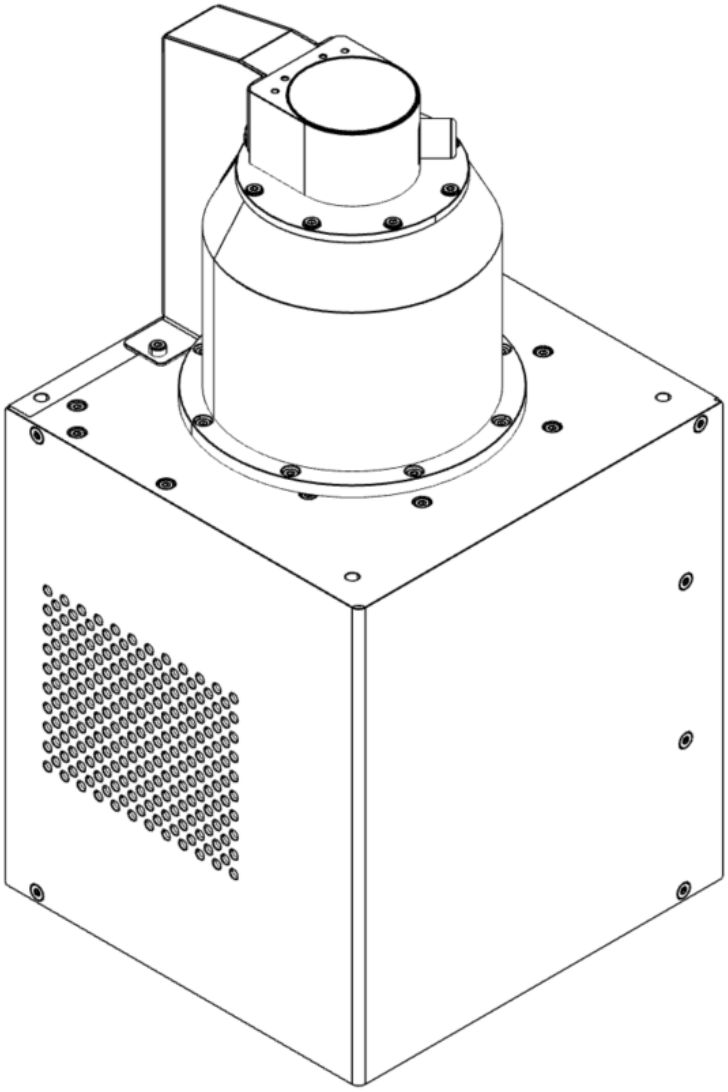
Integrator manual

Xplorer 130 cube

Sealed Microfocus X-Ray Module

XP-130/3-2



comet x-ray

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Copyright

This is the original manual for the Xplorer 130 cube (XP-130/3-2) in English language.

Content

1 About this document

1.1 Contents in this document

This OEM manual is intended to enable integrators to integrate the X-ray module safely into his final product. It contains all the important instructions for safe operation of the module. The Xplorer X-ray module must be operated in accordance with the statutory regulations for X-ray 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 Markings in the text

- Bulleted lists are marked with a round dot.
- Text that is highlighted in this manner [> 8] identifies 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

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:

Danger

Serious risk!

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

Warning

Medium-level risk!

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

Caution

Minor risk!

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

Attention

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:

Danger

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
	Danger from toxic substances

Tab. 1: Warning symbols

Instruction symbols

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

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.
	General information

Tab. 2: Mandatory action 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. 3: Additional symbols

1.2.6 Figures

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

1.3 Other applicable documents

Document	Document number
JSON-RPC Interface	50092568
Comet Connect Operator Manual	50084568

1.4 General business terms and conditions

The general business terms and conditions Comet AG 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 Xplorer X-ray 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 module, always observe the instructions about the warmup and conditioning [>33]

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 nameplate: Module type, serial number and year of construction.

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 of the module and the ISO Certificate of Comet can be found in the Download Center on the website xray.comet.tech. or are available on request

2 Product description

Comet Xplorer X-ray modules are sealed integrated microfocus X-ray modules that set new standards in ease of operation and quality. A web-based GUI is provided for control and monitoring. Custom control software can be created by the system integrator using the Xplorer interface specification provided.

Additional components to be provided by the system integrator

A 24VDC power supply meeting specifications in chapter 4 is required to power the Xplorer X-ray module. The customer is provided standard connectors to be used in construction of power, interlock and signal cables which are also required to operate the X-ray module. An optional integration kit with cables and our recommended 24VDC power supply is available.

Safe shut down of high voltage power

The system integrator needs to ensure the safety of personnel by providing safe shut-down of the high voltage generator of the X-ray module. This must always be carried out by means of the interlock connections using external electromechanical components (disconnect switches or contactors) in the X-ray system (safety devices) as shown in chapter 4.

2.1 Main components of the XP-130/3-2

Item	Designation	Description
1	Tube	X-ray emitting tube head with Beryllium window
2	Module housing	Integrated oil filled high voltage generator & control electronics
3	Cathode protecting cover	Protect the cathode supply connections

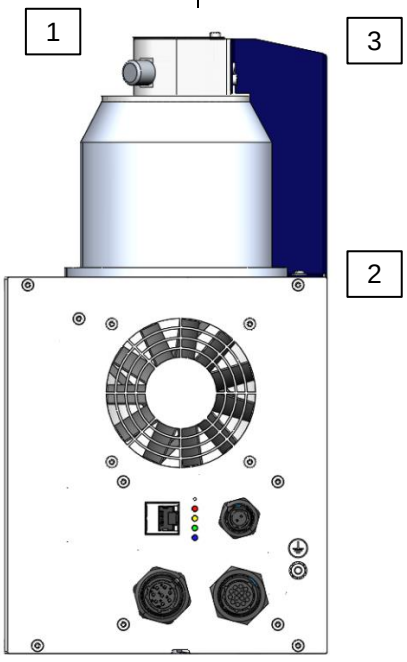

Fig. 1: Main components of the XP-130/3-2

Caution

Minor risk!

The high voltage generator section of the Xplorer X-ray module is filled with SHELL DIALA S4 ZX-I transformer oil. Disposal of this oil has to be carried out in accordance with local regulations. SHELL DIALA S4 ZX-I does not contain. Dioxin. For details, see chapter 8 Decommissioning and disposal [> 42].

2.1.1 Type label

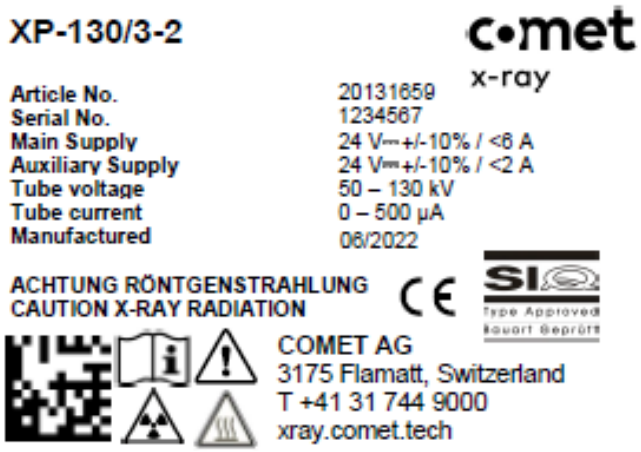

Fig. 2: Type label XP-130/3-2

	Before operating the device, read and understand the manual.
	General safety warning. 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.
	Surface temperature can be hot. Danger of burn hazard.
	Risk of injury from X-ray radiation

2.2 Use of the Xplorer X-ray module

2.2.1 Intended use

The Xplorer X-ray module must be used exclusively for inspection or testing of materials, components, and assemblies. It is designed and intended exclusively for industrial use.

