung
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ROENTGEN-GENERATOR K760
Stromlaufplan/Circuit diagram
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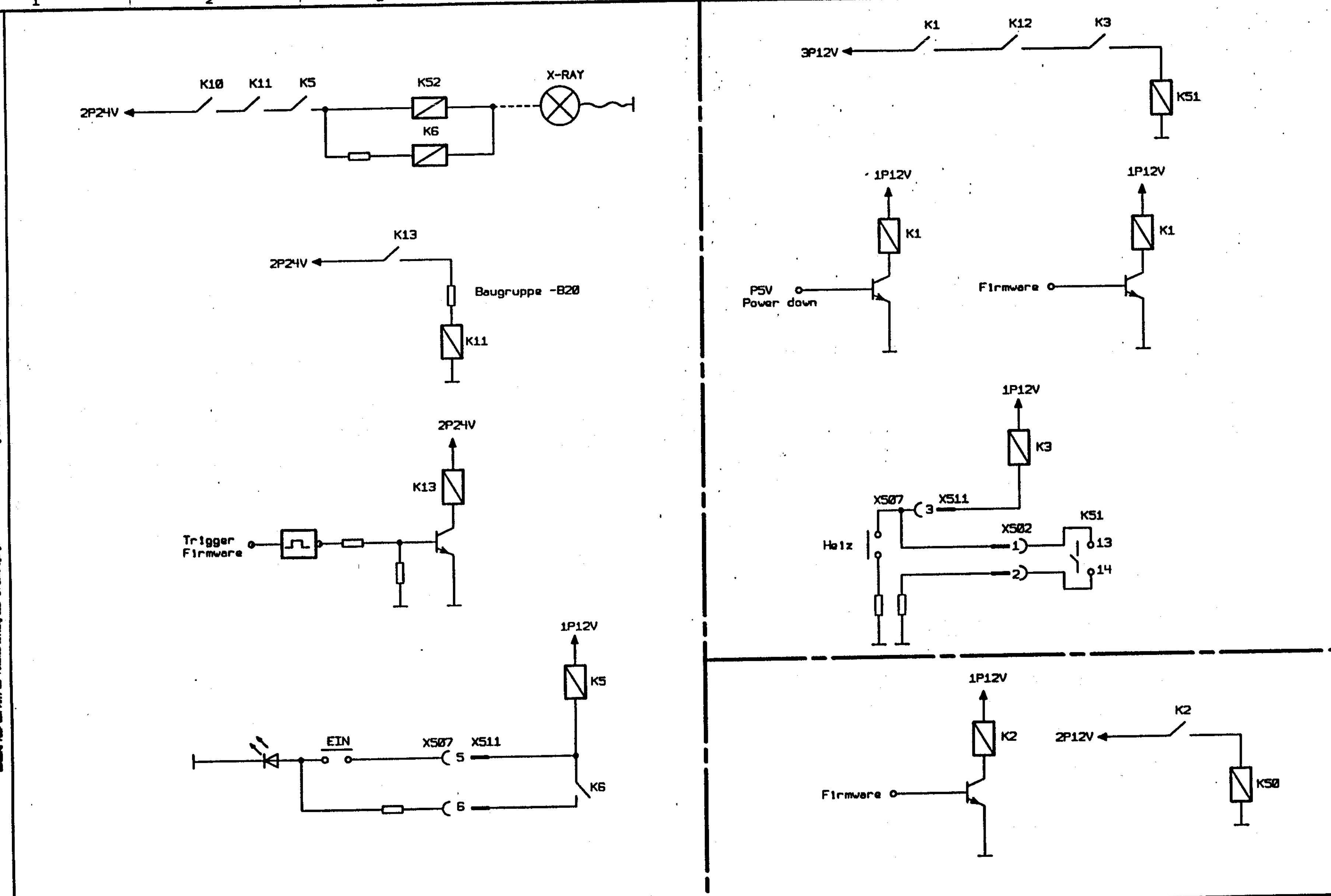
Norm
Urspr./Ers. f./Ers. d.



