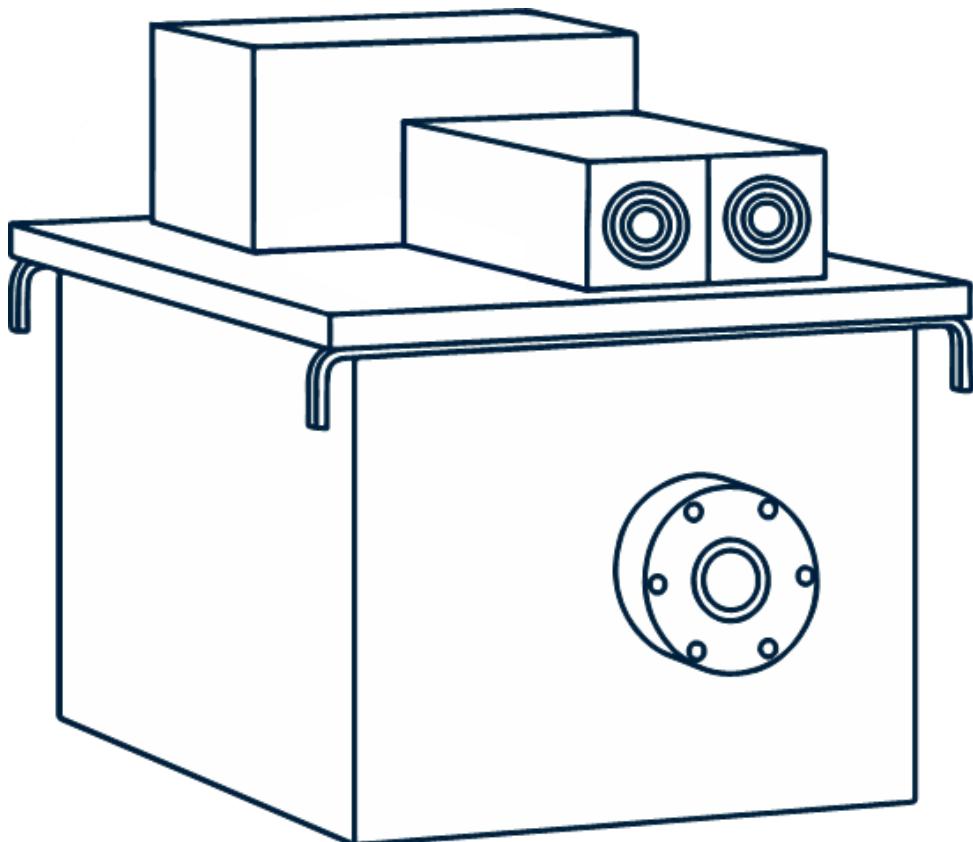


Integrator manual

iVario-series for OEM-users



Copyright

Copyright by Comet AG, 3175 Flamatt, Switzerland, Herrengasse 10

Comet AG is the copyright holder. All rights reserved.

When receiving data carriers, the recipient acquires the personal, non-transferable and non-exclusive limited license for the use and storage of the software in conjunction with the hardware supplied by Comet AG.

Modifications of the software supplied in conjunction with hardware components other than those supplied by Comet AG or copying of the software, except for data backups, are to be first approved by Comet AG in writing.

All rights reserved. This documentation may not be copied, duplicated, reproduced, translated or transferred to electronic media or any other device, completely or partly, without the prior written approval of Comet AG.

Comet AG (hereinafter referred to as Comet) reserves the right to make any modifications in its products required for their technical development. These modifications are not necessarily documented in each individual case.

This installer (integrator) and operator manual and the information contained therein have been compiled with all due care and diligence.

The trademarks and product names mentioned in this installer and operator manual are brands or registered brands of the respective title holders.

Translation of the original iVario manual in German language.

Content

1 About this document	6
1.1 Contents in this document	6
1.2 Style conventions and symbols	6
1.2.1 Making in the text.....	6
1.2.2 Action instructions.....	6
1.2.3 Overview of safety instructions	7
1.2.4 Instructions.....	8
1.2.5 Symbols and definitions used	8
1.2.6 Definitions used in this manual	10
1.2.7 Figures	10
1.3 Other applicable documents.....	10
1.4 General business terms and conditions	10
1.5 Contact with Comet AG	11
1.5.1 Main office contacts	11
1.6 CE Declaration.....	11
2 Product description	12
2.1 Main components of the X-ray module.....	13
2.1.1 Mechanical load capacity during operation	13
2.1.2 Module designations and basic functions.....	14
2.1.3 Possible combinations of the HV components	20
2.1.4 Type label	21
2.2 Use of iVario module	21
2.2.1 Conditions of use	21
2.2.2 Improper use.....	22
2.2.3 Foreseeable misuse	22
2.3 Module components and technical data	22
2.3.1 Mains supply	22
2.3.2 High voltage	24
2.3.3 Tube current.....	25
2.3.4 Timer for exposure time	26
2.3.5 Dimensions and weights of the generator	26
2.3.6 Admissible ambient conditions for iVario generators	28
2.3.7 Mechanical load capacity.....	29
2.3.8 Mechanical load capacity during operation	29
2.3.9 High voltage cables	30
2.3.10 High voltage plug types.....	31
2.3.11 Cooling unit	31
2.3.12 System requirements for iVario control software	31
2.4 Scope of delivery of iVario and iXRS.....	32
2.5 Optional components.....	36
2.5.1 iVario controller	37
2.5.2 iVario cooler interface	40
2.5.3 iVario cover (option for IP54)	40

2.6	Functional safety: Choosing safety components	41
2.6.1	Limitation of the safety function of the X-ray module	41
2.6.2	iVario External Safety: Optional external safety disconnect device	42
2.6.3	Safe switch-off time and constructive requirements	43
3	Safety.....	44
3.1	Safety symbols	44
3.2	Organizational measures.....	44
3.3	Safety impairments	45
3.4	Requirements for fitters, operators and service personnel.....	45
3.5	Electrical safety.....	46
3.6	Transport and installation	46
3.7	Occupational safety	47
3.8	Safety datasheets and Material Compliance	47
3.9	Electromagnetic compatibility	48
3.9.1	Notes.....	48
3.10	Radiation protection	49
3.11	Safety and warning devices.....	52
3.12	Modification of components	53
4	Mounting	54
4.1	Basic conditions.....	54
4.2	Notes on radiation protection.....	55
4.3	Installation site and infrastructure.....	55
4.4	Overview of connections	56
4.4.1	Connections of the iVario generators to the HV tank	56
4.4.2	Connections to the cooler	56
4.4.3	Connections to the tube	57
4.5	Establishing earth connections	57
4.6	Installation of the X-ray tube	59
4.6.1	Distance of the X-ray tube from other components	59
4.6.2	High voltage cable	59
4.7	Installing the cooler	60
4.7.1	Cooler unit connection to X9.....	61
4.7.2	Connection diagram of cooler.....	61
4.7.3	Internal circuit configuration cooling agent temperature and flow rate X9	61
4.7.4	Post-cooling time	63
4.8	Connection to power supply: iVario generator X1/X2.....	64
4.8.1	Connection diagram 1 phase 230/400 V	68
4.8.2	Connection diagram 2 phases 230/400 V	68
4.8.3	Connection diagram 3 phases 230/400 V	69
4.8.4	Wiring diagram – 2 phases 208/240 V including CDRH switch.....	69
4.9	Connection of the X4/X5 control PC	69
4.9.1	Integration of the generator into an IT network.....	70
4.9.2	Connecting the communication cables	72
4.10	Connecting the input/output (I/O signals) to X8 of the IFC	73
4.10.1	Connection of input signals	74

4.10.2	Output signals X8.....	77
4.10.3	Key switch (module component with optional iVario controller)	79
4.11	Connection for X-ray warning lights X10	79
4.11.1	External warning lights (LEDs only)	81
4.11.2	Fuses for external warning lights	81
4.11.3	Wiring diagram for X10	81
4.11.4	Use of dynamic monitoring	81
4.12	Functional safety: Connection of the safety components	82
4.12.1	Connection of safety interlock-door switch signalization to X11	82
4.12.2	Connection of emergency stop signalization to X12	83
4.13	Connection facility for CDRH switch (for US only).....	84
4.14	Minimum requirements for generator start-up	85
4.15	Optional components	87
4.15.1	iVario controller	87
4.16	Replacing an XRP generator	90
4.16.1	Interfaces	90
4.16.2	iVario cooler interface	90
4.17	Installing the bipolar cable	91
4.18	Mounting the IP54 cover	93
4.18.1	Installation of the cable gland	96
4.18.2	Inserting and changing the filters	97
4.19	Mounting the IP21 cover.....	98
5	Commissioning	102
5.1	Installing the iVario control software.....	102
5.2	Configuration	102
5.2.1	Adjustment of configuration	104
5.3	Checking the installation.....	106
5.3.1	Starting the iVario control software.....	107
5.3.2	Switching on Aux	107
5.3.3	Login	110
5.3.4	Switching on mains power	111
5.3.5	Checking the inputs	111
5.3.6	Cooler signals	112
5.3.7	Safety Ready state	112
5.3.8	Ready state.....	112
5.3.9	Checking other states (Prewarn and HV On)	113
5.3.10	Testing of warning lights	115
5.3.11	Checking further safety equipment	116
6	Operation	117
6.1	User interface and symbol.....	117
6.2	Operation of iVario control software and iVario controller	121
6.2.1	iVario control software	121
6.2.2	iVario controller.....	122
6.3	Switching on and shutting down sequence	123

6.3.1	With iVario control software	123
6.3.2	With iVario controller.....	124
6.3.3	Logout.....	129
6.4	Settings.....	129
6.4.1	Voltage (kV)	129
6.4.2	Current (mA)	130
6.4.3	Focus	131
6.4.4	Exposure time (total time)	133
6.4.5	Isowatt.....	134
6.4.6	Loading recipe	137
6.4.7	Saving recipe	138
6.4.8	Temporarily saving working points	140
6.4.9	Configuration options for supervisor	141
6.4.10	Configuration options for normal users.....	152
7	Troubleshooting	155
8	Maintenance and checks performed during operation	156
8.1	Maintenance schedule.....	157
8.1.1	Daily	157
8.1.2	Weekly	158
8.1.3	Every 2 - 6 months.....	158
8.1.4	6 months	159
8.1.5	Annually	159
8.1.6	2 years	160
8.1.7	Every 10 years/1 million ON/OFF cycles.....	160
8.2	Maintenance work.....	160
8.2.1	Function tests	160
8.2.2	Heat exchanger	160
8.3	Spare parts	161
8.4	Repair	161
9	Decommissioning and disposal	162
10	General drawings	164
10.1	Clearance for maintenance and repair	164
10.2	iVario-160 Layout.....	165
10.3	iVario-225 Layout.....	166
10.4	iVario-225-MF Layout	167
10.5	iVario-320 Layout.....	168
10.6	iVario-450/500 Layout.....	169
10.7	iVario-450-MF Layout	170
10.8	iCover IP54	171
10.9	iCover IP21	171
10.10	iVario Controller	172

1 About this document

1.1 Contents in this document

This OEM manual is intended to operators and integrators to work safely with the X-ray modules of the iVario series.

This OEM manual contains all the important instructions for safe operation of the module. The module must be operated in accordance with the statutory regulations for X-ray generators valid in the country of use and with the safety instructions in this manual.



Notice

All instructions in this OEM manual must be strictly adhered to!

1.2 Style conventions and symbols

The symbols used in this OEM manual are intended to help installation technicians and integrators find information more quickly and more easily. These symbols are described below.

1.2.1 Making in the text

- Bulleted lists are marked with a round dot.
- Texts like “XXX” identify cross-references and hyperlinks that refer to linked topics, Internet addresses and additional information.
- Text printed in **bold** identifies highlights or sub-headings.
- *Italicized* text identifies names of menus on operating terminals or in the software.
- Numbering such as 1., 2., 3., etc., identifies action instruction steps (see below).

1.2.2 Action instructions

Action instructions have the following structure:

Heading of the action instruction

- ✓ Requirements that are necessary to implement the action can be optionally named here.
 1. First operating step
 2. Next operating step
 - Partial result after an operating step
 3. Next operating step
- Total result of an action instruction

Example

1. Press HV On (High voltage On)
 - The prewarning light lights up
 - After the prewarning time has elapsed, high voltage is switched on.

1.2.3 Overview of safety instructions

Safety instructions are presented in this document using standardized representation and symbols. Three hazard classes are used corresponding to the probability of occurrence and severity of the consequences:



Serious risk!

This safety instruction warns of an **immediately** hazardous situation which can lead to serious or even fatal injury.



Medium-level risk!

This safety instruction warns of a **possibly** hazardous situation which can lead to serious or even fatal injury.



Minor risk!

This safety instruction warns of a **possibly** hazardous situation which can cause minor to serious injury.



Property damage!

This safety instruction warns about potential damage to property.

In addition to the symbol and the signal word, a safety instruction consists of:

- Type and source of danger
- Consequences
- Avoidance (= measures to avoid the danger)

Example



Electric shock due to high voltage (*type and source of danger*)

Death due to electric shock! (*Consequences*)

- Wait four minutes before working on the connections!
(*Measures*)

1.2.4 Instructions

Important or helpful instructions, information, and tips are structured as follows:



Notice

Application hints and important information is provided under this symbol. These will help you to make the best use of all the functions of your machine/module.

1.2.5 Symbols and definitions used

Warning symbols

A warning symbol is a triangle with a black border and yellow background displaying a symbol.

Symbol	Meaning
	General safety warning
	Warning about a risk from electric shock
	Surface temperature can be hot. Danger of burn hazard.
	Risk of injury from X-ray radiation

Tab. 1: *Warning symbols*

Symbol	Meaning
	This symbol indicates that the module must be completely switched off.
	This symbol indicates the requirement of wearing protective footwear.
	This symbol indicates the requirement of wearing protective gloves.
	This symbol indicates the requirement of wearing protective eyewear.

Tab. 2: *Mandatory action symbols*

Instruction symbols

A mandatory symbol is a blue circle displaying a white symbol.



Notice

General instruction

Tab. 3: *Instruction symbols*

Other symbols used in this manual

Symbols are used in this manual to quickly and effectively provide the integrator with relevant information.

Symbol	Meaning
	This symbol indicates that the manual must be read.

Tab. 4: *Additional symbols*

1.2.6 Definitions used in this manual

If not otherwise specified, power output is given in kW.

1.2.7 Figures

The figures in this manual depict the machine/module in partially simplified or schematic representations.

1.3 Other applicable documents

Please refer also to the manuals for software, T3 protocol description and the individual manuals for coolers and accessories.

1.4 General business terms and conditions

The general business terms and conditions Comet apply as long as no conditions deviating from these have been mutually agreed in writing.

In general, all warranty claims become invalid in cases of unauthorized modifications or repairs to the iVario module or its components, as well as in cases of inappropriate or inadequate maintenance.

Warranty claims are expressly precluded where the claims arise from any of the cases listed below (non-exhaustive list):

- Improper use of the product.
- Incorrect mounting, commissioning, operation, repair or maintenance of the product carried out by unauthorized and/or untrained personnel.
- Use of the product while any safety and protection devices are defective, incorrectly mounted or non-functional.
- Failure to comply with the instructions in this manual regarding transport, storage, mounting, commissioning, operation, repair or maintenance of the product.
- Unauthorized mechanical or electrical modifications to the product.
- Unauthorized modifications to the product (e.g. modifications to the tube housing, modifications to the cooling connections, modifications to the connecting cables).
- Unauthorized modifications to circuit boards (e.g. changing components).
- Inappropriate maintenance or failure to replace wear parts on schedule (e.g. cables, cooling agents or filter pads).
- Insufficient monitoring of wear parts.
- Any unauthorized repairs.
- Cases of force majeure.
- Comet accepts no responsibility for damage that occurs as a result of the use of this product or of the inability to use the product.



Notice

X-ray tubes are vacuum components.

For prolonged storage of the tubes, always observe the instructions in the tube documentation.



Notice

Any modification to the product or the original installation that has not approved by Comet renders the certificate of conformity invalid.

1.5 Contact with Comet AG

If you have any questions about the module, please contact us at the following address or visit our website with the following details:

- Your name and address
- Name of a contact at your company
- Data on the type label: Module type, serial number and year of construction

1.5.1 Main office contacts

Mailing address	Comet AG Industrial X-Ray Herrengasse 10 3175 Flamatt Switzerland
Internet	xray.comet.tech
E-mail	sales.xray.ch@comet.tech
Phone	+41 31 744 90 00

1.6 CE Declaration

The CE Declaration and the Certificate ISO 9001 can be found in the Download Center of the website xray.comet.tech.

2 Product description

The Comet industrial X-ray modules described in the product description are advanced DC X-ray modules designed to meet high standards of ease of operation and quality. Here are some key features and capabilities highlighted in the description:

1. Stability and quality

- The modules deliver high stability, achieved through modern high performance DC converters and generators.
- The use of high operating frequency (70 kHz) for high voltage generation ensures excellent stability over short, medium, and long terms, as well as low ripple.

2. Integrated multi-process controller

- An integrated multi-process controller contributes to excellent operational reliability and performance of the X-ray module.
- Permanent monitoring and highly complex regulation of desired and actual values maintain extremely high stability of X-ray parameters such as high voltage and tube current.

3. Overload protection

- The module is protected against overload by continuously comparing tube operating values against the limit values.

4. User-friendly control

- The iVario module features a menu-based control system that is highly user-friendly.
- System data and error messages are presented in plain text for easy understanding.

5. Flexibility and compact design

- The iVario generation of high voltage generators stands for its flexibility, ease of operation, and compact design.

6. Intelligent control of High Voltage switch-on and shut-down

- The X-ray tube is managed effectively during voltage changes with intelligent control features.
- Specific functions such as warm-up, KV ramp up, KV ramp down, and arc handling are incorporated to handle all different types of X-ray tubes and optimize their behavior.

7. Tube-Specific behavior programming

- The generator is programmed with matching patterns of behavior for different types of tubes, resulting in prolonged service life, shorter cycle times, and excellent availability.

8. Arc handling technology

- Notably, the generator's behavior in the case of arcing in the tube is highlighted. The technology ensures high performance with minimal loss of dose while providing maximum protection to the X-ray module against destruction.

9. Optional protective cover

- The components of the iVario series can be fitted with an optional protective cover to enhance protection against dust and splashing water, raising the protection rating from IP20 to IP54.



Notice

The PC control software (iVario control software) is described in chapter 6 Operation.

In individual cases, special configurations or special control firmware with alternative functions can be made available. These functions and parameters (e.g. selection of possible X-ray tubes or operating parameters) may deviate from descriptions in this manual.

2.1 Main components of the X-ray module

The X-ray modules iXRS-160 to iXRS-500 consist of the following components:



Fig. 1: Main components of iVario series iXRS X-ray module

Item	Designation	Description
1	iVario generator	From iVario-160 to iVario-500
2	iVario control software	See iVario control in chapter 6 Operation
3	High voltage cable	<p>See chapter 0</p> <h4>2.1.1 Mechanical load capacity during operation</h4> <p>The iVario high voltage generator is intended for stationary operation in locations without significant mechanical</p>

Item	Designation	Description
		stress such as shock or vibration.
		High voltage cables
4	X-ray tube	See the X-ray tube operating instructions in the "X-ray tube manual"
5	Cooling unit	See separate documentation



Notice

Following documents and manuals are available on request
 "iVario TCP/IP Communication Protocol documentation"

2.1.2 Module designations and basic functions

Sample configuration (iVario-160/4.5 generator)

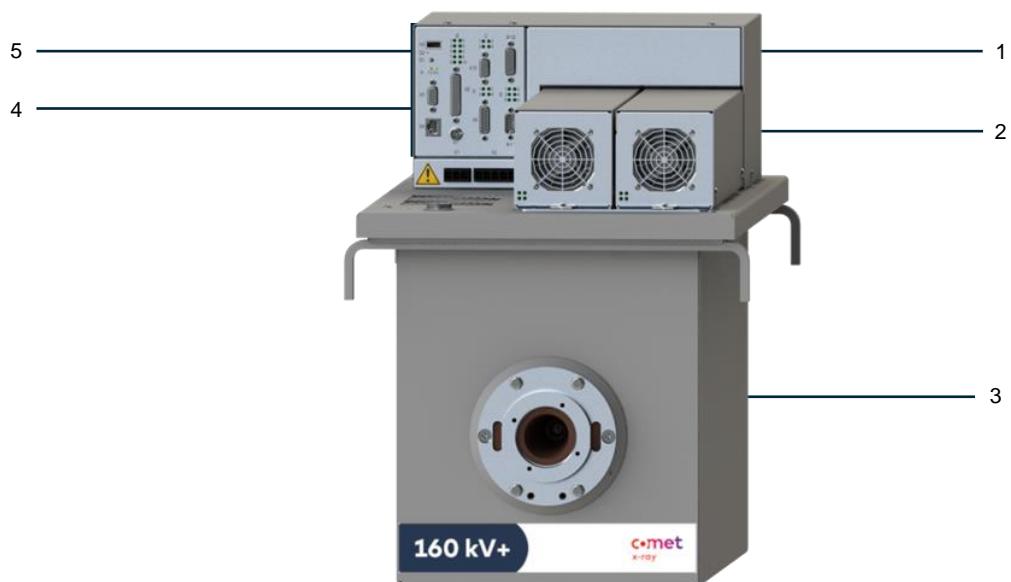


Fig. 2: iVario-160/4.5 generator

Item	Designation	Description
1	iVario backframe	Backframe with power distributor

Item	Designation	Description
2	iVario powercell	Power electronics
3	iVario-T-160K high voltage tank	Oil filled HV part
4	iVario IFC interface controller	Interface connections and monitoring
5	iVario safety interface	Monitoring of safety circuits



Notice

For dual-pole modules, the plus generator (iVario-TxxxA) is used in addition to the minus generator (iVario-TxxxK). In this case, an additional connecting plug is required on the backframe.

2.1.2.1 iVario modules of power unit

The power unit consists of the following components:

iVario IFC

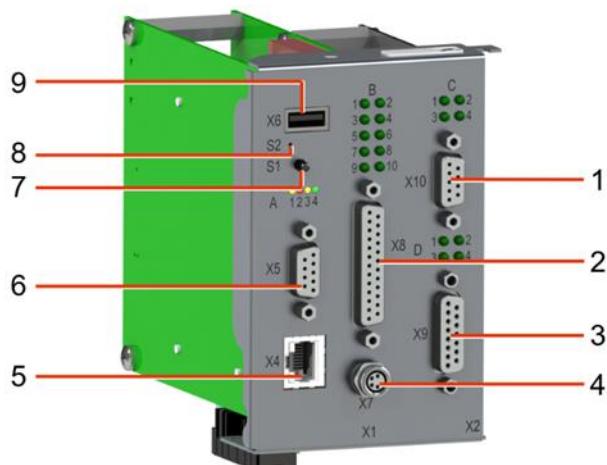


Fig. 3: iVario IFC

Item	Designation	Description
1	X10, D-Sub 9P	24V connection for warning lamps (monitored)

Item	Designation	Description
2	X8, D-Sub 25P	Connections for input/output signals
3	X9, D-Sub 15P	Port for cooling system control
4	X7, M8	Port for future functions (not used so far)
5	X4, RJ45	Ethernet communication interface
6	X5, D-Sub 9P	RS232 communication interface (compatible with XRP, not available for MesoFocus)
7	S1	Push button for log file download or softwareupdates
8	S2	Push button to activate the Rescue System of the software (see "Service Manual")
9	X6, USB	USB interface for USB memory device

iVario safety interface (monitoring purpose only)

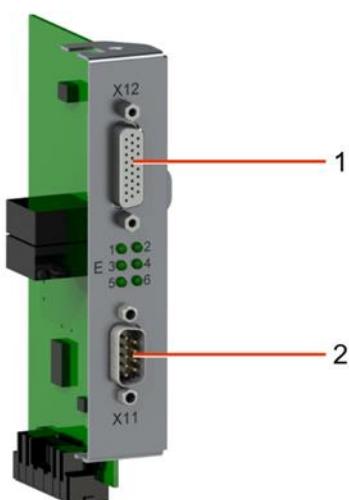


Fig. 4: iVario safety interface

Item	Designation	Description

Item	Designation	Description
1	Port X12, D-Sub 26P	iVario controller and signaling for Emergency stop input signal (not safe, only for monitoring)
2	Port X11, D-Sub 9P	Safety interlock - door switch signaling (not safe, only for monitoring)

iVario powercell (1x = 2.25 kW or 2x = 4.5kW)

Power unit with power output of 2.25 kW. For power output of 4.5 kW, two powercell units are connected in parallel.



Fig. 5: iVario powercell

Backframe

Connecting and mounting module

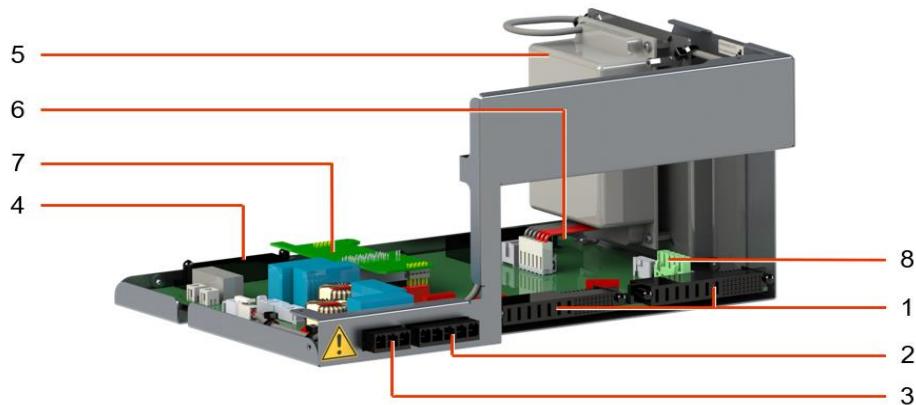


Fig. 6: iVario backframe

Item	Designation	Description
1	Ports for powercells	<p>1 powercell for 2.25 kW* (right port) 2 powercells for 4.5 kW*</p> <p>*Limitations on special models may apply, e.g. iVario-500 is limited to 1.5kW with two powercells</p>
2	X2 port	230 VAC power for power circuit

Item	Designation	Description
3	X1 port	230 VAC power for control circuit
4	Uni-bipolar port	For P-Bipolar-Con connection
5	Power supply	Auxiliary DC power (24V-12V-5V)
6	X3 port	For IP54 Fan
7	P-Config PCB	Connector for configuration “Unipolar 2.25kW/Bipolar” or “Unipolar 4.5kW”
8	P-Fil-Bridge or P-ECU-Supply	P-Fil-Bridge for iVario generators P-ECU-Supply for MesoFocus generators

2.1.2.2 iVario control software

iVario control software for Microsoft Windows PC operating systems



Fig. 7: iVario control software

2.1.3 Possible combinations of the HV components

2.1.3.1 Tube table with system assignment (unipolar)

X-ray module	High voltage generator	Tube series
iXRS-160	iVario-160/2.25 iVario-160/4.5	MXR-160 series
iXRS-225	iVario-225/2.25 iVario-225/4.5	MXR-225 series
iXRS-225 MF	iVario-225/0.5-MF	MXR-225MF series

Tab. 5: Tube table with system assignment (unipolar)

2.1.3.2 Tube table with system assignment (bipolar)

X-ray module	High voltage generator	Tube series
iXRS-320	iVario-320/4.5	MXR-320 series
iXRS-450	iVario-450/4.5	MXR-450 series
iXRS-450 MF	iVario-450/1.0-MF	MXC-450MF series
iXRS-500	iVario-500/1.5	MXR-500 series

Tab. 6: Tube table with system assignment (bipolar)

2.1.4 Type label

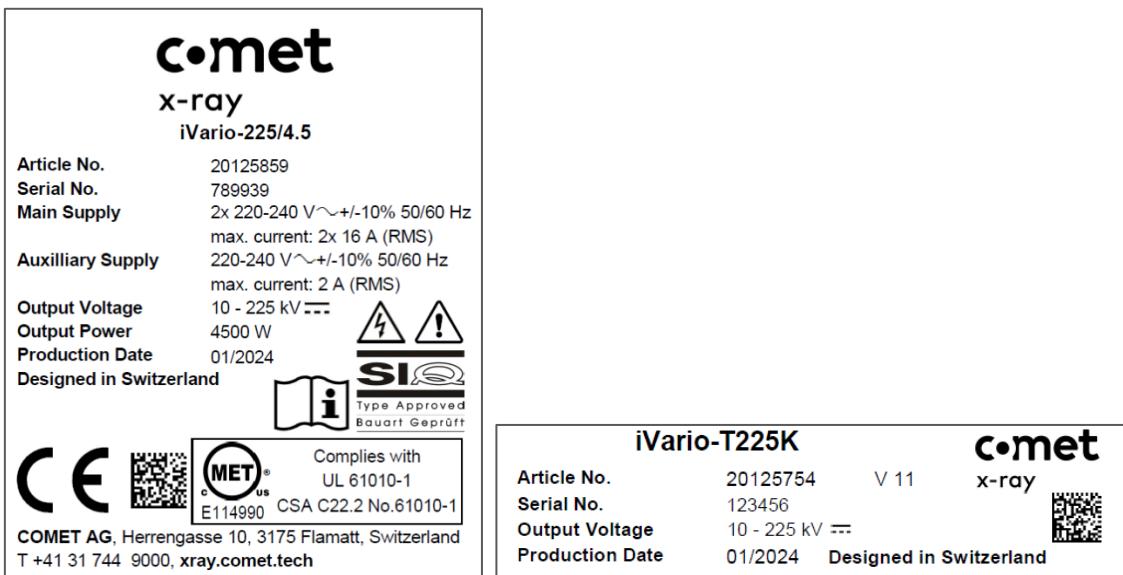
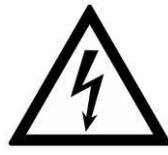


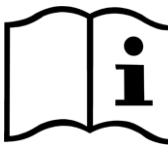
Fig. 8: Type plate (f.e. iVario-225/4.5)



This is a safety symbol. This symbol is used to warn of potential hazards. To prevent serious or even fatal injury, strictly adhere to all safety instructions highlighted with this symbol.



Warning symbol relating to electric shock.



Before operating the device, read the manual.

2.2 Use of iVario module

2.2.1 Conditions of use

The X-ray modules of the iVario series must be used exclusively for material testing and material radiation purposes. The X-ray modules are developed and designed exclusively for industrial use.

The internal control system monitors, controls and regulates all functions required for safe operation of the entire module.

Proper use also includes:

- Compliance with all instructions in this OEM manual and with the applicable statutory safety rules and regulations.
- Performance of all prescribed inspection and maintenance tasks.

2.2.2 Improper use

The iVario must only be used for industrial X-ray applications. Any other use is prohibited, unless approved in writing by the device manufacturer. Always observe the technical specifications and ambient conditions that apply to the iVario. Comply with the statutory radiation protection regulations and install all necessary safety devices. Improper use might cause injury or damage to property. Improper use includes for example:

- Unauthorized modifications to the device components.
- Unauthorized modifications to the radiation protection equipment.
- Non-compliance with relevant radiation protection regulations.
- Operation of the device outside the specified limits (high voltage, emission current, heating current, temperature, etc.).
- Insufficient cooling of X-ray tube.



Warning

Risk arising from improper use

Improper use occurs if parts are installed or attached that are not specified by Comet or have been not authorized for use in conjunction with the device. Such improper use can result in serious or even fatal injury.

2.2.3 Foreseeable misuse

The following misuse is not permitted:

- Taking X-rays of inspection parts whose specifications do not comply with the owner data.
- Any other use other than the proposed intended use.

2.3 Module components and technical data

2.3.1 Mains supply

For detailed information about the connection options of the mains supply, see chapter 4.8 Connection to power supply: iVario generator X1/X2.

Over voltage category: Category II

Auxiliary AC input

Mains voltage	220 – 240 VAC ±10 %
Protective earth resistance (inside the generator)	Max. 0.1 Ω
Mains frequency	50/60 Hz
Max. mains current	2 A _{eff}
Mains cable	Min. 3 x 1,5 mm ² or AWG15, 90 °C; 300 VAC

Tab. 7: Mains input – auxiliary AC input

Mains AC input – iVario-xxx/2.25 (2250W) and iVario-225 MesoFocus

Mains voltage	220 – 240 VAC $\pm 10\%$
Protective earth resistance	Max. 0.1 Ω
Mains frequency	50/60 Hz
Max. mains current	16 A_{eff}
Mains cable	Min. 3 x 2,5 mm ² or AWG13, 90 °C; 300 VAC

Tab. 8: *Mains AC input – iVario generator with 2.25 kW*

Mains AC input – iVario-xxx/4.5 (4500 W), iVario-450 MesoFocus and iVario-500/1.5

Mains voltage	220 – 240 VAC $\pm 10\%$
Protective earth resistance	Max. 0.1 Ω
Mains frequency	50/60 Hz
Max. mains current	2 x 16 A_{eff}
Mains cable	Min. 5 x 2,5 mm ² or AWG13, 90 °C; 300 VAC

Tab. 9: *Mains AC input – iVario generator with 4.5 kW*

**Warning****AC input voltage shall stay stable between 198 VAC and 264 VAC**

Input voltage between lines, line and neutral, line/neutral and earth shall always stay within the input voltage range. Be aware of the earthing system. For instance, IT earthing systems with floating earth or floating neutral are not suitable to supply the iVario generator.

Large load changes on the AC supply network can lead to voltage fluctuations and dips. If such events are outside the tolerances of the declared EMC standards, they can lead to destruction of the powercells. In such cases we recommend the installation of a suitable power conditioner in front of the iVario mains input.

**Notice**

The minimum cross-section of the additional earth conductor must be 10 mm², whereby copper conductors are the preferred option. The earth conductor must be as short as possible and must be connected to the main earthing system of the building. For details, see chapter 4.5 Establishing earth connections.

2.3.2 High voltage

Module	Operating range (kV)
iVario-160	7.5 – 160
iVario-225	10 – 225
iVario-320	15 – 320
iVario-450	20 – 450
iVario-500	20 – 500

Setup	Input through iVario control software or operating interface
Measuring inaccuracy	±1 % of rated voltage
Reproducibility at constant temperature	0.01 % of rated voltage
Long-term deviation (8 h after 1 h warm-up)	Max 0.1 % of rated voltage

Tab. 10: High voltage

2.3.3 Tube current

Module	Operating range (mA)
iVario-160/2.25	0 – 22.5
iVario-160/4.5	0 – 45
iVario-225/2.25	0 – 15
iVario-225/4.5	0 – 30
iVario-225/0.5-MF	0 – 5
iVario-320/4.5	0 – 22.5
iVario-450/4.5	0 – 15
iVario-450/1.0-MF	0 – 5
iVario-500/1.5	0 – 15

Setup	Input through iVario control software, iVario controller or directly through operating interface
Measuring inaccuracy	0.2 % of rated current
Reproducibility at constant temperature	2 µA
Long-term deviation (8 h after 1 h warm-up)	Max. 0.1 % of rated current

Tab. 11: *Tube current*

2.3.4 Timer for exposure time

Setup	Input through iVario control software, iVario controller or directly through operating interface
Time input	In increments of 1 s (hours, minutes, seconds)

Tab. 12: *Timer*

2.3.5 Dimensions and weights of the generator

Module	Width x height x length (mm)	Weight (kg)
iVario-160/2.25	374 x 499 x 640	84
iVario-160/4.5		87
iVario-225/2.25	498 x 529 x 658	126
iVario-225/4.5		129
iVario-225/0.5-MF	578 x 579 x 709	172
iVario-320/4.5 (bipolar)	374 x 911 x 640	164

Module	Width x height x length (mm)	Weight (kg)
iVario-450/4.5 (bipolar)	498 x 971 x 658	252
iVario-450/1.0-MF (bipolar)	578 x 1021 x 709	292
iVario-500/1.5 (bipolar)	498 x 971 x 658	252

Tab. 13: Dimensions and weights of the generator



Notice

For drawings of the generator, see chapter 10 General drawings.
The specifications for iVario-320 and iVario-450 apply to stacked units.

2.3.6 Admissible ambient conditions for iVario generators

	During operation	During transport and storage
Temperature	0°C – +40° C	-25°C – + 70° C
Relative humidity	Max. 90 %, non-condensing at 40° C	Max. 95 %, non-condensing at 40° C
Pollution degree	2 according to IEC/EN 61010-1, not conductive	2 according to IEC/EN 61010-1, not conductive
Air pressure	<p>700 – 1100 hPa Max. altitude 3000 m</p> <ul style="list-style-type: none"> • Up to 1000 m: Rated power (kV and mA) • Between 1000 m and 2000 m: <ul style="list-style-type: none"> ◦ Rated power (kV and mA) at ambient temperature < 30° C ◦ 90 % of rated voltage (kV) and rated power at ambient temperature > 30° C • Between 2000 m and 3000 m: <ul style="list-style-type: none"> ◦ 90 % of rated voltage (kV) and rated power at ambient temperature < 30° C ◦ 85 % of rated voltage (kV) and rated power at ambient temperature > 30° C 	600 – 1100 hPa

Tab. 14: Admissible ambient conditions

IP protection ratings

iVario power unit	IP20 (with optional protective cover IP21 or IP54)
iVario HV tank	IP54

Tab. 15: IP protection classes

Information for iVario generators running in environment with humidity and dust

Humidity and dust must be kept within the limits of pollution degree 2 according to IEC/EN 61010-1: no condensation and non-conductive dust.

In an environment with high humidity and dust, Comet strongly recommends the use of the IP54 cover.

In extreme conditions, i.e. in pollution degree 3 environments where conductive dust is present, additional precautions should be taken. Installing the iVario generator in an air-conditioned cabinet or bringing clean air to the cooling inlet of the generator may give good results in these installations. Pollution level 3 conditions may exist, for example, in foundries and other harsh industrial environments.

2.3.7 Mechanical load capacity

Tests completed	During transport and storage (in original packaging)
Vibrations	Parameters according to EN IEC 60721-3-2:2018 class 2M4: <ul style="list-style-type: none">• Executed on 3 axes• 5 ÷ 20 Hz: spectral acceleration 1 (m/s²) 2/Hz• 50 ÷ 2000 Hz: spectral acceleration 0.5 (m/s²) 2/Hz• RMS value of acceleration: 3.242 g• Duration of the test: 1 hour per axis
Rolling/Pitching	Norm EN 60068-2-31:2008 Parameters according to EN IEC 60721-3-2:2018 class 2M5 and 2M6
Shocks	Norm EN 60068-2-27:2009 Parameters according to EN IEC 60721-3-2:2018 class 2M4: <ul style="list-style-type: none">• 18 shocks in 3 axes with acceleration of 100 m/s², 11 ms• 18 shocks in 3 axes with acceleration of 300 m/s², 6 ms

Tab. 16: Mechanical load capacity

2.3.8 Mechanical load capacity during operation

The iVario high voltage generator is intended for stationary operation in locations without significant mechanical stress such as shock or vibration.

2.3.9 High voltage cables



Notice

High voltage cables must not exceed the lengths shown below for their maximum recommended voltage.

Standard cable length	Max. operating voltage in kV				
	iXRS-160	iXRS-225	iXRS-320	iXRS-450	iXRS-500
5 m	160	225	320	450	500
10 m	160	225	320	450	-
15 m	160	225	320	450	-
20 m	160	220	320	440	-
25 m	160	210	320	420	-
30 m	160	200	320	400	-
35 m	160	200	320	400	-

Tab. 17: Max. operating voltage in kV

Cables with spring-loaded plugs are superior to standard cables for all applications. On the one hand, cables with spring-loaded plugs show no bulging and thus have a longer service life. On the other, the spring keeps the contact pressure constant for a long period of time. In addition, the contact pressure is at all times detectable thanks to the specially designed flanges, which makes maintenance and installation easier.

2.3.10 High voltage plug types

Generator type	Generator side	Tube side
iVario-160/320	R24	R24
iVario-225/450/500	R28	R24 unipolar R28 bipolar

Tab. 18: High voltage plug types

2.3.11 Cooling unit

For detailed information regarding the cooling unit, refer to the separate operating instructions.



Attention

Risk of damage due to insufficient cooling

The maximum permissible operating temperatures of the individual components might vary, depending on their use within the overall system. When devising the cooling, always take into account the overall system. The feed and return temperatures depend on the pipe size, the ambient temperature, and the cooling performance of the cooling unit. The specified limits for the individual components must not be exceeded under any circumstances.

2.3.12 System requirements for iVario control software

The iVario control software runs on Windows operating system. The PC hardware and the operating system must satisfy the following minimum requirements for the iVario control software to be used:

- Windows 7 or 10/11, 64-bit
- 8 GB RAM
- 100 MB of available hard disk space
- 1024 × 768 pixel resolution (16-bit color depth required)
- Ethernet TCP/IP

The installation of the iVario control software is described in chapter 5 Commissioning, and its operation is described in detail in chapter 6 Operation.

2.4 Scope of delivery of iVario and iXRS

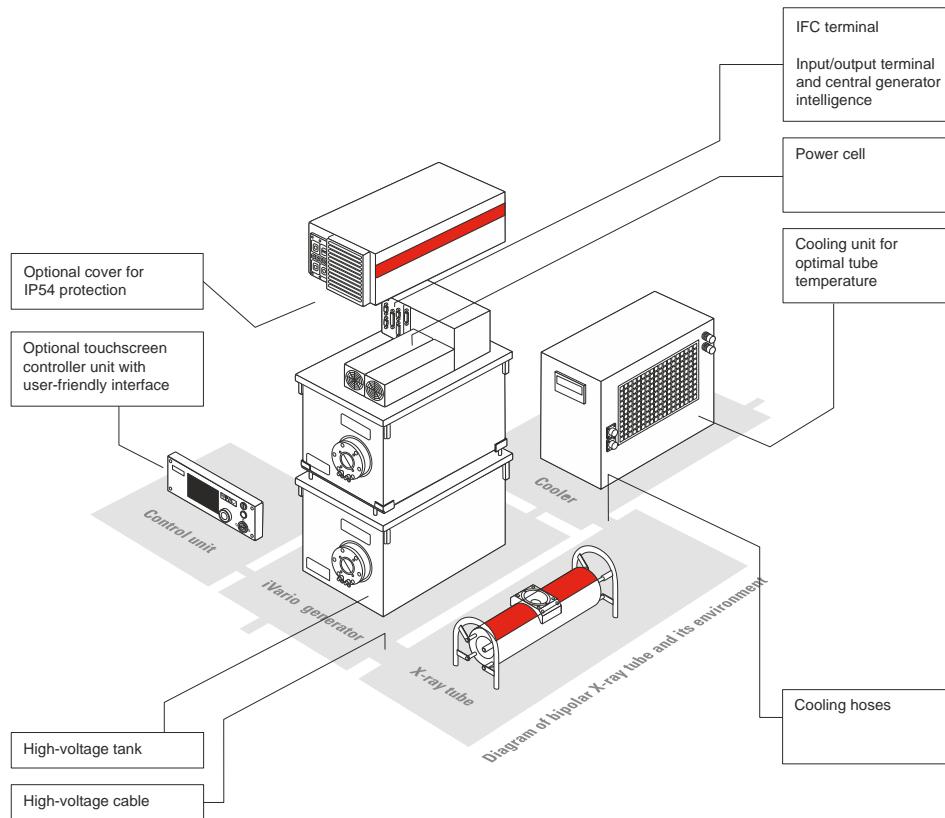


Fig. 9: Example of installation of iXRS

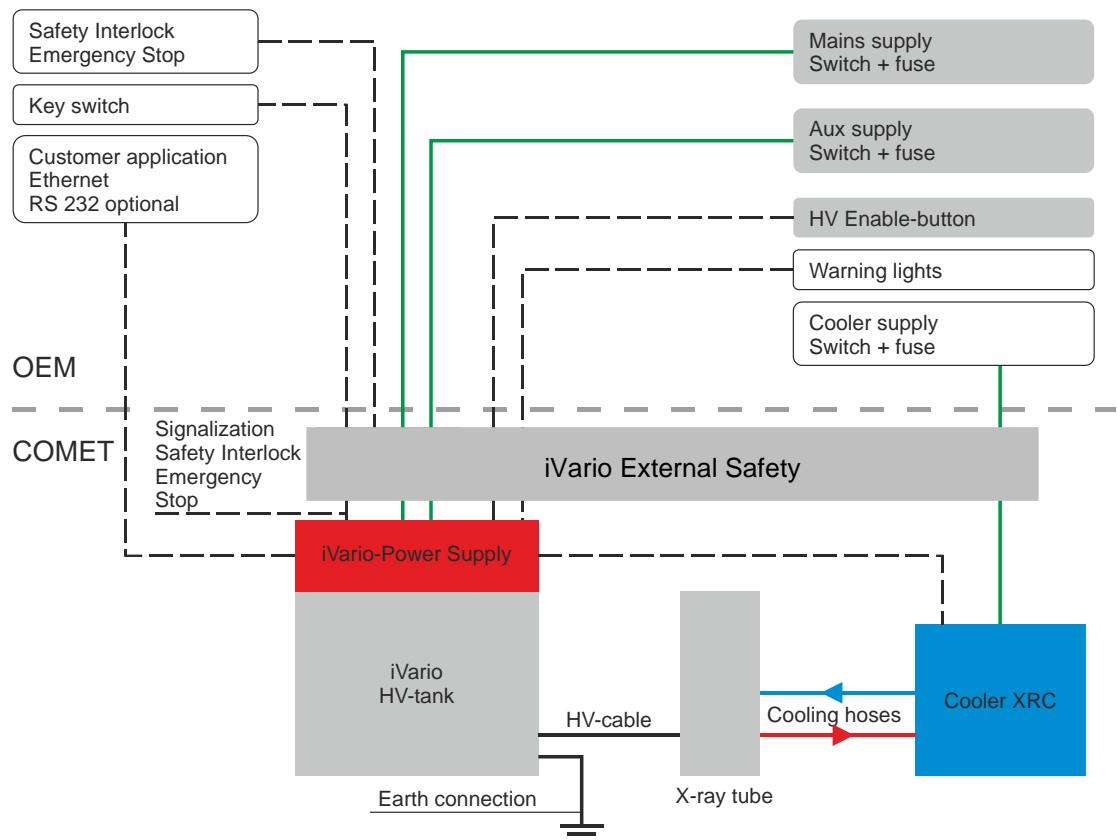
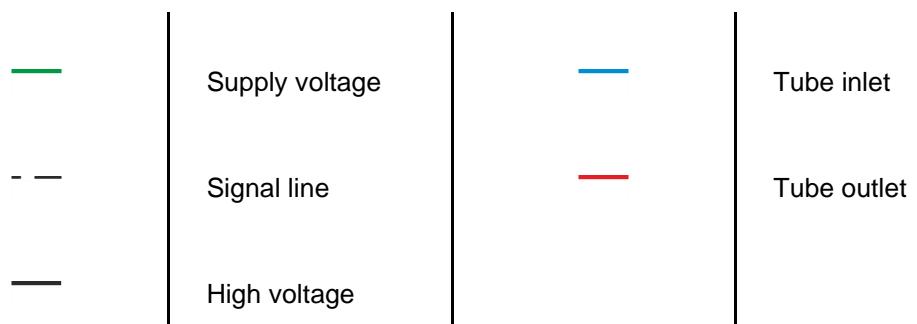


Fig. 10: Example of installation with iVario External Safety



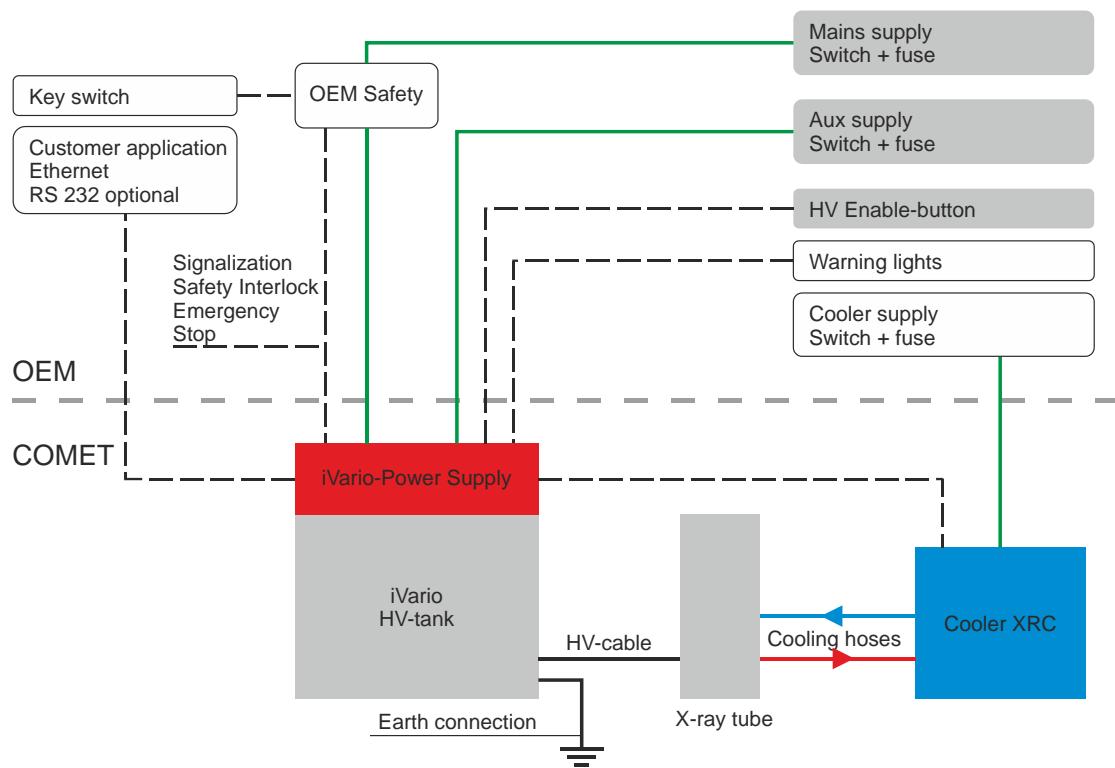
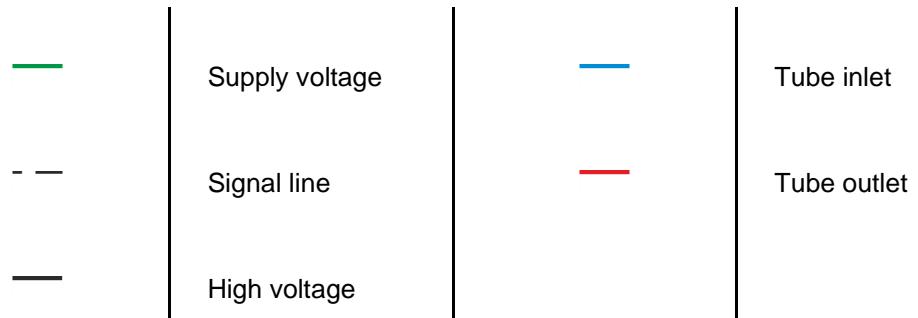


Fig. 11: Example of installation without iVario External Safety



Connecting cables and accessories included in scope of delivery:

- Plugs for mains and auxiliary power
- X9, X11 and X12 connection plugs
- Cable relief
- Documentation: OEM Manual

Included in iVario starter kit (optional):

- X8: Sub D 25-P cable for input/output signals, 9 m, and Sub D converter module for terminal block
- X10: Sub D 9-P cable for warning lights, 9 m, and Sub-D converter module for terminal block
- X11: Dummy plug - safety interlock D Sub 9-P
- X12: Dummy plug – D Sub 26-P emergency stop
- 10 mm² earthing cable, 10 m
- Ethernet cable, 10 m
- USB 3.0 Gigabit Ethernet Adapter
- 1 warning light, red, 24 V

Additional equipment included in scope of delivery of iXRS X-ray source:

- X-ray tube
- High voltage cable
- XRC cooler
- Cooler control cable and cooler power cable
- Cooling hoses
- 10 mm² earthing cable, same length as HV cable

To be supplied by customer:

- Door switch, emergency stop and safety equipment for safe disconnection from the mains power. The safety devices must achieve the following safety integrity level: category 3 or 4, performance level PL=d or PL=e according to EN ISO 13489-1. The optional iVario External Safety is a safety device that can be ordered separately.
- Ethernet cable (optional RS232 cable)
- Mains switch and fuse for mains and auxiliary power
- Power cable, min. 3 x 1.5 mm² or AWG15 for auxiliary power
Power cable, min. 3 or 5 x 2.5 mm² or AWG13 for mains power
- Earthing cable 10 mm²
- Mains switch and fuse for cooler
- Warning lights, warning device
- HV Enable button for HV generator; can be deactivated in software configuration
- HV Off button (optional)
- Key switch for the activation of the system and for operator identification

2.5 Optional components

The optional assemblies allow for the use of add-on functions of the iVario module.