The Xplorer X-ray module is an incomplete product. It will not work stand alone and needs to be powered by an external power source and controlled by signals provided by the system integrator.

Notice

It is the duty of the integrator to ensure X-ray protection and safety compliance.

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 Xplorer X-ray module 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 Xplorer X-ray module. Comply with the statutory radiation protection regulations and install all necessary safety devices. Improper use might cause severe injury or damage to property and/or body. In the event the Xplorer X-ray module is used for an apparatus which requires certain permits, licenses or certificates to be operated in a particular field (e.g. medical applications), it is the responsibility of the manufacturer of such apparatus to make sure that any required permits, licenses or certificates are validly in place.

Improper use includes (non-exhaustive list):

- 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, temperature, etc.).
- Insufficient cooling of the X-ray module.

Danger

Risks arising from improper use

Improper use occurs if parts are installed or attached which 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 Technical Specifications

Tube voltage	50–130 kV
Tube current	0–500 µA
Maximum X-ray power	65 W at 130kV (50W at 100kV)
Focal spot size	< 12 µm at 8W < 100 µm at 65W
Focal spot control	Optimized over the power range
Beam angle	115° both axes
Target material	Tungsten
Window material	Beryllium 0.5 mm
Focus to object distance (FOD)	11 mm
DC Main Supply	24 VDC +/-10%, 6A
DC Auxiliary Supply	24 VDC +/-10%, 2A
Duty cycle on / off	Continuous
Temperature range	5–40 °C
Pollution degree rating	Category 2
Humidity	90% non-condensing
Dimensions L x W x H	172 mm x167 mm x 139 mm w/o connectors
Weight	9.5 kg
Interface Communication	Ethernet RJ45
Interface I/O	Hardware interlock IN High voltage enable IN «X-ray on» OUT
Interface Power	24VDC IN Power Interlock
Internal Fuse F600 on Mainboard Replaceable only by Comet.	T6AH250V or T6AL250V

Tab. 4: Technical specification

2.4 Admissible ambient conditions for the Xplorer X-ray module

	During operation	During transport and storage
Temperature	+5 °C to +40 °C	-20 °C to +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	700 – 1100 hPa Max. altitude 3000 m	600 – 1100 hPa
IP protection rating	IP 20	

Unit is for indoor use only. Pollution degree 2.

Tab. 5: Admissible ambient conditions

2.5 Functional safety: Choosing safety components

Functional safety components do not form part of the Xplorer X-ray module and must be provided and installed by the system integrator / system installer.

2.5.1 Switch-off time and constructive requirements

The Xplorer X-ray module will not emit X-ray radiation within 100 to 400ms after switching off DC Main Supply

Danger

Risk of injury from X-ray radiation!

The system integrator must ensure that, when opening the door of the X-ray system, 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.

Attention

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 Xplorer X-ray module.

2.6 Optional components

Optional assemblies allow an easier integration of the X-Ray module within the host system

Material No.	Component	Description
20134421	Xplorer Cube Integration Kit	Contains all cables and accessories necessary for initial installation • 1x 7.5m X1 Cable DC Auxiliary supply • 1x 7.5m X2 Cable DC Main supply HV • 1x 7.5m X3 Cable Signal • 1x 240W 24VDC industrial power supply • 1x 7.5m 2.5mm^2 earth cable • 1x 5m Ethernet RJ45 cable

Tab. 6: Optional components

3 Safety

The prerequisite for the safe handling and trouble-free operation of the Xplorer X-ray 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

Danger

Risk of injury from high voltage!

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

Danger

Risk of injury from exposure to X-ray radiation!

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

Close to radiation safety symbol a mention “CAUTION: X-Rays produced when energized” might be found

Warning

Hazard point warning!

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

Warning

Risk of injury from hot surface!

This symbol warns of hot surfaces.

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 about this X-ray module, always quote the model and serial numbers. 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 must be shut down and secured against inadvertent operation.

Danger

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 system integrators, operators, and service personnel

Warning

Danger of injury resulting from lack of specialized knowledge!

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

- The Xplorer X-ray module must only be operated by qualified, trained and properly instructed personnel.
- Prior to commissioning the module, read this manual.
- Instruction in operating the system using the Xplorer X-ray module 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 module must be inspected by an authorized person. The maximum permissible high voltage, emission current and power must be suitable for the system the Xplorer X-ray module to be used in.
- Radiation protection must be checked and monitored by authorized personnel after installation and after any maintenance.
- Before carrying out any cleaning work, shut down the module and secure it against inadvertent restart. Clean the Xplorer X-ray module **except for the Beryllium window**, with a moist cloth or with alcohol. The use of other cleaning agents is prohibited.
- Never clean the Xplorer X-ray module with a dripping wet cloth.

3.5 Electrical safety

The Xplorer X-ray module meets the requirements of the European Low Voltage Directive.

The module has 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.

Danger

Danger due to technical and missing safety equipment!

High voltage is generated inside the module.

If the safety guards are removed, there is a risk of electric shock when the module is switched on.

Before carrying out any maintenance or repair work, shut down the module and secure it against inadvertent restart.

Only qualified maintenance technicians are allowed to remove the Xplorer X-ray module from the X-ray inspection system.

Earth conductors

The Xplorer X-ray module must be protected by an earth conductor 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 the external power supply for the Xplorer X-ray module is switched on.

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

Protection covers

Danger

Risk of injury from high voltage!

Neither the cathode protecting cover nor enclosure itself should be opened or removed, as parts with dangerous voltages might become accessible.

3.6 Transport and installation

Please transport the Xplorer X-ray module only in the original Comet packaging. The packaging is not designed for stacking. If the original packaging is no longer available, you should use packaging providing a high level of protection.

Caution

Slip risk on escaped oil

Take up any escaped insulation oil without delay to prevent slipping. Identify the location of the leakage and remove the X-ray module without delay.
If the module is leaking oil or is otherwise defective, return it to the X-ray system manufacturer for repair or replacement by Comet.

Notice

To handle the Xplorer X-ray module, we recommend wearing protective gloves and safety footwear.

- Check the packaging for obvious external damage
- Check the shock indicators if available
- Open each individual package

Notice

Tip: The contents of the packages are listed in the shipping documents.

Prior to installation, compare the scope of supply and the contents of the packages as well as the scope of supply and the purchase order.

3.7 Occupational safety

Notice

Integrators and/or operators are responsible for ensuring that the module is operated in accordance with all legal requirements.