				DATUM	30.09.92
				Bearb	KERSTEN 37E
01	79AE0874	15.06.94	PR	GEPR.	
ZUSTAND	AENDERUNG	DATUM	NAME	NORM	

Urspr./Ers. f./Ers. d. •

Siemens AG

AUT

ROENTGEN-GENERATOR K760

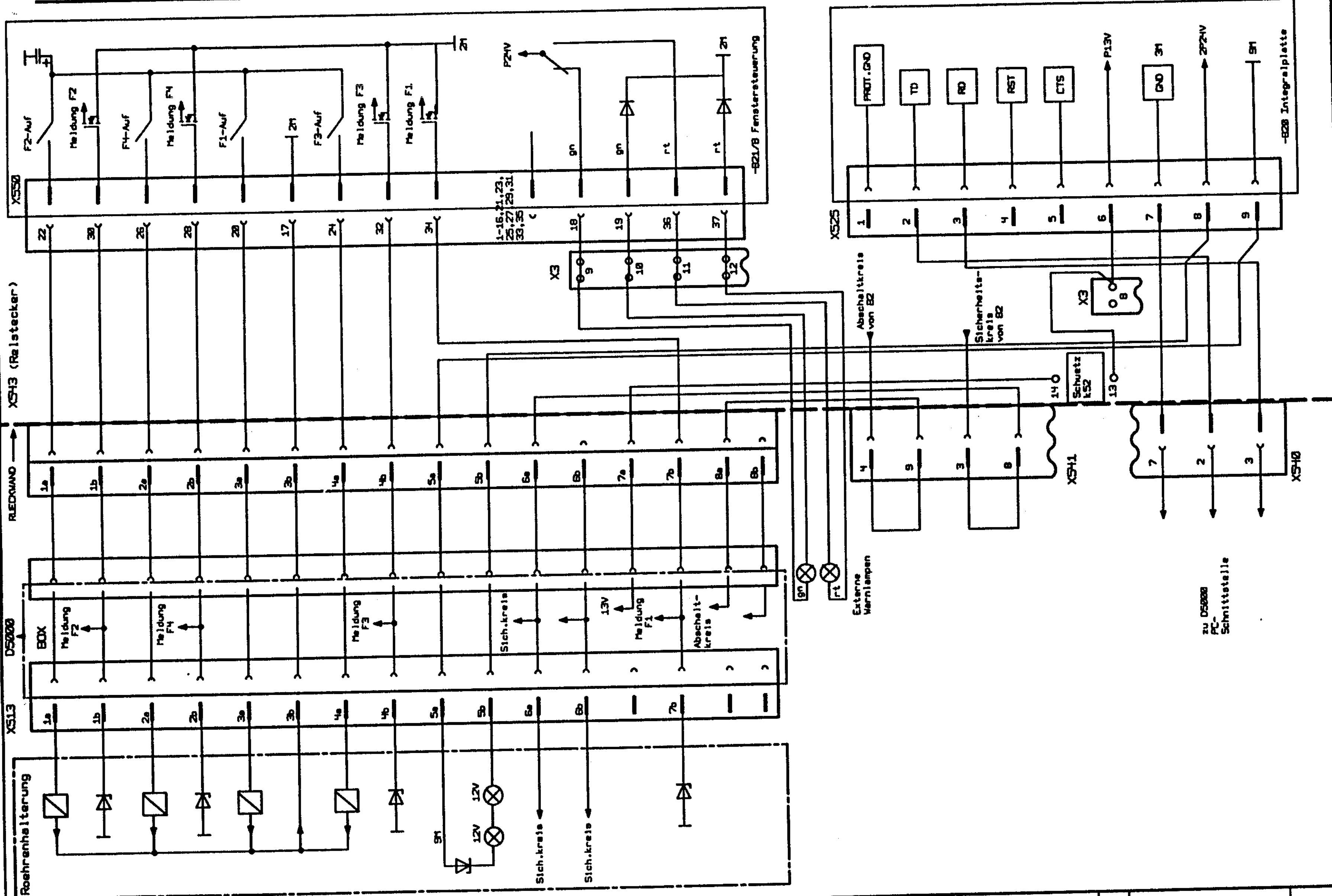
Stromlaufplan/Circuit diagram

C79249-A3054-A1

C79249-A3054-A1-•-12

BLATT 12

12 Bl.



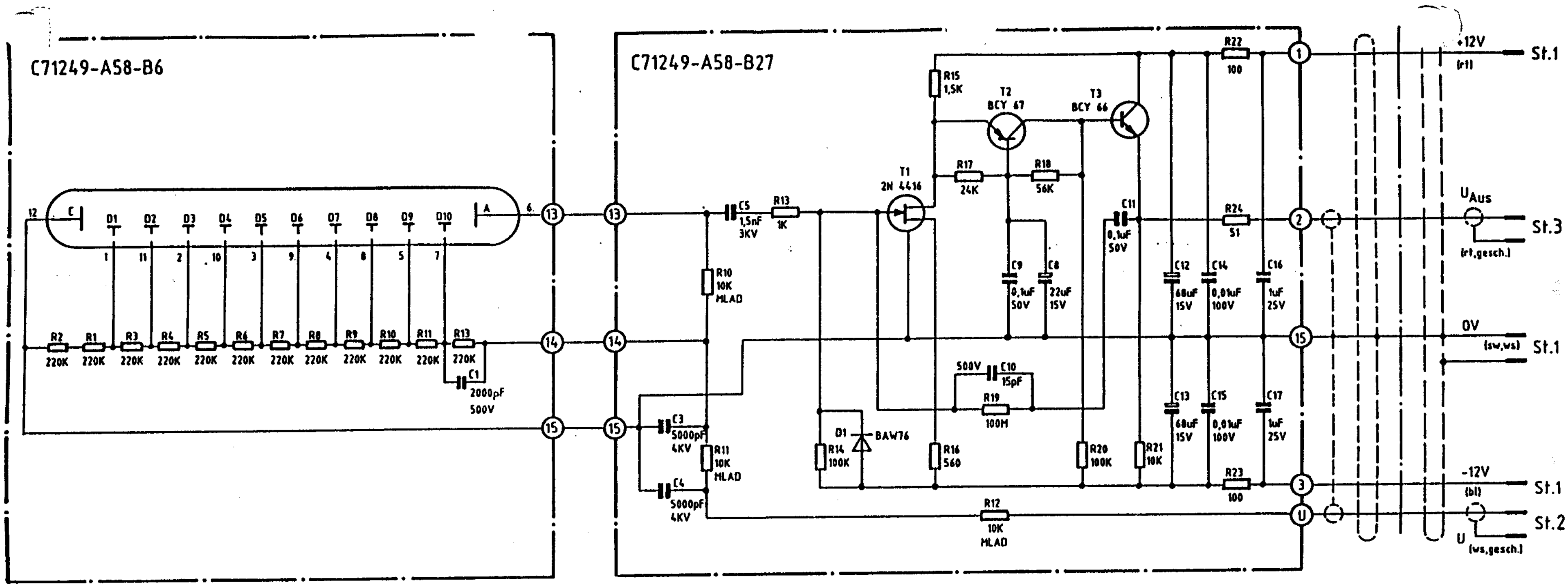
ZUSTAND	AENDERUNG	DATUM	NAME	NORM	Urspr./Ers. f./Ers. d.
01	78AE0874	24.06.94	PR	GEPR.	
			Bearb	KERSTEN 37E	
			DATUM	30.09.92	

Siemens AG
Automatisierungstechnik
AUT

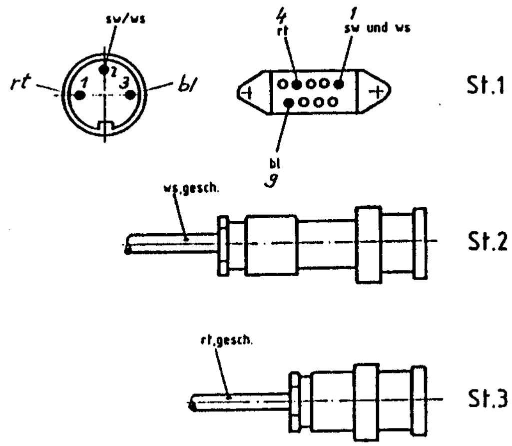
ROENTGEN-GENERATOR K760
Stromlaufplan/Circuit diagram

C79249-A3054-A1
C79249-A3054-A1-*-12

BLATT 11
12 Bl.



bl	blue
rt	red
sw	black
ws	white
gesch.	screened

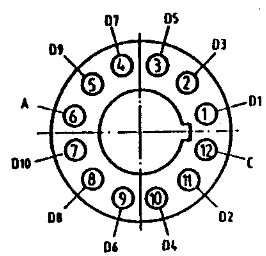


Gesamtschirm des Kabels spektrometerseitig mit der 0-V-Leitung und dem Gehäuse verbunden.

Gesamtschirm des Kabels steckerseitig mit der 0-V-Leitung und dem Steckergehäuse verbunden.

At the spectrometer entire cable screen connected to 0-V line and housing.

At the plug entire cable screen connected to 0-V line and plug housing.



Szintiblock
Scintl block

	765			
2	79AC0829	23.02.92		12.06.91 Nielebock AUT E371A3
1	79NB 0432	11.12.91		
52		7.11.91		
51		20.6.91	Nie.	Siemens AG

Szintillationszähler
Scintillation counter

C79298-A3178-A10-*-11

Contents of Section 8

C79000-M3474-C147-01

Overview (Free-Standing Housing)	C79298-A3136-A101-*-47
Installation Specifications (Free-Standing Housing)	C79298-A3128-A10-*-31
Radiation Protection Certificate	
Piping Diagram (Water)	C79298-A3136-A101-*-12
Overview Circuit Diagram (Diffractometer Configuration)	C79298-A3160-X1-*-12
Allocation Plan (Computer Interface)	C79298-A3160-X1-*-17
Overall Circuit Diagram (Safety System)	C79298-A3160-X2-*-12
Installation Guidelines (Operating Hours Counter)	C79298-A3136-A101-*-28, Sheet 2
Installation Guidelines (Safety Switches)	C79298-A3128-A10-*-28
Installation Specifications (Alarms)	C79298-A3128-D15...16-*-31