The assemblies can be used individually or in conjunction with each other for the operation of the iVario module.

Material No.	Component	Description
20109784	iVario External Safety	Is required for the safe disconnection from the main power supply by means of an Emergency stop device, a safety switch or a door switch.
20083888	iVario Controller	Can be used for controlling the iVario module. In this case, there is no need for a separate control PC. <i>Tab. 19: The iVario controller includes an HV On/Off and key switch. The iVario controller is also available with an Emergency stop switch. For a detailed description, see chapter Tab. 20: Optional components iVario controller.</i>
20114073	iCover IP54	Required for compliance with the IP54 protection rating.
20133589	iCover IP21	Cover with IP21 protection rating.
20129504 20129506 20129507 20129508 20129509 20129510	iVario Cooler Interface 5m iVario Cooler Interface 10m iVario Cooler Interface 15m iVario Cooler Interface 20m iVario Cooler Interface 25m iVario Cooler Interface 30m	This box allows for the connection to existing, older XRC-3001 and XRC-4501 coolers to the iVario generator, using 12-pin Cannon plugs.
20129892	iVario Starter Kit	Contains all plugs and accessories necessary for initial installation.
20103777 20091327 20103778 20103779 20103780 20091329	iVario Cable Kit 5m iVario Cable Kit 10m iVario Cable Kit 15m iVario Cable Kit 20m iVario Cable Kit 25m iVario Cable Kit 30m	3 x 1.5 mm ² cable, with Aux plug 5 x 2.5 mm ² cable, with Mains plug Ground cable

Tab. 20: Optional components

2.5.1 iVario controller

The iVario controller is an operating module with a touch screen. It is used for the activation and control of the iVario generator. Any other PC is not required in the case when iVario controller is used (see chapter 6 Operation).

The iVario controller comes with an integrated key switch to activate/deactivate the Stop button *close* and *open* signals and to switch on and switch off the cooler. **Switching on and switching off the mains power supply is only possible if the system is equipped with the optional iVario External Safety device.** The iVario controller is also available with an optional Emergency stop button that shall be connected to the optional iVario External Safety to cut safely the mains power supply.

The iVario controller features the following built-in warning lights:



Warning (blue or red)



Radiation on (yellow or red)



Safety circuit closed and cooler parameters OK (green)

The warning lights on the X10 can also be used.

The On and Off buttons are used for switching high voltage on and off. The control dial allows for navigation in the iVario control software on the touch panel.



Fig. 12: iVario controller

Item	Designation	Function
1	Control panel	19" front panel with four screw holes
2	On button	Button to switch on X-ray source
3	Off button	Button to switch off X-ray source
4	Key switch	Removable in positions 0 (Off) and 1 (Standby) In combination with iVario External Safety: <ul style="list-style-type: none">• Mains is off in position 0 and 1• Aux is off in position 0 (optional)
5	Control dial	For adjustment of parameter settings (kV, mA, exposure time) and navigation in control software
6	Emergency stop button (optional, not shown)	Emergency stop through shutdown of Mains power supply. Must be installed in combination with iVario External Safety.
7	Touch panel PC	PC with operating software (touch screen for visualization and input)

Protection class of iVario controller

Front plate	IP54
Back cover	IP20

Tab. 21: Protection class of iVario controller

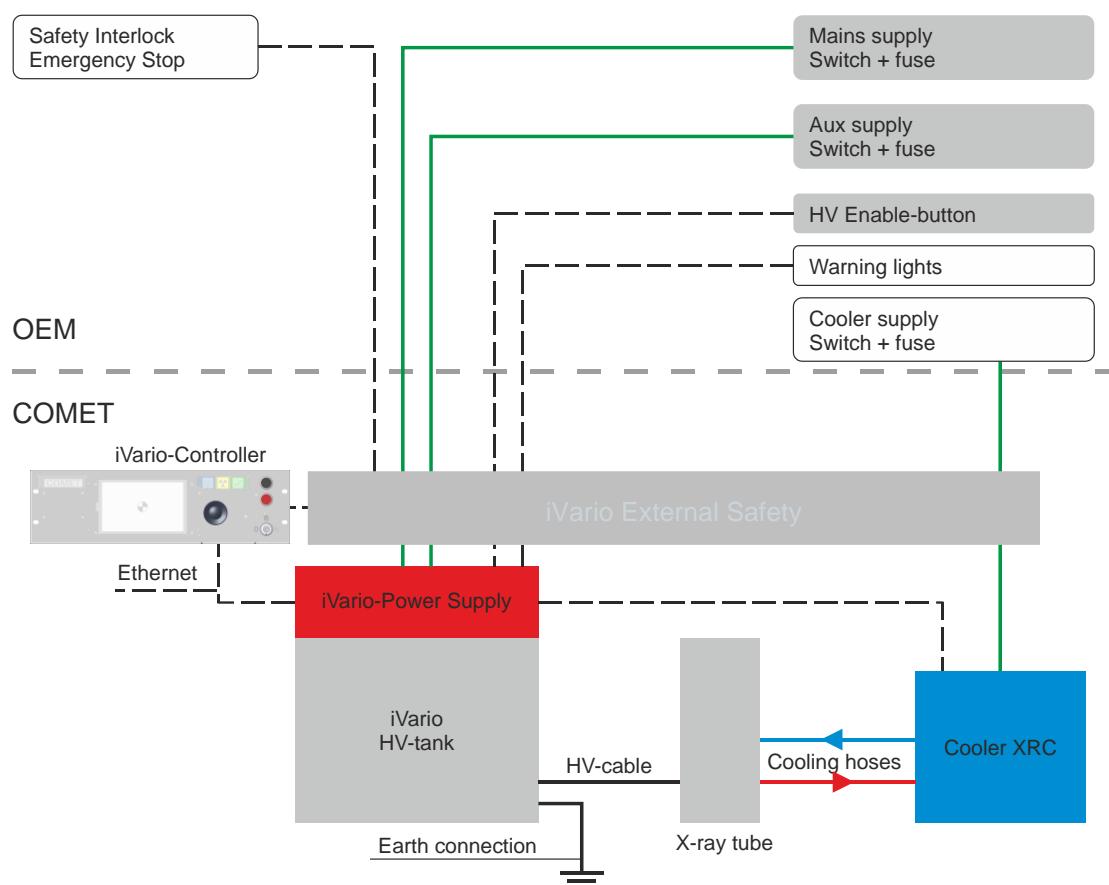
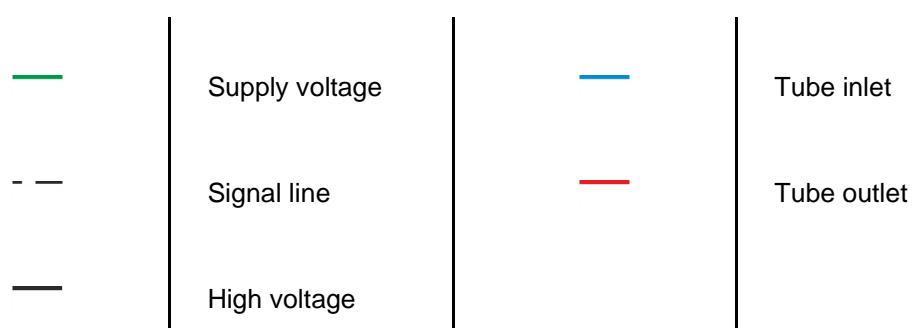


Fig. 13: Installation diagram with iVario Controller



2.5.2 iVario cooler interface

With this interface, older type of coolers can be connected to the iVario module and operated through the interface. The cooler is controlled by the generator.

Material numbers can be found in the table in chapter 2.5 Optional components.

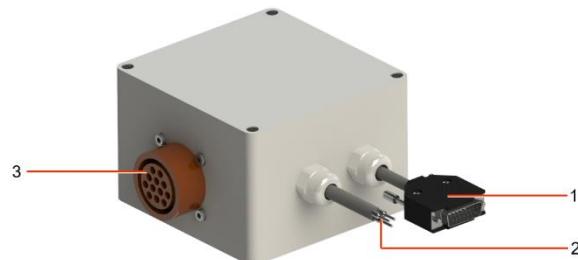


Fig. 14: Connections of iVario cooler interface

Item	Designation	Function
1	Connecting cable with X9 plug, for direct connection to IFC on generator	Monitoring of temperature and flow, switch-on signal for cooler. This cable is always 5 m long.
2	Mains cable	230 VAC (L, N, PE) for cooler power supply. The mains cable is available in different lengths. The length can be selected.
3	12-pin type XRP socket	For connection of an old XRC cooler

2.5.3 iVario cover (option for IP54)

A cover over the power unit is required in order to comply with the IP54 protection rating.



Fig. 15: IP54 Cover on iVario generator

2.6 Functional safety: Choosing safety components

The functional safety components do not form part of the generator and must be provided and installed by the integrator/system installer. In the X-ray module, the protection of personnel from X-ray radiation or risks associated with high voltage is ensured by means of the following devices/functions:

Interlock door safety switch

Dual-channel interlock safety switch or door switch connected to a safety relay, or a safety disconnect device.

If one of the safety door switches is open, the mains power supply must be interrupted so that the X-ray source is safely shut-down. X-ray radiation cannot be switched on again, if an interlock or door switch is open.

The interlock door safety switch and the safety disconnect device are external components and must satisfy the minimum requirements specified in chapter 2.6.1 Limitation of the safety function of the X-ray module.

Emergency stop

Manually triggered emergency stop switch connected to a safety relay or a safety disconnect device outside the generator. The switch itself and the safety disconnect device are external components and must satisfy the minimum requirements specified in chapter 2.6.1 Limitation of the safety function of the X-ray module.

2.6.1 Limitation of the safety function of the X-ray module

The iVario generator series do not integrate safety functions. These must be designed and implemented by the system integrator.

According to EN ISO 13849-1, X-ray devices must be made safe to performance level PL_d or PL_e.



Risk resulting from unsuitable safety components

The interlock door safety switch, the emergency stop switch, the safety relay and the disconnect contactors are external components of the safety system.

- It is the responsibility of the system integrator to select and integrate the safety system components in such a way that the system as a whole achieves the safety integrity and performance level required for the X-ray module.

The minimum requirements for external safety devices are shown in the figure below.

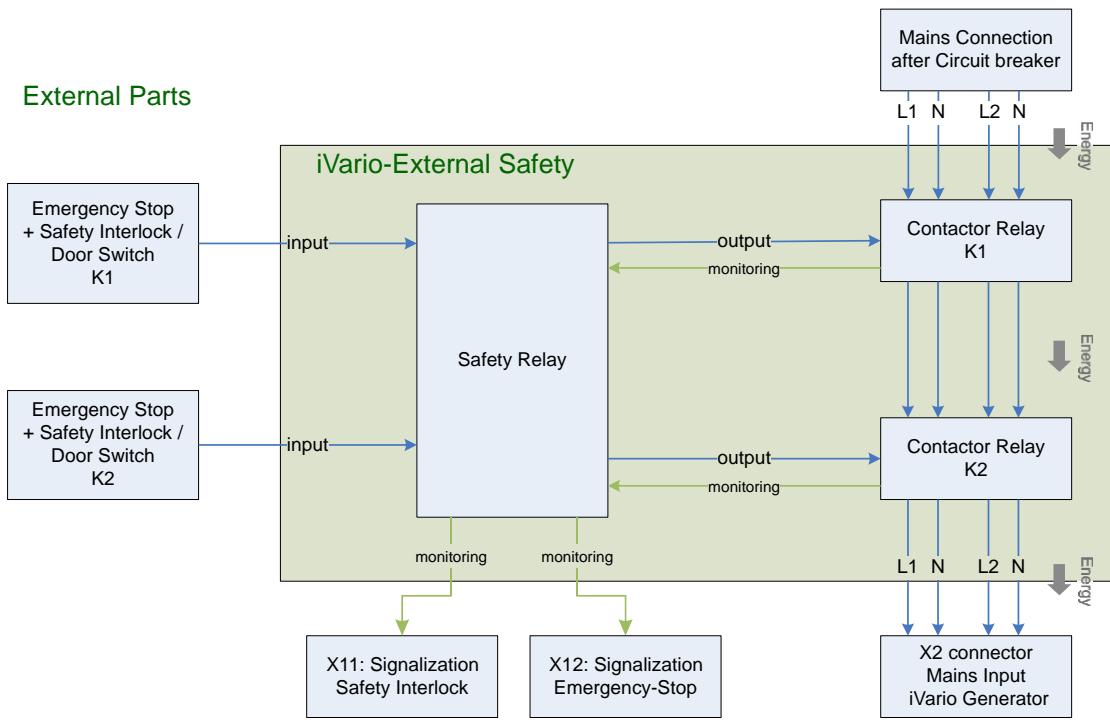


Fig. 16: iVario Optional External Safety

2.6.2 iVario External Safety: Optional external safety disconnect device

An external safety device is available as option. The function of this safety device is to safely disconnect the mains power supply as soon as a safety door switch is opened, or an emergency stop is activated.

The external safety device contains two contactors in series for disconnection from the mains supply. It is installed between the mains supply, after the circuit breakers, and the mains input on the generator. The external safety switches (door switches) and the emergency stop(s) are connected to the dual-channel inputs of the safety device.

They ensure that the power supply (and thus the X-ray source) is immediately shut-down when a radiation-shielded door is opened and also make sure that the system cannot be inadvertently started.

The iVario External Safety device achieves the highest safety level category 4 and performance level PL_e according to EN ISO 13849-1.

The key switch of the iVario controller or an external key switch from the OEM integrator switches the mains power on only when the key switch is in position 2.

It is also possible to configure the external safety device to disconnect the auxiliary power supply when the key switch is in position 0.

See the "iVario External Safety user manual" for detailed information.

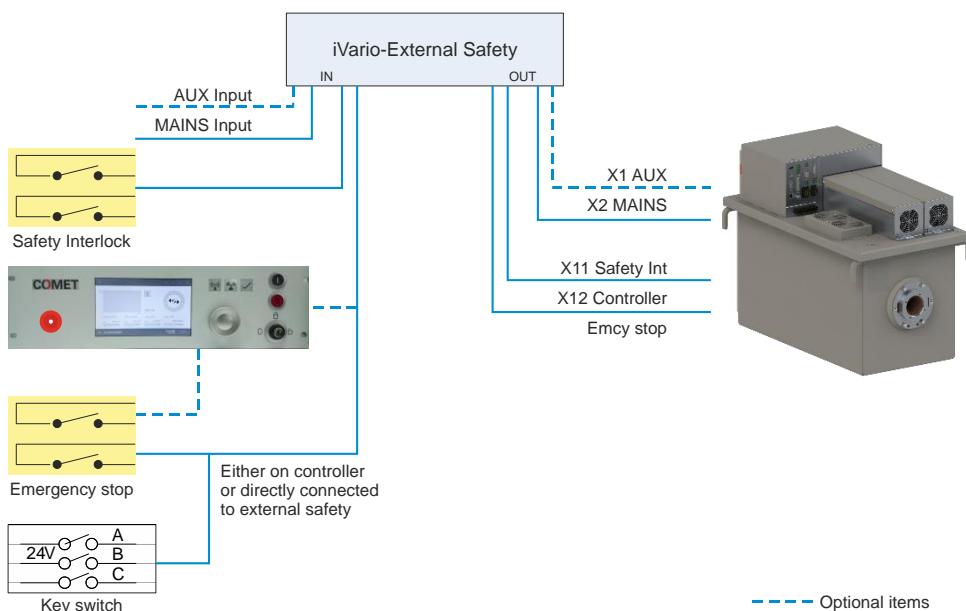


Fig. 17: iVario Optional External Safety

2.6.3 Safe switch-off time and constructive requirements

The high voltage power supply and X-ray radiation are placed in a safe state as soon as mains is switched off.

The module is safe within 50 to 150 ms after switching mains off.



Risk of injury from X-ray radiation!

The system integrator must ensure that, when opening the door of the X-ray module the operator is not exposed to dangerous X-ray radiation during the shut-down time of the machine.

- The necessary constructive measures or door locks must be foreseen.



Risk of damage to equipment resulting from switching off the X-ray generator with a safety monitoring switch or by cutting mains off!

The mains input, the door switches and the emergency stop switch must not be used as routine switch-off, as repeated fast disconnection from the mains power supply significantly shortens the lifetime of the X-ray tube.

3 Safety

The prerequisite for the safe handling and trouble-free operation of the module is knowledge of the fundamental safety instructions and safety regulations.

Special information is especially highlighted by symbols in the corresponding chapters of this OEM manual.

The module is tagged with instructions and/or symbols at hazardous points.

3.1 Safety symbols



Risk of injury from high voltage and electric shock!

This symbol marks connection points or other parts where voltage of 1000 V or more might be present.



Risk of injury from exposure to X-ray radiation!

This symbol is used when there is danger of X-radiation.



Hazard point warning!

This symbol indicates that the module must be completely switched off and secured again inadvertent start-up prior to any maintenance or repair work.



Risk of injury from hot surface!

This symbol warns of hot surfaces.

See also

1.2 Style conventions and symbols

3.2 Organizational measures

- The required personal protective equipment must be provided by the operator.
- All existing safety devices are to be checked at regular intervals.
- When communicating in writing in connection with this X-ray module, always quote the type and model number. This information can be found on the type plates of the individual components.

3.3 Safety impairments

In cases where safe operation can no longer be guaranteed, the module has to be shut-down and secured against inadvertent operation.



Danger due to technical and missing safety equipment!

It is prohibited to operate X-ray tubes or modules if they are in any way defective. Radiation protection components and safety devices must not be removed or modified.

- The responsible customer service department must be notified immediately.

3.4 Requirements for fitters, operators and service personnel



Danger of injury resulting from lack of specialized knowledge!

Inadequate knowledge about the systems and safety regulations endangers the health of everybody involved.

- The X-ray modules of the iVario series must only be installed, operated and dismantled by qualified, trained and properly instructed personnel.
- Prior to commissioning the module, read this manual.
- Instruction in operating the system must be confirmed in writing.
- All calibration, maintenance and repair tasks must be performed by qualified personnel who are aware of the hazards and risks involved.
- During work on the module, a second person must be deployed whose responsibility it is to ensure that nobody can be put at risk or injured by the machine.
- To ensure safe and correct operation of the module, operating and service personnel must observe the generally applicable safety regulations and the safety instructions in this OEM manual.
- After installation, maintenance or repair work, the configuration of the X-ray modules must be inspected by an authorized person. The maximum permissible high voltage, emission current and power must be suitable for the connected X-ray tube and the overall system.
- Radiation protection must be checked and monitored by authorized personnel after any maintenance and repair work.
- Before carrying out any cleaning work, shut-down the generator and secure it against inadvertent restart. Clean the generator with a moist cloth or with alcohol. The use of other cleaning agents is prohibited.
- Never clean the generator with a wet cloth.

3.5 Electrical safety

The generators of the iVario series meet the requirements of the European Low Voltage Directive. The generators have been designed and tested in compliance with IEC/EN 61010-1. Always adhere to the requirements laid down in EN 60204-1 "Safety of machinery – Electrical equipment of machines" and the applicable statutory rules and regulations.



Risk of electric shock!

If the safety guards and/or the cover and/or the Powercell(s) are removed, there is a risk of electric shock. Before carrying out any maintenance or repair work or unplug any Powercell(s), shut-down the module and secure it against inadvertent restart. It is necessary to wait at least **60 seconds** after the power is switched off.

Earth conductors

X-ray modules must be protected by additional earth conductors which, in accordance with national regulations, must be installed on all components. The earth conductor connections must always be in perfect condition. All earth conductor connections between individual components must be connected at the connection points marked "PE" and the building ground before operating voltage of the module is switched on.



This symbol marks the connection points for the additional earth conductors.



Risk of fatal injury from high voltage!

Before a high voltage cable is disconnected from the X-ray tube it is necessary to wait at least **15 seconds** after the high voltage power is switched off. The high voltage cable must then be discharged by bringing it into contact with the earth conductor.

- Only specialist maintenance technicians are authorized to remove module covers or to disconnect the high voltage cable from the X-ray tube and the high voltage generator.
- The electrical contacts and the cone of the high voltage cable must not be touched.

3.6 Transport and installation

Transport the machine in the original Comet packaging. The packaging is not designed for stacking. Observe the position markers on the packaging.

After unpacking, transport the machine by using all four lashing points at the HV tank. The transport gear (crane or industrial truck) and the lifting tackle must be suitable for the weight of the machine.



Warning

Risk of injury from suspended loads

- Suspended load that are suddenly lowered or dropped pose a risk to life and limb.
- Do not stand under suspended loads!
- After unpacking, transport the machine by using the four lashing points at the HV tank.
- Wear protective gloves and safety footwear.



Caution

Slip risk on escaped cooling water or oil

Take up escaped cooling water or oil without delay to prevent slipping. Identify the cause of the leakage and eliminate it without delay.
If the machine is defective, return it to the manufacturer for repair or replacement.



Notice

To transport the generator, we recommend wearing protective gloves and safety footwear.

3.7 Occupational safety



Notice

The operator is responsible for seeing to it that the module and is operated in accordance with all legal requirements.
It is prohibited to operate modules having technical defects.
It is also prohibited to bypass safety equipment or to remove or modify them.

3.8 Safety datasheets and Material Compliance



Notice

All instructions in the related Safety Data Sheets are to be considered.

The safety datasheets are available upon request or can be found in the Download Center of the website xray.comet.tech.

Always check if other country specific or local safety datasheets are available and consider applicable statutory regulations.

Article 33(1) DECLARATION OF REACH COMPLIANCE

Information related to the REACH regulation (Regulation (EC) No. 1907/2006) in accordance with Article 33(1) of the REACH regulation are available upon request or can be found in the Download Center of the website xray.comet.tech.

3.9 Electromagnetic compatibility

The generators of the iVario series meet the requirements of the Directives and EMC standards specified in the Declaration of Conformity.

When operated and maintained properly, this electronic device meets the statutory EMC regulations for industrial applications (class A, group 1) defining the emission levels for electronic devices and their shielding against electrical fields.

Class A devices are suitable for operation at any location, except residential areas. Such devices must not be connected to a power supply network that supplies a domestic environment.

Group 1 devices are designed for use in industrial, scientific and medical environments. If operated properly, they do not generate any high-frequency radiation.

It is however not possible to completely prevent interference by frequencies from high-frequency transmitters, e.g. mobile phones or similar appliances, which themselves meet EMC provisions, which can disturb the trouble-free functioning of this machine, if they are used in its immediate vicinity. The operation of the machine outside an industrial environment might result in conducted or radiated electromagnetic interference. Operation of this module in the immediate vicinity of electronic appliances with high transmission power should be avoided in order to prevent any high-frequency interference.

Compliance with the relevant EMC regulations must be assessed separately for each application.



Risk of injury from electromagnetic radiation

The machine is not designed for operation in residential areas and does not provide adequate protection for radio signals in such environments.

3.9.1 Notes

Electronic devices that satisfy the relevant EMC provisions are manufactured in such a way that, under normal conditions, there is no risk of high-frequency interference. It is however not possible to completely prevent interference by devices with high transmission power, e.g. mobile phones or similar appliances.

Under the most unfavorable circumstances, there might be some residual risks to machine operators.

For this reason, the operation of appliances with high frequency (HF) radiation near the machine should be avoided.

3.10 Radiation protection



Notice

Radiation protection is the responsibility of the operator/integrator. The statements that follow are to be regarded as recommendations. Observe all applicable statutory regulations and safety requirements.



Danger

Risk of injury from exposure to X-ray radiation in connection with improper use of machine!

When the high voltage power is switched on, the module generates X-rays that can cause damage to health if not used as intended.

- The module must only be operated by qualified technical staff. The ON switch and the control software are designed and constructed in such a way that inadvertent switching on of the module is nearly impossible.
- The system operator is responsible for compliance with all statutory regulations during installation and operation of the module.
- Never operate the module if it is defective. Never bypass, bridge, remove or modify safety devices.
- The radiation protection must be checked and monitored by authorized personnel. It must be checked again after every maintenance and servicing measure.
- Additional radiation protection is always required for the safe operation of the X-ray module.
- When reducing the maximum high voltage, combined with a simultaneous reduction of the radiation protection to the reduced value, it is the responsibility of the integrator to implement additional protective measures. As this is beyond the control of Comet, any liability in this case is excluded.



Danger

Risk of injury from exposure to X-ray radiation in connection with insufficient safety protection!

The generators of the iVario series **do not** provide safe connections for safety and protective devices for radiation protection. The safety and protective devices must be correctly installed and configured **by the integrator**. The safety and protective devices must comply with the country regulations of the final country of destination. Among others, the following regulations may be affected:

Germany: X-ray Ordinance (StrlSchV, former RöV) and DIN 54113 (Non-destructive testing – radiation protection rules for the technical application of X-ray equipment up to 1 MV); **France:** NFC 74-100 (Radiology equipment - X-ray equipment - construction and tests – requirements); **USA:** “21CFR §1020.40 Cabinet x-ray systems” of the FDA (Food and Drug Administration) **Switzerland:** X-ray Ordinance; or other applicable national regulations.

- The radiation protection of the X-ray tube is assessed by the manufacturer in accordance to the German X-ray Ordinance (StrlSchV, former RöV and DIN 54113).

-
- Additional radiation protection is always required to ensure safe operation of the X-ray module!



Danger

Risk of injury from exposure to X-ray radiation in connection with unsuitable switch-on conditions!

All components for switching on module X-ray radiation (e.g. a specially constructed external control unit, external push buttons or an external PC) should be installed outside the control cabinet and/or outside the radiation-shielded room. It is strictly prohibited to make it possible that the X-ray radiation can be switched on from inside the radiation-shielded room or cabinet. We strongly recommend installing mechanisms that prevent operating the X-ray tube when the door of the radiation-shielded room or cabinet is open.

A floating contact for such a locking mechanism is available. A connected door interlock magnet is only released after the post-heating time (radiation protection) has elapsed.



Danger

Risk of injury from exposure to X-ray radiation in connection with electric discharge!

The high voltage generator of the X-ray module is equipped with capacitors.

After high voltage has been switched off, these capacitors and the high voltage cable might retain an electric charge. During the post-heating phase, this electric charge is discharged through the tube and the measuring resistor. During this phase, the X-ray warning light remains lit. Normally, this phase is very short (0.2 - 0.3 s) so that it is not discernible.

In exceptional cases, for instance if the system is switched off when the filament is cold (i.e. no tube current before switching off the system), the post-heating phase may last up to 15 s.

During the post-heating phase, all warning lights stay lit and the interlock contacts remain active.



Danger

Risk of injury from exposure to X-ray radiation in connection with faulty radiation protection!

Insufficient cooling of the X-ray tube can cause the lead housing to melt, so that radiation protection is no longer guaranteed. Therefore:

- Use only the coolant specified by Comet for the X-ray tube and ensure that the minimum flow rate is maintained at all times.
- Adhere to the specified post cooling time (cooler delay) after switch-off of the high voltage.
- Operating the X-ray tube without adequate radiation protection (e.g. when lead housing has melted) is strictly forbidden.
- If an X-ray tube has been operated with no or insufficient cooling, the radiation exposure test must be repeated prior to restarting the machine.
- Regularly check and test the coolant, the flow regulation elements and the safety switches and replace them, if necessary. Observe the respective maintenance instructions.
- After a system stop for safety reasons, identify the cause of the problem and eliminate before restarting the machine.

3.11 Safety and warning devices



Risk of injury due to faulty or missing safety or warning devices

In order to prevent any risk of injury from X-ray radiation and/or electricity, the integrator or operator must ensure that the required safety and warning equipment conforms to the applicable standards and the statutory radiation exposure limits and general safety regulations.

Radiation protection components and safety devices must not be removed or modified.

In order to comply with the applicable radiation protection legislation, the operator must ensure that the required safety equipment is connected to the X-ray module and to the whole system. The electrical equipment of the system must conform to the requirements of EN 60204-1 "Safety of machinery – Electrical equipment of machines". The generators of the iVario series meet the requirements of IEC/EN 61010-1.

The safety interlocks/door switches of the X-ray system must meet the safety requirements laid down in EN ISO 13849-1. The X-ray system must be equipped with an Emergency stop switch that conforms to EN ISO 13850. The door switches and the Emergency stop switch must be connected to an external safety system. A safety relay can assume the safety function. In this case, both output channels of the safety relay must be connected for signaling purposes to the dual-channel safety interlock of the generator.

In order to guarantee that only authorized personnel can operate the X-ray module, a key switch or similar identification device conforming to the relevant statutory regulations must be integrated into the iVario generator power supply line.

The following safety and warning devices can be connected to the external safety system and/or the interface of the iVario generator:

- A contact for an external HV Enable push button, which must be integrated in such a way that remote control via software is possible. The push button can be connected to the external safety system to release the mains supply, or to the iVario IFC to send an enable signal to the iVario firmware.
- Two floating door contacts (safety interlock), which operate independently of each other and are monitored for simultaneous opening or closing.
- These contacts must be connected to the inputs of an external safety device so that a minimum safety performance level of PL_d, category 3 is achieved for the machine.
- For the feedback signals from the door contacts (safety interlock) to the iVario generator, auxiliary contacts must be connected to the iVario safety interface inputs. These inputs do not serve any safety function but are used for signalization only.
- A door guard lock magnet on one of the floating outputs with HV On function.
- Inputs for the monitoring of the door guard lock by the iVario firmware.
- External 24 V warning lights whose power supply is monitored by the iVario firmware.
- Prewarn outputs for prewarning (e.g. horn or lamp).
- A CDRH switch that can be connected outside the cabin (in accordance with 21CFR §1020.40).

3.12 Modification of components

- Design modifications, extensions or alterations to components are only permissible with the prior written consent of Comet.
- Defective parts must be replaced without delay.
- Use only original spare parts.

4 Mounting



All work in connection with installation and commissioning must be performed by suitable qualified personnel!

All work in connection with installation and commissioning of the module must be performed by suitably qualified and experienced technicians who are familiar with iVario generators.

- Observe all applicable safety regulations

4.1 Basic conditions

Installation

If the generators are set up in the radiation room or the radiation cabinet, the distance between the X-ray tube and the generator must be at least 1.5 m. The generator must not be positioned in the beam path of the tube.

All connecting lines, and especially the high voltage cable, must be laid in such a way that they cannot be damaged, e.g. by forklift trucks driving over them.

For the installation of the high voltage cable, observe the permissible static and dynamic bending radii. The high voltage cable must be equipped with adequate strain-relief devices. Ensure that the high voltage connections at the generator and at the X-ray tube are free of strain.

For more information, see 4.3 Installation site and infrastructure.

Safety equipment

In order to comply with applicable radiation protection laws, state regulations and regulations at the module installation site, the operator must ensure that the required safety equipment is present and has been connected to the X-ray module. The mains supply of the module must conform to the requirements of EN 60204-1 "Safety of machinery – Electrical equipment of machines" or all equivalent national standards and regulations. The generators of the iVario series meet the requirements of IEC/EN 61010-1.

The safety circuits of the X-ray module must be designed in accordance with the 2006/42/EC Machinery Directive of the European Union, so that the safety-related components of the system comply with category 3 or 4 and the PL_d or PL_e performance levels of the EN ISO 13849-1 international standard. This safety equipment must be externally mounted. The optional iVario External Safety device is available from Comet.

Door switches and Emergency stop switch

The door switches built into the X-ray system must meet the safety requirements laid down in EN ISO 13849-1. The X-ray system must be equipped with an Emergency stop switch that conforms to EN ISO 13850. The door switches and the Emergency stop switch must be connected to an external safety system. A safety relay can assume the safety function. In this case, both output channels of the safety relay must be connected for signalization purposes to the safety interface of the generator.

In order to guarantee that only authorized personnel can operate the X-ray module, a key switch or similar identification device conforming to the relevant statutory regulations must be integrated into the iVario generator power supply line.

Scope of installation

The generator and the iXRS module are pre-assembled and tested at the factory.

The installation of the iXRS module is thus limited to the setup and connection of the components. The instructions starting at chapter 4.5 Establishing earth connections must be strictly adhered to.

4.2 Notes on radiation protection

The X-ray module must be installed at the designated site in compliance with the applicable statutory radiation protection regulations. These prescribe for example the installation of warning lights, door contacts, Emergency stop switches, use of specific warning light colors, etc.

One key requirement is the design and construction of an adequate radiation protection structure, which is usually made of lead, lead glass, concrete or barite concrete.

Prior to commissioning of the X-ray module, the radiation protection structure must be approved and certified by relevant authorities.



Notice

We strongly recommend constantly measuring the radiation dose outside the radiation protection structure when the X-ray module is first switched on.

4.3 Installation site and infrastructure

The installation site must satisfy the following requirements before installation:

- The installation surface for the machine components must be level and of sufficient supporting strength.
- The module components must be installed at least 0.2 m away from walls.
- For maintenance work, a clearance of 0.5 m around and above module components should be maintained.
- We recommend installing the system on a floor or other surface with good thermal conductivity to improve heat transfer.
- For optimized cooling and trouble-free operation of the module, ensure an adequate airflow around the unit, whereby the air temperature must be within the prescribed range.
- Do not place any of the system components on an edge, gutter or similar floor structure.
- The iVario generator is designed exclusively for operation in rooms protected from weather conditions. Operation or storage in aggressive or humid environments, or outdoors can lead to corrosion for which Comet accepts no liability.
- The iVario generator is not approved for operation in potentially explosive atmospheres.
- For details, see the installation drawings and layouts in chapter 10 General drawings.

4.4 Overview of connections



Risk of injury from high voltage

In the case of incomplete or incorrect installation, powered cables might be exposed. This can pose a risk of serious or even fatal injury to persons who come into contact with them.

- The mains supply cable must not be connected to the system until all installation work has been completed.
- Before switching on the module, read the entire chapter 4 Mounting. Ensure that all radiation protection requirements are met.

4.4.1 Connections of the iVario generators to the HV tank

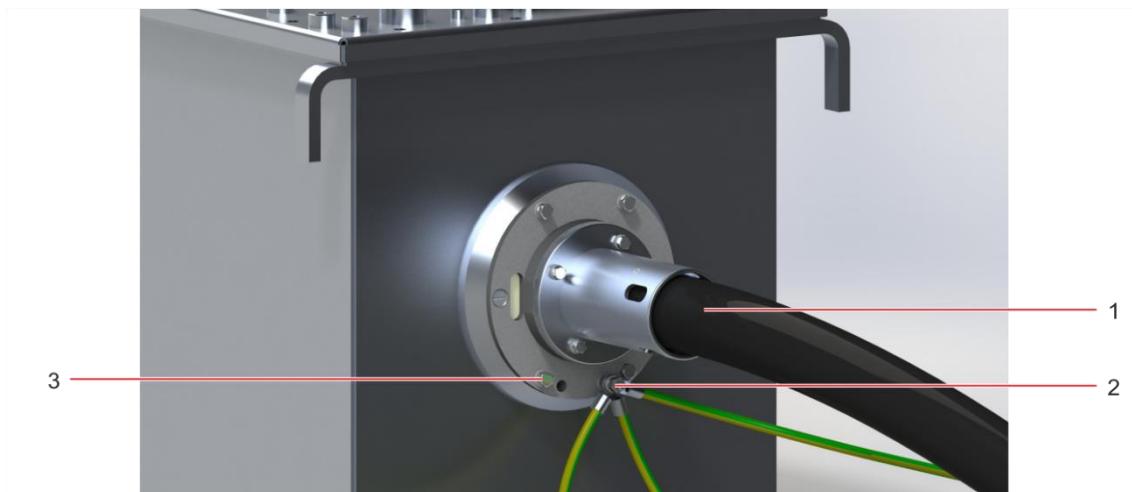


Fig. 18: Connections at HV tank

1	High voltage connection <ul style="list-style-type: none">• R24 for 160/320 kV• R28 for 225/450/500 kV	
2	M6 earthing bolt (central earthing point) for building ground, x-ray tube and anode tank	
3	M6 earthing bolt	

4.4.2 Connections to the cooler

For further information see the separate cooler operating instructions.

4.4.3 Connections to the tube

For information on the X-ray tube connections, see "X-ray tube manual".

The earth connection of the X-ray tube is located on the flange or directly on the tube.

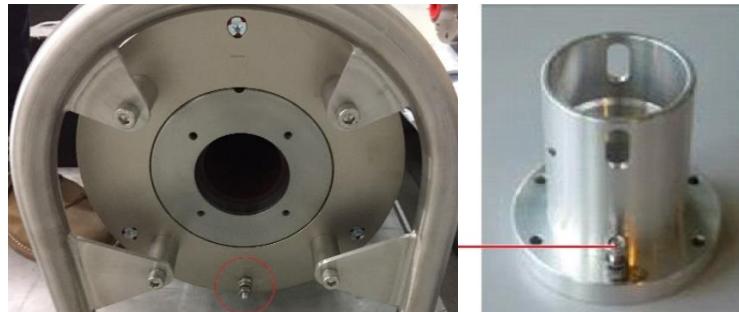


Fig. 19: Earth connection at X-ray tube/flange

4.5 Establishing earth connections



Attention



Danger

Property damage of the generator

Poor or incorrect earth conductors are dangerous and can lead to the destruction of the module.

- Earthing cables must not be rolled up or laid out in loops to avoid increased inductance.
- To keep the earth resistance low, the cables should be laid as short as possible.
- The module must be earthed in accordance with EN 60204-1 and conform to the statutory regulations for high voltage systems.
- On the operator's side, it must be ensured that the building's ground and its supply cord have a corresponding conductor cross-section of at least 16 mm², including the appropriate size of cable shoes.

The earthing bolt services as the central earthing point of the iVario tank (-). The second earthing bolt is provided for the earthing cable of the X-ray tube.



Notice

The module must remain connected from the building ground to the central earthing point even if the mains power plug is disconnected.



Notice

In order to minimize earthing resistance, the cable that is laid should be as short as possible; the required minimum cable diameter of 10 mm² must be maintained all the way to the central earthing point of the building.

1. Establish the following chassis or earth connections (for details, see 4.4.1 Connections of the iVario generators to the HV tank)
2. From the iVario tank to the central earthing point of the building
From the X-ray tube to the iVario tank
3. From the iVario cathode tank to the anode tank (in bipolar setup)

4.6 Installation of the X-ray tube

For information on tube installation, see Operating instructions X-ray tube (document number 50005593) and follow the instructions in the relevant tube documentation.

4.6.1 Distance of the X-ray tube from other components

The X-ray tube must be positioned in such a way that direct radiation **does not** strike other components of the X-ray module such as the generators, the controller, the external safety device or any other electronic components (with the exception of the radiation detector).



Notice

Comet generally recommends a safe distance of 1.5 m from the high voltage generators if no other shielding measures have been carried out.

4.6.2 High voltage cable

For operating Comet X-ray tubes, Comet offers various configurations of high voltage cables (with straight and angled ends), which have been optimized for different system requirements.



Notice

Providing space for maintenance and repair work

For stationary systems, care must be taken that prescribed maintenance work on the high voltage connections can be carried out. The space needed for removing the high voltage cable should be kept empty.



Notice

The bending radii of the high voltage cable must not be less than the prescribed minimum values. This is especially important for inspection systems in which the X-ray tubes are moved frequently. For more information, see the high voltage cable operating instructions.

4.7 Installing the cooler

Depending on the system configuration, one of the following cooling systems is supplied with the machine:

- Water cooler for unipolar X-ray tubes
- Oil cooler for bipolar X-ray tubes
- Tap water cooling (with flow monitor) for unipolar X-ray tubes

To be observed for all cooling units

The electrical connection is established by means of a three-wire mains cable. The safety switches are connected to the generator by means of a 15-pin special plug-type connector. This ensures that the coolant temperature and the flow rate are monitored separately, while the monitoring devices are powered through a separate power supply output.



Notice

When connecting the hoses, observe the direction of flow of the coolant.

The direction of flow is indicated by symbols on both the cooling unit and on the X-ray tube. Color markers indicate the connecting points for the water hoses (blue: feed tube; red: return tube).

Cooling units with air cooling are to be installed upright and with sufficient clearance in order to ensure adequate air circulation (minimum clearance in front of venting grille: 0.5 m). Prior to and after switching on the module for the first time, repeatedly check the coolant level and top up, if required.

Water-air coolers contain anti-freeze so that the equipment is protected against freezing down to a temperature of -25°C.

For the correct anti-freeze concentration, see documentation of the cooler.

Oil coolers must be operated with Shell Diala S4 ZX-I transformer oil. This product can be purchased from Comet. Prior to commissioning the oil coolers, replace the transport plug at the filler neck with the supplied ventilated service plug.



Attention

Property damage due to insufficient cooling capacity

Insufficient cooling can result in damage to the X-ray tube from overheating.

- The factory-set limit flow and coolant temperature values must not be altered!
- Regularly service the cooler and inspect the flow monitors.



Notice

For detailed instructions, see separate cooler manual.

4.7.1 Cooler unit connection to X9

The connection for the cooler is located on the front panel of the IFC:

1. Connect the cable to the X-ray generator to port X9.
2. Secure the cable with the strain-relief clamp: bottom row, position two (from left).
3. Connect the cable for the power supply to an external 230 V power supply.

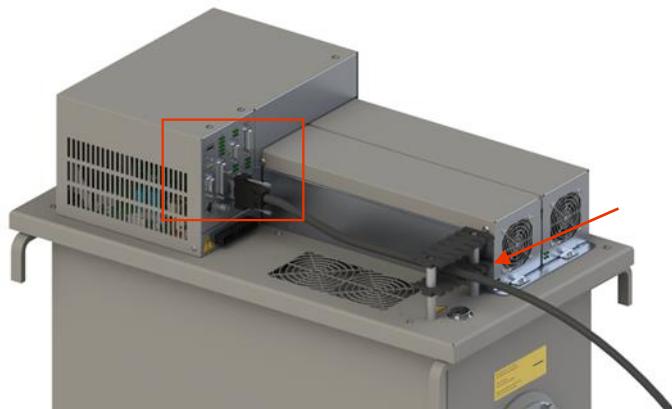


Fig. 20: Connecting the cooler at X9

4.7.2 Connection diagram of cooler

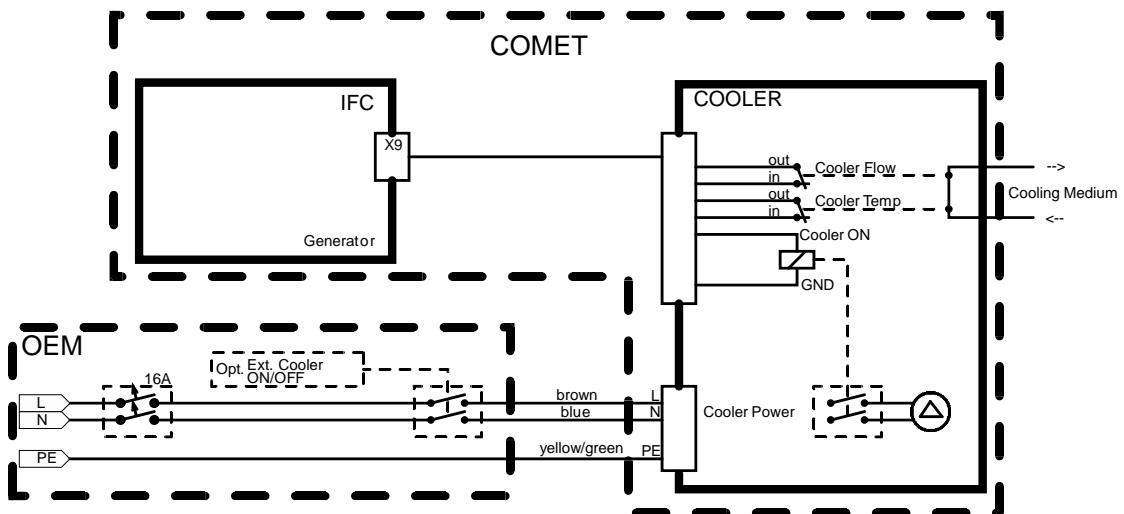


Fig. 21: Connection diagram of cooler

4.7.3 Internal circuit configuration cooling agent temperature and flow rate X9

The internal circuit configuration of flow control and temperature monitoring of the cooler is shown in the following diagrams:

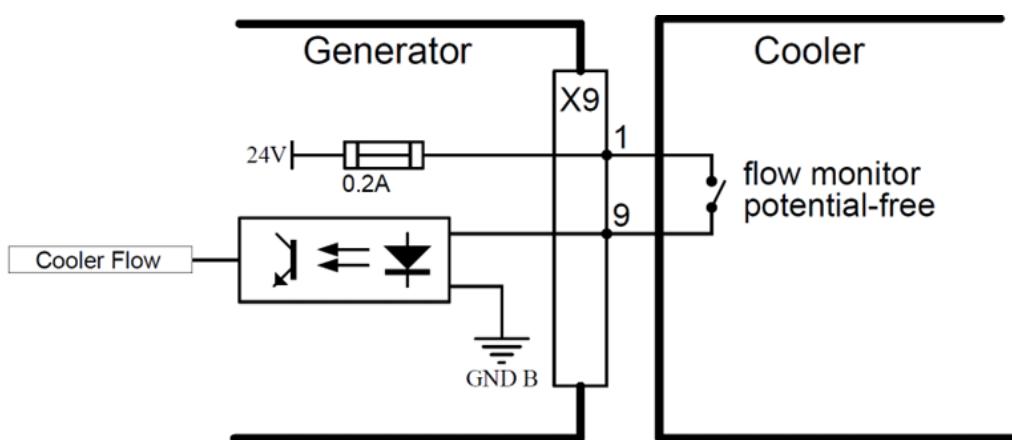


Fig. 22: Internal circuit configuration – coolant temperature X9

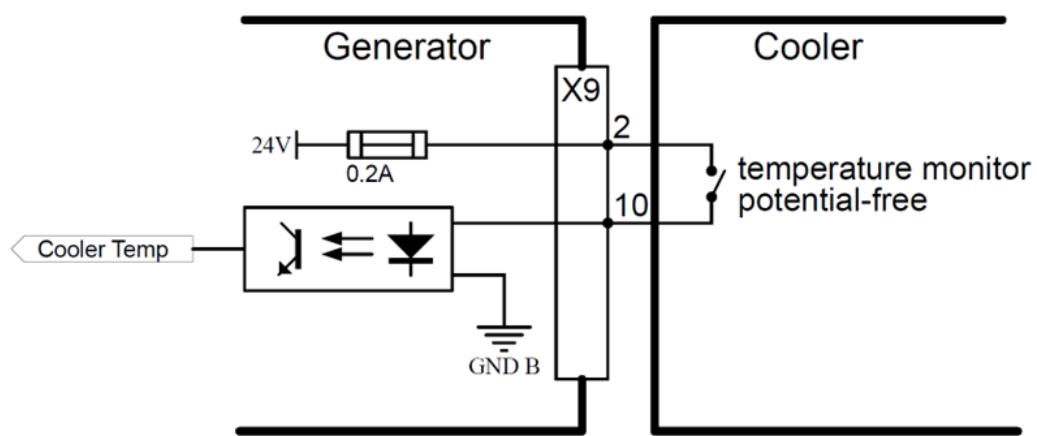


Fig. 23: Internal circuit configuration – flow rate X9

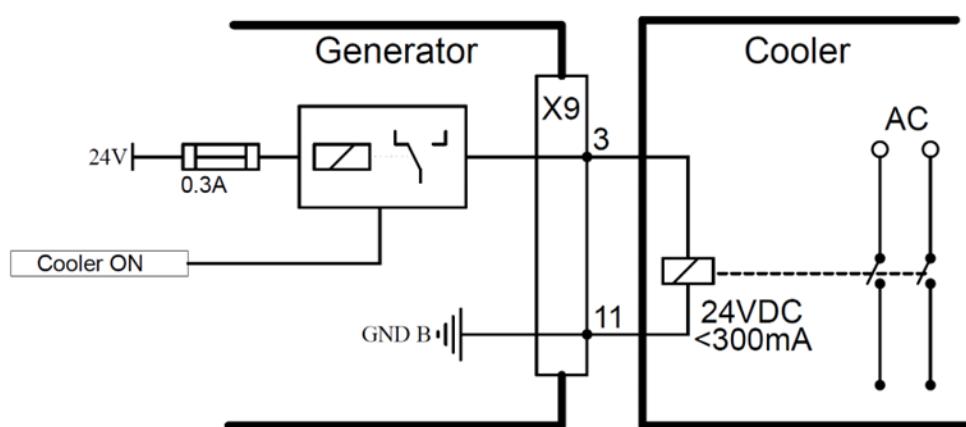


Fig. 24: Internal circuit configuration – power supply output of cooler X9 for switching on/off and cooler delay control

4.7.4 Post-cooling time

To operate the cooler for the time period required for cooling down the tube after the X-ray system has been switched off, install a cooler delay control device.

There are two different configurations:

1. Use of Comet cooler

With cooler-ON function: The post-cooling time is automatically controlled by the IFC.

Cooler delay control is not necessary, as the delay period is automatically controlled by the IFC.

2. Use of third-party cooler

The integrator must ensure adequate post cooling. The post cooling requirements are specified in the X-ray tube documentation.

Connecting a third-party cooler to the cooler delay control

The cooler delay control device must be connected to a separate external socket or if necessary to an uninterruptible power supply (UPS).

Before switching on the cooler, the IFC checks whether there is any flow, i.e. that the flow contact is open. After the cooler has been switched on, the system checks whether the signal changes from open to closed.

The third-party cooler must be switched off and on through the cooler-ON contact, so that any change in flow can be detected.

