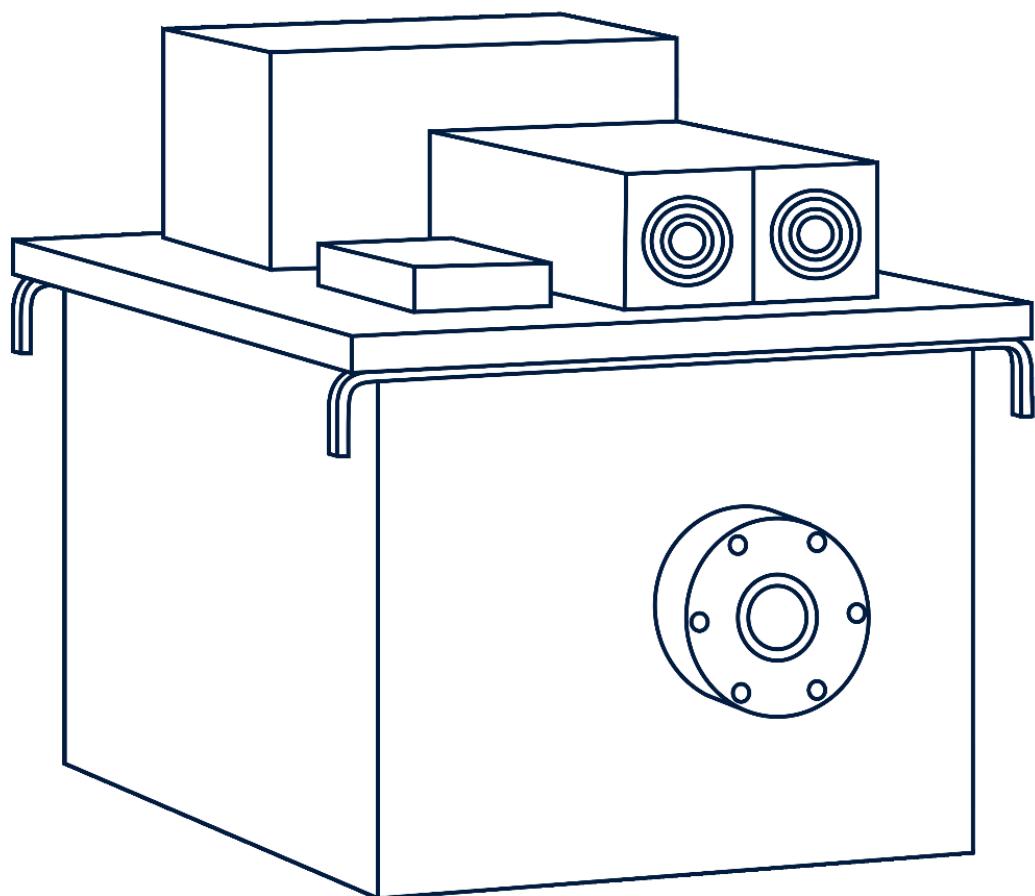


Service Manual

iVario Generator



comet
x-ray

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1 What's new?

1.1 What's new in this Service Manual v2.5 compared to the previous Service Manual?

- A lot of details about compatibility in section 2
- Automated software equalize of the Tank vs IFC in section “15.6 Replacement Tank”
- Restructured some sections in the manual and therefore a lot of new print screens due to WebUI simplicity
- Updated the FAQ section with new FAQs

1.2 New or changed features and improvements for this software version 2.5.0

Automated equalize of Tank software

When the software version of the Tank needs to be aligned regarding the software version of the IFC, the software equalize is performed automatically at the first power on of the generator. This happens for example after a Tank replacement. With the iVario software v2.5.0 and newer, there is no manual software equalize required for the Tank. Just be aware, that the first boot up after a Tank replacement with automatic equalize will take significantly more time.

Improved ARC handling recovery mechanism

Very important change for 450 kV generators (and in general all bipolar generators)

Improved user experience with WebUI Simplicity

Simplified IO configurator	Phase	Output 1	Output 2	Output 3	Output 4	Warn. Light 1	Warn. Light 2	Warn. Light 3	Dyn. Mon.
	Enable	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				
	NOT-READY	<input checked="" type="checkbox"/>	Off ↓	Off ↓	Off ↓	Off ↓	Off ↓	Off ↓	Off ↓
	COOLER CHECK	Off ↓	Off ↓	Off ↓	Off ↓				
	SAFETY READY	Off ↓	Off ↓	Off ↓	Off ↓				
	MAINS CHECK	Off ↓	Off ↓	Off ↓	Off ↓				
	READY	On	Off ↓	Off ↓	Off ↓	Off ↓	Off ↓	Off ↓	Off ↓
	PREWARN	Off ↓	On	Off ↓	Off ↓	Off ↓	Off ↓	Off ↓	Off ↓
	HV ON	Off ↓	Off ↓	On	On	Blink	Off ↓	Off ↓	Off ↓
	SETPT REACHED	Off ↓	Off ↓	On ↓	On ↓	Blink ↓	Off ↓	Off ↓	Off ↓
	Advanced Configuration								

1 click download for all reports. All report file names now with date & time of generation

The screenshot shows the comet software interface with the 'Reports' tab selected. The left sidebar includes 'Operation', 'Generator Info', 'HV Operation', 'Software update', 'Setup' (which is currently active), 'Generator', 'I/O', 'Communication', and 'Application'. The main content area is titled 'Reports' and 'Download'. It lists four options:

- Download all reports**: If you press "Download all reports" all reports will be created in sequence. Up to 3 download pop-ups will be generated. This can take up to 10 minutes. [Download all reports](#)
- Diagnostic Report**: If you press "Download Diagnostic Report" the report (incl. the operational-report) will be created first. This can take up to 5 minutes. [Download Diagnostic Report](#)
- Operational Report**: If you press "Download Operational Report" the report will be created first. This can take up to 30 seconds. [Download Operational Report](#)
- Operational Report History**: If you press "Download Operational Report History" the long term Operation Report will be created. This can take up to 5 minutes. [Download Operational Report History](#)

- Smarter, slimmer and more intuitive structure
- Irregular shutdowns marked in red
- Hide rarely used settings
- Reminders if reboot is required
- Troubleshooting oriented start page «HV Operation»
- More self-understanding explanations
- Moved ARC handling and DHCP configuration to user «ser»

After an update to v2.5.0, the TCP port 50507 is no more available

Scalable iVario Control Software

2 General information

2.1 Validity of the Service Manual

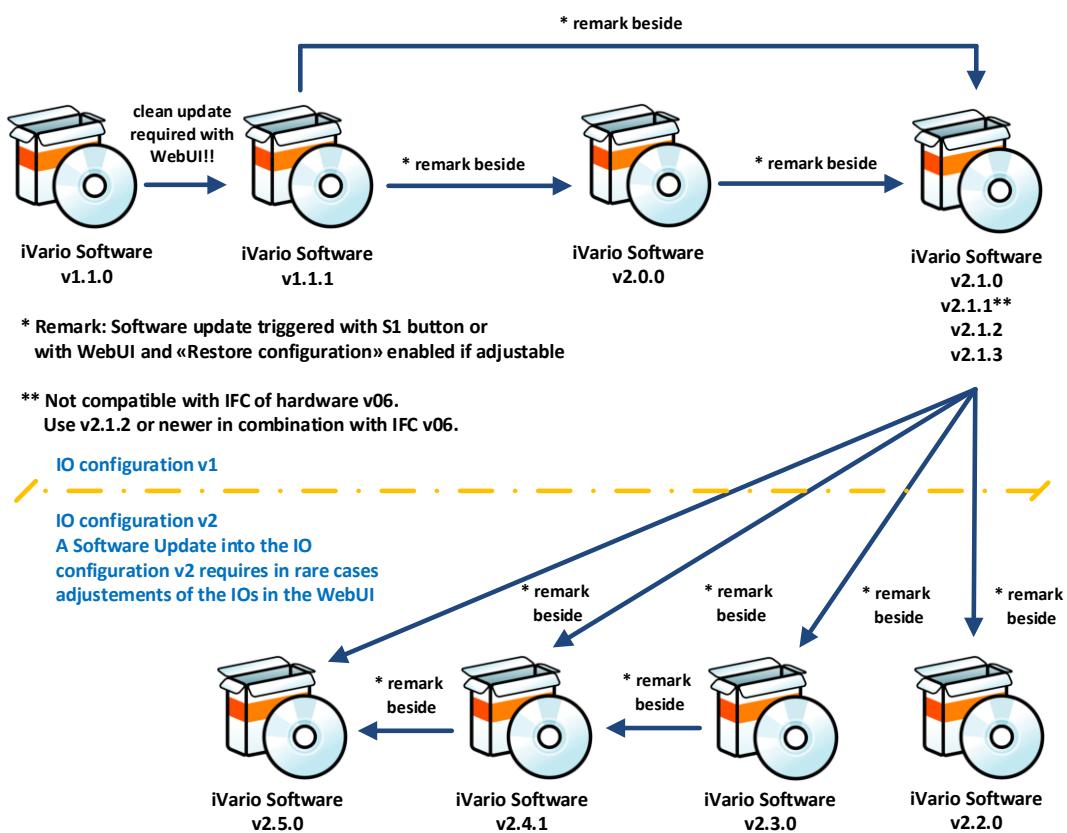
The present iVario Service Manual is valid for the iVario software v2.5.0 in combination with the iVario Control Software v2.5.0 and the iVario optional Controller v2.5.0.

2.2 Software update strategy

The iVario software update strategy is described in the graphic below. Please always follow this strategy.



With the v2.5.0, there is a prevention of downgrade over the normal update mechanism. Downgrading needs the workaround over the rescue system, which does physically only exist on v2.3.0 or newer. On older versions without rescue system, only a rollback to the one previously installed version is possible.



2.3 Software bundle compatibility

iVario Software	Control Software	Controller	Release date	Milestones / Major corrections / Features
1.1.1	1.1.0.255	1.1.0.255	27.07.17	First official series production of iVario
2.0.0	1.2.1.0	1.2.1.255	23.03.18	First version with fully user-friendly WebUI functionality
2.1.0	2.1.0.294	2.1.0.4	10.08.18	Support of "Guarded communication"
2.1.1	2.1.0.294	2.1.0.4	26.11.18	Improvement in stability of communication
2.1.2	2.1.0.294	2.1.0.4	28.06.19	Same as v2.1.1 but compatible with IFC v06
2.1.3	2.1.0.294	2.1.0.4	17.01.20	Same as v2.1.2 but with disabled SD card
2.2.0	2.2.1	2.2.1	09.04.19	New state available "Setpoint reached" Generator fast boot up time of 60s iVario Control Software with exposure time in sec iVario Control Software with Date & Time in US format available
2.3.0	2.3.0	2.3.0	26.07.19	Initial kV and mA settings configurable: Minimum values, fixed values, or resume last used set point. Operational Report generation from iVario Control Software and iVario Optional Controller is working. The TCP communication port 50507 is no more available. The feature Rescue System
2.3.1	2.3.0	2.3.0	05.11.19	Bugfix version for the incompatibility iVario vs MG protocol using command exposure time "T9951"

iVario Software	Control Software	Controller	Release date	Milestones / Major corrections / Features
2.4.1	2.4.0	2.4.0	30.06.20	<p>New or changed features:</p> <ul style="list-style-type: none"> • Powercell is automatically equalized if a version mismatch is detected on boot up • Configurable cooler flow detection to check on transition during boot up of generator • Warm Up with reduced high voltage works now correctly • When the Mains is cut during HV ON, the HV ramp down with max emission current is performed to reduce maximum power <p>Fixed bugs:</p> <ul style="list-style-type: none"> • Possibility to switch on X-Rays with the optional Controller if no cooler is connected on X9 • iVario now switches into "Normal Operation Mode" and state "Not Ready" when booting with open Safety Interlocks. It is not locked in "Booting", "Initializing" anymore • Adapted WarmUp times for some Y.TU tubes • WebUI user "ser": Corrections in "Cathode Only Operation" and "Cycle Test"
2.5.0	2.5.1	2.5.1	09.07.21	<p>New or changed features:</p> <ul style="list-style-type: none"> • Tank is automatically equalized if a version mismatch is detected on boot up • Improved ARC handling recovery mechanism. Very important for 450 kV generators (and all bipolar) • Applying a new tube forces a WarmUp to be performed • Improved user experience with WebUI Simplicity incl. simplified IO configurator • After an update to v2.5.0, the TCP port 50507 is no more available • Moved ARC handling and DHCP to "ser" user

				<ul style="list-style-type: none"> Scalable iVario Control Software <p>Fixed bugs:</p> <ul style="list-style-type: none"> Corrected two issues with optional Controller: <ul style="list-style-type: none"> With a previously triggered HV on signal on the Controller, the Operating status of the system switches from "MAINS check" to "Prewarn" when the safety interlocks are closed. The Warning Light 4 is not automatically enabled after reboot Eliminated the flickering problem with v2.5.1 of Control Software Eliminated the bug with the "paused state" at the end of the WarmUp with Controller v2.5.1
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Software bundle compatibility

There is always a release bundle of iVario Software, iVario Control Software and iVario Controller. Please always use the versions of the bundle.

2.4 Hardware compatibilities



Hardware compatibility exception

Pay attention that there exist some hardware compatibility exceptions for the Interface Controller in relation to the used iVario Software version.
IFC hardware version 06 is NOT COMPATIBLE with iVario Software v2.1.1

	iVario Software Version							
	1.1.0	1.1.1	2.0.0	2.1.0	2.1.1	≥ 2.1.2	≥ 2.2.0	
IFCv06*	no	no	yes	yes	no	yes	yes	
IFCv05	yes	yes	yes	yes	yes	yes	yes	

* Comet started shipping IFCs of hardware v06 in July 2019



General hardware compatibility

Pay attention that from the software v2.0.0 on, the iVario software is checking the compatibility of the hardware components and blocks the system if incompatible hardware versions are detected. Please check the hardware compatibility of your system **prior** performing a software update from to v2.0.0 or newer software versions.

Here is the compatibility table for being able to update to software v2.0.0. or newer. The below listed version for each component is the minimal required version.

Device	Minimal hardware version	Tag in the WebUI of v1.1.1 “System information”, section “HVPS”
IFC	V02	HW Rev IFC >= 2
Powercell	V02	HW Rev PoC 1 >= 2 HW Rev PoC 2 >= 2
Tank	V01	HW Rev Cathode tank >= 1 HW Rev Anode tank >= 1

The screenshot shows the 'System information' page of the iVario WebUI. On the left, a sidebar lists navigation options like HV Operation, Software update, Logs, System setup, I/O configuration, COM Configuration, Application Config, and Services. The main content area is titled 'System information'. It contains two tables: 'Software versions' and 'HVPS'. The 'HVPS' table includes the following rows:

System Serial number:	123456
HW Rev System:	1
HW Rev IFC:	2
HW Rev Cathode tank:	1
HW Rev Anode tank:	N/A
HW Rev PoC 1:	2
HW Rev PoC 2:	N/A

Check the settings of the relevant parameters in the WebUI of software v1.1.1 before updating to version 2.0.0 or newer

2.5 About the available TCP communication ports



Only TCP ports 50505 and 50506 are available

All COMET factory produced and shipped systems of iVario software version 2.3.0 and newer disable the TCP communication port 50507.

After a software update to v2.5.0, the TCP port 50507 is disabled as well.

2.6 Terminology, definitions, abbreviations

Term, Abbreviation	Explanation
Operator	User of the equipment. The user can be a trained operator, a supervisor, a service technician with two different levels of authorization.
Supervisor	Supervisor with expert user level rights in the Control Software
Powercell PoC	Power electronic module generating an AC signal out of mains power to supply the high voltage tank. One Powercell can supply up to 2.25kW. Two powercells can be placed in parallel for unipolar systems or in series for bipolar systems to generate up to 4.5kW.
TACO	Connector pins on the tank, male
NRDY	Not ready. iVario's state machine is based on not-ready-conditions
IFC	Interface Controller. This module provides the communication interfaces and input/output interfaces between the x-ray generator and system. It controls the configuration of the generator and of the x-ray tube.
HVPS iXRS	High voltage power supply, synonym of x-ray or ebeam generator X-ray source as combination of generator, tube, HV cables and cooler.
HV tank	The high voltage tank is a sealed box containing a high voltage transformer and HV multipliers, a filament or transfer transformer. The HV tank supplies the x-ray tube with an acceleration voltage and a filament heating current to generate the emission current.
Backframe	Interface module distributing the power and signals to all others modules.
Power Supply	Set of modules providing the power to the high voltage tank and interfacing with the system. It includes the IFC, the powercells and the backframe.
kV	Acceleration voltage applied between the anode and cathode of the x-ray tube to accelerate the electrons. The required acceleration voltage for the electron is generally high. It is expressed in kV.
More to come	

2.7 Service Tools

There are basically two service tools available for:

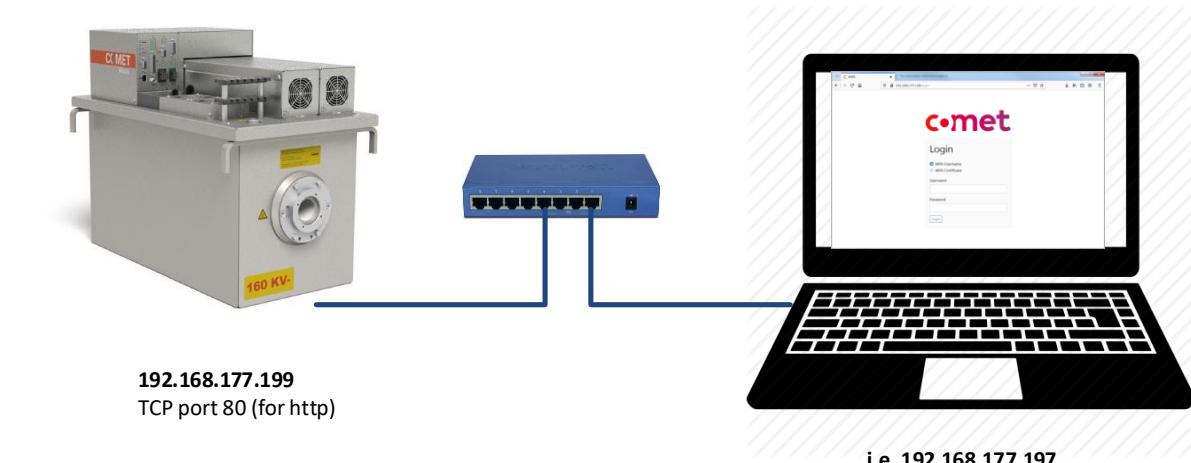
- Commissioning (configuration of I/O's and setup of the application)
- Diagnostic & troubleshooting
- Replacement of field replaceable units
- Control (normal operation)
- Software update

2.7.1 Webserver GUI

Furthermore in this document, the webserver GUI is named WebUI.

The WebUI is a web server application. It enables you to configure the iVario generator and perform troubleshooting tasks. It is a tool for service engineers and is not designed to be used as control software. There is another specific tool for this purpose (iVario Control Software).

Connect your computer through a normal Ethernet patch cable to connector X4 of the iVario. Auxiliary power supply is required to be able to communicate with the iVario after the booting process is accomplished.



To enable the access to the iVario over the WebUI, it is mandatory to plug a USB stick (dongle) with a specific startup file on the X6 connector. By default, this file is **not delivered**. OEM customers can obtain this key file during a training session, after being exposed to the facts of:

- understanding and having the technical knowledge to set up a generator
- running a system with an open web server port and the security impact for the IT infrastructure of the company

This startup file must be present at the very beginning of the iVario boot-up process. It is named "t3-startup" without file extension. The file MUST be copied in the root of the USB stick. A software key enables the WebUI.

We recommend not to leave the dongle with this file in the generator. But, perform your task you have to do with WebUI and remove the dongle afterwards.

You can access the webserver by opening any recommended browser and type in the ip-address of the iVario in the navigation bar.



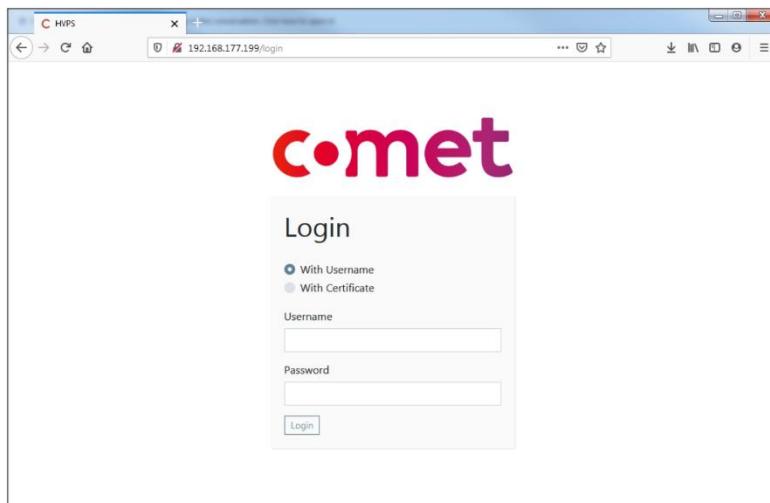
Firefox version 48 or newer

Chrome version 53 or newer

Don't use the Internet Explorer to browse the WebUI

Edge, all versions

You should be able to log in on the landing page 45 seconds after you powered on auxiliary supply.



The access over the WebUI is protected by user management. There are two levels available:

- “oem” with all necessary functionalities for an OEM to build, configure and troubleshoot the iVario
- “ser” with all necessary functionalities for a Service user with a deeper technical impact than an OEM

Below you can fill in the passwords you got on the Comet training.

User	Password
“oem”	[Redacted]
“ser”	[Redacted]

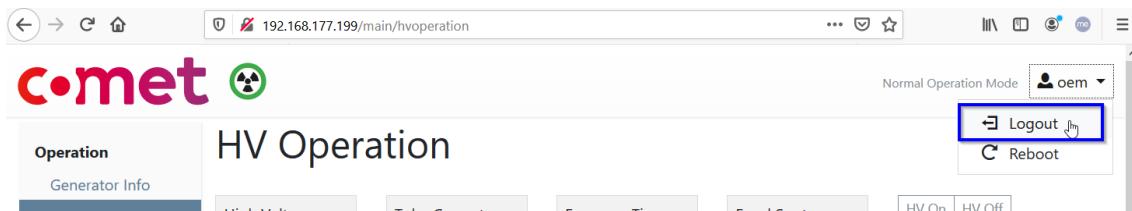
After the successful login, you are able to perform your technical service tasks on the iVario. You will find all the details of the tasks you can perform in the public version of the WebUI Manual.

The WebUI is basically divided into two sections „Operation“ and „Setup“

Operation	
Generator Info	All information about the connected parts: <ul style="list-style-type: none"> hardware types hardware versions serial numbers installed software versions
HV Operation	All information about the high voltage operation: <ul style="list-style-type: none"> status of the state machine setpoints realtime measurements not ready conditions last shutdown reason warm-up
Software Update	Topics about the software update: <ul style="list-style-type: none"> overview of the actually installed software versions perform the system software update equalize all connected devices with the software of the IFC reset / restore of the generator
Reports	Topics about reports and logs <ul style="list-style-type: none"> download the operational report download the diagnostic report history data event logs with filter search

Setup	
Generator	Setup of the generator: <ul style="list-style-type: none"> • date and time • tube selection and serial number • cable length
I/O	Configuration of the digital inputs and outputs: <ul style="list-style-type: none"> • configure if optional control panel is used • auto start cycle • dynamic monitoring • map status of state machine on digital outputs and monitored warning lights • blink period • current monitoring thresholds
Communication	Configuration of the communication settings <ul style="list-style-type: none"> • ip settings of the generator • remote control • serial line
Application	All about the configuration of the application. Settings: <ul style="list-style-type: none"> • prewarning • cooler • force automatic warm-up • filament control • initial Operation Parameters Additional limits: <ul style="list-style-type: none"> • high voltage • tube current • filament • power

There is a session timeout with an automatic logout after 20 minutes of inactivity. Alternatively, you can force a logout with the “Logout” link on the top of the right side in the browser.



You can simply terminate the WebUI session by closing the browser application.



USB dongle

Don't forget to remove the USB dongle once you finished your WebUI tasks. Comet declines any responsibility in relation of disregarding this measure.



iVario IP-Address

Any iVario is delivered with the default IP-Address 192.168.177.199
You can check the FAQs if you don't:

- know how to establish an IP connection from your computer to the iVario
- remember the ip address of your iVario, but want to access the device through WebUI

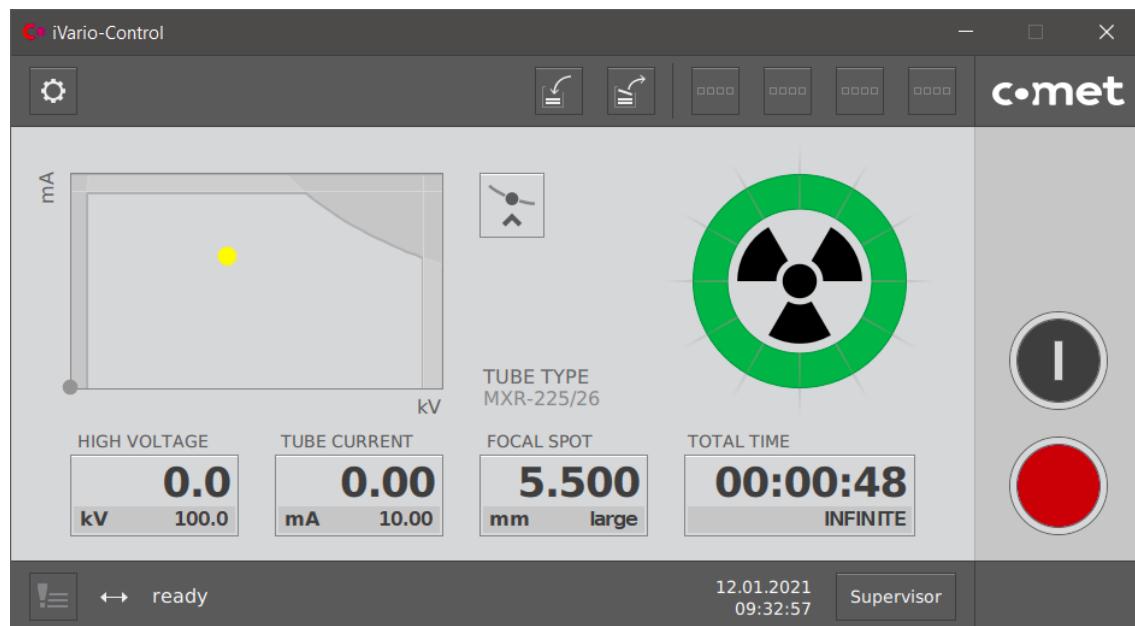
You find all the details of the WebUI in the specific manual "WebUI Manual public", reference [3].

2.7.2 iVario Control Software

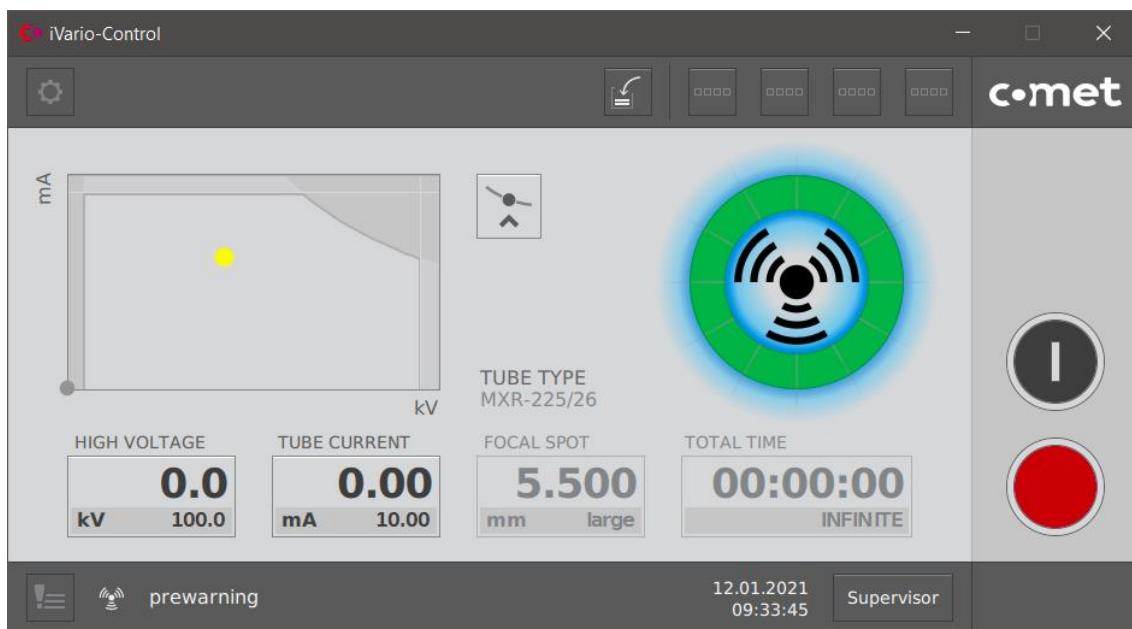
The major purpose of the Control Software is to control and monitor the iVario. Its graphical user interface is designed for an intuitive operation with the x-ray source.



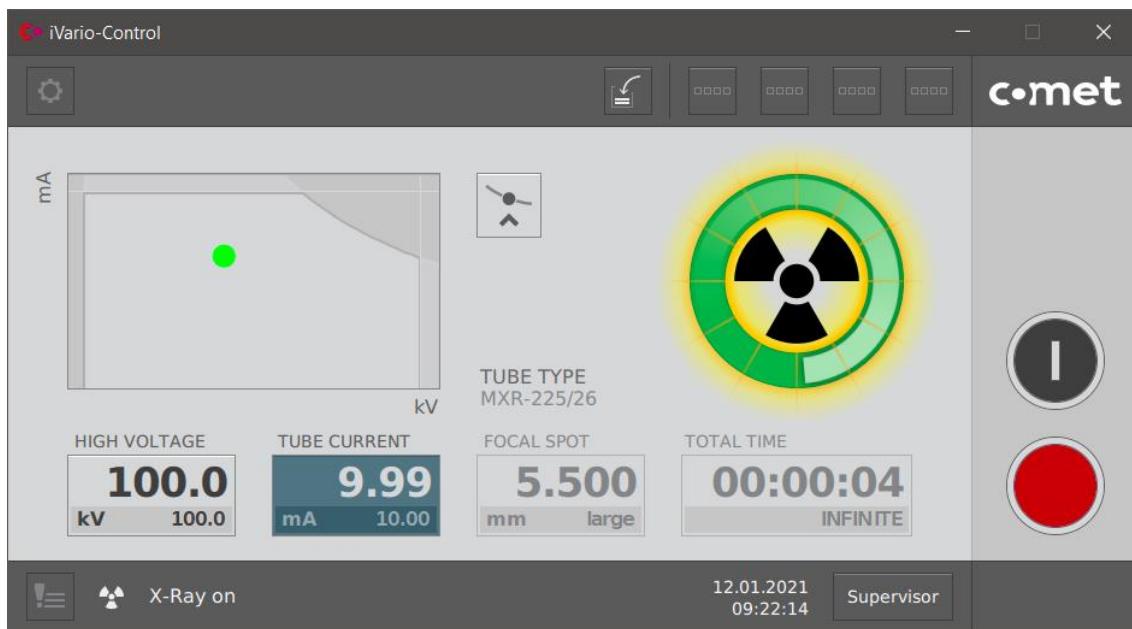
As described in the OEM manual, the Control Software is a very useful tool during commissioning and troubleshooting. It describes the status of the iVario generator. If the generator is in ready state, you can start X-Rays.



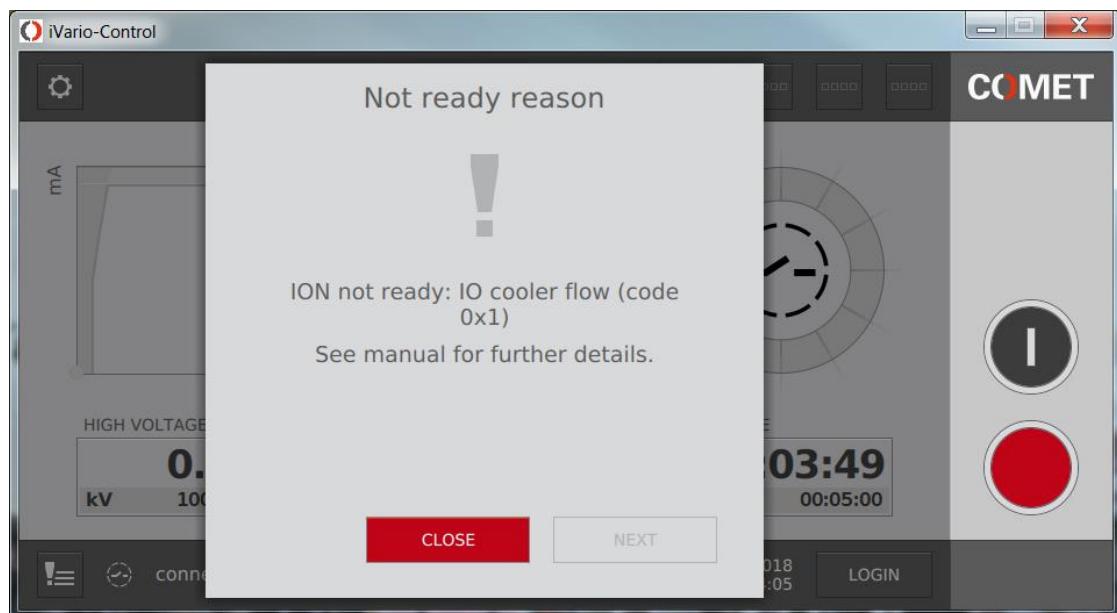
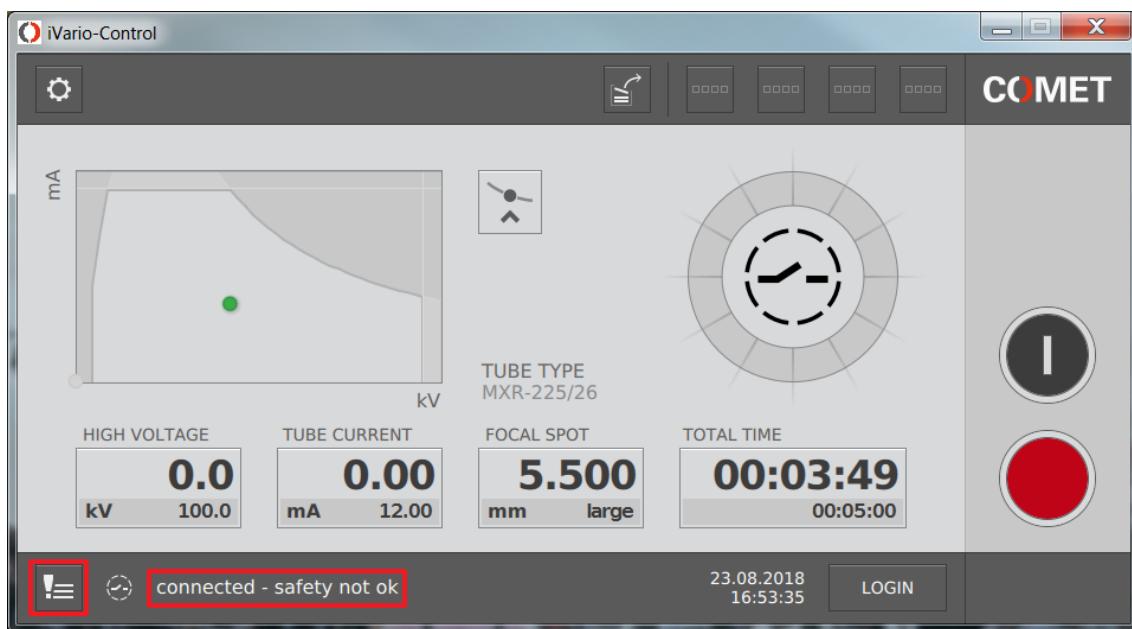
The generator will change from ready into prewarning state



And will turn X-Rays on



If a problem occurs, the status of the generator will be different from ready. You can click the red areas to get a pop-up window with details about the cause.



If a problem occurs during X-Rays on, the generator shuts down and a pop-up window will prompt you about the cause.



The iVario control software runs on Windows OS. 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, 64 bit
- 3 GB RAM (required for running the Windows OS and iVario Control Software)
- 100 MB of available hard disk space
- 1024x768 pixel resolution (16-bit colour depth required).
- Ethernet TCP/IP



Operational report

The Control Software is able to generate an operational report. This report is very useful for troubleshoot purpose and should be generated before you call Comet Technical Customer Service for help. Refer to the specific section in this manual.

2.8 Useful plugs and hardware for testing purpose

Here are listed some useful components of the starter kit and the accessories catalogue.

Dummy plug for safety interface (X11) Bridged safety contacts Part No. 20089406	
Dummy plug for E-stop (X12) Bridged E-stop contacts Part No. 20089407	
HV Dummy plug R24SL for 160kV and 320kV Part No. 20083937 version „connected“	
HV Dummy plug R28SL for 225kV and 450kV Part No. 20083938 version „connected“	

2.9 Service Inquiries

Please address all your second level support inquiries to below e-mail address. In order to ensure the best efficiency in the technical customer support workflow, please always include the actual operational report of your iVario system. The section “Operation report” describes how to generate such an operational report.

In case of failure, service tools as WebUI and iVario Control Software perform self-tests and allow simple and effective diagnostic. Remote support through the help of our service team can be obtained via the Ethernet connection.



E-mail address for COMET second level support: tcs.xray@comet.ch
COMET AG, Herrengasse 10, CH-3175 Flamatt
Tel. +41 31 744 9000, www.comet-xray.com

2.10 Return of Equipment



Any claims must be registered by you and authorized by us prior to return any hardware.

Please refer to the process described on our homepage: xray.comet.tech
Navigate to “Service” and “Return of Equipment”.