Oversized Drawing

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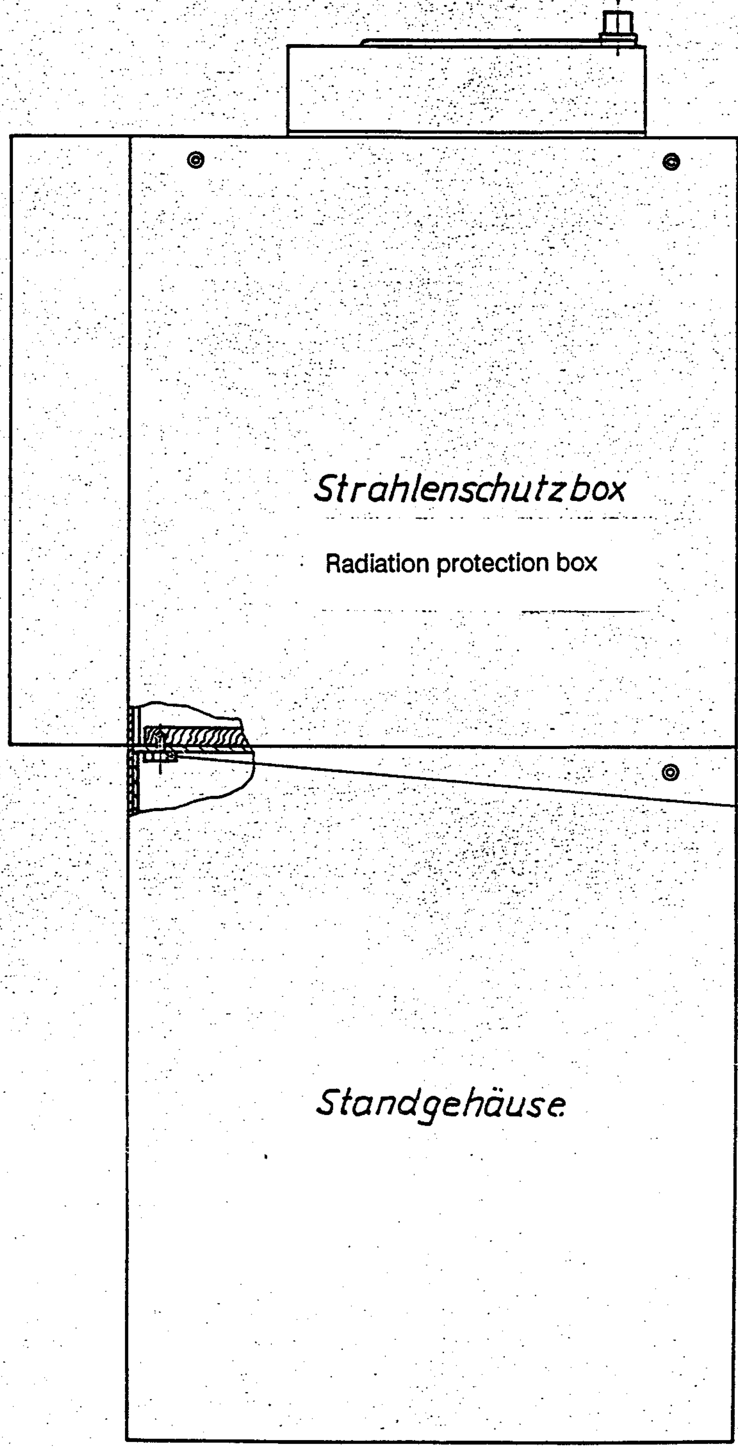
Contact the factory Service Dept. for hardcopy, if needed.

Provide manual number and page number of missing drawing.



Scheibe
6,4 DIN 9021-St/
vernickelt

Sechskantholzschraube
6×25 DIN 571-St/
vernickelt

Washer
6.4 DIN 9021
St/nickel-plated

Hexagonal wood screw
6 x 25 DIN 571
St/nickel-plated

760

Zust.	Mitteilung	Datum	Name
1	79 NW 0092	6.5.88	Nie.
51		3.8.87	Nü.

Datum 18.3.87
Name Nielebock
GWK-TGK 4
Siemens AG

Assembly instructions
Radiation protection box and casing

Montagevorschrift
Strahlenschutzbox - Standgehäuse

Blatt

C79298-A3128-A10-*-31

H31-S6260-N41 30000 5.85 2067

Oversized Drawing

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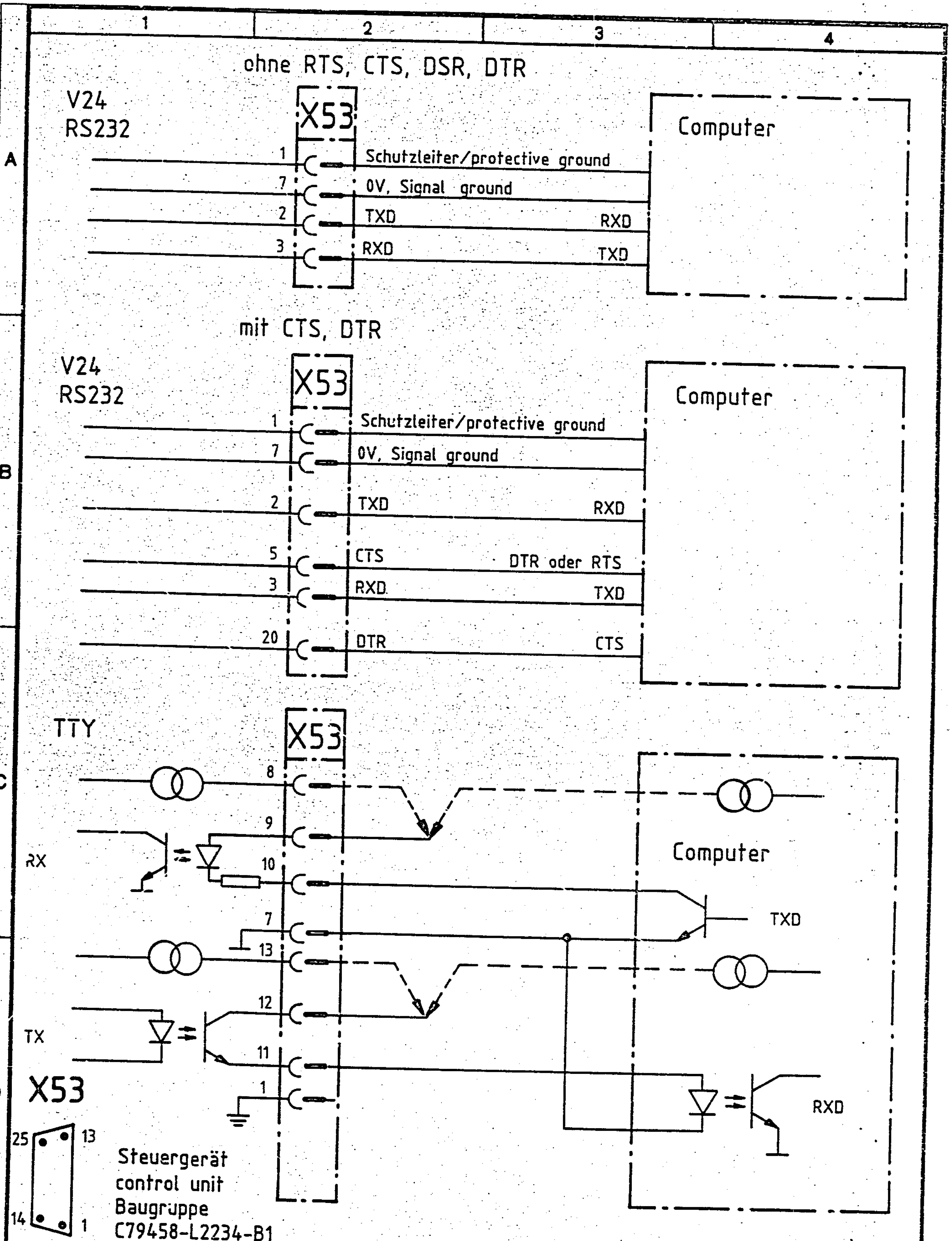
for hardcopy, if needed.

Provide manual number and page
number of missing drawing.



			Datum	23.06.88
			Bearb	Kr Th.
			Gepr.	
			Norm	
				GWK TGK4
3	79AX 1806	31.7.89		
2	79AX 1191	14.6.89		
1	79NW0092	25.8.88		
Zust	Mitteilung	Datum	Name	

Belegungsplan

Rechnerschnittstelle D5000

pin assignment: Interface

SIEMENS AKTIENGESELLSCHAFT

C79298-A3160-X1-*-17

Blatt

Bl.

E6 D210 5000 7.73

Oversized Drawing

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Contact the factory Service Dept.
for hardcopy, if needed.