If the third-party cooling circuit is continuously on, the flow contact can be implemented as shown in the diagram below. The type D-Sub 15PM plug, and the contacts are included in the scope of delivery of the generator. If an iVario cover is installed, the cable diameter should be 8 mm.

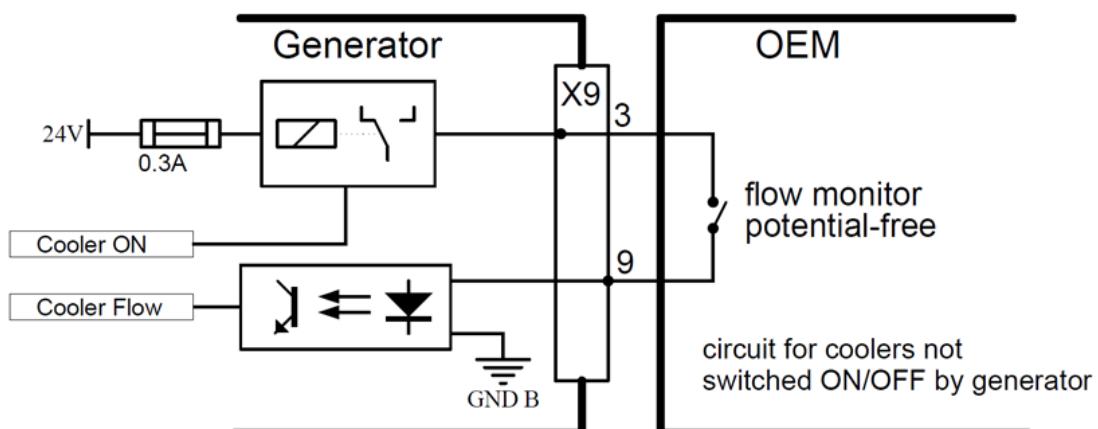


Fig. 25: Internal circuit configuration – cooler delay control X9 for connection of third-party cooler

4.8 Connection to power supply: iVario generator X1/X2

There are various configurations for the power supply of the iVario generator. The fuses and power disconnect devices must be installed by the OEM. The requirements are:

Mains supply input	Recommendation	All other countries	USA/Canada
X1 auxiliary power supply	6 A type C	≤ 3 – 16 A type C or D IEC	≤ 3 – 15 A or 20 A type C or D
X2 mains power supply	16 A type C	16 A or 20 A type C or D IEC	20 A type C or D

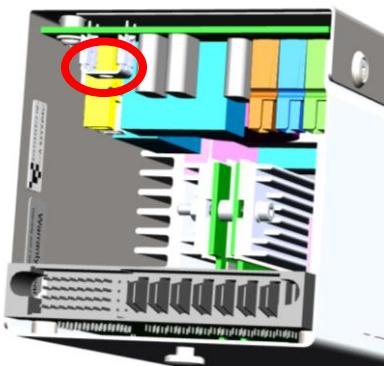
**Routine testing in accordance with Annex F of the
IEC/EN 61010-1 standard
Overvoltage category: Category II**

Each iVario generator is fully tested according to Annex F of the standard before delivery.

Overvoltage limiting devices are connected to the powercells. If an insulation test is repeated before commissioning, the bridge at the input of the powercells must be removed and reinstalled after testing. The test voltage must be defined according to overvoltage category II.



Attention



Danger

Risk of electric shock

If the Powercell(s) are removed, there is a risk of electric shock. Before carrying out any maintenance or repair work or unplug any Powercell(s), shut-down the module and secure it against inadvertent restart. It is necessary to wait at least **60 seconds** after the power is switched off



Warning

AC input voltage has to be stable between 198 VAC and 264 VAC

Input voltage between lines, line and neutral, line/neutral and earth shall always stay within the input voltage range. Be aware of the earthing system. For instance, IT earthing systems with floating earth or floating neutral are not suitable to supply the iVario generator.

All above configurations are explained below. The power supply cables are connected to the front of the backframe

Aux power

1. Remove the cover protecting ports. To do this, remove the screw with a Torx X10 (M3) screwdriver.
2. Connect the cable (min. 3 x 1.5 mm² or AWG 15) for auxiliary power to port X1 as shown in the wiring diagram (see below). The cable must be at least 3 meters long. If an iVario IP54 cover is installed, the cable diameter should be 10 mm.
3. Secure the cable with the strain-relief clamp: bottom row, position one (from left).



Fig. 26: Connection of Aux power supply 1 x 230 V + neutral to X1 + PE

Mains power

The connection for the power supply is located on the front of the backframe:

1. Connect the cable (min. 3 or 5 x 2.5 mm² or AWG13) for mains power to port X2 as shown in the wiring diagram (see below). If an iVario cover is installed, the cable diameter should be 13 mm.
2. Secure the cable with the strain-relief clamp: bottom row, position three (from left).
3. Mount the cover protecting for the ports.

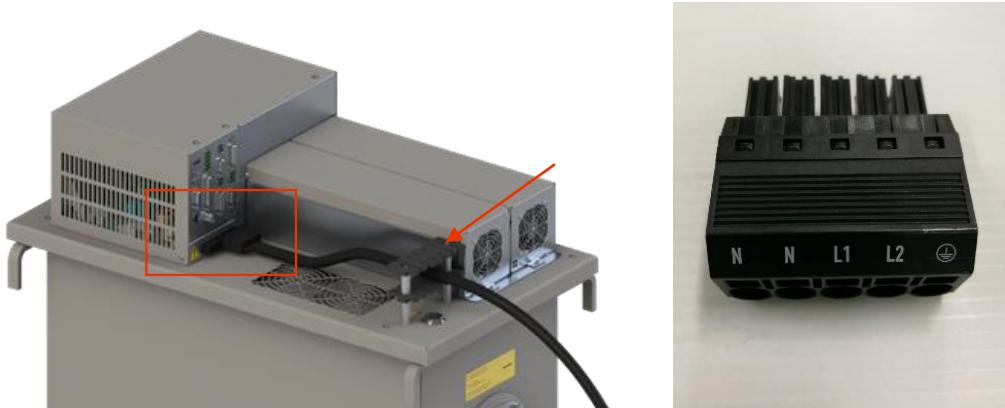


Fig. 27: Connection with Mains power supply 2 x 230 V + neutral to X2

Mounting the plug protection covers

Plugs X1 and X2 must be protected with a cover.

1. Slide the protective cover over plugs X1 and X2.
2. Secure the cover by tightening the screw with a Torx X10 (M3) screwdriver.

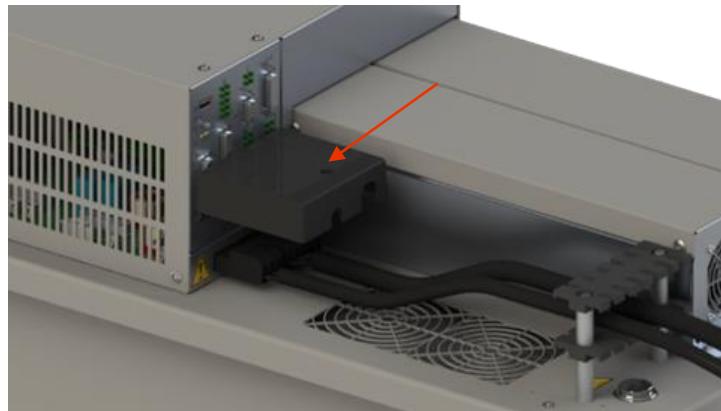


Fig. 28: Mounting protective cover

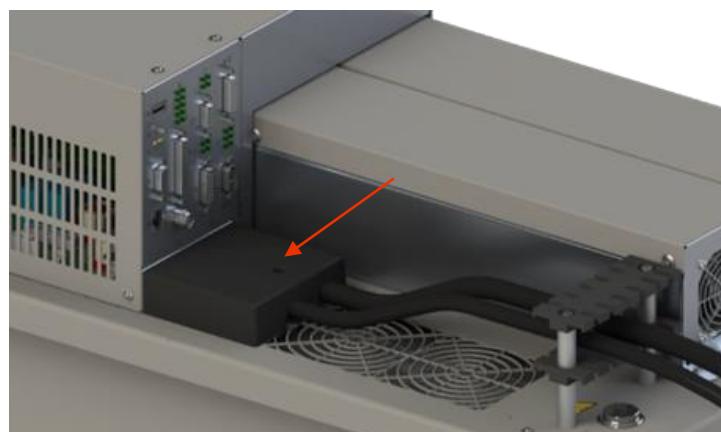


Fig. 29: Securing protective cover

4.8.1 Connection diagram 1 phase 230/400 V

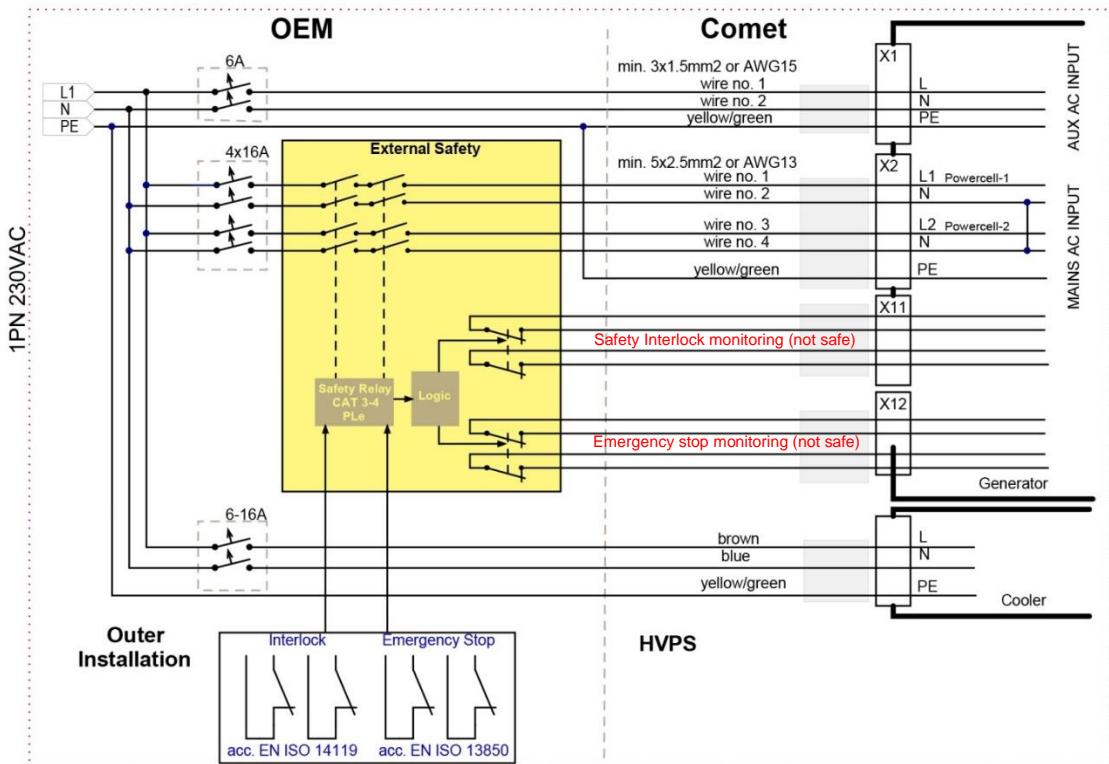


Fig. 30: Connection diagram 1 phase 230/400 V

4.8.2 Connection diagram 2 phases 230/400 V

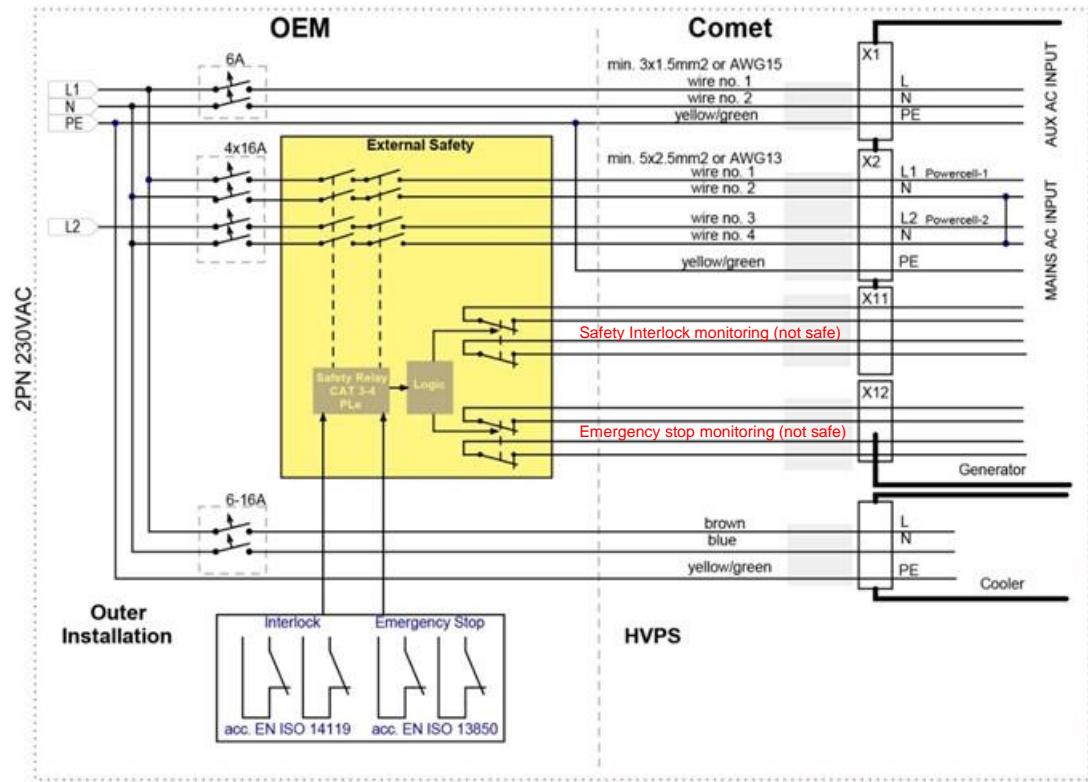


Fig. 31: Connection diagram 2 phases 230/400 V

4.8.3 Connection diagram 3 phases 230/400 V

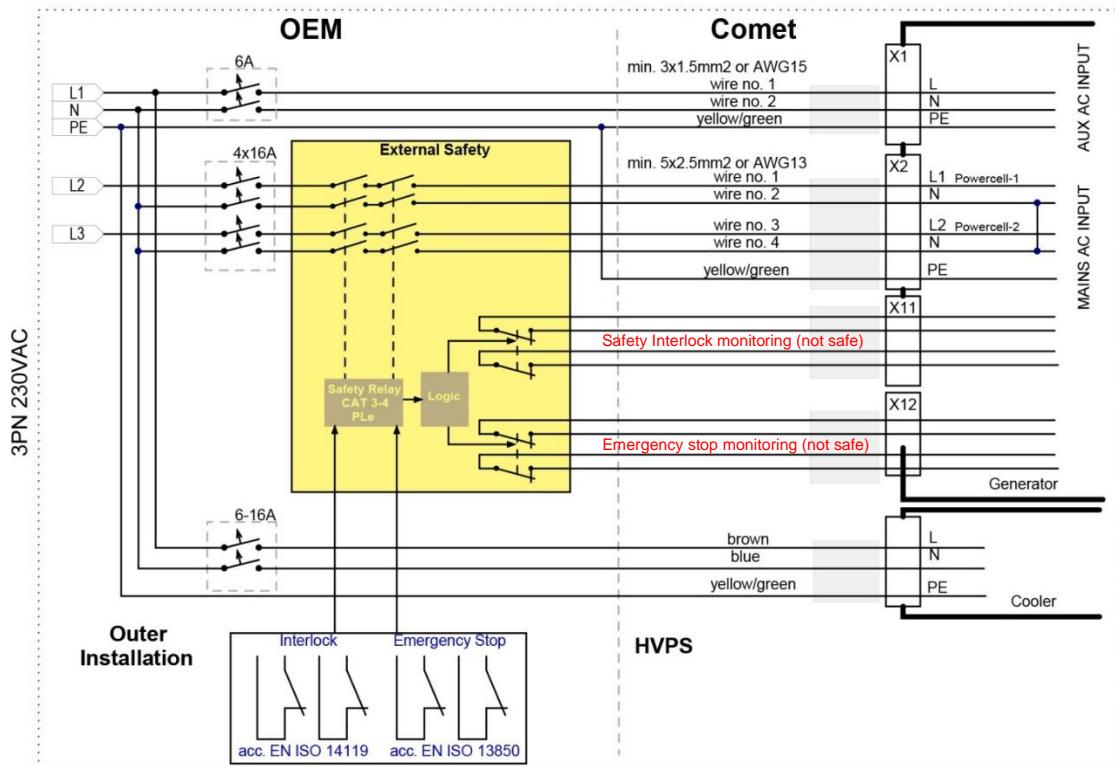


Fig. 32: Connection diagram 3 phases 230/400 V

4.8.4 Wiring diagram – 2 phases 208/240 V including CDRH switch

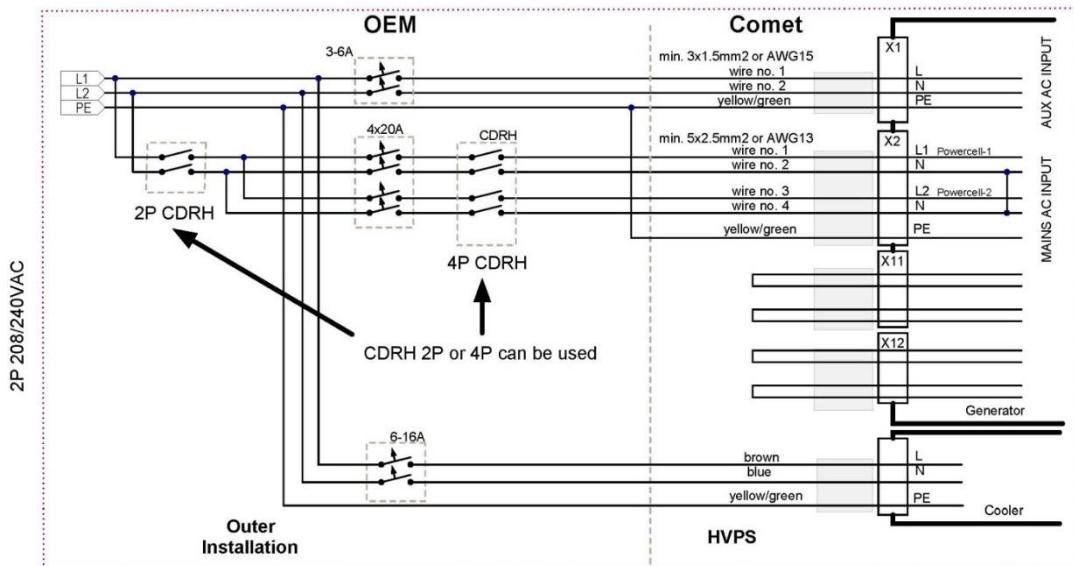


Fig. 33: Wiring diagram – 2 phases 208/240 V

4.9 Connection of the X4/X5 control PC

Communication between the PC and the generator can be established via Ethernet (TCP/IP) or via an RS232 connection. RS232 ensures compatibility with older applications. For details regarding the communication protocol of this interface, refer to the iVario protocol document.

4.9.1 Integration of the generator into an IT network

The easiest way to integrate the iVario generator is a point-to-point Ethernet TCP/IP connection between the control PC or the iVario controller and the iVario generator.

The iVario generator has been assigned static IP address: 192.168.177.199/24.

The address ranges of the control PC and the iVario generators should be identical.

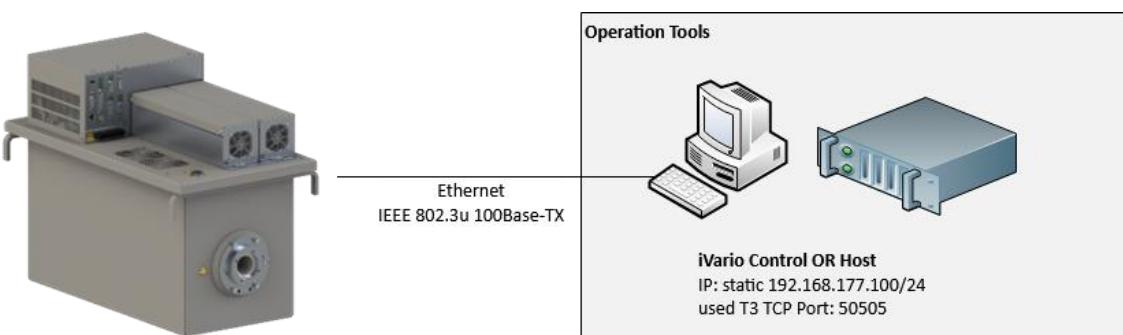
To prevent IP address conflicts, we recommend the following configuration:

- Static address for operator PC/host: 192.168.177.100/24.
- Factory-set static address of iVario controller: 192.168.177.198/24.

The TCP ports of the iVario generator are factory-set as follows:

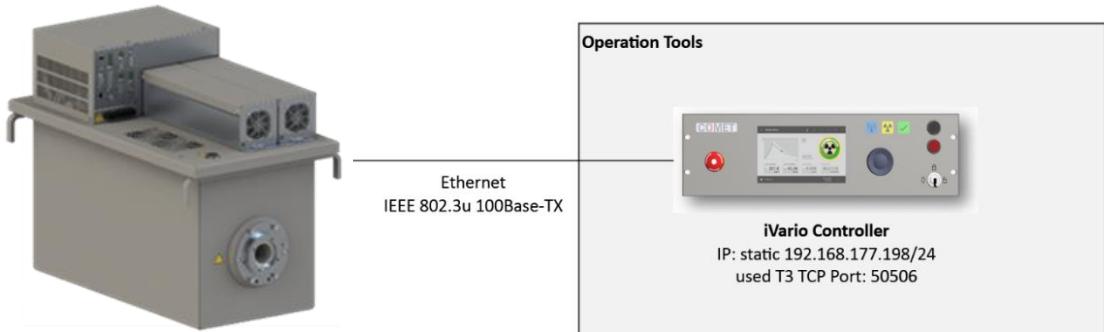
- 50505 for iVario control software or host application (customer application)
- 50506 for iVario controller
- 80 for Web UI

The diagrams below show the possible point-to-point connections:



iVario HVPS
Standard network component
IP:
- static 192.168.177.199/24
T3 TCP Ports:
- 50505 (Host / iVario Control / Service)
- 50506 (iVario Controller)
- 80 (WebUI if started)

Fig. 34: Point-to-point connection with control PC, iVario control software of host application



iVario HVPS
Standard network component
IP:
- static 192.168.177.199/24
T3 TCP Ports:
- 50505 (Host / iVario Control / Service)
- 50506 (iVario Controller)
- 80 (WebUI if started)

Fig. 35: Point-to-point connection with iVario controller

Point-to-point connection servicing

The service PC shall be connected to the ethernet port X5. This can be done either directly from the PC to the iVario, or if a switch is available, it is also possible to connect through the switch.

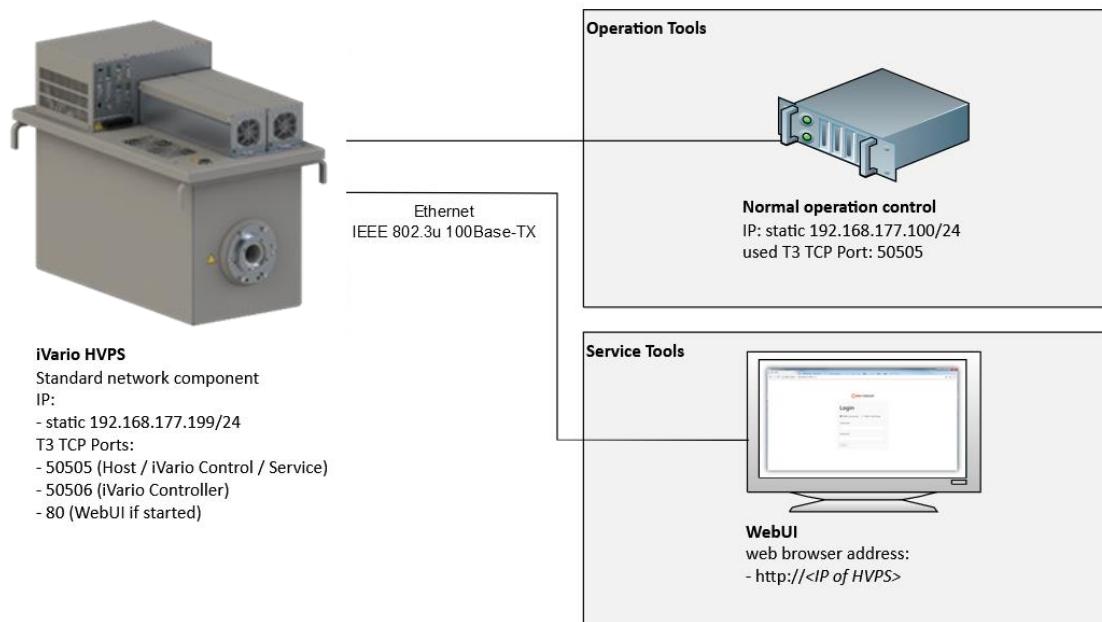


Fig. 36: Point-to-point connection for service – change connection of host on service PC

Integration into customer IT network

By using an Ethernet switch, the iVario generator and the associated devices can be easily integrated into an existing network by setting up an "iVario subnetwork".



Attention

No direct connection of the iVario generator to the internet

We do not recommend connecting the iVario generator directly to the internet, as there are security risks from cyber-attacks, etc. that can result in unforeseeable system behavior. If such a connection is required, the integrator must implement the necessary IT security measures.

For integration of the iVario system into the customer's IT network, it is also necessary to take security precautions, e.g. through the installation of a firewall. We strongly advise against direct connection of the iVario generator to the internet unless the necessary IT security precautions are taken.

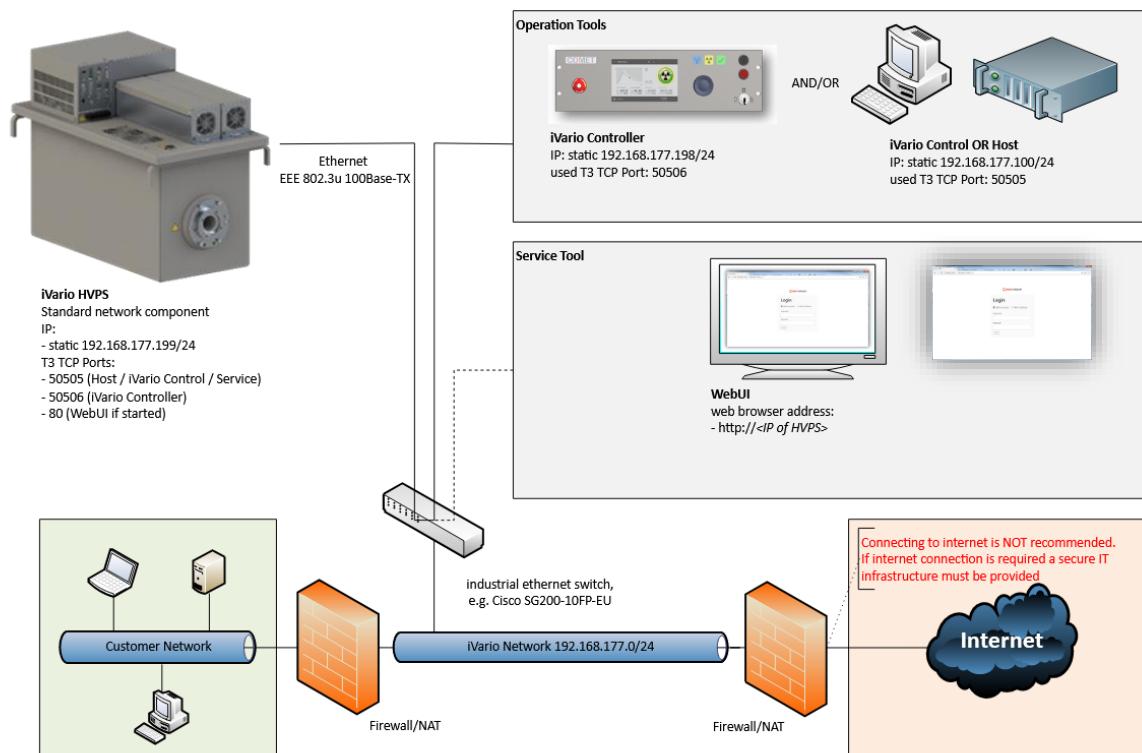


Fig. 37: Integration into customer network with static IP addresses

4.9.2 Connecting the communication cables

The ports for the TCP/IP and the RS232 cables are located on the iVario generator and on the front panel of the IFC:

1. Connect the TCP/IP cable to port X4. We recommend the use of shielded Ethernet RJ45 cable Cat. 5 or 6. If an iVario cover is installed, the cable diameter should be 5 mm.
2. Secure the cable with the strain-relief clamp: top row, position two (from left).

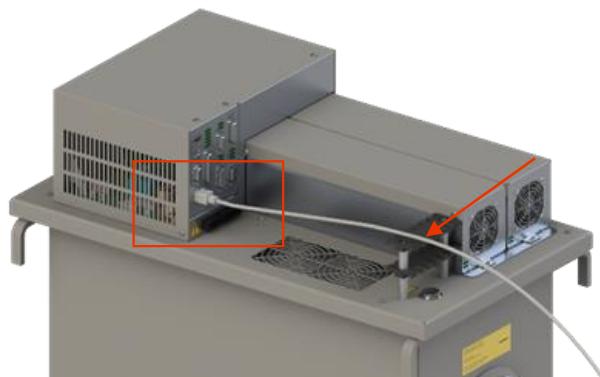


Fig. 38: Connection of control PC via Ethernet to X4

3. Connect the RS232 cable (optional), Sub D 9P male-female extension cable to port X5.
If an iVario cover is installed, the cable diameter should be 5 mm.
4. Secure the cable with the strain-relief clamp: top row, position three (from left).

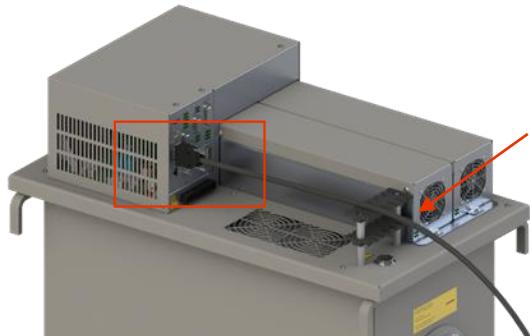


Fig. 39: Connection of control PC via RS232 to X5



Attention

Signal interference due to electromagnetic effects

Interference between signal lines and power supply lines can lead to faults.

- Lay the signal lines and power supply lines in separate ducts.



Notice

Attach each of the cables to a cable bridge.



Notice

According to the RS232 standard, the total length of the control line must not exceed 15 m. In addition, the cable capacitance must not exceed 2,500 pF.

4.10 Connecting the input/output (I/O signals) to X8 of the IFC

These signals are necessary for the following functions:

Input signals:

- HV Enable button (High voltage enabled)
- Stop button (switching High voltage off)
- Customer Interlock 1 (signal from customer's safety equipment)
- Customer Interlock 2 (signal from customer's safety equipment)
- Message 1 (status signal from customer's system)
- Message 2 (status signal from customer's system)

Output signals for generator status:

- Imminent (MAINS supply on; safety circuits closed)
- Safety Ready (customer and safety interlock closed, cooler parameters OK)
- Ready
- Prewarn (preliminary warning)
- HV On (High voltage On)
- Not Ready (only Aux On)

The I/O signals are sent through the Sub-D 25P (female) of the IFC:

1. Connect the cable for the I/O signals to port X8. If an iVario cover is installed, the cable diameter should be 9 mm.
2. Secure the cable with the strain-relief clamp: top row, position three (from left).

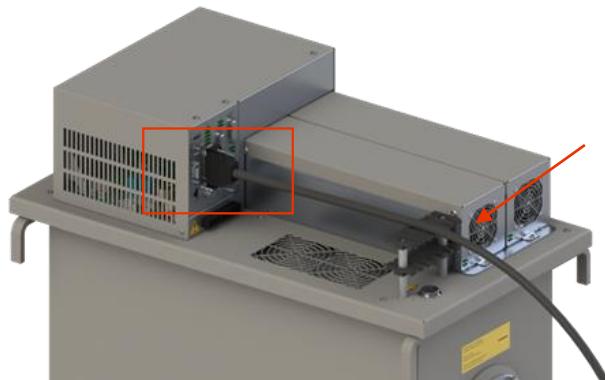


Fig. 40: I/O connection (D-sub 25P) at X8

4.10.1 Connection of input signals



Risk of injury from X-rays due to improper connection of safety components

Incorrect connection of the safety components to the module can result in uncontrolled release of X-ray radiation.

X-ray radiation can cause serious or even fatal injury.

- The machine must be equipped with an HV Enable button (high voltage enable, X8 pins 1-2).
This button activates/enables software-based switching on/switching off.
- This contact must never be bridged. In automated systems, it must be implemented by means of a push button.
- If the X-ray cabinet cannot be accessed and the risk assessment does not prescribe a HV Enable push button, the button can be disabled in the software (see chapter 4.14 Minimum requirements for generator start-up).

The table below shows the pin assignment for signals.

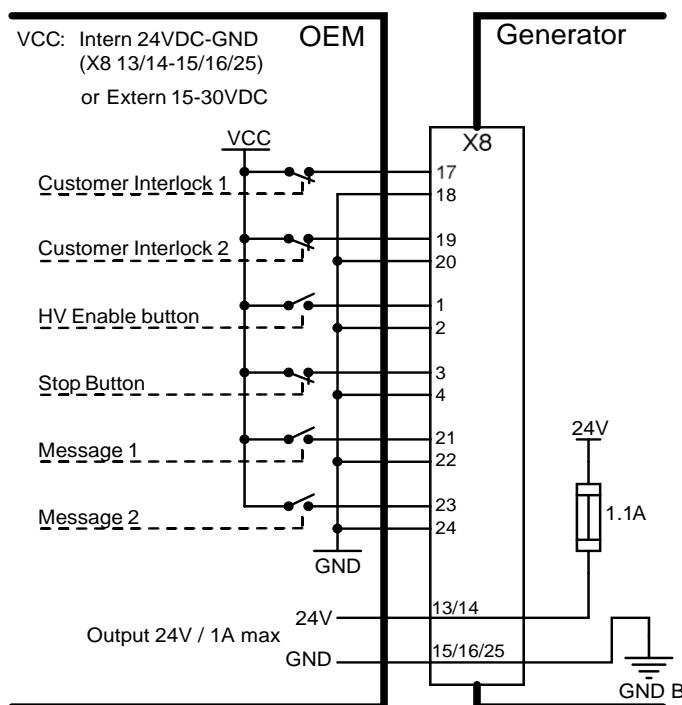


Fig. 41: Input signals at X8

Designation	Description	Pin no.
HV Enable button	<p>Enabling of module: Switching on high voltage with software command <i>HV On</i> or through separate switch.</p> <ul style="list-style-type: none"> The installation of a HV Enable button is mandatory (high voltage enabling at X8 pins 1-2). The generator awaits a pulse signal triggered by this button. The high voltage supply is enabled by opening the contact. If the X-ray cabinet cannot be accessed and the risk assessment does not prescribe a HV Enable push button, the button can be disabled in the software (see chapter 4.14 Minimum requirements for generator start-up). 	1 + 2
Stop button	<p>Stops the generator through a separate NC contact. This button is not mandatory. The generator can also be shut-down by means of software command <i>HV Off</i>. To operate the generator, the input signal must be active (contact closed).</p>	3 + 4

Designation	Description	Pin no.
Customer interlock 1	<p>Input signal for interlock contact. This switch is not mandatory. To operate the generator, the input signal must be active.</p> <p>The input has no safety function.</p>	17 + 18
Customer interlock 2	Same as customer interlock 1	19 + 20
Message 1	<p>Every change in the state (open or closed) of the input contact is recorded in the log file of the IFC with a time stamp. A change of state is transmitted to the host of the communication interface (iVario protocol).</p> <p>This input signal does not affect the state of the generator (Ready or HV On).</p>	21 + 22
Message 2	Same as message 1	23 + 24

4.10.1.1 Wiring of the input signal lines

The inputs require power applied for activation. For this there are two possibilities:

- Supply of external contact from internal 24 V of the generator
- Supply from external power source

These two options are illustrated in the figure below (sample wiring diagram for HV Enable button):

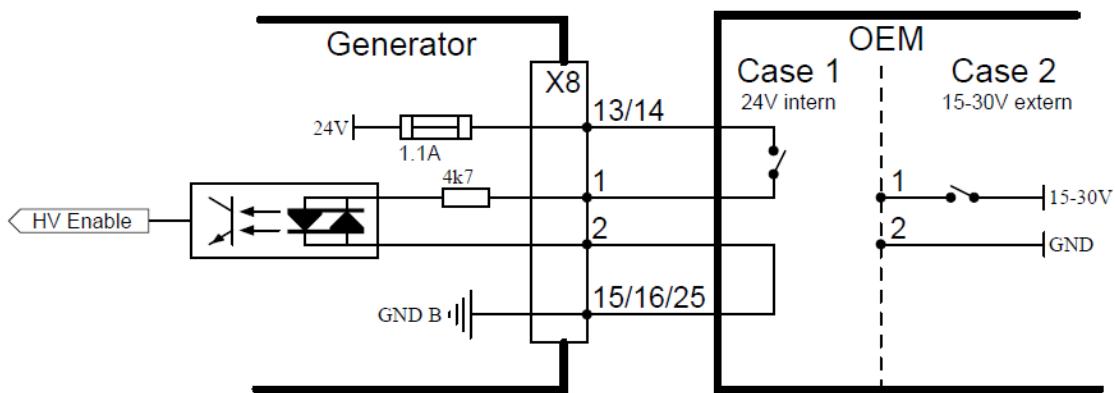


Fig. 42: Sample wiring diagram for HV Enable button

The internal 24 VDC power is available at X8, pin 13 or 14. The earth conductor must be connected to X8, pin 15, 16 or 25. The total maximum current consumption for the input/output interface is 1.0 A (internal 1.1 A fuse).

With an external power source, the voltage must be between 15 V and 30 V. The maximum permissible voltage is 50 V. The internal current is limited by a 4k7 resistor.

Designation	Description	Pin no.
24 V, $I_{max}=1$ A	Power supply for signaling lines	13 + 14
GND	24 V Ground	15 + 16 + 25

4.10.2 Output signals X8

These four outputs with floating contacts can indicate various system states. One of the following system states, or a combination of system states are signaled:

- Ready
- Prewarn
- HV On (High voltage On)
- Imminent (MAINS supply on; safety circuits closed)
- Safety Circuit Ready (safety circuits closed; cooler parameters OK)
- Not Ready (only Aux on)

Each output signals a predefined state or a combination of states of the generator. The contact can be continuously or intermittently closed (flashing).

Flashing interval: The flashing interval can be set to a value between 0.4 s and 1 s. The set interval applies to all outputs that are configured as flashing outputs.

The state signals are configured in the Web UI service software (see chapter 5.2.1 Adjustment of configuration).

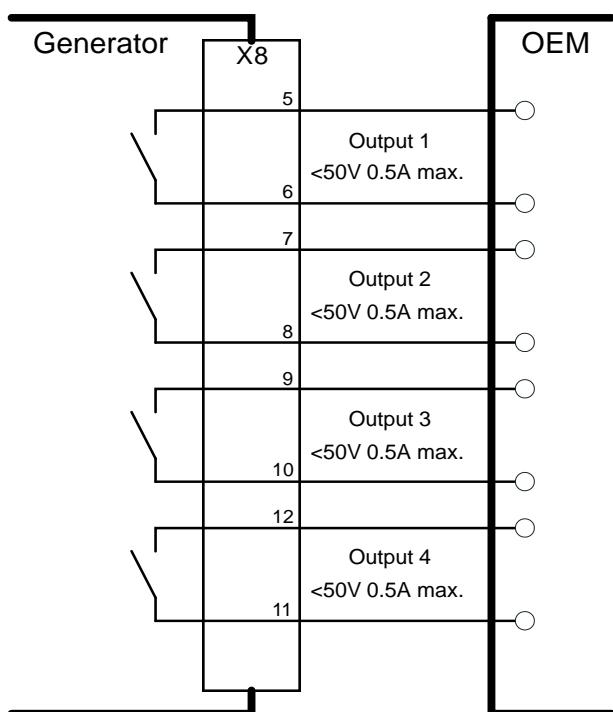


Fig. 43: Output signals at X8

The table below lists the outputs with the preconfigured signal states in the software and the assigned pins:

Designation	Description	Pin no.
Output 1	Preconfiguration: Ready	5 + 6
Output 2	Preconfiguration: Prewarn	7 + 8
Output 3	Preconfiguration: HV On	9 + 10
Output 4	Preconfiguration: HV On	11 + 12

The signal states can be changed in the Web UI service software (see chapter 5.2.1 Adjustment of configuration).

4.10.2.1 Wiring of the output signals

The power wiring for the output signals can be implemented in three ways. These are shown in the following diagrams:

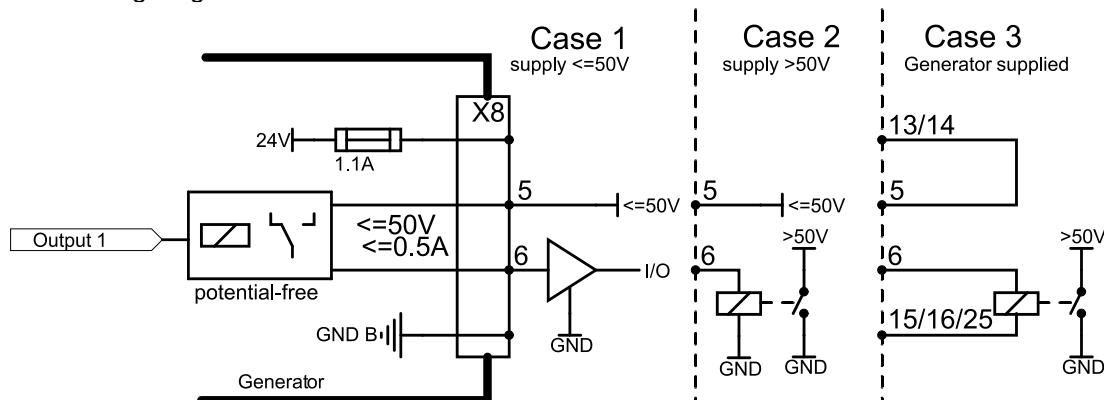


Fig. 44: Sample wiring diagram for output 1

The contact can be powered with 0-50 VDC/max. 0.5 A (internal fuse with spark suppression/inductive load (VDR)).

4.10.2.2 Signaling of Ready state

This state is reached when the safety devices are closed (door switches, emergency stop, customer interlocks 1 and 2) and there is a cooling monitoring signal (cooler contacts for flow and temperature closed).

4.10.2.3 Signaling of Prewarn state

This state exists only during the prewarning time, i.e. after a HV On command and prior to switching on the high voltage. It ensures that a visual or acoustic signal is transmitted before the emission of X-Ray radiation from the source.

4.10.2.4 Signaling of HV On state

This state is achieved at the end of the prewarning time and drops off when the post-heating time elapses. The contact can be connected for electromagnetic locking of radiation protection doors, cabinet windows or similar equipment.

4.10.2.5 Monitoring of door locking signals

If the machine is equipped with a door lock safety system, the monitoring contact of the door locks can be monitored through an input at the generator. The monitoring function must be activated in the software (see chapter 4.11 Connection for X-ray warning lights X10).

4.10.3 Key switch (module component with optional iVario controller)



Danger

Risk of injury from exposure to X-ray radiation due to incorrect machine operation

Incorrect wiring or operation of the X-ray system can result in uncontrolled release of X-ray radiation.

X-ray radiation can cause serious or even fatal injury.

- According to international safety regulations, only authorized and trained operators are permitted to operate the X-ray module. These operators must be identified by the X-ray module by means of a key or a similar hardware-based identification device.
- The key switch must be integrated into the module in an appropriate way by the system manufacturer. We recommend integrating the key switch using the customer interlock 1 or 2 at X8.
- This connection does not constitute a safety function.
- For the safe shut-down of the generator, it must be disconnected from the mains power supply.



Notice

If no iVario controller is installed, the installation and connection of an HV Enable button is mandatory (see chapter 4.15.1 iVario controller).

If the X-ray cabinet cannot be accessed and the risk assessment does not prescribe a HV Enable push button, the can be disabled in the software (see chapter 4.14 Minimum requirements for generator start-up).

4.11 Connection for X-ray warning lights X10

The iVario generator provides a function for the monitoring of external warning lights. These lights can be configured through the software as "continuously on-steady" or "blinking".

It is possible to connect up to three warning lights. The following states of combinations of states can be indicated:

- Ready
- Prewarn
- HV On
- Imminent (MAINS supply on; safety circuits closed)

- Safety Circuit Ready (safety circuits closed, cooler parameters OK)
- Not Ready (only Aux on)

Flashing interval: The flashing interval can be set to a value between 0.4 s and 1 s. The set interval applies to all lights that are configured as flashing.

The state of the warning light is monitored by measuring the current to the light. Three different current levels can be configured: Threshold current for ON or OFF, and maximum current.

- Light is off: current in light is below threshold for OFF.
- Light is on: current in light above threshold for ON but smaller than the maximum current.
- If the current is outside the range defined by the thresholds, the generator cannot be switched on or is automatically shut-down and an error message to this fact is displayed.
- If the current in the light exceeds the set maximum current, a short circuit occurred, and an error signal is triggered. As a short circuit at a light is deemed a critical fault, the generator is automatically shut-down and can only be switched on again after a complete restart of the system (Aux power supply off-on).

Adjustable value ranges

Thresholds: 10 mA to 100 mA. These thresholds should be set to the mean current consumption value of the lights. It is possible to set the two thresholds to the same value.

Maximum current: 50 mA to 250 mA. The maximum current value must be smaller than 250 mA.

The parameters and states are configured in the Web UI service software (see chapter 5.2.1 Adjustment of configuration). By default, all lights are activated and flash in state HV On at intervals of 0.5 s. The default thresholds for ON and OFF are set to 40 mA and the maximum current is factory-set to 220 mA.

The port for the X-ray warning lights is located on the front of the IFC, port Sub-D 9P (female).

1. Connect the cable for the X-ray warning lights to port X10. If an iVario cover is installed, the cable diameter should be 5 mm.
2. Secure the cable with the strain-relief clamp: top row, position five (from left).

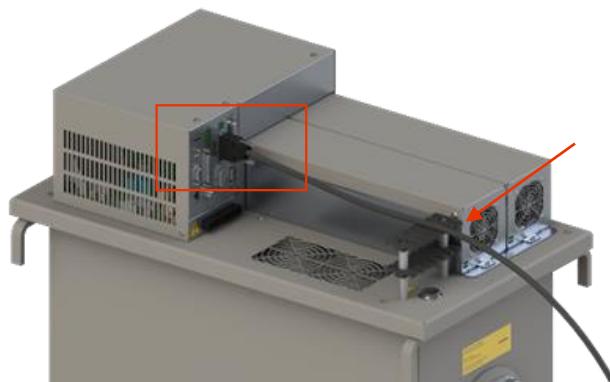


Fig. 45: Connection of X-ray LED to port X10

4.11.1 External warning lights (LEDs only)

The following lights are available from Comet:

Product No.	Designation	Color
20047292	Monitorable LED light 150 mA (WERMA 82917055)	Red
20047293	Monitorable LED light 150 mA (WERMA 82937055)	Yellow
20050168	Monitorable LED light 150 mA (WERMA 82947055)	Clear

4.11.2 Fuses for external warning lights

The connections are fail-safe. After a short circuit, functionality is restored latest after 60 s. As a short circuit at a light is deemed a critical fault, the generator must be restarted (Aux power supply off and on).

4.11.3 Wiring diagram for X10

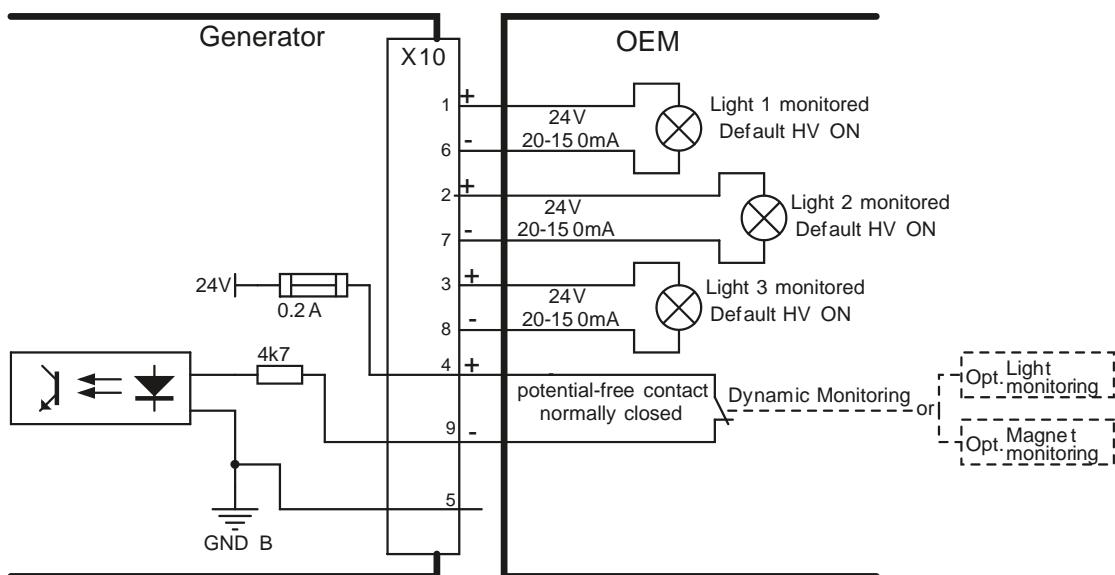


Fig. 46: Wiring diagram for X10

4.11.4 Use of dynamic monitoring

The *dynamic monitoring* input can be used for the monitoring of the external warning devices/lights. The *dynamic monitoring* input is monitored for the same states/combinations of states as the warning lights.

The contact can be configured to monitor either the open or closed state. This allows for the connection of multiple warning lights (in series or in parallel) or the connection of an interlock monitoring contact (see chapter 4.10.2.5 Monitoring of door locking signals).

If, during the active monitoring phase, the contact is not in the correct state, the X-ray generator is automatically shut-down and an error message to this fact is displayed.

Monitoring takes place while the warning lights are switched on.

The input monitoring is configured in the software and in the same way as for the warning lights. By default, the function is disabled, i.e. no monitoring.

4.12 Functional safety: Connection of the safety components

In the X-ray system, the safety of personnel from X-ray radiation or hazardous high voltage is ensured by interrupting the main power supply to the X-ray generator by means of external safety equipment. The monitoring contacts of the safety equipment, such as the output of the safety relays, must be used as signalization contacts for the iVario generator:



Notice

Selecting the external components for the safety functions

The interlock door safety switch and the Emergency stop switches are external safety system components.

It is the **responsibility of the system integrator** to select and integrate the safety system components in such a way that the system as a whole achieves the performance level required for the X-ray module.