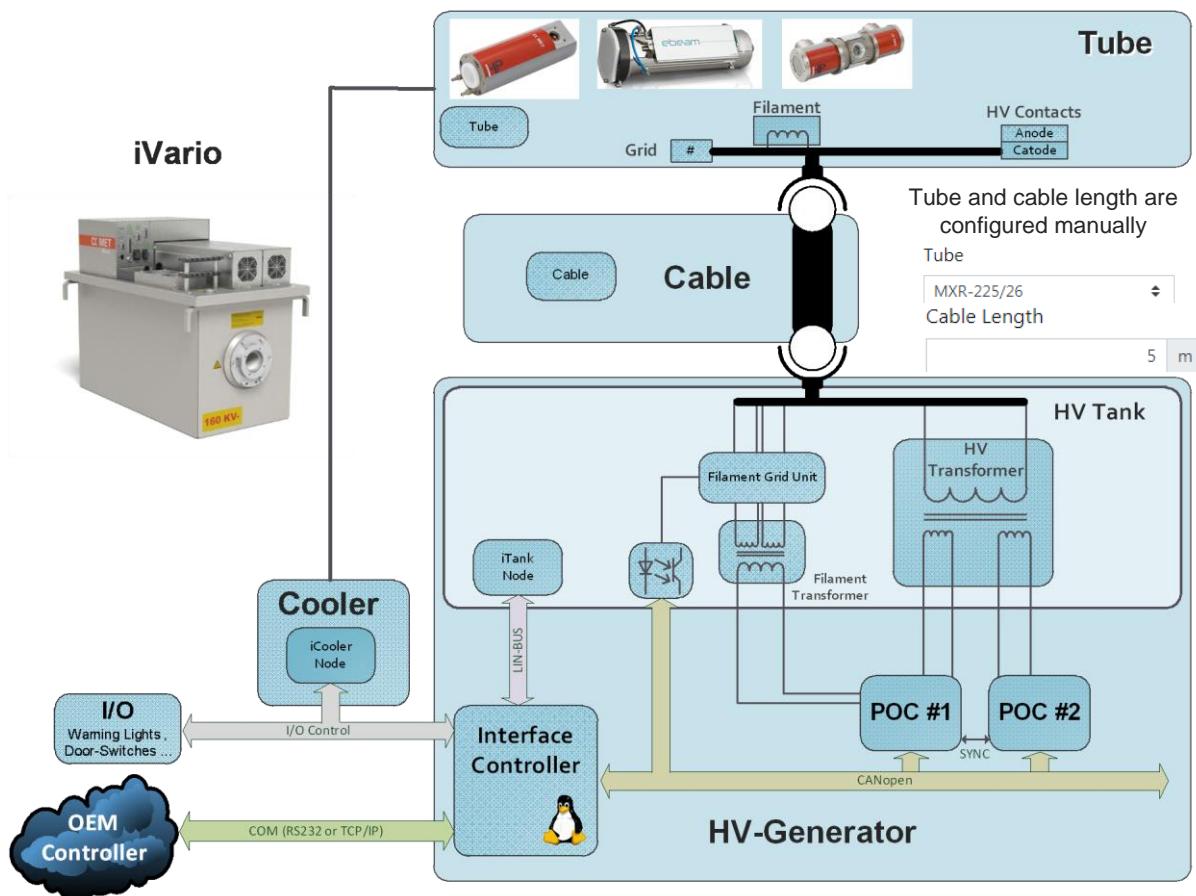
E-mail address for COMET first level support:
service.xray.ch@comet.tech
COMET AG, Herrengasse 10, CH-3175 Flamatt
Tel. +41 31 744 9000, xray.comet.tech

When a component is suspected of being defective, a full diagnosis of the failure mechanism is required. Our three repair centers offer a thorough check of all industrial X-ray components.

[View more >](#)

3 Main components (Field replaceable units)

The Interface Controller (IFC) automatically collects the configurations of the Powercells (PoC) and the Tank over the CAN open bus, respectively LIN bus. The Tube type and the cable length of the High Voltage cable have to be configured manually.



The power unit with an output rating of 2.25 kW or 4.5 kW consists of the following components:

- iVario Interface Controller
- iVario Safety Interface
- iVario Powercell (1 or 2 pieces)
- iVario Backframe

3.1 Powercell

3.1.1 Description

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

It is mandatory to equip the master Powercell to run a system.

(Unipolar) Systems with only 1 Powercell have to be equipped with the master Powercell.

The other slot is for the slave Powercell.



A unipolar generator can also be run with 2 Powercells. If 2 Powercells are used, the load for the kV switcher is symmetrical. The power for the filament is always provided by the master Powercell.

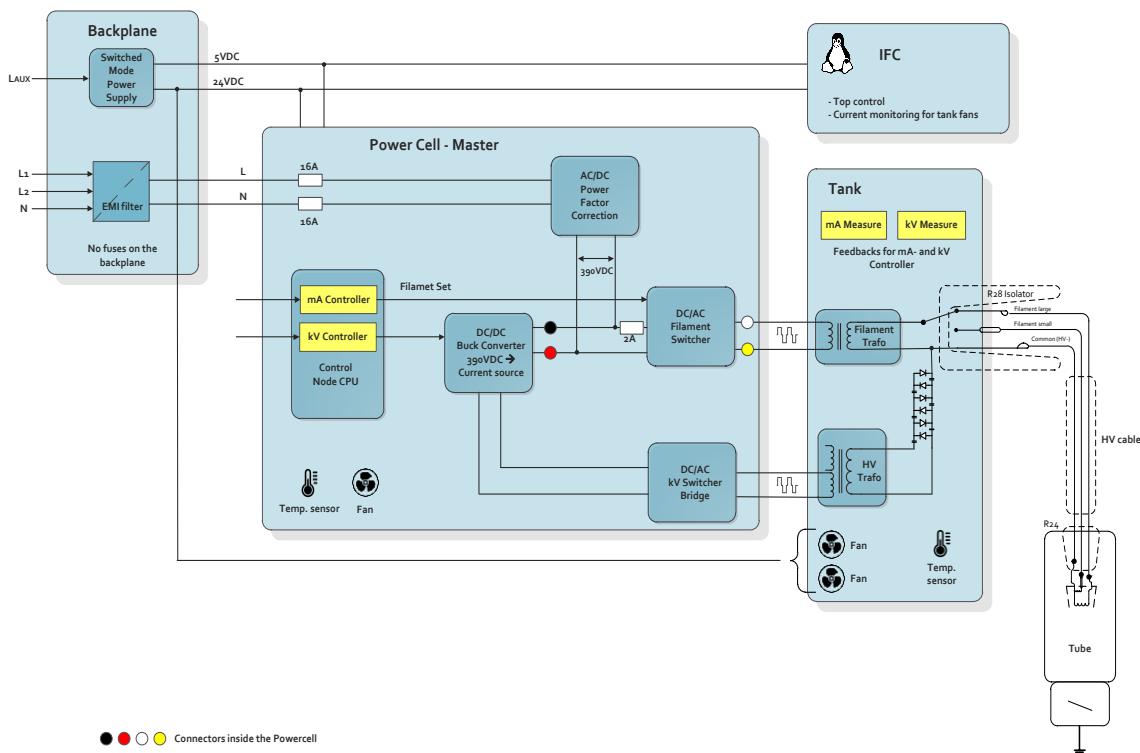
A bipolar system requires 2 Powercells (Powercell 1 and Powercell 2). The Powercell 1 supplies the cathode tank, the Powercell 2 supplies the anode tank.

For replacing a damaged Powercell, please refer to the section “Replacement Powercell” in “Replacements step-by-step procedures”.



For troubleshooting purpose, both the Powercells can be swapped, in order to determine if the error is moving with the swapped Powercell or it is related to its slot.

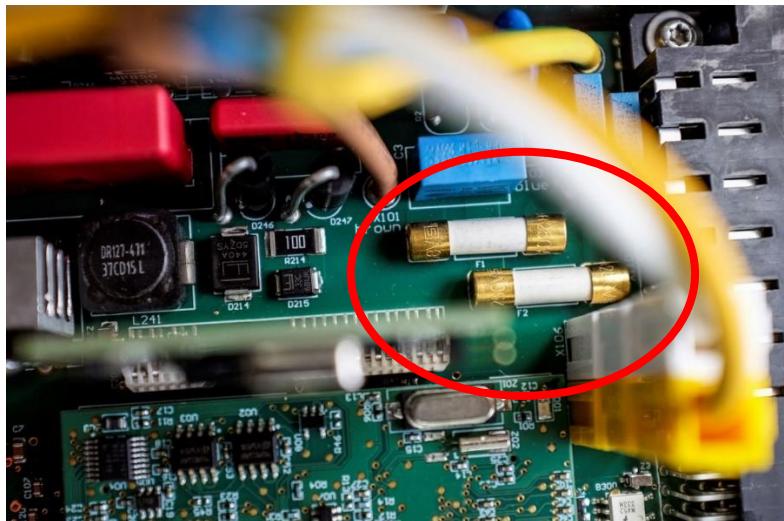
3.1.2 Schematic overview



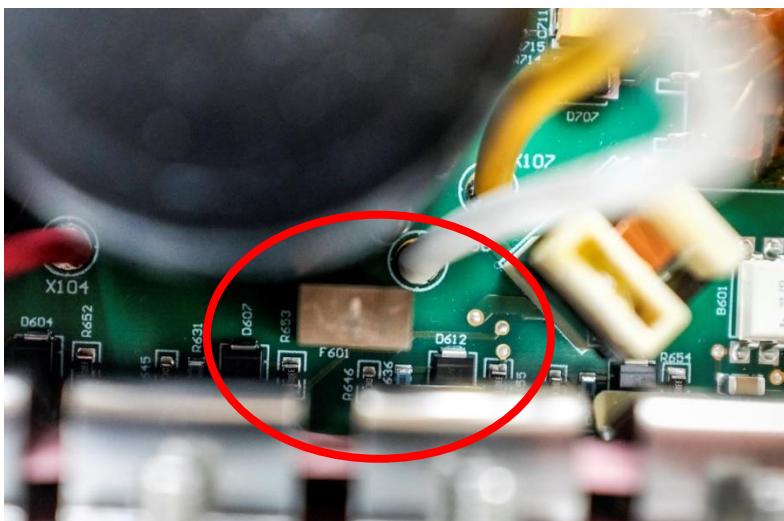
3.1.3 Fuses inside the Powercell

There are 3 fuses inside the Powercell. All three fuses are soldered. So, you should not exchange or repair them on your own. Please send back to Comet the entire Powercell with a precise error description.

Fuses F1, F2
(16 A each)



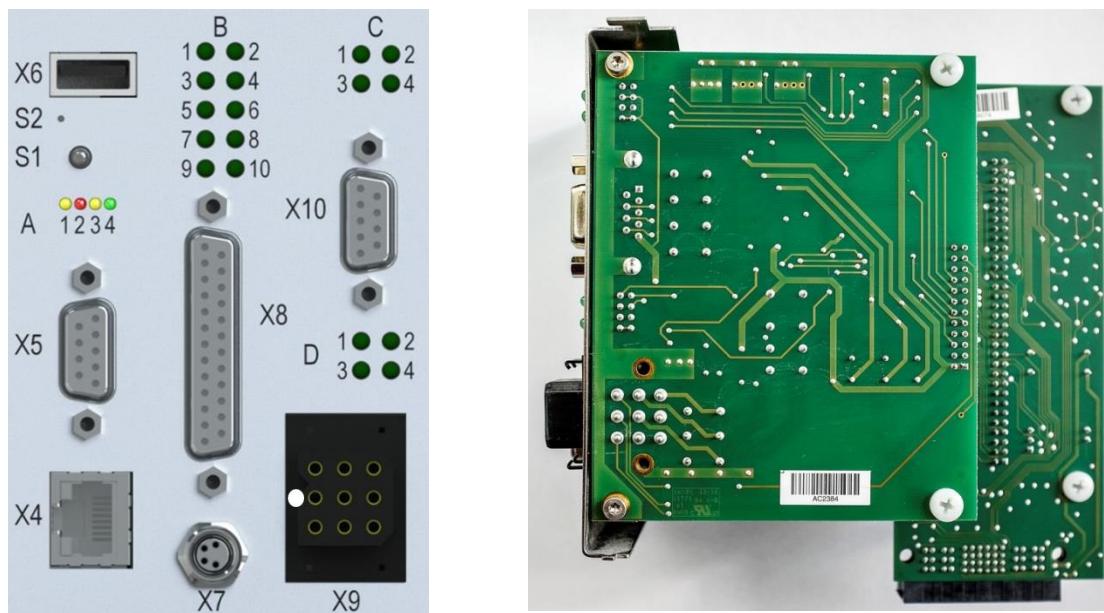
Fuse F601 (2 A)



3.2 Interface Controller (IFC) CPU Board

3.2.1 Description

The Interface Controller is the core part and is built on an embedded Linux.



3.2.2 Setup date and local time

It is very important to setup the generator's date and time to the correct values as a first action right when you start the commissioning. The best manner is to set the generator to the local time. Therefore, all the operational reports and diagnostic logs are tagged at local time and it is more transparent if somebody's analyzing or searching for an incident. You can synchronize with a computer or set it up manually.

comet ☢

Generator Setup

Operation

- Generator Info
- HV Operation
- Software update
- Reports

Setup

- Generator**
- I/O
- Communication

Date and Time

Generator Time:

Fri, 09 Jul 2021 15:53:18 +0200

Set Time Manually:

YYYY.MM.DD hh:mm:ss Europe/Zurich Apply

Set Time Automatically

Sync with Computer

This will synchronize the clock of the Generator with the time of your computer.
NOTE: The timezone has to be set manually first.

3.2.3 Battery

There is a battery on the IFC. It buffers the RTC and therefore the system clock and date of the embedded Linux.



If the battery is flat, the iVario generator will be reset to Genesis time (1.1.1970 00:00:00), the generator doesn't boot-up anymore and is stuck in severe error. The led A2 is blinking red (1 Hz). The battery must be replaced with AUX and MAINS powered off in order to set the time again accordingly to enable the generator to boot-up again.

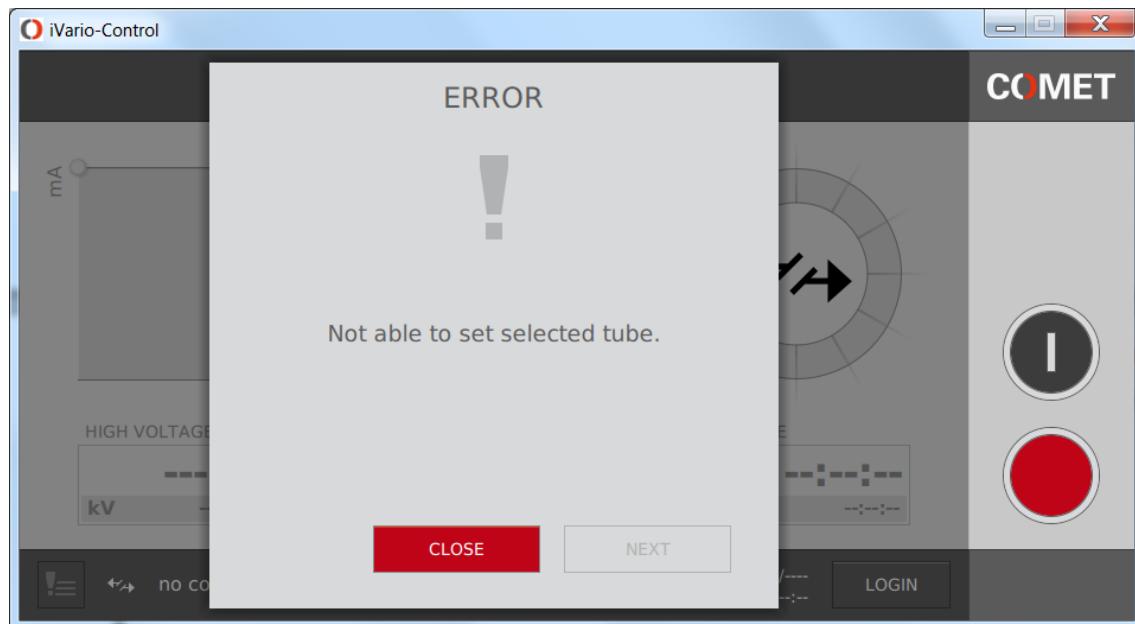
The WebUI displays the message "Genesis time detected: Internal error" and mostly all the fields are empty

COMET GROUP ! Genesis time detected ; Internal error

Generator Information

Operation	Main Software Version	V.2.5.0.T4.e66161f			
Generator Info	General Settings	Part	Setting		
HV Operation	Cathode Tank	none			
Software update	Anode Tank	none			
Reports	Tube Type	0			
Setup	Cable Length	5 m			
Generator	Network IP	192.168.177.199			
I/O	Network MAC	50:2d:f4:0c:3d:7d			
Communication	Component Software	Part	SW Version		
Application	IFC	V.2.5.0.T4.e66161f			
	BSP	V.2.5.0.bab1b2e			
	POC1				
	s-cpu POC1				
	POC2				
	s-cpu POC2				
	Cathode tank				
	Anode tank				
	Tube				
	FGU				
Hardware	Part	HW Rev	Material Nbr	Serial Nbr	Config Version
HVPS					
IFC	0.	0	0		
POC1	.				
POC2	.				
Cathode tank	.				
Anode tank	.				
Tube				N/S	
FGU	.				

The iVario Control Software displays a different message. It is less accurate and not so self-understanding that the system is reset to Genesis time.



How to recover the system step-by-step

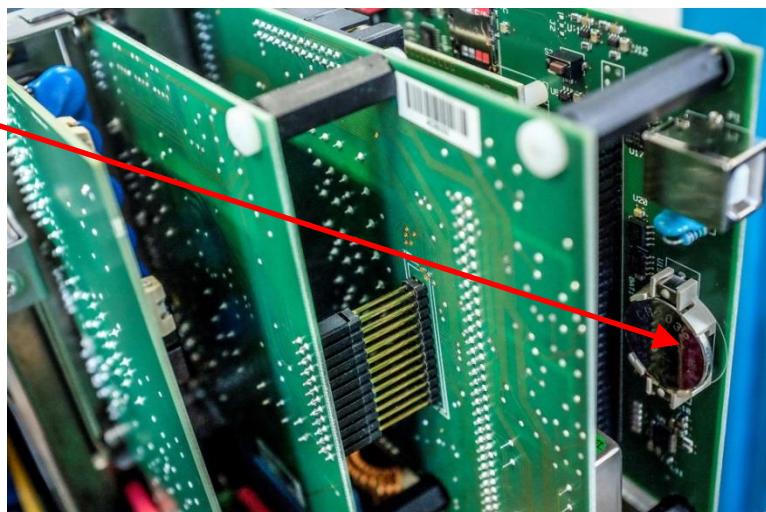
Power off the entire system (MAINS and AUX) and wait for more than 30s after the fans of the powercell(s) are no longer running.

Remove the old battery.

You can use a toothpick or another insulated tool to remove the old battery.

Insert the new battery.

The battery is of type CR2032 3V, lithium button cell coin.



Switch on AUX again.

Connect to WebUI, log in and set the system time. You can set it manually or automatically by sync with the computer.

comet

Genesis time detected ; Internal error

Operation

- Generator Info
- HV Operation
- Software update
- Reports

Setup

- Generator**
- I/O
- Communication

Generator Setup

Date and Time

Generator Time:

Thu, 01 Jan 1970 01:38:10 +0100

Set Time Manually:

YYYY.MM.DD hh:mm:ss Europe/Zurich

Set Time Automatically

Sync with Computer

This will synchronize the clock of the Generator with the time of your computer.
NOTE: The timezone has to be set manually first.

Reboot the system.

3.2.4 About the Micro SD Flash Card

The Micro SD Flash Card on the IFC contains:

- The backup of the installed Software version of the IFC and the connected components
- All the log- and diagnostic files for debug and analyze purpose
- All the statistics of the generator (later on as well the statistics of all the ever connected tubes)
- The history of the saved configurations of the system

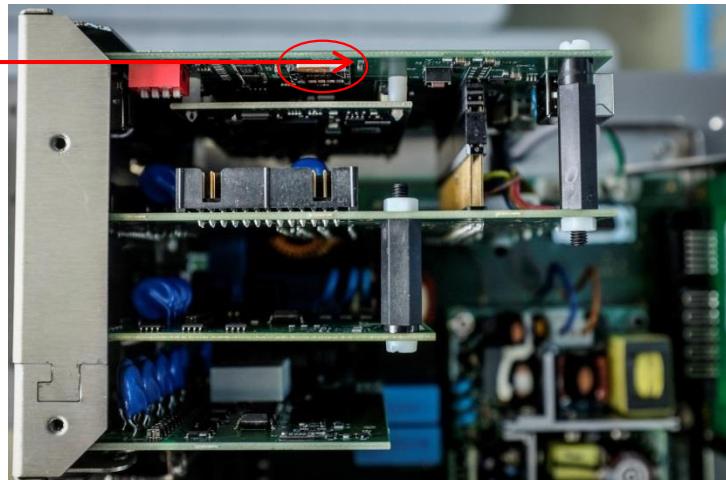
Specification of the Micro SD Card

The actually delivered card is a Sandisk of

- 32 GB size
- Class 10



Emplacement of the Micro SD Card





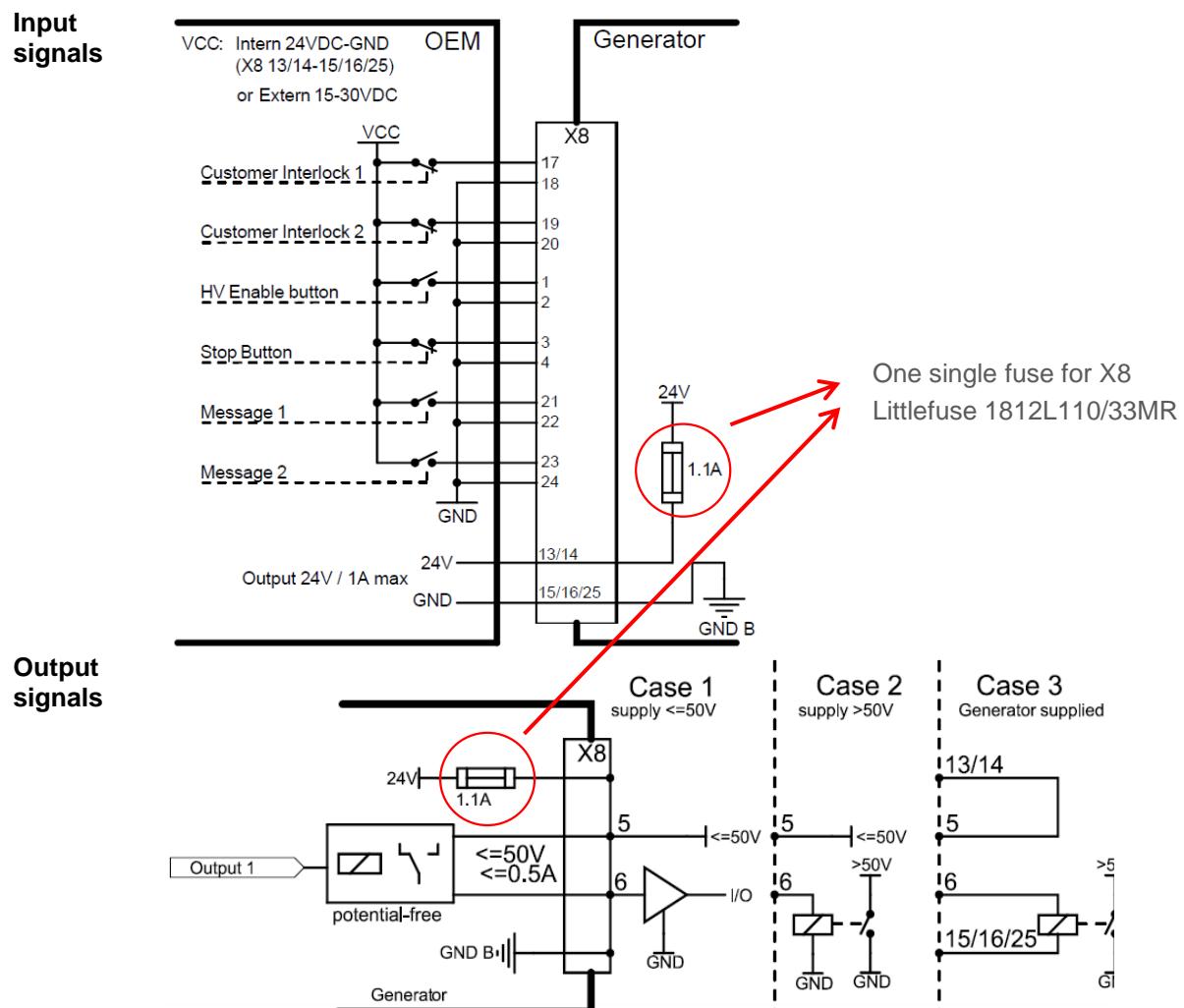
iVario Software v1.1.1 to v2.1.2 absolutely require the SD card.
iVario Software v2.1.3 and newer (v2.2.0, v2.3.0, v2.4.1 and future versions) don't require the SD card. It is disabled by the software.

3.2.5 Fuses

There are several self-resettable fuses of the type PTC on the IFC component.

Fuse for input and output signals on "X8"

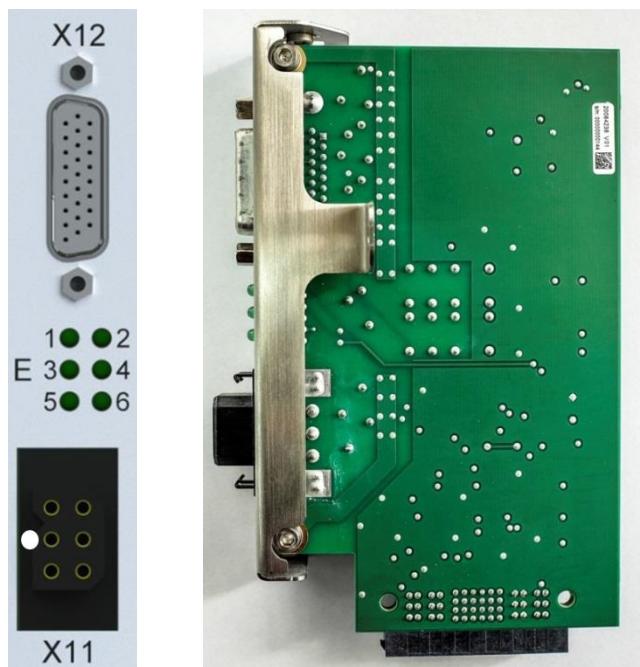
There is one single fuse for the input and output signals (1.1A, Littlefuse 1812L110/33MR). This fuse is located on the SIG1 board of the IFC. After a short circuit, the functionality is restored latest after 60 seconds.



3.3 Safety Interface Board

3.3.1 Description

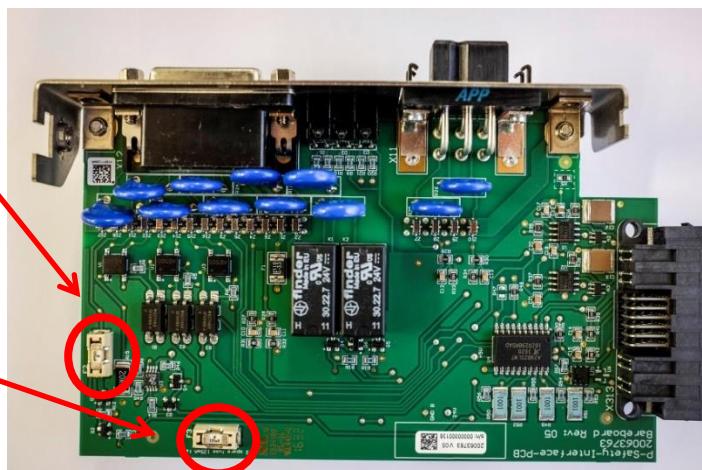
Tobe done



3.3.2 Fuse

There is a 125mA fuse (F2) to protect the 24VDC in case of a problem on the Control Panel (connected through "X12"). This fuse is of type "Littlefuse 154.125".

The Safety Board is equipped with a spare fuse on F3. Refer to the picture beside.



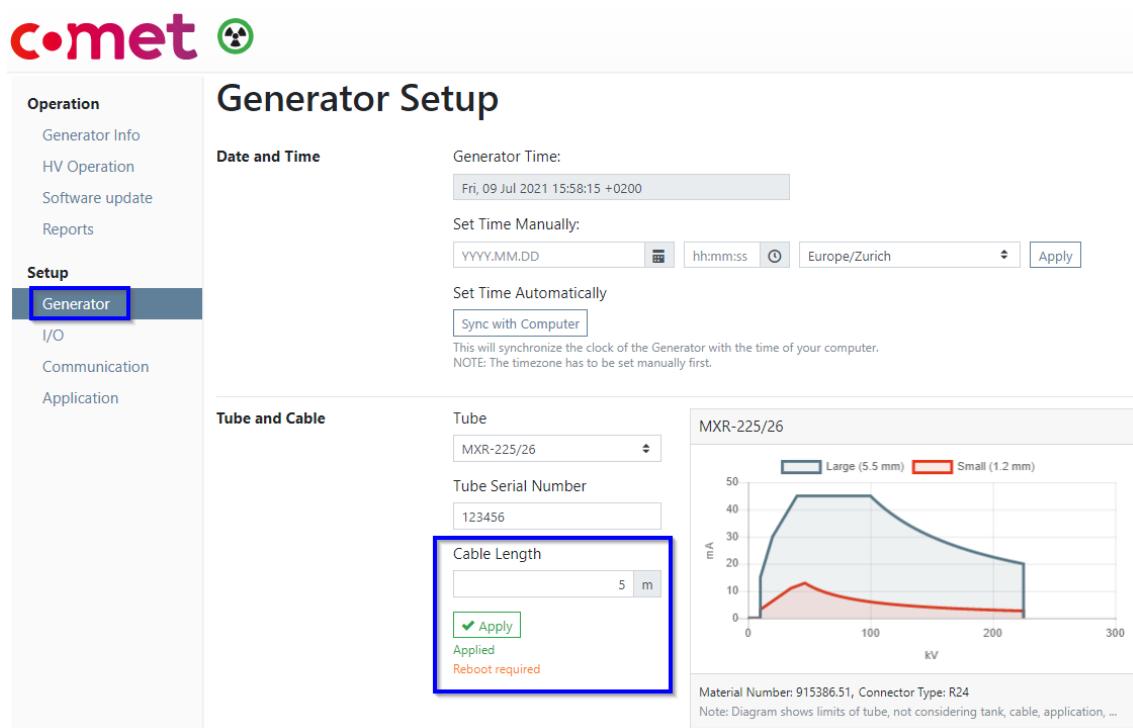
3.4 Generator (HV Tank)

3.4.1 Description

To be done

3.5 HV Cables

In order to apply the correct regulation parameters, it is very important to configure the system with the real used high voltage cable length.



The screenshot shows the 'Generator Setup' page in the comet software. The left sidebar has a 'Setup' section with 'Generator' selected. The main area has two tabs: 'Date and Time' and 'Tube and Cable'. In 'Date and Time', the 'Generator Time' is set to 'Fri, 09 Jul 2021 15:58:15 +0200'. Under 'Tube and Cable', the 'Tube' is set to 'MXR-225/26' and the 'Tube Serial Number' is '123456'. The 'Cable Length' input field is highlighted with a blue border and contains '5 m'. Below it are 'Apply' and 'Reboot required' buttons. To the right is a graph titled 'MXR-225/26' showing current (mA) vs. voltage (kV). The graph has two curves: a blue one for 'Large (5.5 mm)' and a red one for 'Small (1.2 mm)'. A note at the bottom of the graph area says: 'Material Number: 915386.51, Connector Type: R24. Note: Diagram shows limits of tube, not considering tank, cable, application, ...'

It is mandatory to press the “Apply” button and the “Reboot” button in order to enable the configuration. This will therefore initialize the system correctly.



You must respect that the high voltage cables must not exceed the lengths for their maximum recommended voltage. There is a table about these characteristics in the OEM manual.

The use of cables with spring-loaded plugs is recommended as they are superior to standard cable 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 easier.

3.6 Tubes

The connected tube is selected and configured in the WebUI on the page „Setup → Generator”. You can pick the tube in the drop down menu. The serial number must be entered manually. It is important to type in the correct serial number of the tube. Otherwise all the accumulated statistics about the operation hours etc. will be wrong.

Operation

- Generator Info
- HV Operation
- Software update
- Reports

Setup

- Generator**
- I/O
- Communication
- Application

Generator Setup

Date and Time

Generator Time:
Fri, 09 Jul 2021 15:58:15 +0200

Set Time Manually:
YYYY.MM.DD hh:mm:ss Zone Apply

Europe/Zurich

Set Time Automatically
Sync with Computer

This will synchronize the clock of the Generator with the time of your computer.
NOTE: The timezone has to be set manually first.

Tube and Cable

Tube: MXR-225/26

Tube Serial Number: 123456

Cable Length: 5 m

mA

kV

MXR-225/26

Large (5.5 mm) Small (1.2 mm)

Material Number: 915326.51, Connector Type: R24

Note: Diagram shows limits of tube, not considering tank, cable, application, ...

It is mandatory to press the “Apply” button and the “Reboot” button in order to enable the configuration. This will therefore initialize the system correctly.



ALWAYS CHECK THE
LABEL ON THE TUBE!

Contact Comet if your tube is not listed and therefore not selectable from the drop down menu.



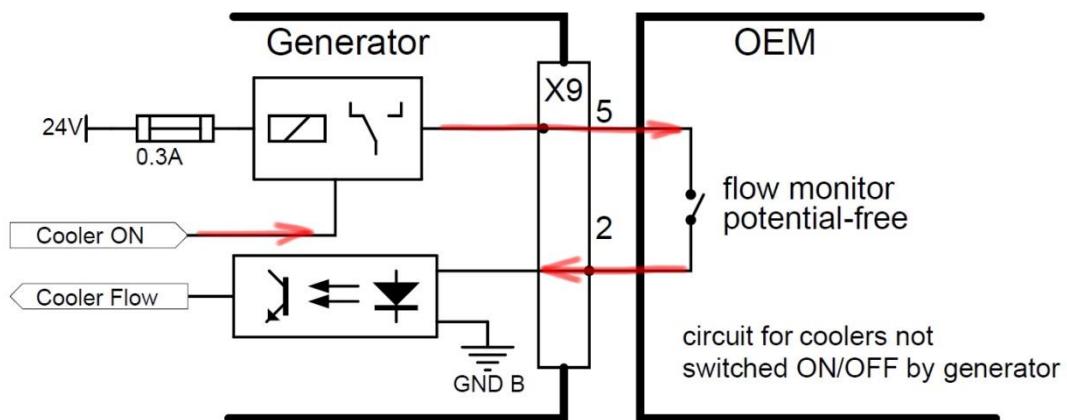
3.6.1 Monitoring the cooler flow for transition at boot up

With iVario software v2.4.1 we introduced an additional monitoring feature for the cooling of the tube. At the boot up of the generator, the cooler flow is checked for a transition. With this feature, the system operator will be notified if the flow switch is blocked.

This feature is configurable in the WebUI. It is automatically enabled with v2.4.1 and newer software versions.

The screenshot shows the 'Application Configuration' settings page. On the left, a sidebar lists 'Operation', 'Setup' (with 'Generator', 'I/O', 'Communication', and 'Application' options), and 'Reports'. The 'Application' option is selected and highlighted with a blue box. The main area is titled 'Settings' and contains sections for 'Prewarning', 'Cooler', and 'Warm-Up'. Under 'Cooler', there are fields for 'Regular post-cooling time' (60 s), 'Emergency post-cooling time' (5 s), 'Cooler flow timeout' (10 s), and a checked checkbox labeled 'Check cooler flow transition'. A note above the 'Cooler' section states: 'The following topics are treated as settings and are independent of the generator wide configuration calculation.' Another note below it says: 'After applying new configuration values a reboot is required.'

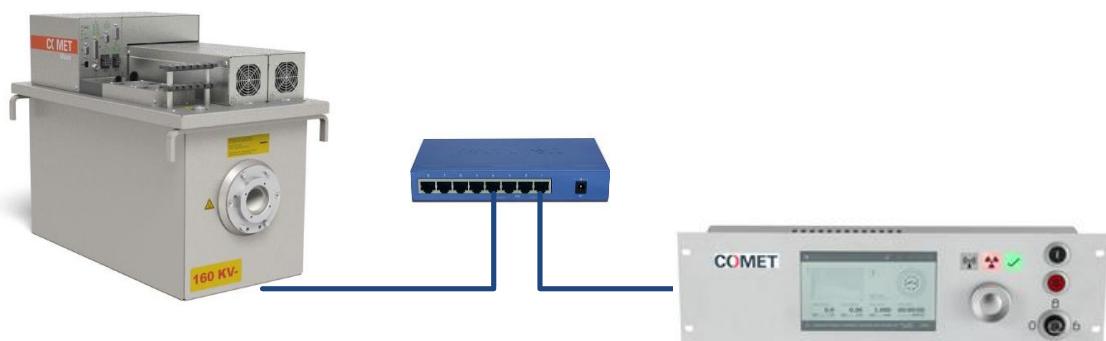
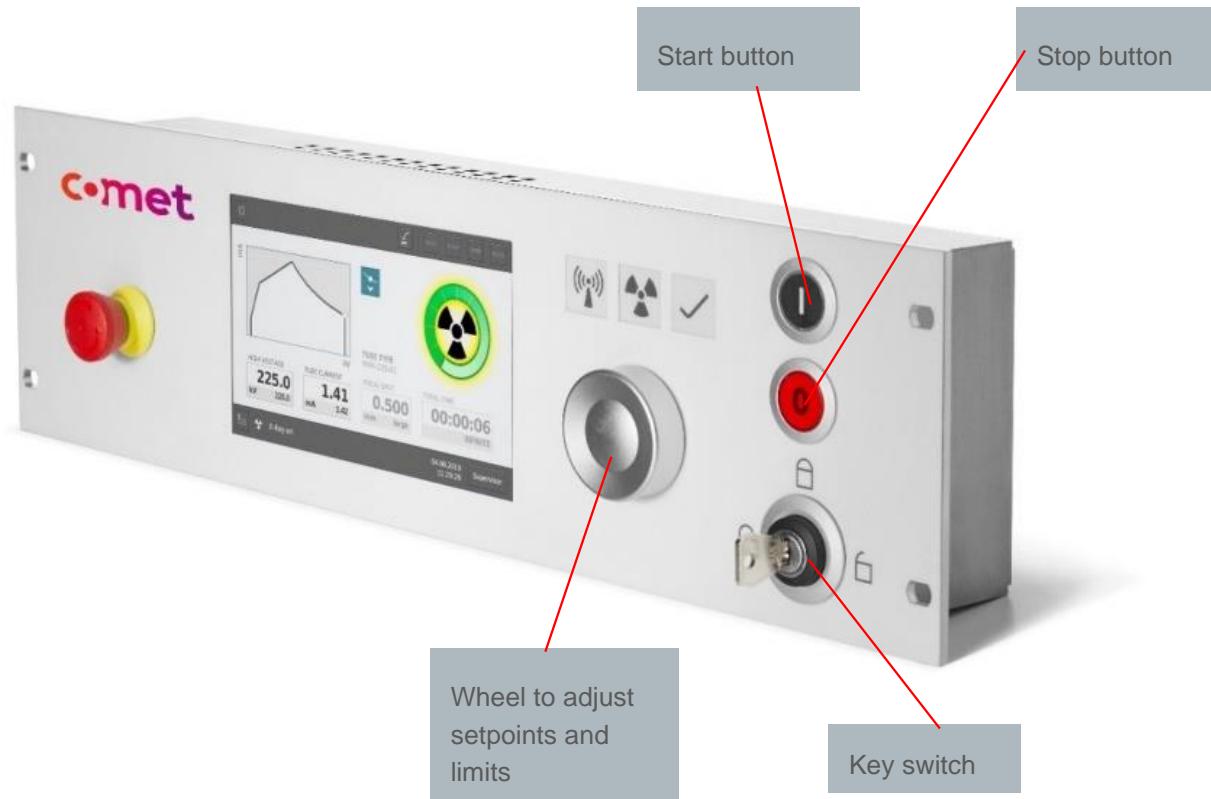
If you are running a third party cooler or if the cooling circuit is continuously on, the flow contact can be implemented as shown in the diagram below. This picture is an extract of the OEM Manual.