It is prohibited to operate modules with 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 Xplorer X-ray module meets 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.
In reference to latest valid CISPR11 edition, table 2, Class A devices are suitable for operation at any location, except residential areas. Such devices must not be connected to a 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 functioning of this device if they are used in the immediate vicinity. The operation of the device 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.

Caution

Risk of injury from electromagnetic radiation

This equipment is not intended for use in residential environments and may not provide adequate protection to radio reception 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 device operators.
For this reason, the operation of appliances with HF radiation near the device should be avoided.

3.10 Radiation protection

Notice

Radiation protection is the responsibility of the system integrator & operator.

The statements that follow are to be regarded as recommendations. Observe all applicable statutory regulations and safety requirements.

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

Danger

When the high voltage power is switched on, the X-ray module generates X-ray that can cause damage to health.

- The X-ray module must only be operated by qualified technical staff.
- The system integrator is responsible for compliance with all statutory regulations during installation and operation of the module.
- Never operate the X-ray 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.
- After installation, maintenance or repair work, the configuration of the X-ray module 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.
- For the safe operation of the Xplorer X-ray module, additional radiation protection is always necessary.
- 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

3.11 Safety and warning devices

Danger

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, 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 safety circuits need to be designed to meet the requirements of the machinery directive 2006/42/EC of the European Community, considering that the safety related parts of the module must achieve the needed category and performance level of the international standard EN ISO 13849-1.

Possible door switches installed into the X-ray module enclosure or cabinet must fulfil the required safety levels according to EN ISO 13849-1. An emergency button must be integrated into the overall system and must fulfil the requirements of the standard EN ISO 13850.

3.12 Modification of components

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 Installation

Warning

All work in connection with installation and commissioning must be performed by suitably 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 the Xplorer X-ray module. Special care has to be given to avoid mechanical shocks during handling.

- Observe all applicable safety regulations.

Warning

Medium level risk!

Before starting the installation process, take into account the following precautions to avoid personal injuries.

- Read the manual
- Verify the correct supply voltage and temperature rating. For further details see chapter 2.3 Technical Specifications [> 14].

Danger

Danger from toxic substances

Exit windows from Xplorer X-ray modules are made of Beryllium.

This Beryllium window is protected by metal cover for transportation and installation. Please remove cover before use.

Do not scratch or damage the surface of the window!

Beryllium can only constitute a danger in the case of improper use, e.g. scratching or damaging the Beryllium window.

Beryllium dusts and salts may lead to liver damage; inhaling the dusts may cause permanent lung damage.

Beryllium is a carcinogenic working substance classified in Group III A2 in animal tests. Skin contact may lead to inflammatory skin diseases.

In case of damage of Beryllium window, please mount the window protective cover and return the unit to manufacturer for repair.

In the event of a fire, toxic substances such as Beryllium can be released

4.1 Basic conditions

Unpacking

The whole X-ray module is shipped in a single package. When the X-ray module is unpacked, inspection of all parts should be made immediately. Any damage should be reported at this time. The problem must be clearly described and if possible, accompanied with a photo. Check the packing list of the delivery during unpacking.

Before installing

- Inspect the Xplorer X-ray module for damage.
- Remove exit window protection cover
- Ensure X-ray radiation protection.

Installation notes

The Xplorer X-ray module is shipped to the integrator in a single package, completely assembled and ready for set up. When mounting the unit into the X-ray system, do not place it so that the cooling fans or other vent holes are blocked. The Xplorer X-ray module is an incomplete product. It will not work stand alone and needs to be powered by an external power source, which is provided by the integrator. There must be an external disconnecting device for Main Supply and Auxiliary supply. External disconnecting device must be easily accessible by the operator and must have marked position O/I. This is switch is part of end product which is the X-ray system

Danger

Exposure to X-ray radiation

- The X-ray module includes no protections against radiation.
- It is the duty of the integrator to ensure X-ray protection, safety measurements and proper installation.

Functional safety does not form part of the Xplorer X-ray module and must be provided and installed by the system integrator / system installer

Safety equipment

To comply with applicable radiation protection laws, state regulations and regulations at the module installation site, the integrator must ensure that the required safety equipment is present and has been connected to the X-ray module. The AC mains supply to the external power supply must conform to the requirements of EN 60204-1 "Safety of machinery – Electrical equipment of machines" or all equivalent national standards and regulations.

Radiation protection notes

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 enclosure, which is usually made of lead, lead glass, and steel.

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

Notice

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

4.2 Mounting

- Please refer to chapter 9.1 Outline drawing for mounting points. [> 44].
- As seen in the outline drawings, mounting points are provided on the front, top, bottom and one side. Ensure adequate mechanical fixation. We recommend mounting to two surfaces, if possible. Do not use only the front surface for mounting.
- Please leave the protective window cover in place during installation.
- We recommend installing the Xplorer X-ray module with good thermal conductivity to improve heat transfer i.e. mount the module directly to a smooth metal bracket or plate.
- To avoid overheating of the X-ray module, ensure an adequate clearance around the unit, and adequate airflow to ensure the ambient temperature is within the prescribed range during extended and continuous operation. [> 14].
- Ensure that the cooling fans or other vent holes are not blocked by a wall or other objects.
- Verify that adequate airflow is available around the X-ray module. Verify the ambient air temperature in the enclosure is $\leq$ 40°C. Install additional cooling devices (fan, etc.) if necessary
- The integrator must provide the appropriate radiation shielding for the Xplorer X-ray module
- The Xplorer X-ray module is designed exclusively for operation in protected enclosures 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 Xplorer X-ray module is not approved for operation in potentially explosive atmospheres.

4.3 Electrical connections

Danger

Risk of injury from radiation

Before switching on the module, read the entire chapter 4 Installation [> 24]. Ensure that all radiation protection requirements are met.

The interfaces of the XP-130/3-2 are described in the figures below:

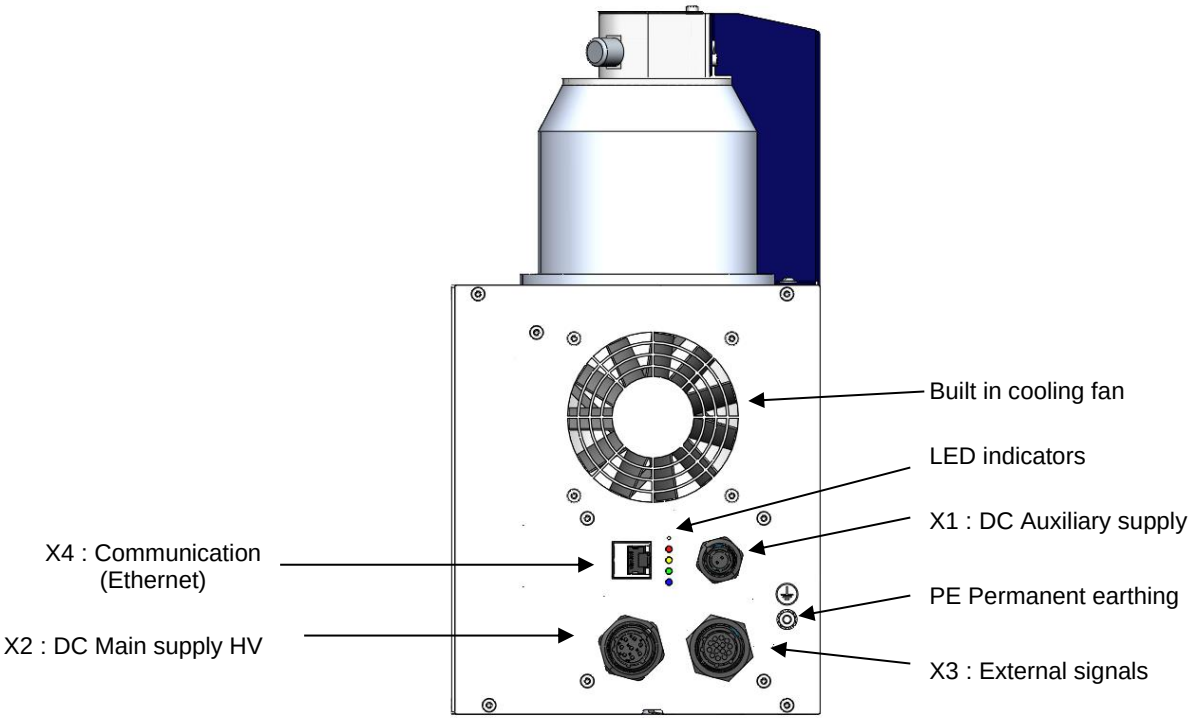

Fig. 3: Components to be noted for installation

4.3.1 Electrical connections diagram

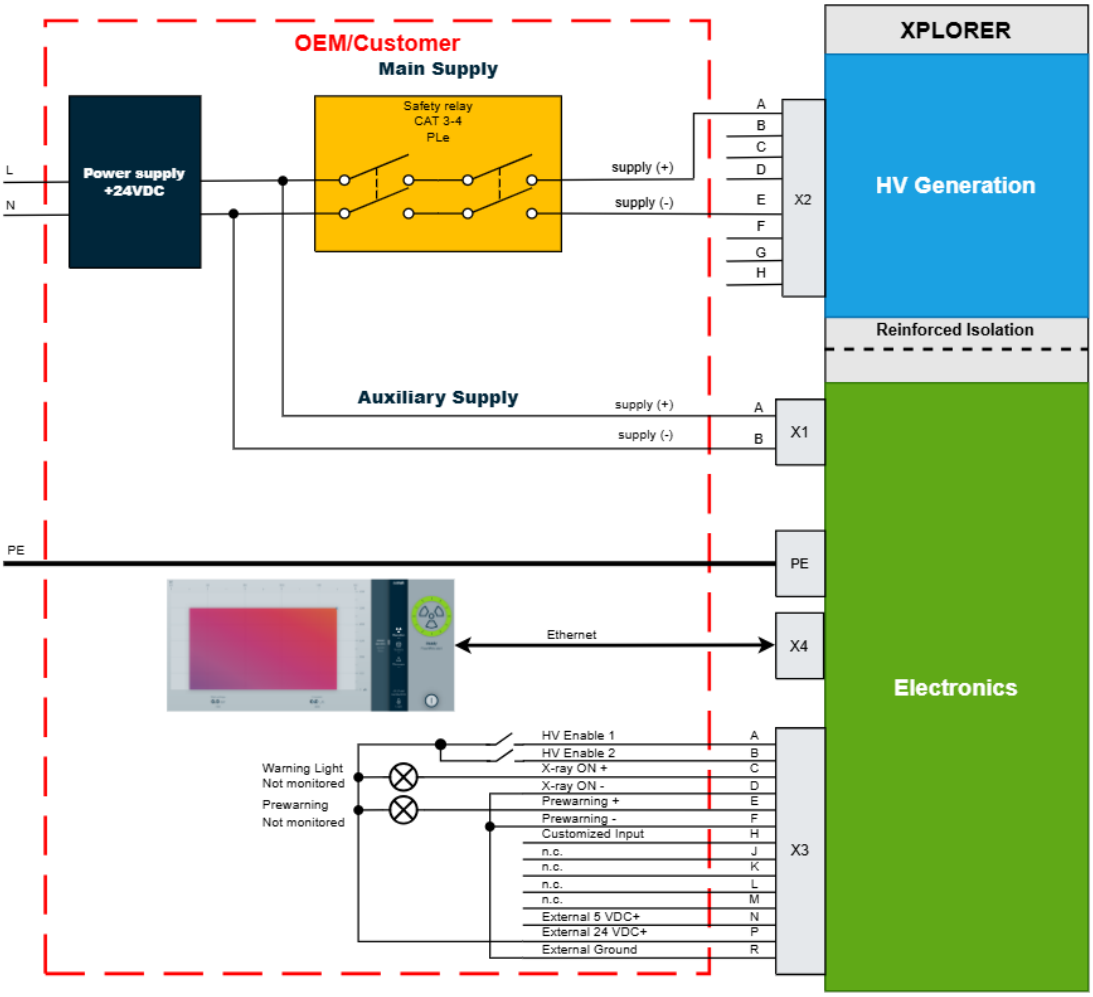

Fig. 4: Electrical Connections. See connector pinning below.

Warning

Interlock connections

- Connect your interlock circuits to the DC Main supply connector as shown in diagram (Fig. 4:) above. Ensure that the contacts of the interlocks are compatible with a 24VDC 6A power supply.
- When connecting the interlock circuit, use a cable with wire at least as thick as stranded wire AWG18 (0.8mm^2). The cable length for this cross section should be less than 7.5 m. If the cable length must be longer, more pins must be used to reduce the voltage drop caused by the supply cable
- Resistance of these external interlock circuits and the 24VDC supply wiring should each be < 0.5 Ohm.
- Note that interlock outputs will have 24VDC during operation.
- All pins and cables should be insulated from ground.

- To ensure proper performance, the 24V DC supply should be set as needed to achieve ≥ 24V at pin A to D referred to ground pin E to H **during operation at full power**.
- **After wiring is complete and all safety precautions taken,** the voltage at pin A to D should be verified to be **>** 24V with Xplorer X-ray module operating at full power and maximum kV. Otherwise, the Xplorer X-ray module performance will not be ensured.

Warning

X-ray Indicator

The Xplorer X-ray module provides a potential free contact (X3, Pin C-D) which can be connected to an indicator light. An internal solid state relay closes both contacts during X-ray radiation (24VDC, <1A). Nevertheless, the module does not monitor the status of the indicator light. It is the duty of the integrator to ensure X-ray protection and safety measurements!

Danger

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

When the X-ray module is energized, this module might start to generate X-rays which in case of misuse can be detrimental to health. The module may only be operated by skilled qualified personnel.

The module owner is responsible for observing the local legal regulations when installing and using the module.

It is prohibited to operate modules having technical defects. It is not allowed to bypass, remove or modify safety devices.

The radiation protection must be checked and monitored by authorized persons. It must be checked again after each maintenance or service intervention.

For the safe operation of the Xplorer X-ray module additional radiation protection is always necessary!

4.3.2 Power Supply required

The power supply is provided by the integrator and must be separated from mains voltage by reinforced / double insulation.