Provide manual number and page
number of missing drawing.

Oversized Drawing

(intentionally left out)

Contact the factory Service Dept.
for hardcopy, if needed.

Provide manual number and page
number of missing drawing.

1 | 2 | 3 | 4

Einbau der Betriebsstundenzähler in den Meßplätzen

Einbau des Betr.-Std.-Zählers	Betriebsart	Einbauplatz	Sach-Nr. der Anschlußleitung
1 Stück	Einzelbetrieb	Netzschalterstreifen	C79298-A3136-D8
2 Stück	2x Einzelbetrieb	1x Netzschalterstreifen	C79298-A3136-D8
		1x Generatorrückseite	C79298-A3136-D8
	Wechselbetrieb	Frontplatte der Umschaltelektronik	C79298-A3136-D8

Bei Einzelbetrieb erfolgt der Anschluß der Betriebsstundenzähler im Generator an der Klemmleiste X3.3 und X3.4 .

Bei Wechselbetrieb erfolgt der Anschluß an der Klemmleiste in der Umschaltelektronik. Für Arbeitsplatz 1 an Punkt 10 und 11, für Arbeitsplatz 2 an Punkt 12 und 13.

Das Kabel C79298-A3136-D8 wird zunächst mit seiner Steckhülsenseite von innen durch die Rückwand des Generators gezogen. Zuvor ist eine der beiden Knickschutztüllen aus der Rückwand des Generators zu entfernen. Der Schirm mit Anschlußleitung ist unter die vor der Klemmleiste X3 sitzende Kabelschelle zu klemmen, die Knickschutztülle des Kabels mittels Kleber (Pattex o. ä.) an dem Rückblech zu sichern.

zugehöriger Stromlaufplan: C79249 - A3028 - X1 - * - 11 , Bl. 2
(im Handbuch Röntgengenerator K710/K710H)

Zust	Mitteilung	Datum	Name
3	79 AB 0456	14.12.90	Nie.
2	79 AX 1705	7.8.89	Nie
1	79 NW 0092	2.2.88	Ku

Datum 2.2.88
Bearb Kästner
Gepr
Norm

TG44

SIEMENS AKTIENGESELLSCHAFT

Einbaurichtlinie
Einbau der Betriebsstundenzähler

C79298 - A3136 - A101 - * - 28

Blatt 2-
Bl

Installation of the operating-hours counter in the measuring stations

Installation of the operating-hours counter	Mode	Location	Code number of the connecting line
1 unit	Stand-alone mode	Mains switch strip	C79298-A3136-D8
	2 x stand-alone mode	1 x mains switch strip	C79298-A3136-D8
		1 x rear of generator	C79298-A3136-D7
2 units	Alternate mode	Front panel of the changeover electronics	C79298-A3136-D7

The operating-hours counter is connected to terminal strip X3.3 and X3.4 in the generator for stand-alone mode.

It is connected to the terminal strip in the changeover electronics for alternate mode. It is connected to pins 10 and 11 for workstation 1 and to pins 12 and 13 for workstation 2.

Cable C79298-A3136-D7 or D8 is first passed through the generator rear panel from the inside with the pin bushing first. One of the two anti-kink sleeves must first be removed from the rear panel of the generator. The shield and connecting lead must be connected below the cable clamp in front of terminal strip X3 and the anti-kink sleeve of the cable secured to the rear panel with adhesive (Pattex or similar).

Corresponding circuit diagram: C79249-A3028-X1-*-11, Sheet 2 (included in the KRISTALLOFLEX 710/710 H X-ray generator manual)

Oversized Drawing

(intentionally left out)

Contact the factory Service Dept.
for hardcopy, if needed.

Provide manual number and page
number of missing drawing.

Oversized Drawing

(intentionally left out)

Contact the factory Service Dept.
for hardcopy, if needed.

Provide manual number and page
number of missing drawing.

1	2	3	4

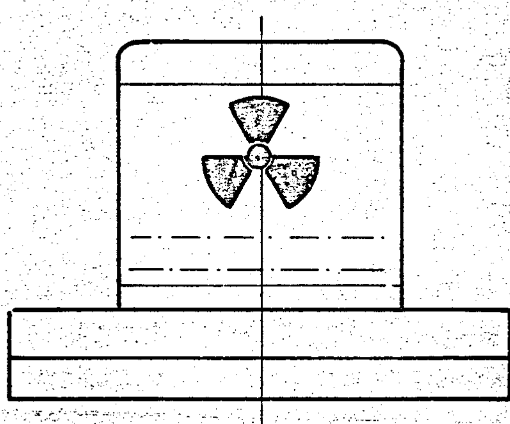
Anschluß der zusätzlichen Warnlampen

Entsprechendes Schild (X-RAYS ON oder SHUTTER-OPEN) auf Kappe aufkleben.

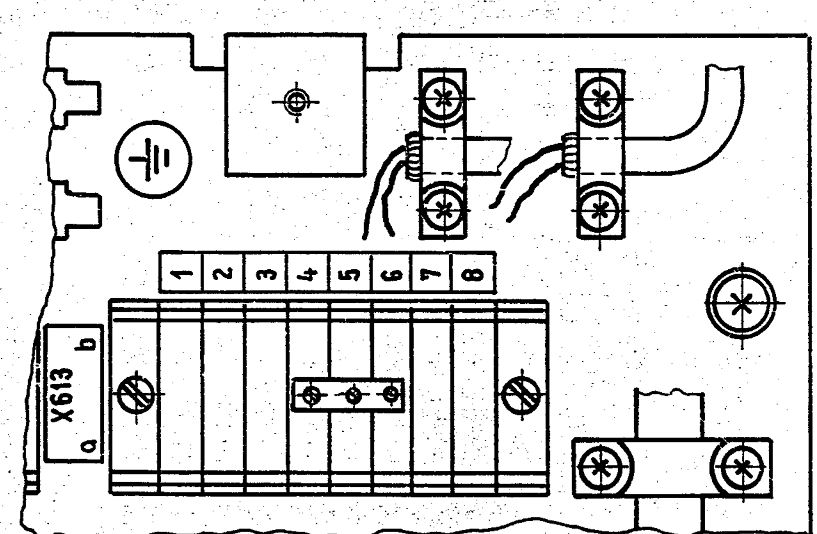
Anschluß

Netzstecker ziehen.
Verteilerkasten in der Strahlenschutzbox öffnen.
Schirmgeflecht und Leitung mit Leitungsschelle festklemmen.

Warnlampe SHUTTER OPEN an X613/6b und X613/7b
Warnlampe X-RAYS ON an X613/5b und X613/8b anschließen.



Brücken auf Flachbaugruppe Fenstersteuerung C79458-L2234-B4 schließen.
siehe C79298-A3160-X1-*-37 (Hardware Programmierung)



Zust	Mitteilung	Datum	Name		
				Datum	5.5.88
				Bearb.	Nielebock
				Gepr	
				Norm	
				GWK-TGK 4	
3	79 AX 1917	22.8.89	Nie.	SIEMENS AKTIENGESELLSCHAFT	
2	79 AX 1150	17.4.89	Nie.		
1	79 NW 0092	6.5.88	Nie.		

Montagevorschrift

Warnlampen

C79298-A3128-D15...D16-*-31

Blatt

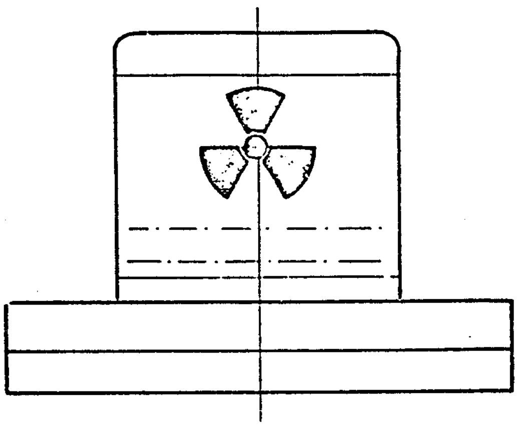
Bl.