4.12.1 Connection of safety interlock-door switch signalization to X11

In the iVario generator, the connection for safety interlock-door switch **is ONLY used for signaling purposes**. The monitoring contacts of the safety equipment, e.g. safety relay output, might be connected to the safety interface. In this case, the opening of the safety interlock is reported accordingly to the software.

If the signalization is implemented in a different way, the safety interlock signalization connection must be bridged. The safety interlock signalization port is located on the front panel of the safety interface (D-Sub 9P port (female)):

1. Connect the cable for the safety interlock signals to port X11. If an iVario cover is installed, the cable diameter should be 5 mm.
2. Secure the cable with the strain-relief clamp: bottom row, position four (from left).

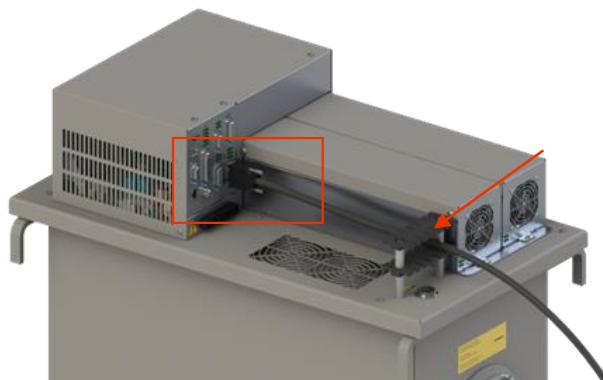


Fig. 47: Connection signaling safety interlock on X11

4.12.1.1 Wiring diagram safety interlock signalization X11

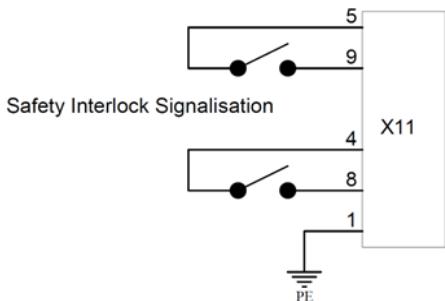


Fig. 48: Wiring diagram safety interlock signalization X11

4.12.1.2 Signals of safety interlocks signalization 1 and 2

The safety interlock signalization must only be used for signaling the state of the safety circuit.

X-ray radiation can only be switched on when both contacts are closed. The X-ray source is automatically shut-down when a contact is opened.

The monitoring circuit is designed so that both contacts must be opened and simultaneously closed in order to switch on the high voltage. The maximum permissible delay between the two door contacts is 0.5 s.

The monitoring contacts must be floating contacts. The iVario generator supplies the contacts with a voltage of 24 VDC and a current of 1 mA.

If the signalization of the state of the safety circuit is not implemented by means of safety interlock signals, these contacts must always be bridged.



Warning

Signalization inputs for interlock door safety switch and emergency stop without safety function

The signalization inputs for the interlock door safety switch and the emergency stop do **not** perform a safety function.

- Use the interlock safety door switch input for signalization purposes only. Otherwise, the contact must be bridged.
- Use the emergency stop input for signalization purposes only. Otherwise, the contact must be bridged.

4.12.2 Connection of emergency stop signalization to X12

The iVario generator does not provide an emergency stop function. The port for the emergency stop signalization **must ONLY be used for signalization purposes**. The monitoring contacts of the safety equipment, e.g. safety relay output, might be connected to the safety interface. In this case, the triggering of an emergency stop is reported accordingly in the software.

The monitoring contacts must be floating. The iVario generator supplies the contacts with a voltage of 24 VDC and a current of 1 mA. If signaling is implemented differently, the emergency stop signaling contact must be bridged. The emergency stop signalization port is located on the front panel of the safety interface (SUB-D 26p port (female)):

1. Connect the cable for the emergency stop signalization to port X12. If an iVario cover is installed, the cable diameter should be 6 mm.
2. Secure the cable with the strain-relief clamp: top row, position five (from left).

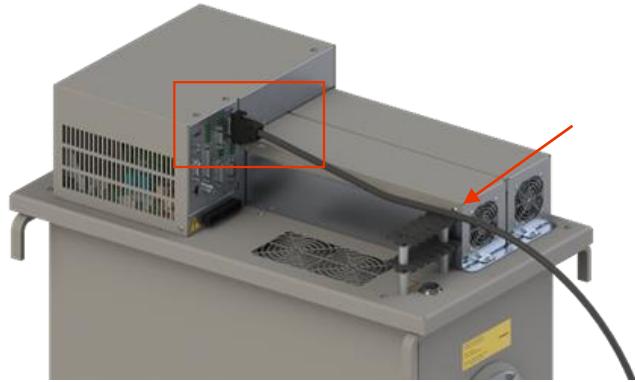


Fig. 49: Emergency stop signalization connection (D-sub26P) at X12

4.12.2.1 Wiring diagram for X12

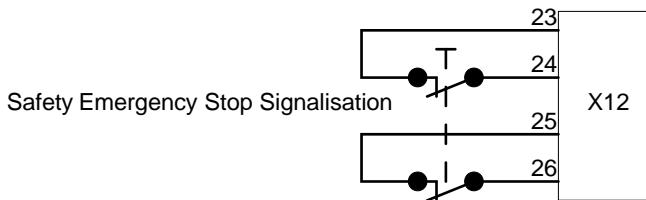


Fig. 50: Wiring diagram for X12

4.13 Connection facility for CDRH switch (for US only)

To meet the requirements of the US CFR 1020.40 standard, a CDRH switch must be integrated into the power supply line. This switch interrupts the primary supply of the current converter by disconnecting both phases L1 and L2.

Earth conductors must not be interrupted by the CDRH switch.

The required cross-section of the connecting cable depends on the type of installation.

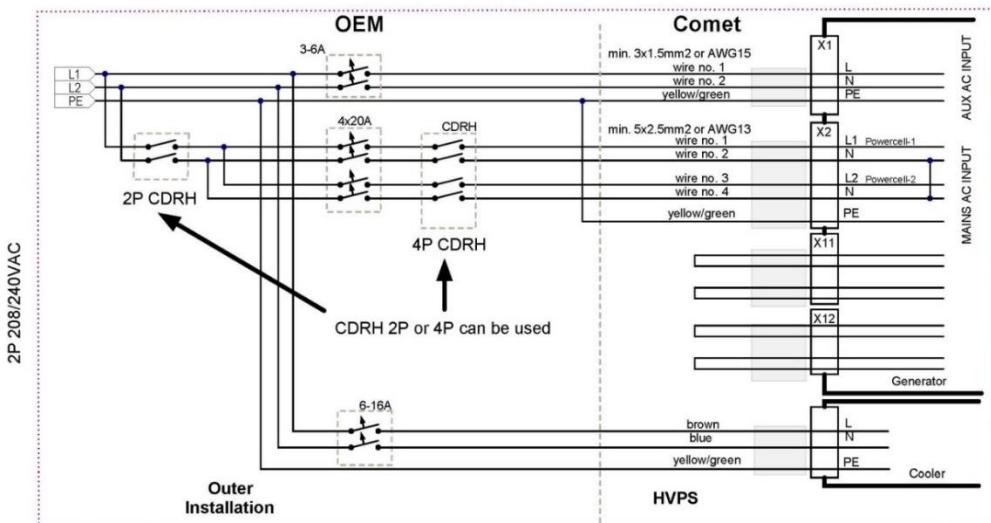


Fig. 51: Connection options for CDRH switch (for USA only)



Danger

Risk of injury from X-ray radiation

Improper use of the safety components of the X-ray system can result in the release of X-ray radiation.

People can be killed or seriously injured by X-ray radiation.

- A CDRH switch may only be used as additional safety equipment. It is not allowed to be used as a replacement for other safety equipment such as door switches.

4.14 Minimum requirements for generator start-up

The diagrams below show the minimum number of connections bridges at port X8, X11 and X12 for generator start-up.

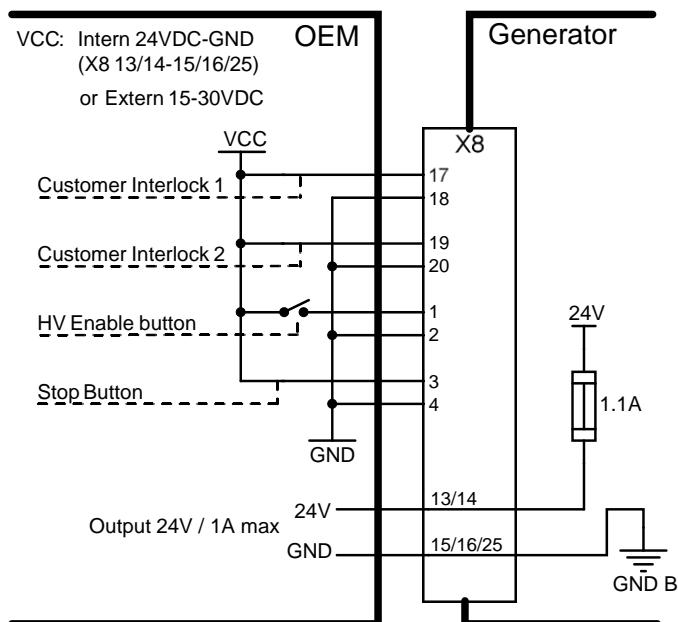


Fig. 52: Minimum number of connections and bridges for iVario generator start-up

Bridge at X11 (included in iVario starter kit)

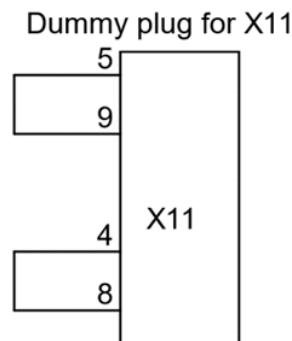


Fig. 53: Bridge at X11

Bridge at X12 (included in iVario starter kit)

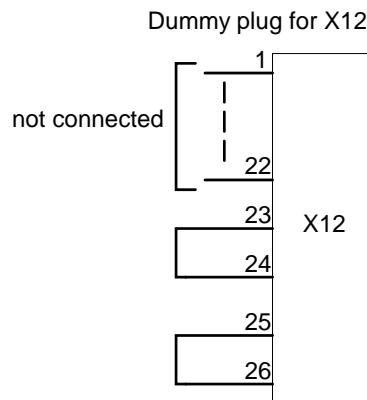


Fig. 54: Bridge at X12

Deactivation of HV Enable

If the X-ray cabinet cannot be accessed and the risk assessment does not prescribe a HV Enable push button, the button can be disabled in the software. This configuration can be made in the Web UI software (see chapter 5.2.1 Adjustment of configuration). In this case, the HV Enable button is not required prior to start x-ray via communication interface.

Configuration in Web UI:

To deactivate the HV Enable button click and activate option “Ignore HV Enable Button on X8“.

4.15 Optional components

4.15.1 iVario controller

The optional iVario controller is not available for MesoFocus.

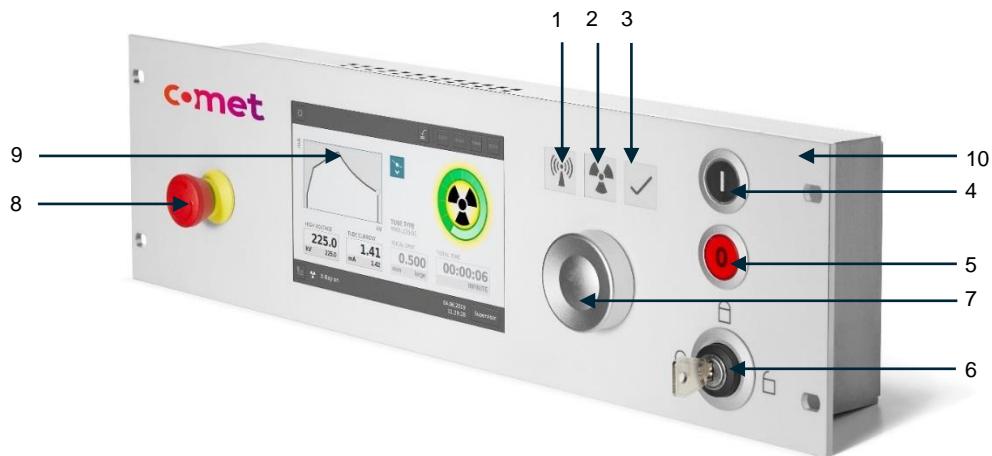


Fig. 55: iVario controller

1	Prewarning light, blue or red (color must be defined in order documentation)	6	Key switch
2	X-ray ON light, red or yellow (color must be defined in order documentation)	7	Control dial
3	Read light, green	8	Emergency stop button (optional, only in conjunction with iVario External Safety)
4	ON button	9	Touch panel PC
5	OFF button	10	Control panel

4.15.1.1 Connection of iVario controller

Communication between the iVario controller and the iVario module is established through the TCP/IP port X4 at the IFC.

The TCP/IP port is located on the front panel of the IFC:

1. Connect the TCP/IP cable to X4 connection.
2. Secure the cable with the strain-relief clamp: top row, position two (from left).

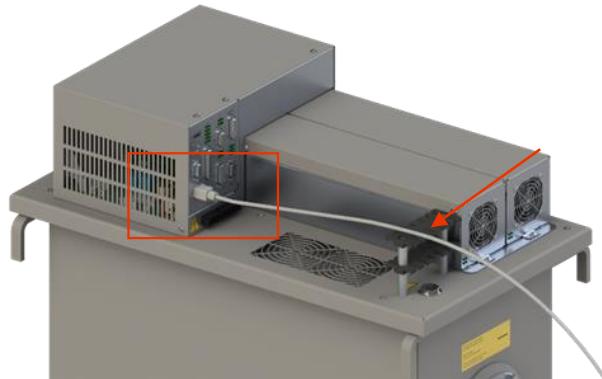


Fig. 56: Connection of iVario controller via Ethernet at X4

3. Connect the cable for the signals to X12.
4. Secure the cable with the strain-relief clamp: top row, position six (from left).



Fig. 57: Connection (D-sub 26P) at X12

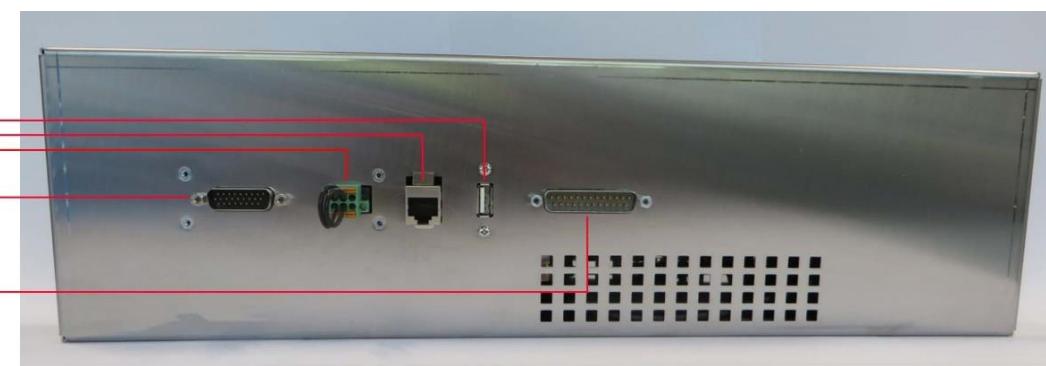


Fig. 58: Ports of the iVario controller

1	USB port for update of iVario controller software	3	Port for external Emergency stop device (to be bridged, if no such device is connected)
2	TCP/IP port	4	D-sub 26P port
5	The enclosed 25 pole connector must be plugged in		

Bridging of connection for external Emergency stop device

If an iVario controller is installed with the iVario External Safety, the Emergency stop device can be integrated in the controller and further devices can be connected in series on the connector 3. When activated, the Emergency stop cuts the mains power supply by means of the safety relay installed in the iVario External Safety.

If no external Emergency stop device is used or if the iVario External Safety is not installed, two bridges must be connected as shown below.

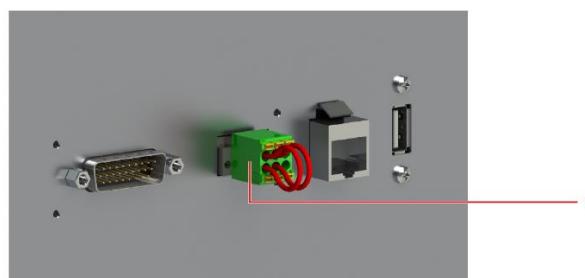


Fig. 59: Bridges at iVario controller

1	Bridges at external Emergency stop port
---	---

4.15.1.2 Configuration of the iVario controller in the IFC software

The iVario controller must be configured in the IFC software through the Web UI service software (see chapter 5.2.1 Adjustment of configuration).

4.16 Replacing an XRP generator

An XRP series generator can be replaced with a generator of the iVario series.

4.16.1 Interfaces

To do this, the following components are required:

- iVario cooler interface for the connection of the special 7-pin plug of the MG cooler to the iVario generator
- External safety device to connect safely the safety interlocks – door switches

The following components are optional and reduce the work required for the installation:

- Optional cover: iVario cover for IP54 protection
- iVario controller for the manual control of the machine
- iVario External safety

4.16.2 iVario cooler interface



Fig. 60: Ports of cooler interface

1	X9 port	3	15-pin port (for the connection of the existing cooler cable)
2	Power supply		

Connecting the cooler

The special 7-pin plug-type adapter of the XRP cooler is connected at the cooler interface of the iVario generator.

The power supply is established by means of a 3-wire cable connected to an external power supply (control cabinet).

Connect the X9 port of the cooler interface for the monitoring of the coolant temperature and flow rate to the IFC of the iVario generator.

The X9 port is located on the front panel of the IFC:

1. Connect the cable to port X9.
2. Secure the cable with the strain-relief clamp: bottom row, position two (from left).

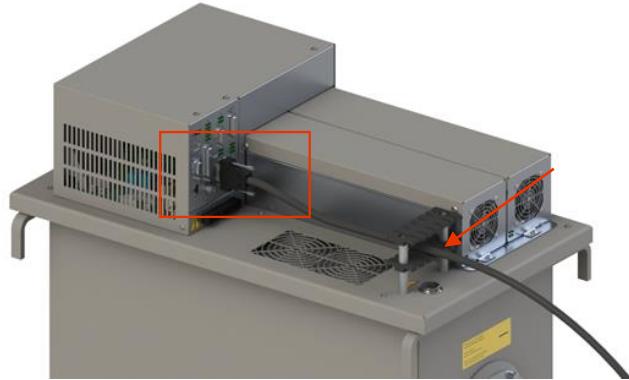


Fig. 61: Connection to cooler interface at X9

4.17 Installing the bipolar cable

Standard IP20 power supply

The port for the connection of the bipolar cable is located on the rear of the iVario backframe:

1. Disconnect the iVario generator from the power supply.
 2. Remove the cover of the iVario backframe.
 3. Connect the bipolar cable plug to the iVario backplane. Secure the plug bracket with two M3x6 Torx screws.
 4. Tighten the cable gland.
 5. Mount the cover of the iVario backframe by sliding the hood between the cable gland plate and the plug bracket. Secure the cable gland plate from the outside to the hood of the iVario backframe and secure with screws.
 6. Secure the cover of the iVario backframe with two Philips screws to the plug bracket.
- The bipolar cable is installed.

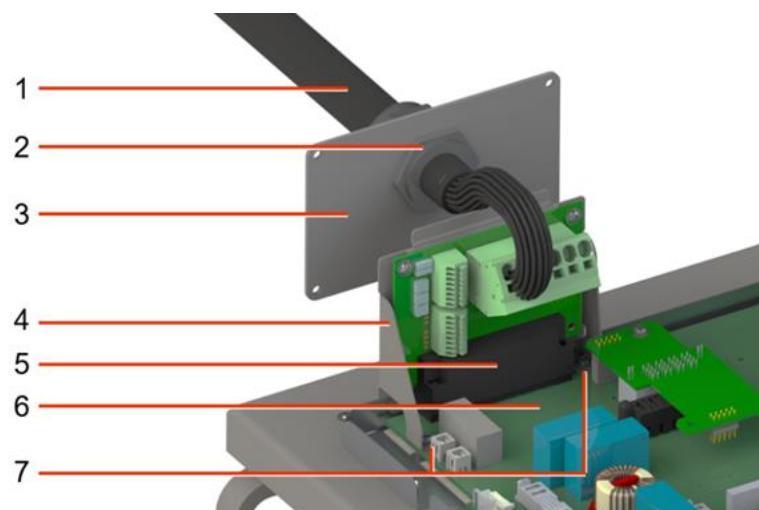


Fig. 62: Bipolar cable connected to iVario backplane

1	Bipolar cable	5	Bipolar plug
2	Cable gland	6	iVario backplane
3	Cable gland plate	7	Fastening screws
4			Plug bracket



Fig. 63: Cover of iVario backframe

1	Cover of iVario backframe	2	Cable gland plate
---	---------------------------	---	-------------------



Fig. 64: Fixture of cable gland plate to cover iVario backframe

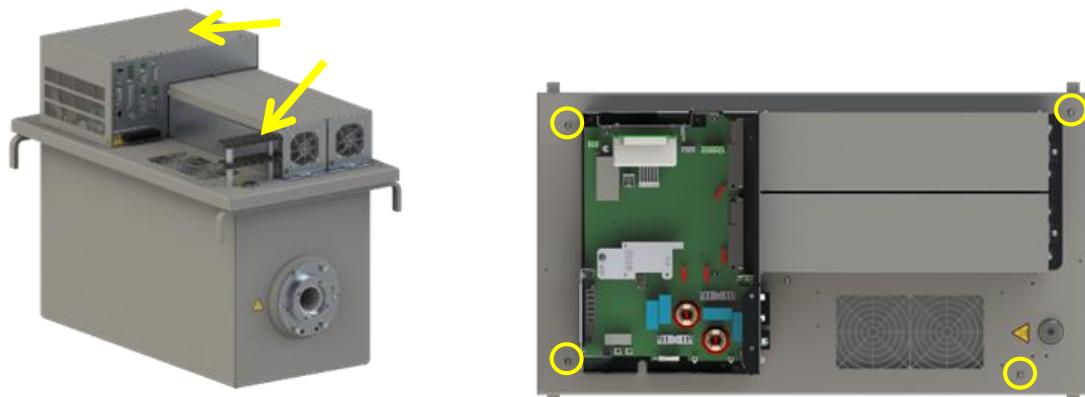
4.18 Mounting the IP54 cover



Fig. 65: iVario with mounted IP54 Cover

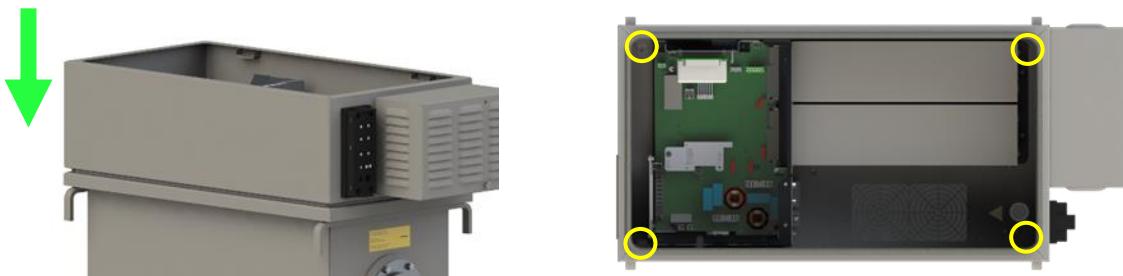
1st step: Removal of backframe, cable strain relief and screw

If an IP54 cover is to be retrofitted to a generator, the backframe cover, the cable strain relief and the marked screws must be removed.



2nd step: Positioning the basic unit of the IP54 cover

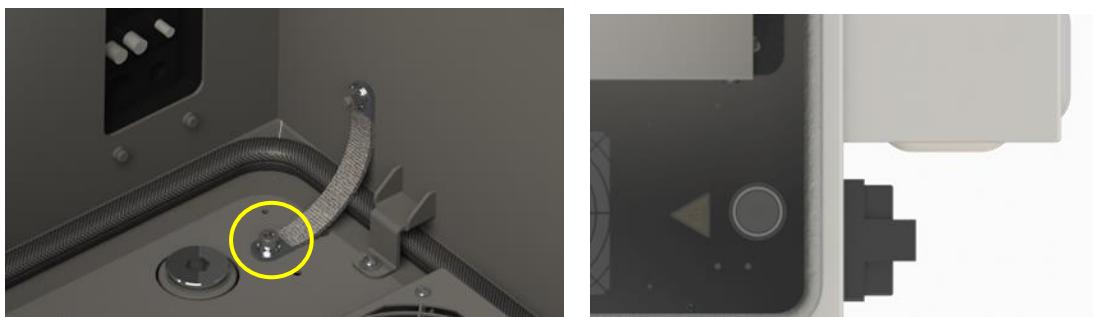
The basic unit of the IP54 cover has to be positioned on the generator and fasten with the marked screws.



3rd step: Attach earth strap

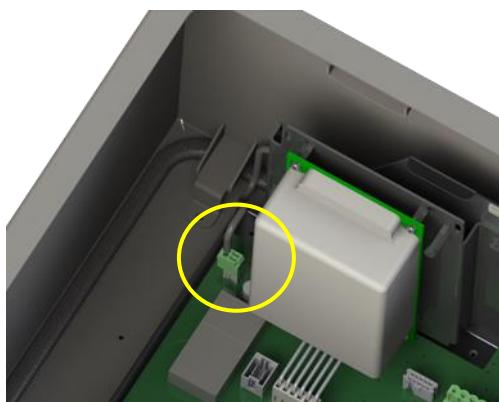
The earth strap must be attached as shown below. On the generator side, the earth strap must be connected to the mounting point without color and has to be mounted with the washer.

Notice: Tightening torque 0.8 Nm



4th step: Connecting the cable for the fan

The cable for the fan is connected as shown below.

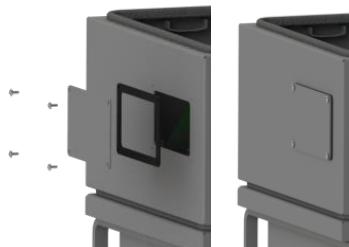


5th step: Installation of connecting cables

Unipolar version:

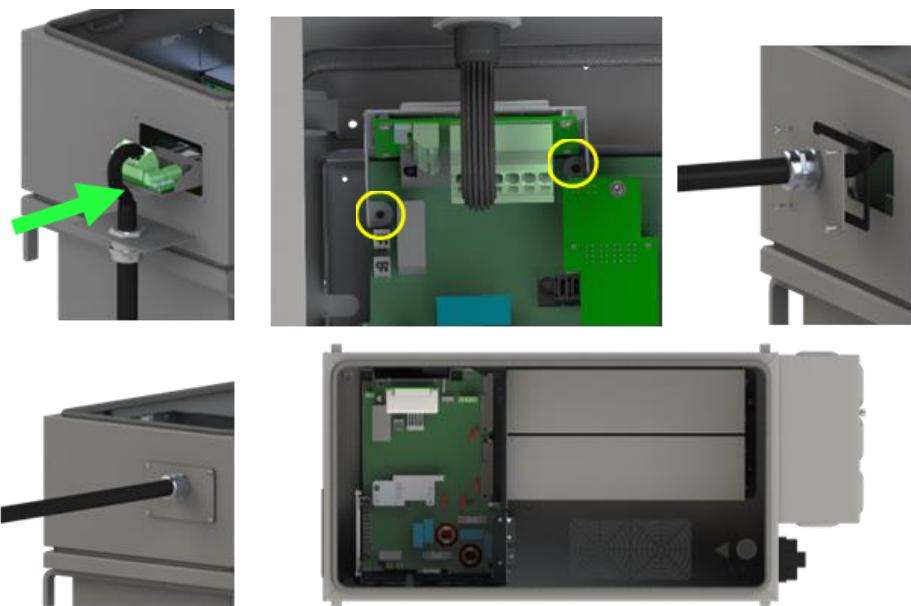
Close unneeded opening with gasket and blind plate.

Notice: Tightening torque 0.4 Nm



Bipolar version:

1. Insert the bipolar connection through the cut-out into the frame and attach it.
Notice: Tightening torque 0.8 Nm
2. Mount gasket and cover plate.
Notice: Tightening torque 0.4 Nm



6th step: Backframe cover

Install and tighten backframe cover.

Notice: Tightening torque 0.8 Nm.



7th step: Connect the earth cable

Connect the earth cable with the lid of the cover. Put the lid on and fasten it with the supplied key.



4.18.1 Installation of the cable gland

The cable feedthrough ensures complete sealing of the cover in the area of the cables. The cable gland seals the cover near the cable and acts as a strain-relief device. For correct cable diameters, see table below.

Feed the cable through the inserts in the cable glands, as shown in the diagrams below. The cables must not be crossed. For the individual cable gland patterns, we offer matching inserts (see figure below). If required, inserts with different diameters can be ordered from Comet.



Fig. 66: Cable gland for use without cover

X1	8 mm	X11	4 mm
X2	13 mm	X8, X12	6 mm
X4, X5, X9, X10			5 mm

4.18.2 Inserting and changing the filters

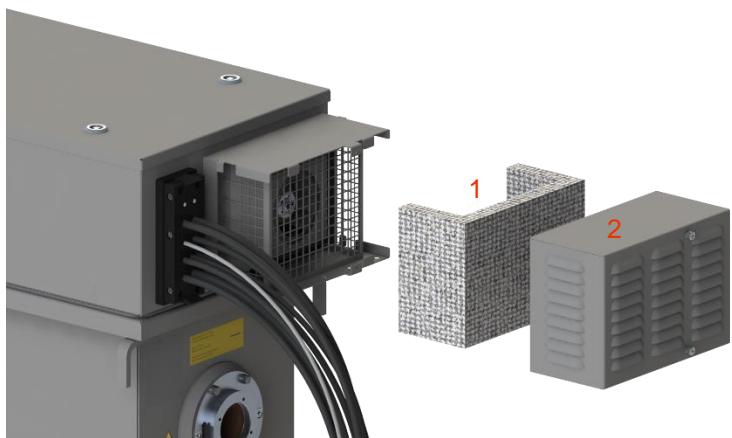


Fig. 67: Insert filter

1 Filter pad 2 Filter cover

Please note: The dense side of the filter shall be placed on the inner side.

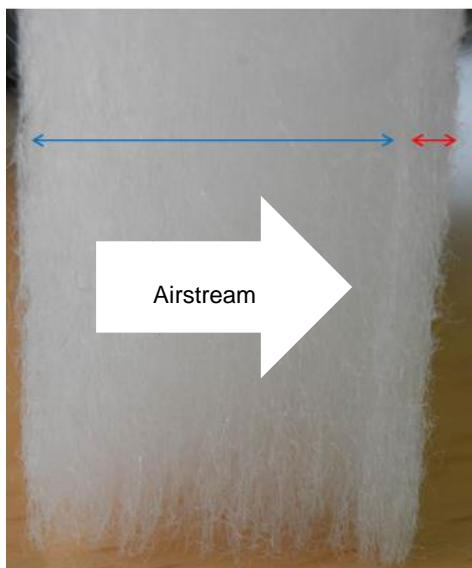


Fig. 68: Filter

4.19 Mounting the IP21 cover



Fig. 69: iVario with mounted IP 21 cover

1st step: Removal of backframe, cable strain relief and screw

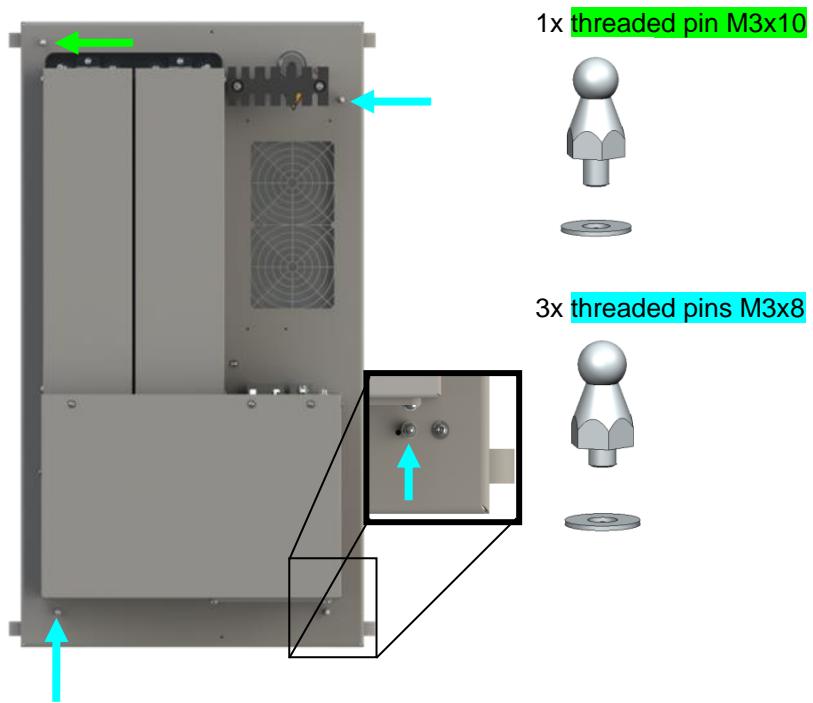
If an IP21 cover is to be retrofitted to a generator, the first thing to do is to attach the plug-in tongue for connecting the grounding cable. This is mounted with a screw and toothed lock washer.



2nd step: Install threaded pins

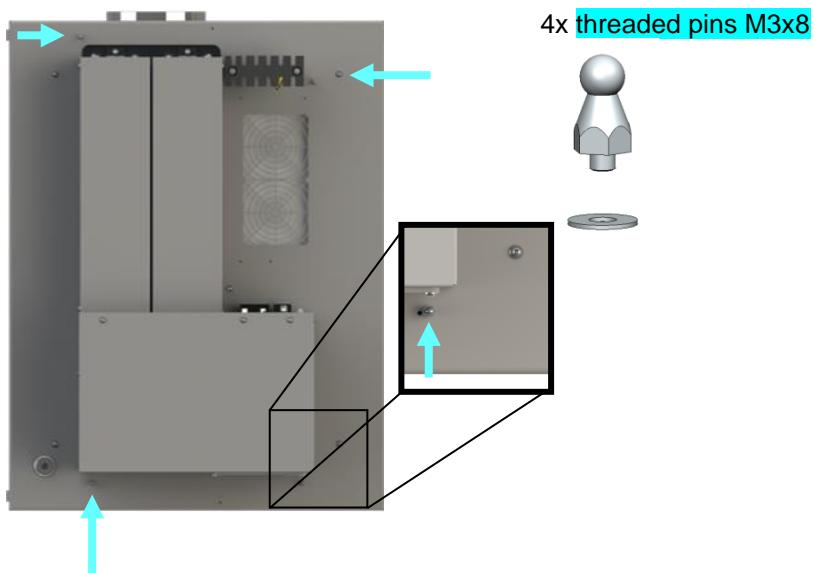
Version 160/320

Screw threaded pins with lock washer (secure with Locitite)

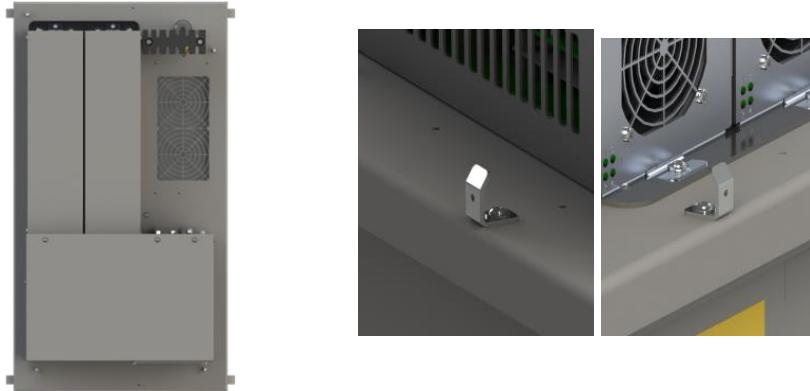


Version 225/450

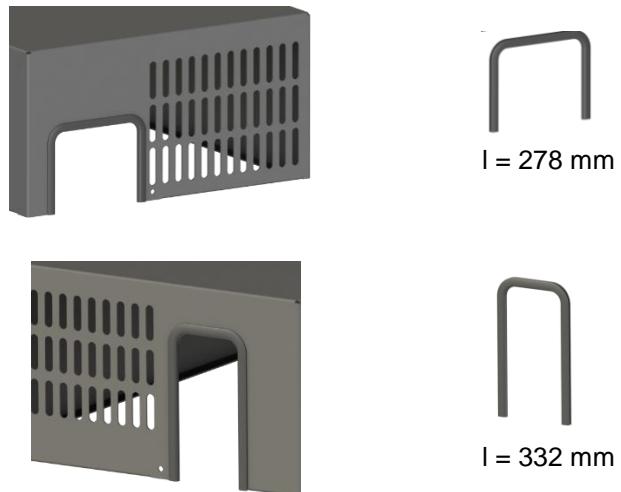
Screw in threaded pins with lock washer (secure with Loctite).



3rd step: Install mounting supports and align with housing edge

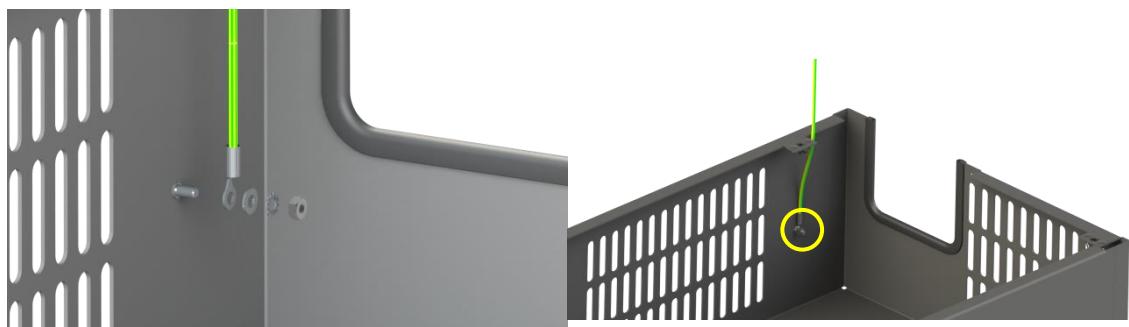


4th step: Install edge protection



5th step: Install earth cable

Screw earth cable with washer and nut on the cover as shown below.

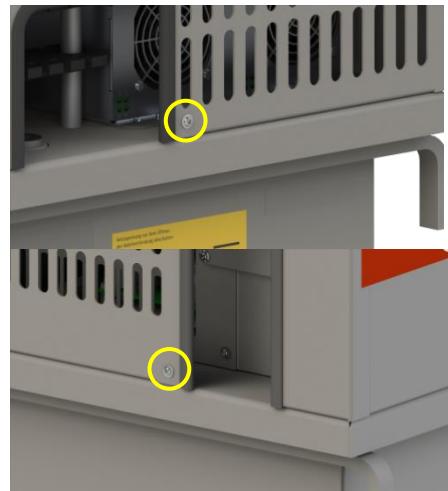
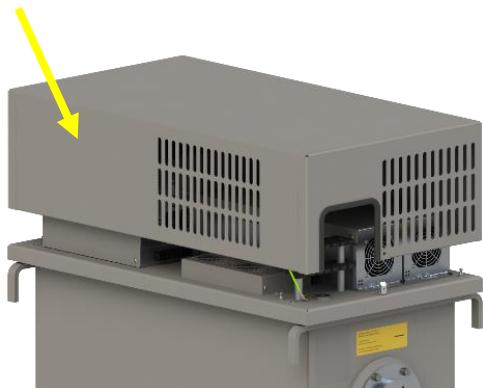


Connect earth cable on the lid.



6th step: Put on cover

Put on cover and fasten with screws.



5 Commissioning

5.1 Installing the iVario control software

The iVario control software must be placed on the control PC through which the iVario generator is to be controlled.

Creating installation directory

The iVario control software does not need to be installed by means of an installation utility. The installation directory of the iVario control software is supplied on a USB memory device.

1. Plug in the delivered USB memory device containing the iVario control software on the PC to be used to control the iVario generator.
2. Copy the directory named *iVario-Control* from the USB memory device to a directory of the control PC, for instance in the root directory c:\.
3. Place the USB memory device back on IFC, X6 of the iVario Generator. The iVario generator requires the file *t3-startup* on USB device for log functions.

To run the control software, double-click on *iVario-Control.bat* or run the *iVario-Control.exe* file in the bin directory. For further instructions, see *Readme.txt* file and read the next chapters.

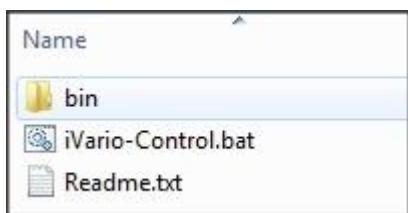


Fig. 70: Installation folder (example)

5.2 Configuration

The iVario generator is factory configured or customer configured according to the specifications from the order. If different configurations are needed, contact our service department.

Configuration parameters	Default	Connection
Monitoring safety interlock – emergency stop	Active but not to be considered as safe. Can be bridged or used for signaling purposes.	X11.1-2 X11.4-5 X12.23-24 X12.25-26
HV Enable button (Start button)	Pulse enabling required (switching from Safety Ready to Ready)	X8.1 / X8.2
Customer interlocks 1 and 2	Must be active to achieve Safety Ready state	X8.17 / X8.18 X8.19 / X8.20
Output 1	Ready	X8.5-6

Configuration parameters	Default		Connection
Output 2	Prewarn		X8.7-8
Output 3	HV On		X8.9-10
Output 4	HV On		X8.11-12
Warning light 1 Warning lights 2 and 3 are off	Active Status HV On Flashing Flashing interval ON: 500 ms; OFF: 500 ms Threshold current OFF: 40 mA Threshold current ON: 40 mA Max. current: 220 mA		X10.1-6
Dynamic monitoring input	Inactive		
Post cooling time Emergency post cooling	60 s 5 s		
Default IP address Subnet mask Gateway DNS server Port DHCP	192.168.177.199 255.255.255.0 192.168.177.1 192.168.177.1 50505, 50506 Disabled		
RS232	Baud rate Data bits Parity Stop bits Flow control	9600 8 None 1 None	
X-ray tube	According to order		
Prewarn time	2 s		
Warm-up	Automatic warm-up start activated		

Tab. 22: Default configuration

5.2.1 Adjustment of configuration

The configuration can be adjusted through the Web UI service software.

Web UI is a web server application. It enables you to configure the iVario generator and perform troubleshooting tasks.

1. Open a browser window, e.g. Chrome.
 2. Enter the IP address of the generator (e.g. 192.168.177.199) in the address bar of the browser.
 3. Press the Return key.
- The Web UI login page is displayed.

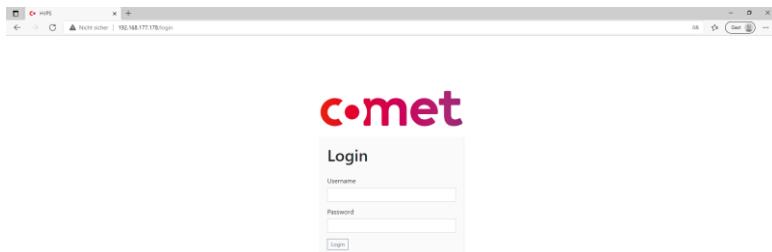


Fig. 71: Web UI login page

Web UI login

1. Password: Access only for trained technicians
2. Click the *Log in* button

For information on the available functions, refer to the "Web UI manual".

5.2.1.1 Adjusting configuration of inputs/outputs and warning lights

The inputs, outputs and warning lights can be individually enabled or disabled. The states signaled by the outputs and light can be configured on the *Phase configuration* page.

I/O configuration

General	<input checked="" type="checkbox"/> Use Optional Controller <input checked="" type="checkbox"/> Ignore HV Enable Button of X8 <input type="button" value="Apply"/>																																																																																																				
Phase Selection	<p>With the following settings the I/Os can be mapped to the phases of the HVPS:</p> <ul style="list-style-type: none"> • ON: Steady switched ON in selected phase • Blink: Blinking selected phase <table border="1"> <thead> <tr> <th>Phase</th> <th>Output 1</th> <th>Output 2</th> <th>Output 3</th> <th>Output 4</th> <th>Warn. Light 1</th> <th>Warn. Light 2</th> <th>Warn. Light 3</th> <th>Warn. Light 4</th> <th>Dyn. Mon.</th> </tr> </thead> <tbody> <tr> <td>Enable</td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> <tr> <td>NOT-READY</td> <td><input type="checkbox"/></td> </tr> <tr> <td>COOLER CHECK</td> <td><input type="checkbox"/></td> </tr> <tr> <td>SAFETY READY</td> <td><input type="checkbox"/></td> </tr> <tr> <td>MAINS CHECK</td> <td><input type="checkbox"/></td> </tr> <tr> <td>READY</td> <td><input type="checkbox"/></td> </tr> <tr> <td>PREWARN</td> <td><input type="checkbox"/></td> </tr> <tr> <td>HV ON</td> <td><input type="checkbox"/></td> </tr> <tr> <td>SETPT REACHED</td> <td><input type="checkbox"/></td> </tr> </tbody> </table> <p>There is an advanced configuration set.</p> <p><input type="button" value="Advanced Configuration"/></p>	Phase	Output 1	Output 2	Output 3	Output 4	Warn. Light 1	Warn. Light 2	Warn. Light 3	Warn. Light 4	Dyn. Mon.	Enable	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	NOT-READY	<input type="checkbox"/>	COOLER CHECK	<input type="checkbox"/>	SAFETY READY	<input type="checkbox"/>	MAINS CHECK	<input type="checkbox"/>	READY	<input type="checkbox"/>	PREWARN	<input type="checkbox"/>	HV ON	<input type="checkbox"/>	SETPT REACHED	<input type="checkbox"/>																																																																				
Phase	Output 1	Output 2	Output 3	Output 4	Warn. Light 1	Warn. Light 2	Warn. Light 3	Warn. Light 4	Dyn. Mon.																																																																																												
Enable	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>																																																																																												
NOT-READY	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																																																																																												
COOLER CHECK	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																																																																																												
SAFETY READY	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																																																																																												
MAINS CHECK	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																																																																																												
READY	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																																																																																												
PREWARN	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																																																																																												
HV ON	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																																																																																												
SETPT REACHED	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																																																																																												
Apply Changes	<input type="button" value="Apply"/> <input type="button" value="Reset All"/> <input type="button" value="Discard Changes"/>																																																																																																				
Blink Period	<p>The On- and Off-times for blinking are used for all blinking I/Os.</p> <p>Blink on time Blink off time</p> <table border="1"> <tr> <td>500 ms</td> <td>500 ms</td> </tr> </table> <p><input type="button" value="Apply"/></p>	500 ms	500 ms																																																																																																		
500 ms	500 ms																																																																																																				
Current Monitoring Thresholds	<p>The current monitoring thresholds are used for a correct detection if an I/O is correctly switched.</p> <p><input type="button" value="Start auto configuration"/></p> <table border="1"> <thead> <tr> <th>Light</th> <th>off threshold</th> <th>on threshold</th> <th>shortcircuit threshold</th> </tr> </thead> <tbody> <tr> <td>Warning light 1</td> <td>40 mA</td> <td>40 mA</td> <td>220 mA</td> </tr> <tr> <td>Warning light 2</td> <td>40 mA</td> <td>40 mA</td> <td>220 mA</td> </tr> <tr> <td>Warning light 3</td> <td>40 mA</td> <td>40 mA</td> <td>220 mA</td> </tr> </tbody> </table> <p><input type="button" value="Apply"/></p>	Light	off threshold	on threshold	shortcircuit threshold	Warning light 1	40 mA	40 mA	220 mA	Warning light 2	40 mA	40 mA	220 mA	Warning light 3	40 mA	40 mA	220 mA																																																																																				
Light	off threshold	on threshold	shortcircuit threshold																																																																																																		
Warning light 1	40 mA	40 mA	220 mA																																																																																																		
Warning light 2	40 mA	40 mA	220 mA																																																																																																		
Warning light 3	40 mA	40 mA	220 mA																																																																																																		
Dynamic Monitoring	<p>This input is able to monitor magnetic switches and the failure contacts from external warning lights.</p> <p>Failure mode contact logic:</p> <p><input type="radio"/> Normally open (multiple failure mode contacts may be connected in parallel)</p> <p><input checked="" type="radio"/> Normally closed (multiple failure mode contacts may be connected in series)</p> <p>Dynamic Monitoring feedback timeout</p> <table border="1"> <tr> <td>120 ms</td> </tr> </table> <p><input type="button" value="Apply"/></p>	120 ms																																																																																																			
120 ms																																																																																																					
Reboot	<p>A reboot of the device is necessary to apply the configuration.</p> <p><input type="button" value="Reboot"/></p>																																																																																																				

Fig. 72: I/O configuration with Web UI

5.2.1.2 Configuration of the iVario controller in the IFC software

The iVario controller can be activated and configured through the I/O configuration page of the Web UI-Software. To do this, the following configuration options must be activated:

I/O configuration

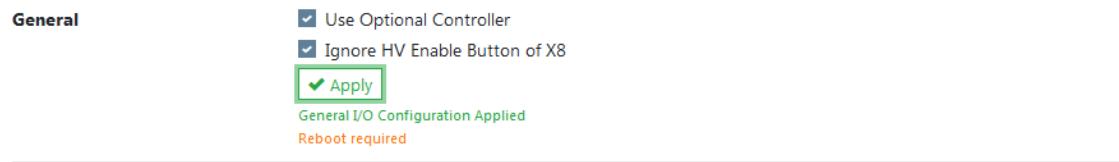


Fig. 73: I/O configuration page in Web UI

At the “Radiation ON” light of the iVario controller, state “HV On” must be set to “blink”.

Phase Selection	With the following settings the I/Os can be mapped to the phases of the HVPS: • ON: Steady switched ON in selected phase • Blink: Blinking selected phase									
Phase	Output 1	Output 2	Output 3	Output 4	Warn. Light 1	Warn. Light 2	Warn. Light 3	Warn. Light 4	Dyn. Mon.	
Enable	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
NOT-READY	<input checked="" type="radio"/>	<input type="button" value="Off"/>	<input type="button" value="Off"/>	<input type="button" value="Off"/>	<input type="button" value="Off"/>					
COOLER CHECK	<input checked="" type="radio"/>	<input type="button" value="Off"/>	<input type="button" value="Off"/>	<input type="button" value="Off"/>	<input type="button" value="Off"/>					
SAFETY READY	<input checked="" type="radio"/>	<input type="button" value="Off"/>	<input type="button" value="Off"/>	<input type="button" value="Off"/>	<input type="button" value="Off"/>					
MAINS CHECK	<input checked="" type="radio"/>	<input type="button" value="Off"/>	<input type="button" value="Off"/>	<input type="button" value="Off"/>	<input type="button" value="Off"/>					
READY	<input checked="" type="radio"/>	<input type="button" value="On"/>	<input type="button" value="Off"/>	<input type="button" value="Off"/>	<input type="button" value="Off"/>	<input type="button" value="Off"/>	<input type="button" value="Off"/>	<input type="button" value="Off"/>	<input type="button" value="Off"/>	
PREWARN	<input checked="" type="radio"/>	<input type="button" value="On"/>	<input type="button" value="On"/>	<input type="button" value="Off"/>	<input type="button" value="Off"/>	<input type="button" value="Off"/>	<input type="button" value="Off"/>	<input type="button" value="Off"/>	<input type="button" value="Off"/>	
HV ON	<input checked="" type="radio"/>	<input type="button" value="On"/>	<input type="button" value="Off"/>	<input type="button" value="On"/>	<input type="button" value="On"/>	<input type="button" value="Blink"/>	<input type="button" value="Off"/>	<input type="button" value="Off"/>	<input type="button" value="Blink"/>	
SETPT REACHED	<input checked="" type="radio"/>	<input type="button" value="On"/>	<input type="button" value="Off"/>	<input type="button" value="On"/>	<input type="button" value="On"/>	<input type="button" value="Blink"/>	<input type="button" value="Off"/>	<input type="button" value="Off"/>	<input type="button" value="Blink"/>	

There is an advanced configuration set.