4.3.3 Cables required

Any cables and any connections to the X-ray module must be provided by the integrator unless optional XP-130/3 Integration Kit has been ordered. Cables required are:

- RJ45 ethernet cable
- X1 DC Auxiliary supply cable
- X2 DC Main supply HV cable
- X3 I/O interface cable
- >= 2.5mm^2 Earthing cable

4.3.4 Pin assignment auxiliary supply connector (X1)

		Signal name	Type	Voltage	Current	Description	Minimum cable cross-section	Maximum cable cross-section
1	A	24VDC+IN AUX	Input	+24VDC, +/-10%	<2 A	DC Auxiliary supply	0.5mm^2 (AWG21)	0.75mm^2 (AWG19)
2	B	24VDC-IN AUX	Input	0V	<2 A	Ground Auxiliary supply	0.5mm^2 (AWG21)	0.75mm^2 (AWG19)

4.3.5 Pin assignment DC Main supply connector (X2)

		Signal name	Type	Voltage	Current	Description	Minimum cable cross-section	Maximum cable cross-section
1	A	24VDC+IN	Input	+24VDC, +/-10%	<6 A	DC Main supply	0.8mm^2 (AWG18)	1.5mm^2 (AWG15)
2	B	24VDC+IN	Input	+24VDC, +/-10%	<6 A	DC Main supply (optional)	0.8mm^2 (AWG18)	1.5mm^2 (AWG15)
3	C	24VDC+IN	Input	+24VDC, +/-10%	<6 A	DC Main supply (optional)	0.8mm^2 (AWG18)	1.5mm^2 (AWG15)
4	D	24VDC+IN	Input	+24VDC, +/-10%	<6 A	DC Main supply (optional)	0.8mm^2 (AWG18)	1.5mm^2 (AWG15)
5	E	24VDC-IN	Input	0V	<6 A	Ground Main supply	0.8mm^2 (AWG18)	1.5mm^2 (AWG15)
6	F	24VDC-IN	Input	0V	<6 A	Ground Main supply (optional)	0.8mm^2 (AWG18)	1.5mm^2 (AWG15)
7	G	24VDC-IN	Input	0V	<6 A	Ground Main supply (optional)	0.8mm^2 (AWG18)	1.5mm^2 (AWG15)
8	H	24VDC-IN	Input	0V	<6 A	Ground Main supply (optional)	0.8mm^2 (AWG18)	1.5mm^2 (AWG15)

Notice

Please use a cable with

- Min. Recommended wire size: 0.8mm2 (AWG18)
- Min. temperature rating: 80°C
- Min. voltage rating: 150VRMS
- Max. Cable length < 7.5 m

Be aware that Souriau UTS connector enables wire with max. size of 1.5 mm2 (AWG15)
If the cable length must be longer than 7.5m, more pins must be used to reduce the voltage drop caused by the supply cable

4.3.1 Pin assignment Interface Signal connector (X3)

	Signal name	Type	Voltage	Allowed Range	Description
A	HV Enable 1	Input+	+24VDC	Max: +30VDC * Min: -1V* * to EXT GND	Enable high voltage ON Software controlled shut down, not safe 0V: HV ON disable, +24V: HV ON enable
B	HV Enable 2	Input+	+24VDC	Max: +30VDC * Min: -1V* * to EXT GND	Enable high voltage ON Software controlled (STM) shut down, not safe 0V: HV ON disable, +24V: HV ON enable
C	X Ray ON +	Output+	Potential-free contact with PIN D, 24VDC, 1A	Max: +/-30VDC * * to EXT GND	Generic signalization X-ray ON Closed when HV is ON, not monitored
D	X Ray ON -	Output-	Potential-free contact with PIN C, 24VDC, 1A	Max: +/-30VDC * * to EXT GND	Generic signalization X-ray ON Closed when HV is ON, not monitored
E	Prewarning+	Output+	Potential-free contact with PIN F, 24VDC, 1A	Max: +/-30VDC * * to EXT GND	Signalization before X-Ray is generated
F	Prewarning -	Output-	Potential-free contact with PIN E, 24VDC, 1A	Max: +/-30VDC* * to EXT GND	Signalization before X-Ray is generated
H	Customized Input	Input+	+5VDC	+5 VDC, CMOS* * to EXT GND	Input trigger Triggering pulsed beam functionality
J	Beam ON	Output+	+5VDC	+5 VDC, CMOS* * to EXT GND	Output signalization Beam ON, (DSP output) Fast signalization for external synchronization
K	n.c.				
L	n.c.				
M	n.c.				
N	External 5 VDC+	Output+	+5VDC		Isolated external supply, +5VDC, 50mA
P	External 24 VDC+	Output+	+24VDC		Isolated external supply, +24VDC, 100mA
R	External Ground	Output-	EXT GND	Max +/-30V* * to PE	External Ground GND of isolated +24VDC and +5VDC output, usable for all inputs and outputs

4.3.2 Establishing earth connections

Attention

Risk of damage of the module!

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

- Earth cables must not be rolled up or laid out in loops.
- The module must be earthed in accordance with EN 60204-1 and conform to the statutory regulations for high voltage systems.

The earth thread serves as the central earth point of the Xplorer X-ray module.

Danger

Risk of injury from electrical shock

The X-ray module shall be properly connected to the main protective ground / earth termination in the system

An additional earth conductor which is protected against mechanical damage is mandatory. The module must remain permanently connected to the main earthing system of the building even if the main power plug is disconnected.

Notice

In order to minimize earth resistance, the cable that is connected should be as short as possible; The required minimum cable diameter of the additional earth conductor must be at least 2.5 mm^2 (AWG14) , whereby copper conductors are the preferred option. It must be maintained all the way to the central earthing point of the X-ray system.

5 Operation

Important procedures to operate the Xplorer X-ray module are preheating, short warmup and long warmup. They are included within the build in FW

Notice

The high voltage values (kV) are provided from a single channel kV feedback circuit, realized using resistive divider with accurate and stable HV resistor

5.1 Preheating and Warmup

Frequent preheating and warmup will be automatically performed according to the table below to ensure optimal performance of the module if the conditions are fulfilled (recorded “off time” and module ready/interlock closed).

	Pre-Heating	Short Warmup	Long Warmup
Recommended if power off for more than	5 min	1 day	1 week
Duration	2 min	22 min	62 min

Tab. 7: Warm up and conditioning

Notice

The control electronics and heater are powered from the auxiliary supply.

The power off is referring to the heater control and therefore a pre-heating is not required if safety interlocks are open.

During warmup, the unit might arc. If the warmup is not successful, the maximum allowed number of arcs for a warmup might be reached. Please restart the warmup. If the warmup is still not successful, then please contact the Comet service

5.1.1 Pre-Heating

The procedure is mandatory if the module has been powered off for more than 5min.