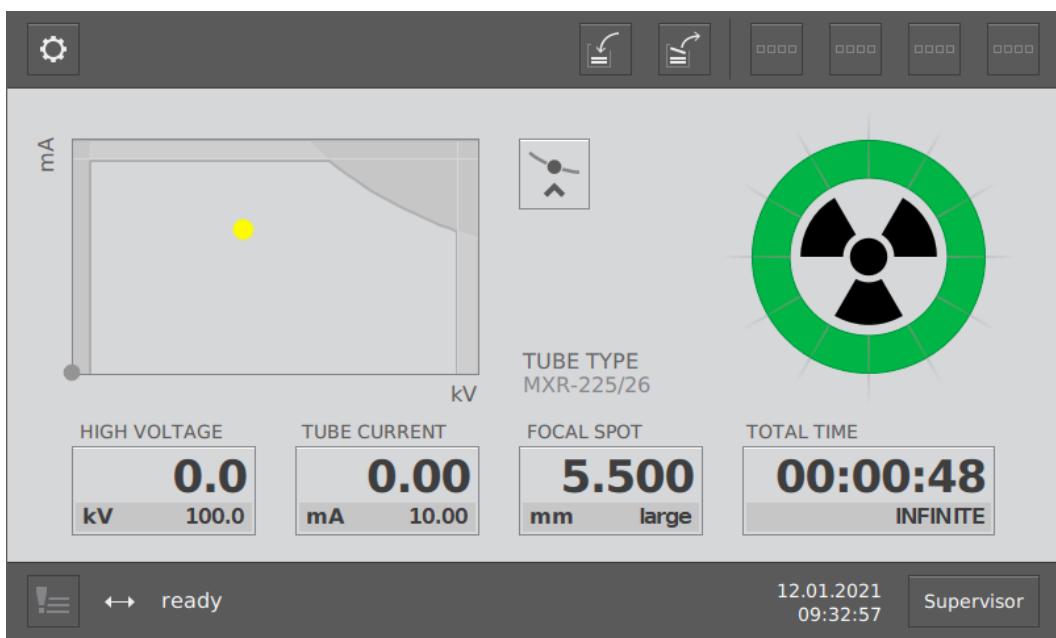
3.7 Options / Accessories

3.7.1 Optional Controller

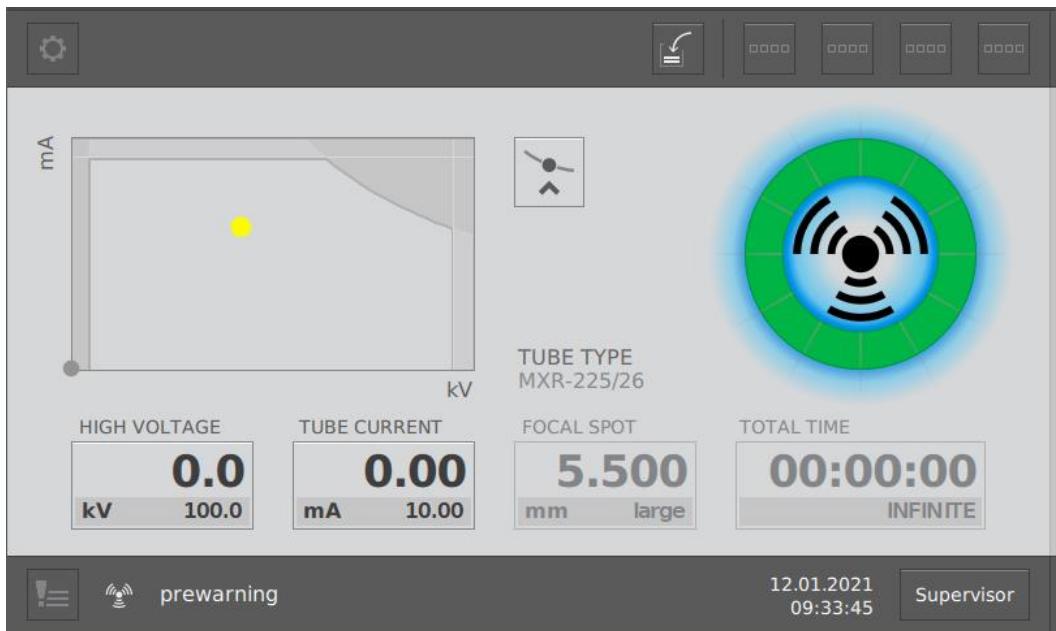
The major purpose of the optional Controller is to control and monitor the iVario. Its graphical user interface is designed for an intuitive operation with the x-ray source.



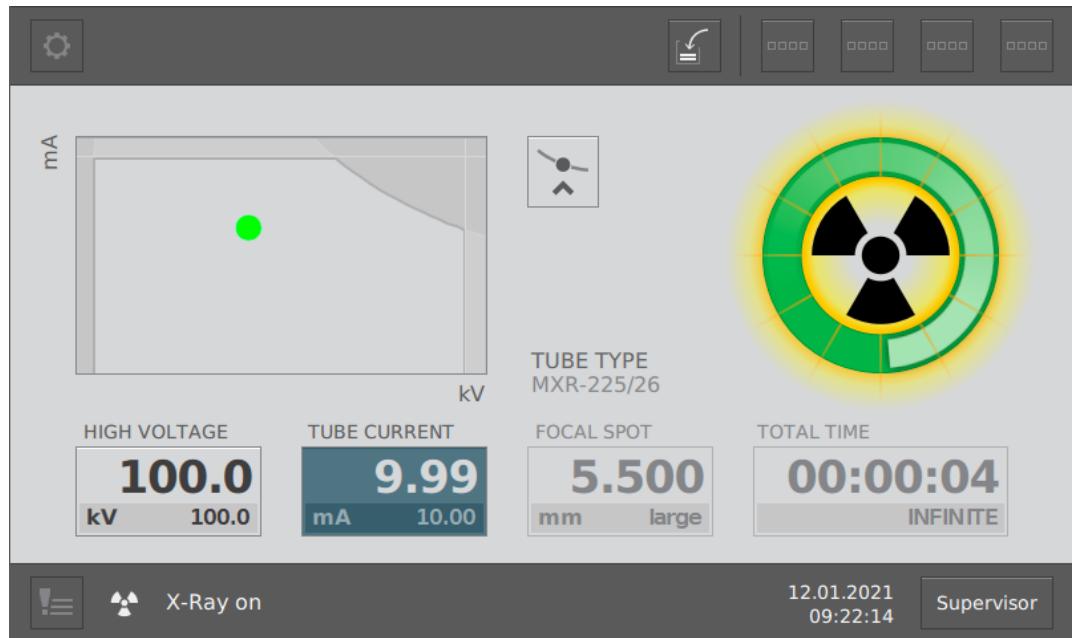
192.168.177.199
Available TCP ports: 50505, 50506
One single Control Software instance allowed per port



As described in the OEM manual, the optional Controller is a very useful tool during commissioning and troubleshooting. It describes the status of the iVario generator. If the generator is in ready state, you can start X-Rays. The generator will change from ready into prewarning state



And will turn X-Rays on



3.7.1.1 Available versions of the optional Controller

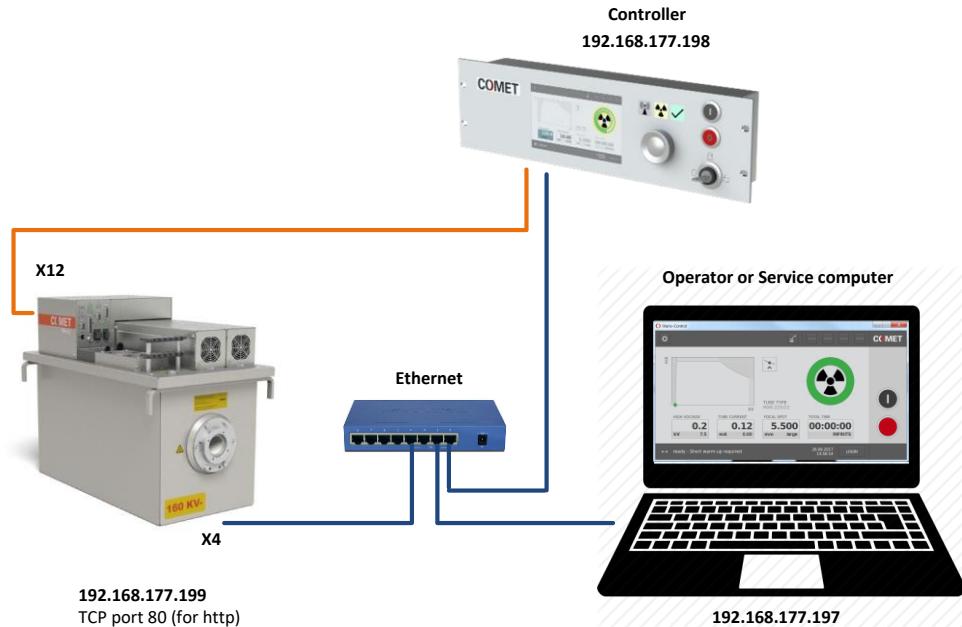
The optional Controller is a spare part. It should not be opened for repair or for re-configuration purposes. The controller comes in 8 different configurations. Check which one fits your requirements.

Configuration	Emergency Stop	X-Ray LED	Prewarn LED	Ordering number
C1	No	Red	Blue	20106319
C2	Yes*	Red	Blue	20107576
C3	No	Yellow	Blue	20108210
C5	No	Red	Red	20108108
C7	No	Yellow	Red	20104363

* The emergency stop is only safe in use with the original Comet external safety box.

3.7.1.2 How to connect the optional controller

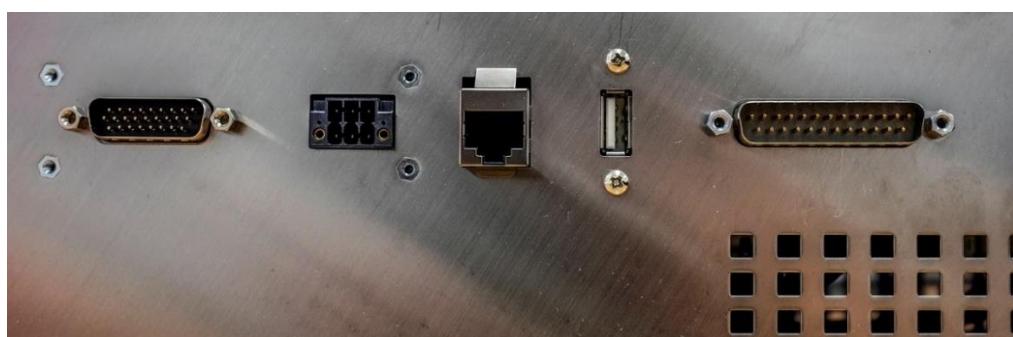
Here is the schematic overview how to integrate the optional Controller into a network with an iVario generator.

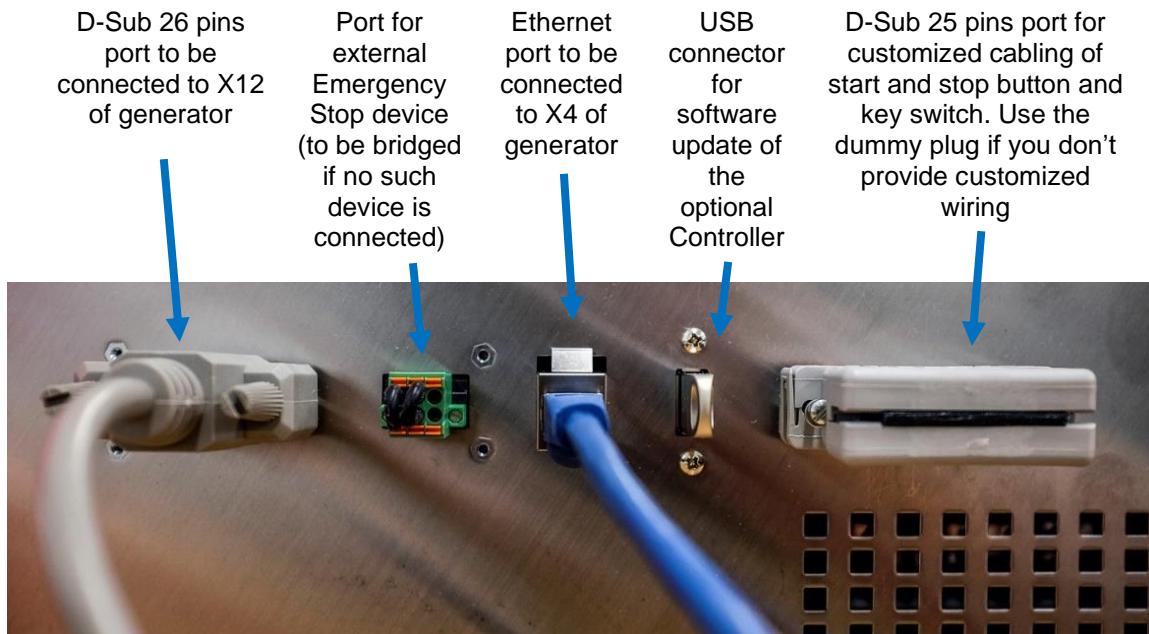


The iVario controller cables (it is a bundle including the 26 pins X12 and Ethernet cable) are available in six different lengths

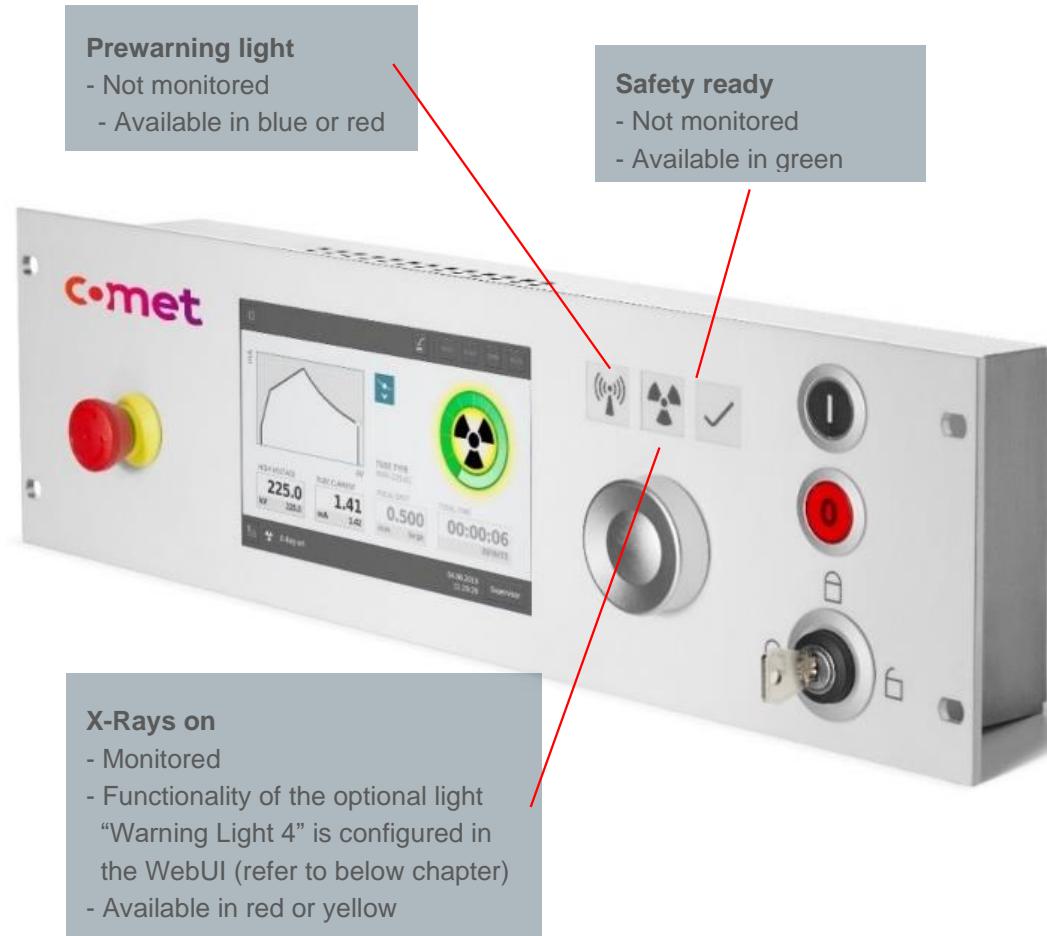
Cable length	Ordering number
5m	20106693
10 m	20089506
15 m	20106694
20 m	20106704
25 m	20106705
30 m	20089505

On the Ethernet side, plug the controller with an Ethernet Patch cable CAT5 (max. 100m without an amplifier such as i.e. a switch) in the appropriate length to the iVario "X4" Ethernet connector. View of the rear side of the optional controller (naked and once with connected cables / devices).





3.7.1.3 Warning lights of the optional Controller



3.7.1.4 Configuration in the WebUI to use the optional controller

Enable the optional controller in the WebUI by ticking both, “Use Optional Controller” and “Ignore HV Enable Button of X8”.

„Warning Light 4“

When enabling the optional controller in the WebUI the optional light „Warning Light 4“ will be available to be configured. The „Warning Light 4“ is monitored with a fix current of > 3mA.

The screenshot shows the comet WebUI interface. The left sidebar has sections for Operation (Generator Info, HV Operation, Software update, Reports), Setup (Generator, I/O, Communication, Application), and I/O. The I/O tab is selected and highlighted with a blue box. The main area is titled 'I/O configuration'. Under 'General', there are two checked checkboxes: 'Use Optional Controller' and 'Ignore HV Enable Button of X8', with a green 'Apply' button below them. A message indicates 'General I/O Configuration Applied' and 'Reboot required'. The 'Phase Selection' table lists phases like Enable, NOT-READY, COOLER CHECK, SAFETY READY, MAINS CHECK, READY, PREWARN, HV ON, and SETPT REACHED. Each phase has a row of checkboxes for Output 1 through Warn. Light 4. The 'Warn. Light 4' column is highlighted with a blue box. The 'Dyn. Mon.' column shows 'Off' for most phases except HV ON and SETPT REACHED, where it shows 'Blink'.

Always confirm the settings with the “Apply” button.



At the end, when you finished the configuration of the I/Os, the system has to be re-booted.

Lights for „Prewarning“ and „Safety Ready“

When enabling the optional controller in the WebUI, the lights for „Prewarning“ and „Safety Ready“ are automatically enabled and set in the background. You can check the settings under „Advanced Configuration“.

The screenshot shows the comet WebUI interface with the title "I/O configuration". On the left, a sidebar menu includes "Operation", "Setup" (with "Generator" and "I/O" selected), and "Communication/Application". The main content area has two sections: "General" and "Phase Selection".

General: Contains checkboxes for "Use Optional Controller" and "Ignore HV Enable Button of X8", with an "Apply" button highlighted in green. A message below says "General I/O Configuration Applied" and "Reboot required".

Phase Selection: A table maps I/O outputs to phases across different generator states. The columns are Phase, Output 1, Output 2, Output 3, Output 4, Warn. Light 1, Warn. Light 2, Warn. Light 3, Warn. Light 4, and Dyn. Mon. The rows represent states: Enable, NOT-READY, COOLER CHECK, SAFETY READY, MAINS CHECK, READY, PREWARN, HV ON, and SETPT REACHED. The "HV ON" row is highlighted with blue boxes around the "On" and "Blink" buttons for Outputs 1 and 4 respectively. The "Advanced Configuration" button at the bottom right is also highlighted with a blue box.

Phase	Output 1	Output 2	Output 3	Output 4	Warn. Light 1	Warn. Light 2	Warn. Light 3	Warn. Light 4	Dyn. Mon.
Enable	✓	✓	✓	✓	✓				
NOT-READY	Off	Off	Off	Off	Off	Off	Off	Off	Off
COOLER CHECK	Off	Off	Off	Off	Off	Off	Off	Off	Off
SAFETY READY	Off	Off	Off	Off	Off	Off	Off	Off	Off
MAINS CHECK	Off	Off	Off	Off	Off	Off	Off	Off	Off
READY	On	Off	Off	Off	Off	Off	Off	Off	Off
PREWARN	Off	On	Off	Off	Off	Off	Off	Off	Off
HV ON	Off	Off	On	On	Blink	Off	Off	Blink	Off
SETPT REACHED	Off	Off	On	On	Blink	Off	Off	Blink	Off

In the tab „Review“.

- „Output 5“ (Safety Ready) is steady on for the states „Ready“, „Prewarn“ and „HV ON“. In both, Normal Operation and WarmUp.
- „Output 6“ (Prewarn) is flashing for the state „Prewarn“.

Step 3: Review

The table below gives you an overview of the configuration of outputs and warning lights.

Output	States
Output 1	<input checked="" type="radio"/> Normal Operation/Ready <input checked="" type="radio"/> Warmup Operation/Ready
Output 2	<input checked="" type="radio"/> Normal Operation/Prewarn <input checked="" type="radio"/> Warmup Operation/Prewarn
Output 3	<input checked="" type="radio"/> Normal Operation/HV ON <input checked="" type="radio"/> Warmup Operation/HV ON
Output 4	<input checked="" type="radio"/> Normal Operation/HV ON <input checked="" type="radio"/> Warmup Operation/HV ON
Output 5	<input checked="" type="radio"/> Normal Operation/Ready <input checked="" type="radio"/> Normal Operation/Prewarn <input checked="" type="radio"/> Normal Operation/HV ON <input checked="" type="radio"/> Warmup Operation/Ready <input checked="" type="radio"/> Warmup Operation/Prewarn <input checked="" type="radio"/> Warmup Operation/HV ON
Output 6	<input checked="" type="radio"/> Normal Operation/Prewarn <input checked="" type="radio"/> Warmup Operation/Prewarn
Warning Light 1	<input checked="" type="radio"/> Normal Operation/HV ON <input checked="" type="radio"/> Warmup Operation/HV ON
Warning Light 2 (disabled)	
Warning Light 3 (disabled)	
Warning Light 4	<input checked="" type="radio"/> Normal Operation/HV ON <input checked="" type="radio"/> Warmup Operation/HV ON
Dynamic Monitoring	(disabled)

 Show Register-Values for T3-Protocol

Step 4: Apply Changes

[Apply](#) [Discard Changes](#)

Basic Configuration

[Return to basic configurator.](#)

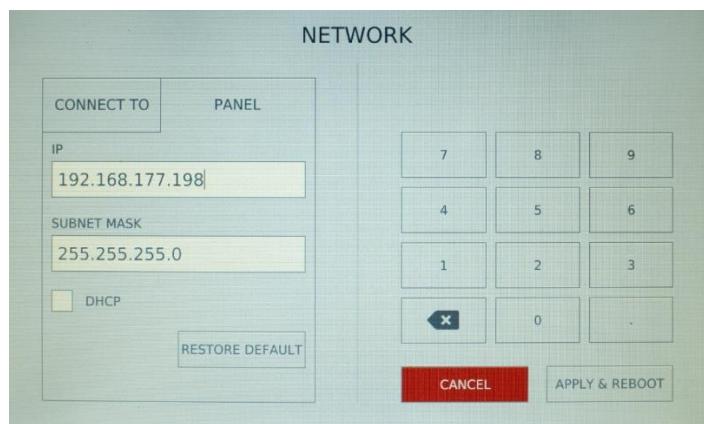
[Basic Configuration](#)

To get back to the basic configurator, click on „Basic Configuration“.

3.7.1.5 Modify the IP address of the optional controller

Any controller is delivered with the preconfigured default IP-address 192.168.177.198. If you want to integrate the controller in your own Ethernet network you will have to adapt and reconfigure the IP settings of the controller.

Therefore login as “Supervisor” with the password “1111” and hit the “Network” button. Under the tab “Panel”, you can configure the IP settings of the optional Controller.



Don't forget to hit the “Apply & Reboot” button.

3.7.1.6 Operational report download



The generator boots up with a connected USB stick on X6 with the startup-file and the SSH feature enabled. The operational report is exported from the Controller to the USB stick on the generator (X6).

The operational report can be generated and viewed exactly the same way as with the iVario Control Software installed on computers:

- Refresh the Operational report on the Controller
- Download the Operational report
- Report is saved on the USB stick on X6 of the generator

The requirements for the USB stick and download workflow are the same as described in section “Additional practices for troubleshooting”, chapter “Operational Report” for the iVario Control Software.

3.7.1.7 Controller software update

The software update of the controller can be performed having the new optional Controller software ready on a USB stick, connected on the rear side of the controller.



The optional Controller software is a binary file and is always named regarding the syntax: "iVario_Controller_VA.B.C.bin".

Where A, B, C define the version number. Install the file "iVario_Controller_V2.5.0.bin" to be compatible with iVario v2.5.0.

Software update workflow

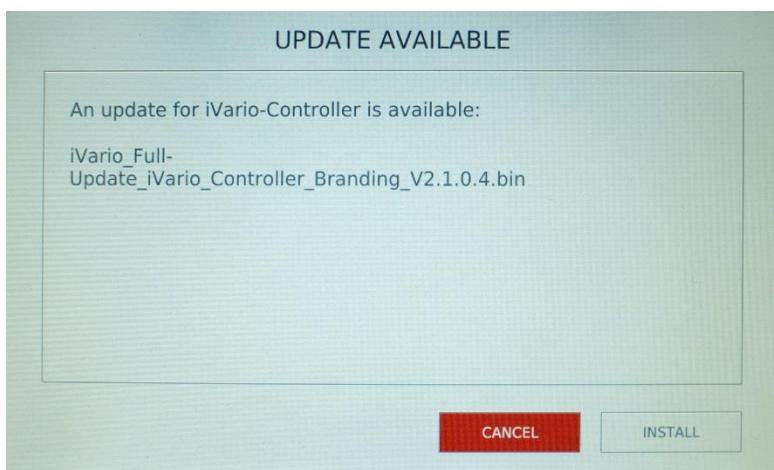
Copy the software on the root of your previously FAT32 formatted USB stick and plug the stick on the USB connector on the backside of the controller.



On the controller, log in as Supervisor with the password "1111"

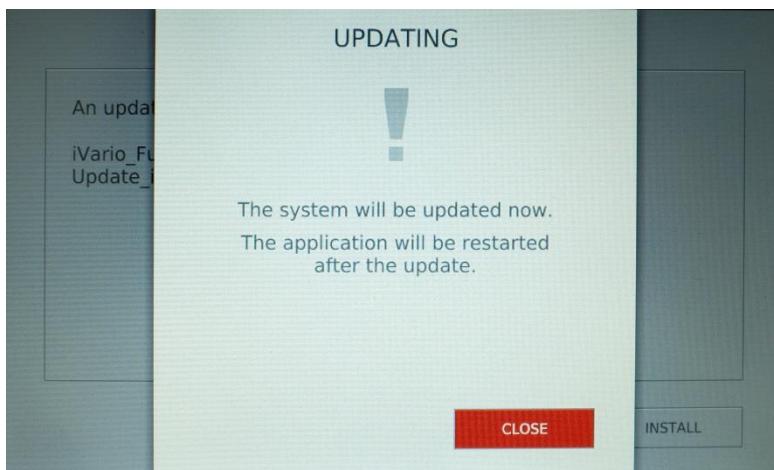
Click the "Settings" button on the top left side. Click the "Info" tab and navigate one screen to the right

Hit the "Update" button



All the available versions on the USB stick will be displayed

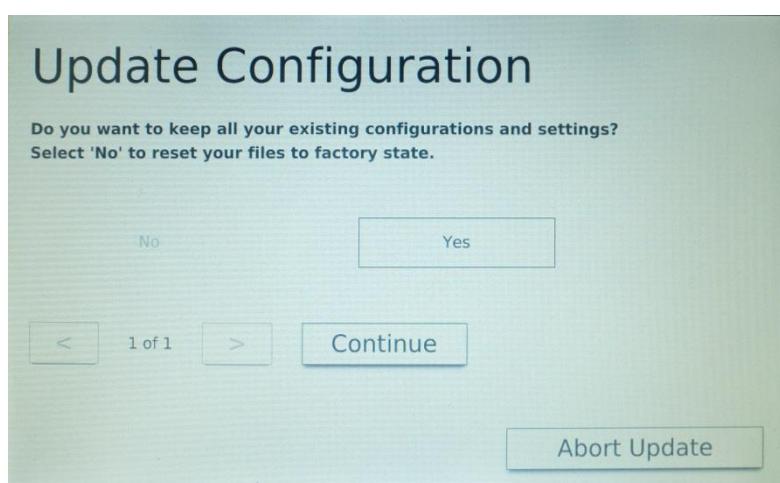
Select the one you want to install and hit "Install"



This screen is visible for a very short time

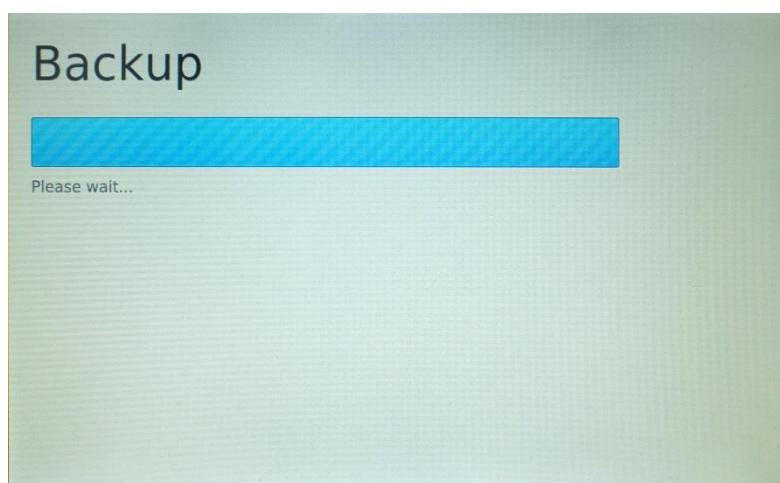


Simply hit “Continue” to perform the software update

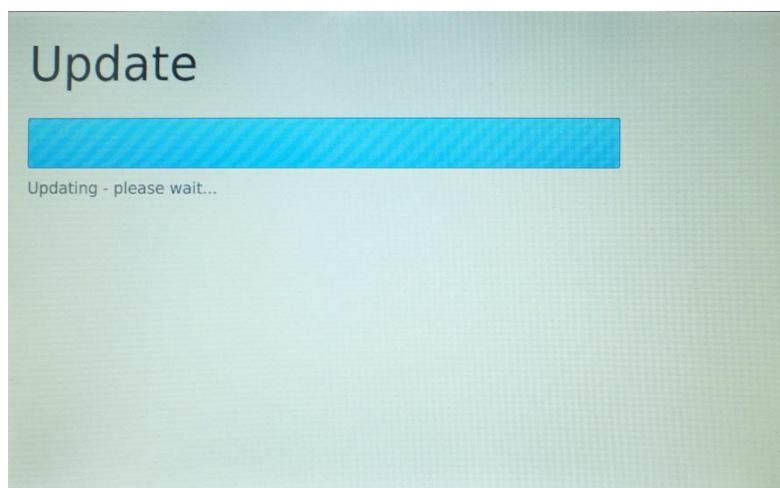


Hit “Yes” for keeping all your existing configurations and settings

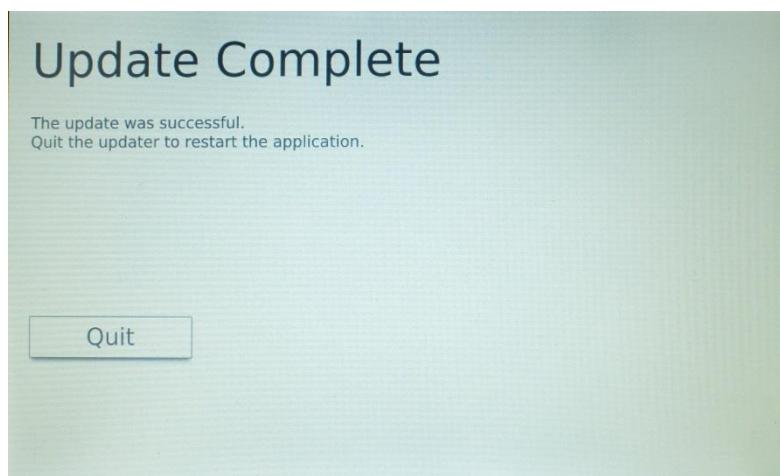
And then hit “Continue”



The system is backing up all the settings for security reason



The real software update is performed



This is the message that the update is complete and it was successful

Hit "Quit" and the Controller will reboot.

Check the signature of the installed version

After the reboot of the Controller, log in as "Supervisor" with the password "1111". Back-check the just previously installed software version in "Settings", tab "Info" and one navigation page to the right. You will find in the "System Information" the version of the actually installed iVario Controller version.

3.7.1.8 How to integrate the Emergency Stop of the Controller into the external safety

This chapter has to be done for a next version of the Service Manual. Refer to the manual of the Comet external safety box.

3.7.2 Cooler interface

The Service Manual related content about “Cooler Interface” will be done in a later version of this manual. Basic information about the “Cooler Interface” is available in the OEM Manual in the sections 2.5.2, 4.4.2 and 4.7.

3.7.3 IP 54 cover

The Service Manual related content about “IP 54 cover” will be done in a later version of this manual. Basic information about the “IP 54 cover” is available in the OEM Manual in the sections 2.5.3 and 4.18.

3.7.4 External safety box

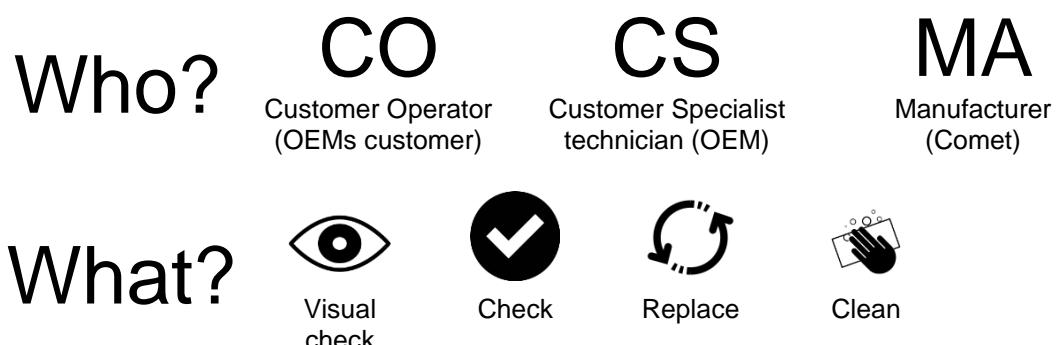
At the day of generating the first official version of the Service Manual, the external safety box is still in the prototype phase and will be described in detail later. Basic information about the principle of the external safety is described in the OEM Manual in the sections 2.6.1 and 2.6.2.

4 Periodic Maintenance



- Daily
- Weekly
- Every 2-6 months
- Every 6 months
- Annually
- Every 2 years
- Every 10 years or after 1 million ON/OFF cycles

Who should maintain what in which schedule?



4.1 Daily maintenance

Component	Task	Description	Who
Mains switch, door switch Operating and indicating elements		Function test Refer to chapter 5.8	CO

4.2 Weekly maintenance

Component	Task	Description	Who
Connecting cables		Visual inspection for damage	CO
Safety and warning devices		Function test Refer to chapter 5.8	CO
Air filter of iVario cover	 	Visual inspection, clean if necessary	CO
Cooler module		Visual inspection for leakage	CO
Cooler module	 	Coolant level in the cooler module. Top up if necessary	CO

Cooling fins / heat exchanger of the tank		Visual inspection for damage. Clean if necessary Refer to chapter 5.9	CO
---	--	--	----

4.3 Every 2-6 month

Component	Task	Description	Who
iVario cover		Replace the air filter In case of heavy polluted ambient air, the replacement interval must be reduced.	CO

4.4 Every 6 month

Component	Task	Description	Who
High-voltage plug at the X-ray tube (for not spring-loaded cables)		Visual inspection for damage and re-apply silicone grease 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 situations, adhere to shorter maintenance intervals. Refer to Tube Manual and HV cable installation Manual	CS
High-voltage plug at the generator (for not spring-loaded cables)		Visual inspection for damage and re-apply silicone grease Refer to Tube Manual and HV cable installation Manual	CS
Water cooler		Clean filter	CO

4.5 Annually

Component	Task	Description	Who
High-voltage plug at the X-ray tube (for spring-loaded cables)		Visual inspection for damage and re-apply silicone grease 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 situations, adhere to shorter maintenance intervals. Refer to Tube Manual and HV cable installation Manual	
High-voltage plug at the generator (for spring-loaded cables)		Visual inspection for damage and re-apply silicone grease Refer to Tube Manual and HV cable installation Manual	

Safety components and safety devices		Visual inspection and function test. Check the state of the electrical contacts and the moving machine parts.	CS
Radiation protection		Measurement of X-ray leakage radiation	CS
Oil cooler		Replace OMF filter (absorbant and paper filter)	

4.6 Every 2 years

Component	Task	Description	Who
Water cooler and oil cooler		Change coolant	CS
Radiation protection		Measurement of X-ray leakage radiation	CS

4.7 Every 10 years or after 1 million ON/OFF cycles

Component	Task	Description	Who
Total system		Complete inspection and service	CS, M

4.8 Function test

The operator must regularly inspect the X-ray module for visible damage (adhere to maintenance schedule Daily and Weekly). 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.

4.9 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.

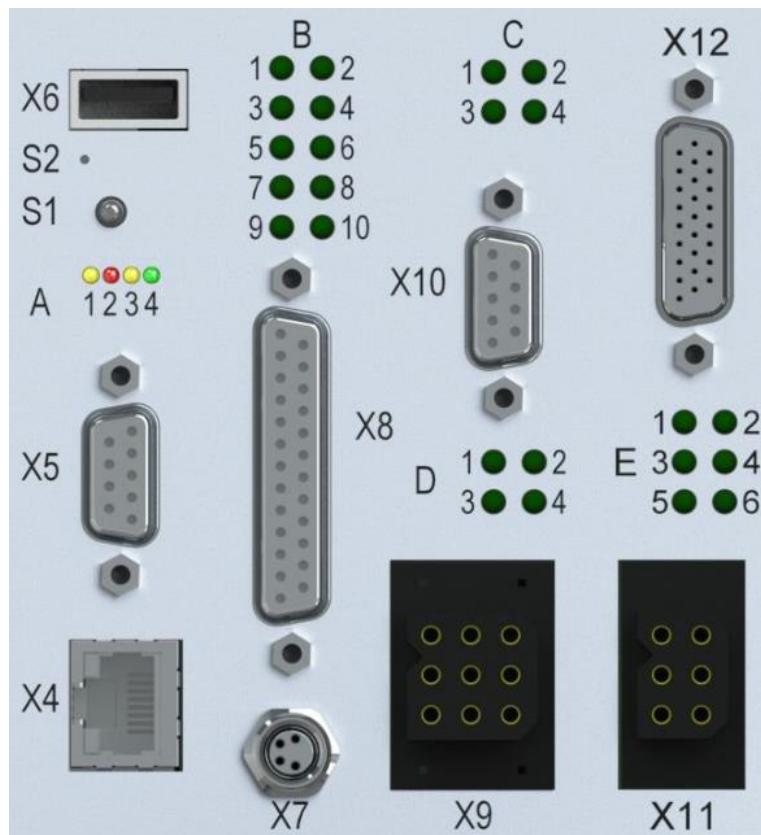


Indication for pollution is a decreasing cooling performance, possibly leading to the automatic shut-down of the X-ray system due to coolant over-temperature.