Connection of the additional warning lamps

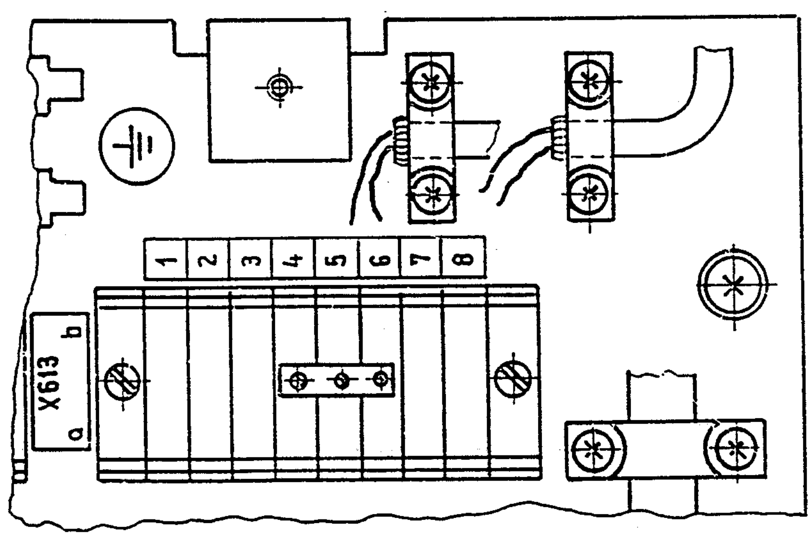
The corresponding label (X-RAYS ON or SHUTTER OPEN) must be affixed to the cap.

Connections

Disconnect the mains plug.
Open the distribution box on the radiation protection box.
Secure the shield braiding and line with a cable clamp.
Connect warning lamp SHUTTER OPEN to X613/6b and X613/7b.
Connect warning lamp X-RAYS ON to X613/5b and X613/8b.



Close the jumpers on the printed card board "window control" C79458-L2234-B4.
Refer to C79298-A3160-X1-*-37 (hardware programming).



				Datum	5.5.88
				Bearb	Nielebock
				Gepr	
				Norm	
				GWK-TGK 4	
3	79 AX 1917	22.8.89	Nie.	SIEMENS AKTIENGESELLSCHAFT	
2.	79 AX 1150	17.4.89	Nie.		
1	79 NW 0092	6.5.88	Nie.		
Zust	Mitteilung	Datum	Name		

Assembly instructions
Warning lamps

C79298-A3128-D15...D16-*-31

Blatt

Bl

E 6 D 210 5000 7.73

Oversized Drawing

(intentionally left out)

Contact the factory Service Dept.
for hardcopy, if needed.

Provide manual number and page
number of missing drawing.

Contents of Section 9

Maintenance Tips	C79298-A3160-D1-*-20
Hardware Programming	C79298-A3160-X1-*-37

C79000-M3474-C149-01

Die Bausteine des Diffraktometer-Meßplatzes sind im wesentlichen wartungsfrei.
Je nach Betriebsart, Betriebsdauer und Einsatzbedingungen wird jedoch empfohlen, regelmäßige Kontrollen der nachstehend genannten Wartungsstellen durchzuführen:

1. Goniometer

1.1 Reinigen bzw. Austauschen der Filterpapiere (Ersatzteilliste Nr. 4.9) an beiden Seiten des Goniometergehäuses.

1.2 Reinigen und Nachschmieren bzw. Austauschen der Schmierbürsten (Ersatzteilliste Nr. 4.1.4) an den Schneckenantrieben für Theta und 2 Theta.
Zum Nachschmieren ist ausschließlich das Schmierfett "Molymagus NT-3" zu verwenden.
Lieferant: Wiho-Chemie, Virchowstr.7, D 8500 Nürnberg.
Hersteller: Strub & Co. AG, CH 6260 Reiden.

2. Probenwechsler

2.1 Drehprobenwechler
Reinigen des Zahneingriffs,
Nachschmieren mit handelsüblichem Schmierfett.

2.2 40-Probenwechsler
Reinigen der Zahnstange und der Führungsbuchsen,
Nachschmieren mit handelsüblichem Schmierfett.

3. Wartung des Röntgengenerators siehe Gerätehandbuch K 710/K 710 H.

				Datum 9.3.89	Wartungshinweise Diffraktometer-Meßplatz	
				Bearb. Kästner		
				Gepr.		
				Norm.		
				GWK TGK4		
				SIEMENS AKTIENGESELLSCHAFT	C79298-A3160-D1-K-20	Blatt 1+
1	79NW0092	21.3.89	[illegible]			2 Bl
Zust.	Mitteilung	Datum	Name			

E8 D210 5000 7 73

The components of the diffractometer measuring equipment are mainly maintenance-free.
Depending on the operating time, and the mode and conditions in which the equipment is operated, it is, however, recommended to regularly check and service the following components:

1. Goniometer

1.1 Clean or replace the filter papers (parts list item no. 4.9) at both sides of the goniometer housing.

1.2 Clean and lubricate, or replace the lubricating brushes (parts list item no. 4.1.4) at the worm drives for theta and 2 theta.
Only use the lubricant "Molymagnus NT-3" which is supplied by Wiho-Chemie, Virchowstr. 7, D-8500 Nürnberg and manufactured by Strub & Co. AG, CH-6260 Reiden.

2. Sample Changer

2.1 Rotary sample changer
Clean the gear meshing and lubricate using commercial grease.

2.2 40-sample changer
Clean the gear rack and guide bushings, lubricate using commercial grease.