5.1.2 Short Warmup

The procedure is recommended if the X-rays are powered off for more than one day. The built-in procedure will follow the following pattern

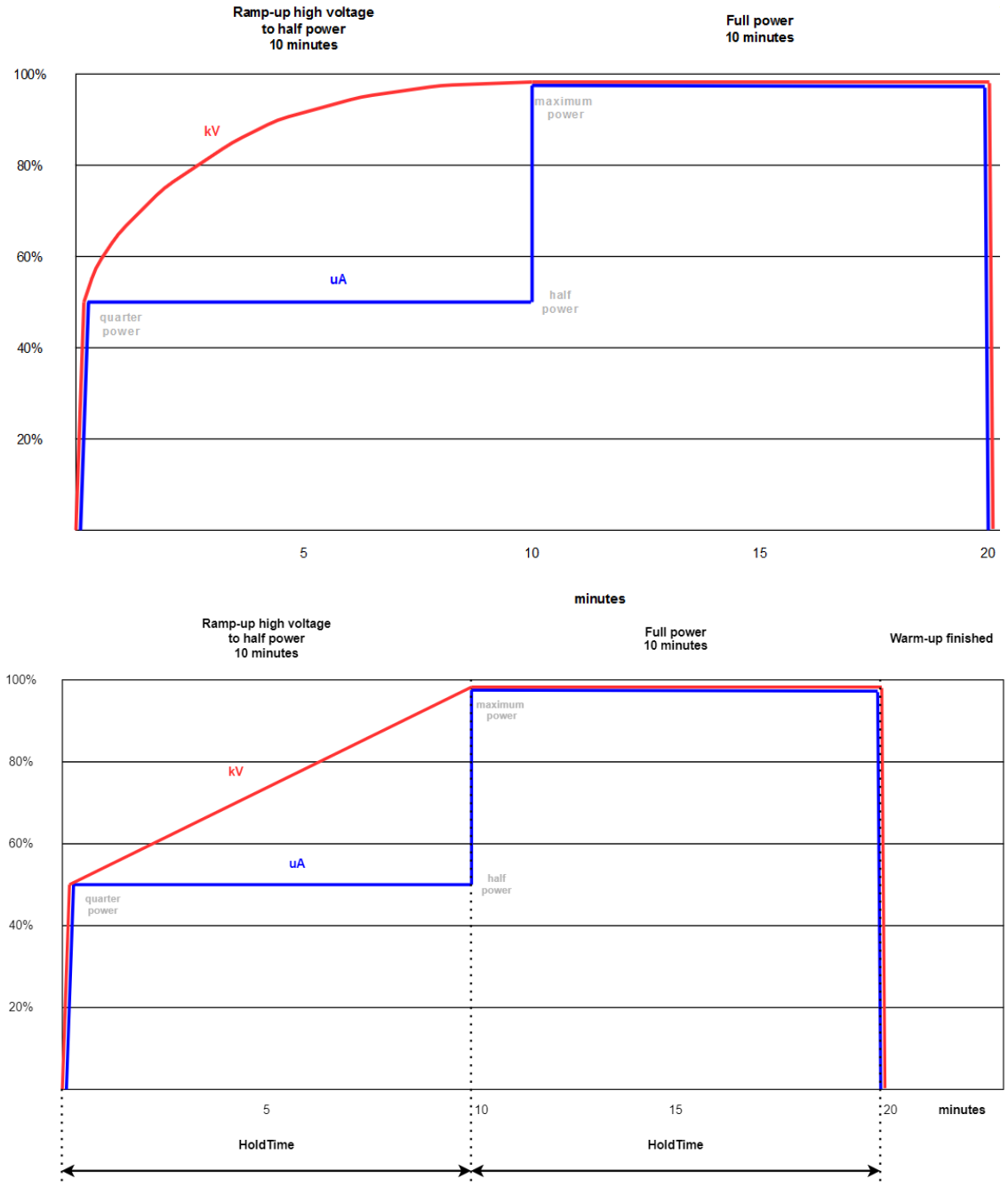

Fig. 5: Short warmup

5.1.3 Long Warmup

The procedure is recommended if the X-rays are powered off for more than one week.

The built-in procedure will follow the following pattern

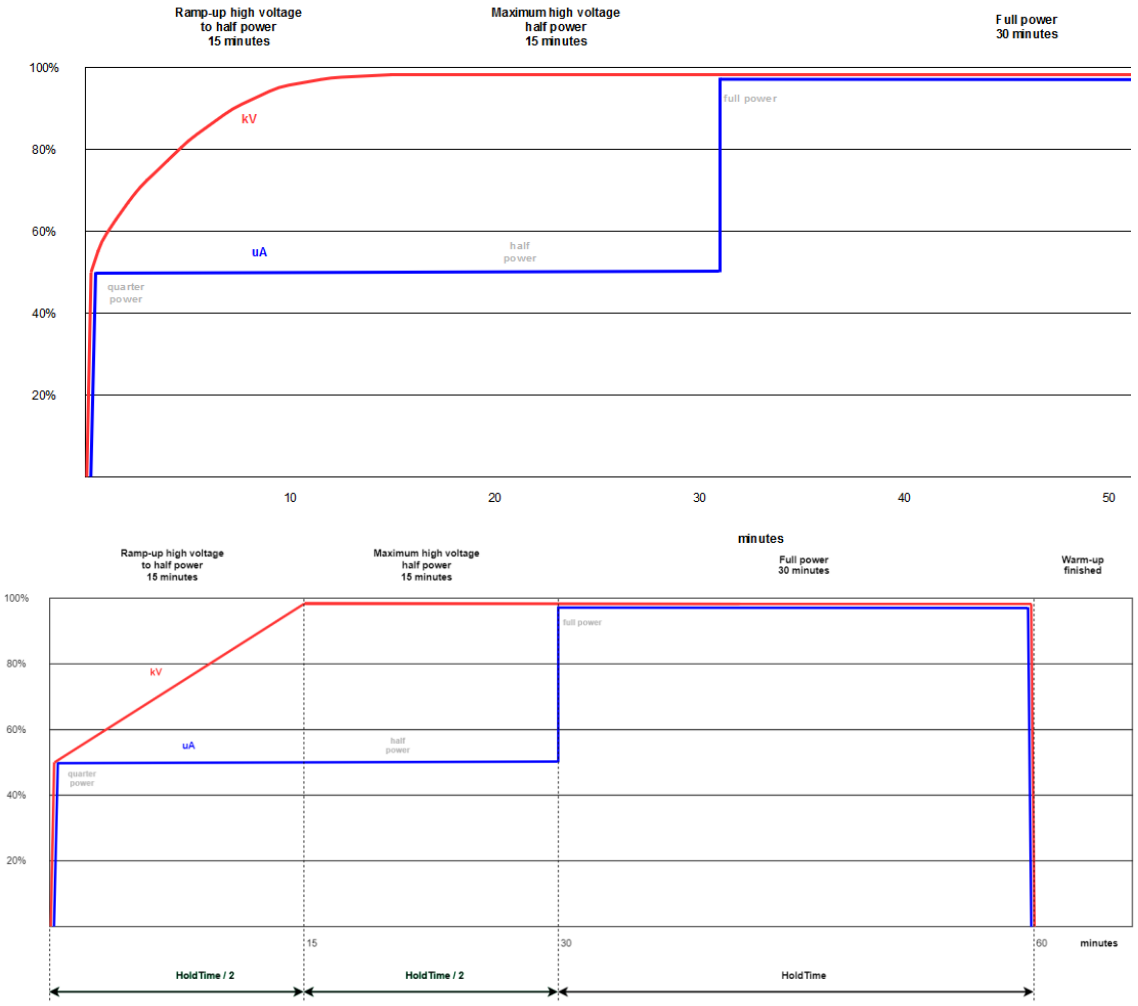

Fig. 6: Long warmup

5.2 Comet Connect

The Xplorer X-ray module is operated via ethernet interface. You can either use the default Comet control software Comet Connect or directly implement the required protocol within your own software solution. For the second option, please refer to document “Xplorer interface”.