5 Diagnostic LEDs

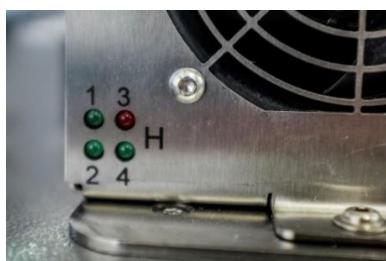
Visible from the outside of the housing, the diagnostic LEDs indicate to the operator the status of the generator and are split in five groups A-E.

5.1 Overview of all the LEDs and interfaces on the Interface Controller (IFC)



- | | | | |
|-----------|---|------------|---|
| A | LEDs for Interface Controller, IFC | X4 | Ethernet |
| B | LEDs for dig. IN/OUT of X8 | X5 | RS-232 |
| C | LEDs for status monitored warning lights | X6 | USB Stick |
| D | LEDs for Cooler control | X7 | Not implemented |
| E | LEDs for iVario controller | X8 | Digital IN/OUT signals |
| S1 | Press button for Log file generation or Software update trigger | X9 | Cooler interface |
| S2 | Press button to enter into the Rescue System | X10 | Monitored warning lights |
| | | X11 | Input signals for safety interlocks |
| | | X12 | Input signals for safety emergency stop |

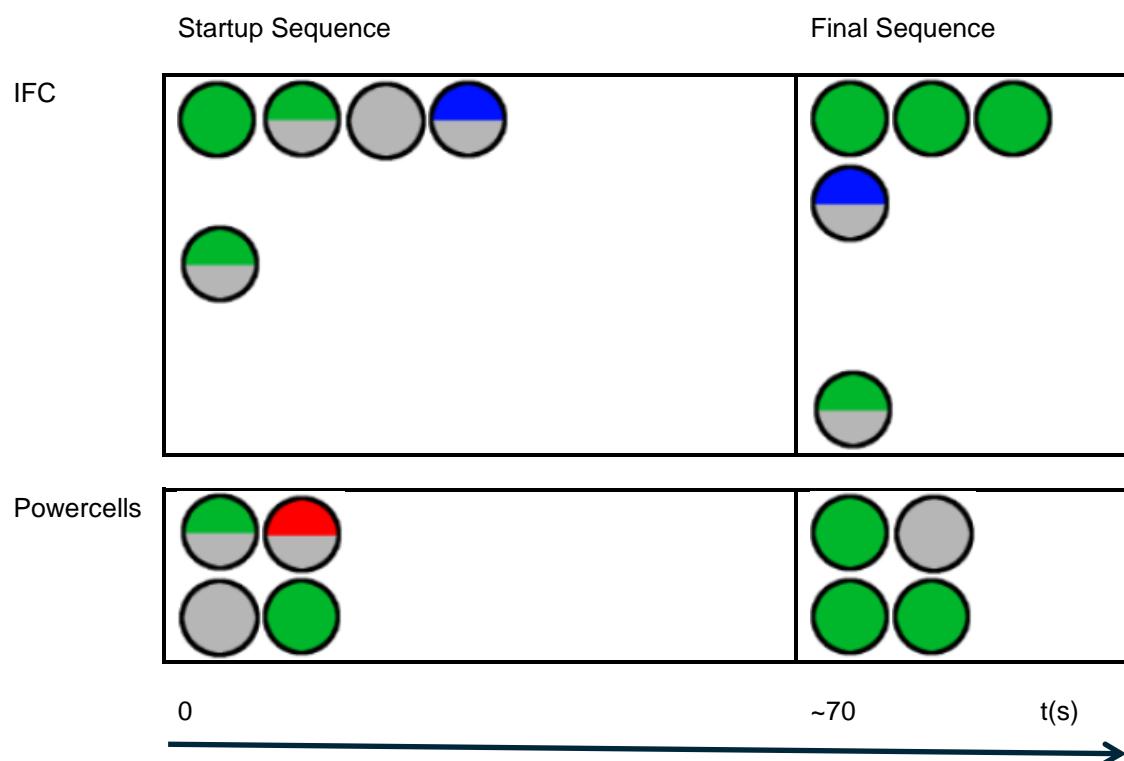
5.2 Overview of the 4 LEDs on the Powercell



5.3 Correct startup sequence for LEDs of IFC and Powercell 1 and 2

Prerequisite

If working with a single Powercell system, the Powercell must be plugged as a Master. If working with a double Powercell system, both Powercell 1 and 2 are plugged.



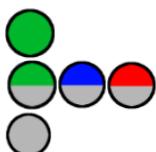
- WebUI login is accessible after approximatively 45 seconds. The LED A3 is steady on green.
 - The entire system is ready after approximatively 90 seconds



Please refer to chapter “Detailed overview of all the diagnostic LEDs” for the detailed description of each LED

5.4 Detailed overview of all the diagnostic LEDs

Explanation about the status of LEDs:



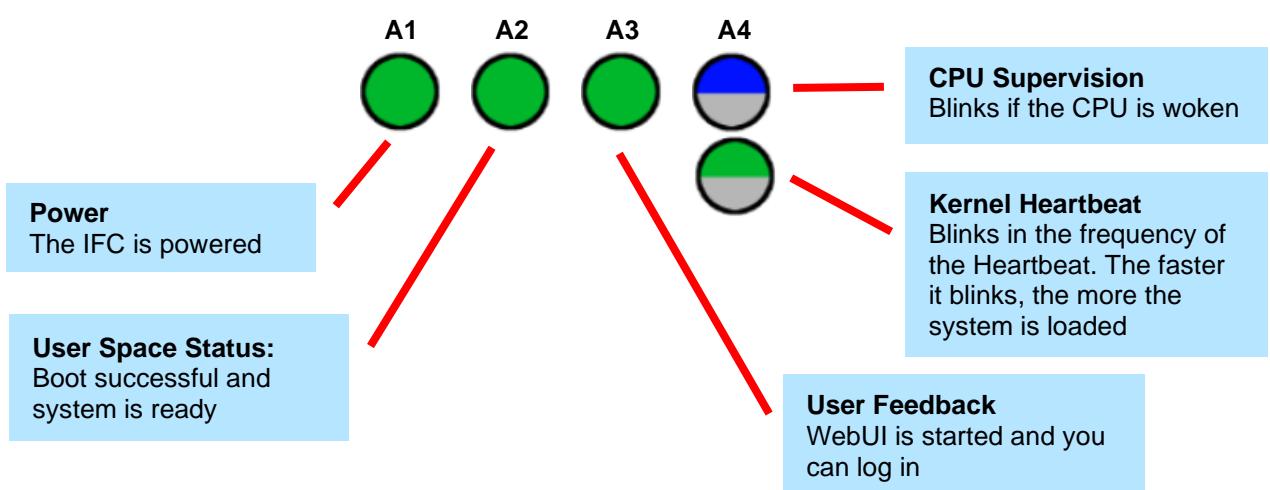
A full circle signifies the LED is steady on

A semi-circle signifies the LED is blinking

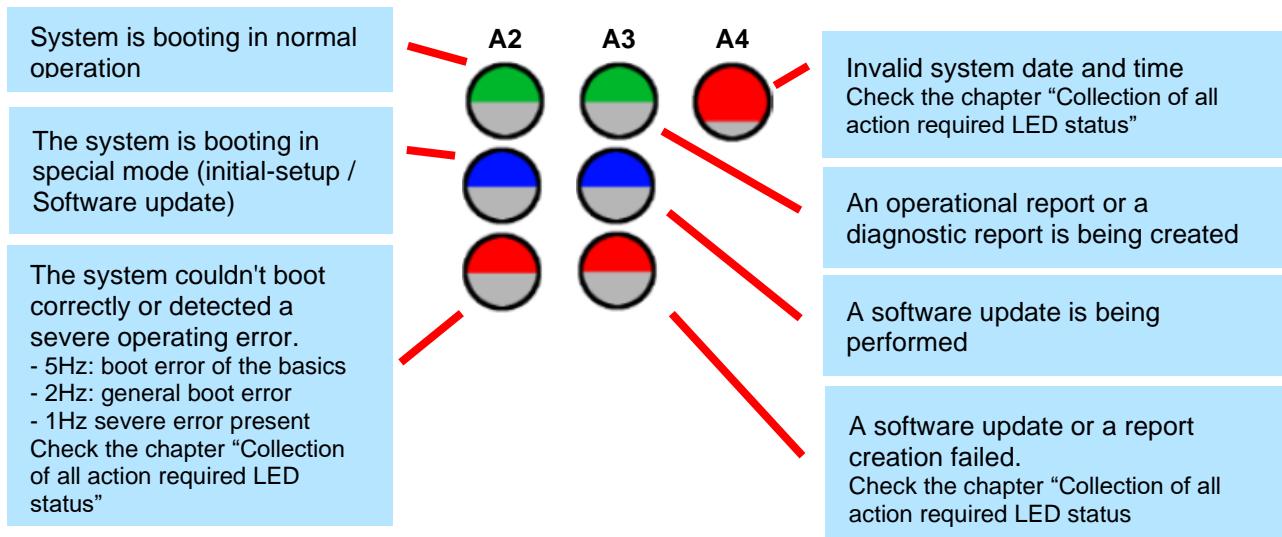
An empty circle signifies the LED is steady off

5.4.1 LEDs A – Interface Controller (IFC)

In normal running conditions, the LEDs of the IFC are in following state.



All other, exceptional states are described below.

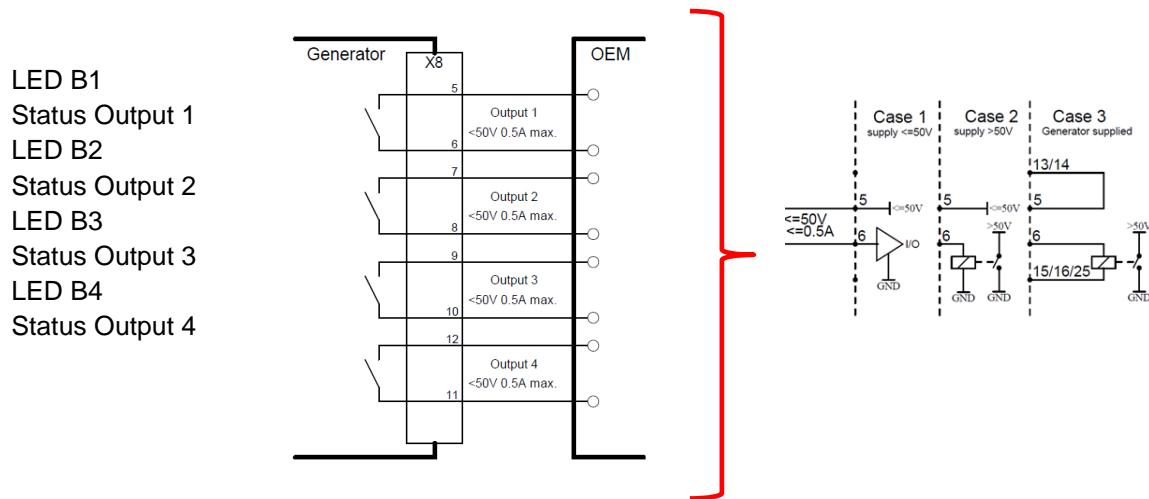


If the LED A4 doesn't blink blue, green or red, the Linux operating system has crashed. Please reboot the generator and generate a diagnostic report.

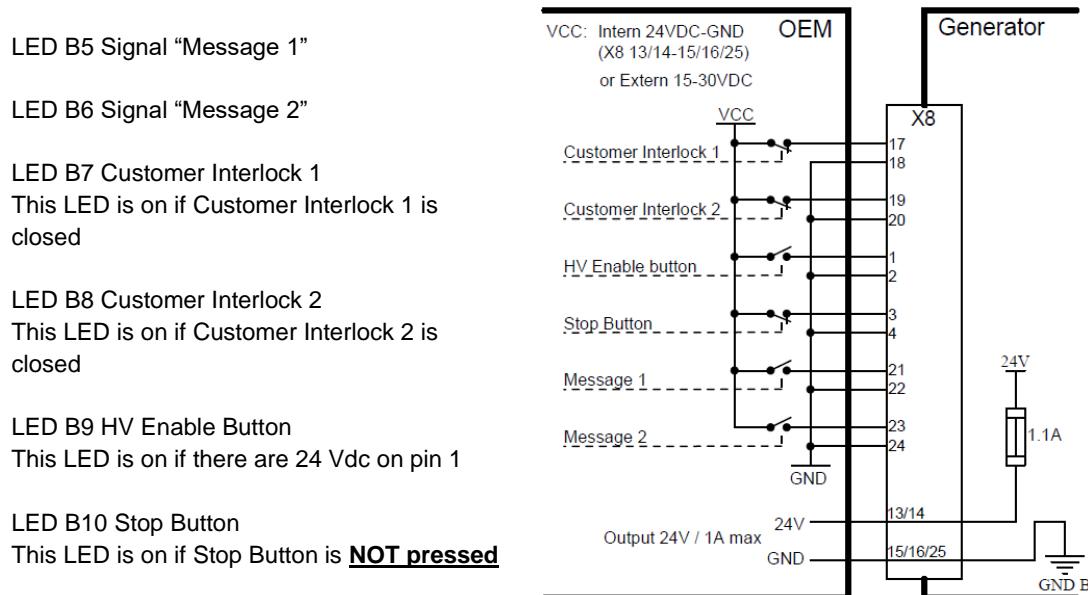
5.4.2 LEDs B – Digital In- and Outputs on Connector X8

LEDs B1..4 show the status of the 4 digital outputs on connector X8.

The specific LED is on if the respective output is set.

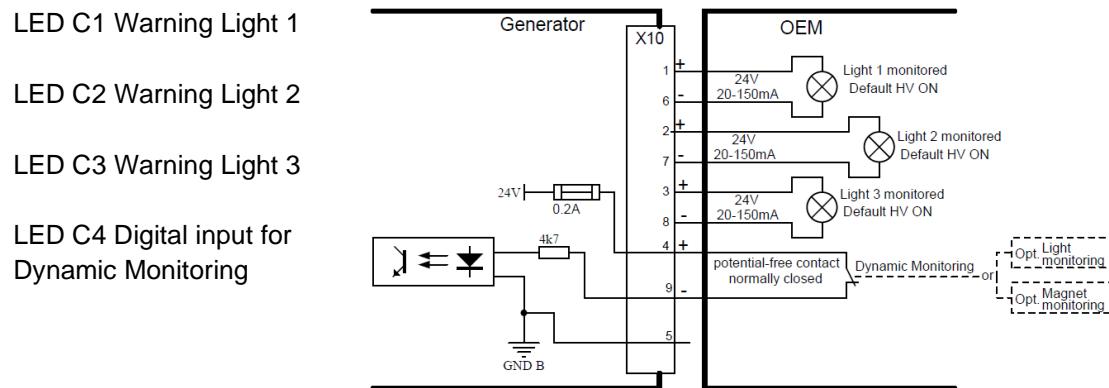


LEDs B5..10 show the status of the 6 digital inputs on connector X8



5.4.3 LEDs C – Warning Lights

LEDs C1..4 show the status of the 3 monitored warning lights and the status of the potential-free contact for the dynamic monitoring on connector X10. LED “ON” indicates that the warning light is “ON”. The respective LED is “Blinking” if the warning light is blinking.



5.4.4 LEDs D – Cooler Control

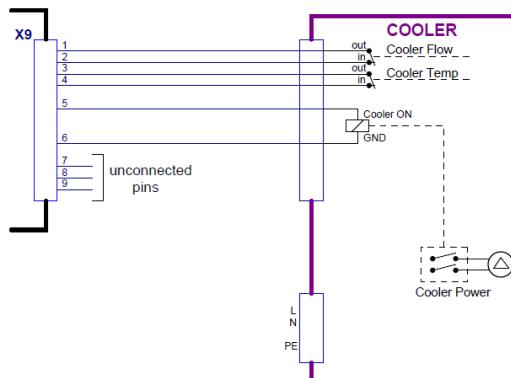
LEDs D1..4 show the status of the cooler control signals on connector X9

LED D1 “Feedback Cooler flow” is on if flow is detected

LED D2 “Feedback Cooler temperature” is on if the temperature is in range

LED D3 “Feedback Cooler” is on if the cooler is on

LED D4 not used



5.4.5 LEDs E – iVario Controller

LEDs E1..6 show the status of the iVario Controller signals

LED E1 (iVario controller start button)

LED E2 (iVario controller stop button)

LED E3 (iVario controller key switch on position 1 or 2)

LED E4 (iVario controller “HV ON” light)

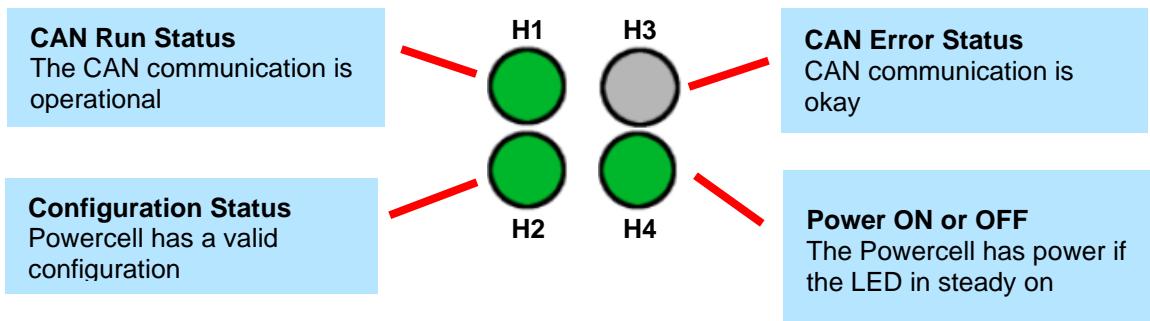
LED E5 (iVario controller “Ready” light)

LED E6 (iVario controller “Prewarn” light)

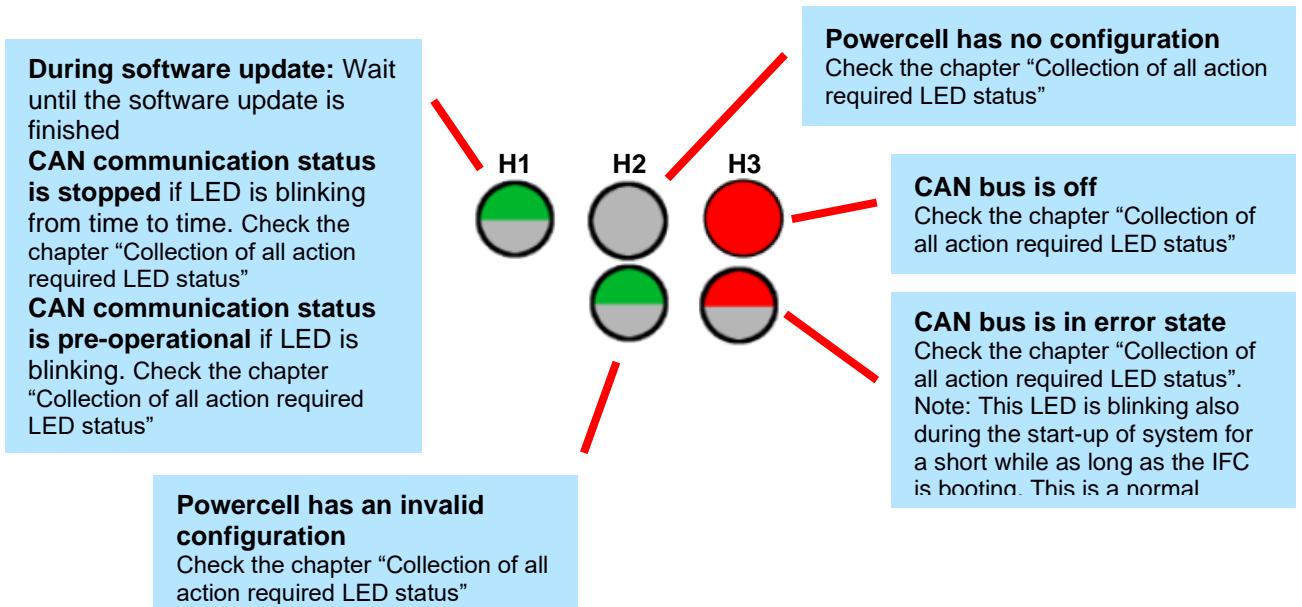
5.4.6 LEDs H – Powercell

There are 4 LEDs on each Powercell, LEDs H1..4

In normal running conditions, the LEDs of the Powercell(s) are in following state.



All other, exceptional states are described below.



6 I/O Handling

6.1 Basic I/O Handling

The basic I/O handling allows you to map the basic system states to your IOs in three steps.

- 1 Enable / disable the specific IO
- 2 Set the action ("off", "blink", "on") to the specific IO for the selected "system state"
- 3 Press the "Apply" button to apply the configuration

c•met ☢

I/O configuration

Operation

- Generator Info
- HV Operation
- Software update
- Reports

Setup

- Generator
- I/O**
- Communication
- Application

System state

General

Use Optional Controller
 Ignore HV Enable Button of X8

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	Dyn. Mon.
Enable	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				
NOT-READY	<input checked="" type="radio"/>	Off ↕	Off ↕	Off ↕	Off ↕	Off ↕	Off ↕	Off ↕
COOLER CHECK	<input checked="" type="radio"/>	Off ↕	Off ↕	Off ↕	Off ↕	Off ↕	Off ↕	Off ↕
SAFETY READY	<input checked="" type="radio"/>	Off ↕	Off ↕	Off ↕	Off ↕	Off ↕	Off ↕	Off ↕
MAINS CHECK	<input checked="" type="radio"/>	Off ↕	Off ↕	Off ↕	Off ↕	Off ↕	Off ↕	Off ↕
READY	<input checked="" type="radio"/>	On	Off ↕	Off ↕	Off ↕	Off ↕	Off ↕	Off ↕
PREWARN	<input checked="" type="radio"/>	Off ↕	On	Off ↕	Off ↕	Off ↕	Off ↕	Off ↕
HV ON	<input checked="" type="radio"/>	Off ↕	Off ↕	On	Blink	Blink	Off ↕	Off ↕
SETPT REACHED	<input checked="" type="radio"/>	Off ↕	Off ↕	On ↕	Blink ↕	Blink ↕	Off ↕	Off ↕

IO ← An arrow points to the "Dyn. Mon." column header in the table.

Advanced Configuration

Apply Changes

Apply | **Discard Changes**

Click on the "eye" icon to physically and visually test the IO for the specific state

HV ON  Off ↕ Off ↕ On ↕ Blink ↕ Blink ↕ Off ↕ Off ↕ Off ↕



6.1.1 Include the Optional Controller

If you want to include an Optional Controller, simply enable it in two steps

- 1** Enable “Use Optional Controller” and press “Apply”
- 2** Reboot the system because the Optional Controller has been enabled

The screenshot shows the comet software interface for I/O configuration. On the left, there's a navigation menu with 'Operation', 'Setup' (selected), and 'I/O' (highlighted with a blue box). The main area is titled 'I/O configuration' and contains two sections: 'General' and 'Phase Selection'. In the 'General' section, there are three checkboxes: 'Use Optional Controller' (highlighted with a blue box), 'Ignore HV Enable Button of X8', and 'Apply' (highlighted with a blue box). Below the 'Apply' button is a red box containing the text 'Reboot required'. In the 'Phase Selection' section, there's a table where rows represent phases and columns represent outputs and warning lights. The 'READY' row has its first output set to 'On'. The 'HV ON' row has its second output set to 'On' and its third output set to 'Blink'. The 'SETPT REACHED' row has its fourth output set to 'On'. The 'Warn. Light 4' column is also highlighted with a blue box. At the bottom of the 'Phase Selection' section is a 'Advanced Configuration' link. Below the table is a 'Apply Changes' section with an 'Apply' button (highlighted with a blue box) and a 'Discard Changes' button.

If you need to modify the default actions of the Optional Controller’s settings follow these three steps

- 1** Modify the action of “Warning Light 4” (the monitored led on the Controller) in the basic configurator
- 2** Modify the actions of “Output 5” and “Output 6” in the advanced configurator (refer to the chapter below)
- 3** Press “Apply” in the “Apply changes” section

6.2 Advanced I/O Handling

The advanced I/O handling allows a finer granularity to map system states and system information to IOs. It is set up in five steps

- 1** Virtually define all the “system states” and “system information” you want to map to the generator’s “I/O’s”
- 2** Physically allocate the “I/O’s”
- 3** Map the actions for a specific “system state” and “system information” and test with “preview”
- 4** Check the review & summary table
- 5** Apply the configuration

6.3 Virtually define the system states and system information you want to map

Below is the overview of all the available “system information” and “system states”.

System states	Substate #1	Substate #2
Booting		
Severe Error		
Normal Operation →	Not-Ready Cooler Check Safety Ready Mains Check Ready Prewarn HV ON	Preparing Ramping Setpoint reached Hot Standby Postheat HV Extant
		Irregular Shutdown
Warmup Operation →	Not-Ready Cooler Check Safety Ready Mains Check Ready	Paused Interrupted
	Prewarn HV ON	Starting Up Filament Heating Post Filament Heating HV Ramping HV Stabilization Current Ramping Stabilization
System information		
Imminent		
Arc Active		
System Unstable		
Warmup Required		
Temperature Critical		

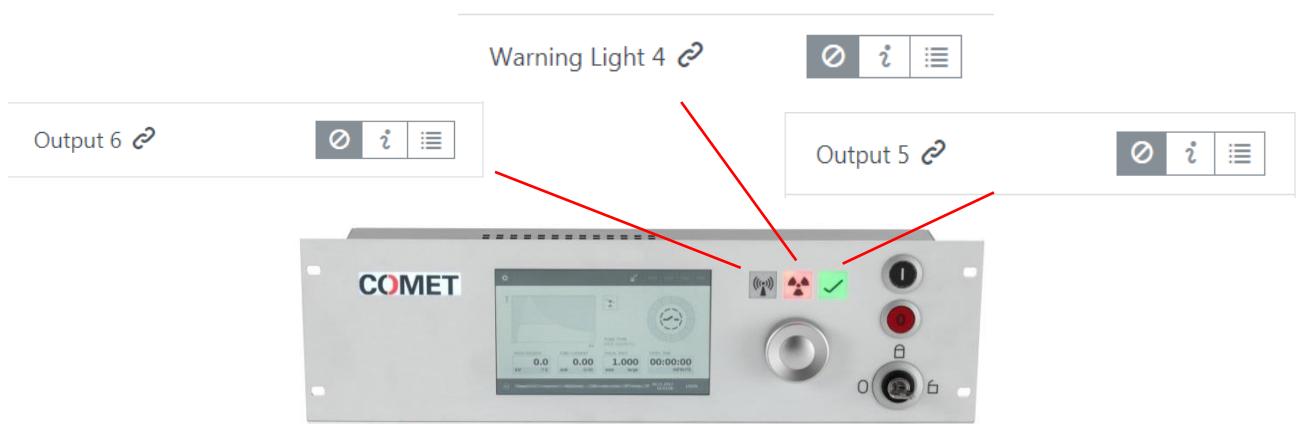
6.4 Physically allocate the I/O's

All these signals are considered as "I/O's". In the table below, they are all disabled.

Output 1				
Output 2				
Output 3				
Output 4				
Warning Light 1				
Warning Light 2				
Warning Light 3				
Dynamic Monitoring				

4 digital outputs on connector X8

3 monitored warning lights on connector X10



If the checkbox "Optional Panel Active" is checked, the Outputs 5 & 6 and the Warning Light 4 (monitored) are automatically assigned to the Optional Panel.

Each specific I/O can be

- disabled
- allocated to one or several “system information”
- allocated to one or several “system states”

In the example below:

- Digital Outputs 1 and 2 are allocated to “system information”
- Digital Output 3 and Warning Light 1 are allocated to “system states”
- All the other I/O's are disabled

Output 1			<i>i</i> System Information (e.g. imminent)
Output 2			
Output 3			System States (e.g. HV-on, Prewarn etc.)
Output 4			Disabled (Do not use this output)
Output 5			
Output 6			
Warning Light 1			System States (e.g. HV-on, Prewarn etc.)
Warning Light 2			Disabled (Do not use this output)
Warning Light 3			
Warning Light 4			
Dynamic Monitoring			



- All the disabled I/O's will not be visible in the action mapping section
- A specific I/O can't be mapped at the same time to a “system state” and to a “system information”. It's either “system state” or “system information”.

6.5 Map the actions and preview them

The action you can map to any “system state” or “system information” is

- off (switched off for the selected state)
- blink (blinking for the selected state)
- on (steady switched on for the selected state)

Browse to the specific “system state” or “system information” you want to map and select the action to perform.

In the example below, the “system state” “Setpoint Reached” is represented by “Output 3” “on” and “Warning Light 1” “blinking”.

This is the starting point, →
the root. You can always
get here by clicking on the
“home” icon

Start navigating here
and browse through
all the substates until you
reach the desired state

The navigation path is →
always visible on the top
and can be used for
backwards navigation as
well

All the available I/O's are
listed for the specific
“system state” or “system
information”

You can define all the
actions (off, blink or
steady on) you want to
allocate

Select substate on the left to edit

System States

System Information

Output 3 Off Blink On

Warning Light 1 Off Blink On

Off: Switched Off in selected state

Blink: Blinking in selected state

On: Steady switched ON in selected state

You can preview a state by clicking on the  icon beside the label of the state. This trigger will apply the currently stored action on the mapped I/O's. The "Output 3" will switch to "steady on" and the "Warning Light 1" will blink. This is an optical test for you. This feature is independent of the actual state of the iVario generator.

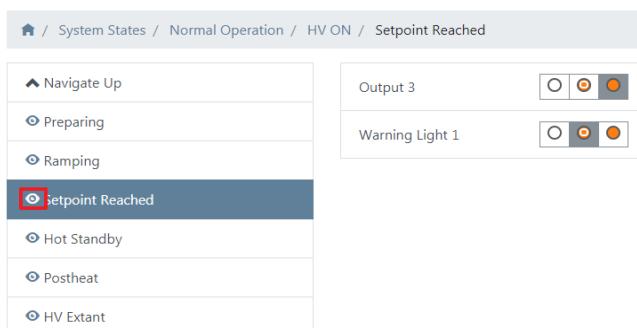
Click on the  icon to preview the associated action(s). The message

 Stop preview of: Safety Ready

does appear.

You can stop the preview by clicking on the

message or on the  icon



The screenshot shows the 'System States / Normal Operation / HV ON / Setpoint Reached' screen. On the left is a navigation tree with nodes like 'Navigate Up', 'Preparing', 'Ramping', 'Setpoint Reached' (which is highlighted in blue), 'Hot Standby', 'Postheat', and 'HV Extant'. To the right are two status displays: 'Output 3' and 'Warning Light 1', each with three indicator lights (red, yellow, green) showing different combinations of active states.

6.6 Review and summary

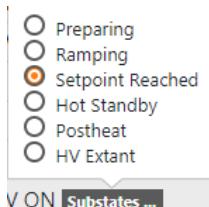
There is a summary available of all the configured I/O's and its associated actions for a specific system state or system information.

Step 3: Review

The table below gives you an overview of the configuration of outputs and warning lights.

Output	States
Output 1	 System Information/Warmup Required
Output 2	 System Information/Temperature Critical
Output 3	 Normal Operation/HV ON Substates ...
Output 4 (disabled)	
Output 5 (disabled)	
Output 6 (disabled)	
Warning Light 1	 Normal Operation/HV ON Substates ...
Warning Light 2 (disabled)	
Warning Light 3 (disabled)	
Warning Light 4 (disabled)	
Dynamic Monitoring (disabled)	

The mouse-over feature helps to visualize which sub-state is configured.



6.7 Apply the changes

All the performed changes will only take effect after applying them

You are also able to discard the changes before you apply them

No reboot is required after the "Apply".

7 Initial Operation Parameters

The „Initial Operation Parameters“ define the basic operation parameters after a reboot of the generator.

Available features are:

- Use minimal values (default mode)
- Use pre-set values
- Use last used values

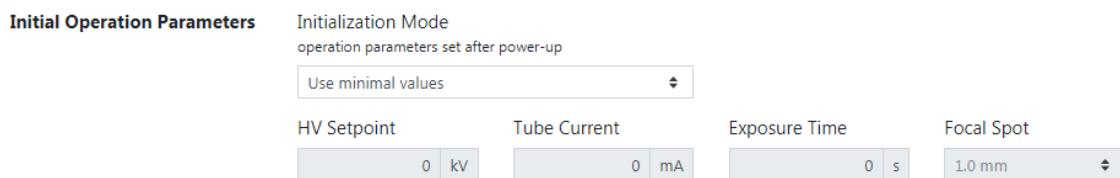
The configuration is performed in the WebUI → Application → Initial Operation Parameters

The screenshot shows the comet WebUI interface. The left sidebar has a dark blue background with white text and includes sections for Operation (Generator Info, HV Operation, Software update, Reports), Setup (Generator, I/O, Communication), and Application (selected). The main content area is titled "Application Configuration" and contains a "Settings" section. Below it, there are several groups of settings: "Prewarning", "Cooler", "Warm-Up", "Filament Control", and "Initial Operation Parameters". The "Initial Operation Parameters" group is highlighted with a thick blue border. It contains a dropdown menu set to "Use pre-set values" and four input fields for "HV Setpoint" (120 kV), "Tube Current" (5 mA), "Exposure Time" (0 s), and "Focal Spot" (5.5 mm). At the bottom are two buttons: "Apply Settings" and a green "Apply" button with a checkmark icon.

7.1 Use minimal values

After a reboot, the minimal values for high voltage and the tube current are set. The focal spot is set to "large" and the exposure time to zero (means infinite exposure). This is the same behavior like before version 2.3.0.

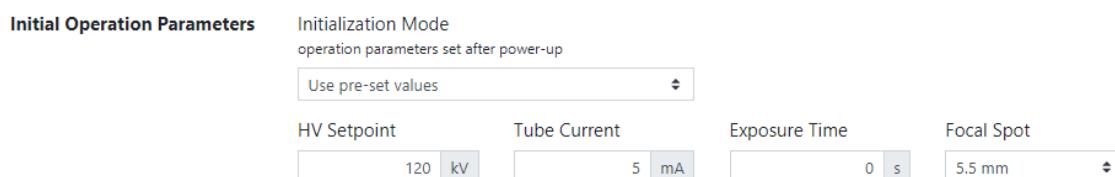
The fields for "HV Setpoint", "Tube Current", "Exposure Time" and "Focal Spot" are not editable in this mode.



After "Apply" and the "Reboot" of the generator, the configured feature is available.

7.2 Use pre-set values

A set of values for the operation parameters can be configured below. After a reboot, these values are loaded. The fields for "HV Setpoint", "Tube Current", "Exposure Time" and "Focal Spot" are editable.



After "Apply" and the "Reboot" of the generator, the configured values are available.



7.3 Use auto saved values

The system keeps the last used operation parameters after a reboot. The values are stored every time the system enters the HV-OFF state. Therefore, you have to start HV at least once for a set of new values to be saved.

The fields for “HV Setpoint”, “Tube Current”, “Exposure Time” and “Focal Spot” are not editable.

Initial Operation Parameters	Initialization Mode		
	operation parameters set after power-up		
Use last used values			
HV Setpoint	Tube Current	Exposure Time	Focal Spot
120 kV	4 mA	10 s	0.4 mm

After “Apply” and the “Reboot” of the generator, the configured feature is available.

8 Troubleshooting by state-machine and Not-Ready-Conditions

Quick Trouble-Shoot guide

Check the system status in the WebUI “HV Operation” page and refer to the specific section of this chapter.

Strategy

The best way to troubleshoot is always to know and understand in which status my iVario is. Start troubleshooting from this point, consider only the relevant parts and narrow down the problem to fix it. This is intuitive guided debugging using system status, system relevant not-ready conditions, shutdown reasons and system warnings.

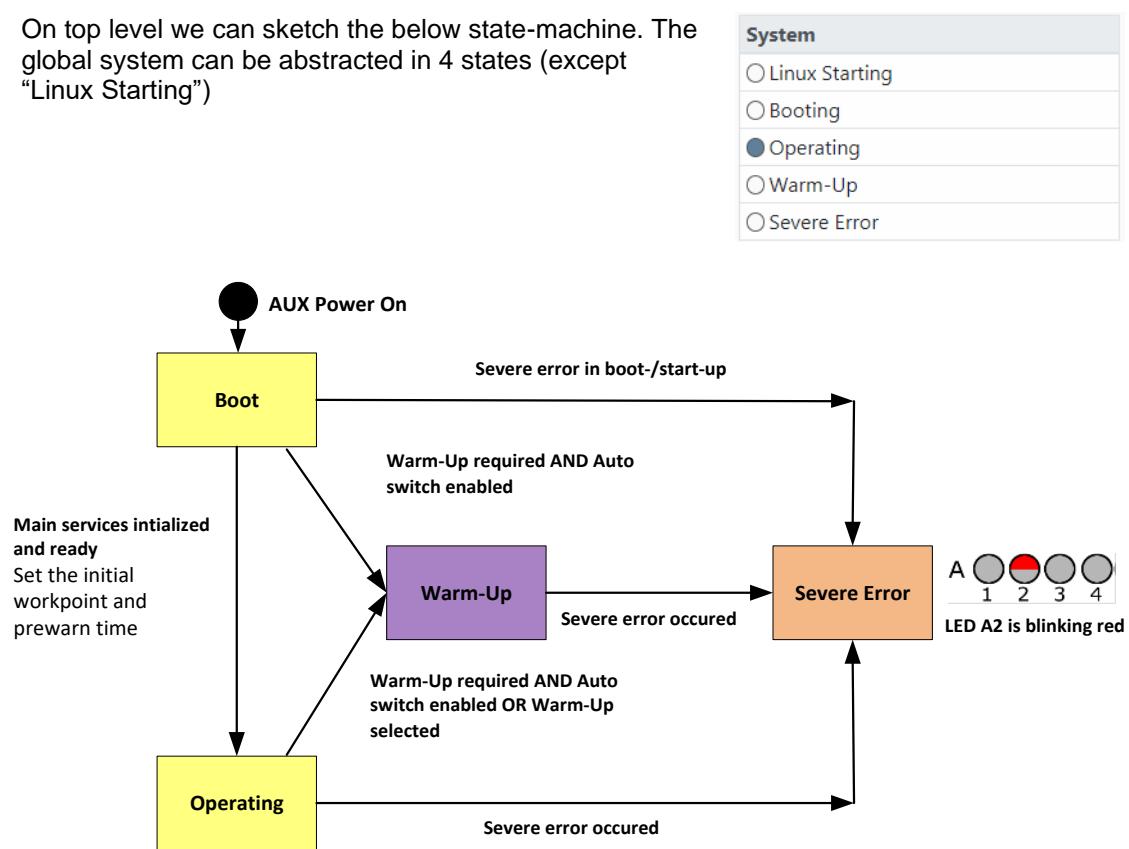
The operation of the iVario is a teamwork of different devices (e.g. IFC and Powercell) and each device provides its functionality. The functionality is mostly represented by state-machines, for example the iVario indicates that it is driving high voltage with a status. The status are implemented in the “fall through” technique.