Advanced Configuration

Apply Changes

phasekeys Applied

Discard Changes

Fig. 74: Configuration of optional warning light

5.3 Checking the installation

- ✓ The iVario control software is installed on the control PC.
1. Connect the control PC with a patch cable (RJ45) to the iVario generator.
 2. Check the connections at the iVario generator and the status LEDs at the IFC according to the instructions in the following chapters. For a detailed description of the user interface, see chapter 6 Operation.

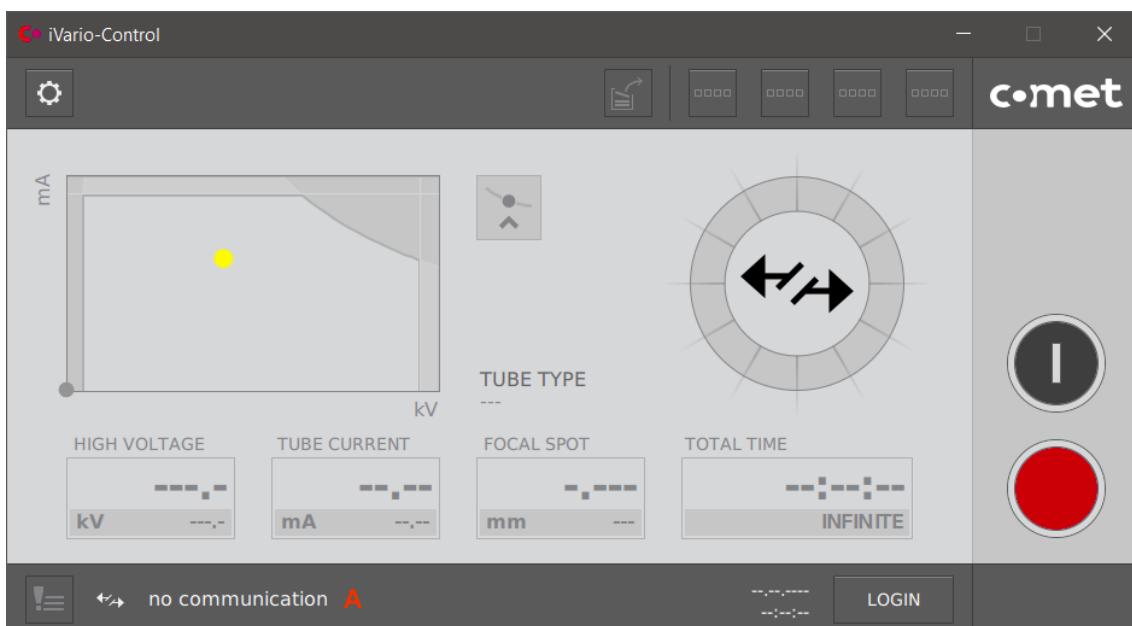
The iVario generator can be operated in three ways:

1. iVario Control Software
2. iVario Controller
3. Control via interface from OEM customer software (Ethernet or RS232)

In the following, only the control via the iVario Control Software and the iVario Controller manual control unit will be discussed.

5.3.1 Starting the iVario control software

- ✓ The control PC and the iVario generator are connected with a patch cable (RJ45).
 1. Execute the *iVario-Control.bat* file.
→ The following window is displayed.

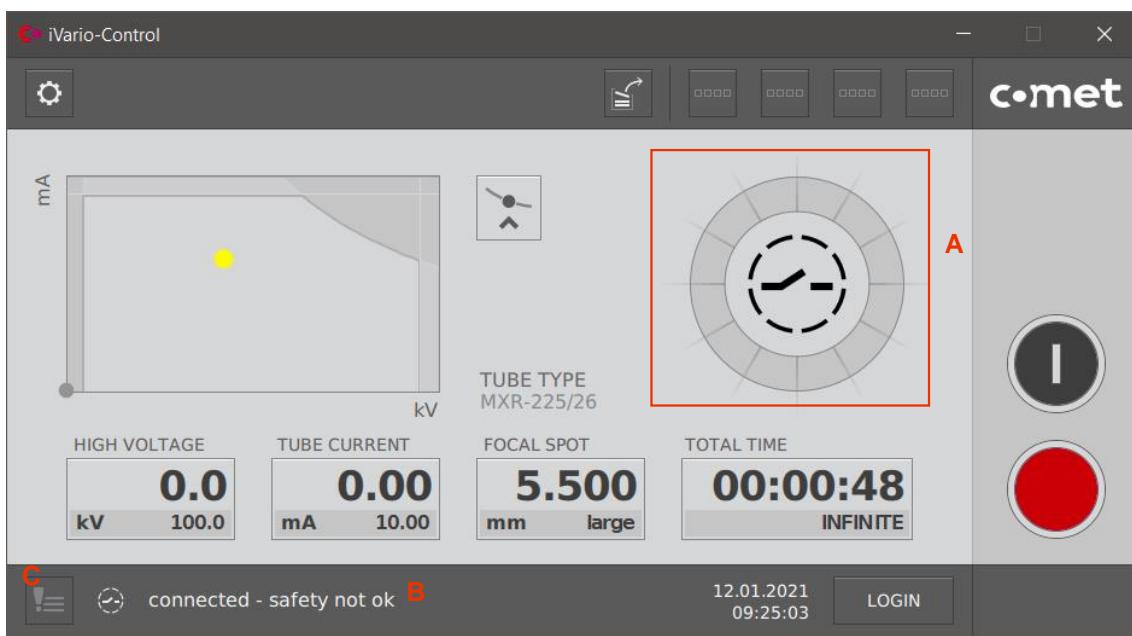


→ *No communication* is displayed in the status line **A**.

5.3.2 Switching on Aux

After switching on Aux, the IFC software starts automatically. The IFC software boot-up takes about 90 s. The iVario control software indicates the state of the iVario generator.

- ✓ The iVario control software is running.
 1. Switch Aux on.
 - The IFC software starts up. After about 90 s, the LEDs on the IFC indicate the state of the inputs and outputs.
 - LEDs 1, 2 and 4 at the powercell light up.
 - The following window is displayed in the iVario control software:



→ The iVario control software shows the state of the iVario generator in the section **A** and in the status line **B**.

→ Aux is switched on.

If there are not ready messages, they indicate why the iVario Generator cannot be switched on. If you click on **C** the pending messages are shown as displayed in the following window. Click on next to see other not ready messages.

The causes and remedies for not ready messages and warnings are described in the "T3 Status manual".

LED signals at IFC and safety interface

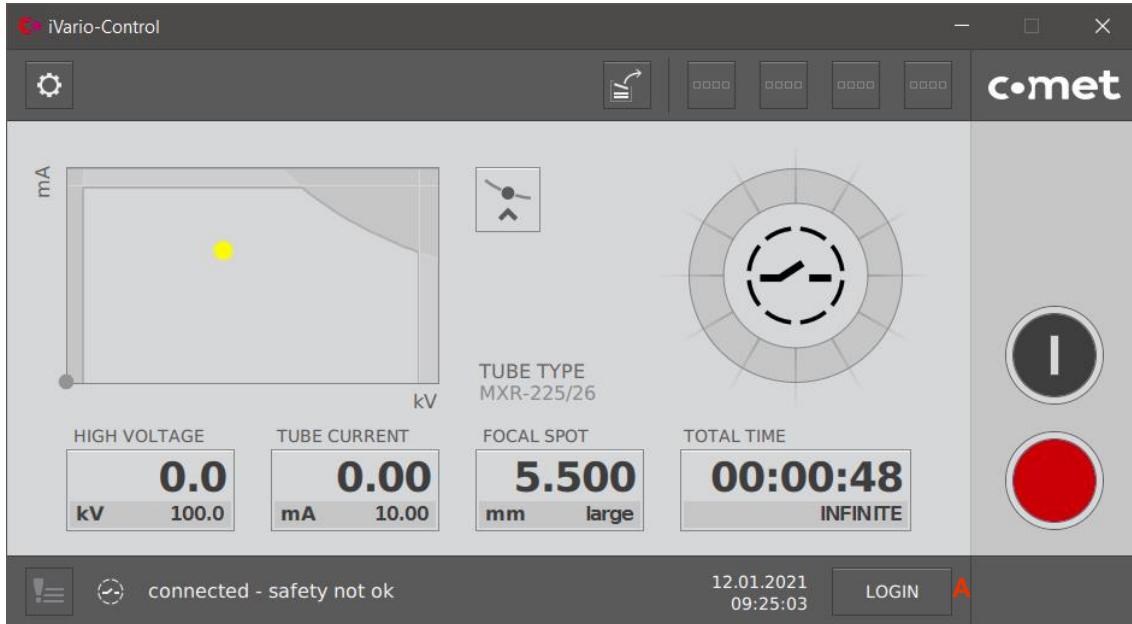


Fig. 75: IFC and safety interface

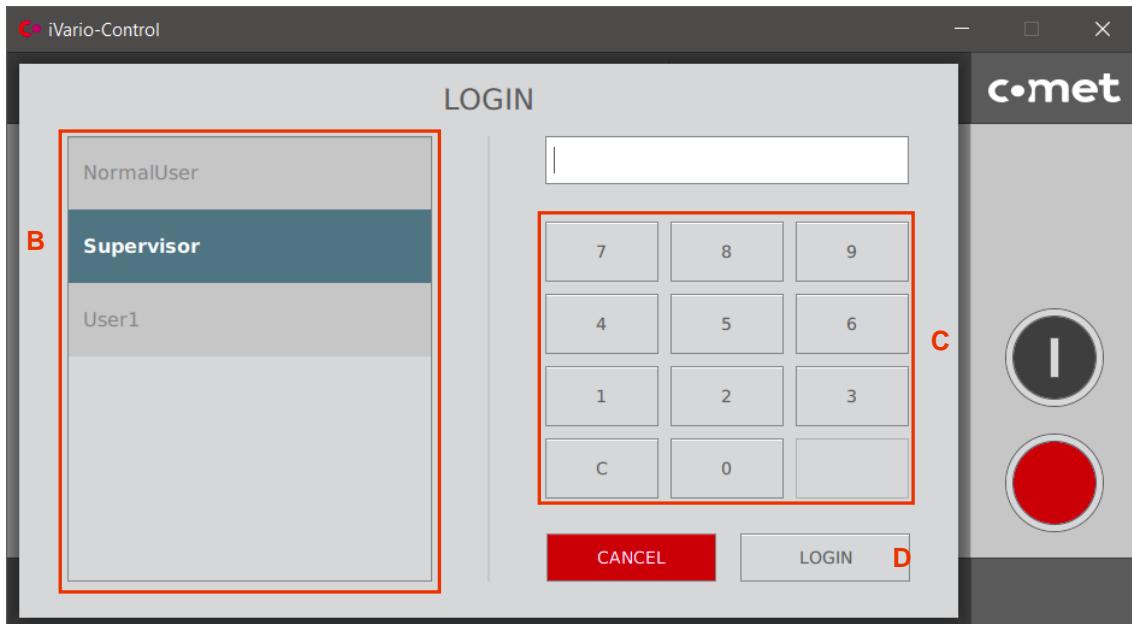
A	
A1	Power status
A2	User space status
A3	User feedback
A4	Linux kernel status
B	
B1	LED output 1
B2	LED output 2
B3	LED output 3
B4	LED output 4
B5	LED message 1
B6	LED message 2
B7	LED customer interlock 1
B8	LED customer interlock 2
B9	LED start button
B10	LED stop button
C	
C1	LED light 1
C2	LED light 2
C3	LED light 3
C4	LED dynamic monitoring
D	
D1	LED cooler flow
D2	LED cooler temp
D3	LED cooler on
D4	Not used
E	
E1	iVario Controller start button
E2	iVario Controller stop button
E3	iVario Controller key switch in position 1 or 2
E4	iVario Controller HV On light
E5	iVario Controller Ready light
E6	iVario Controller Prewarn light

5.3.3 Login

- ✓ Aux is switched on.



1. Click the *Login* button A.
→ The following window is displayed:



2. Select user *Supervisor* in section B.
 3. Enter password 1111 using the screen keyboard C and click the Login button D.
- The iVario control software is started and you are logged on.

5.3.4 Switching on mains power

- ✓ Aux is switched on.
- 1. Switch Mains on.
 - The powercell fan is started.
 - Message *powercell mains power not available* is no longer displayed in the not ready messages.
- Mains is switched on.

5.3.5 Checking the inputs

All inputs must be checked to ensure that they correspond to the intended installation. All possible configurations are described below.

Customer interlock 1

- ✓ Mains is switched on.
- 1. Connect the contact to customer interlock 1.
 - LED B7 at the IFC lights up.
 - Message *IO customer interlock 1 open* is no longer displayed in the not ready messages.
- Customer interlock 1 is closed.

Customer interlock 2

- 1. Connect the contact to customer interlock 2.
 - LED B8 at the IFC lights up.
 - Message *IO customer Interlock 2 open* is no longer displayed in the not ready messages.
- Customer interlock 2 is closed.

Stop button

- 1. Close the contact at stop button.
 - LED B10 at the IFC lights up.
 - Message *IO stop button* is no longer displayed in the not ready messages.
- The stop button is closed.

Inputs for safety interlock signals

Both input signals must remain simultaneously locked or bridged.

If they are bridged, message *Mains Off* is displayed every time the radiation-shielded door is opened.

If the input signals are connected to the auxiliary contacts of the external safety relay, message *safety interlock open* is displayed. In addition, the system now monitors the synchronicity for opening and closing.

Emergency stop inputs

If no emergency stop button is installed, the two input signals must remain bridged.

If the emergency stop is wired to an external safety device, the signal line can be connected to X12. Actuation of the emergency stop button is indicated in the not ready messages.

5.3.6 Cooler signals

Cooler-ON output

As soon as customer interlock 1 and 2 are closed, the cooler is switched on at the Cooler-ON output. LED D3 at the IFC lights up.

Cooler temperature input

If the temperature of the coolant is within the set temperature range, the contact must be closed. LED D2 at the IFC lights up. Message *IO cooler temp* is no longer displayed in the not ready messages.

Cooler flow input

After the cooler has been switched on, the flow rate is measured. If the flow rate is within the set range, LED D1 at the IFC lights up.

Message *IO cooler flow* is no longer displayed in the not ready messages.

5.3.7 Safety Ready state

When all safety signals and system states are correct, the iVario generator is set to *Safety ready* state. The iVario generator can be operated in three ways:

1. iVario control software
2. iVario controller
3. Control via interface (Ethernet or RS232)

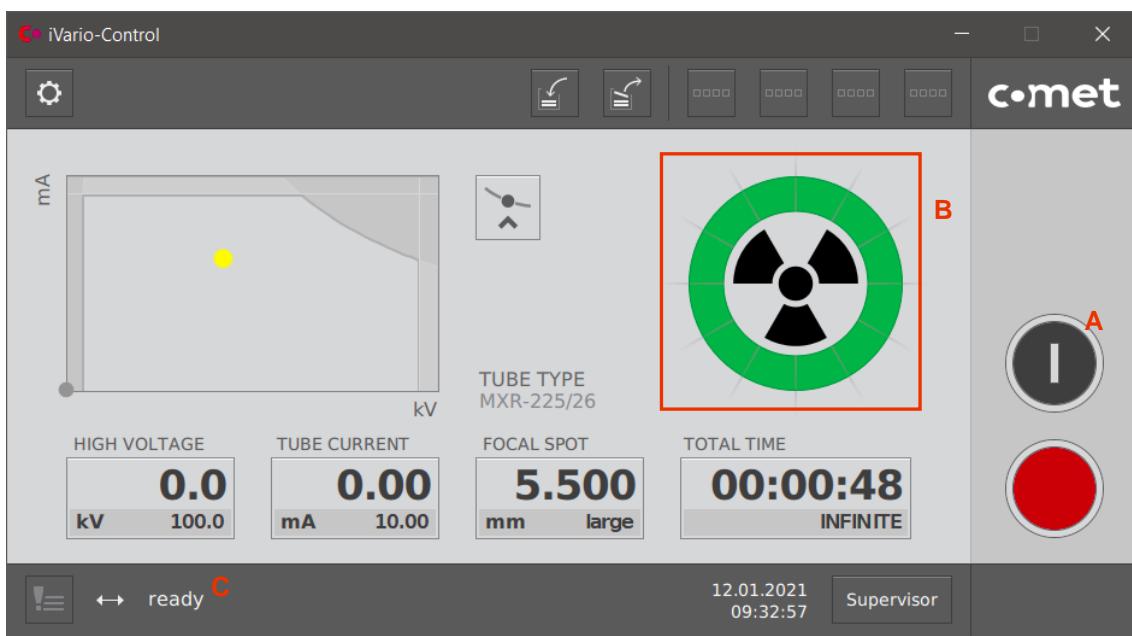


Notice

If the iVario controller is connected and active, the *Safety ready* state is skipped, and the machine goes directly to *Ready* state.

5.3.8 Ready state

- ✓ The *Safety ready* state is reached.
 1. Press the *HV Enable* button (button HV Enable on X8 pin 1 – 2, see chapter 4.10 Connecting the input/output (I/O signals) to X8 of the IFC)
 2. Start button A.
 - When the contact is closed, LED B9 at the IFC lights up.
 - When the contact is opened, the iVario generator state changes to *Ready*.
 - By default, output 1 signals *Ready* state. Output 1 is switched on as soon as the machine is in *Ready* state (see chapter 5.3.9 Checking other states (Prewarn and HV On)).
 - LED B1 indicates the status of output 1.
 - The following window is displayed in the iVario control software:



→ The iVario control software displays the *Ready* state **B**. Message *Ready* is displayed in the status line **C**.

→ The machine is in *Ready* state, and the generator is ready to be switched on.

The iVario generator can now be switched on by pressing the *On* button on the iVario controller or by clicking the *Start* button **A** in the iVario control software.

5.3.9 Checking other states (Prewarn and HV On)

To perform the tests of the remaining outputs and warning lights, the iVario generator must be switched on.

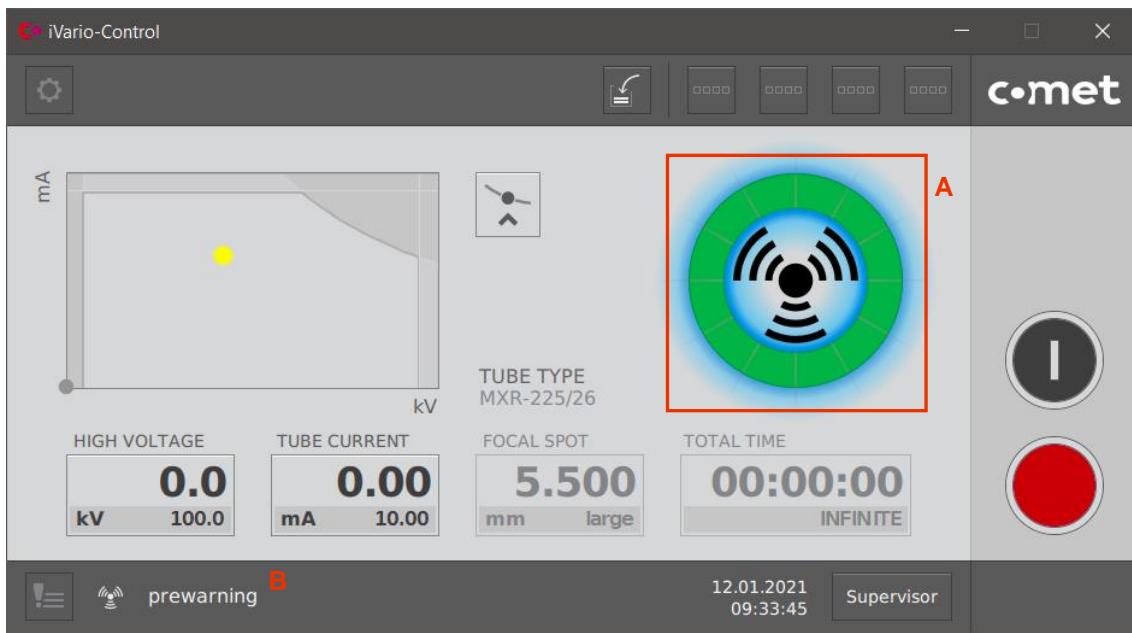
Ensure that the radiation area is closed and that all precautions necessary to ensure the safety of personnel have been taken.

Switching on the iVario generator

- ✓ The radiation area is closed off.
 - ✓ The machine is in *Ready* state.
 1. Set *high voltage* to a low value, for example 10 kV.
 2. Set *Tube current* to 0 mA.
 3. Click the *Start* button (in iVario control software) or press the *HV On* button (at iVario controller).
- The iVario generator is switched on.

Prewarn

After switching on, the system is set to Prewarn state for the set prewarning time (default 2 s). By default, output 2 is set to Prewarn state. Output 2 is switched on and LED B2 indicates the state of output 2.

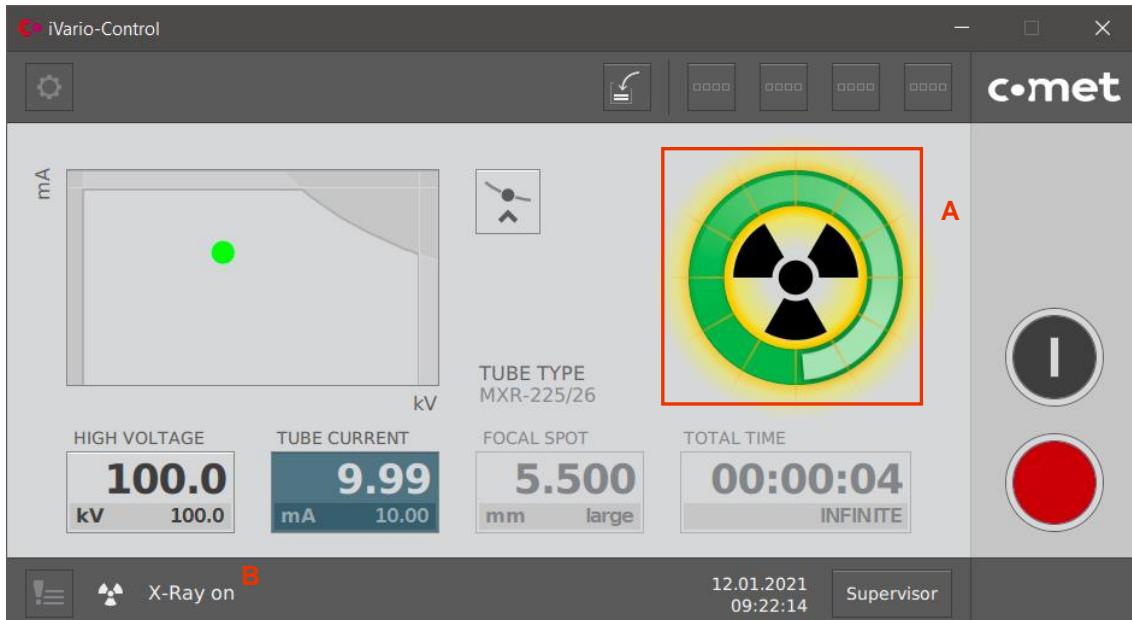


- In the iVario control software, *Prewarn* state is displayed in section **A**. Message *prewarning* is displayed in the status line **B**.

High voltage On

As soon as the prewarning time has elapsed, the machine changes to state *HV On*. Output 2 is switched off and output 3 and 4 (default state: *HV On*) are switched on. LEDs B3 and B4 at the IFC indicate the respective states.

- The following window is displayed in the iVario control software:



- *HV On* state is displayed in section **A**. Message *X-ray on* is displayed in the status line **B**.

5.3.10 Testing of warning lights

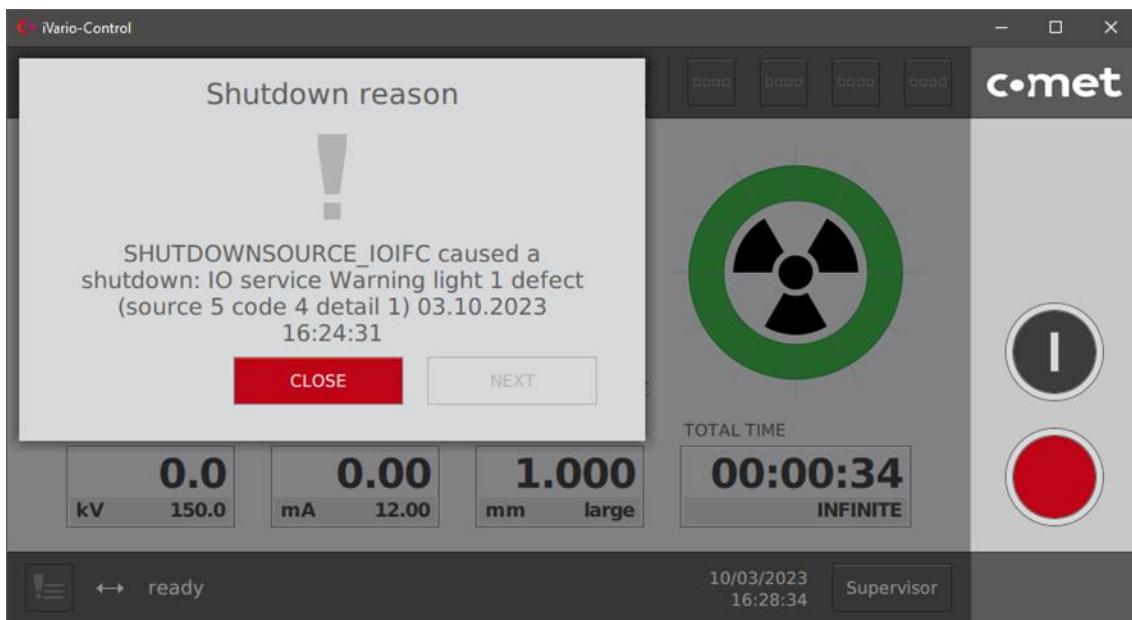
When the machine is in *HV On* state, all warning lights are continuously monitored.

The lights are monitored/check by measuring their current consumption. If the current consumption is smaller than the preset threshold value, the iVario generator is automatically shut-down. An error message to this fact is displayed and the respective light must be replaced.

Testing warning lights

To test the warning lights, proceed as follows:

1. Disassemble all configured warning lights (by default, only one light is configured).
 2. Switch on the iVario generator.
 - After the prewarning time has elapsed, the iVario generator is instantly shut-down.
- The following window is displayed in the iVario control software:



5.3.11 Checking further safety equipment

Customer interlock

- ✓ The machine is in *Ready* state.
 - 1. Switch on the iVario generator.
 - 2. Open the customer interlock.
- The iVario generator switches off and error message **A** is displayed.



External safety equipment (door switches, mains)

- ✓ The machine is in *Ready* state.
 - 1. Switch on the iVario generator.
 - 2. Switch off the mains power supply or open the external safety equipment.
- The iVario generator shuts down and an error message to this fact is displayed.

6 Operation

The iVario generator can be operated in three different ways:

1. iVario control software
2. iVario controller
3. Control interface from OEM customer software (Ethernet or RS232)

The description below refers only to operation through the iVario control software and the manual iVario controller.

6.1 User interface and symbol

User interface

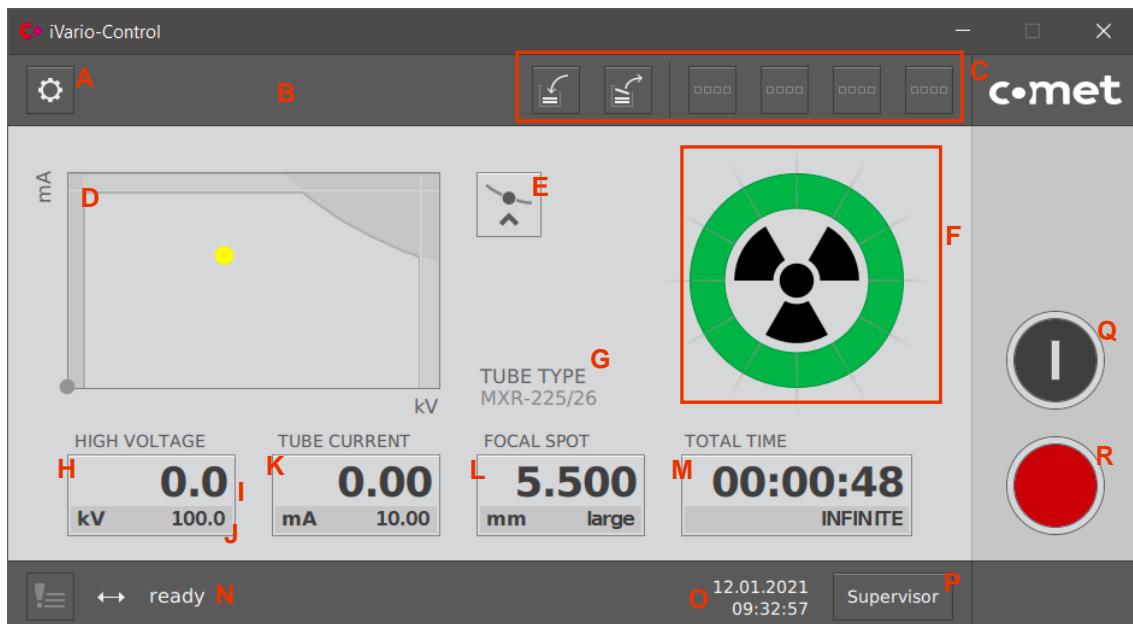


Fig. 76: User interface

Item	Description
A	Configuration (creating users, recipes, etc.)
B	Name of loaded recipe (not displayed here)

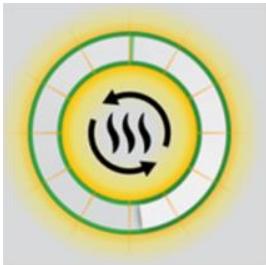
Item	Description
C	<p>Stored target values (values for voltage and current) Target values can be saved so that operators can quickly choose voltage and current values. The target values are only retained while the iVario software is running.</p> <p>Up to four separate target values each for voltage and current can be saved. Saving target values: Press and hold the Save button until it changes to white. The set kV and mA values as well as the exposure time are saved. Loading target values: Briefly press the Save button to apply the saved values.</p>
D	Power characteristic of connected tube
E	Isowatt selection
F	Status section
G	X-ray tube type
H	Tube voltage
I	Actual value (of respective parameter)
J	Target value (of respective parameter)
K	Tube current
L	Focus
M	Exposure time
N	Status line
O	Current date and time

Item	Description
P	Username After login, the name of the user is displayed here
Q	Only with iVario control software: Generator start
R	Only with iVario control software: Generator stop

Symbol status display

Symbol	Status line message	State, comment
	No communication	NOT READY Aux off or communication not established
	Not ready messages	NOT READY Aux on, safety circuit open, communication established
	IO press start button	SAFETY READY – IMMINENT System ready, cooler parameters OK, stop button actuated and/or HV Enable button not yet actuated

Symbol	Status line message	State, comment
	Connected	<p>READY</p> <p>Mains on, X-ray tube ready, HV Enable button actuated, High voltage off</p>
	Prewarn	<p>PREWARN</p> <p>Prewarning (default time: 2 s) pending, High voltage not yet on</p>
	X-ray On	<p>High voltage On</p> <p>Voltage and current ramp up to target values or have reached these</p>
	X-ray On	<p>Voltage and current have reached target values, exposure time is running:</p> <p>Green segments: elapsed time White segments: remaining time</p>
	Warm-up upon next switching on	<p>A warm-up is required next time the system is switched on, based on time for which the generator was shut-down.</p>

Symbol	Status line message	State, comment
	Warm-up	Generator being warmed up
	Error	Error/fault; error message is displayed

6.2 Operation of iVario control software and iVario controller

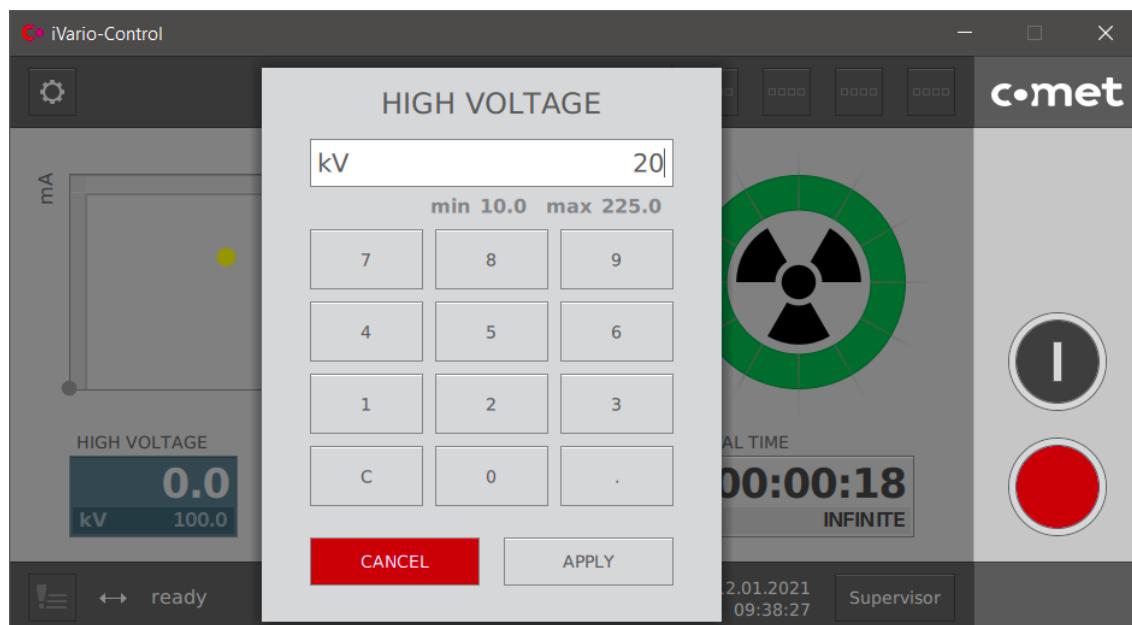
This chapter describes the operating concept and the user interface of the iVario control software.

6.2.1 iVario control software

In the iVario control software, values can be modified in several ways.

Changing values using the screen keyboard

1. Using the mouse, click the field of the value you want to change and keep the mouse button down until the screen keyboard is displayed.
→ The selected field is highlighted in blue, and the following dialogue is displayed:



2. Enter the value using the screen keyboard.
3. Click Apply or press Return on the keyboard to save the value.

Changing values using the scroll wheel

1. Click field of the value you want to change.
→ Turn the mouse scroll wheel to increase or decrease the value.
- The value has been changed.

6.2.2 iVario controller

At the iVario controller, values and settings can be changed by operating the control dial or the touch panel.

Control dial

1. On the touch panel, press the field whose value you want to change.
→ The selected field is highlighted in blue, and the following dialogue is displayed:



2. Turn the control dial clockwise to increase the value.
3. Turn the control dial anti-clockwise to decrease the value.
- The value has been changed.

Touch panel

1. On the touch panel, press the field whose value you want to change and keep it pressed until the screen keyboard appears.
2. Enter the value using the screen keyboard.
3. Press the *Apply* button to save the value.
- The value has been changed.

6.3 Switching on and shutting down sequence

6.3.1 With iVario control software

6.3.1.1 Switching on

- ✓ The installation has been fully commissioned and tested.
 1. Execute the *iVario-Control.exe* or the *iVario-Control.bat* file to start the iVario control software.
 2. Switch on Aux at the iVario generator.
 - The IFC software start-up is completed after approx. 90 s.
- LEDs 1, 2 and 4 at the powercell light up.

Login

- ✓ The iVario control software is running.
 1. Click the *Login* button.
 2. Selected a user from list (e.g. *Supervisor*).
 3. Enter the password, using the screen keyboard. Default password: 1111
 4. Click *Login*.
 - The logged-in user is displayed.
 - Additional symbols are displayed in the header.
- The user is logged in.

Switching on the iVario generator

1. Switch Mains on.
 - The powercell fans are switched on.
 2. Close all safety circuits (customer interlocks 1 and 2, stop button, emergency stop button).
 - The cooler is switched on.
 - The iVario generator changes to *Safety ready* state.
 3. Click the *Start* button.
 - The iVario generator changes to *Ready* state.
- The machine is in *Ready* state and HV On can be switched on.

Switching high voltage on

1. Click the *Start* button to switch on the iVario generator.
 - In the iVario control software, *X-ray on* state is displayed. After the prewarning phase has elapsed, message *X-ray on* is displayed in the status line.
- High voltage is switched on.

6.3.1.2 Switching off

- ✓ The X-ray tube must be switched on.
- 1. To switch off the high voltage, press the *Stop* button.
 - State *Ready* is displayed.
- 2. Switch off Mains or open one of the door switches.
 - Status *Not ready* is displayed.
 - The iVario generator remains power to maintain communication.
- 3. After the cooler delay has elapsed: Switch Aux off.
 - The iVario generator is now shut-down.

6.3.2 With iVario controller

6.3.2.1 Switching on

Key switch

The iVario controller can be started when the key switch is in position  (Supply Voltage ON) or  (Module ON).

The key can be removed in positions OFF and Supply Voltage ON . If the key is removed, no functions can be actuated at the iVario controller.

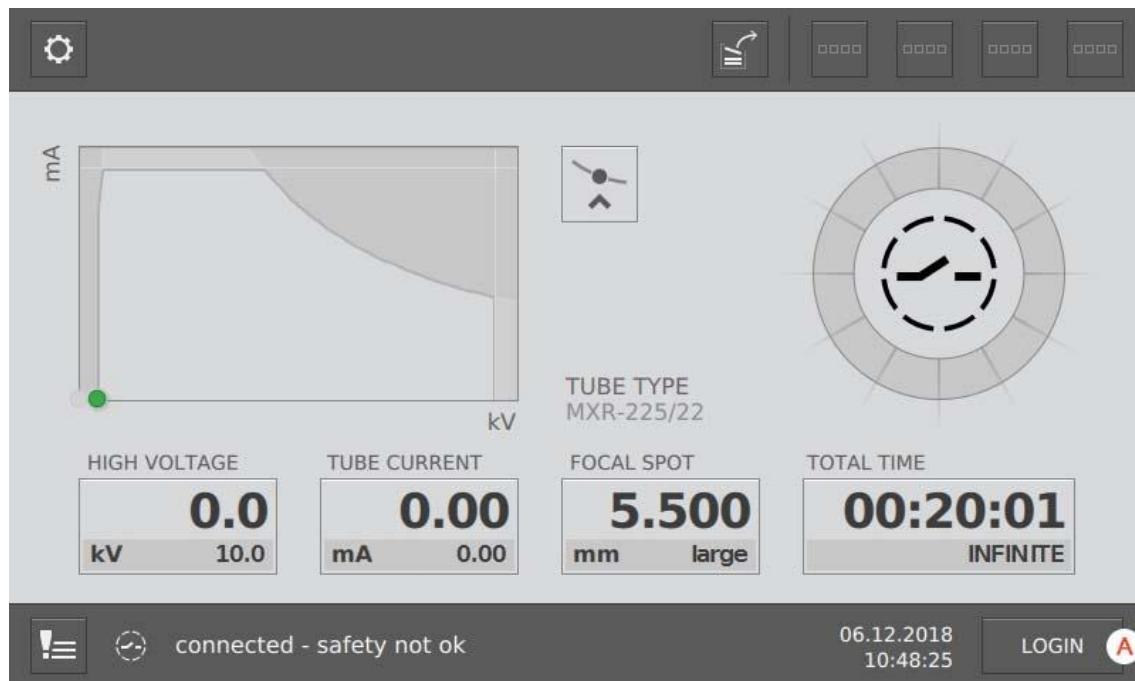
- ✓ The installation has been fully commissioned and tested.
- 1. Switch on Aux at the iVario generator.
 - The IFC software start-up is completed after approx. 90 s.
- LEDs 1, 2 and 4 at the powercell light up.

Switching on the iVario generator

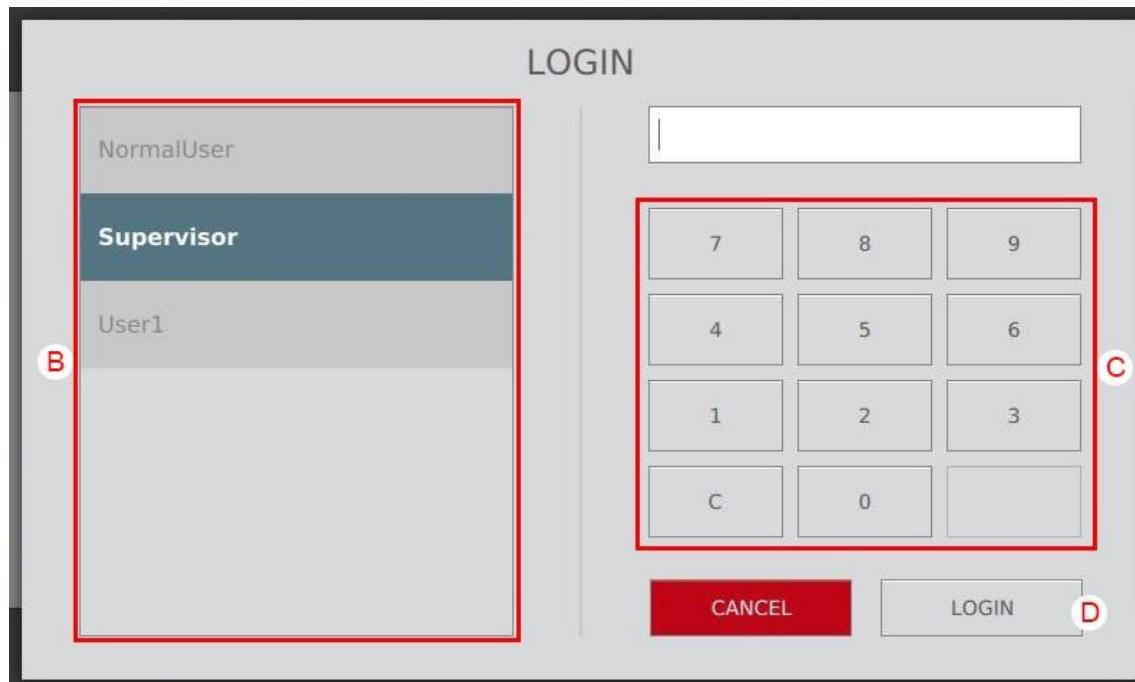
- 1. Switch Mains on.
 - The powercell fans are switched on.
- 2. Close all safety circuits (customer interlocks 1 and 2, stop button, emergency stop button).
- 3. Turn the key switch at the iVario controller to position  (Supply Voltage ON).
- The iVario controller starts and is ready for operation after approx. 20 s.

Login

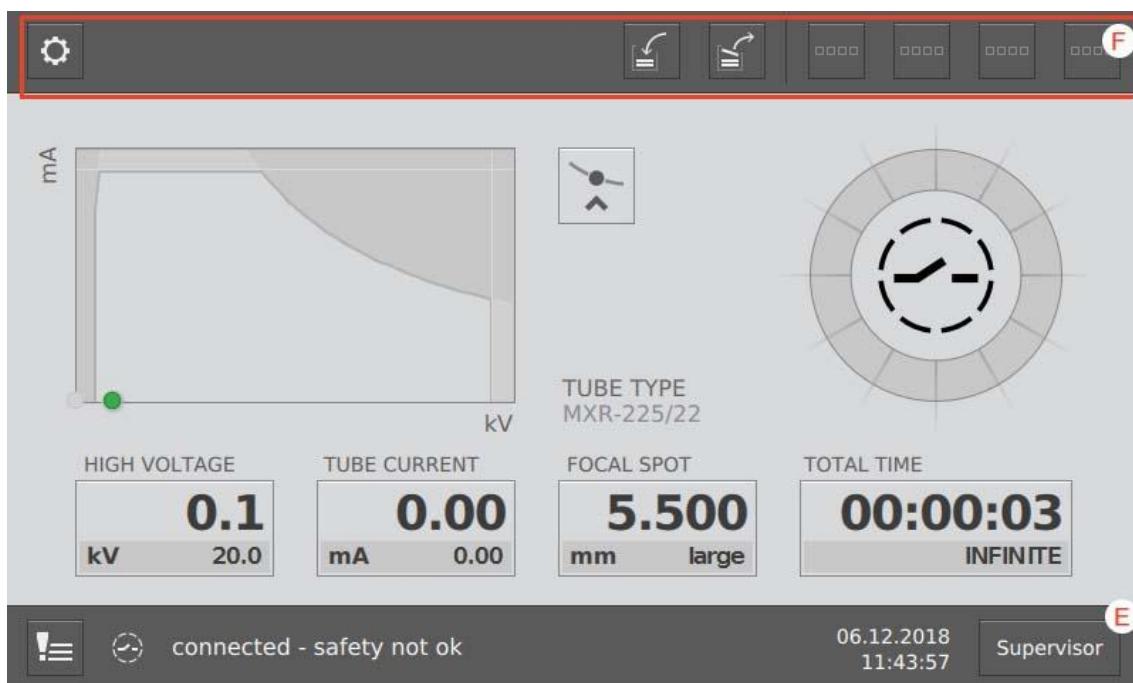
- ✓ The iVario controller is started.



1. Click the *Login* button **A**.
→ The following window is displayed:



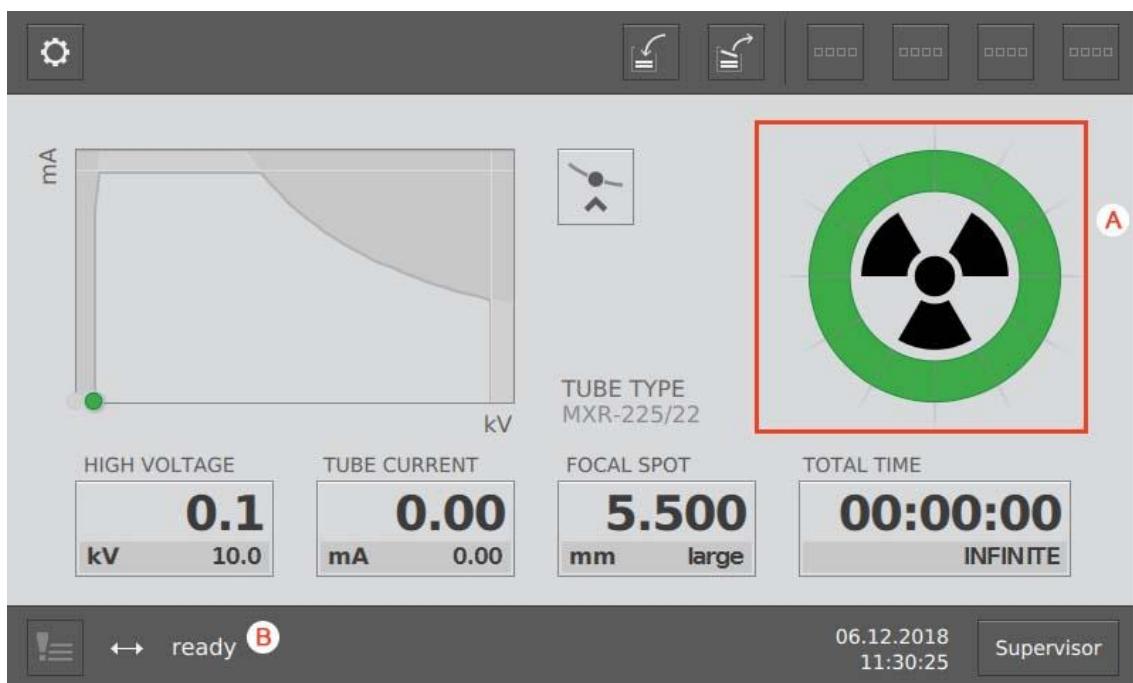
2. Selected a user from list **B** (e.g. *Supervisor*).
3. Enter the password, using the screen keyboard **C**. Default password: 1111
4. Click *Login* **D**.
→ The following window is displayed:



- The logged-in user is displayed on button **E**.
- Additional symbols are displayed in the header **F**.
- The user is logged in.

Switching on the iVario generator

1. Switch Mains on.
→ The powercell fans are switched on.
2. Close all safety circuits (customer interlocks 1 and 2, stop button, emergency stop button).
→ The cooler is switched on.
→ The iVario generator changes to *Ready* state.
→ The following window is displayed on the iVario controller:



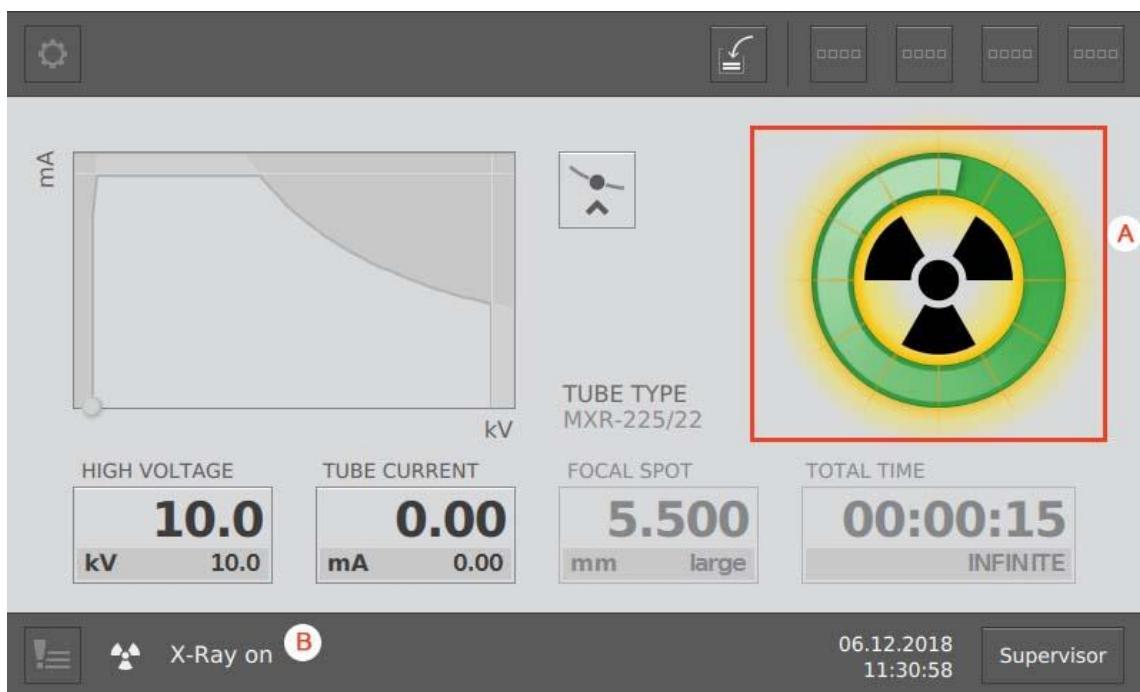
- At the iVario controller, *Ready* state is display in section **A**. Message *ready* is displayed in the status line **B**.
- The machine is in *Ready* state and HV On can be switched on.