3. Maintenance of the X-ray Generator
See Manual K 710/K 710 H.

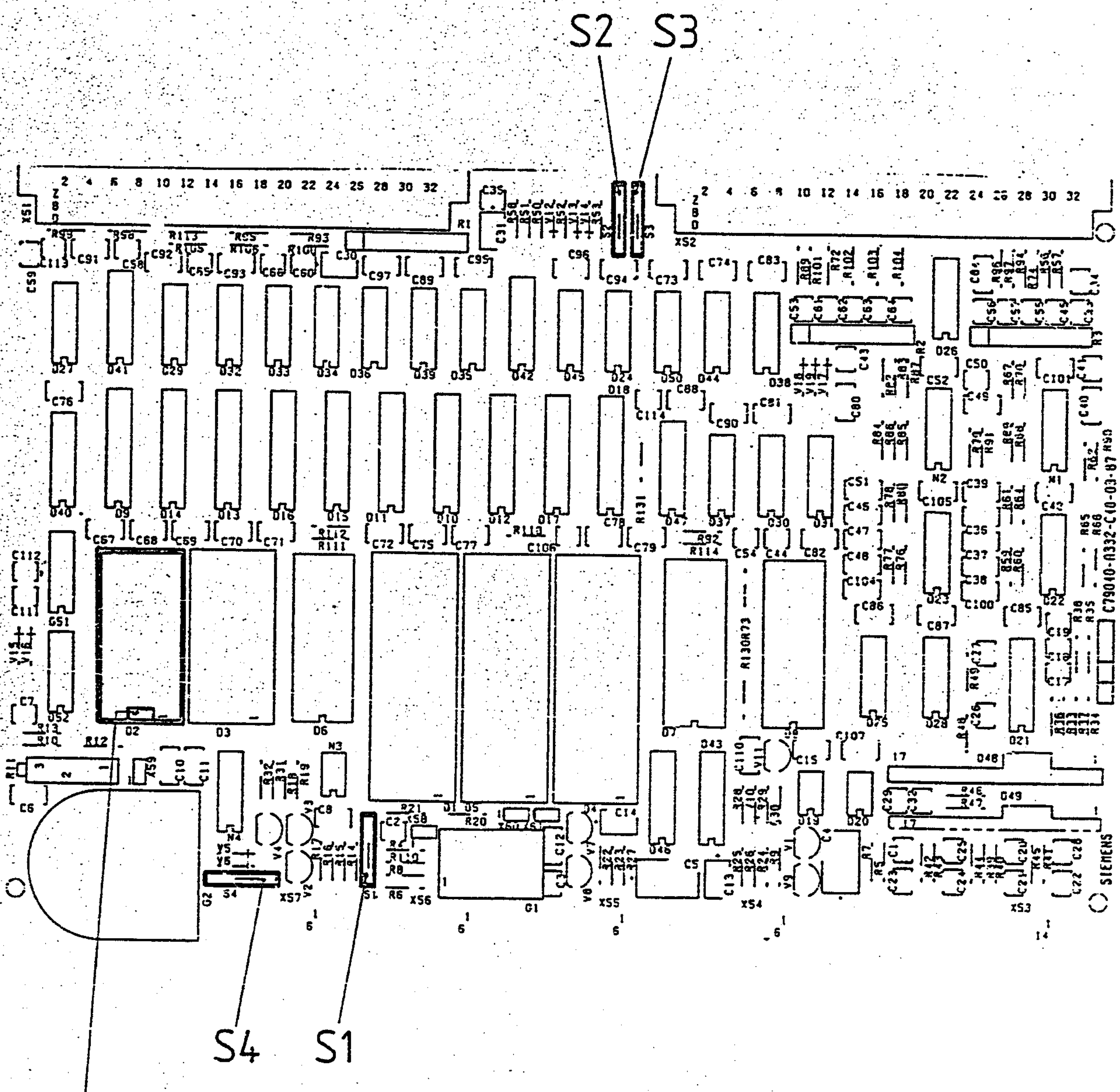
1 | 2 | 3 | 4

A

B

C

D

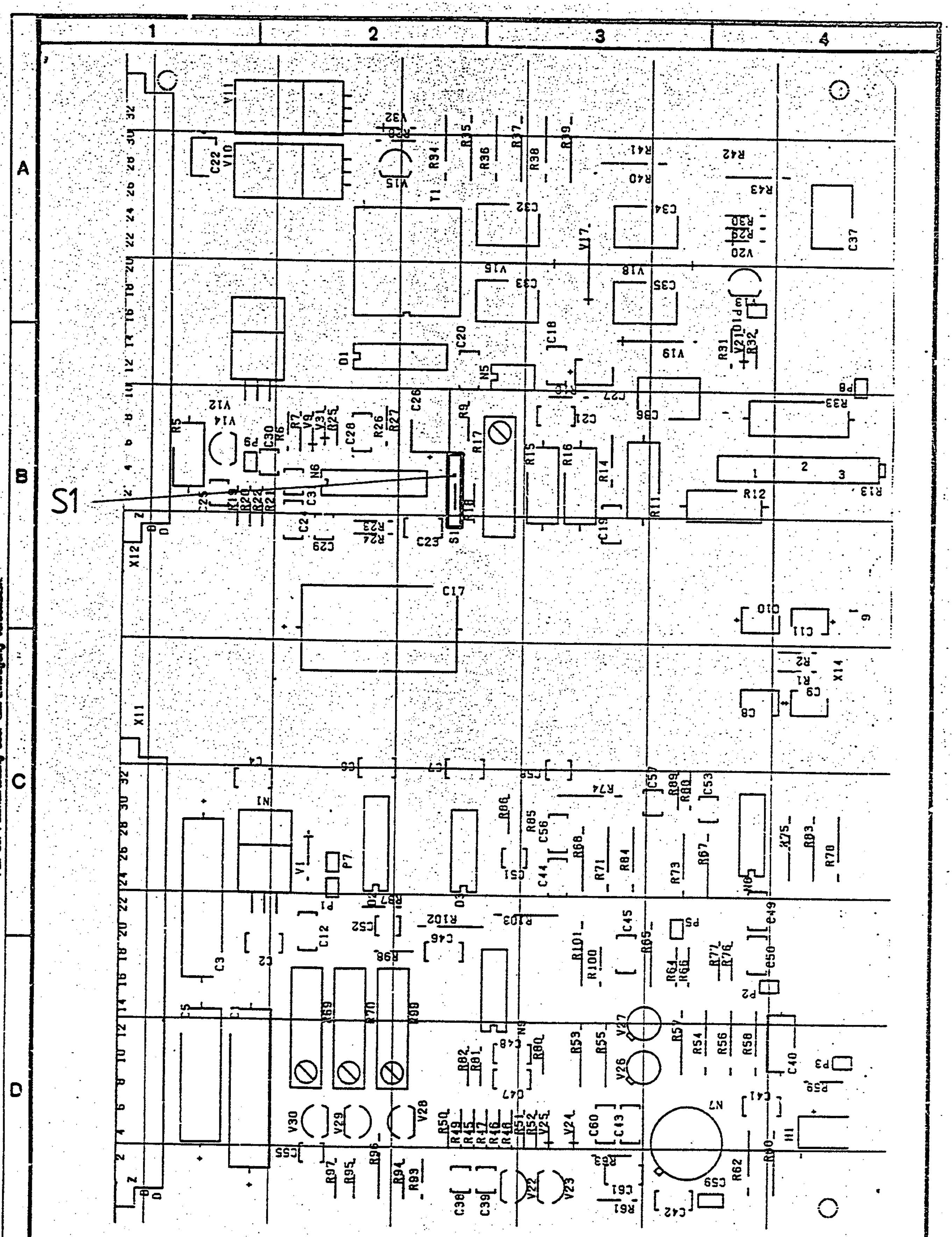


Einbaukennzeichnung

Einbauplatz für Festspeicher S79610-G18-A900 : Grundgerät
S79610-G17-A900 : Textur

			Datum	10.3.89	Hardware Programmierung D5000
			Bearb.	Kästner	Hardware programming D5000
			Gepr		C79458-L2234-B1
			Norm.		
			GWK TGK4		
			SIEMENS AKTIENGESELLSCHAFT		C79298- A3160- X1-*-37
1	79NW0092	21.3.89	Kr		Blatt 2+
Zust.	Mitteilung	Datum	Name		Bl.

E 6 D 210 5000 7.73



				Datum	10.3.89
				Bearb.	Kästner
				Gepr.	
				Norm.	
				GWK TGK4	
1	79NW0092	21.3.89	Xr	SIEMENS AKTIENGESELLSCHAFT	
Zust.	Mitteilung	Datum	Name		