The iVario state-machines are triggered by changes of not-ready conditions, shutdown reasons and HV status.

This state-machine is represented in the WebUI on the page “HV Operation”. This page is always the entry point for our debugging. The page will display iVario’s actual operation- and sub operation status.

8.1 Overview of the System States

On top level we can sketch the below state-machine. The global system can be abstracted in 4 states (except "Linux Starting")



In the WebUI, on the page "HV Operation" you will find the below "System States". In the present example, the system is in "Normal Operating" mode, in "HV Operation" state and the Setpoint is reached.

The screenshot shows the comet WebUI interface with the following details:

- Left Sidebar:**
 - Operation:** Generator Info, HV Operation (selected), Software update, Reports.
 - Setup:** Generator, I/O, Communication, Application.
- HV Operation Page:**
 - Control Panel:** High Voltage (120.0 kV), Tube Current (5.0 mA), Exposure Time (9.0 s), Focal Spot (5.5 mm), HV On/HV Off buttons, Apply Setpoint button.
 - Status Bar:** Status: 2,7,100,0,0.
 - System Status Table:**

System	Operating Status	Operating Sub-Status
<input type="radio"/> Linux Starting	<input type="radio"/> Initializing	<input type="radio"/> HV OFF
<input type="radio"/> Booting	<input type="radio"/> Not Ready	<input type="radio"/> Safety Checks and Preparing
<input checked="" type="radio"/> Operating	<input type="radio"/> Cooler Check	<input type="radio"/> Ramping
<input type="radio"/> Warm-Up	<input type="radio"/> Safety Ready	<input checked="" type="radio"/> Setpoint reached
<input type="radio"/> Severe Error	<input type="radio"/> MAINS Check	<input type="radio"/> Hot Standby
	<input type="radio"/> Ready	<input type="radio"/> Postheating
	<input type="radio"/> Prewarn	<input type="radio"/> HV Extant (HV on unsafe level)
	<input checked="" type="radio"/> HV-Operation	
	<input type="radio"/> Error	
 - Log/Feedback:** Shutdown Reason: (0,0,0), Boot-Error: 0x0, HVPS-Error: 0x0, Warnings: 0x0.

8.2 Overview of all the reachable states and sub-states

8.2.1 System State “Booting”

Status: 1,0,0,0,0	
System	Operating Status
<input type="radio"/> Linux Starting	<input checked="" type="radio"/> Initializing
<input checked="" type="radio"/> Booting	<input type="radio"/> Not Ready
<input type="radio"/> Operating	<input type="radio"/> Cooler Check
<input type="radio"/> Warm-Up	<input type="radio"/> Safety Ready
<input type="radio"/> Severe Error	<input type="radio"/> MAINS Check
	<input type="radio"/> Ready
	<input type="radio"/> Prewarn
	<input type="radio"/> HV-Operation
	<input type="radio"/> Error

In the System State “Booting”, the only reachable Operating State is “Initializing”.

The operating state machine requires a correctly finished boot process. The boot- and start-up process is visualized on the status LEDs of the IFC. Please check the specific chapter for getting more details about the startup sequence of the LEDs.

- The WebUI login is possible after approximatively 45 seconds
- The entire system is ready after approximatively 70 seconds

After 45 seconds you can follow the status of the system in the WebUI.

The screenshot shows the comet WebUI interface. On the left, there's a sidebar with 'Operation' (selected), 'Generator Info', 'HV Operation' (selected), 'Software update', and 'Reports'. Below that is 'Setup' with 'Generator'. The main content area has a header 'HV Operation' and a sub-header 'System booting'. It says 'Starting autodiscovery...'. There are four sections: 'High Voltage' (0.0 kV), 'Tube Current' (0.0 mA), 'Exposure Time' (0.0 s), and 'Focal Spot' (5.5 mm). At the bottom, it says 'Status: 1,0,0,0,0'. On the right, there are 'HV On' and 'HV Off' buttons.

Simply close the pop-up window “Generator is booting” by clicking on the background and navigate to the page “HV Operation” to visualize the evolution.

Only the AUX power is required in this state. MAINS power is not yet required.



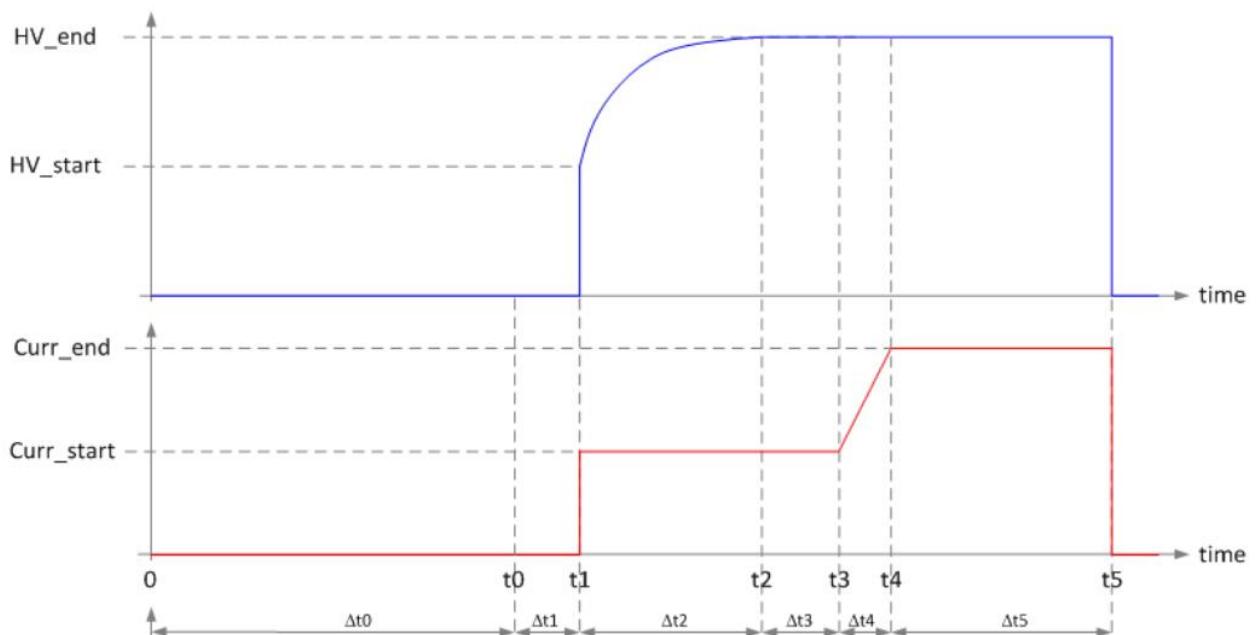
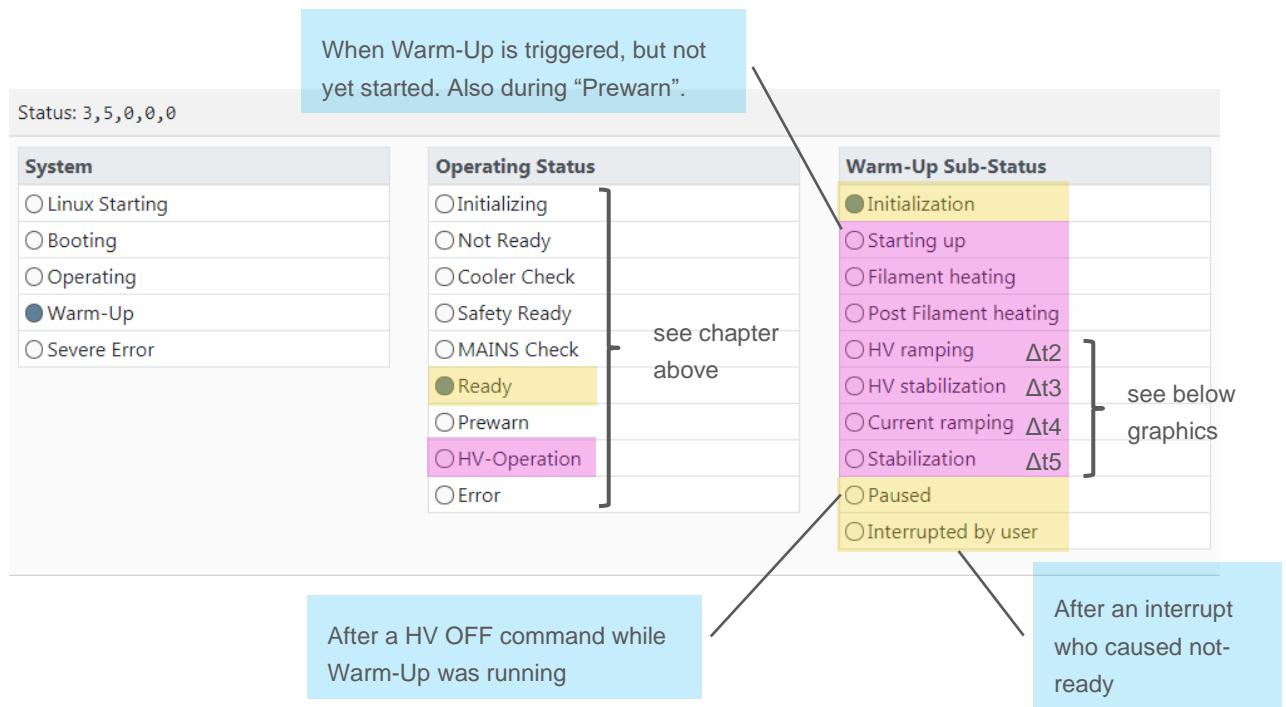
**Rebound to “Severe Error” in boot-/start-up.
The LED A2 is blinking red.
Check the not-ready conditions in all devices and subsystems that are different to 0x0.**

8.2.2 System State “Operating”

This is the “normal” operating mode.



8.2.3 System State “Warm-Up”



8.2.4 System State “Severe Error”

 ∅ Tube data corrupt or inconsistent ; Internal error

HV Operation

High Voltage

0.0 kV

-0.001 kV

Tube Current

0.0 mA

0 mA

Exposure Time

0.0 s

0 s

Focal Spot

5.5 mm

5.5 mm ▾

HV On

HV Off

Status: 4294967295,0,0,0,0

System

Linux Starting

Booting

Operating

Warm-Up

Severe Error

Operating Status

Initializing

Not Ready

Cooler Check

Safety Ready

MAINS Check

Ready

Prewarn

HV-Operation

Error

8.3 Overview of all the possible system information

There are five system information available:

- Imminent
- Arc active
- System unstable
- Warm-Up required
- Temperature critical

They all can be mapped on the I/Os.

8.4 System Overall Not-Ready States

The all-over status of the system is displayed on the top bar of the WebUI. It is visible from any page of the WebUI and needs our first attention.



If the system is not-ready, the “ready” icon will not be displayed. On the right side of the icon are displayed the not-ready-reasons.



If there is more than one reason, the quantity of reasons are specified and can be listed when clicking on the number.



The “System Overall Not-Ready Status” is a kind of collective alarm for all the not ready conditions. This status is visible in the section “HV Operation” of the WebUI.

8.4.1 State is READY

In the picture below, the status is “READY” because all the “Not-Ready-Conditions” are “0x0” and all the device-level LEDs (IFC, POC(s) and iDevice(s)) are green. This is the image of a well running system with no need for debugging.

The screenshot shows the comet web interface with the following details:

- Operation** menu:
 - Generator Info
 - HV Operation** (selected)
 - Software update
 - Reports
- HV Operation** panel:
 - High Voltage: 0.0 kV (120 kV)
 - Tube Current: 0.0 mA (5 mA)
 - Exposure Time: 0.0 s (0 s)
 - Focal Spot: 5.5 mm (5.5 mm)
 - Buttons: HV On, HV Off, Apply Setpoint
- Setup** menu:
 - Generator
 - I/O
 - Communication
 - Application
- HV Operation** panel:
 - Status: 2, 0, 0, 0
 - System:
 - Linux Starting
 - Booting
 - Operating
 - Warm-Up
 - Severe Error
 - Operating Status:
 - Ready
 - Initializing
 - Not Ready
 - Cooler Check
 - Safety Ready
 - MAINS Check
 - Prewarn
 - HV-Operation
 - Error
 - Operating Sub-Status:
 - HV OFF
 - Safety Checks and Preparing
 - Ramping
 - Setpoint reached
 - Hot Standby
 - Postheating
 - HV Extant (HV on unsafe level)
- Shutdown Reason:** (0,0,0)
- Boot-Error:** 0x0 **HVPS-Error:** 0x0 **Warnings:** 0x0
- Not-Ready Conditions** (highlighted with a blue box):
 - HVPS: 0x0
 - IFC 0x0
 - I/O 0x0
 - OP 0x0
 - CAN 0x0
 - LIN 0x0
 - COM 0x0
 - POC(s) 0x0
 - master 0x0
 - slave 0x0
 - iDevice(s) 0x0
 - cTank 0x0
 - aTank 0x0
 - FGU 0x0

8.4.2 State is NOT-READY

If the “System Overall Not-Ready Status” is “NOT-READY”, then you will have to analyze the “Not-Ready-Conditions”, the “Warning Codes” and “Shutdown Reasons” for debug purpose.

The screenshot shows the comet software interface with the following details:

- Top Bar:** comet I/O Incorrect cooler flow
- Left Sidebar (Operation):**
 - Generator Info
 - HV Operation** (selected)
 - Software update
 - Reports
- Left Sidebar (Setup):**
 - Generator
 - I/O
 - Communication
 - Application
- HV Operation Screen:**
 - High Voltage:** 0.0 kV (120 kV)
 - Tube Current:** 0.0 mA (5 mA)
 - Exposure Time:** 0.0 s (0 s)
 - Focal Spot:** 5.5 mm (5.5 mm)
 - HV On / HV Off**
 - Apply Setpoint**
- Status Section:** Status: 2,1,0,0,0

System		Operating Status		Operating Sub-Status	
<input type="radio"/> Linux Starting	<input type="radio"/> Initializing	<input checked="" type="radio"/> Not Ready	<input type="radio"/> Cooler Check	<input type="radio"/> HV OFF	
<input type="radio"/> Booting	<input type="radio"/> Safety Ready	<input type="radio"/> Operating	<input type="radio"/> Safety Checks and Preparing	<input type="radio"/> Ramping	
<input checked="" type="radio"/> Operating	<input type="radio"/> MAINS Check	<input type="radio"/> Warm-Up	<input type="radio"/> Setpoint reached	<input type="radio"/> Hot Standby	
<input type="radio"/> Warm-Up	<input type="radio"/> Ready	<input type="radio"/> Severe Error	<input type="radio"/> Postheating	<input type="radio"/> HV Extant (HV on unsafe level)	
<input type="radio"/> Severe Error	<input type="radio"/> Prewarn		<input type="radio"/> Error		
	<input type="radio"/> HV-Operation				
	<input type="radio"/> Error				
- Shutdown Reason:** (0,0,0)
- Boot-Error:** 0x0 **HVPS-Error:** 0x0 **Warnings:** 0x0
- Not-Ready Conditions:** (highlighted with a blue box)

HVPS: 0x80000001	
<input checked="" type="radio"/> IFC	0x80000008
<input type="radio"/> I/O	0x1
<input type="radio"/> OP	0x0
<input type="radio"/> CAN	0x0
<input type="radio"/> LIN	0x0
<input type="radio"/> COM	0x0
- Device Status:**

<input checked="" type="radio"/> POC(s) 0x0	master 0x0	<input checked="" type="radio"/> iDevice(s) 0x0	cTank 0x0	<input checked="" type="radio"/> FGU 0x0	aTank 0x0
slave 0x0					

You should follow the debug strategy:



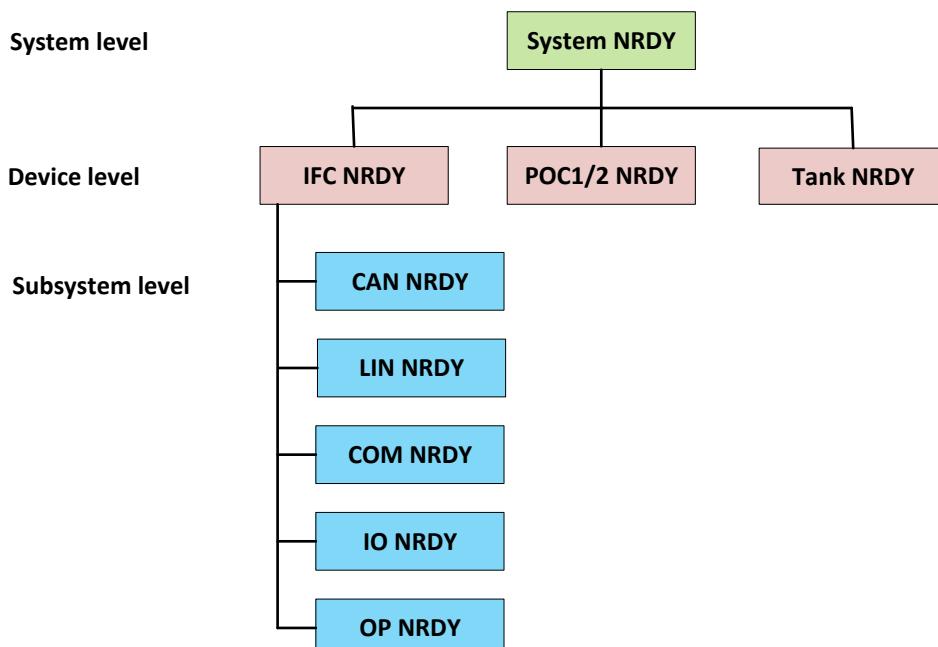
- Check the Not-Ready-Conditions of the System, Device and Subsystem
- Check the Shutdown reasons
- Check the Warnings

8.4.3 Not-Ready Conditions

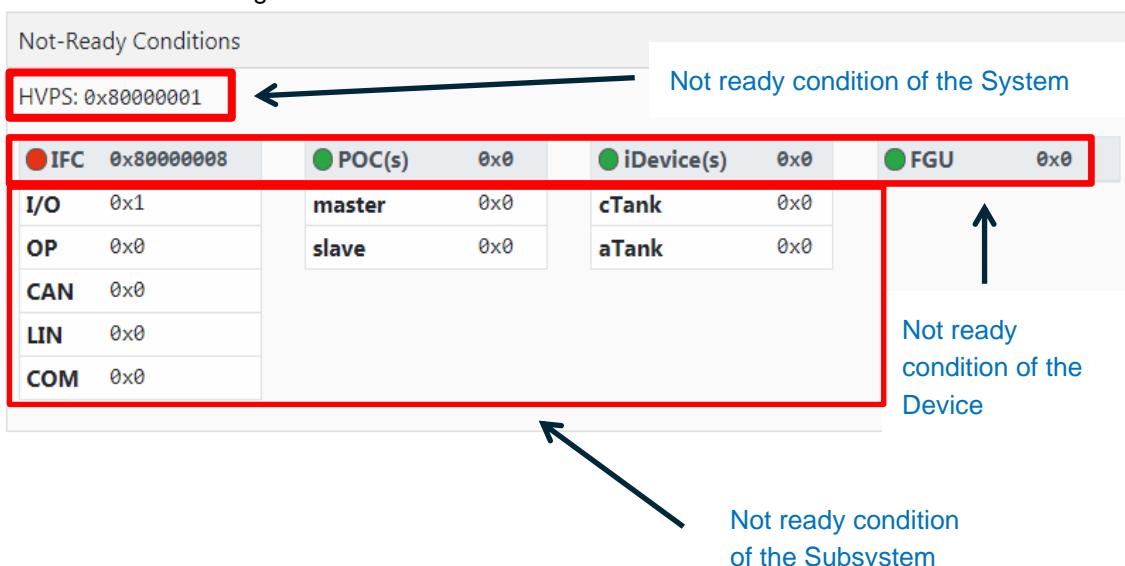
As a top-down explanation for the debug strategy:

- The not-ready condition of the **System** signals the concerned device that is not ready
- Each **Device** signals over its not-ready condition which part (if available) is not ready
- Each **Part/Subsystem** (if available) signals why it is not ready

All not ready conditions are 32 bit registers from where each bit is ORable (one or more bits can be signalized).



If a not-ready condition is “0x0”, the concerned system part is ready and its LED is green. In the example below is set a not-ready-condition on the Subsystem “I/O”. In fact, there is a problem with the cooler flow signal.



There is a mouse-over pop-up feature as first degree troubleshooting help. Move your mouse over the hexadecimal code and a popup will appear with indications.

IFC NRDY flag: General System NRDY flag			
HVPS: 0x80000001			
● IFC 0x80000008	● POC(s) 0x0 master 0x0 slave 0x0	● iDevice(s) 0x0 cTank 0x0 aTank 0x0	● FGU 0x0
I/O 0x1			
OP 0x0			
CAN 0x0			
LIN 0x0			
COM 0x0			

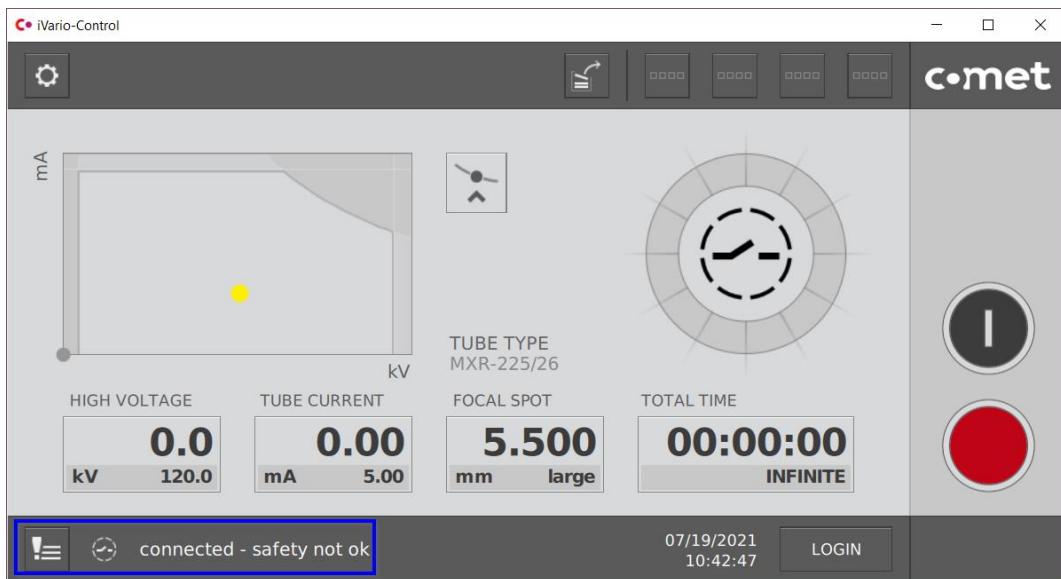
Not ready condition of the Subsystem

Not ready condition of the Device

Not-Ready Conditions			
IO NRDY flag: General IFC NRDY flag			
● IFC 0x80000008	● POC(s) 0x0 master 0x0 slave 0x0	● iDevice(s) 0x0 cTank 0x0 aTank 0x0	● FGU 0x0
I/O 0x1			
OP 0x0			
CAN 0x0			
LIN 0x0			
COM 0x0			

Not-Ready Conditions			
HVPS: 0x80000001			
● Incorrect cooler flow	● POC(s) 0x0 master 0x0 slave 0x0	● iDevice(s) 0x0 cTank 0x0 aTank 0x0	● FGU 0x0
I/O 0x1			
OP 0x0			
CAN 0x0			
LIN 0x0			
COM 0x0			

Alternatively, you can also use the “Control Software” to get the Not-Ready condition directly in clear text on the status bar.



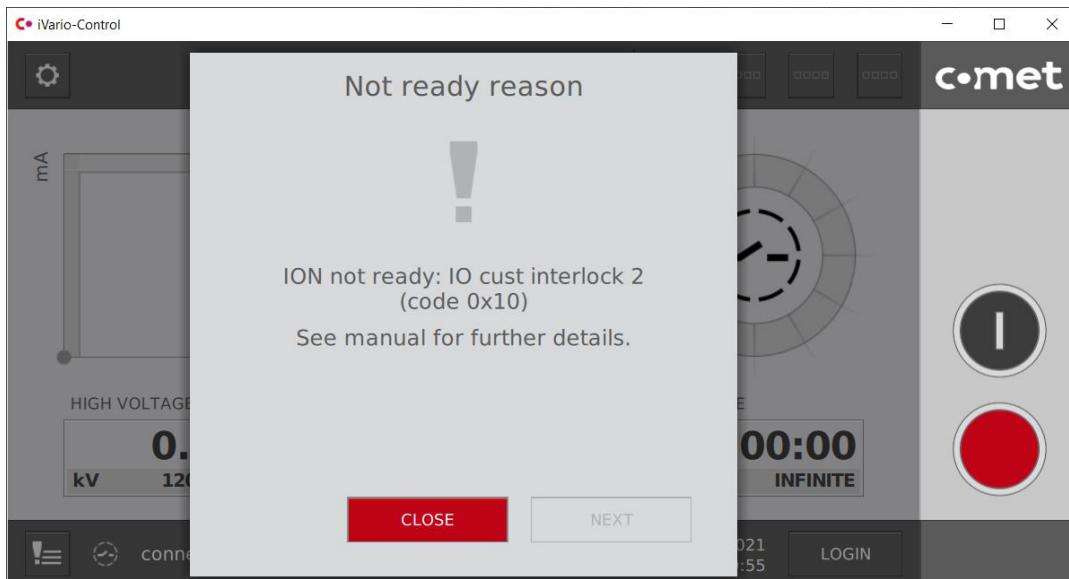
The system indicates that the “Safety is not okay”.



Click on the

to get details about the not ready conditions

Click on the If you click on the message “IO cooler flow” in the status bar, you will get the details about the not ready reason in a pop-up window.



Refer to the appendix for the entire Not Ready Conditions list.

8.4.4 Shutdown reasons

There are regular (expected) and (irregular) unexpected shutdown reasons available. A shutdown reason is set, for example, when the iVario needs to switch the high voltage OFF due to a specific reason.

Regular shutdown reasons are

- Switch off command received over communication protocol
- Stop button pressed
- Exposure timer elapsed
- Warm-up finished

Irregular shutdown reasons are

- all others than regular shutdown reasons
- i.e. Customer interlock open while HV ON, Mains off while HV ON, Hardware failure, Filament check not successful, ...

The shutdown reason is constructed as a coma separated triple of numbers.

Source	Code	Detail
The source that causes the system to switch OFF high voltage	The code of the shutdown cause	The detail belonging to the shutdown code. This is more detailed information to the cause.

This construction makes a precise diagnosis possible. The source determines which device or part / sub-system is causing the shutdown. To each source the code and detail of the shutdown reasons describe precisely why the iVario was shut down.

Here is an example:

The screenshot shows the comet software interface with the 'HV Operation' screen selected. On the left, there's a navigation sidebar with 'Operation' (selected), 'Generator Info', 'HV Operation' (highlighted in blue), 'Software update', and 'Reports'. Under 'Setup', there are links for 'Generator', 'I/O', 'Communication', and 'Application'. The main area has a title 'HV Operation'. It includes sections for 'High Voltage' (set to 0.0 kV), 'Tube Current' (set to 0.0 mA), 'Exposure Time' (set to 0.0 s), and 'Focal Spot' (set to 5.5 mm). There are also 'HV On' and 'HV Off' buttons and an 'Apply Setpoint' button. Below these controls is a status bar showing 'Status: 2,1,0,0,0'. To the right of the controls are three columns: 'System' (status: Linux Starting, Booting, Operating, Warm-Up, Severe Error), 'Operating Status' (status: Initializing, Not Ready, Cooler Check, Safety Ready, MAINS Check, Ready, Prewarn, HV-Operation, Error), and 'Operating Sub-Status' (status: HV OFF, Safety Checks and Preparing, Ramping, Setpoint reached, Hot Standby, Postheating, HV Extant (HV on unsafe level)). At the bottom of the screen, a red box highlights the 'Shutdown Reason' field, which contains the value '(5,2,1)'. Other status indicators at the bottom include 'Boot-Error: 0x0', 'HVPS-Error: 0x0', and 'Warnings: 0x0'.

Source = 5

The source that causes the system to switch OFF high voltage is the "I/O"

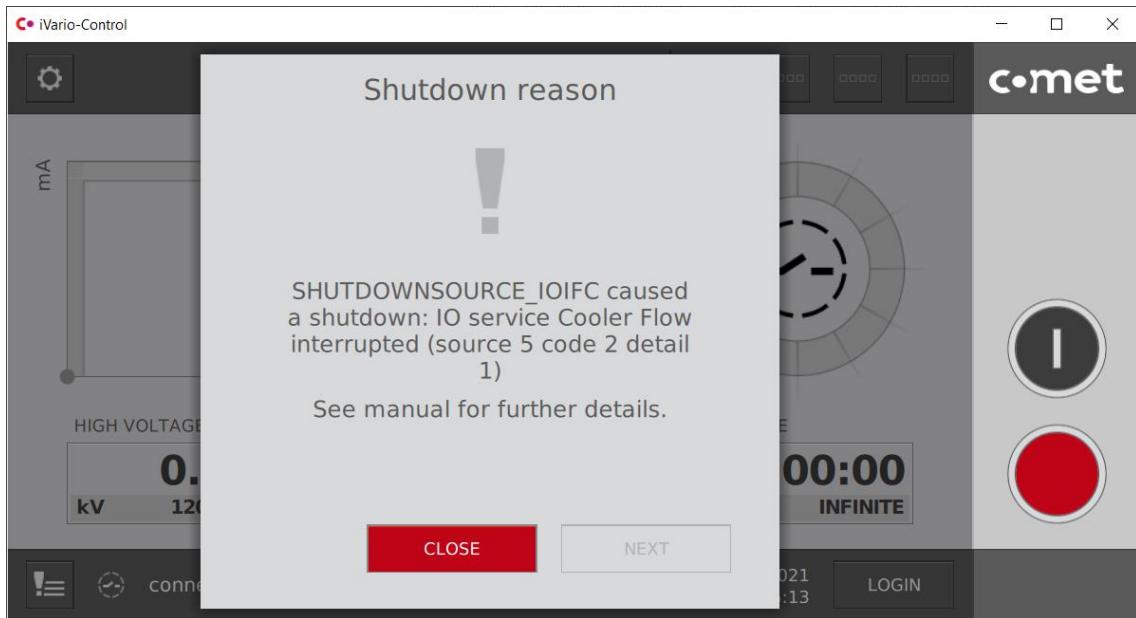
Code = 2

The shutdown cause is because of the cooler

Detail = 1

The detail describes that the cooler flow is not available

Alternatively, you can also use the “Control Software” to get the Shutdown Reason directly in clear text in the pop-up window.

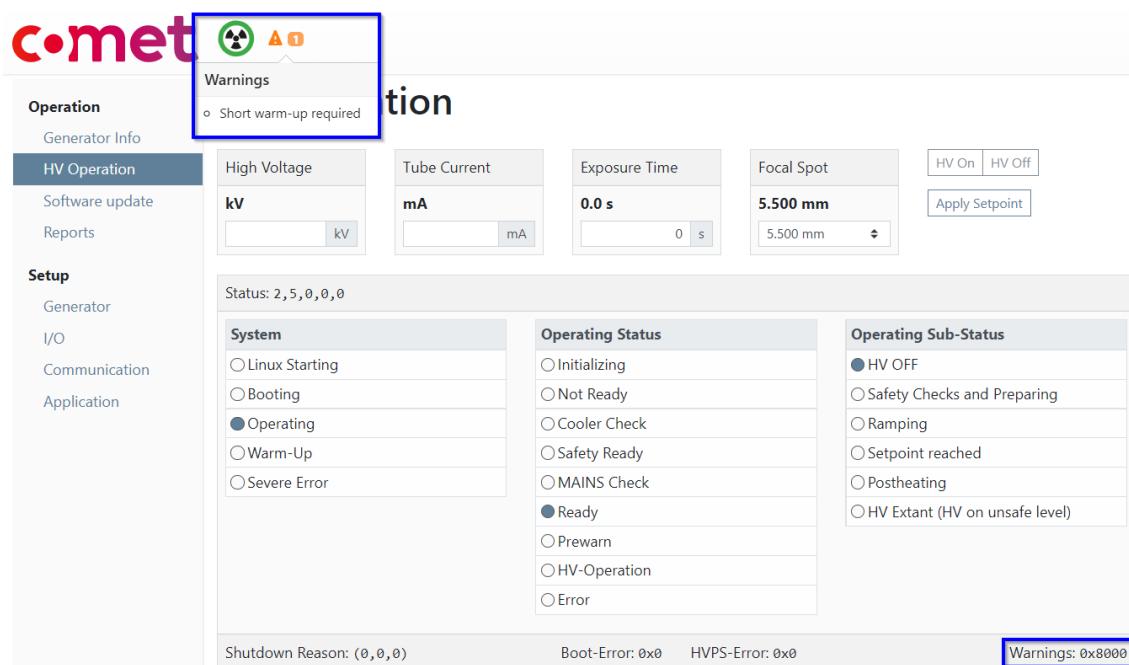


The really detailed shutdown reason is obtained through the shutdown reason list of the appendix.

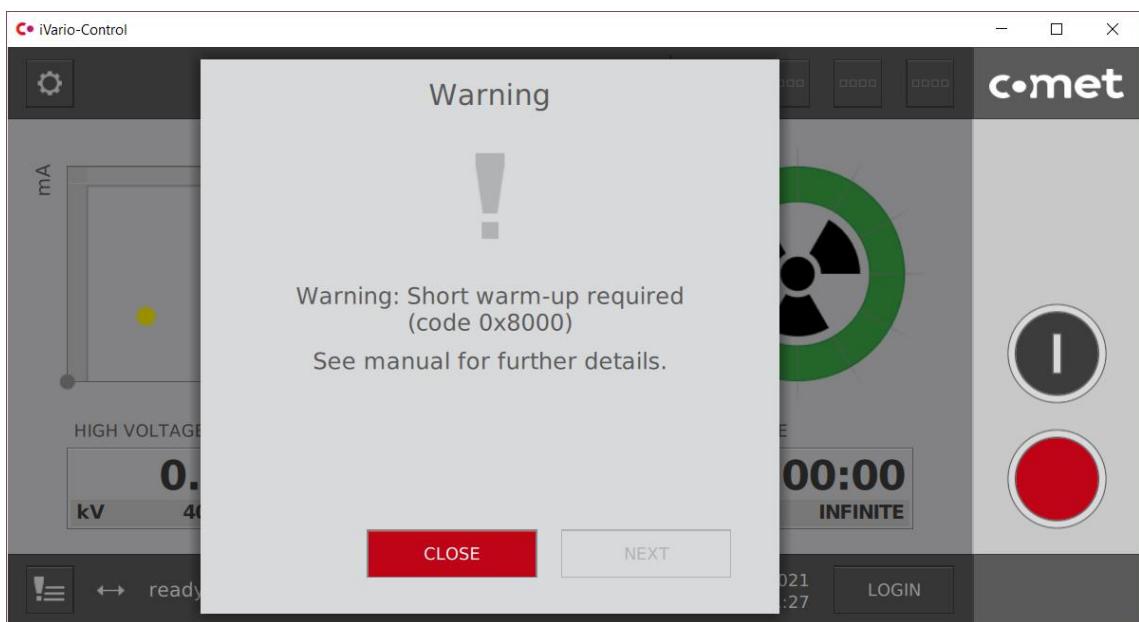
8.4.5 Warnings

The iVario generates warning codes to warn the operator when a specific measured value is running out of tolerance. A warning is an additional indication before an error or a crash. A warning may increase the danger, e.g. for the iVario itself, the application or for the superior system where the iVario is built in.

Here is a warning example for the “Short warm up”. The system is in normal operating mode. The tube was down during the last 12.5 hours, therefore a shot warm up will be required. This warning is an indication that you should perform a short warm up in order to use your tube under the best conditions.



In the iVario Control software, the warning is displayed down left side with the exclamation sign. If you click on the sign you will get this pop-up.



Refer to the appendix for the entire Warning list and the interpretations.

8.5 System State Operation

The operation of the iVario is a team work of different devices (e.g. IFC and Powercell) and each device provides its functionality. The functionality is mostly represented by state-machines, for example the iVario indicates that it is driving high voltage with a status.

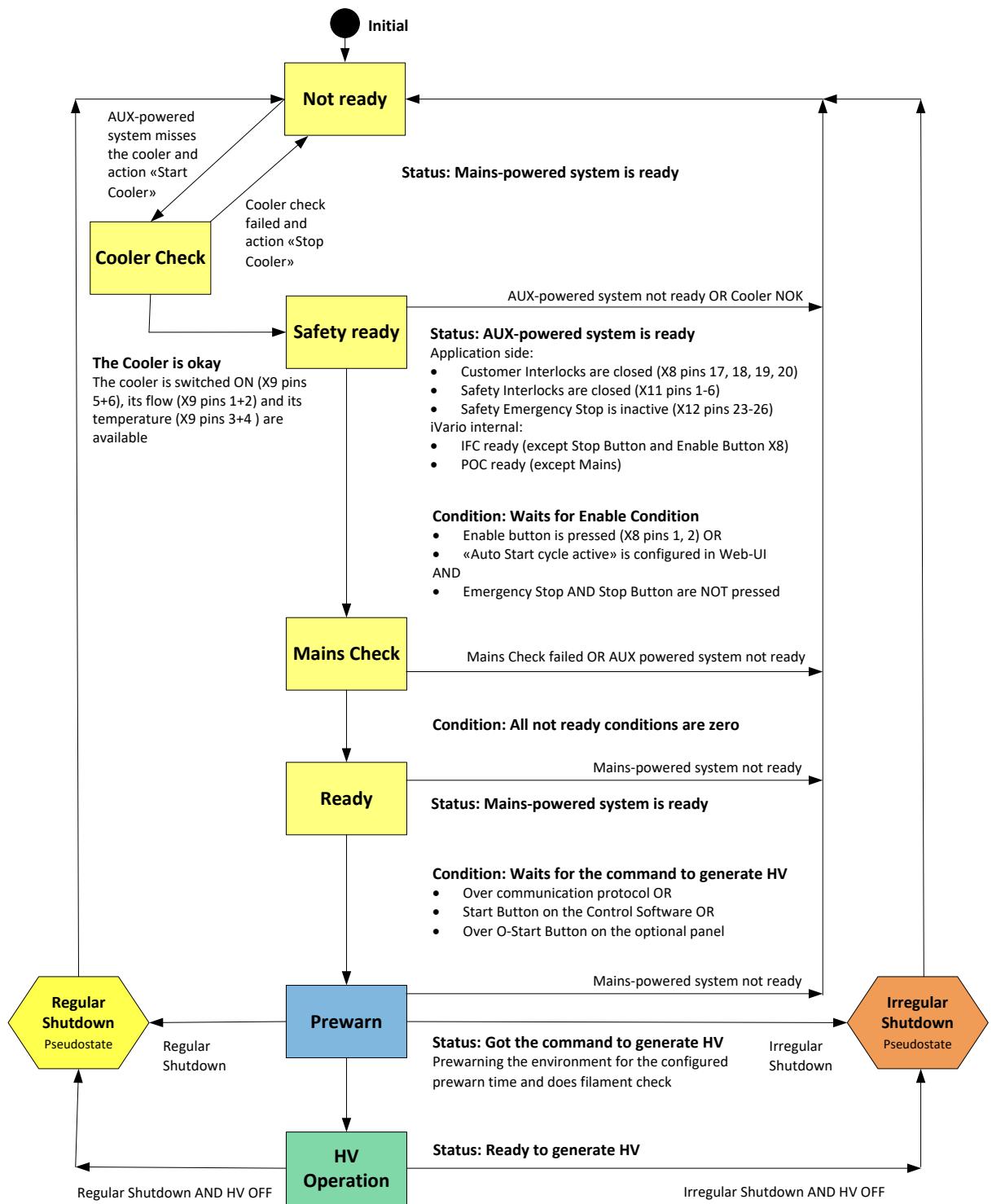
The iVario state-machines are triggered by changes of not-ready conditions, shutdown reasons and HV status.