The Comet Connect is a basic Graphical User Interface GUI for simple operation, demonstration purposes and for simple service cases (download of logfiles, update of software version). For further details, please the see dedicated manual.

No software installation is required to start the Comet Connect besides a recent web browser. The default IP address should be entered into the browser: **192.168.177.197**

6 Troubleshooting

6.1 LED indicators

Just above the ethernet plug, 4 LEDs are indicating the status of the module

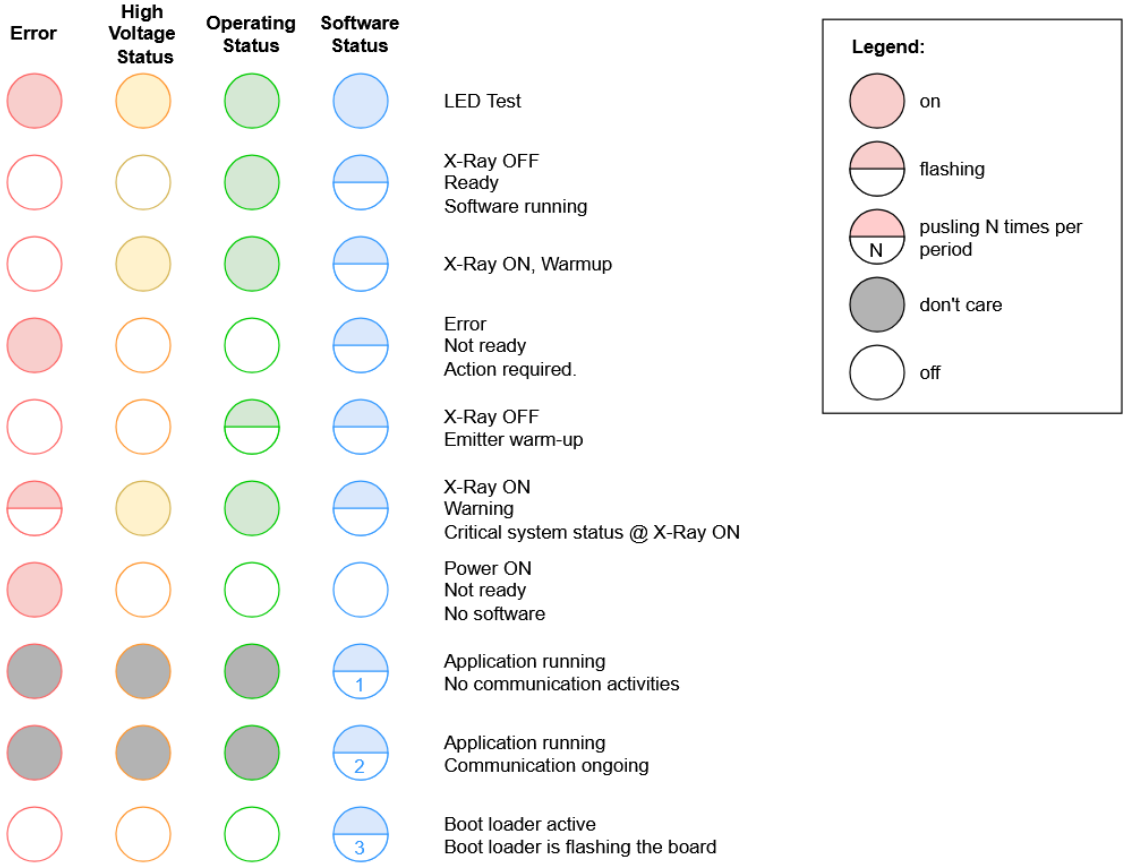

Fig. 7: LED combinations

6.2 Warning and error indicators

Issue	Explanation / Solution
Failure Anode	Failure anode voltage. Please switch the X-ray ON again
Failure Cathode	Failure cathode voltage. Please switch the X-ray ON again
Failure Grid	Failure grid voltage. Please switch the X-ray ON again.
Failure Emission	Failure emission current. Please switch the X-ray ON again
Failure Heater	Failure anode supply. Please switch the X-ray ON again
Failure Work Point Manager	Please reboot the system.
Tube Arc	A tube arc occurred. Please switch the X-ray ON again.
Failure Measurements	Failure in the measurement occurred. Please switch the X-ray ON again
Failure Protection	Failure in protection occurred. Please switch the X-ray ON again
Failure Control Device Supervisor	Please reboot the system.
Failure Internal LPC	Please reboot the system.
Failure CPU1	Hardware Failure. Please contact the technical customer support.
Failure CPU2	Hardware Failure. Please contact the technical customer support.
Failure CLA1	Hardware Failure. Please contact the technical customer support.
Failure CLA 2	Hardware Failure. Please contact the technical customer support.
Failure Voltage Supply	Please check the supply voltages.
Interlock Input Activated	Please close the interlock input.
HV Enable Input Activated	Please close the HV-enable input.
24V Auxiliary out of Range	Please check the supply voltages.
24V HV Supply Voltage out of Range	Please check the supply voltages.
15V Auxiliary out of Range	Please check the supply voltages.
Temperature Fan out of Range	Please check the environment.
Temperature Tank out of Range	Please check the environment.
Temperature Electronic out of Range	Please check the environment.
Failure Control Device	Hardware Failure. technical customer support.
Failure Connectivity Device	Hardware Failure. technical customer support.
Failure Configuration	Hardware Failure. Please contact the technical customer support.

Tab. 8: Errors / issues

7 Maintenance and Service

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

1. Before starting work, shut down the module and secure it against inadvertent restart.
1. Allow hot components to cool.
2. Wear suitable protective clothing (e.g. protective footwear or gloves).
3. Before restarting operation, mount and connect all safety devices provided on site.
4. Perform a function test of the safety devices.
5. After work is complete, remove all tools and other objects from the area around the Xplorer X-ray module.

7.1 Safety instructions for maintenance and checks during operation

Danger

Risk of fatal injury from high electric voltage!

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

- De-energize the Xplorer X-ray module.
- Ensure that the module is completely de-energized.
- Do this according to the manufacturer data and comply with all manufacturer safety instructions.
- Secure the Xplorer X-ray module against inadvertent restart.
- E.g. lock the main switch, remove the key and attach a warning sign to the main switch.

Danger

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 module and its surrounding components works correctly before staring operation.
- Only release the module for use after it has passed all checks and tests.

Danger

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

After all maintenance work 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

Danger

Danger posed by module starting up!

The uncontrolled start-up of the module can cause serious injury.

- Before performing any work on the Xplorer X-ray module, shut it down and remove any power connection
- The secure the main switch of the system against inadvertent restart.

Warning

Risk of injury from hot surface!