Switching high voltage on

1. Click the Start button **A** to switch on the iVario generator.



- The following window is displayed:



- At the iVario controller, *X-ray on* state is displayed in section A. After the prewarning phase has elapsed, message *X-ray on* is displayed in the status line B.
- High voltage is switched on.

6.3.2.2 Switching off

- ✓ X-ray is switched on.

1. Press the *Off* button A to switch off the high voltage.



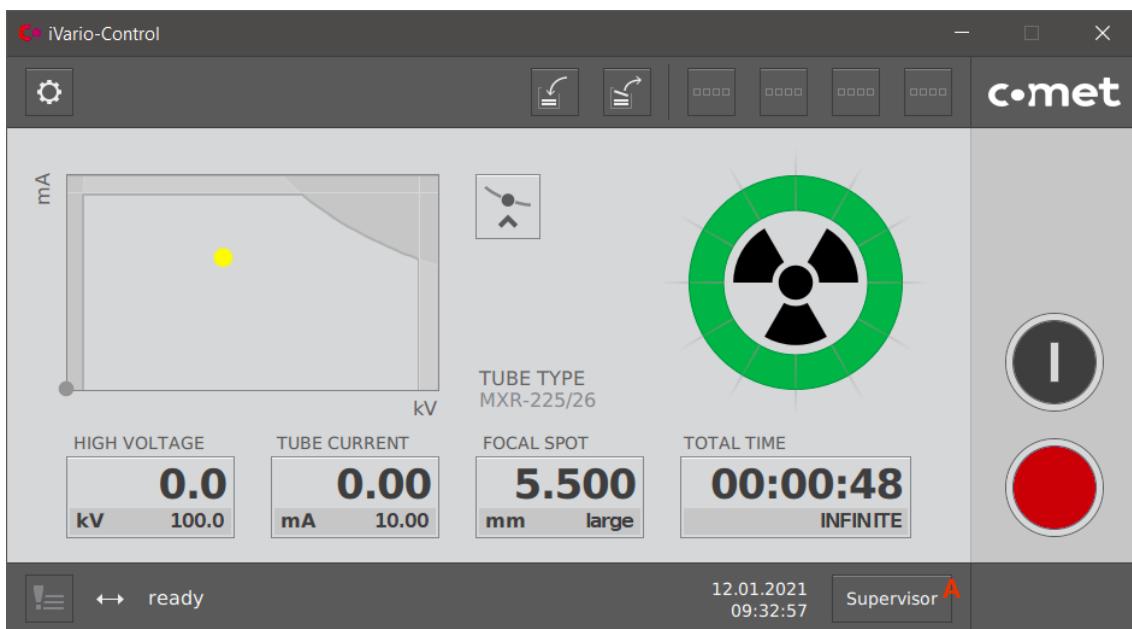
- State *Ready* is displayed.
- 2. Switch off Mains or open one of the door switches.
→ Status *Not Ready* is displayed.
- 3. Turn the key switch at the iVario controller to position 0 and remove the key.
→ The iVario controller is switched off. The iVario generator remains powered to maintain communication.
- 4. After the cooler delay has elapsed: Switch Aux off.
→ The iVario generator is now shut-down.

6.3.3 Logout

The instructions below apply to both the iVario control software and the iVario controller.

Logout

- ✓ User1 is logged in.



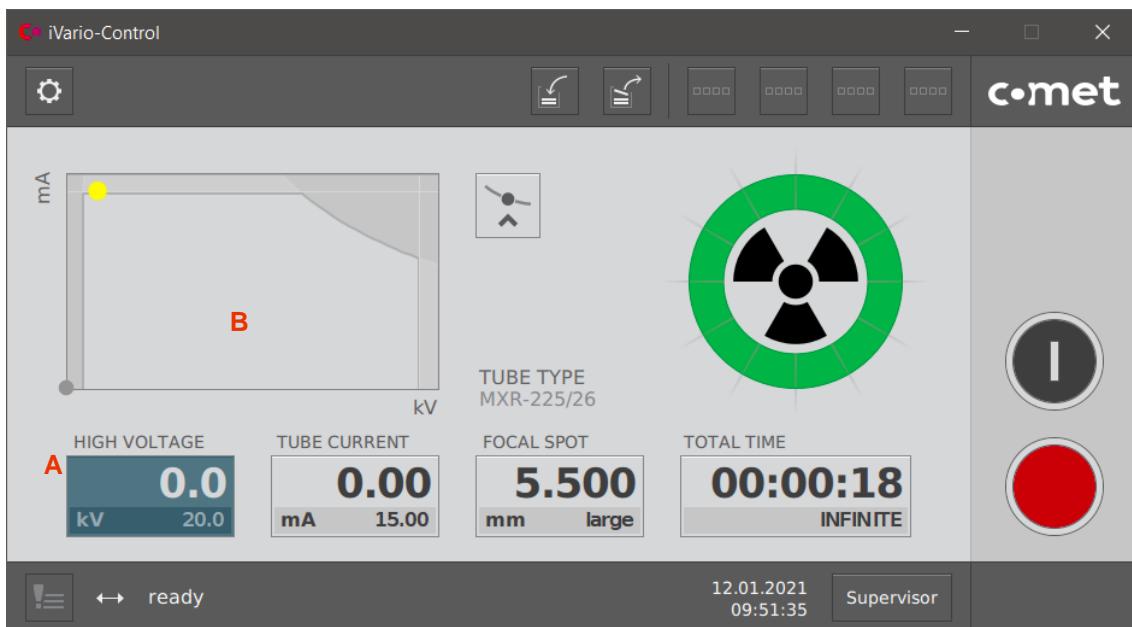
1. Click button *Supervisor A*.

→ The user is logged out.

6.4 Settings

6.4.1 Voltage (kV)

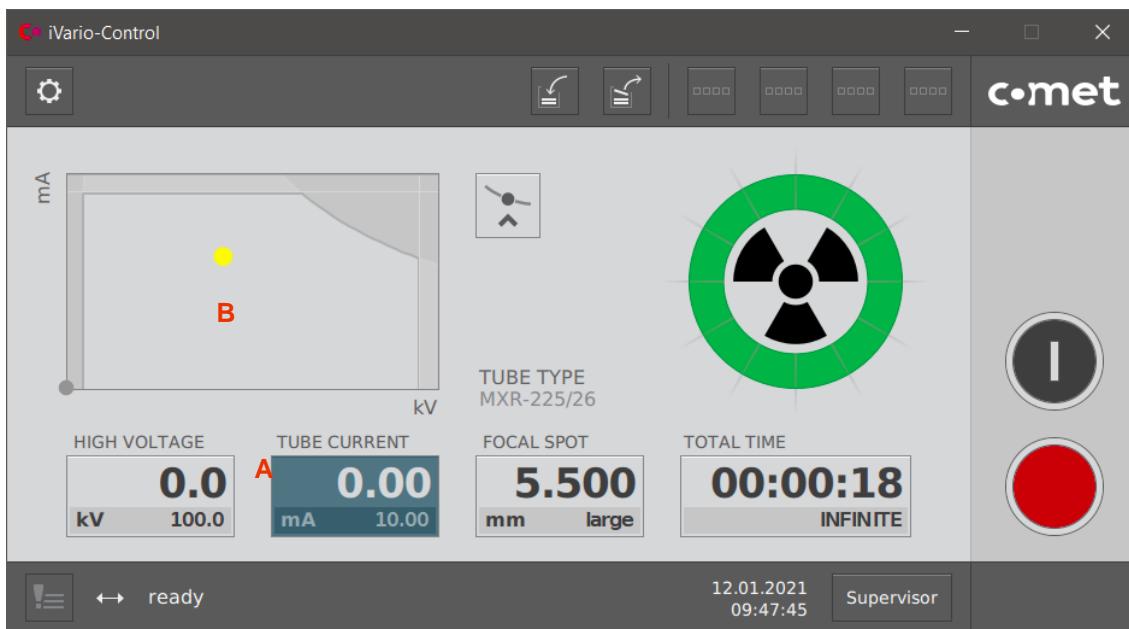
- ✓ The iVario control software or the iVario controller is switched on.
- 1. Click the *High voltage* field.
→ The following window is displayed:



- The *High voltage A* field is highlighted in blue.
- Enter the target (see chapter 6.2 Operation of iVario control software and iVario controller).
 - The target value is displayed in the *High voltage* field and in the power curve **B**.
- Voltage is switched on.

6.4.2 Current (mA)

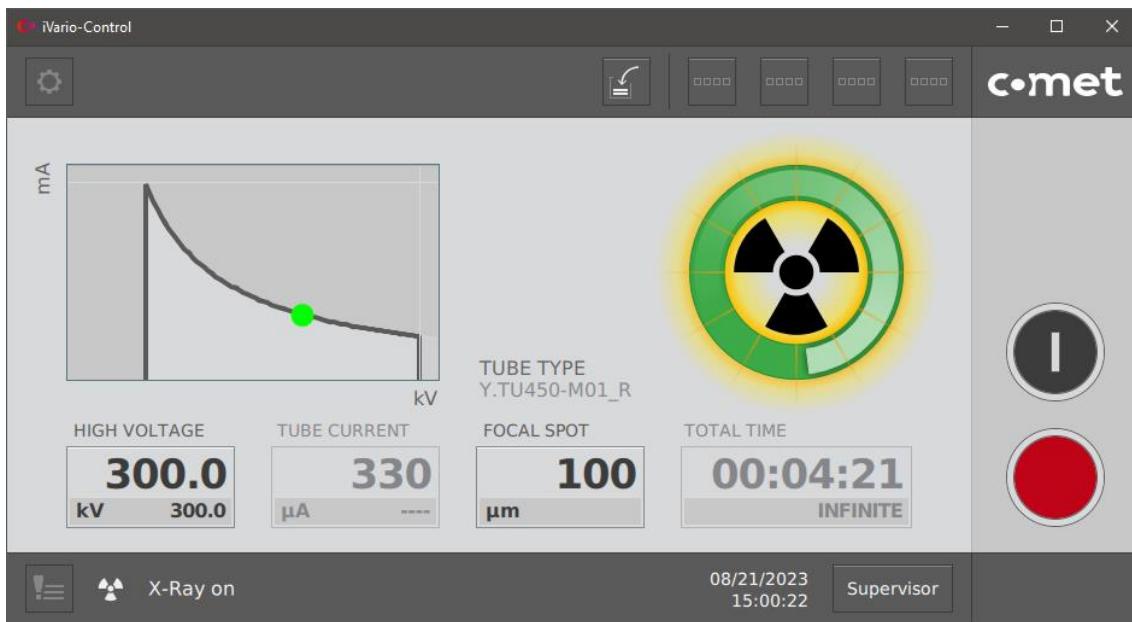
- ✓ The iVario control software or the iVario controller is switched on.
- Click the *Tube current* field.
 - The following window is displayed:



- The *Tube current A* field is highlighted in blue.
- Set the target value (see chapter 6.2 Operation of iVario control software and iVario controller).
 - The target value is displayed in the *Tube current* field and in the power curve **B** as a working point.
- The current is set.

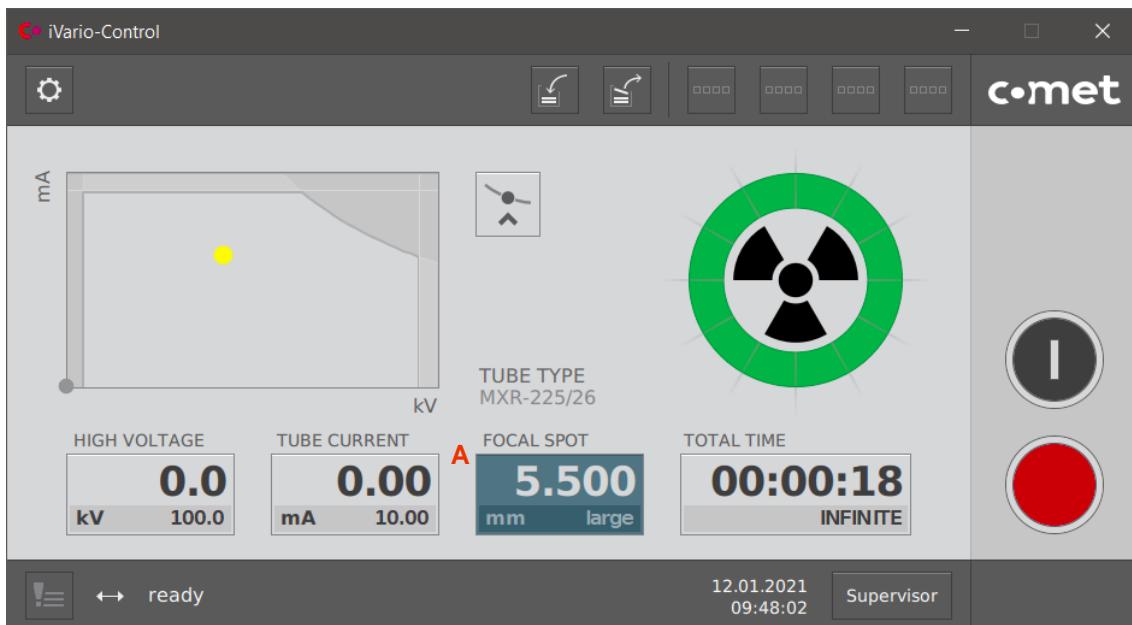
For an iVario MesoFocus system, the current is defined by the maximum power available for a given focal spot. The current cannot be adjusted.

In the following example, an iVario-450MF has 100 W and for the focal spot 100 µm. The current is therefore automatically calculated so that the power of 100 W is maintained.

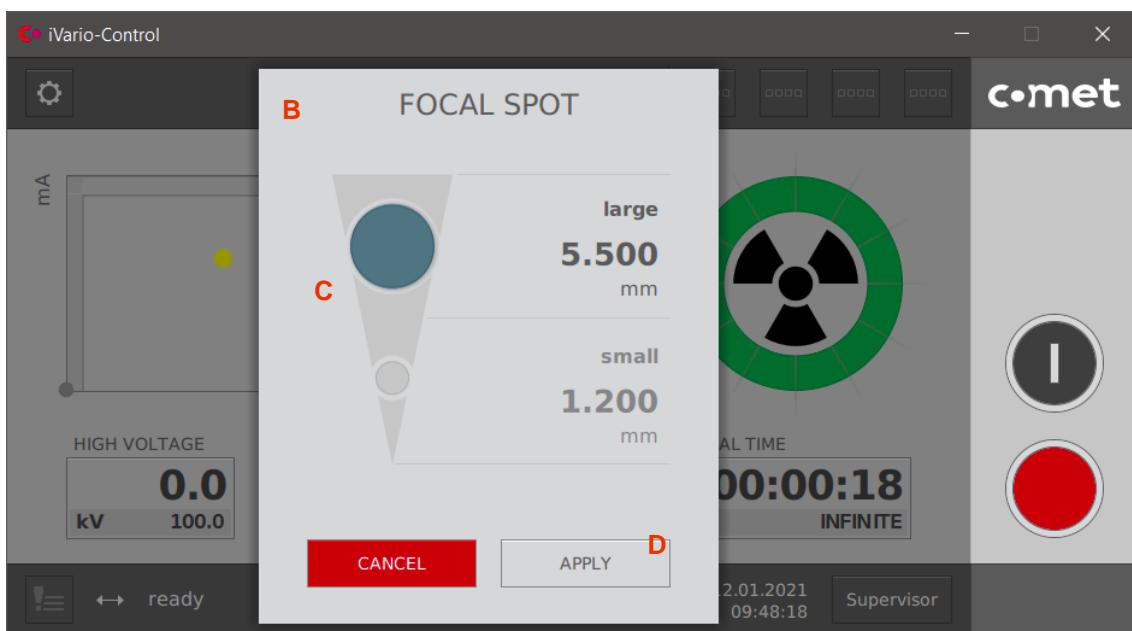


6.4.3 Focus

- ✓ The iVario control software or the iVario controller is switched on.
- ✓ The generator is switched off (e.g. in *Ready* state).
 1. Click the *Focal spot* field.
→ The following window is displayed:

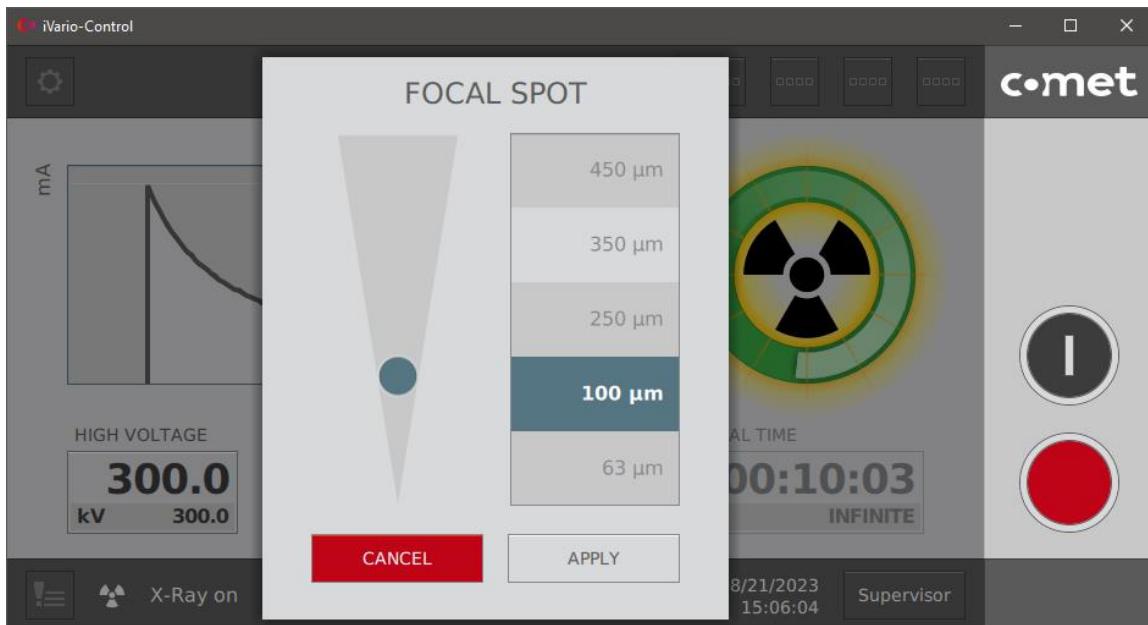


- The *Focal spot* field **A** is highlighted in blue.
- The focus can be switched between large and small.
- 2. Click the *Focal spot* field **A**. The *Focal spot* window **B** is displayed.
→ The following window is displayed:



3. Select Focus **C**.
 4. Click the *Apply* button **D** to save the value.
Click the *Cancel* button to cancel saving.
→ The target value is displayed in the *Focal spot* field.
- The focus is set.

For the iVario MesoFocus systems, up to five focal spots can be selected. The focal points can be changed during high voltage operation.



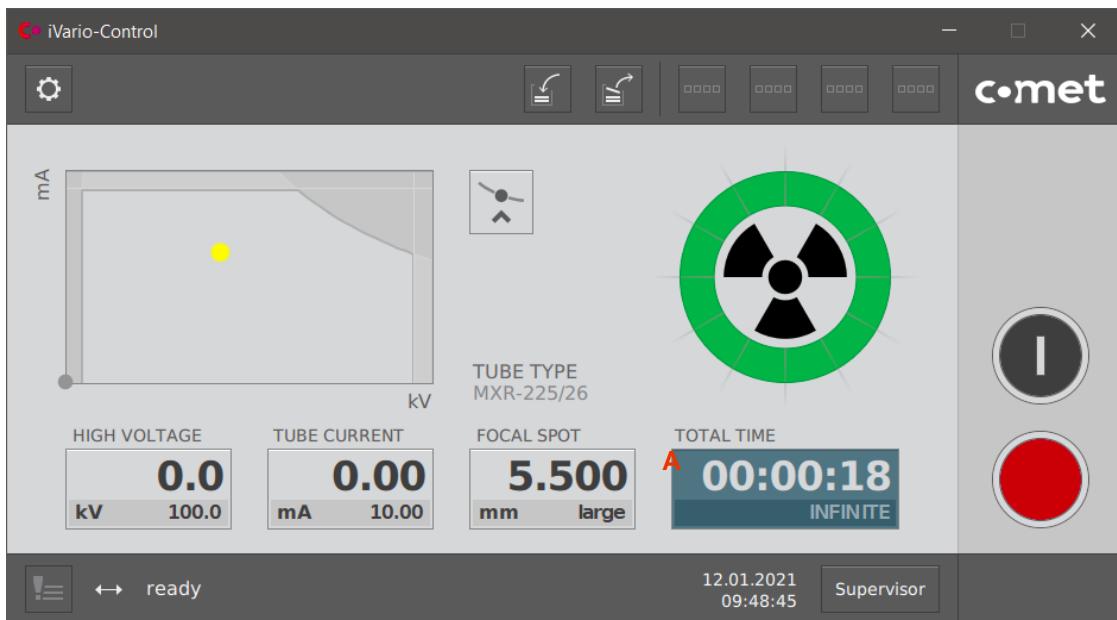
6.4.4 Exposure time (total time)

✓ The iVario control software or the iVario controller is switched on.

✓ The generator is switched off (e.g. in *Ready* state).

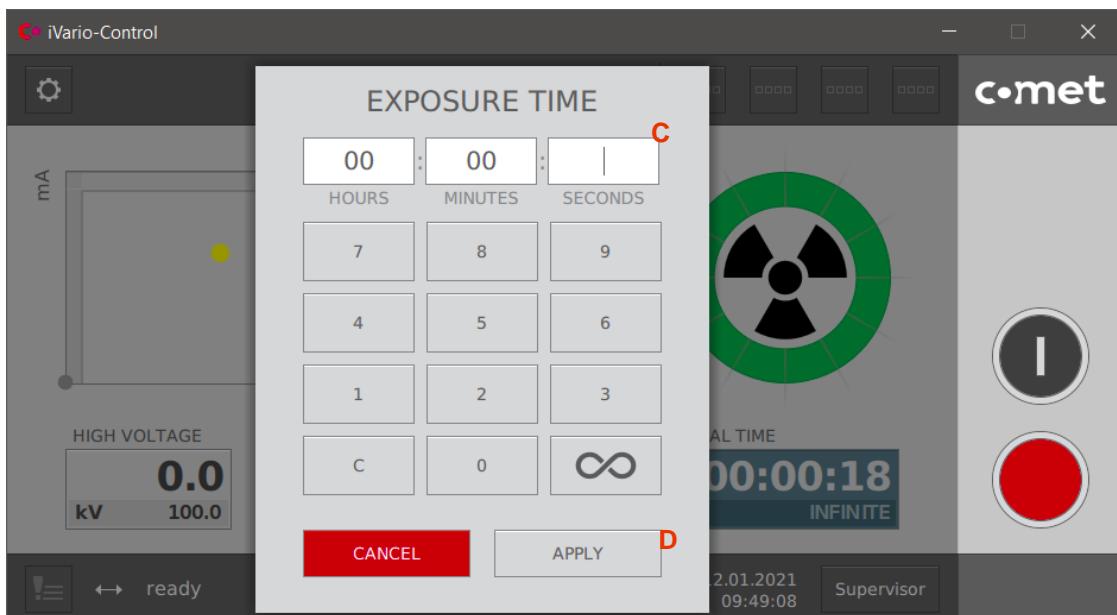
1. Click the *Total time* field.

→ The following window is displayed:



→ The *Total time* field **A** is highlighted in blue.

→ The *Exposure time* window is displayed.



2. Click the text fields for *Hours*, *Minutes* and *Seconds* **C** and enter the exposure time, using the screen keyboard.

3. Click the *Apply* button **D** to save the value.

Click the *Cancel* button to cancel saving.

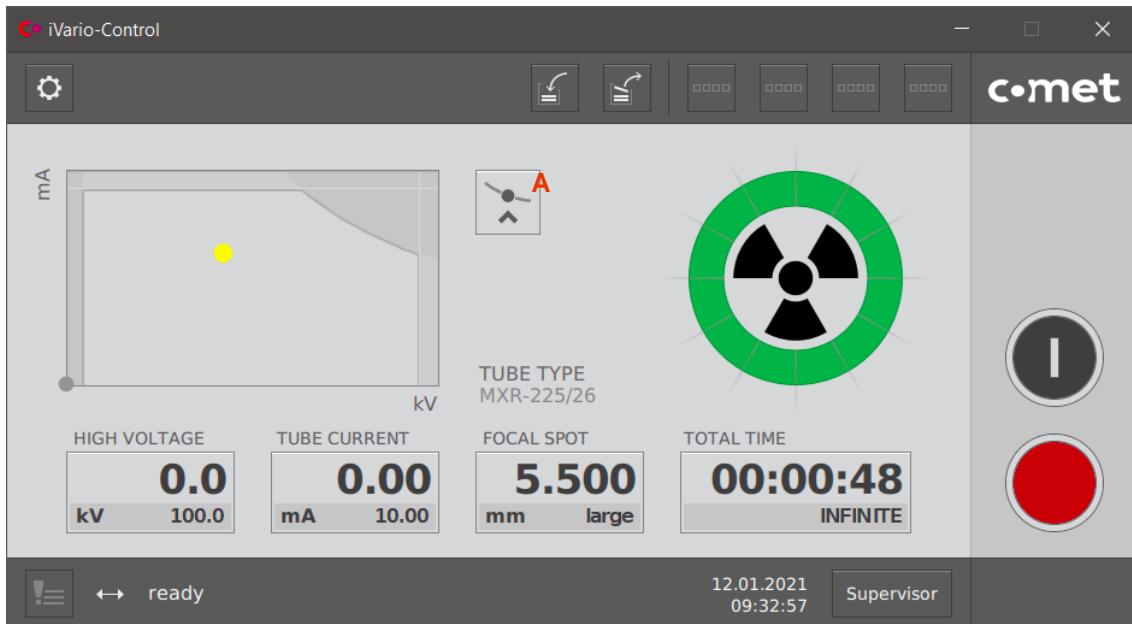
→ The target value is displayed in the *Total time* field.

→ The exposure time is set.

6.4.5 Isowatt

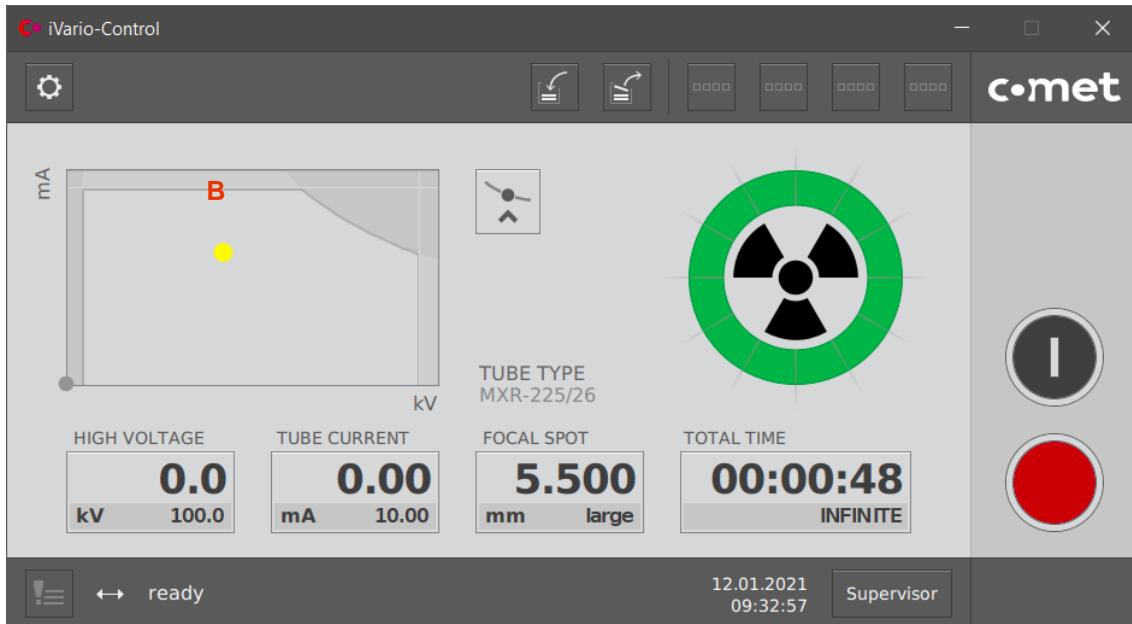
Adjustment with mouse

- ✓ The iVario control software or the iVario controller is switched on.



1. Click the *Isowatt* button A.

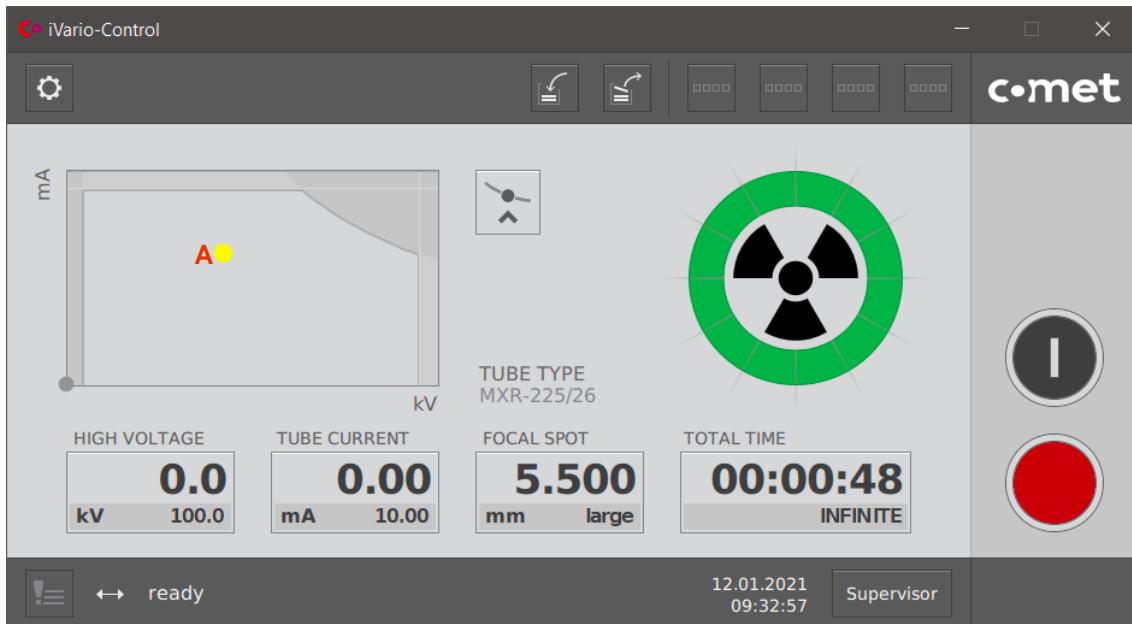
→ The following window is displayed:



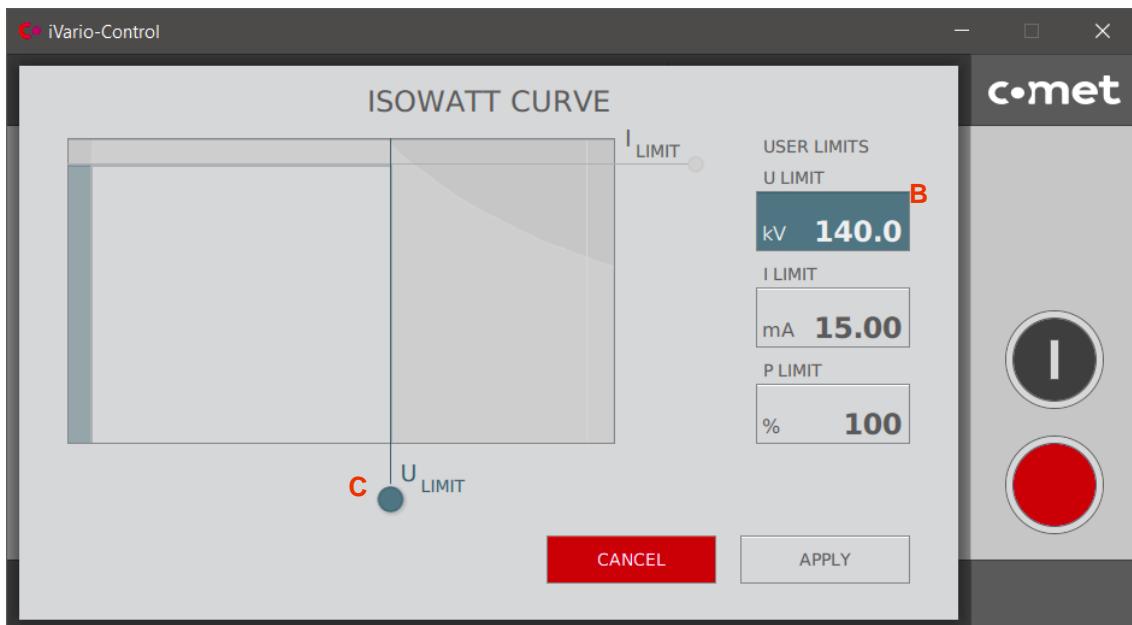
→ Working point B can be adjusted with the mouse or the control dial along the maximum output level of the X-ray tube.

2. Set the working point.
- Isowatt is switched on.

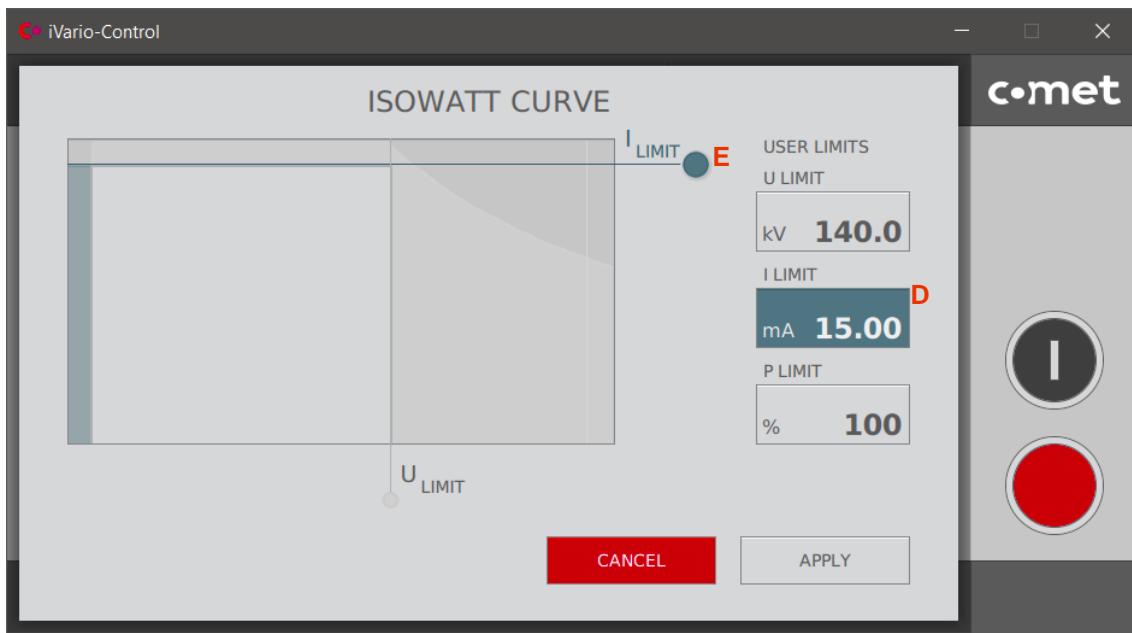
Adjusting limits for isowatt characteristic



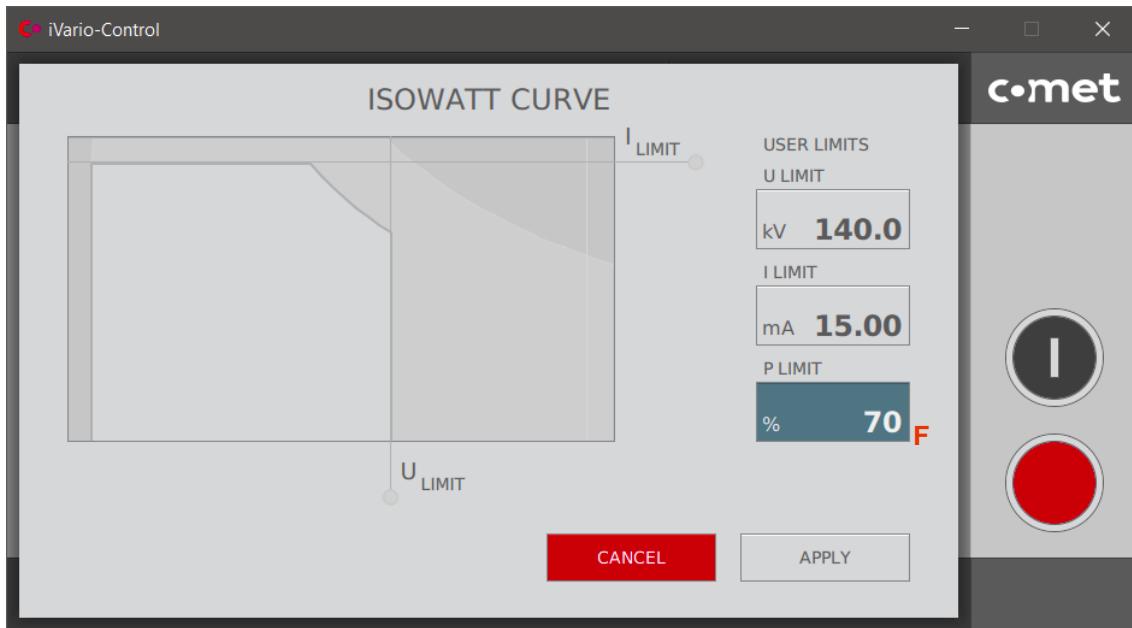
1. Click the *Isowatt* button **A** to call up the *Isowatt curve* window.
→ The following window is displayed:



2. Click *U Limit* **B** and move the mouse scroll wheel/control dial for the voltage limit value (U_{LIMIT}) to limit point **C**.



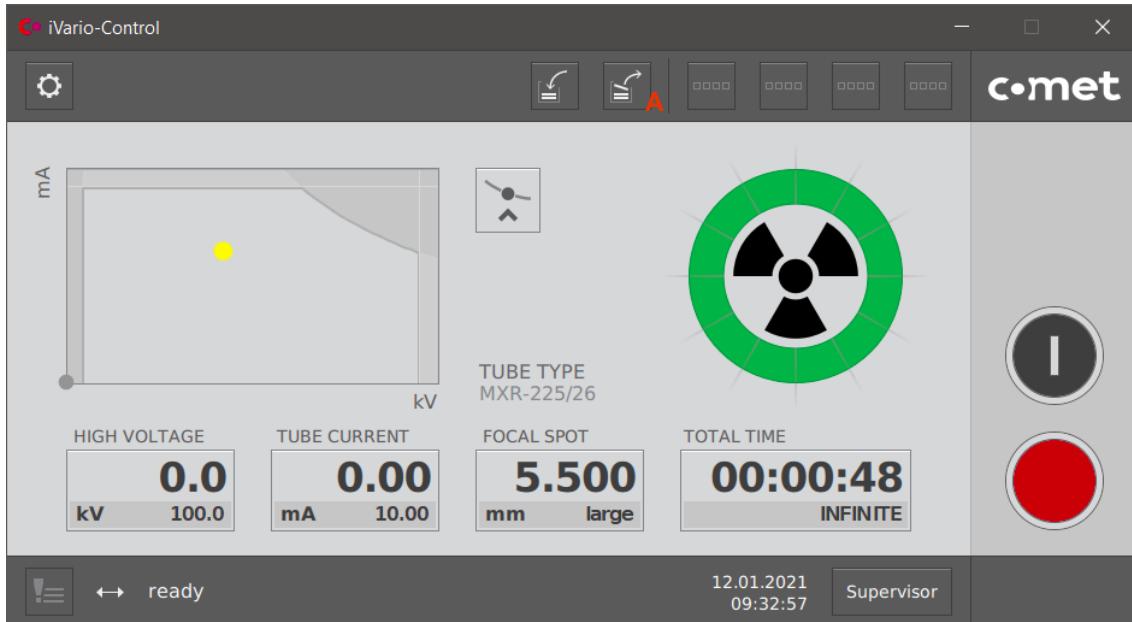
3. Click *I Limit D* and move the mouse scroll wheel/control dial for the current limit value (I_{LIMIT}) to limit point **E**.
This function is not available for the iVario MesoFocus systems.
4. Adjust value *P Limit F*, using the mouse scroll wheel/control dial.



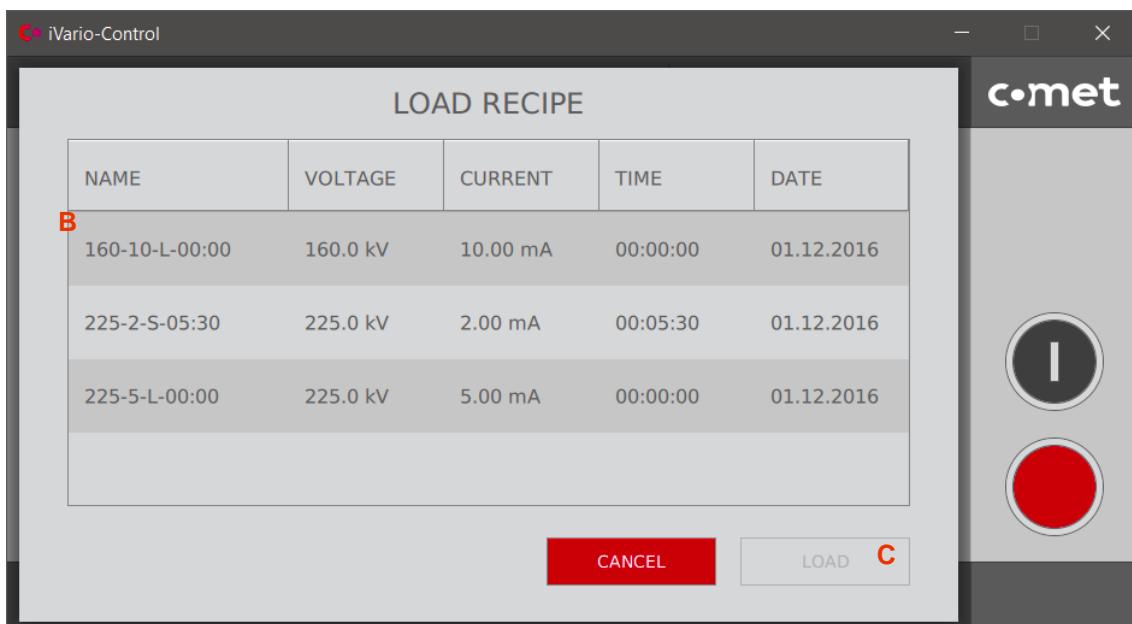
5. Click the *Apply* button to save the setting.
→ The limits of the isowatt characteristic are defined.

6.4.6 Loading recipe

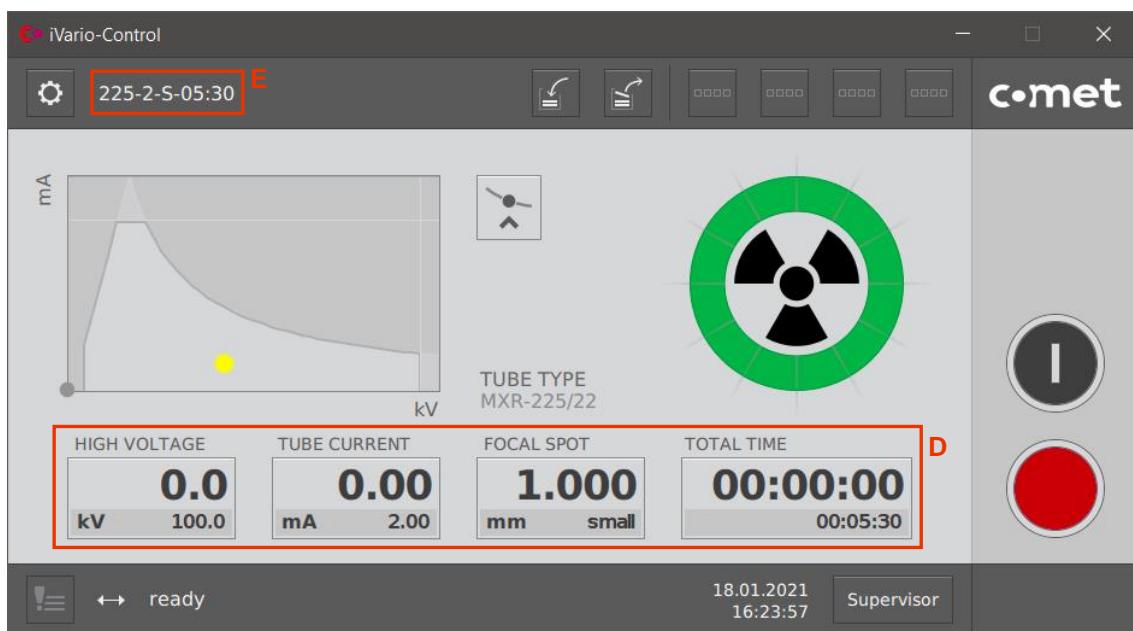
- ✓ The iVario control software or the iVario controller is switched on.
 - ✓ You are logged in as a user.
1. Click the Load recipe button **A** to load an existing recipe.



- A recipe contains predefined settings for voltage, power, focus and exposure time.
- The following window is displayed:



2. Select a recipe from the *Load recipe* list **B**.
3. Click the *Load* button **C** to load the selected recipe.



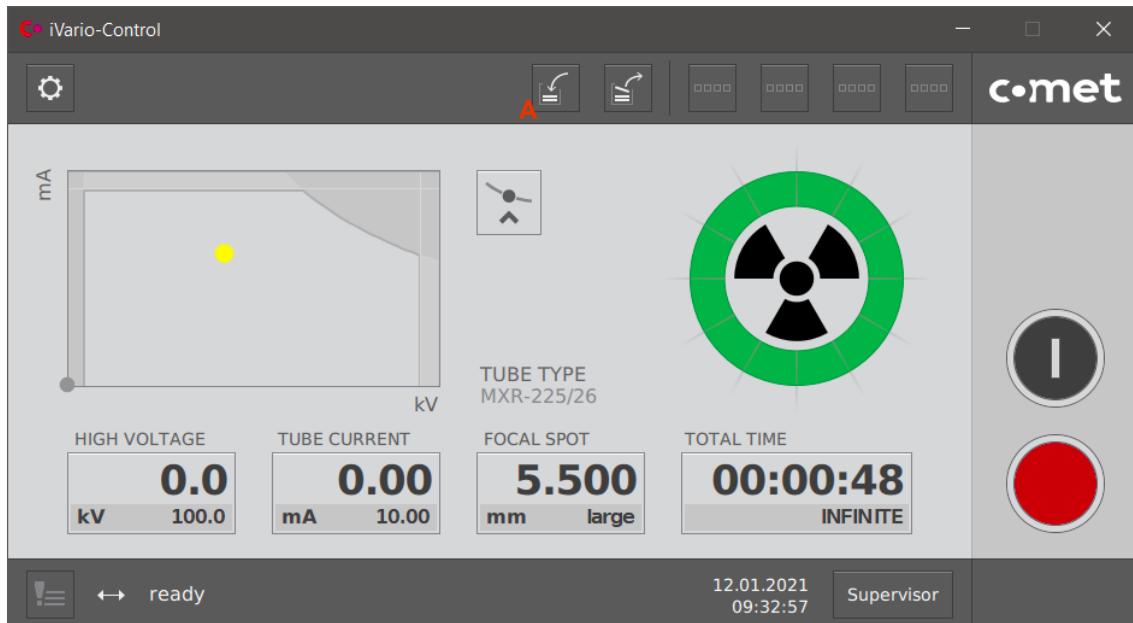
→ The values stored in the recipe are applied (section **D**).

4. The name of the loaded recipe is displayed in section **E**.
- The recipe is loaded.

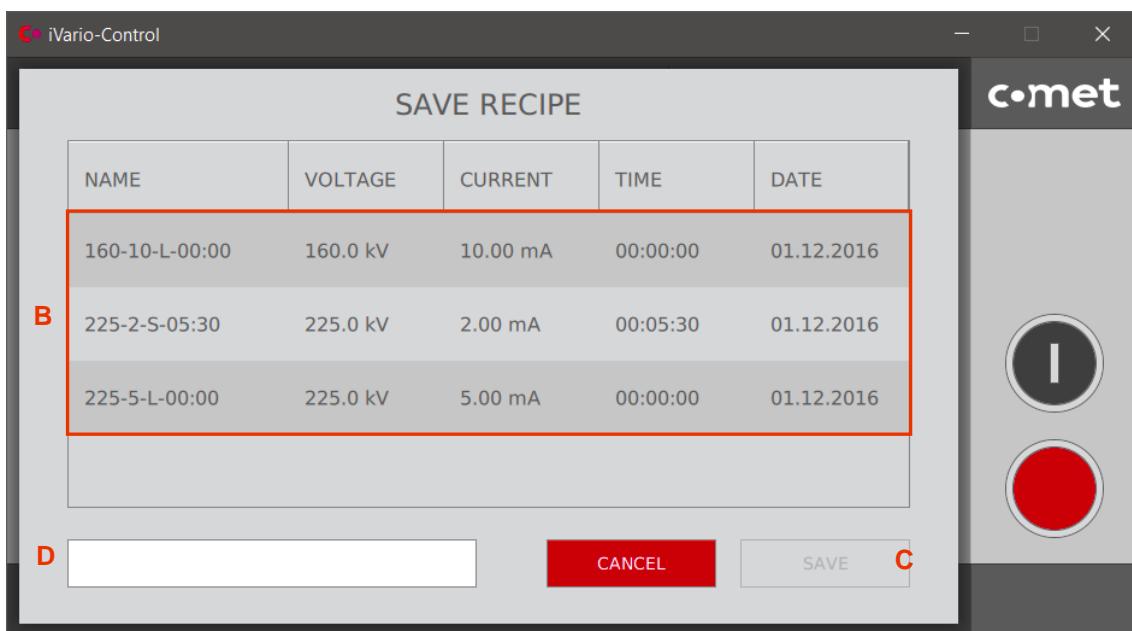
6.4.7 Saving recipe

Set kV, mA, focus and exposure time

- ✓ The iVario control software or the iVario controller is switched on.
 - ✓ You are logged in as *Supervisor*.
1. Click the *Save recipe* button **A**.