The entry point for debugging is always the page “HV Operation” of the WebUI. This page will display iVario’s actual operation- and sub operation status.

Generally, the basic operation can be represented with the state machine shown below. There are different co-state-machines running on the iVario. They are influencing the operating state-machine.

The following seven states (and the conditions how to reach the next status) are explained in details:

- Not ready
- Cooler Check
- Safety Ready
- Mains Check
- Ready
- Prewarn
- HV Operation



8.5.1 State “Not Ready”

The iVario is not ready. This is the major entry- and fallback-point of the operation state-machine. From the status “Not Ready” we can reach the status “Cooler Check” and “Safety Ready”.

NOTE: Most often, the iVario is not ready due to opened safety- / customer interlocks.

Conditions to leave the “Not Ready” status

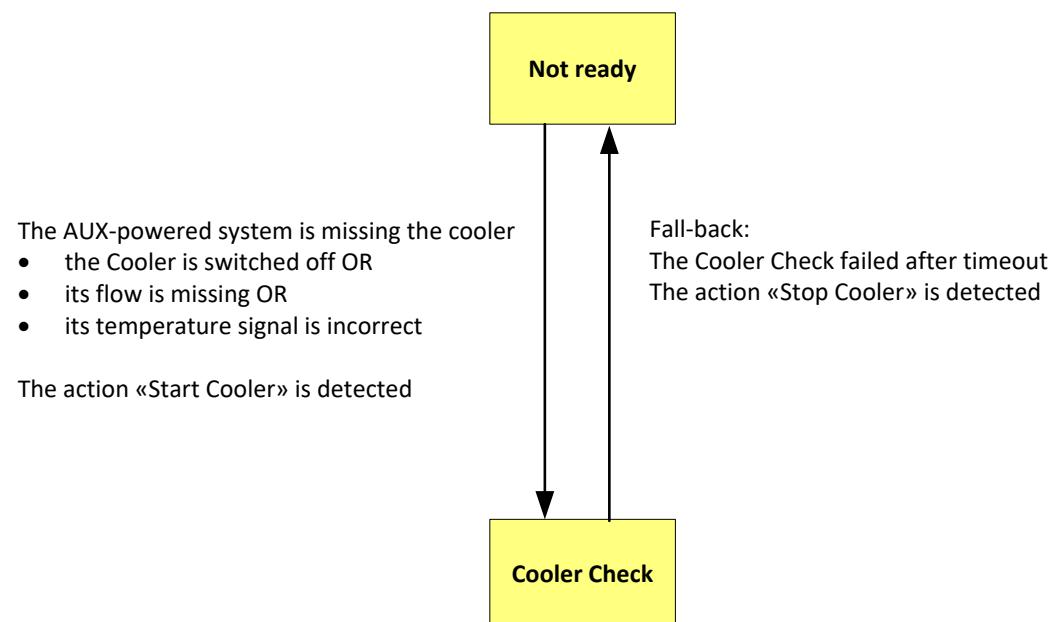
Application side:

- Close Customer interlocks
- Close Safety interlocks

Internal:

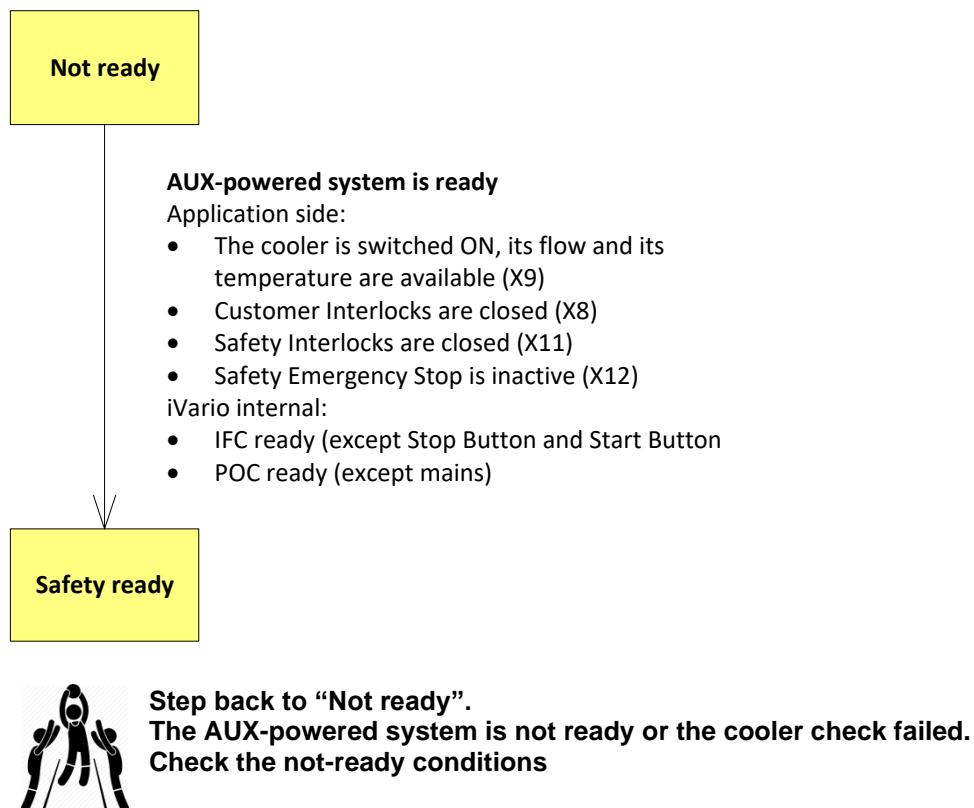
- IFC is ready (except stop button and start button cycling)
- Powercell is ready (except mains)

Conditions to access the status “Cooler Check”



Step back to “Not Ready”.
Cooler check has failed or a cooler stop is detected.
Check the not-ready conditions

Conditions to access the status “Safety Ready”



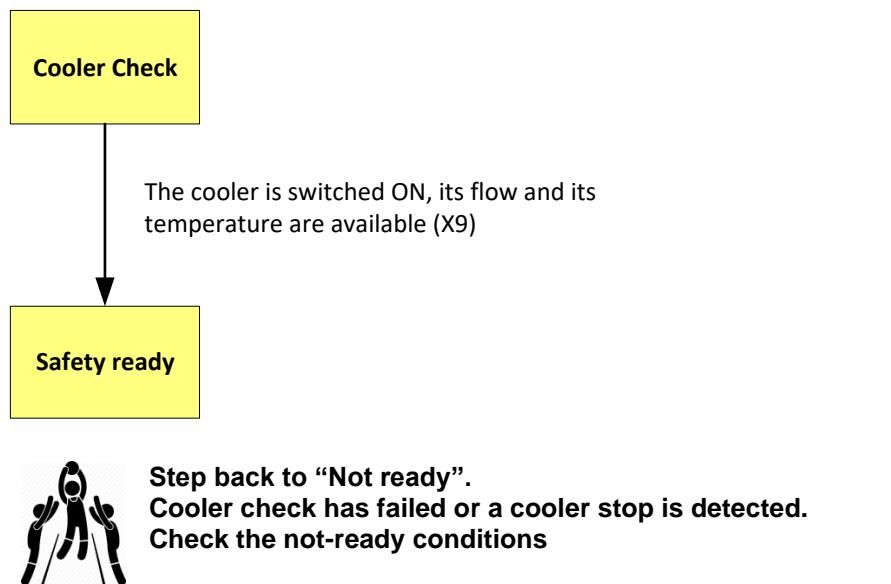
8.5.2 State “Cooler Check”

The iVario checks the cooler flow and temperature after the cooler was switched on. After a specific timeout and the cooler check failed, the status is switched back to “Not Ready”.

NOTE: The cooler flow timeout can be set as an application parameter in the WebUI (page “Application Config”).

Regular post-cooling time	Emergency post-cooling time	Cooler flow timeout
60 s	5 s	10 s

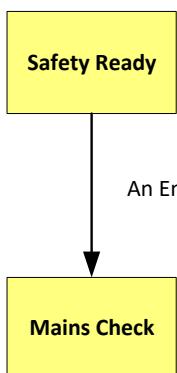
Conditions to access the status “Safety Ready”



8.5.3 State “Safety Ready”

The safety relevant part of the iVario is ready (i.e. safety- and customer interlocks are closed), but the start condition is missing. The start condition influences the status change from “Safety Ready” to “Mains Check”.

Conditions to access the status “Mains Check”



To release the iVario for commanding over the communication protocol, an enable condition must be performed.

There are two options how to trigger this start signal:

- the enable button is executed (Connector X8, pins 1, 2)
- the “auto Start Cycle” configuration is enabled in the WebUI (I/O Configuration)
Auto start cycle active:

The **start condition is released if**

- Safety- and customer interlocks are closed AND
- Emergency Stop AND Stop Button are NOT pressed



The **start condition is interrupted** (i.e. another start button cycle is needed) if either:

- the safety circuit is opened
 - a customer interlock is opened
 - the emergency stop is activated
- OR/AND
- the stop button was pressed



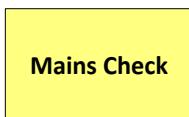
Step back to “Not ready”.
The AUX-powered system is not ready or the cooler is not ok.
Check the not-ready conditions

8.5.4 State “Mains Check”

The iVario waits until MAINS is switched on and all parts of the iVario are ready.

If we reach this condition and MAINS is already on, this condition is directly passed-through.

Conditions to access the status “Ready”



- MAINS-powered system is ready**
- MAINS must be available **AND**
 - Each device must be ready
(all not ready conditions == 0)



All not ready conditions are 0x0.

Not-Ready Conditions	
HVPS:	0x0
IFC	0x0
I/O	0x0
OP	0x0
CAN	0x0
LIN	0x0
COM	0x0
POC(s)	0x0
master	0x0
slave	0x0
iDevice(s)	0x0
cTank	0x0
aTank	0x0
FGU	0x0

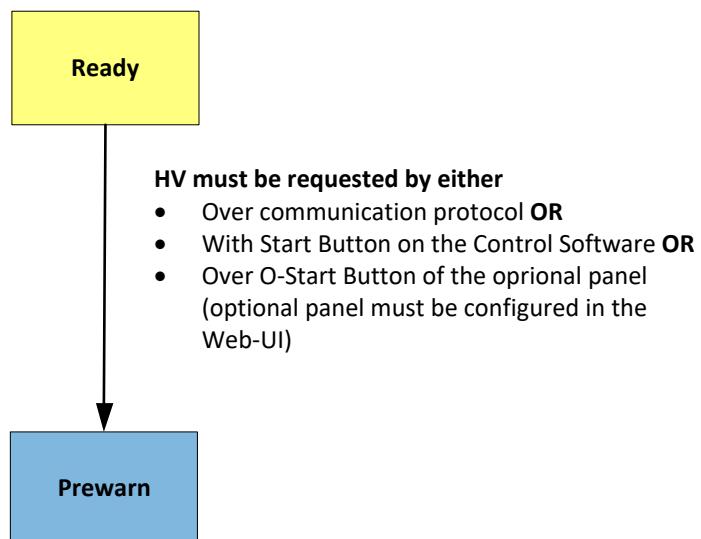


Step back to “Not Ready”.
The AUX-powered system is not ready or the cooler is not ok.
Check the not-ready conditions

8.5.5 State “Ready”

The iVario is ready and waits for the command to generate HV.

Conditions to access the status “Prewarn”



IMPORTANT: Commanding the HVPS to switch on HV is only possible when the system is ready.

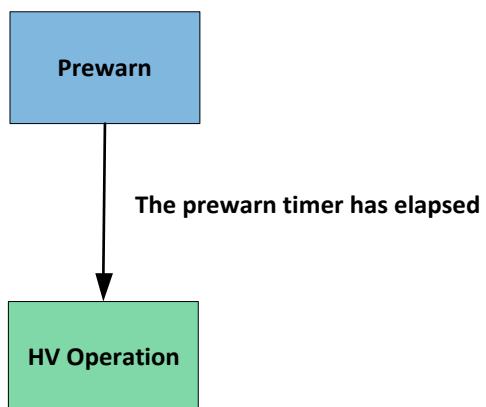


Step back to “Not Ready”.
MAINS-powered system is not ready
Check the not-ready conditions

8.5.6 State “Prewarn” (including filament check)

The iVario got the command to generate HV and is prewarning the environment for the configured prewarn time. Straight at the beginning, the iVario checks if the filament is available. The filament check ensures that the system cannot create high voltage with an open HV connector. The filament check is still done, even if you choose a prewar time of “0” seconds. The only way to avoid the filament check is to enable the feature “Auto Preheat” in the WebUI, page “Application Config”, “Limits”.

Conditions to access the status “HV Operation”

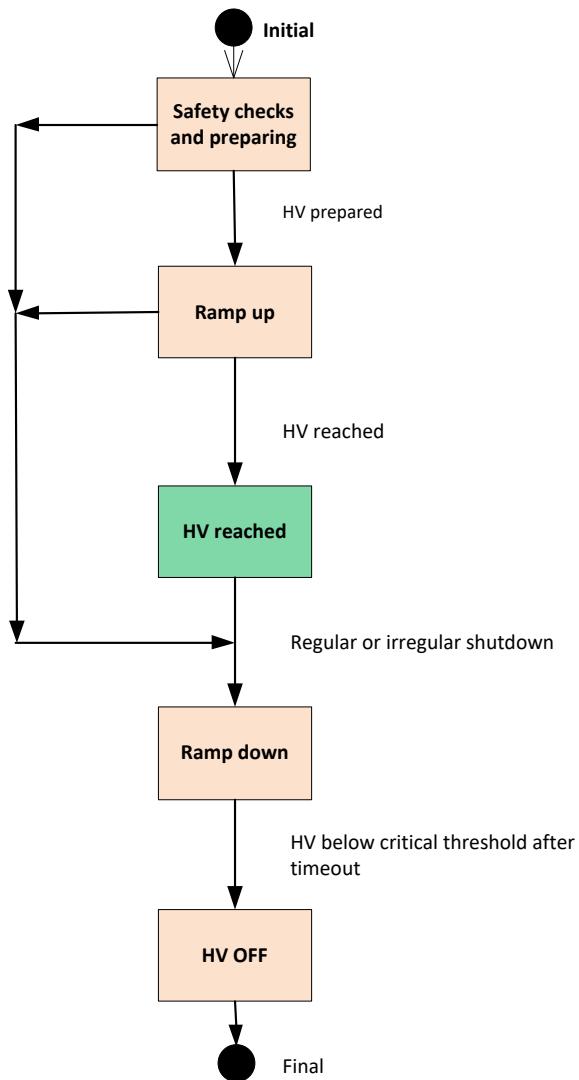


Step back to “Not Ready”.
MAINS-powered system is not ready
Check the not-ready conditions

Step back to “Irregular Shutdown”.
An irregular shutdown occurred.
Check the detailed shutdown reasons

8.5.7 State “HV Operation”

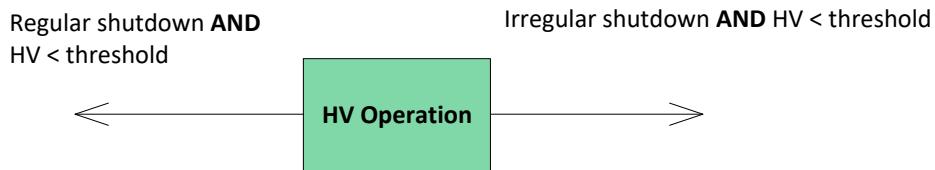
The iVario generates high voltage. Before ramping up to the required setpoint, it verifies that the HV measurement circuit is working by creating a HV pulse. The following figure shows the sub-states implemented in the Powercell Software.



Conditions to leave the state “HV Operation”

When switching OFF, the iVario ramps down and enters a post-heat phase where the measured HV must drop below a certain threshold (5kV) before it is taken as switched OFF (HV OFF).

When the HV is not dropping below this threshold, a warning is logged and a shutdown reason is generated after a certain timeout.



Most popular regular shutdown reasons are:

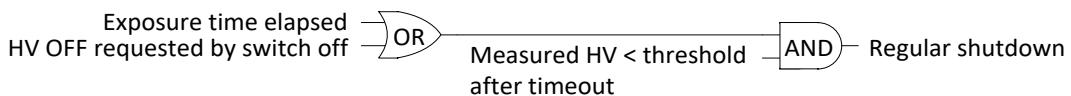
- Switch off command received over communication protocol
- Stop button pressed
- Exposure timer elapsed

Irregular shutdown reasons are:

- all others than regular shutdown reasons
- i.e. Customer interlock open while HV ON, Mains off while HV ON, Hardware failure, Filament check not successful, ...

A regular shutdown is defined by

- Exposure time elapsed OR HV OFF requested by switch off AND
- Measured HV < threshold after timeout



Step back to “Not Ready”.
HV OFF and regular shutdown occurred
Check the not-ready conditions and the detailed shutdown reason

Step back to “Irregular Shutdown”.
An irregular shutdown occurred.
Check the detailed shutdown reasons

8.5.8 Irregular Shutdown

When the iVario shuts down irregularly, the system runs through a pseudo status called "Irregular Shutdown". This status is used for signalizing errors.

An irregular shutdown is defined by:

- Unexpected shutdown OR (Measured HV > HV threshold after timeout)

For example:

- Customer interlock open while HV ON
- Mains off while HV ON
- Hardware failure
- Filament check not successful



**Step back to "Irregular Shutdown".
An irregular shutdown occurred.
Check the detailed shutdown reasons**

8.6 System State Warm Up

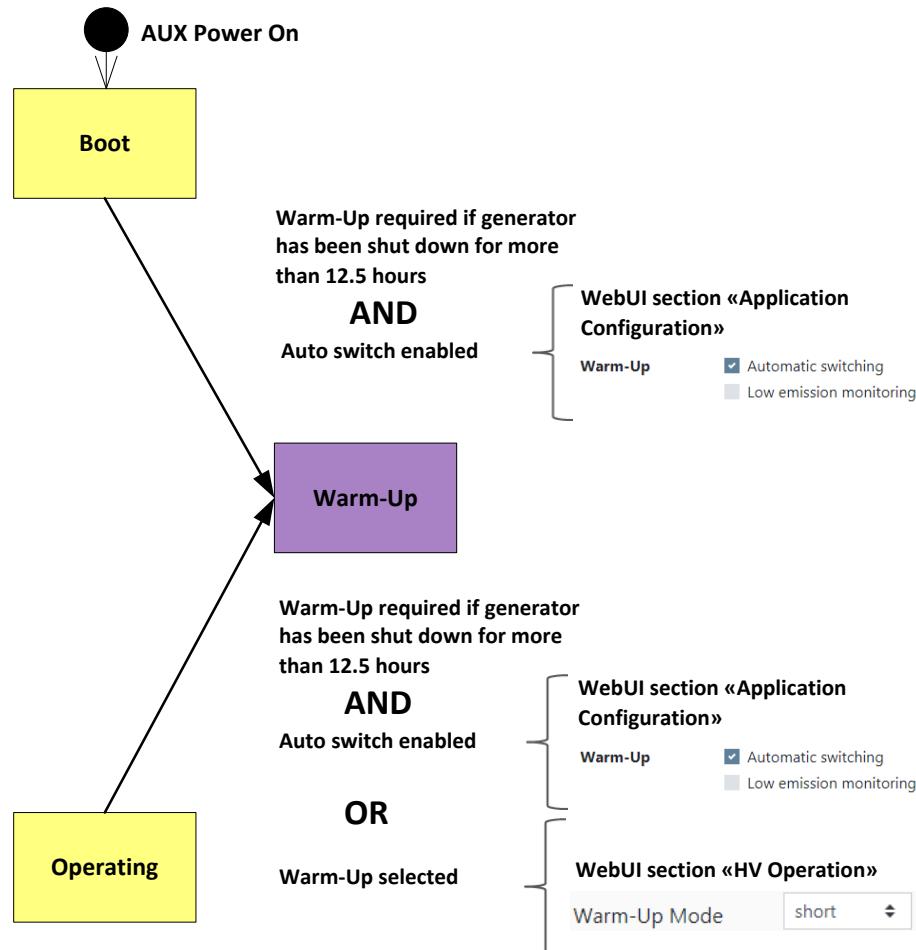
If your system was down for a specific period of time, a minimal Warm Up will be required for the health of the tube. Please refer to below table.

Downtime	Minimum required Warm-Up
12.5 hrs	Short, 20 minutes
168 hrs (7 days)*	Medium, 40 minutes
336 hrs (14 days)	Long, 60 minutes

* However, for a few tubes, not mentioned here, the medium WarmUp is required more severe, after 96 hrs (4 days).

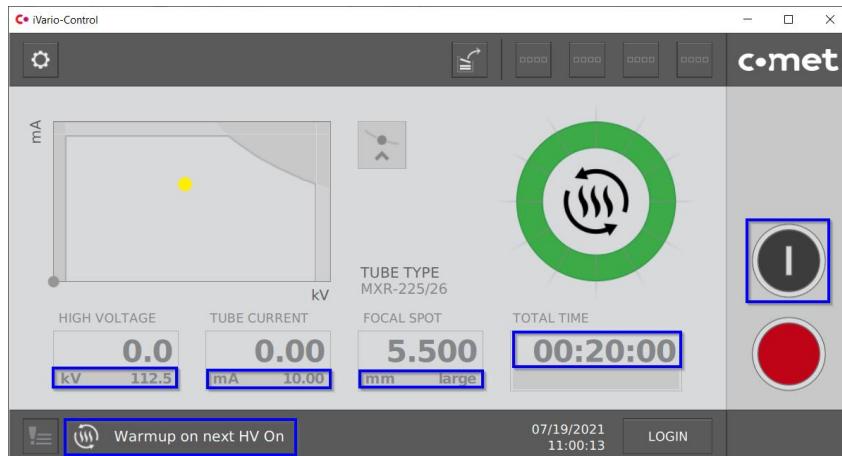
After 12.5 hrs of downtime, a short Warm Up is forced before you can run X-Rays again. The warm-up requested by the generator cannot be shortened. It is however possible to set a longer warm-up cycle than the one automatically requested.

Below are described the conditions of the state diagram to switch into warm-Up mode.

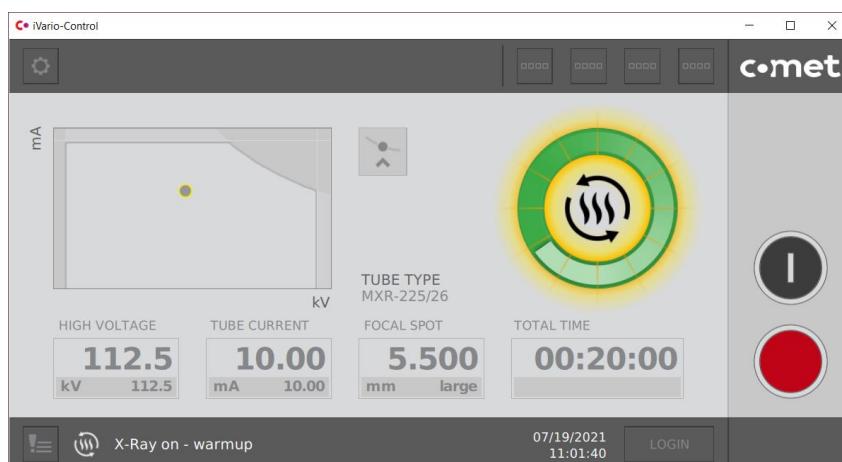


We have following situation on the iVario Control software

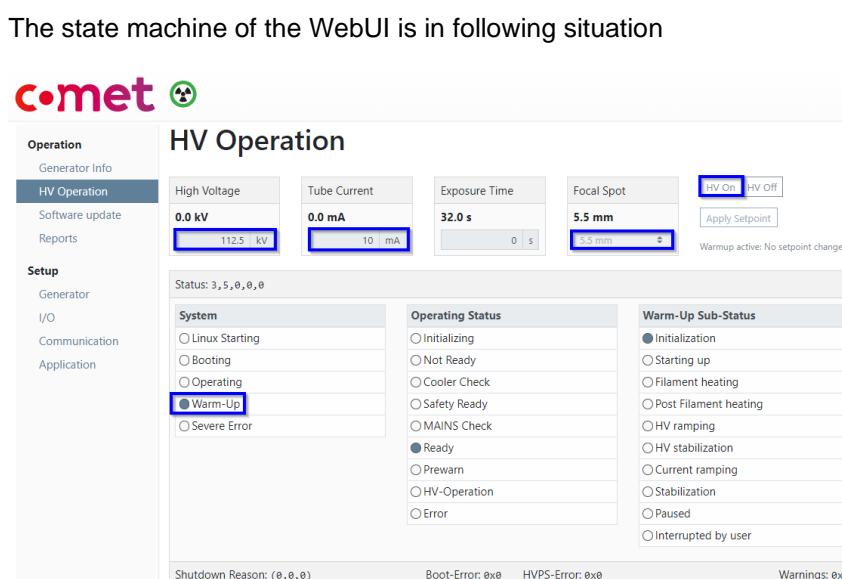
- Green icon for Warm Up
- Message / warning “Warmup on next HV On”
- Warm Up starts at half full range kV and mA
- Exposure time is set to 20 minutes (short Warm Up)



Press the start button to launch the Warm Up



Once the Warm Up is launched, the icon changes and HV is ramping



Press the HV On button to launch the Warm Up

8.6.1 Limit the Warm Up in kV

If you don't use your system at full scale, you are allowed to minimize the kV in the Warm Up. Therefore, the Warm Up will be shorter. Please refer to below example.

In the WebUI on the page "Operation", section "HV Operation". The 225 kV tube is limited to 180 kV.

The screenshot shows two windows side-by-side. The top window is a "Warm-Up" configuration screen with the following settings:

Warm-Up Mode	disabled
HV End	180 kV
<input checked="" type="button"/> Apply	
HV End Applied	

The bottom window is the main "iVario-Control" interface with the following data:

HIGH VOLTAGE kV	0.0
TUBE CURRENT mA	0.00
FOCAL SPOT mm	5.500 large
TOTAL TIME 00:07:44	

At the bottom of the interface, there is a message: "Warmup on next HV On".

8.7 System State Severe Error

During the emission of x-ray a Powercell shut down and the generator lost a device, the Powercell. It is straight forward displayed on the top of the WenUI. The generator felt in state "Severe Error" and the operating status is "Initializing". There is an irregular shutdown 7,1,1 and in the not-ready-conditions we can read that we have issues on the IFC and the Powercells.

The screenshot shows the HV Operation page of the WenUI. On the left, there's a sidebar with 'Operation' (selected), 'Generator Info', 'HV Operation' (highlighted in blue), 'Software update', and 'Reports'. Under 'Setup', it lists 'Generator', 'I/O', 'Communication', 'Application', and 'Contact'. The main area has tabs for 'High Voltage' (set to 20.0 kV), 'Tube Current' (set to 2.0 mA), 'Exposure Time' (set to 7.0 s), and 'Focal Spot' (set to 5.5 mm). Below these are buttons for 'HV On' and 'HV Off', and 'Apply Setpoint'. In the center, a table shows 'System' status (Linux Starting, Booting, Operating, Warm-Up, Severe Error) and 'Operating Status' (Initializing, Not Ready, Cooler Check, Safety Ready, MAINS Check, Ready, Prewarn, HV-Operation, Irregular Shutdown). The 'Severe Error' option in the system table is highlighted with a red box. At the bottom, a red box highlights the 'Shutdown Reason' field containing '(7,1,1)'. Status indicators at the bottom show 'Boot-Error: 0x0', 'HVPS-Error: 0x14', and 'Warnings: 0x0'.

The shutdown reason 7,1,1 is resolved from the appendix's shutdown reasons:

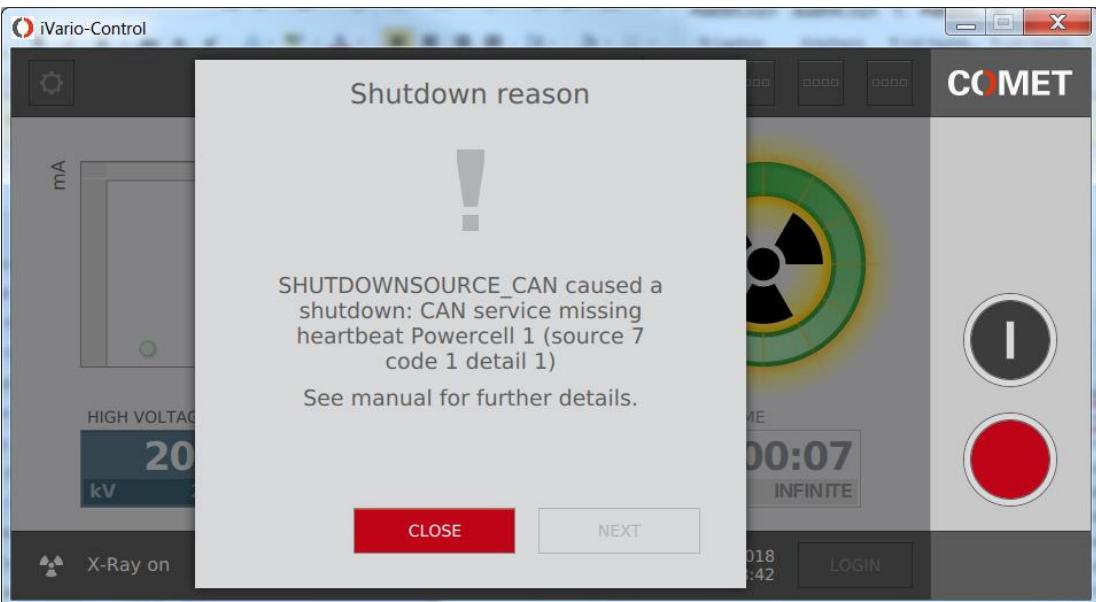
18.2.6 Source 7: Shutdown code and detail of "internal communication" (INT)

The following table shows the possible shutdown code and detail of this part.

Code #	Detail #	Description	Why does it occur?	How to get rid of it?	If it is still there, then ...
1	1	Can service, master Powercell heartbeat missing (due to communication loss)	Communication problem between IFC - POC1	Reboot	Replace POC
	2	Can service, slave Powercell heartbeat missing (due to communication loss)	Communication problem between IFC - POC2	Reboot	Replace POC
	4	Can service, FGU heartbeat missing (due to communication loss)	Not implemented		

Not-Ready Conditions			
HVPS: 0x8000001f			
● IFC 0x80000001	● POC(s) 0x-80000000	● iDevice(s) 0x0	● FGU 0x80000000
I/O 0x0	master 0x80000000	cTank 0x0	
OP 0x0	slave 0x80000000	aTank 0x0	
CAN 0x80000000			
LIN 0x0			
COM 0x0			

There is also a very straight forward error message on the iVario Control Software about the missing Powercell heartbeat.



8.8 System State Imminent

“Imminent” is a very specific status and can be mapped on a monitored warning light or a digital output.

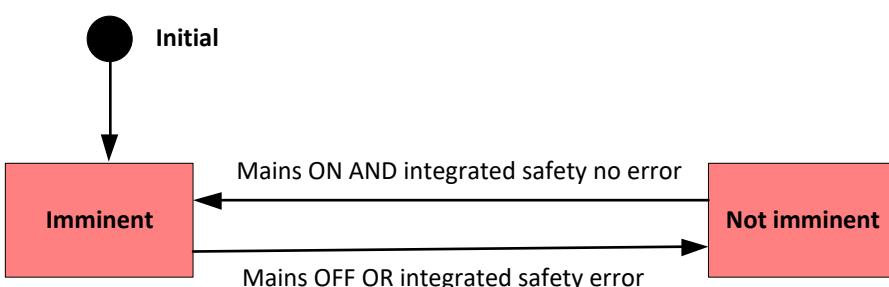
The system **is imminent** when

- MAINS is present AND
- integrated safety reports NO error

The system **leaves imminent** when either

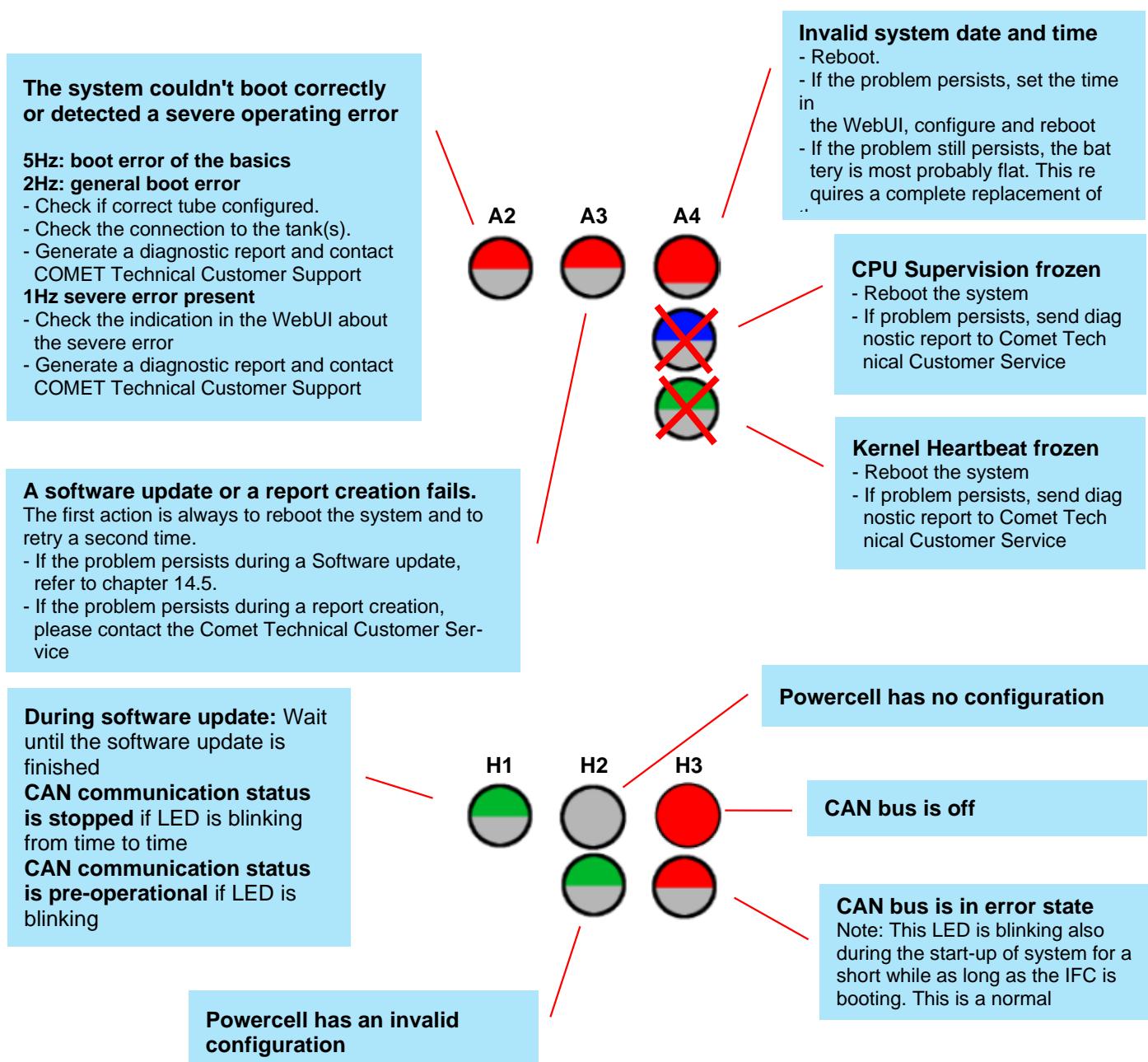
- MAINS is NOT present OR
- integrated safety reports an error

The imminent status influences the outputs or warning lights when configured.



9 Troubleshooting with the Diagnostic LEDs

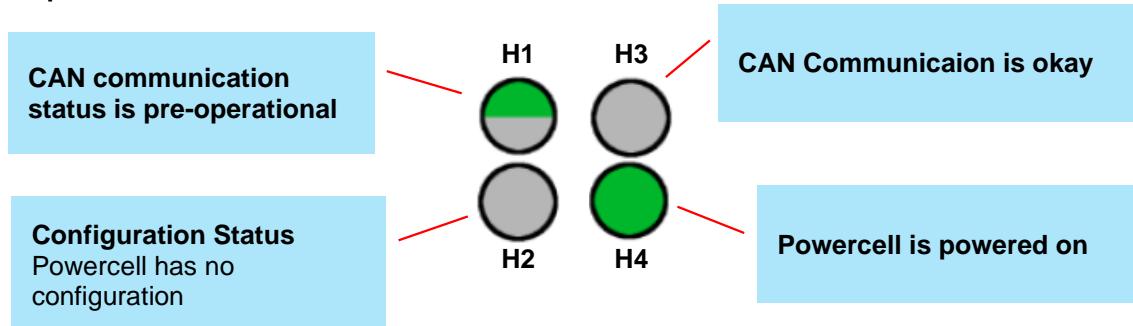
9.1 Collection of all action required LED status patterns



For all these H1..3 LED error patterns, check the not-ready-conditions on the:
 - "HV Operation" page of the WebUI
 - iVario Control Software
 Refer to the actions described in the appendix.

9.2 Special patterns for LEDs of Powercell(s)

After more than 90 seconds, the Powercell(s) doesn't (don't) reach the final boot up sequence for LEDs. It is stuck in below state.



Possible root causes are

- Software incompatibility
- Master Powercell is not available

9.2.1 Software incompatibility

There is a software incompatibility between the components IFC, Powercell 1, Powercell 2 or tank. Check the installed Software version of every single device in the WebUI (i.e. Powercell 1 has a wrong software version)

Component Software	Part	SW Version
	IFC	V.2.0.0.c2883d4
	BSP	V.2.0.0.813ad4b
	POC1	V.1.1.1.24630
	s-cpu POC1	K2TestString
	POC2	
	s-cpu POC2	
	Cathode tank	V.2.0.0.c2883d4
	Anode tank	
	Tube	N/S
	FGU	



If the system detects an inconsistency of the software versions of the single devices, it will block during the boot process with the message:



Compatibility error



This should no more happen, because with software version v2.5.0 and newer, spare Powercells and Tanks are automatically equalized with the software of the IFC. Update the single device if necessary to match the Software version of the IFC. Please refer to the sections „Software update“ or „Replacements step-by-step procedures“ for the Powercell and Tank.

9.2.2 Master Powercell not available / damaged

The Master Powercell is not available/not plugged or damaged. The system stacks in the initializations of the booting state machine.