Hardware Programmierung D5000

Hardware programming D5000

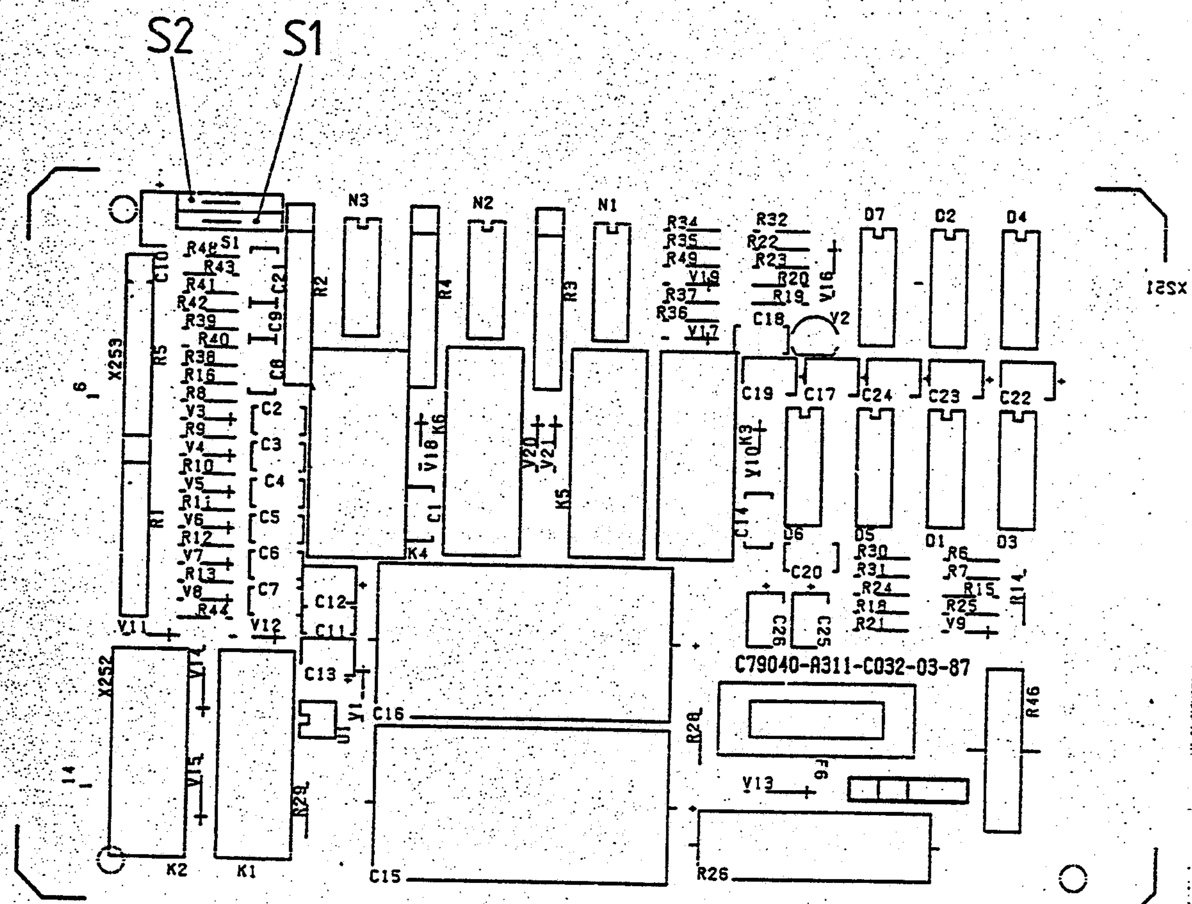
C79458-L2234-B3

C79298- A3160- X1-*- 37

Blatt 3+

Bl.

E6D210 5000 7.73



				Datum	10.3.89
				Bearb.	Kästner
				Gepr.	
				Norm.	
				GWK TGK4	
1	79NW0092	21.3.89	Xr		
Zust.	Mitteilung	Datum	Name		

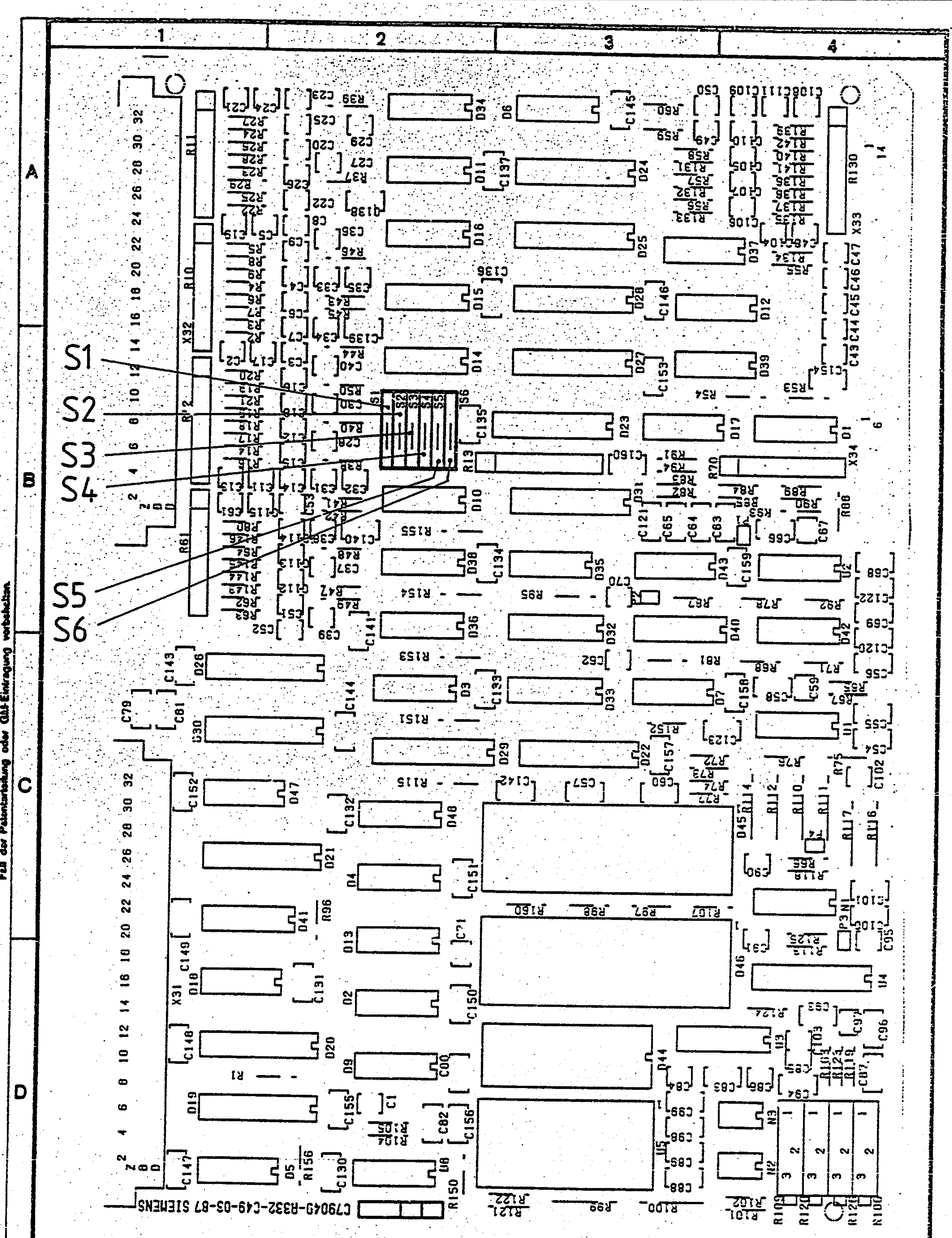
SIEMENS
AKTIENGESELLSCHAFT

Hardware Programmierung D5000
Hardware programming D5000
C79458-L2234-B4

C79298- A3160- X1-*- 37

Blatt 4+
Bl.