→ The following window is displayed:

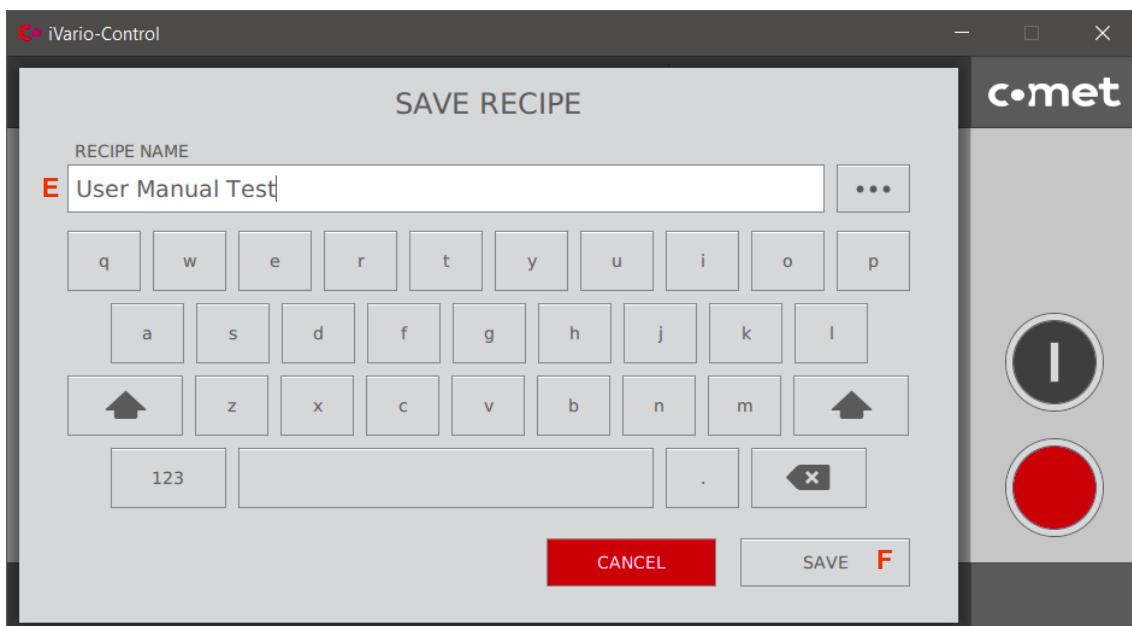


Overwrite existing recipe

1. Select a recipe **B** and click its name.
→ The selected list item is highlighted in blue.
2. Click the Save button **C** to save the selected recipe.
→ The selected recipe is overwritten and can again be selected and loaded.

Saving recipe under a new name

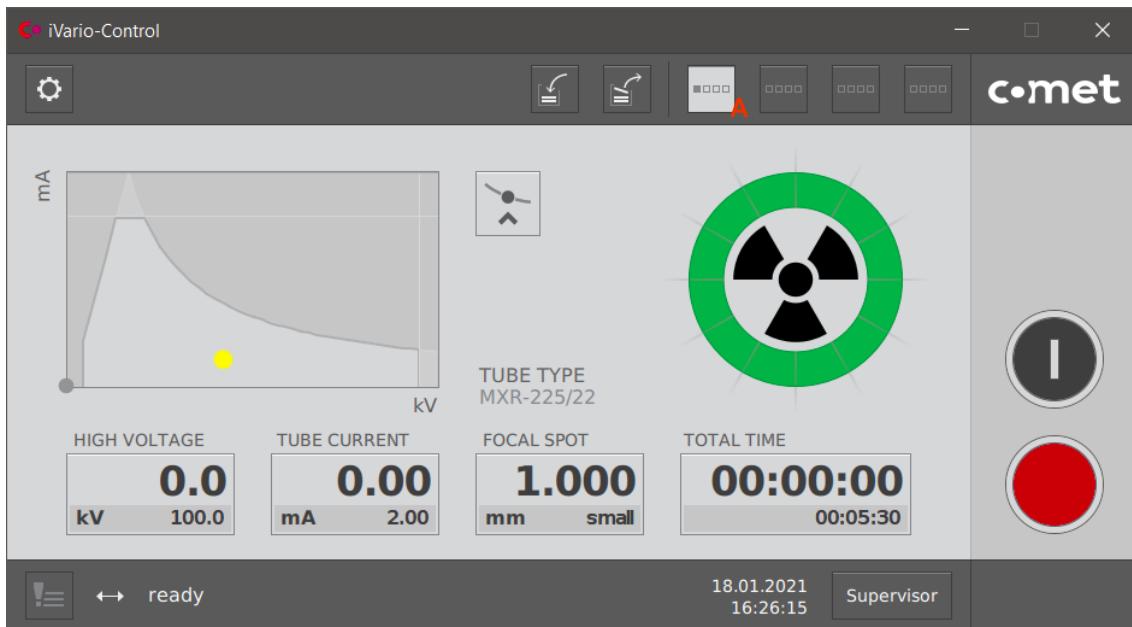
1. Click text field **D**.
→ The following window is displayed:



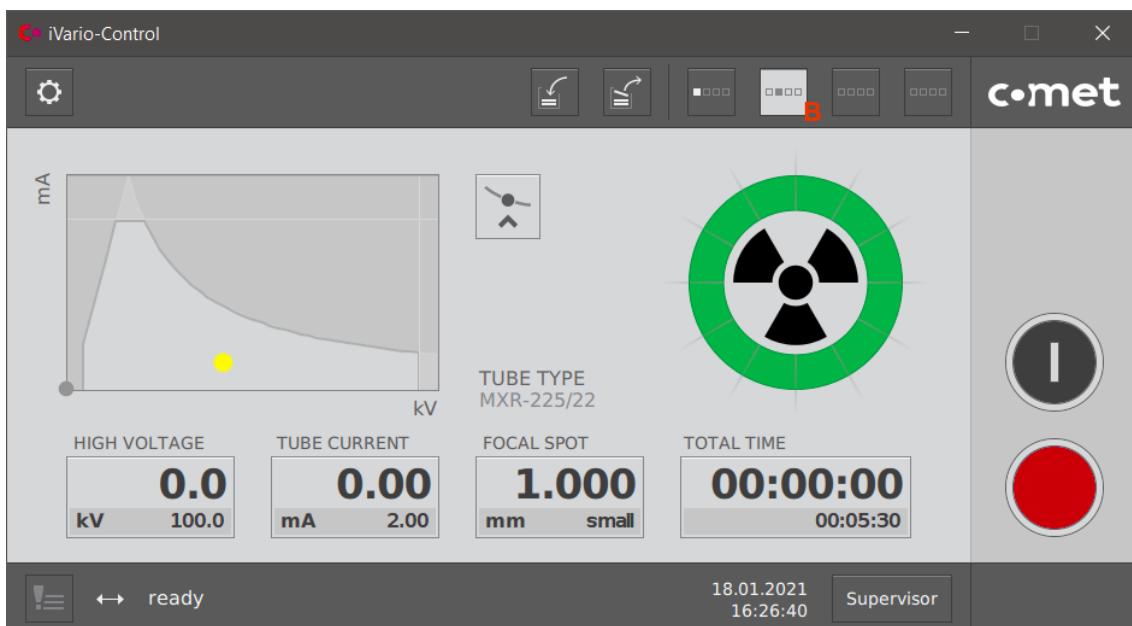
2. Enter the name of the recipe in text field *Recipe name E*.
3. Click the Save button **F** to save the recipe under a new name.
→ The recipe is written and can be selected and loaded from list **B**.

6.4.8 Temporarily saving working points

- ✓ The iVario control software or the iVario controller is switched on.
- ✓ You are logged in as a user.
 1. Click and hold one button in section A until the button changes to white.
 - The working point (i.e. values for kV, mA, focus and exposure time) is saved.
 - The working point is lost when the iVario control software or the iVario controller are switched off.

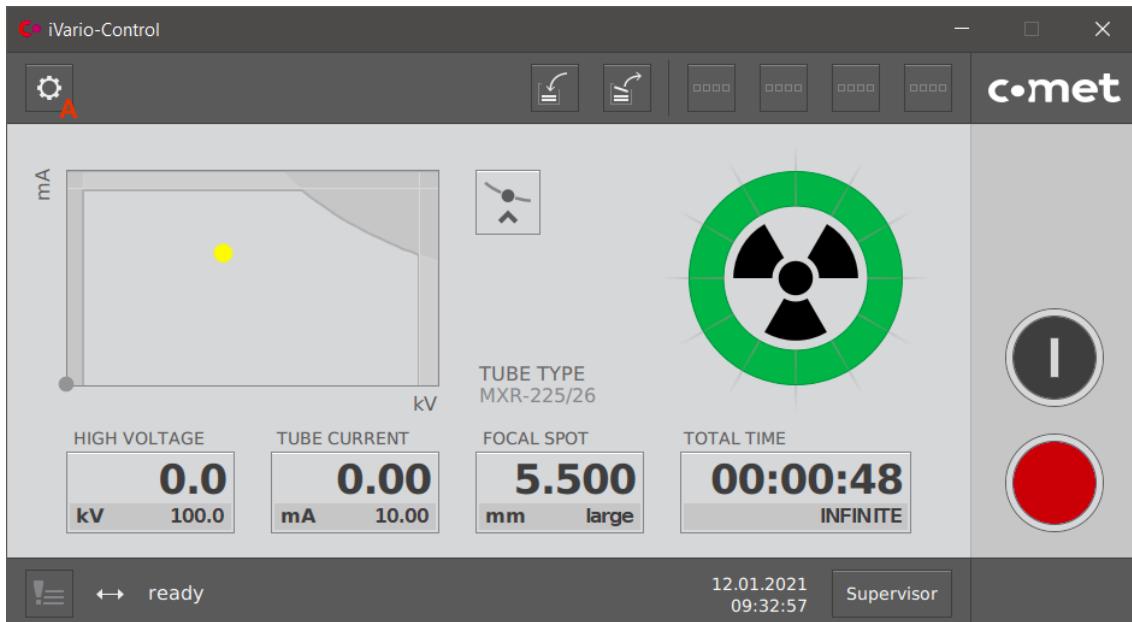


2. To call up the values of the working point, click the respective working point button **B**.

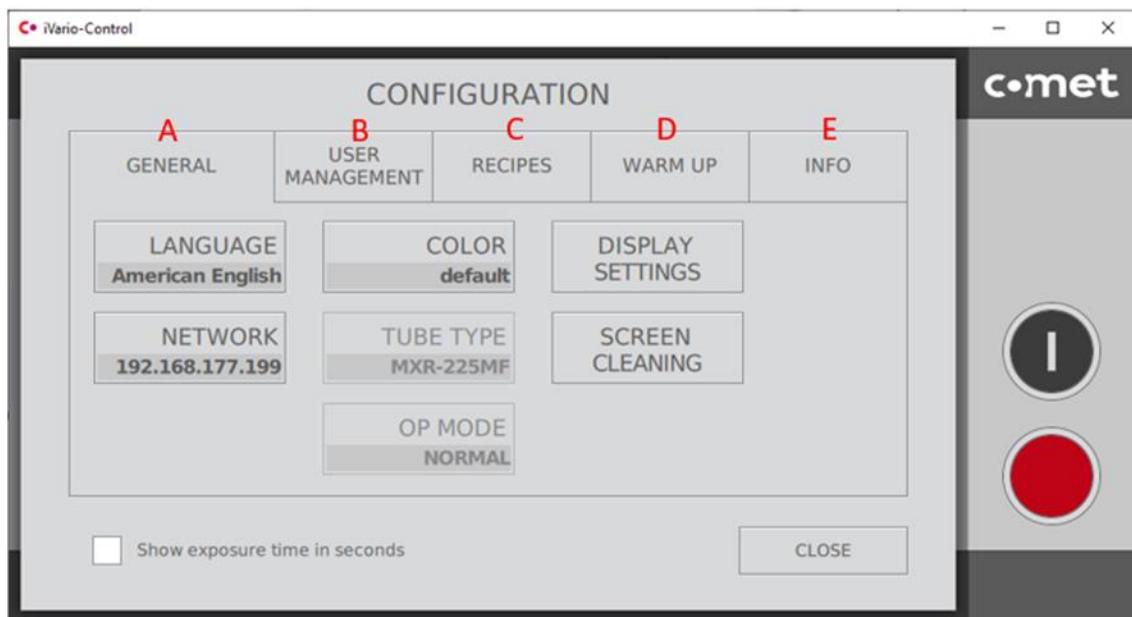


6.4.9 Configuration options for supervisor

- ✓ The iVario control software or the iVario controller is switched on.
- ✓ You are logged in as *Supervisor*.
- 1. Click button A.



→ The following window is displayed:



Configuration options

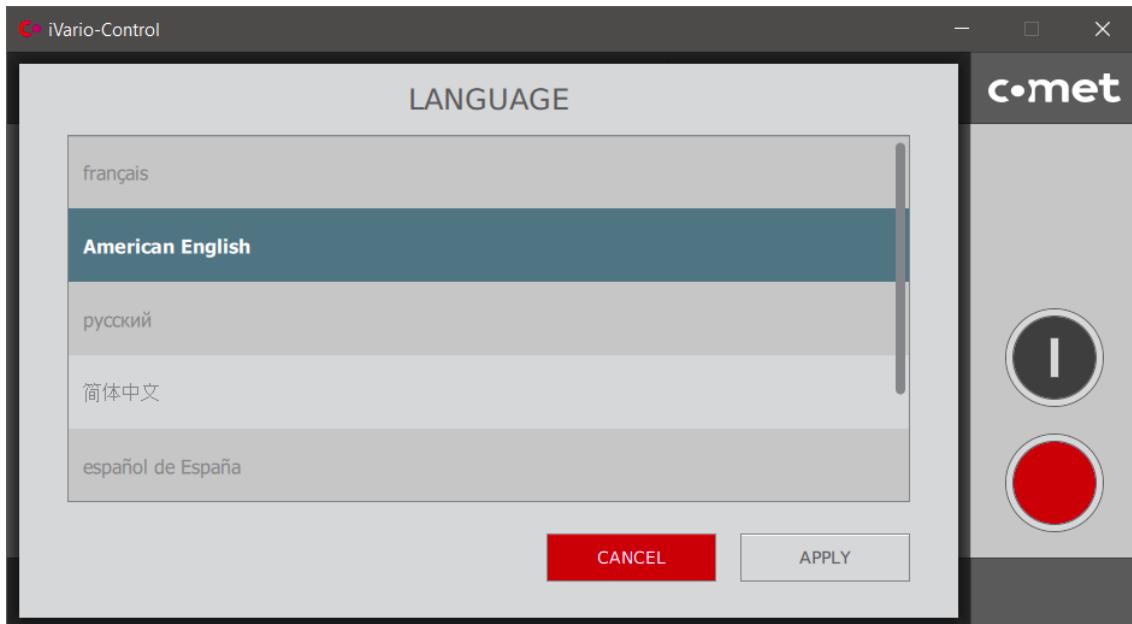
- General **A** (see chapter 0 General)
- User Management **B** (see chapter 6.4.9.2 User Management)
- Recipes **C** (see chapter Fehler! Verweisquelle konnte nicht gefunden werden. Recipes)
- Warm-up **D** (see 6.4.9.4 Warm-up)
- Info **E** (see 6.4.9.5 Info)

6.4.9.1 General

- ✓ The Configuration window for *Supervisor* is opened.
 1. Click the *General* tab.

Change language

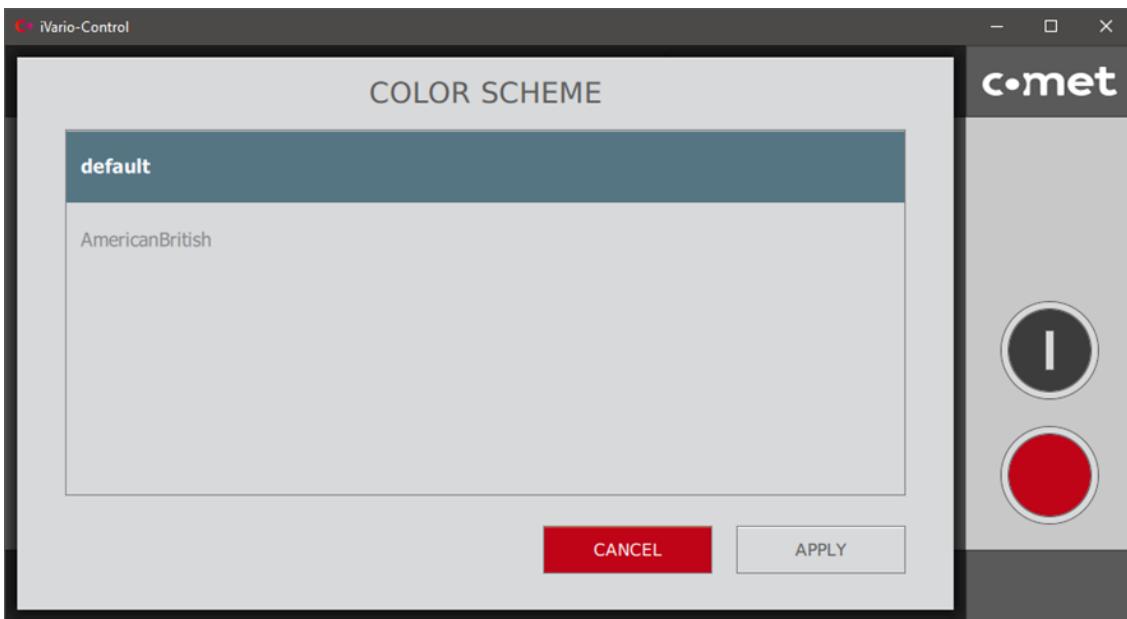
1. Click the *Language* button.
→ The following window is displayed:



2. Select the user interface language (American English language setting also changes the display of the date format to US date format).
3. Click *Apply* to apply the selection.

Color scheme

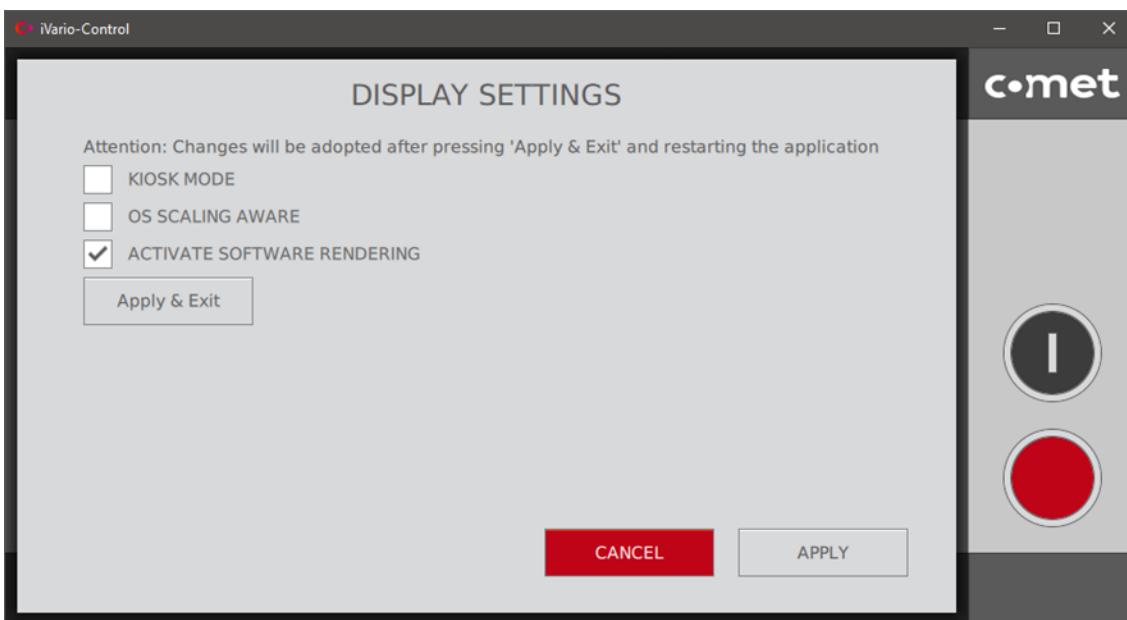
1. Click the *Color* button.
→ The following window is displayed:



- The color of the X-ray display can be adjusted from yellow to red for AmericanBritish.

Display settings

1. Click the *Display settings* button.
 - The following window is displayed:



Kiosk Mode runs iVario Control Software in full screen mode. “Alt-F4” must be pressed to close the application.

OS Scaling Aware should be selected if iVario Control is running on another operating system.

Activate Software Rendering should be selected if artifacts or errors appear on the screen.

To activate these parameters, the *Apply* and *Close* buttons must be pressed and the iVario Control software must be started again.

Selecting X-ray tube



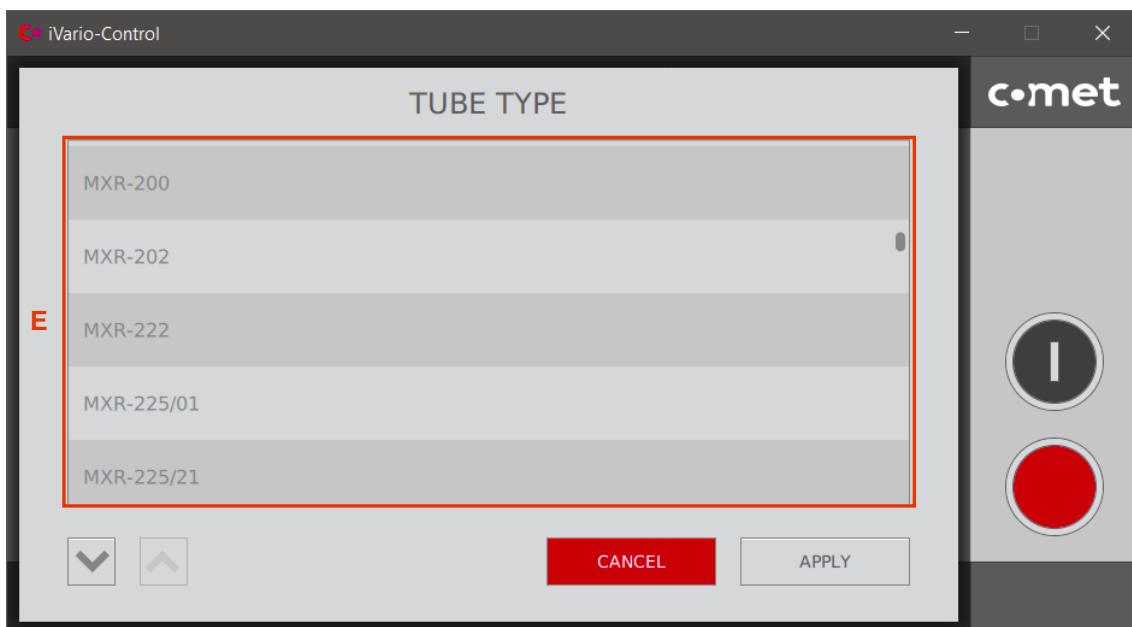
Danger

Risk of injury from exposure to X-ray radiation and risk of damage to X-ray tube

If the wrong X-ray tube is chosen in the configuration menu, there is a risk that the radiation exposure limits are exceeded and/or the X-ray tube is damaged. This can cause serious injury to personnel and damage to equipment, including destruction of the X-ray tube.

- Make sure that you always select the X-ray tube that is installed in the machine.
- After changing the X-ray tube in the device, adjust the settings, if necessary.

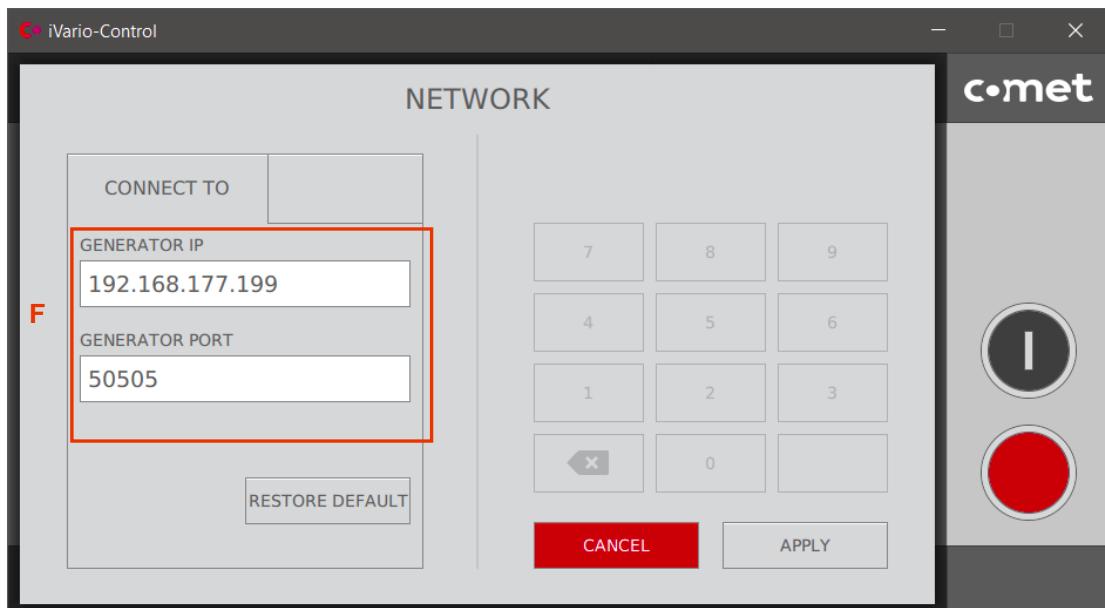
1. Click the *Tube type* button.
→ The following window is displayed:



2. Select the installed X-ray tube from list E.
This can be done with the mouse or the arrow buttons of the keyboard (iVario control software) or the control dial (iVario controller).
3. Click *Apply* to apply the selection.
→ The generator is automatically restarted.

Adjusting network settings

1. Click the *Network* button.
→ The following window is displayed:



2. Enter the IP address and the port in the test fields **F**.
3. Click *Apply* to apply the selection.

Display of exposure time in seconds

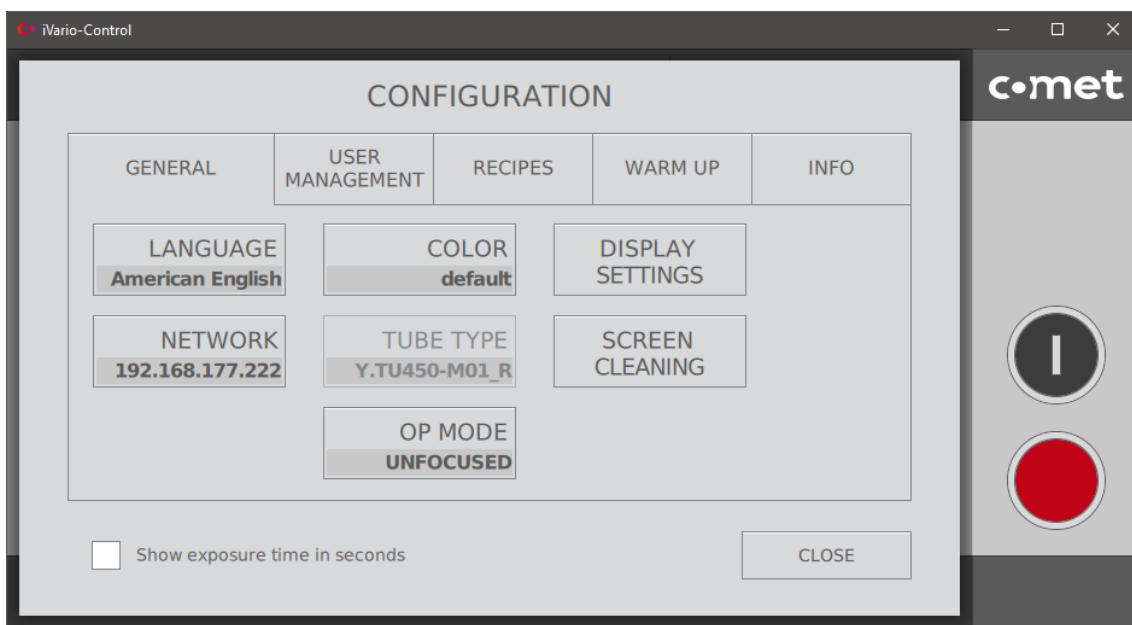
When selecting *Show exposure time in seconds*, the *Total Time* will be shown in *seconds* instead of *Hours:Minutes:Seconds*.

Show exposure time in seconds

Operational mode ONLY for the iVario MesoFocus systems

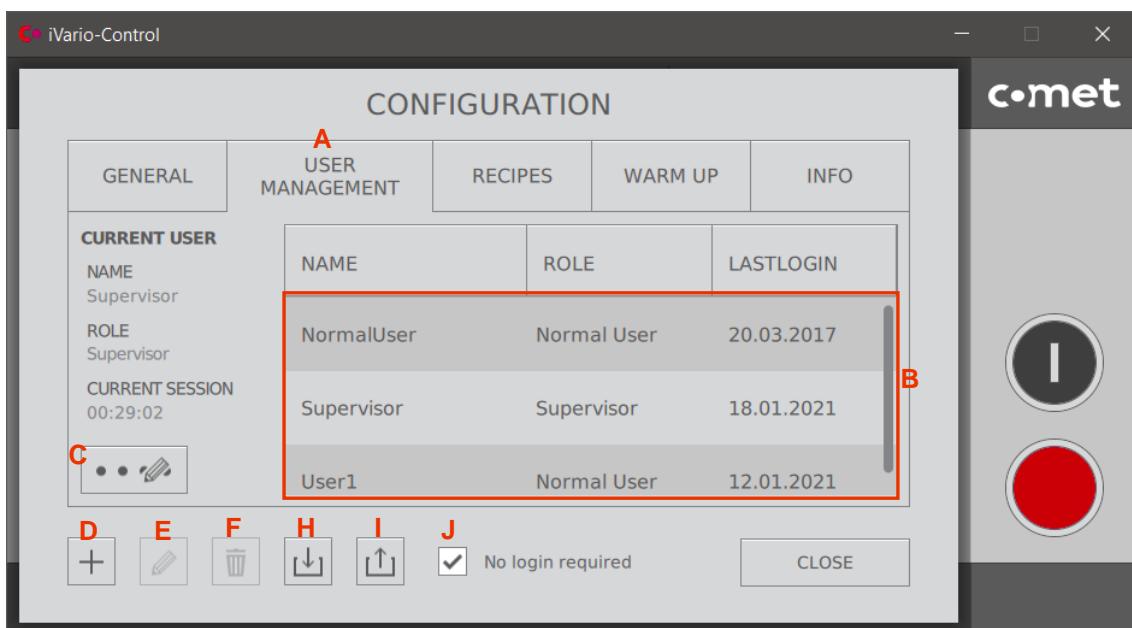
If you are operating a MesoFocus system, click the *OP mode* button to switch the operational mode from *normal* to *unfocused*.

This mode allows you to adjust the power or current, for example to carry out the calibration of the detector. In this mode the focal spot becomes larger and remains unfocused.



6.4.9.2 User Management

- ✓ The Configuration window for *Supervisor* is opened.
 - 1. Click the *User Management* tab **A**.
- The following window is displayed:



Selecting user

1. Select the user from the list **B**.

Changing password

1. To change the password of the current user, click button **C**.
2. Enter the old password and then the new password.
3. Click the *Apply* button to save the new password.
Click the *Cancel* button to cancel saving.

Creating new user

1. To set up a new user, click button **D**.
→ In the next window, enter the name, user rights and password.

Reset password of an existing user, as Supervisor

1. To edit the settings of an existing user, click button **E**.
→ Select the user from the list.
2. Change password of the selected user.

Deleting user

1. To delete the selected user, click button **F**.
2. Click Yes to delete the user.
Click No to abort.

Importing users

Users can also be set up through file import. Should a username you wish to import already exist, you are prompted to confirm whether the existing records are to be overwritten. If you opt for overwriting, all existing user records are overwritten, and the imported users are saved.

Otherwise, no user records are overwritten, and only new users are imported.

1. To import a file with users, click button **H**.
→ A window with available files for import is displayed.
2. Select the file you wish to import and confirm the import.
→ The new users are shown in list **B**.

Exporting users

1. To export users to a file, click button **I**.
→ In the next window, select the location to which you wish to save the export file.
2. Confirm the export.
→ Any existing user records in the file are overwritten.

NOTICE! The export file contains all user details, including passwords.

Extending user rights of default user

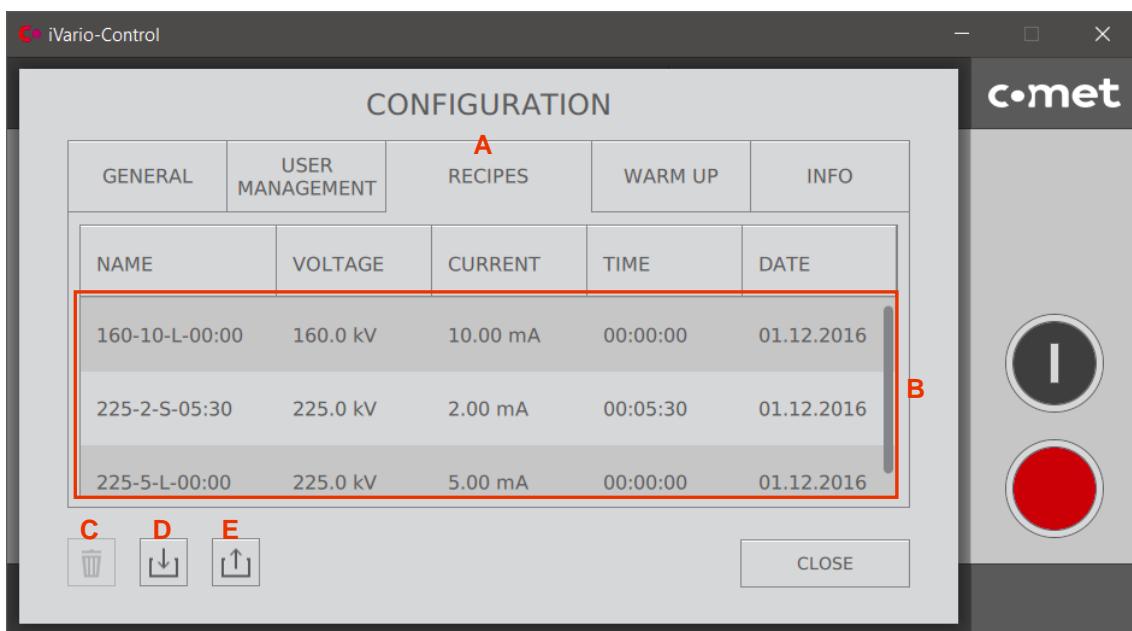
By default, users who are not logged in cannot make any changes to the settings for kV, mA, focus or exposure time. Only the *Start* and *Stop* buttons are enabled.

User login can be disabled. In this case, all users can change settings without having to log in.

1. To do this, select *No login required J* (to release the user rights of standard users without logging in).

6.4.9.3 Recipes

- ✓ The Configuration window for *Supervisor* is opened.
1. Click the *Recipes* tab **A**.
→ The following window is displayed:



Selecting recipe

1. Select the recipe from the list **B**.

Deleting recipe

1. To delete the selected recipe, click button **C**.
 - In the next window, you are prompted to confirm that you wish to delete the recipe.

Importing recipes

Recipes can also be set up through file import. Should one or more recipe names you wish to import already exist, you are prompted to confirm whether the existing records are to be overwritten. If you opt for overwriting, all existing recipes are overwritten and the imported recipes are saved.

Otherwise, no recipe records are overwritten, and only new recipes are imported.

1. To import a file with recipes, click button **D**.
 - A window is displayed where you can choose the file you wish to import.
2. Select the file you want to import and confirm the import.
 - The new recipes are shown in list **B**.

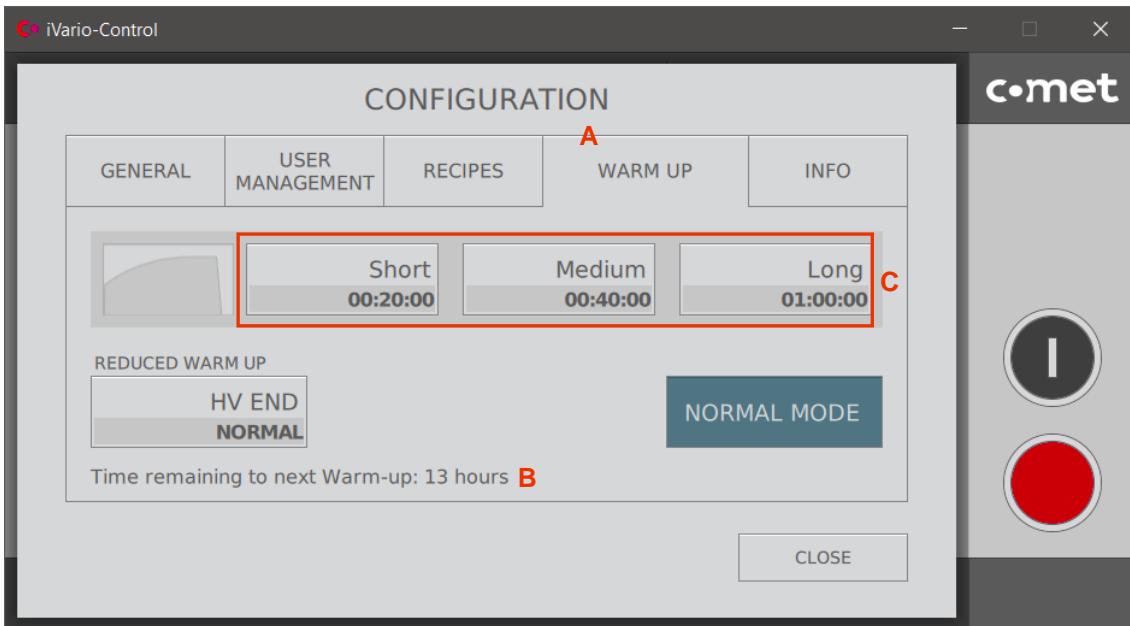
Exporting recipes

1. To export recipes to a file, click button **E**.
 - In the next window, select the location to which you wish to save the export file.
2. Confirm the export.
 - The recipes are written to the file.

6.4.9.4 Warm-up

- ✓ The Configuration window for *Supervisor* is opened.
- 1. Click the *Warm-up* tab **A**.

→ The following window is displayed:



- Line **B** shows the time remaining to the automatic warm-up cycle start.
The automatic warm-up cycle is necessary to make the iVario generator ready for operation.

A warm-up cycle is automatically always required if the generator has been shut-down for more than one day:

- A short warm-up of 20 minutes for shut-down periods between 12.5 hours and 7 days.
- A medium warm-up of 40 minutes for shut-down periods between 7 and 14 days.
- A long warm-up of 1 hour for shut-down periods of more than 14 days.

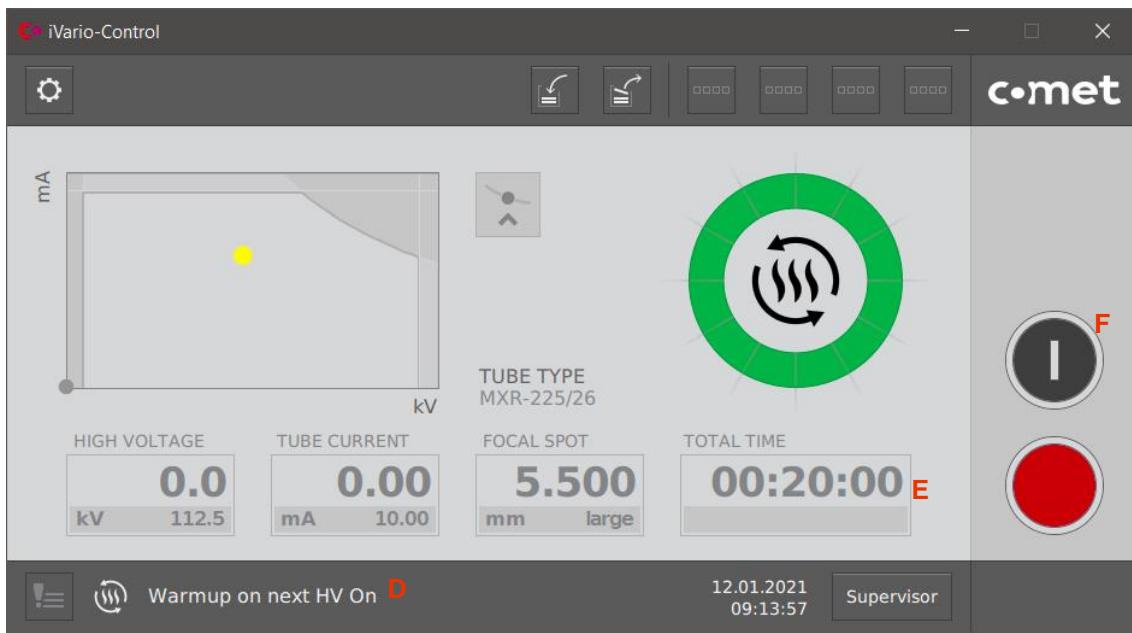
The warm-up requested by the generator cannot be shortened. It is however possible to set longer warm-up cycle than the one imposed by the generator. The warm-up can be done on either large or small focus. The focus can be selected before or after the warm-up selection.

Configuring warm-up cycle

1. If there is no warm-up requested, select the warm-up cycle you wish to run in section **C**.

Starting warm-up cycle manually

1. Click the *Close* button to trigger an automatic warm-up next time *HV On* is started.
→ The following window is displayed:



- Line **D** indicates that a warm-up will be performed next time *HV On* is switched on.
 - The *Total Time* field **E** shows the duration of the warm-up cycle.
2. Click *HV On* button **F** to start the warm-up cycle.

→ While the warm-up is performed, the following window is displayed:

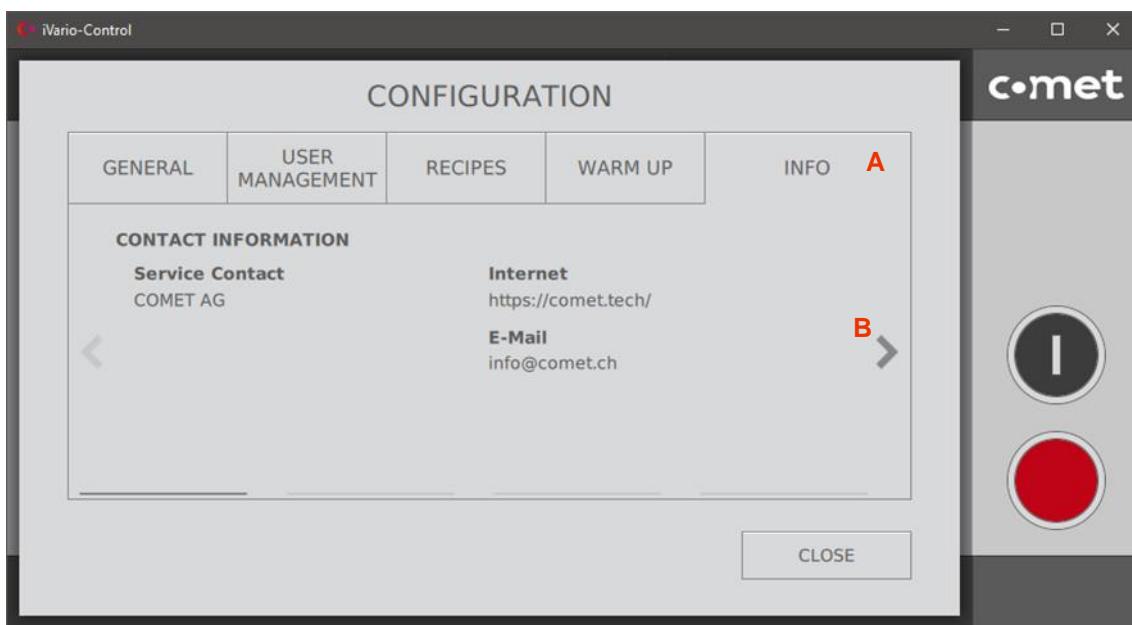


6.4.9.5 Info

- ✓ The Configuration window for *Supervisor* is opened.

1. Click the *Info* tab **A**.

→ The following window is displayed:



Data in Info window

The Info window consists of four pages. The window contains the following data and information:

- Contact details and address of Comet service and path for log file upload. Service contact can be set to OEM service contact in branding file
- System information (serial number, material number, hardware version of the generator) and configuration details (tube type, cable length, IP address)
- Software and hardware version
- Limits of generator and set limit values

Procedure

Click the arrow **B** to display the sheets in the Info window one by one.

6.4.10 Configuration options for normal users

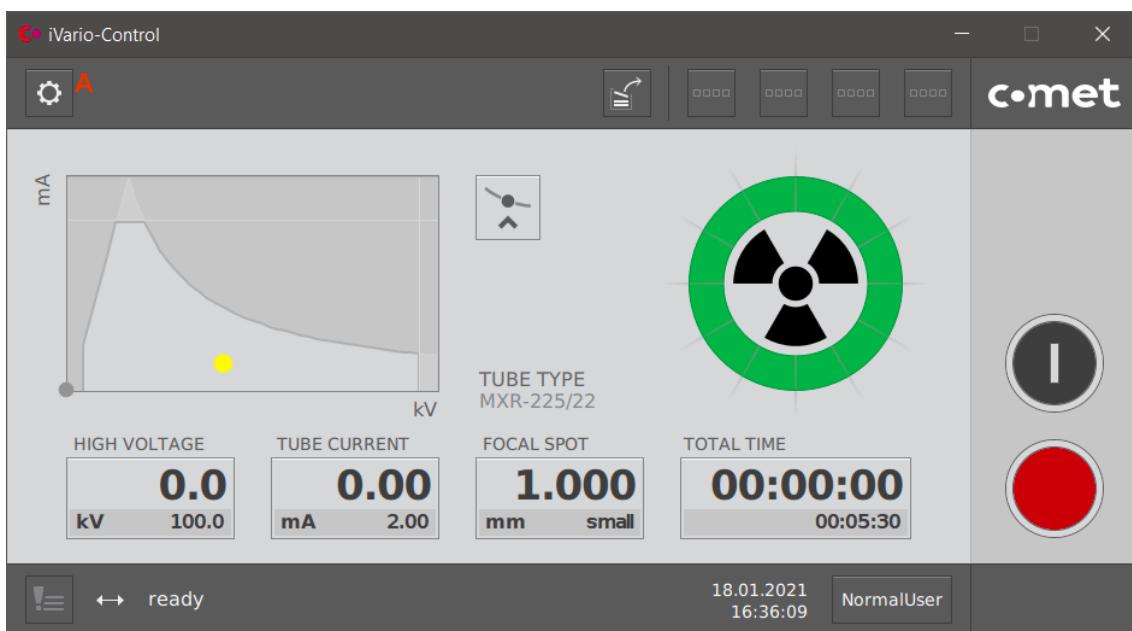
The configuration options for normal users in the Configuration window are restricted:

- Normal users cannot save recipes.
- In the *User management*, only the own password (and not those of other users) can be changed.

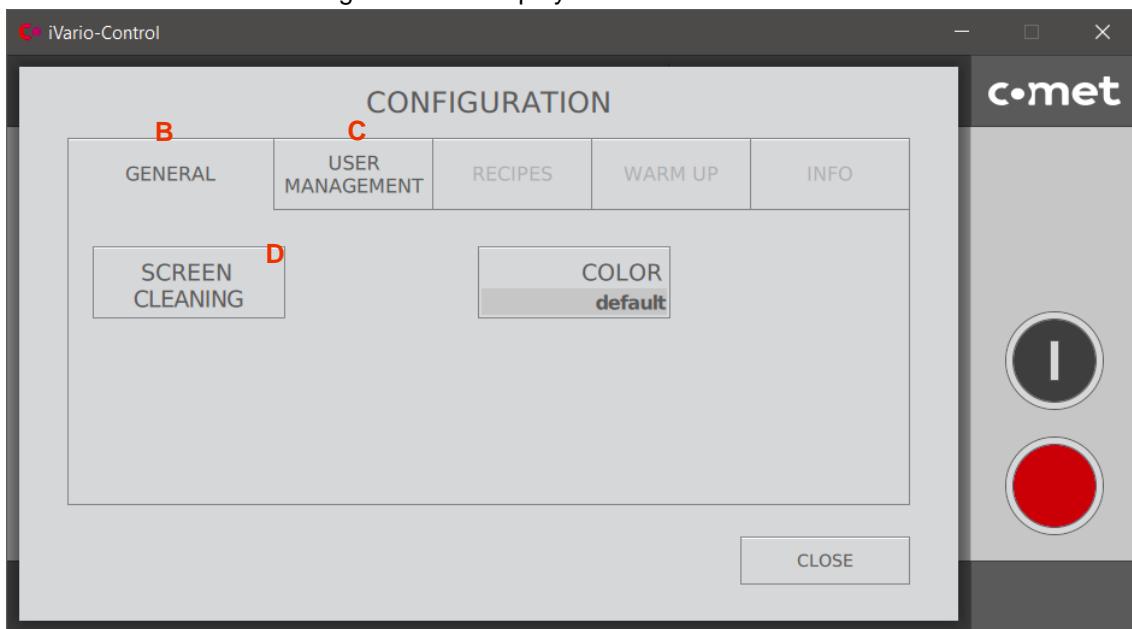
Changing password as normal user

- ✓ The *iVario* control software or the *iVario* controller is switched on.
- ✓ You are logged in as *NormalUser*.

1. Click button **A**.



→ The following window is displayed:



Configuration options

- General **B**
- User Management **C**

6.4.10.1 General

- ✓ The Configurations window for *Normal/User* is displayed.
- 1. Click the *General* tab **B**.

Cleaning iVario controller touch screen

1. To clean the touch screen, click the *Screen cleaning* button **D** to clean the touch screen from fingerprints.
- The cleaning time is displayed.

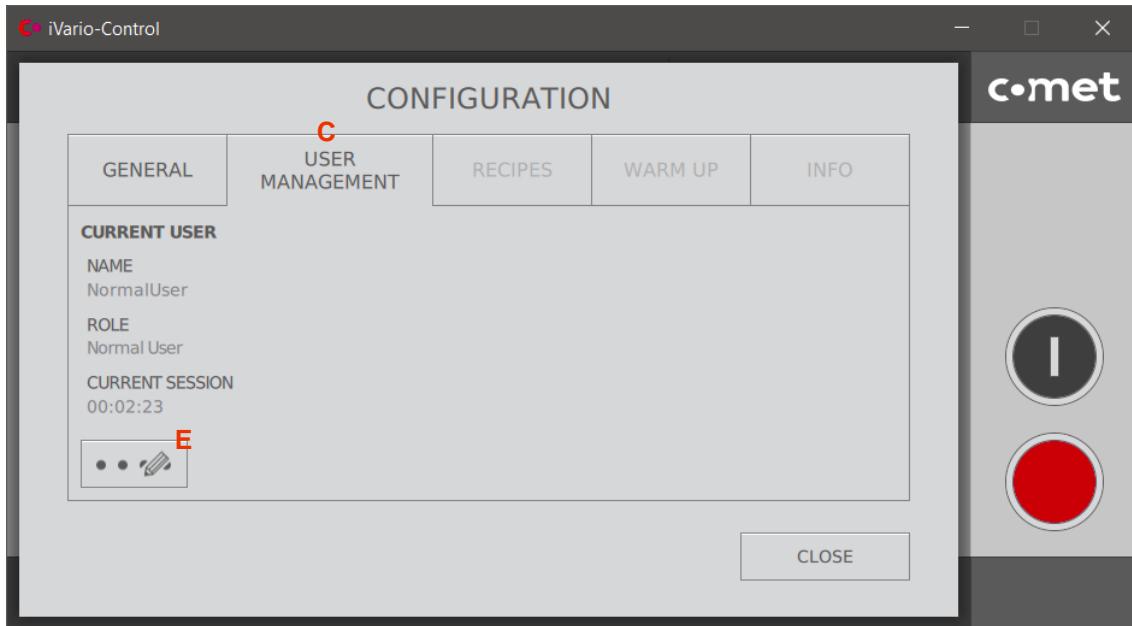
→ After completion of the cleaning process, the Configuration window is displayed.