The screenshot shows the comet software interface with the following details:

- Operation** menu:
 - Generator Info
 - HV Operation** (selected)
 - Software update
 - Reports
- Setup** menu:
 - Generator
 - I/O
 - Communication
 - Application
 - Contact
- HV Operation** panel:
 - High Voltage: 0.0 kV
 - Tube Current: 0.0 mA
 - Exposure Time: 0.0 s
 - Focal Spot: 5.5 mm
 - HV On / HV Off button
 - Apply Setpoint button
- Status:** 1,0,0,0,0
- System** status:
 - Linux Starting
 - Booting** (highlighted with a red box)
 - Operating
 - Warm-Up
 - Severe Error
- Operating Status** list:
 - Initializing** (highlighted with a red box)
 - Not Ready
 - Cooler Check
 - Safety Ready
 - MAINS Check
 - Ready
 - Prewarn
 - HV-Operation
 - Irregular Shutdown

There is an unsuccessful scan for CAN network clients and there is set the general not ready flag for both Powercells.

The screenshot shows the comet software interface with the following details:

- Operation** menu:
 - Generator Info
 - HV Operation** (selected)
 - Software update
 - Reports
- HV** panel:
 - High V: 0.0 kV
- Not-Ready Conditions** list:
 - I/O StartButton need to be pressed
 - OP Initializing
 - CAN Scanning for network clients
 - CAN Unknown Not-Ready-Code (30)
 - POC1 general NRDY
 - POC2 general NRDY

The Master Powercell (Powercell 1) is not recognized at all.



I/O StartButton need to be pressed

Operation

Generator Info

HV Operation

Software update

Reports

Setup

Generator

I/O

Communication

Application

Contact

Generator Information

Main Software Version V.2.0.0.c2883d4

General Settings

Part	Setting
Cathode Tank	225-
Anode Tank	none
Tube Type	MXR-225/22 (mxr-225-22)
Cable Length	5 m
Network IP	192.168.177.199
Network MAC	50:2d:f4:09:c7:87

Component Software

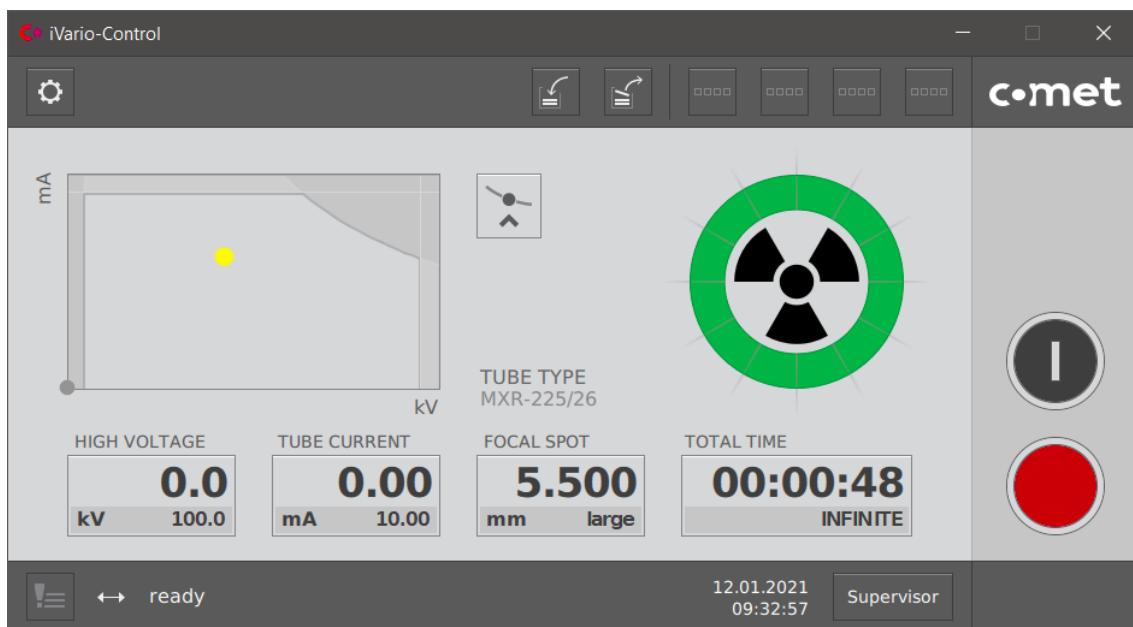
Part	SW Version
IFC	V.2.0.0.c2883d4
BSP	V.2.0.0.813ad4b
POC1	
s-cpu POC1	
POC2	V.2.0.0.c2883d4
s-cpu POC2	IAR: Jul 18 2016 0.7 E115
Cathode tank	V.2.0.0.c2883d4
Anode tank	
Tube	N/S
FGU	

Plug a well running Powercell on the Master plug or replace the damaged Powercell on the Master plug. Refer to the section „Replacements step-by-step procedures” for the Powercell.

10 Examples of the troubleshooting Workflow

10.1 System is ready or not-ready

This is the system in ready state. The green icon describes the ready state. There are no specific not-ready conditions and the system status is “ready”. One can switch on and start generating X-Rays.



This is the view in the WebUI of a ready system. The icon on the top left side is green. The system is in “Operating” mode and its status is “Ready”. There are no not-ready conditions available in the lower part of the picture. The ready states of “IFC”, “Powercells” and “Tank” are all marked with a green “ready” led.

COMETGROUP

HV Operation

Operation

- Generator Info
- HV Operation**
- Software update
- Reports

Setup

- Generator
- I/O
- Communication
- Application

High Voltage: 0.0 kV (10 kV)

Tube Current: 0.0 mA (0 mA)

Exposure Time: 0.0 s (0 s)

Focal Spot: 5.5 mm (5.5 mm)

HV On | **HV Off**

Apply Setpoint

Status: 2,5,0,0,0

System		Operating Status	Operating Sub-Status
<input type="radio"/> Linux Starting	<input type="radio"/> Initializing	<input type="radio"/> HV OFF	
<input type="radio"/> Booting	<input type="radio"/> Not Ready	<input type="radio"/> Safety Checks and Preparing	
<input checked="" type="radio"/> Operating	<input checked="" type="radio"/> Cooler Check	<input type="radio"/> Ramping	
<input type="radio"/> Warm-Up	<input type="radio"/> Safety Ready	<input type="radio"/> HV reached	
<input type="radio"/> Severe Error	<input type="radio"/> MAINS Check	<input type="radio"/> Hot Standby	
	<input checked="" type="radio"/> Ready	<input type="radio"/> Postheat	
	<input type="radio"/> Prewarn	<input type="radio"/> HV Extant (Unsafe HV Level)	
	<input type="radio"/> HV-Operation		
	<input type="radio"/> Irregular Shutdown		

Shutdown Reason: (0,0,0) | Boot-Error: 0x0 | HVPS-Error: 0x0 | Warnings: 0x0

Measurement Details		Temperatures	
HV POC1	0.0 kV	IFC	29.3 °C
Power	0.0 W	POC1	21.0 °C
Filament Current	0.0 A	POC2	27.8 °C
		Tank Cathode	27.8 °C
		Tank Anode	0.0 °C

Not-Ready Conditions

HVPS: 0x0

IFC: 0x0 | **POC(s)**: 0x0 | **iDevice(s)**: 0x0 | **FGU**: 0x0

This is the system in not-ready state.

iVario-Control Examples of Debugging Workflow!

COMET

mA vs **kV** graph

TUBE TYPE: MXR-225/26

HIGH VOLTAGE: 0.0 kV (10.0 kV)

TUBE CURRENT: 0.00 mA (0.00 mA)

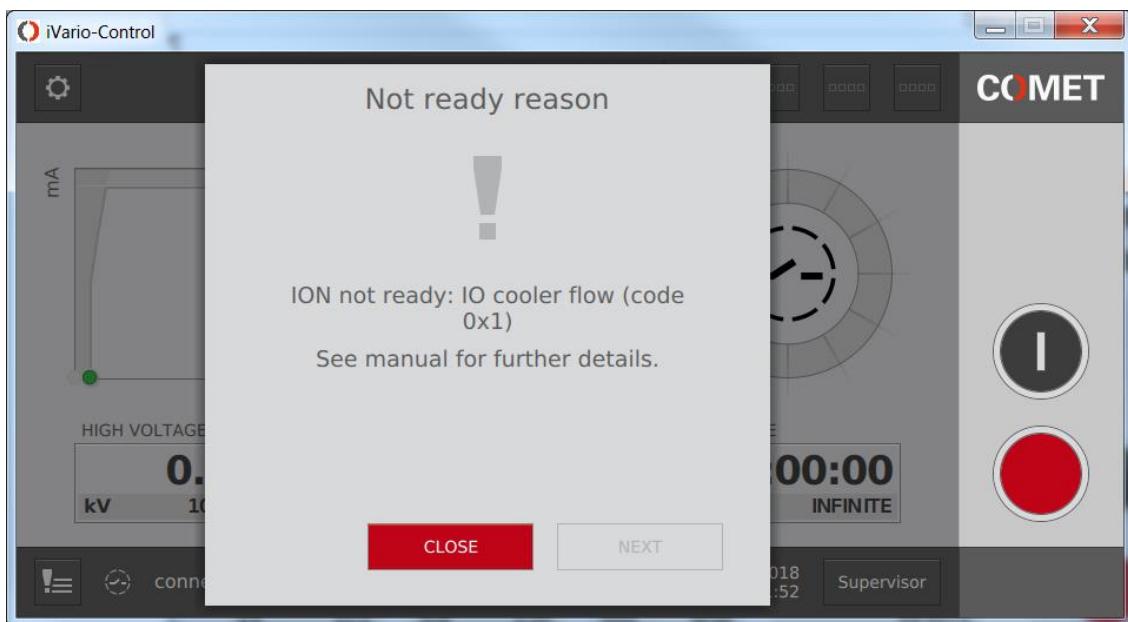
FOCAL SPOT: 5.500 mm (large)

TOTAL TIME: 00:00:00 (INFINITE)

connected - safety not ok

17.08.2018 16:29:19 | Supervisor

The iVario Control Software is connected to the iVario, but the safety of the iVario is not okay. The status icon is not in green state. Click on the red marked areas to get details about the not-ready conditions.



If there are more than one not-ready conditions, tab through the list by clicking on the "NEXT" button.

In the WebUI we have following visual pattern if the system is not-ready because of missing cooler flow:

- The icon on the top left side is not green.
- If you click on the not-ready condition beside the grey icon, you get all the conditions listed. This is a very efficient workflow if you have more than one not-ready conditions.
- The system is in "Operating" mode and its status is "Not Ready".
- There are not-ready conditions available in the lower part of the picture. The ready state of "IFC" is red. The mouse-over feature will give you precise information about the not-ready cause of the sub-device "I/O".



The screenshot shows the comet software interface for HV Operation. The left sidebar has sections for Operation, Generator Info, HV Operation (selected), Software update, and Reports. The Setup section includes Generator, I/O, Communication, and Application.

HV Operation Setup:

- I/O:** Shows a status message "I/O Incorrect cooler flow" with a red box around it.
- Not-Ready Conditions:** A list with "HV" and "I/O Incorrect cooler flow" items, both highlighted with red boxes.
- Controls:** Buttons for HV On (blue) and HV Off (grey), and a "Apply Setpoint" button.

HV Operation Status:

- Status:** 2, 1, 0, 0, 0
- System:** Options include Linux Starting, Booting, Operating (selected), Warm-Up, and Severe Error. "Operating" is highlighted with a red box.
- Operating Status:** Options include Initializing, Not Ready (selected), Cooler Check, Safety Ready, MAINS Check, Ready, Prewarn, HV-Operation, and Irregular Shutdown. "Not Ready" is highlighted with a red box.
- Operating Sub-Status:** Options include HV OFF, Safety Checks and Preparing, Ramping, HV reached, Hot Standby, Postheat, and HV Extant (Unsafe HV Level).

Metrics:

- Shutdown Reason:** (0,0,0)
- Boot-Error:** 0x0
- HVPS-Error:** 0x0
- Warnings:** 0x0

Measurement Details:

HV POC1	0.0 kV
Power	0.0 W
Filament Current	0.0 A

Temperatures:

IFC	29.5 °C
POC1	20.7 °C
POC2	27.8 °C
Tank Cathode	28.5 °C
Tank Anode	0.0 °C

Not-Ready Conditions:

HVPS: 0x80000001
IFC 0x80000008
I/O 0x1
OP 0x0
CAN 0x0

Diagnosis:

POC(s) 0x0
master 0x0
slave 0x0
iDevice(s) 0x0
cTank 0x0
aTank 0x0
FGU 0x0

10.2 A simple example

Unipolar system with Master Powercell and a 160kV tube

Tube and Cable	Tube MXR-161
	Tube Serial Number 123456
	Cable Length 5 m
	<input type="button" value="Apply"/>
Tank Types in Use	Cathode 160-
	Anode none

Two warning lights are configured.

Phase	Output 1	Output 2	Output 3	Output 4	Warn. Light 1	Warn. Light 2	Warn. Light 3	Dyn. Mon.
Enable	Off	Off	Off	Off	On	On	Off	Off
NOT-READY	Off	Off	Off	Off	Off	Off	Off	Off
COOLER CHECK	Off	Off	Off	Off	Off	Off	Off	Off
SAFETY READY	Off	Off	Off	Off	Off	Off	Off	Off
MAINS CHECK	Off	Off	Off	Off	Off	Off	Off	Off
READY	Off	Off	Off	Off	On	Off	Off	Off
PREWARN	Off	Off	Off	Off	Blink	Off	Off	Off
HV ON	Off	Off	Off	Off	Off	Blink	Off	Off
SETPT REACHED	Off	Off	Off	Off	Off	Blink	Off	Off

The system runs with “Auto Start Cycle Active” checked.

I/O configuration

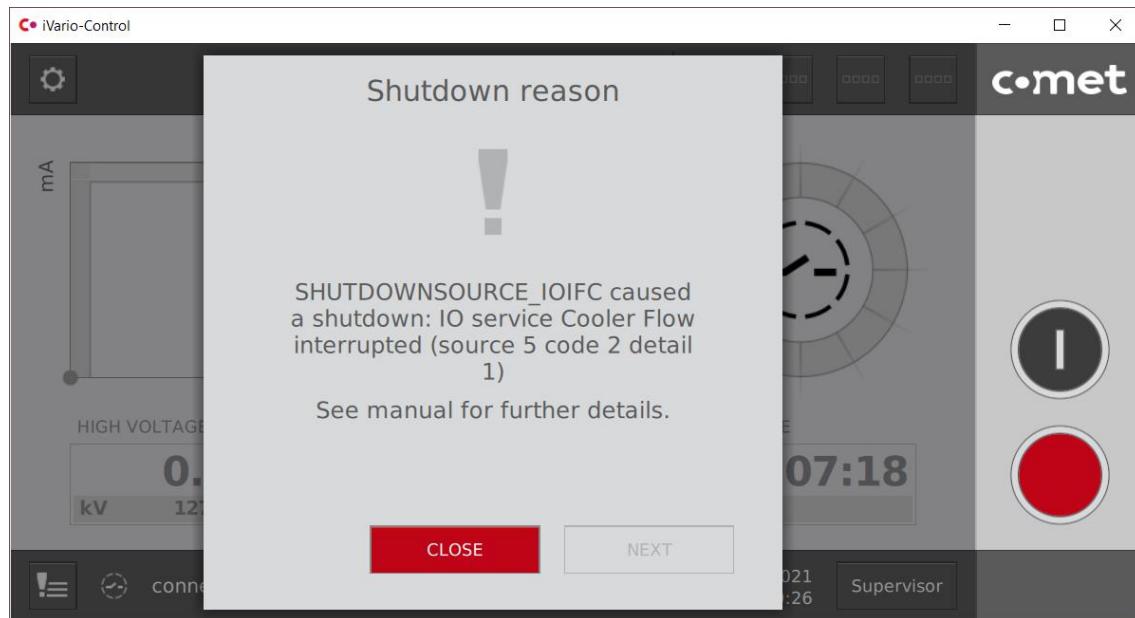
General	<input type="checkbox"/> Optional Panel Active
	<input checked="" type="checkbox"/> Auto Start Cycle Active
	<input type="button" value="Apply"/>

We are driving HV and

- Cut the cooler flow
- Open the customer interlock 1

What happens on the Control Software?

An irregular shutdown occurs because of the missing cooler flow. The effect of opening the customer interlock 1 is not directly visible in the iVario Control software, because it happened afterwards.



What happens on the WebUI on the page “HV Operation”?

The screenshot shows the comet WebUI interface for 'HV Operation'. The left sidebar has 'Operation' selected. The main area shows 'HV' parameters: High Voltage (0.0 kV), Tube Current (0.0 mA), Exposure Time (0.0 s), and Focal Spot (5.5 mm). A 'Not-Ready Conditions' section is highlighted with a blue box, listing 'I/O Incorrect cooler flow' and 'I/O Customer interlock 1'. Below this, the 'Operating Status' section shows 'Not Ready' selected. The 'Shutdown Reason' field displays '(5,2,1)'. A red box highlights the 'I/O Cooler flow not available' message. The bottom section shows a detailed list of shutdown reasons, with 'Incorrect cooler flow; Customer interlock 1' highlighted in a blue box. Other listed reasons include I/O (0x9), OP (0x0), CAN (0x0), LIN (0x0), and COM (0x0). To the right are sections for POC(s), iDevice(s), and FGU, all showing 0x0.

The system is in “Normal Operation” mode, in “Not Ready” state and HV is OFF.

The first triggered **shutdown reason** was the key 5:2,1. The shutdown occurred on source “5”. In reference of the shutdown reason table in the appendix, we will find the below decoded shutdown reason

Source 5
I/O

Code 2, Detail 1

The shutdown cause is because of the cooler. Cooler flow is not available

Refer to the appendix to find the actions to take.

16.2.4 Source 5: Shutdown code and detail of “I/O” (IO)

The following table shows the possible shutdown code and detail of this part.

Code #	Detail #	Description	Why does it occur?	How to get rid of it?	If it is still there, then ...
2	1	Cooler flow not available	Check cooler (X9, pins 1+2), if open or no change at start up	Switch off/on the cooler	Check flow switch on cooler

The system is “Not Ready” and some **not ready conditions** are different from 0x0.

Not-Ready Conditions			
HVPS: 0x80000001			
● IFC 0x80000008 I/O 0x9 OP 0x0 CAN 0x0 LIN 0x0 COM 0x0	● POC(s) 0x0 master 0x0 slave 0x0	● iDevice(s) 0x0 cTank 0x0 aTank 0x0	● FGU 0x0

The system overall not ready condition is different from 0x0.

The LED of the device “IFC” is red and the not ready condition of the subsystem “I/O” is different from 0x0.

Refer to the appendix to find the actions to take.

System	0x80000001 → 0x00000001	The IFC is not ready			
	0x80000000	General not-ready flag			
Bitcode	Device	Description			
0x00000001	IFC	The IFC is not ready			
		Action			
Device IFC	0x80000008 → 0x00000008	The I/O subsystem is not ready			
	0x80000000	General not ready flag			
Bit-Code	Subsystem	Description			
0x00000001	Sub-system CAN	The CAN sub-system is not ready			
0x00000002	Sub-system LIN	The LIN sub-system is not ready			
0x00000004	Sub-system COM	The COM sub-system is not ready			
0x00000008	Sub-system IO	The Input/Output sub-system is not ready			
0x00000010	Sub-system OP	The Operation sub-system is not ready			
0x80000000	General	General not-ready flag			
		Action			
		Check the not ready conditions of the IFC			
		Check the not ready conditions of the CAN subs;			
		Check the not ready conditions of the LIN subs;			
		Check the not ready conditions of the COM subs;			
		Check the not ready conditions of the I/O subs			
		Check the not ready conditions of the OP subs;			
		The general not-ready flag is set when at least one other flag is set.			
Subsystem I/O	0x00000009 → 0x00000001	Cooler flow missing			
	0x00000008	Customer interlock 1 open			
Bit-Code	Description	Additional Comment	Why does it occur?	How to get rid of it?	If it is still there, then
0x00000001	Cooler flow missing	Sub-system IO	Check cooler (X9 ... open or no change at start up)	Switch off/on cooler	Check flow switch cooler
0x00000008	Customer interlock 1 open	Sub-system IO	Check if X8 pin 17 24V and pin 18 ground	Check wiring of X8	Check 24V



Fix the cooler and the customer interlock 1
 → All not ready conditions are back to 0x0 and the system switches from “Not Ready” into “Ready”



Operation

Generator Info

HV Operation

Software update

Reports

Setup

Generator

I/O

Communication

Application

HV Operation

High Voltage

0.0 kV

Tube Current

0.0 mA

Exposure Time

0.0 s

Focal Spot

5.5 mm

HV On HV Off

Apply Setpoint

Status: 2,5,0,0,0

System

- Linux Starting
- Booting
- Operating
- Warm-Up
- Severe Error

Operating Status

- Initializing
- Not Ready
- Cooler Check
- Safety Ready
- MAINS Check
- Ready
- Prewarn
- HV-Operation
- Error

Operating Sub-Status

- HV OFF
- Safety Checks and Preparing
- Ramping
- Setpoint reached
- Hot Standby
- Postheating
- HV Extant (HV on unsafe level)

Shutdown Reason: (5,2,1)

Boot-Error: 0x0 HVPS-Error: 0x0

Warnings: 0x0

Not-Ready Conditions

HVPS: 0x0

● IFC	0x0	● POC(s)	0x0	● iDevice(s)	0x0	● FGU	0x0
I/O	0x0	master	0x0	cTank	0x0		
OP	0x0	slave	0x0	aTank	0x0		
CAN	0x0						
LIN	0x0						
COM	0x0						

10.3 A more tricky example

Unipolar system with Master Powercell and a 160kV tube

Tube and Cable	Tube MXR-161
	Tube Serial Number 123456
	Cable Length 5 m
	Apply
Tank Types in Use	Cathode 160-
	Anode none

Two warning lights are configured.

Phase	Output 1	Output 2	Output 3	Output 4	Warn. Light 1	Warn. Light 2	Warn. Light 3	Dyn. Mon.
Enable	Off	Off	Off	Off	On	On	Off	Off
NOT-READY	Off	Off	Off	Off	Off	Off	Off	Off
COOLER CHECK	Off	Off	Off	Off	Off	Off	Off	Off
SAFETY READY	Off	Off	Off	Off	Off	Off	Off	Off
MAINS CHECK	Off	Off	Off	Off	Off	Off	Off	Off
READY	Off	Off	Off	Off	On	Off	Off	Off
PREWARN	Off	Off	Off	Off	Blink	Off	Off	Off
HV ON	Off	Off	Off	Off	Off	Blink	Off	Off
SETPT REACHED	Off	Off	Off	Off	Off	Blink	Off	Off

The system runs with “Auto Start Cycle Active” checked.

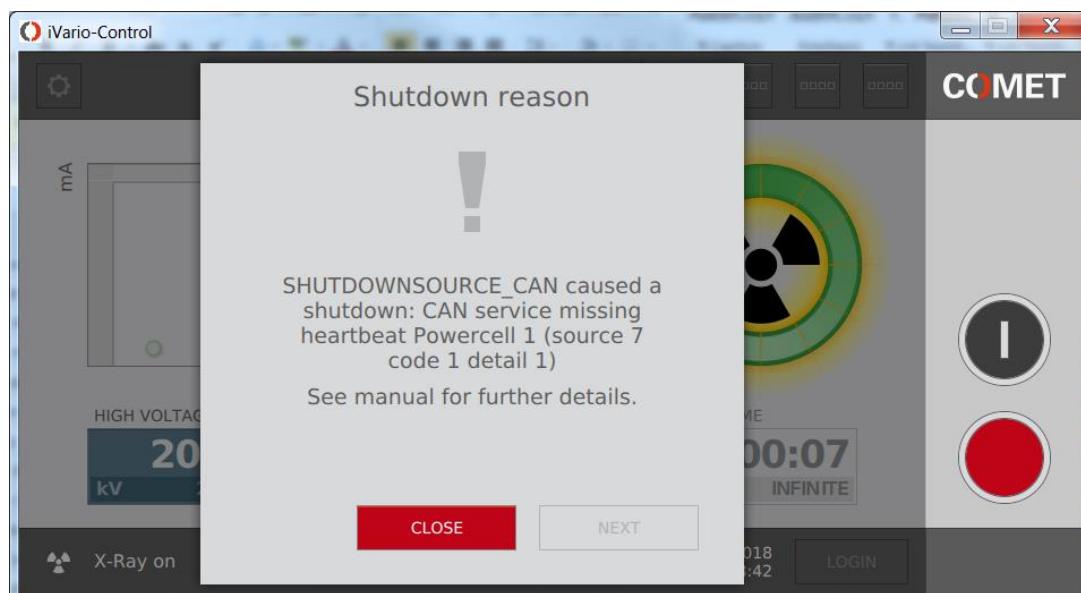
I/O configuration

General	Optional Panel Active
	<input checked="" type="checkbox"/> Auto Start Cycle Active
	Apply

We are driving HV and the Powercell 1 blows up

What happens on the Control Software?

There is also a very straight forward error message on the iVario Control Software about the missing Powercell heartbeat.



What happens on the WebUI?

The screenshot shows the comet WebUI interface. At the top, there is a red box around a warning message: "Lost a device (communication loss); Lost service/application (missing process)". Below this, there are four input fields for setpoints: 20.0 kV, 2.0 mA, 18.0 s, and 5.5 mm, each with a dropdown menu. To the right is a "Apply Setpoint" button. On the left, a sidebar menu includes Software update, Reports, Setup (selected), Generator, I/O, Communication, Application, and Contact. Under Setup, there are sub-options: Generator, I/O, Communication, Application, and Contact. The main content area shows a status message: "Status: 4294967295,0,0,0,0". Below this is a table titled "Operating Status" with a red box around the "Severe Error" row. The "Severe Error" row is highlighted with a red box. The table lists various operational states: Linux Starting, Booting, Operating, Warm-Up, Initializing (selected), Not Ready, Cooler Check, Safety Ready, MAINS Check, Ready, Prewarn, HV-Operation, and Irregular Shutdown. At the bottom of the status area, there is a box with a red border containing the text "[Internal Communication] POC1 heartbeat missing (due to communication loss)" with a mouse-over help text pointing to it. To the right of this box are buttons for "Shutdown Reason: (7,1,1)", "Boot-Error: 0x0", "HVPS-Error: 0x14", and "Warnings: 0x0".

The system status is on “Severe Error” and fell back into “Initializing” operation status.

The triggered and irregular shutdown reason is 7,1,1. We have the mouse-over help telling us that it is due to internal communication.

Source 7

IFC INT (Internal communication)

Code 1, Detail 1

POC1 heartbeat missing due to communication loss

The appendix will explain the next steps to perform.

Code #	Detail #	Description	Why does it occur?	How to get rid of it?	If it is still there, then ...
1	1	Can service, POC1 heartbeat missing (due to communication loss)	Communication problem between IFC - POC1	Reboot	Replace POC

IFC NRDY flag; POC1 NRDY flag; POC2 NRDY flag; POC3 NRDY flag; FGU NRDY flag; General System NRDY flag					
HVPS: 0x8000001f					
● IFC 0x80000001	● POC(s) 0x-80000000	● iDevice(s) 0x0	● FGU 0x80000000		
I/O 0x0	master 0x80000000	cTank 0x0			
OP 0x0	slave 0x80000000	aTank 0x0			
CAN 0x80000000					
LIN 0x0					
COM 0x0					

The mouse-over help gives information about all the system's general not-ready flags:

- Check not-ready flags of IFC
- Check not-ready flags of Powercell 1
- Check not-ready flags of Powercell 2

● POC	general NRDY 0000
master	0x80000000
slave	0x80000000

The general not-ready condition of the Powercell is set.
Also the general not-ready conditions of the master and slave Powercells are set.

If we look-up the Powercells not-ready condition in the appendix

0x80000000	System is booting OR no communication (IFC <-> POC)	System is booting and not yet ready	Wait until the system has booted.	Re-Boot Disconnect, reconnect PoC
------------	---	-------------------------------------	-----------------------------------	--------------------------------------

CAN NRDY flag; General IFC NRDY flag	
● IFC 0x80000001	
I/O 0x0	
OP Error state	
CAN 0x80000000	
LIN 0x0	
COM 0x0	

The general not-ready condition of the IFC tells that the CAN bus is not ready.

The subsystem CAN not ready condition tells that the CAN bus is on error state

If we look-up the CAN not-ready condition in the appendix

0x80000000	Error state (needs R&D logs for details)	Sub-system CAN		Call the support and send the log files.
------------	--	----------------	--	--



- Reboot the system.
- If the problem persists:
 - Disconnect and reconnect the Powercell
 - Replace the Powercell

If the problem still persists send the diagnostic logfile to the COMET technical customer service.
Refer to section "Diagnostic Report" how to generate this report.

11 Additional practices for troubleshooting

11.1 Event log

11.1.1 Events in the live view

In the WebUI, the operational report events are visible in a live view in the section “Operation” on the page “Reports”. Scroll down to find it.



Operation

- Generator Info
- HV Operation
- Software update
- Reports**

Setup

- Generator
- I/O
- Communication
- Application

Reports

Download

Download all reports

If you press "Download all reports" all reports will be created in sequence. Up to 3 download pop-ups will be generated.
This can take up to 10 minutes.

[Download all reports](#)

Diagnostic Report

If you press "Download Diagnostic Report" the report (incl. the operational-report) will be created first.
This can take up to 5 minutes.

[Download Diagnostic Report](#)

Operational Report

If you press "Download Operational Report" the report will be created first.
This can take up to 30 seconds.

[Download Operational Report](#)

Operational Report History

If you press "Download Operational Report History" the long term Operation Report will be created.
This can take up to 5 minutes.

[Download Operational Report History](#)

Event Log

Filter...

ERROR 0 WARNING 0 INFO 0 OTHER 0 Pause

```
Jul 19 16:01:34 IFC: [NOTE] statistics Shutdown Reason: ITF,1,0 (type=1) Temp: IFC=31.2°C, HV[kV]=40.0(set)/40.0/40.0, Curr[mA]=5.0, expTime[s]=0.0/0.0, foc=Large, pwTime[s]=0.0/0.0, lastExposure[ms]=5788 info stats
Jul 19 16:01:34 IFC: [NOTE] statistics Statistics: HV[kV]=40.0(set)/40.0/40.0, Curr[mA]=5.0, expTime[s]=0.0/0.0, foc=Large, pwTime[s]=0.0/0.0, lastExposure[ms]=5788 info stats
Jul 19 16:01:34 IFC: [NOTE] statistics Statistics: expTime[s]=0.0/0.0, foc=Large, pwTime[s]=0.0/0.0, lastExposure[ms]=5788 info stats
Jul 19 16:01:34 IFC: [INFO] op-svc 1[ms] from operating status 'HV-Operation' to 'Ready'
Jul 19 16:01:34 IFC: [NOTE] op-svc HVPS Ready
Jul 19 16:01:35 IFC: [NOTE] statistics ***** Exposure #5789 start *****
Jul 19 16:01:37 IFC: [NOTE] op-svc 2008[ms] from operating status 'Ready' to HV-Operation
Jul 19 16:01:39 IFC: [INFO] op-svc Setpoint reached after 1939ms, re-setting regular prewa
Jul 19 16:01:39 IFC: [NOTE] statistics ***** Last exposure #5789 info stats
Jul 19 16:01:39 IFC: [NOTE] statistics Shutdown Reason: ITF,1,0 (type=1) Temp: IFC=31.2°C, HV[kV]=40.0(set)/40.0/40.0, Curr[mA]=5.0, expTime[s]=0.0/0.0, foc=Large, pwTime[s]=0.0/0.0, lastExposure[ms]=5789 info stats
Jul 19 16:01:39 IFC: [NOTE] statistics Statistics: HV[kV]=40.0(set)/40.0/40.0, Curr[mA]=5.0, expTime[s]=0.0/0.0, foc=Large, pwTime[s]=0.0/0.0, lastExposure[ms]=5789 info stats
Jul 19 16:01:39 IFC: [NOTE] statistics Statistics: expTime[s]=0.0/0.0, foc=Large, pwTime[s]=0.0/0.0, lastExposure[ms]=5789 info stats
Jul 19 16:01:39 IFC: [INFO] op-svc 1169[ms] from operating status 'Ready' to 'Ready'
Jul 19 16:01:41 IFC: [NOTE] op-svc HVPS Ready
Jul 19 16:01:40 IFC: [INFO] op-svc 1[ms] from operating status 'HV-Operation' to 'Ready'
Jul 19 16:01:40 IFC: [NOTE] op-svc HVPS Ready
Jul 19 16:01:40 IFC: [NOTE] statistics ***** Exposure #5790 start *****
Jul 19 16:01:41 IFC: [NOTE] statistics ***** Last exposure #5790 info stats
Jul 19 16:01:41 IFC: [INFO] op-svc 1169[ms] from operating status 'Ready' to 'Ready'
Jul 19 16:01:41 IFC: [NOTE] op-svc HVPS Ready
Jul 19 16:01:41 IFC: [NOTE] statistics Shutdown Reason: ITF,1,0 (type=1) Temp: IFC=31.2°C, HV[kV]=40.0(set)/40.0/40.0, Curr[mA]=5.0, expTime[s]=0.0/0.0, foc=Large, pwTime[s]=0.0/0.0, lastExposure[ms]=5790 info stats
Jul 19 16:01:41 IFC: [NOTE] statistics Statistics: HV[kV]=40.0(set)/40.0/40.0, Curr[mA]=5.0, expTime[s]=0.0/0.0, foc=Large, pwTime[s]=0.0/0.0, lastExposure[ms]=5790 info stats
Jul 19 16:01:41 IFC: [NOTE] statistics Statistics: expTime[s]=0.0/0.0, foc=Large, pwTime[s]=0.0/0.0, lastExposure[ms]=5790 info stats
Jul 19 16:01:44 IFC: [NOTE] statistics ***** Exposure #5791 start *****
Jul 19 16:01:46 IFC: [NOTE] op-svc 2009[ms] from operating status 'Ready' to HV-Operation
Jul 19 16:01:47 IFC: [INFO] op-svc Setpoint reached after 1894ms, re-setting regular prewa
```

You can filter (display/hide) specific kind of events. By default, all the four types (error, warning, info and other) are visible.

If you are only interested in "Error" and "Warning", just hide "Info" and "Other" by clicking the tabs.



There is even an advanced filtering available if you use the full-text search in the events. For example, if you are only interested in the shutdowns, then you can search the events for "Shutdown" and press the loupe icon.



The screenshot shows a log viewer with a search bar at the top containing the word "Shutdown". A magnifying glass icon is highlighted with a red box. Below the search bar are tabs for ERROR (0), WARNING (0), INFO (32), and OTHER (77). The main area displays a list of log entries from November 21, 2010, at 10:00:46. All entries are of type [NOTE] and relate to statistics and shutdown reasons, with temperatures around 31.1°C. A "Pause" button is visible in the top right corner.

```
Nov 21 10:00:46 IFC: [NOTE] statistics Shutdown Reason: ITF,1,0 (type=1) Temp: IFC=31.0°C,  
Nov 21 10:00:53 IFC: [NOTE] statistics Shutdown Reason: ITF,1,0 (type=1) Temp: IFC=31.1°C,  
Nov 21 10:01:05 IFC: [NOTE] statistics Shutdown Reason: IO,2,1 (type=2) Temp: IFC=31.1°C,  
Nov 21 10:01:17 IFC: [NOTE] statistics Shutdown Reason: ITF,1,0 (type=1) Temp: IFC=31.1°C,  
Nov 21 10:06:17 IFC: [NOTE] statistics Shutdown Reason: ITF,1,0 (type=1) Temp: IFC=31.1°C,  
Nov 21 10:06:26 IFC: [NOTE] statistics Shutdown Reason: ITF,1,0 (type=1) Temp: IFC=31.1°C,  
Nov 21 10:06:30 IFC: [NOTE] statistics Shutdown Reason: ITF,1,0 (type=1) Temp: IFC=31.1°C,  
Nov 21 10:07:11 IFC: [NOTE] statistics Shutdown Reason: ITF,1,0 (type=1) Temp: IFC=31.2°C,  
Nov 21 10:07:20 IFC: [NOTE] statistics Shutdown Reason: ITF,1,0 (type=1) Temp: IFC=31.1°C,
```

11.2 Operational Report

The operational report contains a summary of current conditions about the iVario generator and all the relevant logs about operational actions, warnings, shutdown reasons and errors. This report helps you troubleshooting your system.



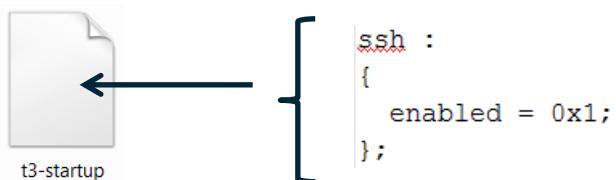
In general, this operational report is also required if you ask for help from the Comet Technical Support.

The latest log messages are listed bottom down. The messages are split into several levels of strength (Info, Note, Warning, Error, Critical, Alert and Emergency). Here's a typical report of a successful exposure.