Surface temperature can be hot. Danger of burn hazard

7.2 Maintenance schedule

.

Please regularly ensure that the cooling fans or other vent holes are not blocked by dust, debris, a wall or other objects

7.3 Spare parts

Material No.	Component	Description
20140025	Xplorer Cube Connector Kit unassembled	Spare straight plugs (X1, X2, X3) with contacts !! Required crimping tool is not part of the delivery
20133857	Window protection cover	Spare window protection cover
20140025	XP-130/1 Power Interface Connector	• X1 Straight connector housing (UTS6JC8E2S) with connector contacts • X2 Straight connector housing (UTS6JC128S) • X3 Straight connector housing (UTS6JC12E14P) with connector contacts • 10x connector contacts female (RC16M23K) for X2

7.4 Comet Technical Customer Support and Repair process

Danger

High Voltage when open unit.

The Xplorer X-ray module is not repairable, neither by the integrator nor by the operator. In case of failure, return the unit to manufacturer for repair.

Never remove the module cover as there are live parts & high voltage parts which are not protected against accidental contact when the unit is connected to the mains

The Comet Technical Customer Support TCS and Repair Service provide the after sales support for Comet products. Wear and spare parts, if applicable to the product, can be ordered through the regular sales contact.

Technical Customer Support TCS

Technical questions or support requests shall be addressed to the nearest Service Center of Comet, preferably to the TCS email address, listed below. Please provide the serial number of your Xplorer X-ray module. If you need help on technical problems, please provide as much information as possible to speed-up the troubleshooting: What exactly is the issue? What has been done so far to fix the problem? Are there any data or documents (photos, reports) available?

Repair Process

If repair of interior parts of the Xplorer X-ray modules becomes necessary, the product must be sent to Comet AG. In order that all incoming goods are directed quickly and efficiently to the appropriate party, the information you give us is of greatest importance. Please complete the Field Failure Report (FFR) and e-mail it to the Service email address, listed below. We will then send you a service notification with an RMA-number by e-mail. You can find the FFR form on the website *xray.comet.tech* as a service document under the section “Return and Repair”.

Please observe the following rules when returning the Xplorer X-ray module to Comet

- If possible, use the original packaging for transport. If the original packaging is no longer available, you should use packaging providing a high level of protection.
- Attach the service notification with the RMA-number to the shipping documents form and ship the product for repair to your service center

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8 Decommissioning and disposal

X-ray modules contain components which may damage the environment and must therefore be disposed of in an environmentally friendly manner. It is prohibited to dispose of electronic waste, Transformer oil, lubricants and Beryllium parts together with normal industrial or household waste. The applicable statutory regulations for waste disposal must be observed. If handled properly, an X-ray module does not pose a risk to users of the environment.

There is no danger to humans or the environment if instructions in this manual and the safety data sheet(s) are considered and if X-ray modules were properly handled, operated and the housing 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 of by Comet, the same shipping procedure should be used as for repairs.

Materials harmful to the environment

Product	Material	Relevant safety data sheet
Xplorer X-ray module	Beryllium	The safety data sheets for Beryllium, and coolant are available on the https://xray.comet.tech/en/download-center website or on request
Xplorer X-ray module	SHELL DIALA S4 ZX-I transformer oil	

Tab. 9: Materials harmful to the environment

Additional Information to Beryllium:

- On the technical datasheet accompanying our products, you can find information whether your X-ray tube containing Beryllium or not.
- Beryllium windows in Comet X-ray tubes are made with a thin protective coating. It prevents the formation of Beryllium dust or other contaminants. Do not scratch or damage the surface of the window!
- Beryllium can only constitute a danger in the case of improper use, e.g. touching, scratching, or damaging the Beryllium window.
- Beryllium dusts and salts may lead to liver damage, inhaling the dust may cause permanent lung damage.
- Beryllium is a carcinogenic working substance classified in Group III A2 in animal tests. Skin contact may lead to inflammatory skin diseases.
- The instructions in the safety data sheet are to be considered.

Danger

Danger from toxic substances

Do not touch or scratch Beryllium window.
Always protect Beryllium window with metal cover for transportation and disposal.

Notice

Comet products are classified as "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.

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.

9 Outline drawing

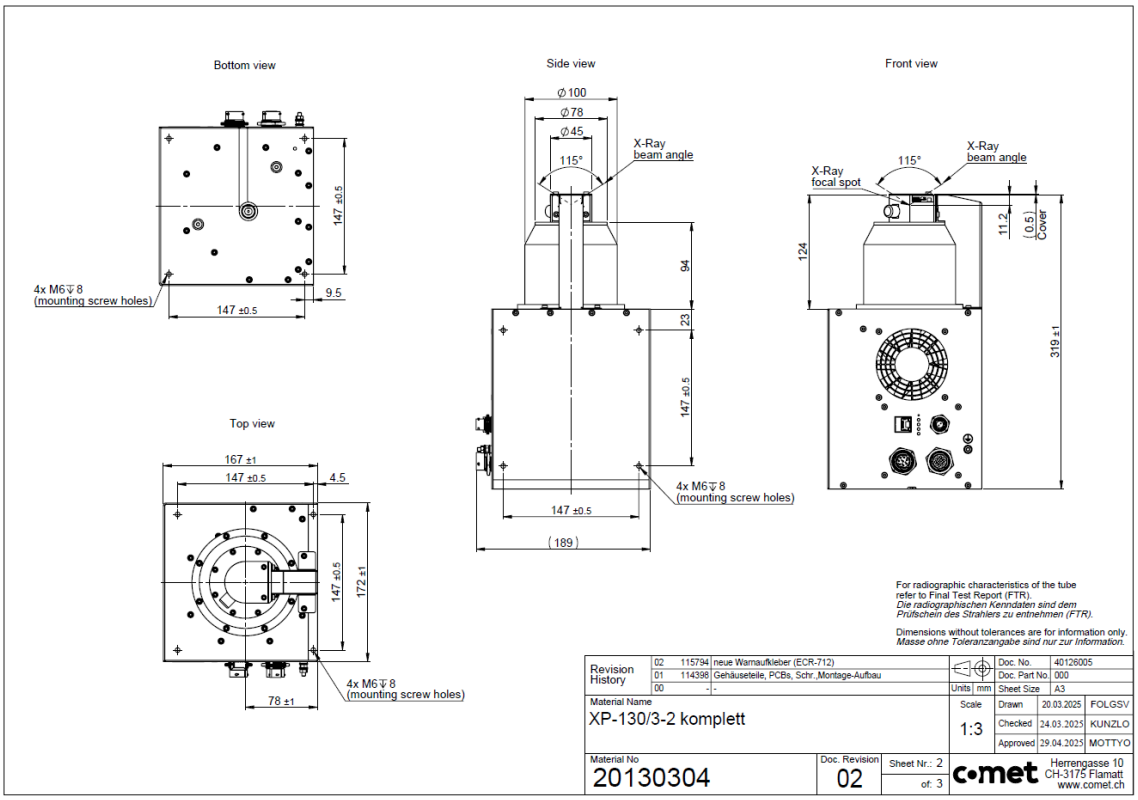

Fig. 8: Outline drawing

List of Figures

List of tables

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