6.4.10.2 User Management

✓ The Configuration window for *NormalUser* is opened.

1. Click the *User Management* tab **C**.

→ The following window is displayed:



Changing password

1. To change the password of the currently logged in user, click button **E**.
2. Enter the old password and then the new password.
3. Click the *Apply* button to save the new password.
Click the *Cancel* button to cancel saving.

7 Troubleshooting

Information on troubleshooting can be found in the “Service Manual” or in the “T3 Status document”.

The “Service Manual” is handed over as part of the mandatory training at Comet.

8 Maintenance and checks performed during operation

The following principles apply to maintenance and checks of the machine. These tasks must only be carried out by specially trained and authorized personnel.

1. Before starting work, shut-down the machine and secure it against inadvertent restart.
2. Allow hot components to cool.
3. Wear suitable protective clothing.
4. Certain components of the iVario generator are very heavy. To lift them, use suitable lifting and securing equipment.
5. Before restarting operation, mount and connect all safety devices provided on site.
6. Perform a function test of the safety devices.
7. After work is complete, remove all tools and other objects from the area around the iVario generator.

Safety instructions for maintenance and testing during operation



Risk of fatal injury from high electric voltage!

Contact with electrical voltage can cause serious or even fatal injury.

- De-energize the iVario generator.
- Ensure that the machine is completely de-energized.
- Do this according to the manufacturer data and comply with all manufacturer safety instructions.
- Secure the iVario generator against inadvertent restart.
- Lock the main switch, remove the key and attach a warning sign to the main switch.



Risk of injury due to missing or defective safety equipment!

If safety equipment is missing or defective, X-ray radiation may be released, causing serious or even fatal injury.

- Ensure that all the safety equipment on the machine functions correctly before starting operation!
- Only release the machine for use after it has passed all checks and tests.



Warning

Risk of injury from exposure to X-ray radiation following maintenance or service work

After all maintenance and service work, perform a radiation protection test, as X-ray radiation can cause serious or even fatal injury.

- The radiation protection must be checked and monitored by authorized personnel. It must be thoroughly re-checked after every maintenance and servicing measure.
- After installation, maintenance or repair work, the configuration of the X-ray modules must be inspected by an authorized person. The maximum permissible high voltage, emission current and power must be suitable for the connected X-ray tube and the overall system.



Warning

Danger posed by generator starting up

The uncontrolled startup of the iVario generator can cause serious injury.

- Before performing any work on the iVario generator, shut it down.
- Shut-down the generator at the main switch and secure it against inadvertent restart.



Notice

Regular maintenance

Regular maintenance is an integral part of the proper use of the machine and an essential requirement for safe and efficient operation.

8.1 Maintenance schedule

This chapter describes the maintenance tasks that need to be performed and the maintenance intervals for the iVario generator.

8.1.1 Daily

Components	What needs to be done*	Description of work	Person responsible**
Mains switch, operating and indicating elements	Ch	Function tests	CO

* V = Visual check, Ch = Check, R = replace, C = Clean

** CO = Customer operator, CS = Customer specialist technician, M = Manufacturer

Tab. 23: Daily maintenance schedule

8.1.2 Weekly

Components	What needs to be done*	Description of work	Person responsible**
Connecting cables	V	Visual inspection for damage	CO
Safety and warning devices	Ch	Function tests	CO
Air filter of iVario cover	V, C	Visual inspection, clean if necessary	CO
Cooler module	V	Visual inspection for leakage	CO
Cooler module	Ch, R	Coolant level in cooler module, top up if necessary	CO
Cooling fins/heat exchanger	V, C	Visual inspection for damage, clean if necessary	CO

* V = Visual check, Ch = Check, R = replace, C = Clean

** CO = Customer operator, CS = Customer specialist technician, M = Manufacturer

Tab. 24: Weekly maintenance schedule

8.1.3 Every 2 - 6 months

Components	What needs to be done*	Description of work	Person responsible**
iVario cover	R	Replace air filter	CO

* V = Visual check, Ch = Check, R = replace, C = Clean

** CO = Customer operator, CS = Customer specialist technician, M = Manufacturer

Tab. 25: 2 - 6 months maintenance schedule

8.1.4 6 months

Components	What needs to be done*	Description of work	Person responsible**
High Voltage plug at the X-ray tube	Ch	Visual inspection for damage NOTICE! Read the “operating manual of the X-ray tube”. Under certain circumstances, maintenance might be required more frequently than given in this schedule. In such cases, adhere to the shorter maintenance intervals.	CS
High Voltage plug at the generator	Ch	Visual inspection for damage	CS
Water cooler	C	Clean filter	CO

* V = Visual check, Ch = Check, R = replace, C = Clean

** CO = Customer operator, CS = Customer specialist technician, M = Manufacturer

Tab. 26: 6 months maintenance schedule

8.1.5 Annually

Components	What needs to be done*	Description of work	Person responsible**
Safety components and safety devices	Ch, R	Visual inspection and function test. Check the state of the electrical contacts and the moving machine parts.	CS
Radiation protection	Ch	Measurement of X-ray leakage radiation	CS

* V = Visual check, Ch = Check, R = replace, C = Clean

** CO = Customer operator, CS = Customer specialist technician, M = Manufacturer

Tab. 27: Annual maintenance schedule

8.1.6 2 years

Components	What needs to be done*	Description of work	Person responsible**
Water cooler	R	Change coolant	CS

* V = Visual check, Ch = Check, R = replace, C = Clean

** C= = Customer operator, CS = Customer specialist technician, M = Manufacturer

Tab. 28: 2 years maintenance schedule

8.1.7 Every 10 years/1 million ON/OFF cycles

Components	What needs to be done*	Description of work	Person responsible**
Total system	Ch, R	Complete inspection and service	CS, M

* V = Visual check, Ch = Check, R = replace, C = Clean

** C= = Customer operator, CS = Customer specialist technician, M = Manufacturer

Tab. 29: 10 years maintenance schedule

8.2 Maintenance work

The following sections describe how maintenance work must be carried out.

8.2.1 Function tests

The operator must regularly inspect the X-ray module for visible damage (adhere to maintenance schedule). If there are operational defects or other deviations from the normal operating performance, shut-down the machine without delay and contact Comet service department. Do not restart the machine unless all defects have been eliminated.

Operating the iVario generator with defective components can lead to an increasing the safety risk.

8.2.2 Heat exchanger

The cooling fins exposed to ambient air must be checked weekly and cleaned, if necessary. If the ambient air is heavily contaminated, the inspection and cleaning intervals might need to be shortened.



Notice

Indication for pollution is a decreasing cooling performance, possibly leading to the automatic shut-down of the X-ray system due to cooling water overtemperature.

8.3 Spare parts

Spare part lists are available from our service department. Please always quote the material, type and serial number and the designation of the part you require.

Spare parts are available from your authorized Comet dealer. For contact details, see our homepage xray.comet.tech

8.4 Repair

iVario generators are of modular design. This simplifies service in the field. Components such as powercells, IFC interface controller, safety interface and backframe can be replaced by trained personnel (see chapter 8.3 Spare parts). If repair of a complete generator becomes necessary, it must be sent to the nearest Service Center of Comet for repair. In order that all incoming goods at Comet are directed quickly and efficiently to the appropriate party, the information you give us is of greatest importance. Please complete the Filed Failure Report (FFR) and e-mail it to the Service Center in charge. We will then send you a service notification with an RMA-number by e-mail. You can find the form in the download center of the website xray.comet.tech

Please use a packaging that guarantees the greatest possible protection for the return shipment.

Service Center Europa & RoW

Comet AG
Herrengasse 10
CH-3175 Flamatt
Switzerland

T +41 31 744 90 00
F +41 31 744 90 90
service.xray.ch@comet.tech
xray.comet.tech

Service Center USA

Comet Technologies USA, Inc.
100 Trap Falls Road Extension
Shelton, CT 06484
USA

T +1 203 447 31 65
F +1 203 925 03 64
service.xray.us@comet.tech
xray.comet.tech

Service Center Asia

Comet China
1201 Gui Qiao Road
Building 10, 1st floor
Pudong, Shanghai 201206
P.R.China

T +86 21 6879 9000
F +86 21 6879 9009
service.xray.cn@comet.tech
xray.comet.tech

9 Decommissioning and disposal

Comet X-ray modules are constructed according to the latest state of safety and environmental protection. To adhere to the regulations or for technical reason it is partly necessary to use materials in X-ray modules, which might be harmful to the environment.

X-ray modules contain components and/or substances which may cause damage to humans or to the environment and therefore must be disposed in an environmentally friendly manner. It is prohibited to dispose electronic waste, oil, cooling liquid, lubricants, lead and beryllium etc. parts together with normal industrial or household waste. The applicable statutory regulations for waste disposal must be strictly observed and adhered by the owner of the modules.

There is no danger to humans or the environment if instructions in this manual and the safety datasheet(s) are considered and if X-ray modules were properly handled, operated and the casing parts remain sealed.



Notice

Comet devices must not be disposed of in unsorted commercial refuse.



Notice

Comet will assist you in properly disposing of the materials mentioned above and recycling reusable materials using certified disposal companies, and thereby help reduce pollution of our environment. Notify the certified disposal companies.

If an X-ray module is to be disposed by Comet, the same shipping procedure should be used as for repairs.



Notice

If you have agreed on an individual solution with Comet or a local sales partner based on which proper disposal is implemented by you directly, please ensure that the device is properly recycled according to the applicable statutory regulations. We strongly recommend commissioning a specialist disassembly, recycling and disposal company certified by the environmental authorities. Also inform Comet or your sales partner about the successful disposal and resulting recovery rates so that this information can be sent to the responsible government authorities.

In the case of disposal, please contact Comet directly or your local sales partner to determine the current method of return. We shall be glad to help you with any queries you might have.

Materials harmful to humans and/or the environment

Product	Material	Relevant safety data sheet
Generator (Tank)	SHELL DIALA S4 ZX-I transformer oil	See chapter 3.8 Safety datasheets and Material Compliance
Cooler	Coolant	See chapter 3.8 Safety datasheets and Material Compliance

Tab. 30: Materials harmful to humans and/or the environment



Avoiding direct contact

Avoid direct contact to transformer oil and coolant. The instructions in the Safety Data Sheet are to be considered.

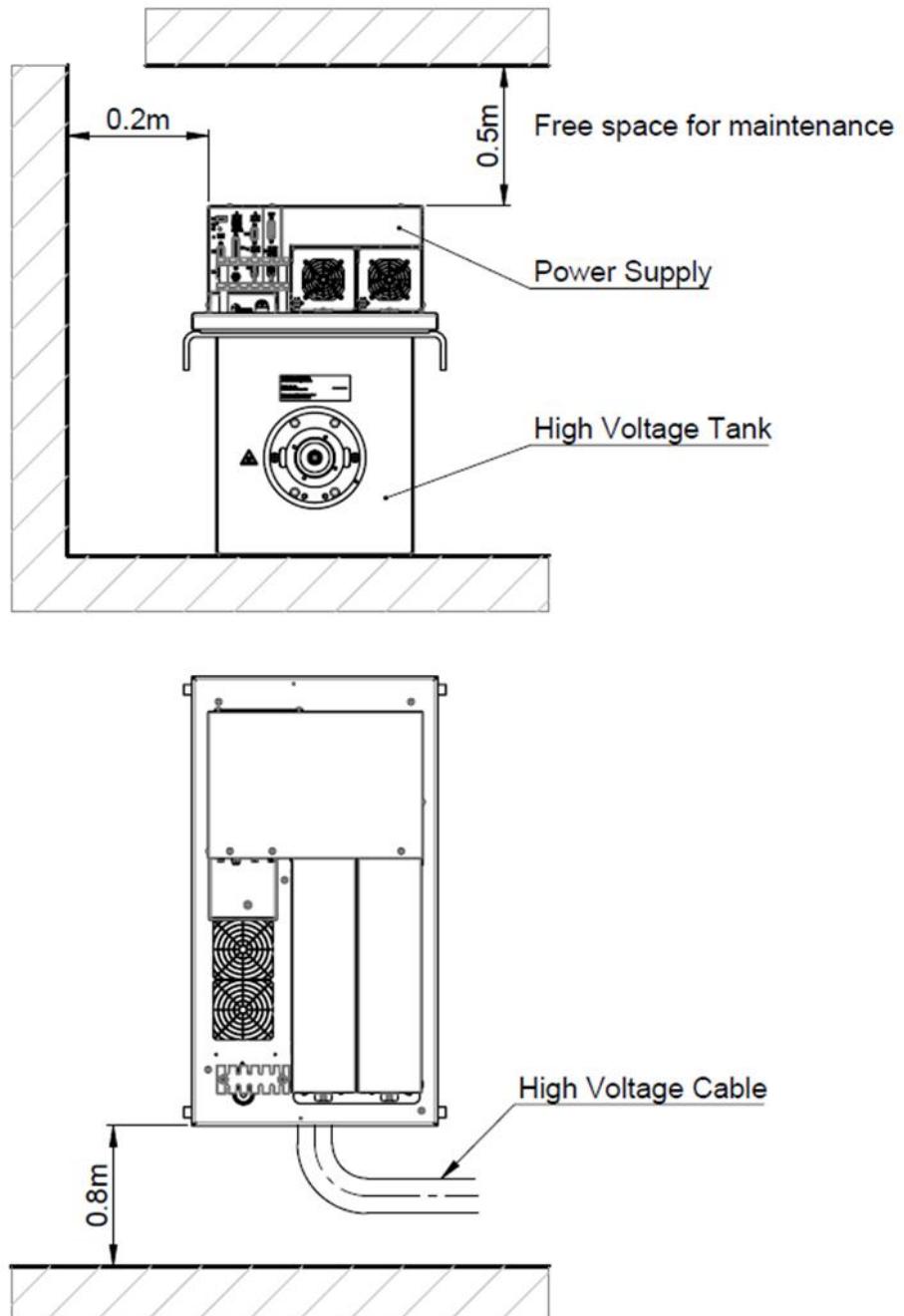


Notice

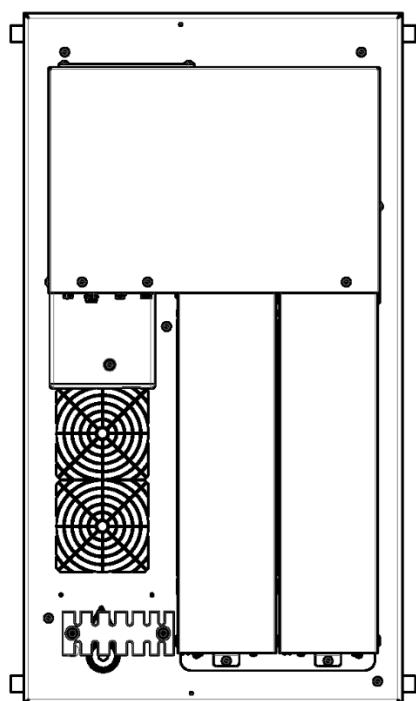
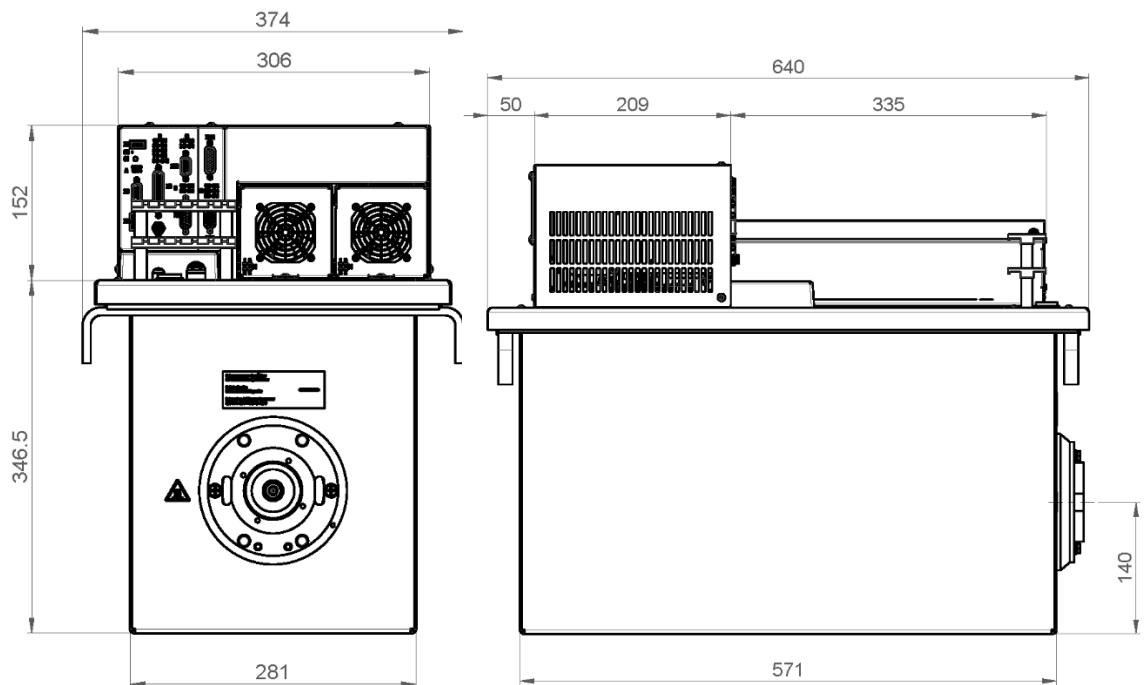
Comet products are classified a "large-scale stationary industrial tools" or parts of such tools and are therefore not covered by the WEEE Directive. That is why the WEEE symbol is not applied directly on the type plate. Comet strongly advises against disposing of the device through the municipal waste disposal services, as they need to be properly disposed of through authorized recycling firms. Alternatively, return the device to Comet for disposal.

10 General drawings

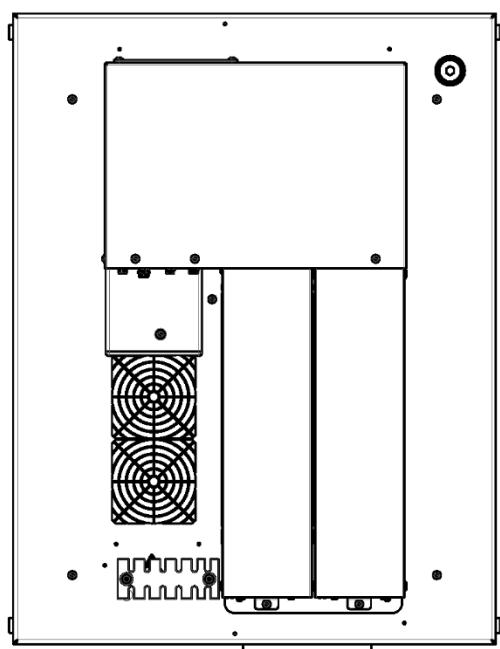
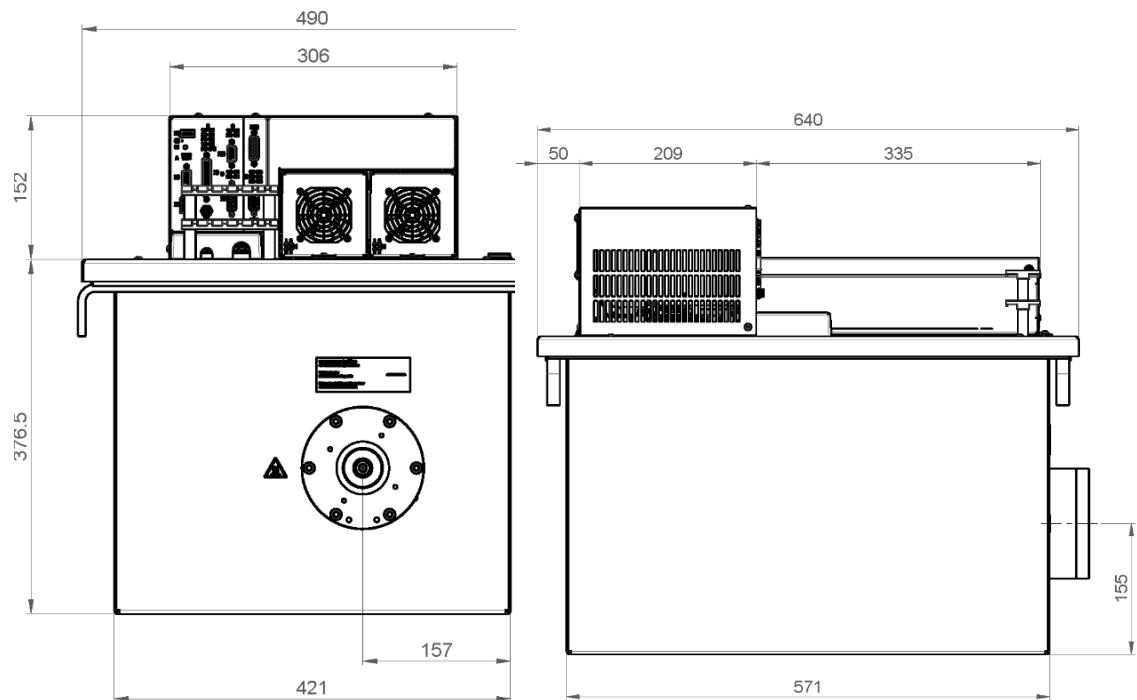
10.1 Clearance for maintenance and repair



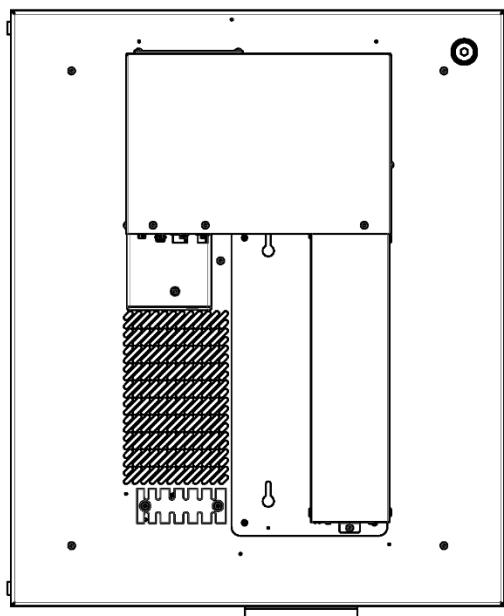
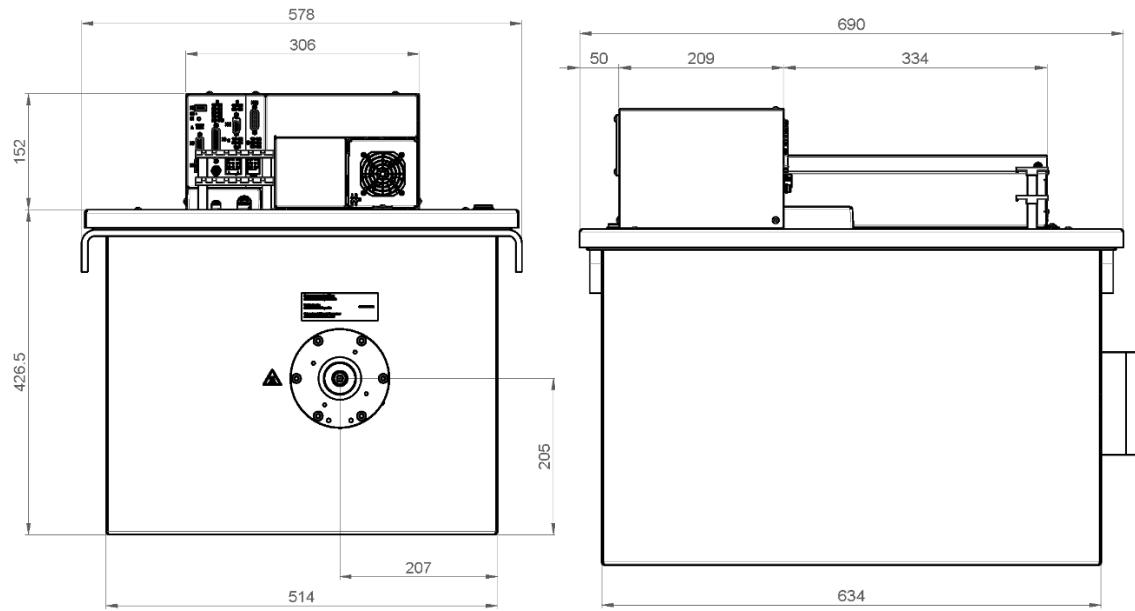
10.2 iVario-160 Layout



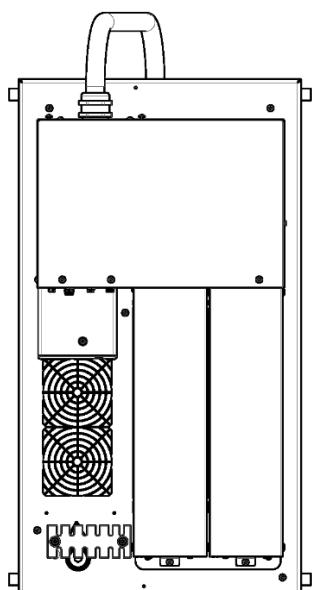
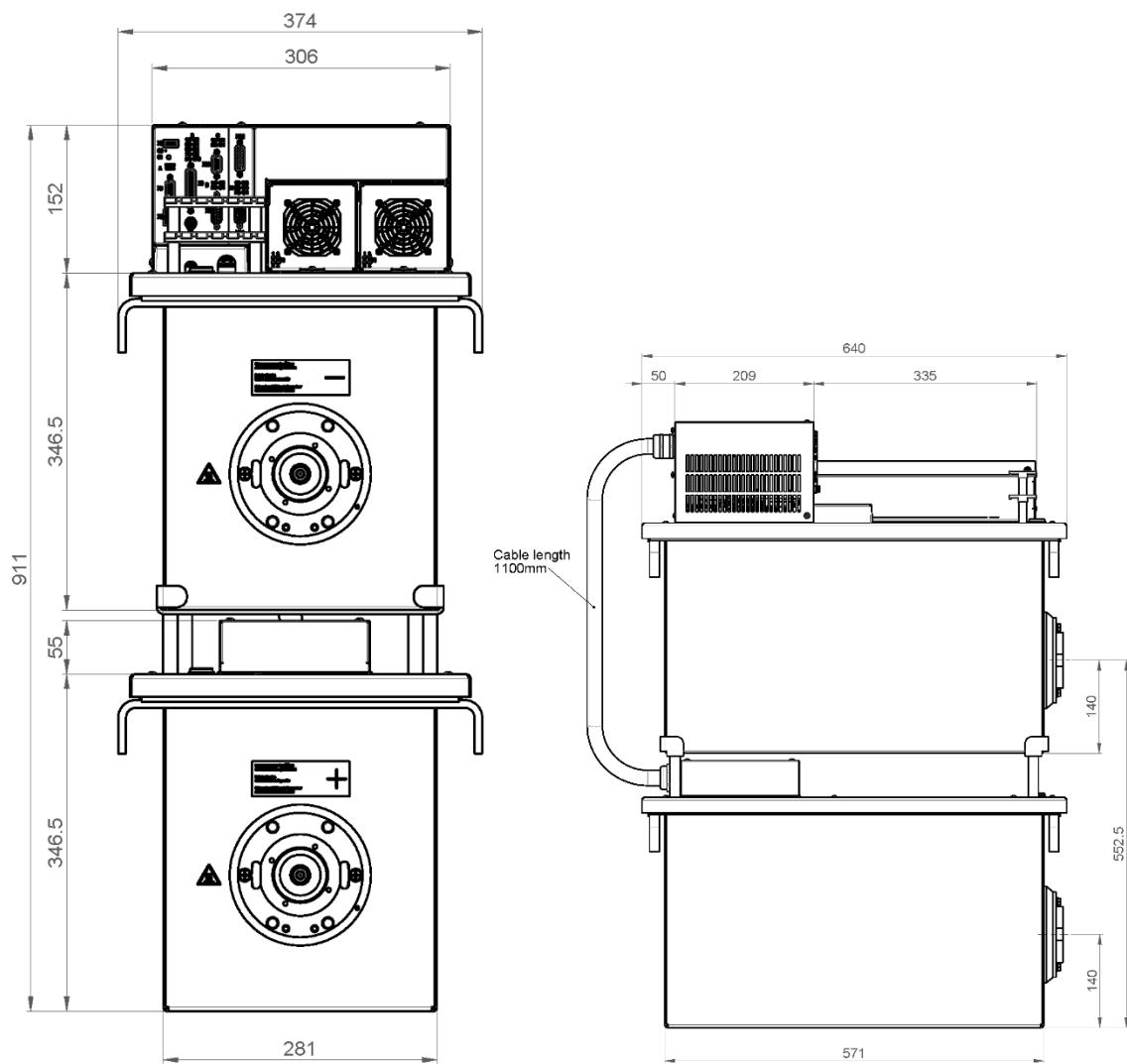
10.3 iVario-225 Layout



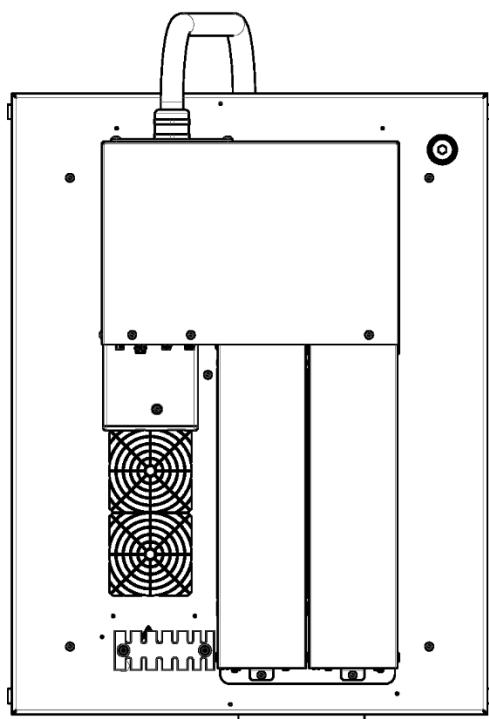
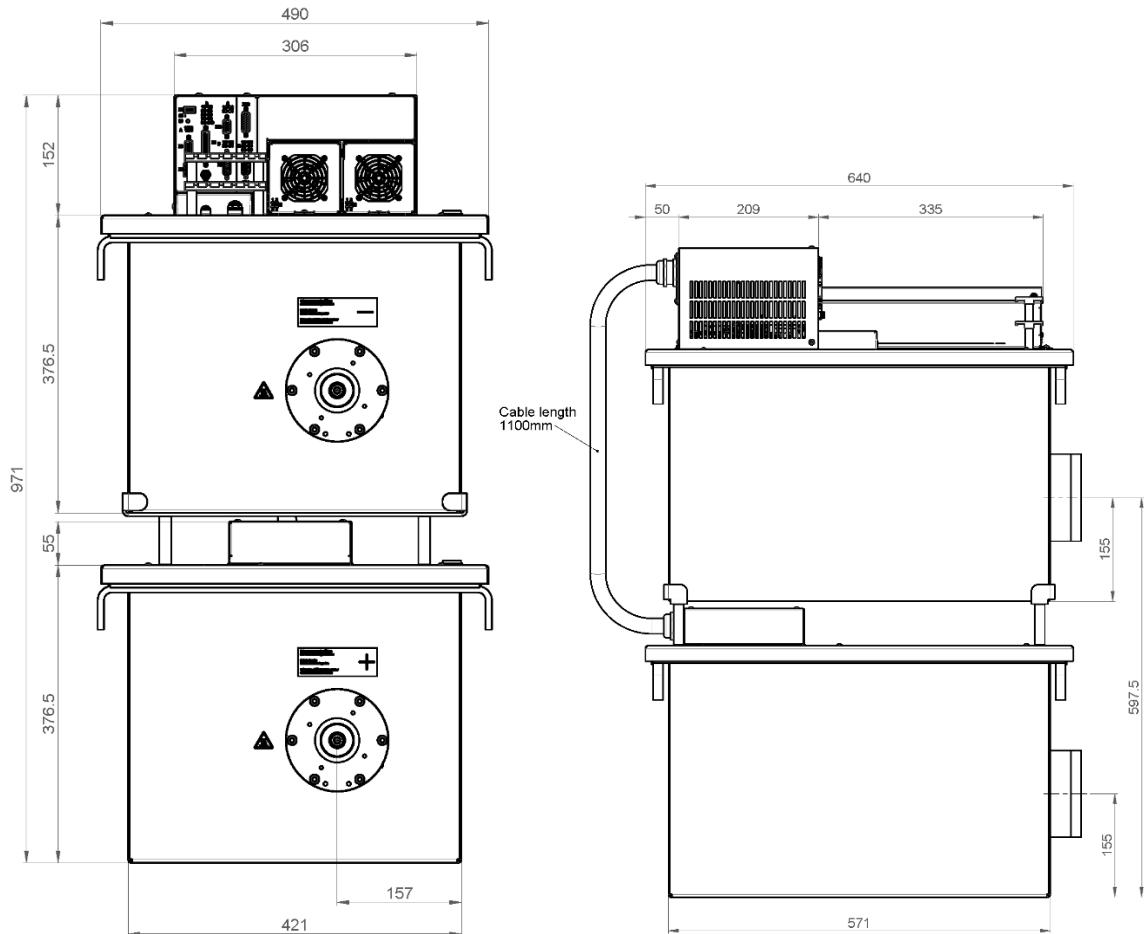
10.4 iVario-225-MF Layout



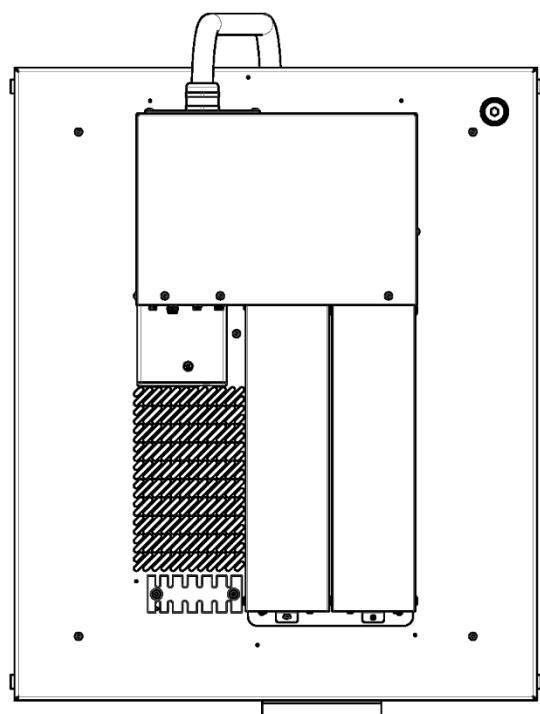
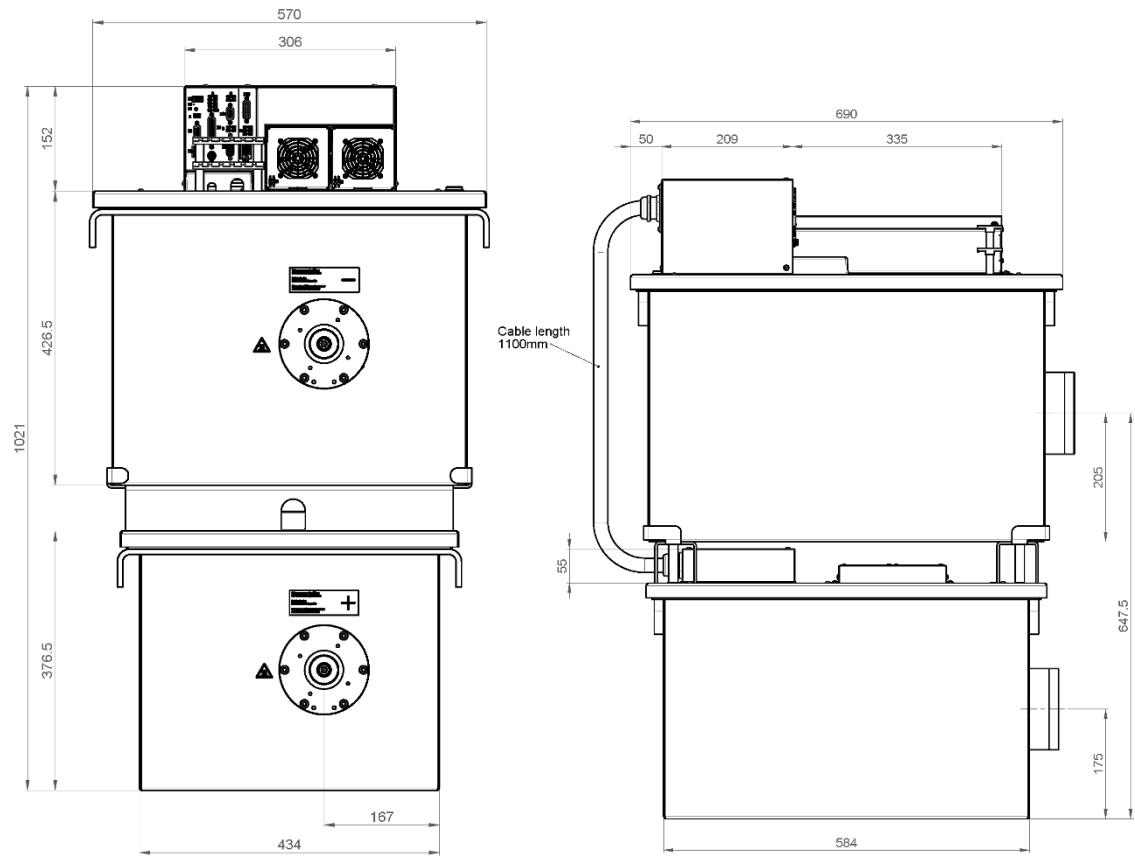
10.5 iVario-320 Layout



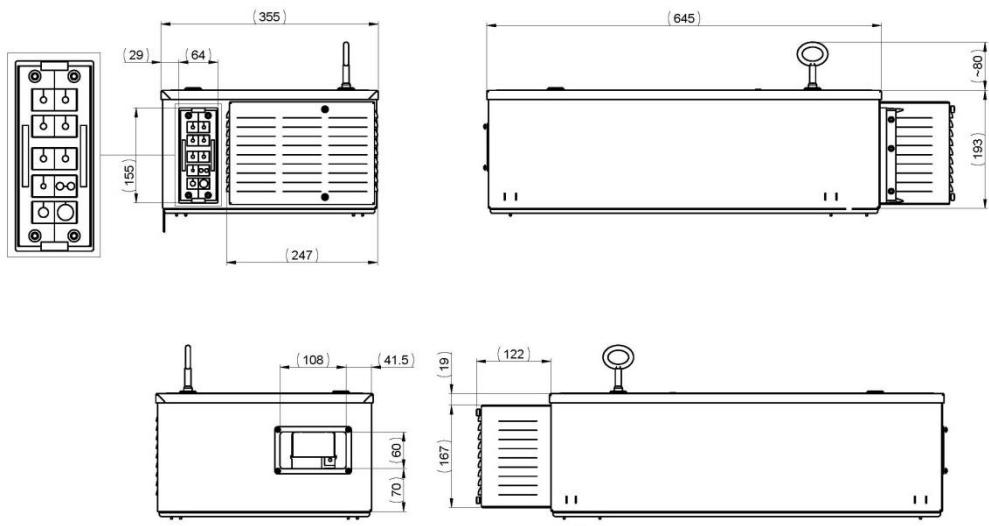
10.6 iVario-450/500 Layout



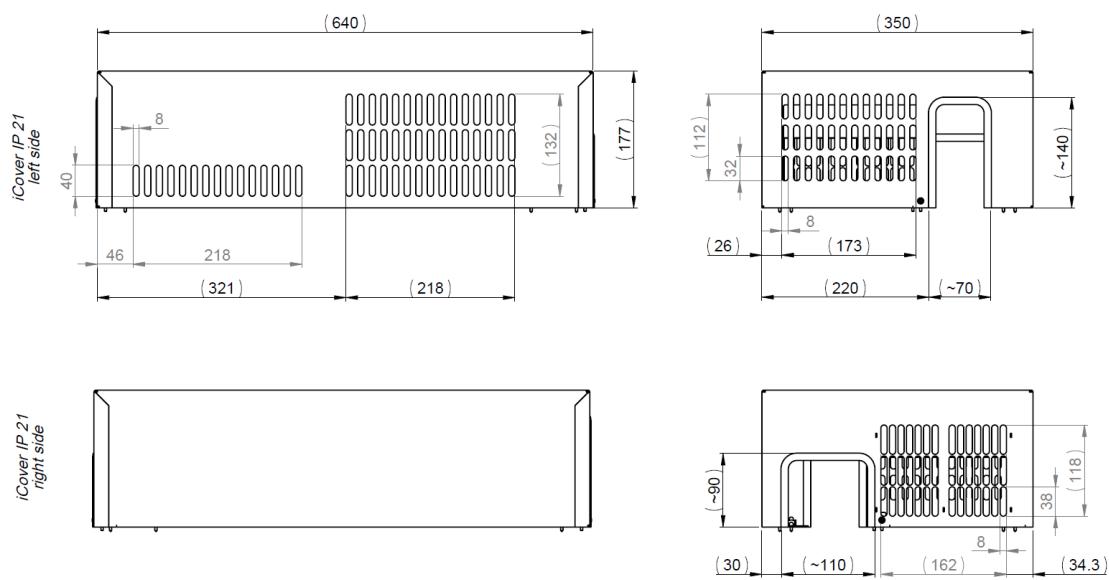
10.7 iVario-450-MF Layout



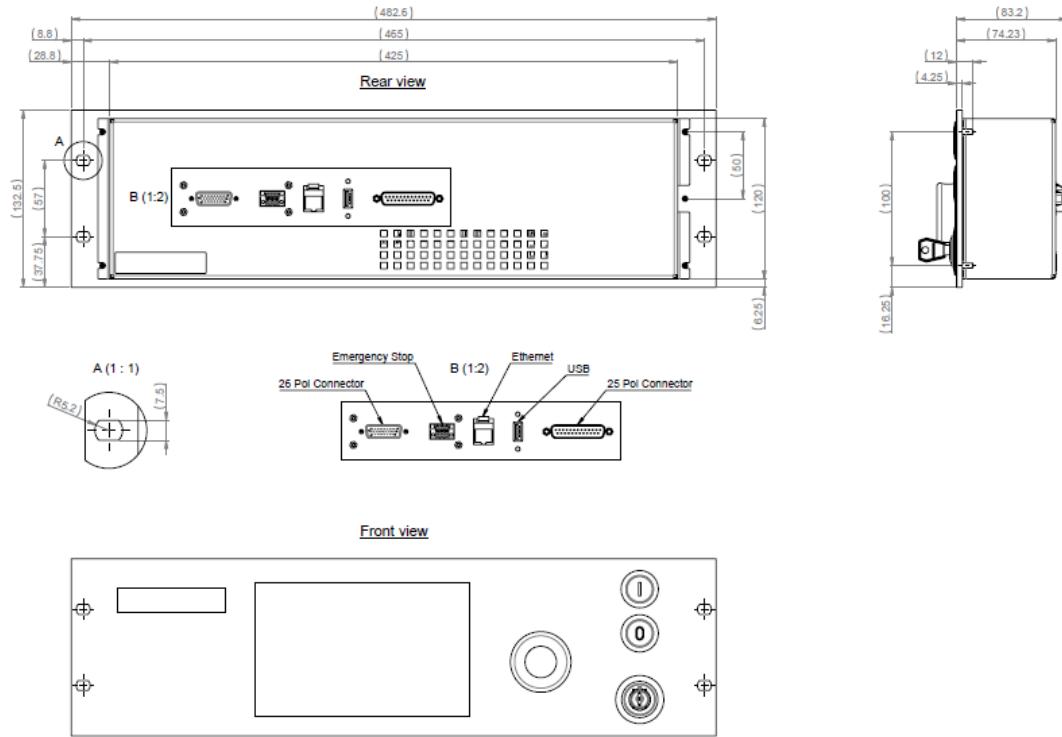
10.8 iCover IP54



10.9 iCover IP21



10.10 iVario Controller



List of Figures

Fig. 1: Main components of iVario series iXRS X-ray module	13
Fig. 2: iVario-160/4.5 generator	14
Fig. 3: iVario IFC	15
Fig. 4: iVario safety interface	16
Fig. 5: iVario powercell	18
Fig. 6: iVario backframe	18
Fig. 7: iVario control software	19
Fig. 8: Type plate (f.e. iVario-225/4.5)	21
Fig. 9: Example of installation of iXRS	32
Fig. 10: Example of installation with iVario External Safety	33
Fig. 11: Example of installation without iVario External Safety	34
Fig. 12: iVario controller	38
Fig. 13: Installation diagram with iVario Controller	39
Fig. 14: Connections of iVario cooler interface	40
Fig. 15: IP54 Cover on iVario generator	40
Fig. 16: iVario Optional External Safety	42
Fig. 17: iVario Optional External Safety	43
Fig. 18: Connections at HV tank	56
Fig. 19: Earth connection at X-ray tube/flange	57
Fig. 20: Connecting the cooler at X9	61
Fig. 21: Connection diagram of cooler	61
Fig. 22: Internal circuit configuration – coolant temperature X9	62
Fig. 23: Internal circuit configuration – flow rate X9	62
Fig. 24: Internal circuit configuration – power supply output of cooler X9 for switching on/off and cooler delay control	62
Fig. 25: Internal circuit configuration – cooler delay control X9 for connection of third-party cooler	63
Fig. 26: Connection of Aux power supply 1 x 230 V + neutral to X1 + PE	65
Fig. 27: Connection with Mains power supply 2 x 230 V + neutral to X2	66
Fig. 28: Mounting protective cover	67
Fig. 29: Securing protective cover	67
Fig. 30: Connection diagram 1 phase 230/400 V	68
Fig. 31: Connection diagram 2 phases 230/400 V	68
Fig. 32: Connection diagram 3 phases 230/400 V	69
Fig. 33: Wiring diagram – 2 phases 208/240 V	69
Fig. 34: Point-to-point connection with control PC, iVario control software of host application	70
Fig. 35: Point-to-point connection with iVario controller	70
Fig. 36: Point-to-point connection for service – change connection of host on service PC	71
Fig. 37: Integration into customer network with static IP addresses	72
Fig. 38: Connection of control PC via Ethernet to X4	72
Fig. 39: Connection of control PC via RS232 to X5	73
Fig. 40: I/O connection (D-sub 25P) at X8	74
Fig. 41: Input signals at X8	75
Fig. 42: Sample wiring diagram for HV Enable button	76
Fig. 43: Output signals at X8	77
Fig. 44: Sample wiring diagram for output 1	78

Fig. 45: Connection of X-ray LED to port X10	80
Fig. 46: Wiring diagram for X10	81
Fig. 47: Connection signaling safety interlock on X11	82
Fig. 48: Wiring diagram safety interlock signalization X11	83
Fig. 49: Emergency stop signalization connection (D-sub26P) at X12	84
Fig. 50: Wiring diagram for X12	84
Fig. 51: Connection options for CDRH switch (for USA only)	84
Fig. 52: Minimum number of connections and bridges for iVario generator start-up	85
Fig. 53: Bridge at X11	85
Fig. 54: Bridge at X12	86
Fig. 55: iVario controller	87
Fig. 56: Connection of iVario controller via Ethernet at X4	88
Fig. 57: Connection (D-sub 26P) at X12	88
Fig. 58: Ports of the iVario controller	89
Fig. 59: Bridges at iVario controller	89
Fig. 60: Ports of cooler interface	90
Fig. 61: Connection to cooler interface at X9	91
Fig. 62: Bipolar cable connected to iVario backplane	92
Fig. 63: Cover of iVario backframe	92
Fig. 64: Fixture of cable gland plate to cover iVario backframe	93
Fig. 65: iVario with mounted IP54 Cover	93
Fig. 66: Cable gland for use without cover	96
Fig. 67: Insert filter	97
Fig. 68: Filter	97
Fig. 69: iVario with mounted IP 21 cover	98
Fig. 70: Installation folder (example)	102
Fig. 71: Web UI login page	104
Fig. 72: I/O configuration with Web UI	105
Fig. 73: I/O configuration page in Web UI	106
Fig. 74: Configuration of optional warning light	106
Fig. 75: IFC and safety interface	108
Fig. 76: User interface	117

List of tables

Tab. 1: Warning symbols	8
Tab. 2: Mandatory action symbols	9
Tab. 3: Instruction symbols	9
Tab. 4: Additional symbols	9
Tab. 5: Tube table with system assignment (unipolar)	20
Tab. 6: Tube table with system assignment (bipolar)	20
Tab. 7: Mains input – auxiliary AC input	22
Tab. 8: Mains AC input – iVario generator with 2.25 kW	23
Tab. 9: Mains AC input – iVario generator with 4.5 kW	23
Tab. 10: High voltage	25
Tab. 11: Tube current	26
Tab. 12: Timer	26
Tab. 13: Dimensions and weights of the generator	27
Tab. 14: Admissible ambient conditions	28
Tab. 15: IP protection classes	28
Tab. 16: Mechanical load capacity	29
Tab. 17: Max. operating voltage in kV	30
Tab. 18: High voltage plug types	31
Tab. 19: Optional components	36
Tab. 20: Protection class of iVario controller	39
Tab. 21: Default configuration	103
Tab. 22: Daily maintenance schedule	157
Tab. 23: Weekly maintenance schedule	158
Tab. 24: 2 - 6 months maintenance schedule	158
Tab. 25: 6 months maintenance schedule	159
Tab. 26: Annual maintenance schedule	159
Tab. 27: 2 years maintenance schedule	160
Tab. 28: 10 years maintenance schedule	160
Tab. 29: Materials harmful to humans and/or the environment	163

Europe & RoW

Comet AG
Herrengasse 10
CH-3175 Flamatt
Switzerland

T +41 31 744 90 00
F +41 31 744 90 90
service.xray.ch@comet.tech
xray.comet.tech

USA

Comet Technologies USA, Inc.
100 Trap Falls Road Extension
Shelton, CT 06484
USA

T +1 203 447 31 65
F +1 203 925 03 64
service.xray.us@comet.tech
xray.comet.tech

Asia

Comet China
1201 Gui Qiao Road
Building 10, 1st floor
Pudong, Shanghai 201206
P.R.China

T +86 21 6879 9000
F +86 21 6879 9009
service.xray.cn@comet.tech
xray.comet.tech