E6D210 5000 7.73



Zust.	Mitteilung	Datum	Name
1	79NW0092	21.3.89	[illegible]

Datum 10.3.89
Bearb. Kästner
Gepr.
Norm.
GWK TGK4

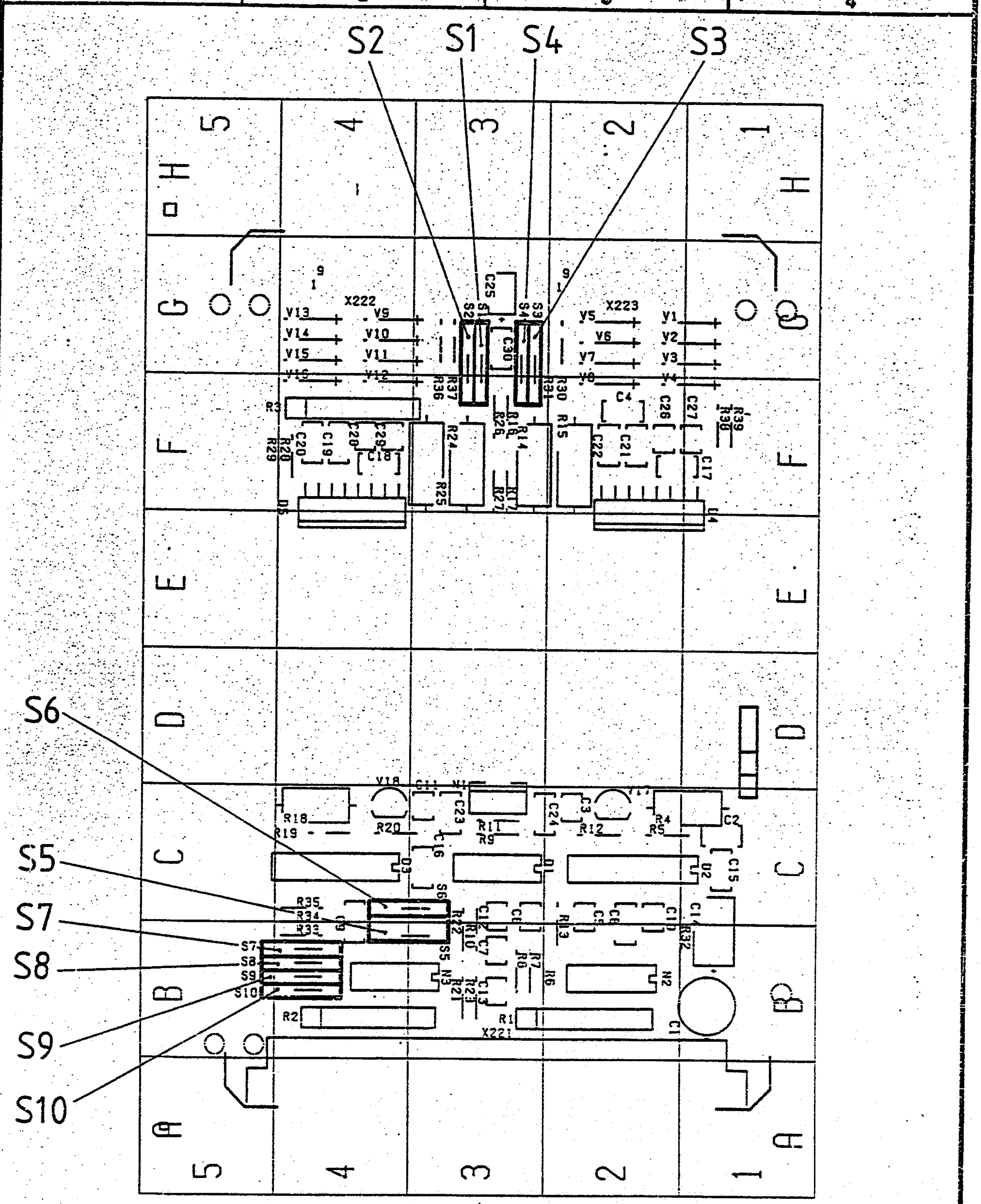
SIEMENS
AKTIENGESELLSCHAFT

Hardware Programmierung D5000
Hardware programming D5000
C79458-L2234-B2

C79298- A3160- X1-*- 37

Blatt 5+
Bl.

E6 D210 5000 7.73



Datum	10.3.89
Bearb.	Kästner
Gepr.	
Norm.	
GWK TGK4	

Hardware Programmierung D5000
Hardware programming D5000
C79458-L2234-B6

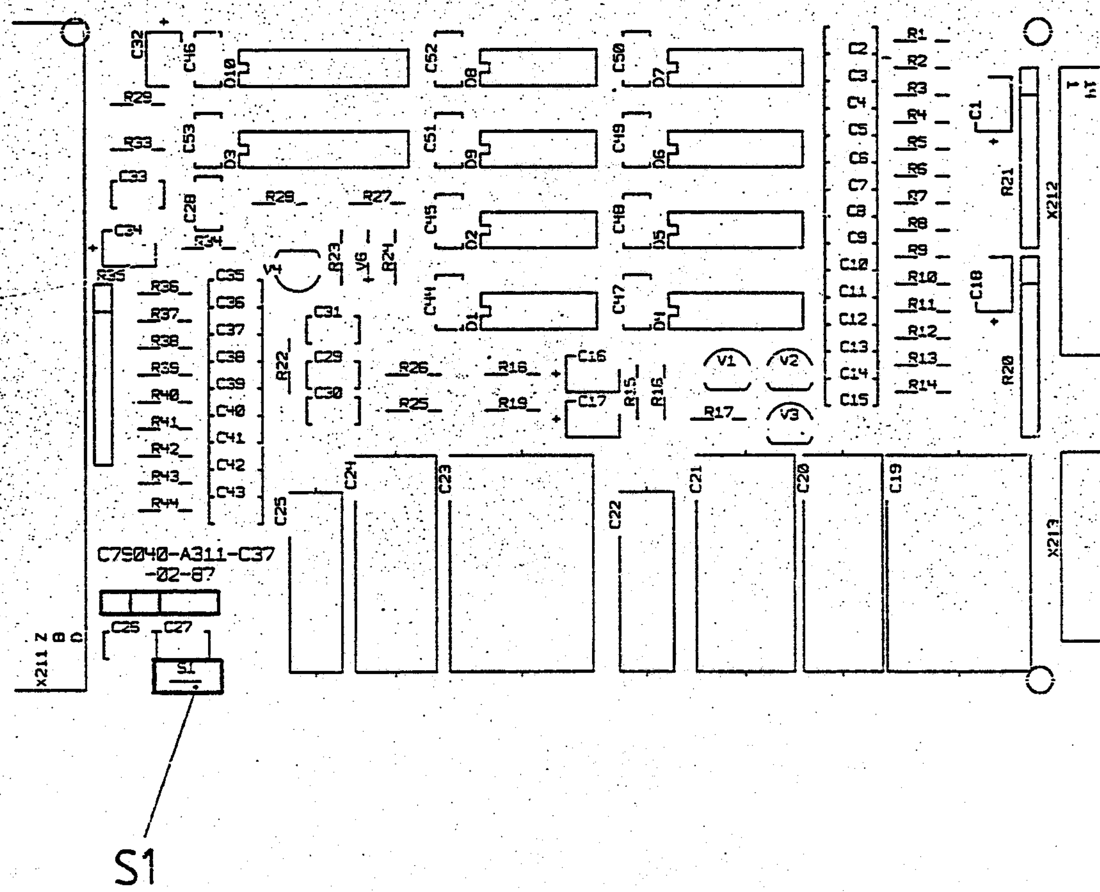
SIEMENS
AKTIENGESELLSCHAFT

C79298- A3160- X1-*- 37

Blatt 6+
Bl.

Zust.	Mitteilung	Datum	Name
1	79NW0092	21.3.89	Ahr

ESD 210 5000 7.73



Datum	10.3.89
Bearb.	Kästner
Gepr.	
Norm.	
	GWK TGK4

SIEMENS
AKTIENGESELLSCHAFT

Hardware Programmierung D5000
Hardware programming D5000
C79458-L2234-B8

C79298- A3160- X1-*- 37

Blatt 7-

Zust.	Mitteilung	Datum	Name
1	73NW0092	21.3.89	Kr

E6 D210 5000 7.73