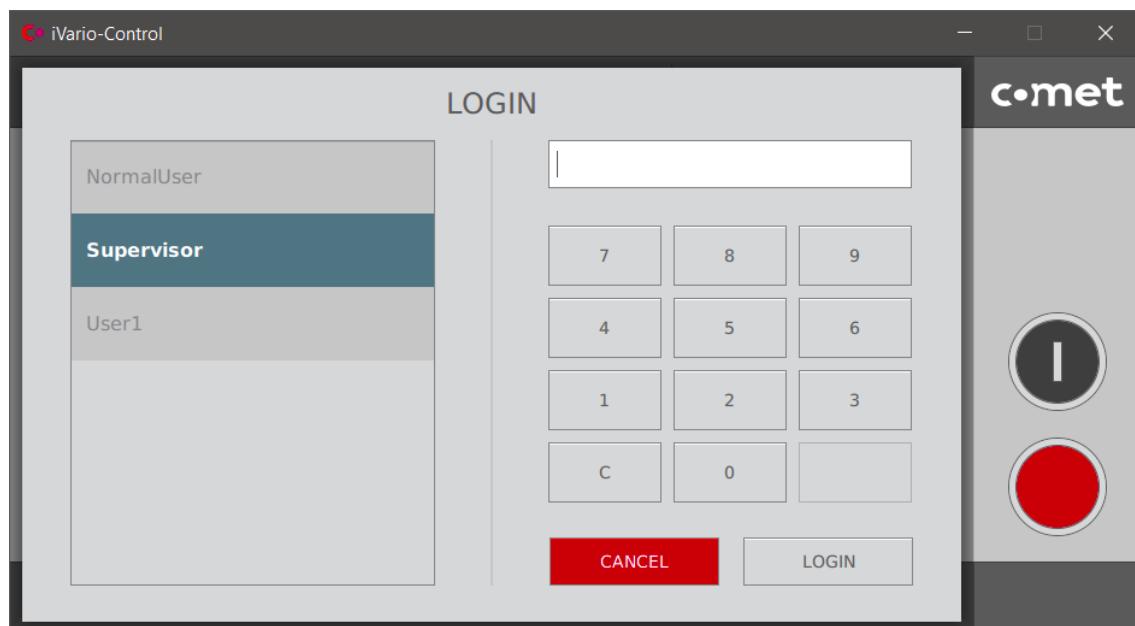
```
Sep 18 09:09:46 IFC: [NOTE] op-svc ***** START of Exposure *****  
Sep 18 09:09:46 IFC: [INFO] op-svc HV ON - HV=114565.0V, Current=0.006667A, Foc=0  
Sep 18 09:09:46 IFC: [INFO] op-svc Temperatures: CTank=31.1°C, IFC=35.6°C, POC1= 8.3°C  
Sep 18 09:09:46 IFC: [INFO] op-svc Resuming warm-up process  
Sep 18 09:10:07 IFC: [NOTE] op-svc Shutdown Reason: ITF,1,0 (type=1)  
Sep 18 09:10:07 IFC: [NOTE] op-svc HV OFF - ExposureTime=14s, HV=117965.0V, Current=0.006667A, Foc=0  
Sep 18 09:10:07 IFC: [NOTE] op-svc Temperatures: CTank=31.1°C, IFC=35.6°C, POC1= 7.8°C  
Sep 18 09:10:07 IFC: [NOTE] op-svc Total number of ARCs = 0  
Sep 18 09:10:07 IFC: [NOTE] op-svc Last exposure setpoint: exposureTime=0.0s, prewarnTime=5s, HV=117965  
Sep 18 09:10:07 IFC: [NOTE] op-svc Last exposure workpoint [min/max/avg]: HV=0.0/118.0/104.2kV, Curr=0  
Sep 18 09:10:07 IFC: [NOTE] op-svc Last exposure temperatures [min/max/avg]: ifc=35.6/35.6/35.6°C, poc=0  
Sep 18 09:10:07 IFC: [NOTE] op-svc ***** END of Exposure *****
```

11.2.1 Generate an operational report with the iVario Control Software

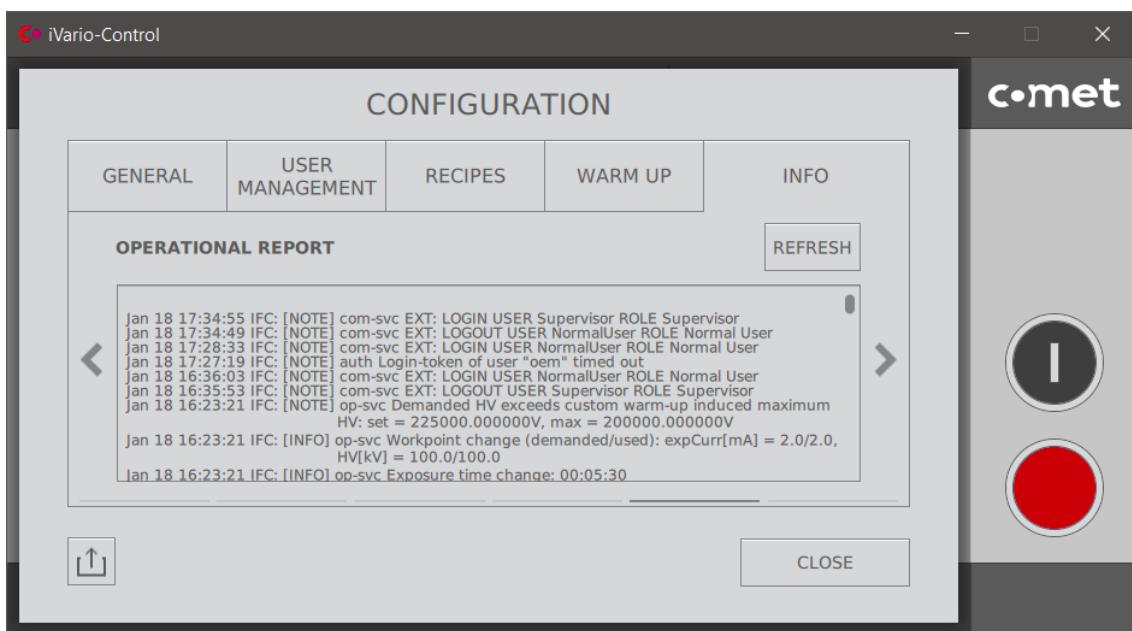
This feature requires a plugged USB stick on connector X6, containing the startup file that enables the access to generate log files. The “t3-startup” file MUST be copied on the root of the USB stick. Inside the file, a key enables the SSH access. This enable key MUST be present at the boot up of the generator.



Start the Control Software and log in as „Supervisor“ with the password „1111“.



Open the “Configuration” and navigate to the tab “INFO”.

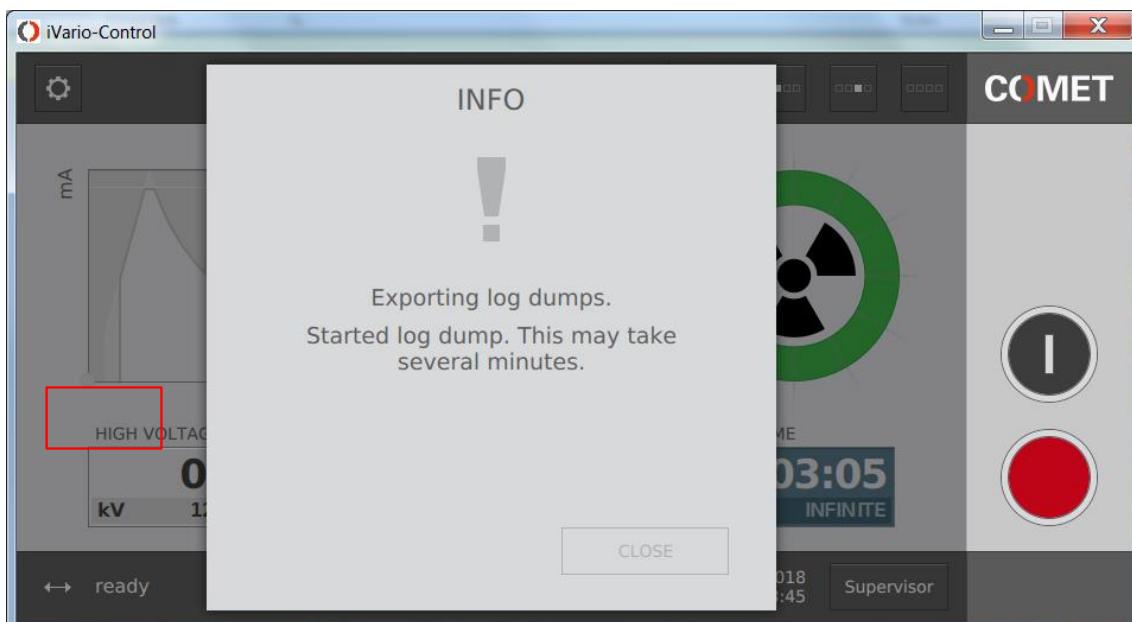


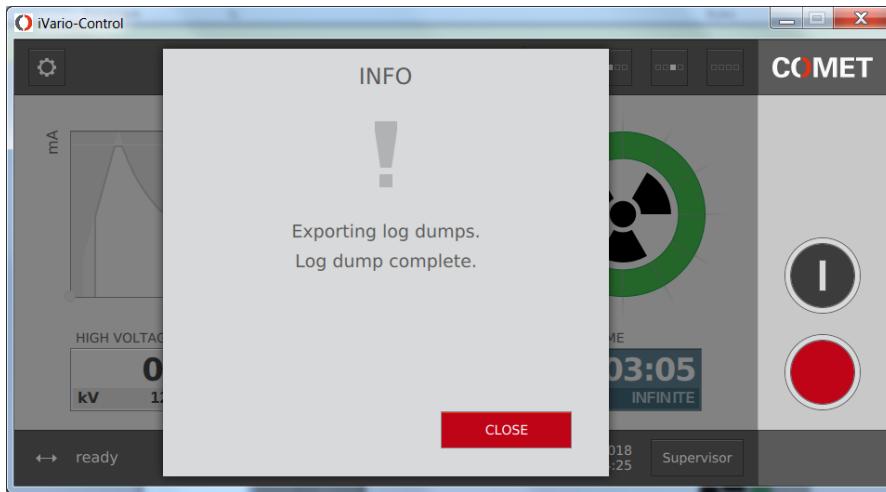
Scroll with the “>” to the screen with the operational report.

In order to load the operational report into the iVario Control software, click „Refresh“ to load the latest data. The report is about to load.

This can take up to several minutes.

Once the report has finished loading, click „Download“ to save the report on your computer. Because, it is more efficient to browse for a specific telegram with the file on your computer. For further analysis, you can send the log file to Comet Technical Service.





You will find a zip-file in the specific folder on your computer. The file is named with the iXRS Serial Number, the IFC Serial Number and the date and time of the operational report generation.

 operational-report-history-SN123456-IFC309-2021.07.19_16.19.43.zip

Unzip the file and you will get a folder

operational-report

within the operational

Best practice is to analyze the report with a smart text editor, as for example “Notepad++”. You

```
C:\Temp\operational\report\syslog-operation.txt - Notepad++  
File Edit Search View Encoding Language Settings Tools Macro Run Plugins Window ?  
  
syslog-operation.txt  
  
6149 Nov 21 10:06:26 IFC: [NOTE] statistics Statistics: HV[kV]=120.0(set)/120.0/120.0, Curr[mA]=6.0(set)/5.9/5.9, pwr[W]=0.0/0.0/0.0, FilCurr[A]=4.7/2.8/4.7  
6150 Nov 21 10:06:26 IFC: [NOTE] statistics Statistics: expTime[s]=0.0/0.0, focLarge, pwTime[s]=(mod:3,long:10,reg:2), arcs=0, wpch=0  
6151 Nov 21 10:06:26 IFC: [NOTE] statistics ***** Last exposure #134 info end *****  
6152 Nov 21 10:06:26 IFC: [INFO] op-svc 1[m]s from operating status 'HV-Operation' to 'Ready'  
6153 Nov 21 10:06:26 IFC: [NOTE] statistics ***** Exposure #135 start *****  
6154 Nov 21 10:06:26 IFC: [NOTE] statistics ***** Last exposure #135 info end *****  
6155 Nov 21 10:06:29 IFC: [NOTE] statistics Statistics: HV[kV]=2012.0(set) from operating status 'Ready' to HV-Operation, prewarn was 2[s]  
6156 Nov 21 10:06:30 IFC: [NOTE] statistics ***** Last exposure #135 info start *****  
6157 Nov 21 10:06:30 IFC: [NOTE] statistics Shutdown Reason: ITF,1.0 (type=1) Temp: Irc=31.1°C, POC1=21.2°C, POC2=27.8°C CTank=29.7°C ATank=31.9°C FGU-Oil=0.0  
6158 Nov 21 10:06:30 IFC: [NOTE] statistics Statistics: HV[kV]=120.0(set)/94.9/94.9, Curr[mA]=6.0(set)/0.0/0.0, pwr[W]=0.0/0.0/0.0, FilCurr[A]=4.7/4.7/4.7  
6159 Nov 21 10:06:30 IFC: [NOTE] statistics Statistics: expTime[s]=0.0/0.0, focLarge, pwTime[s]=(mod:3,long:10,reg:2), arcs=0, wpch=0  
6160 Nov 21 10:06:30 IFC: [NOTE] statistics ***** Last exposure #135 info end *****  
6161 Nov 21 10:06:31 IFC: [INFO] op-svc 0[m]s from operating status 'HV-Operation' to 'Ready'  
6162 Nov 21 10:06:31 IFC: [NOTE] op-svc HVPS Ready  
6163 Nov 21 10:06:48 IFC: [NOTE] com-svc EXNT: LOGIN USER Supervisor ROLE Supervisor  
6164 Nov 21 10:06:57 IFC: [INFO] op-svc Workpoint change (demanded/used): expCurr[mA] = 6.0/6.0, HV[kV] = 160.0/160.0  
6165 Nov 21 10:07:02 IFC: [INFO] op-svc Workpoint change (demanded/used): expCurr[mA] = 4.0/4.0, HV[kV] = 160.0/160.0  
6166 Nov 21 10:07:04 IFC: [NOTE] statistics ***** Exposure #136 start *****  
6167 Nov 21 10:07:06 IFC: [NOTE] op-svc 2000[m]s from operating status 'Ready' to HV-Operation, prewarn was 2[s]  
6168 Nov 21 10:07:07 IFC: [INFO] op-svc Setpoint reached after 1444ms, re-setting regular prewarn time (2 s)  
6169 Nov 21 10:07:11 IFC: [NOTE] statistics ***** Last exposure #136 info start *****  
6170 Nov 21 10:07:11 IFC: [NOTE] statistics Shutdown Reason: ITF,1.0 (type=1) Temp: Irc=31.2°C, POC1=20.7°C, POC2=27.8°C CTank=29.7°C ATank=32.0°C FGU-Oil=0.0  
6171 Nov 21 10:07:11 IFC: [NOTE] statistics Statistics: HV[kV]=160.0(set)/155.7/160.0, Curr[mA]=4.0(set)/2.4/4.5, pwr[W]=638.9/0.0/641.6, FilCurr[A]=2.6/2.6/4.7  
6172 Nov 21 10:07:11 IFC: [NOTE] statistics Statistics: expTime[s]=0.0/0.0, focLarge, pwTime[s]=(mod:3,long:10,reg:2), arcs=0, wpch=0  
6173 Nov 21 10:07:11 IFC: [NOTE] statistics ***** Last exposure #136 info end *****  
6174 Nov 21 10:07:12 IFC: [INFO] op-svc 1[m]s from operating status 'HV-Operation' to 'Ready'  
6175 Nov 21 10:07:12 IFC: [NOTE] op-svc HVPS Ready  
6176 Nov 21 10:07:13 IFC: [NOTE] statistics ***** Exposure #137 start *****  
6177 Nov 21 10:07:15 IFC: [NOTE] op-svc 2000[m]s from operating status 'Ready' to HV-Operation, prewarn was 2[s]  
6178 Nov 21 10:07:16 IFC: [INFO] op-svc Setpoint reached after 1477ms, re-setting regular prewarn time (2 s)  
6179 Nov 21 10:07:20 IFC: [NOTE] statistics ***** Last exposure #137 info start *****  
6180 Nov 21 10:07:20 IFC: [NOTE] statistics Shutdown Reason: ITF,1.0 (type=1) Temp: Irc=31.1°C, POC1=21.0°C, POC2=27.8°C CTank=29.7°C ATank=32.0°C FGU-Oil=0.0  
6181 Nov 21 10:07:20 IFC: [NOTE] statistics Statistics: HV[kV]=160.0(set)/155.7/160.0, Curr[mA]=4.0(set)/2.4/4.5, pwr[W]=639.4/0.0/693.9, FilCurr[A]=2.6/2.6/4.7  
6182 Nov 21 10:07:20 IFC: [NOTE] statistics Statistics: expTime[s]=0.0/0.0, focLarge, pwTime[s]=(mod:3,long:10,reg:2), arcs=0, wpch=0  
6183 Nov 21 10:07:20 IFC: [NOTE] statistics ***** Last exposure #137 info end *****  
6184 Nov 21 10:07:20 IFC: [INFO] op-svc 1[m]s from operating status 'HV-Operation' to 'Ready'  
6185 Nov 21 10:07:20 IFC: [NOTE] op-svc HVPS Ready
```

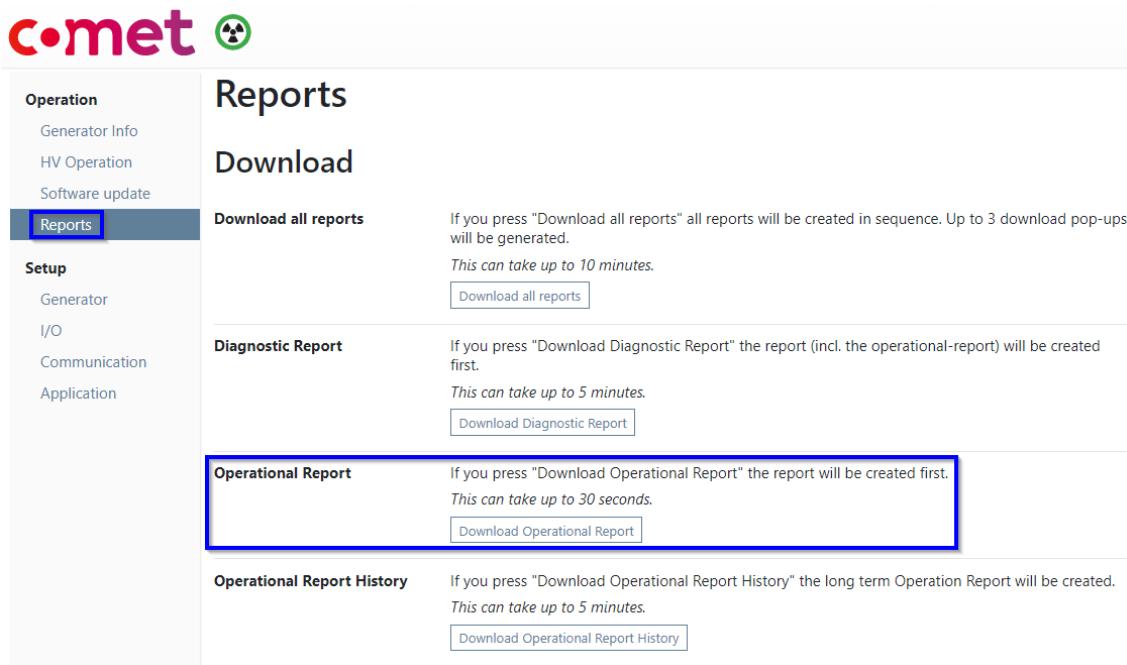


Generating an operational report can take up to several minutes.

11.2.2 Generate an operational report in the WebUI

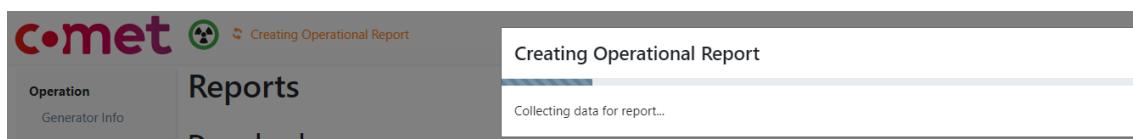
In the WebUI, the operational report is available from the section “Reports”. It is available in the form of a very short and condensed PDF file and as a “User History” for a longtime history operational report in text format.

11.2.2.1 Operational Report in PDF



The screenshot shows the comet WebUI interface. On the left, there's a sidebar with 'Operation' and 'Setup' sections. Under 'Operation', 'Generator Info' and 'HV Operation' are listed. Under 'Setup', 'Generator', 'I/O', 'Communication', and 'Application' are listed. A blue box highlights the 'Reports' button under 'Setup'. The main content area has a title 'Reports' and a 'Download' section. The 'Download all reports' option is described as creating up to 10 minutes of pop-ups. The 'Diagnostic Report' option is described as creating up to 5 minutes. The 'Operational Report' option is highlighted with a blue box and described as creating up to 30 seconds. The 'Operational Report History' option is described as creating up to 5 minutes. Each option has a 'Download' button.

Click the button “Download Operational Report” and the creation of the report in PDF file format will be initiated. During the creation time, a page overlay is visible to provide a feedback with accurate details about the current executed tasks in the background.



The screenshot shows the comet WebUI interface with the 'Reports' section selected. A modal window titled 'Creating Operational Report' is open, showing a progress bar and the message 'Collecting data for report...'. This indicates that the report is currently being generated.

Depending on your browser and its download strategy, the operational report may directly open in your preferred PDF viewer. If this is not the case, please check the download folder for the file “operational-report-***.pdf”. The file is named with the iXRS Serial Number, the IFC Serial Number and the date and time of the operational report generation.

 [operational-report-SN123456-IFC309-2021.07.19_16.26.42.pdf](#)

The Operational Reports consists of four main sections:

- Information
- Configuration
- Generator Status
- Statistics

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The 500 last logged events are displayed in the section 4.3.

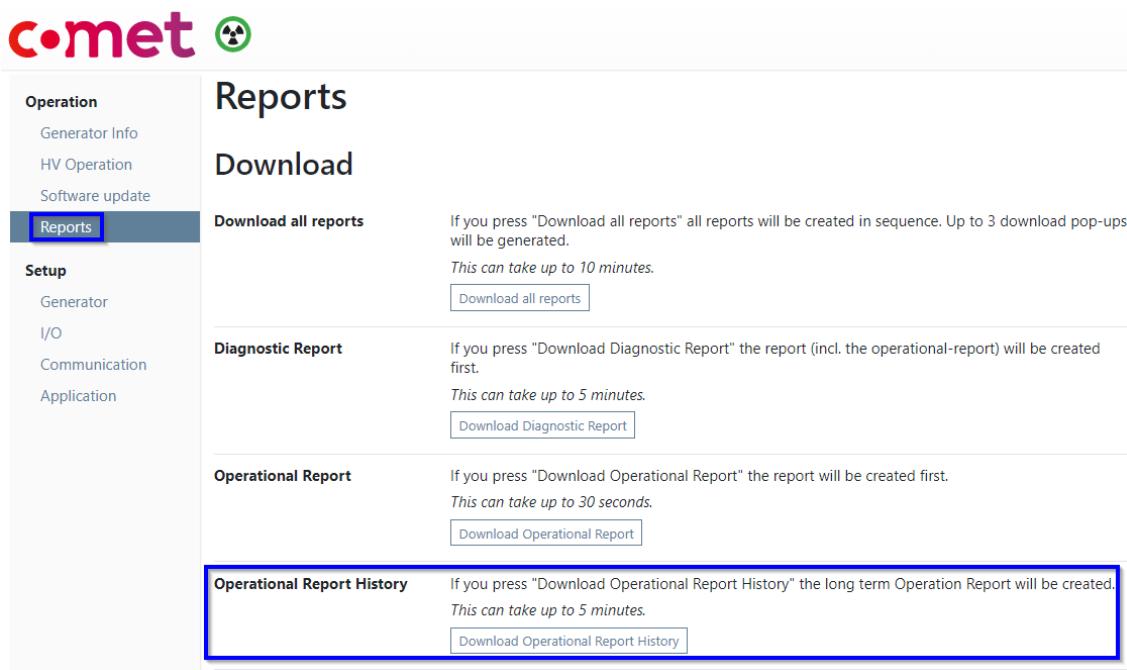
4.3 Event Log

The Event Log shows you the last 500 lines of the operational system log.

```
Jul 19 10:57:28 IFC: [INFO] op-svc 0[ms] from operating status 'Not Ready' to 'Cooler Check'  
Jul 19 10:57:28 IFC: [INFO] op-svc Start cooler check timeout (10000ms)  
Jul 19 10:57:38 IFC: [INFO] op-svc 0[ms] from operating status 'Cooler Check' to 'Not Ready'  
Jul 19 10:57:38 IFC: [INFO] op-svc Start postcooling time (60000ms)  
Jul 19 10:57:38 IFC: [INFO] op-svc 0[ms] from operating status 'Not Ready' to 'Cooler Check'  
Jul 19 10:57:38 IFC: [INFO] op-svc Start cooler check timeout (10000ms)  
Jul 19 10:57:48 IFC: [INFO] op-svc 0[ms] from operating status 'Cooler Check' to 'Not Ready'  
Jul 19 10:57:48 IFC: [INFO] op-svc Start postcooling time (60000ms)  
Jul 19 10:57:48 IFC: [INFO] op-svc 0[ms] from operating status 'Not Ready' to 'Cooler Check'  
Jul 19 10:57:48 IFC: [INFO] op-svc Start cooler check timeout (10000ms)  
Jul 19 10:57:50 IFC: [INFO] op-svc 0[ms] from operating status 'Cooler Check' to 'Not Ready'  
Jul 19 10:57:58 IFC: [INFO] op-svc Start postcooling time (60000ms)  
Jul 19 10:57:58 IFC: [INFO] op-svc 0[ms] from operating status 'Not Ready' to 'Cooler Check'  
Jul 19 10:57:58 IFC: [INFO] op-svc Start cooler check timeout (10000ms)  
Jul 19 10:58:08 IFC: [INFO] op-svc 0[ms] from operating status 'Cooler Check' to 'Not Ready'  
Jul 19 10:58:08 IFC: [INFO] op-svc Start postcooling time (60000ms)  
Jul 19 10:58:08 IFC: [INFO] op-svc 0[ms] from operating status 'Not Ready' to 'Cooler Check'
```

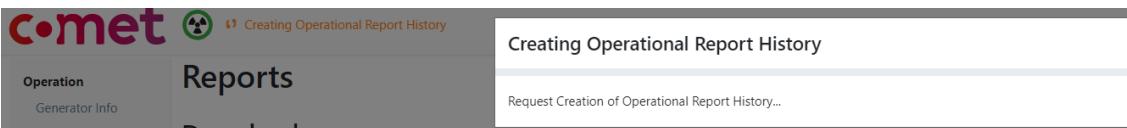
11.2.2.2 Operational Report History as a long time operational report

The “Operational Report History” is a long time operational report in text format. You can generate this report from the WebUI page “Reports”. Scroll down to the right section and press the download button.



The screenshot shows the comet WebUI interface. On the left, there's a sidebar with 'Operation' (Generator Info, HV Operation, Software update), 'Reports' (selected), and 'Setup' (Generator, I/O, Communication, Application). The main area is titled 'Reports' and has a 'Download' section. It lists four options: 'Download all reports' (takes up to 10 minutes), 'Diagnostic Report' (takes up to 5 minutes), 'Operational Report' (takes up to 30 seconds), and 'Operational Report History' (takes up to 5 minutes). The 'Operational Report History' option is highlighted with a blue border around its row.

The “Operational Report History” is about to be created.



The screenshot shows the comet WebUI interface. The 'Reports' section is active. A modal dialog box is open with the title 'Creating Operational Report History'. Inside the dialog, it says 'Request Creation of Operational Report History...'.

The “Operational Report History” is saved in your download folder. The file is named with the iXRS Serial Number, the IFC Serial Number and the date and time of the Operational Report History generation.

 [operational-report-history-SN123456-IFC309-2021.07.19_16.44.19.zip](#)

Unzip the file and you will get the report as a txt-file.

 [syslog-operation.txt](#)

Best practice is to analyze the report with a smart text editor, as for example “Notepad++”. You can start analyzing the presumed period of time. The latest events of the “User History” are listed bottom-down.



Generating an “Operational Report History” can take up to several minutes.

11.3 Diagnostic report

When do I have to generate a diagnostic report?

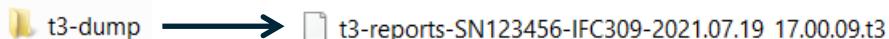
If you have troubles debugging your system and there is not enough accurate information available in the operational report. By creating a diagnostic report, you will get the most accurate diagnostic information out of the generator. This diagnostic file contains the deepest available debug information and is very useful for Comet if you run into troubles and need tech support assistance going beyond the operation report. This report contains a very long history of, at least, the last 30 days of use.

There are two possibilities to create this diagnostic report:

11.3.1 Generate a diagnostic report through “S1” button

Plug your USB stick on “X6” and press between 2-4 seconds the “S1” push-button to generate the diagnostic report on the root of the plugged USB stick. The LED A3 starts blinking green. Do not unplug the USB stick before the LED A3 stops blinking.

On the root of the USB stick is created a folder “t3-dump”. Inside the folder, you will find the binary file “t3-reports-SN***.t3”. The file is named with the iXRS Serial Number, the IFC Serial Number and the date and time of the Diagnostic Report generation.

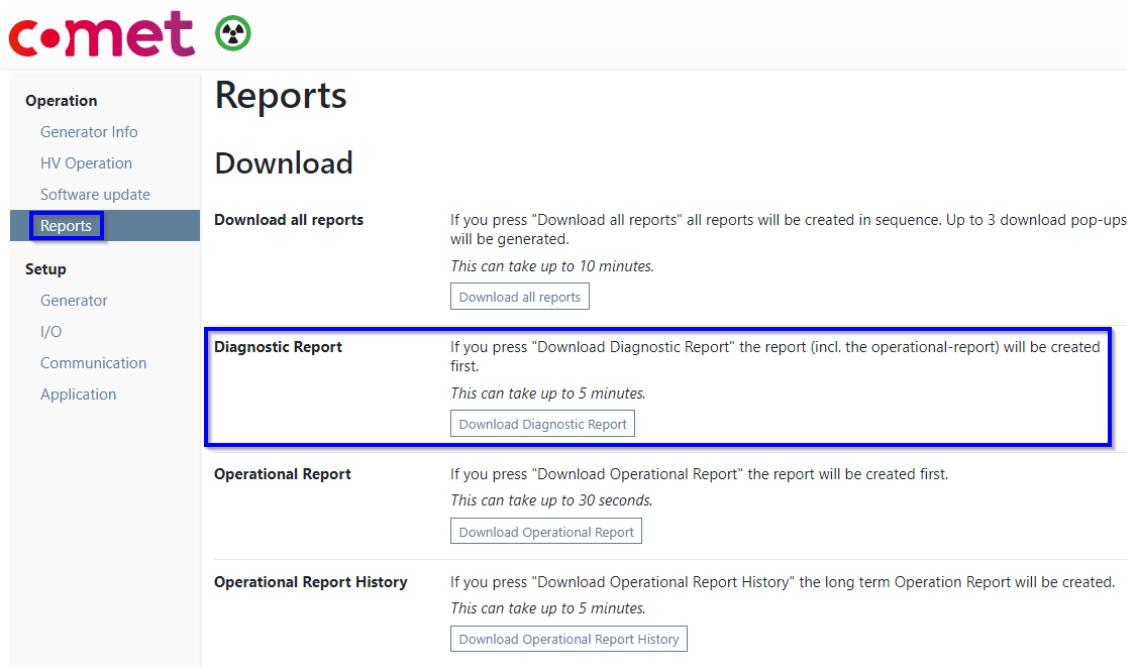


Generating a diagnostic report can take up to several minutes. The LED A3 will blink during the whole generation process and will stop blinking if the report is generated. **Never** unplug the USB Stick before the LED A3 stops blinking.

The diagnostic report is a binary file, it is not readable by yourself. Please send it to the COMET Technical Customer Support.

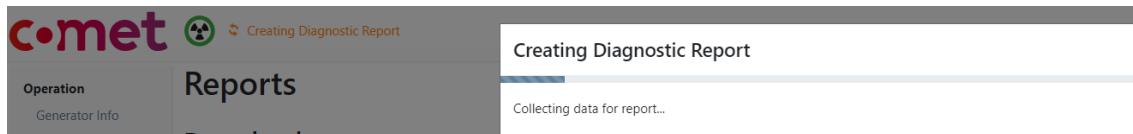
11.3.2 Generate a diagnostic report through WebUI

In the WebUI, the diagnostic report is available from the section “Reports” in the form of a binary file.



The screenshot shows the COMET WebUI interface. On the left, there's a sidebar with tabs for Operation, Reports (which is selected and highlighted in blue), and Setup. The main content area is titled "Reports" and contains a "Download" section. Under "Download", there are four options: "Download all reports", "Diagnostic Report" (which is highlighted with a blue border), "Operational Report", and "Operational Report History". Each option includes a brief description and a "Download" button. The "Diagnostic Report" section is described as taking up to 5 minutes and has a "Download Diagnostic Report" button.

Click the button “Download Diagnostic Report” and the creation of the report will be initiated.



This screenshot shows the same COMET WebUI interface as above, but the "Reports" section is now titled "Creating Diagnostic Report". A progress bar is visible, and below it, the text "Collecting data for report..." is displayed, indicating the process is underway.

The diagnostic report is saved in your download folder.

 t3-reports-SN123456-IFC309-2021.07.19_18.20.47.t3

The file is named with the iXRS Serial Number, the IFC Serial Number and the date and time of the Diagnostic Report generation.



The diagnostic report is a binary file, it is not readable by yourself. Please send it to the COMET Technical Customer Support.

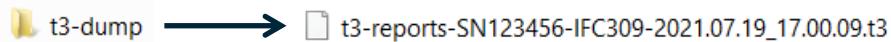
Generating a diagnostic report can take up to several minutes. The LED A3 will blink during the whole generation process and will stop blinking if the report is generated.

11.4 Generate all the reports at once

11.4.1 Generate all the reports on your USB stick

Plug your USB stick on “X6” and press between 2-4 seconds the “S1” push-button to generate all the reports on the root of the plugged USB stick. The LED A3 starts blinking green. Do not unplug the USB stick before the LED A3 stops blinking.

On the root of the USB stick is created a folder “t3-dump”. Inside this folder, you will find the “Diagnostic Report”.



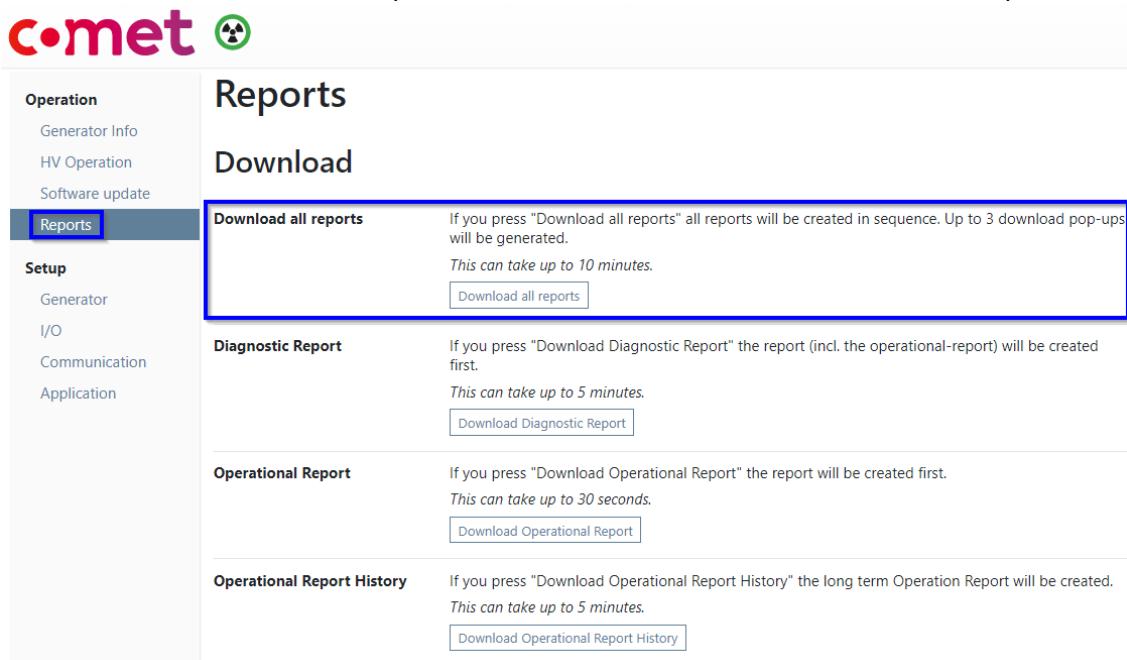
On the root of the USB stick is as well created a folder “operational-report”. Inside this folder, you will find the “Operational Report History” and the “Operational Report”.



Generating all the reports at once can take up to several minutes. The LED A3 will blink during the whole generation process and will stop blinking if the reports are generated. **Never** unplug the USB Stick before the LED A3 stops blinking.

11.4.2 Generate all the reports from WebUI

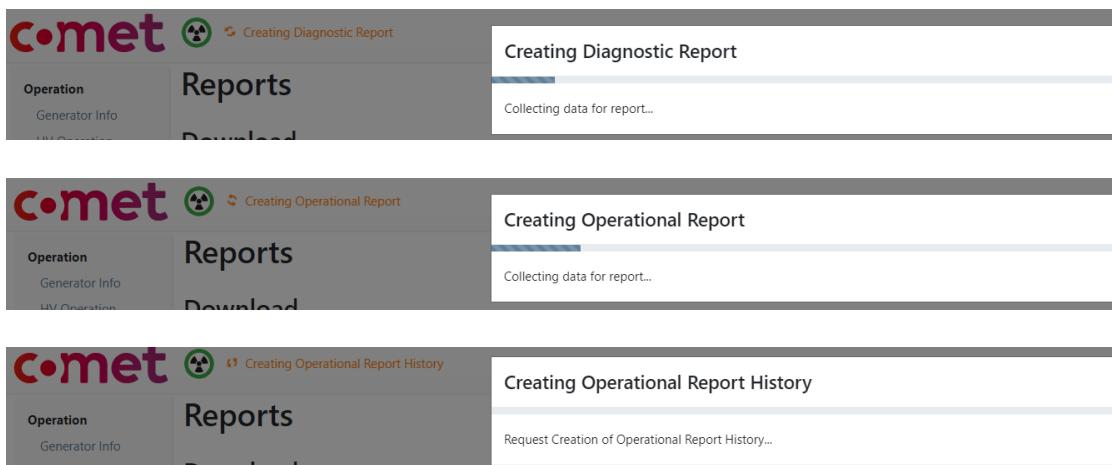
In the WebUI, the Generate all reports with one click is available from the section “Reports”.



The screenshot shows the comet WebUI interface. On the left, there's a sidebar with 'Operation' (Generator Info, HV Operation, Software update), 'Reports' (selected), and 'Setup' (Generator, I/O, Communication, Application). The main area is titled 'Reports' and has a 'Download' tab selected. Under 'Download', there are four options: 'Download all reports', 'Diagnostic Report', 'Operational Report', and 'Operational Report History'. Each option includes a description and a 'Download' button. The 'Download all reports' button is highlighted with a blue box.

Action	Description	Time	Download Button
Download all reports	If you press "Download all reports" all reports will be created in sequence. Up to 3 download pop-ups will be generated.	This can take up to 10 minutes.	Download all reports
Diagnostic Report	If you press "Download Diagnostic Report" the report (incl. the operational-report) will be created first.	This can take up to 5 minutes.	Download Diagnostic Report
Operational Report	If you press "Download Operational Report" the report will be created first.	This can take up to 30 seconds.	Download Operational Report
Operational Report History	If you press "Download Operational Report History" the long term Operation Report will be created.	This can take up to 5 minutes.	Download Operational Report History

Click the button “Download all reports” and the download of all the reports will be initiated one by one, starting with the Diagnostic Report.



The three screenshots show the progress of generating reports. Each screenshot shows the comet WebUI interface with the 'Reports' tab selected and the 'Download' sub-tab. A modal window is open in each case:

- Creating Diagnostic Report**: Shows a progress bar and the message "Collecting data for report..."
- Creating Operational Report**: Shows a progress bar and the message "Collecting data for report..."
- Creating Operational Report History**: Shows a progress bar and the message "Request Creation of Operational Report History..."

All the reports are saved in your download folder.

-  t3-reports-SN123456-IFC309-2021.07.19_18.28.41.t3
-  operational-report-history-SN123456-IFC309-2021.07.19_18.35.26.zip
-  operational-report-SN123456-IFC309-2021.07.19_18.35.03.pdf

The files are all named with the iXRS Serial Number, the IFC Serial Number and the date and time of the report generation.



Generating all the reports at once can take up to several minutes. The LED A3 will blink during the whole generation process and will stop blinking if the reports are regenerated.

12 General hardware functionality check

12.1 General

Any high voltage problem should be enclosed to the following 3 main parts of a system

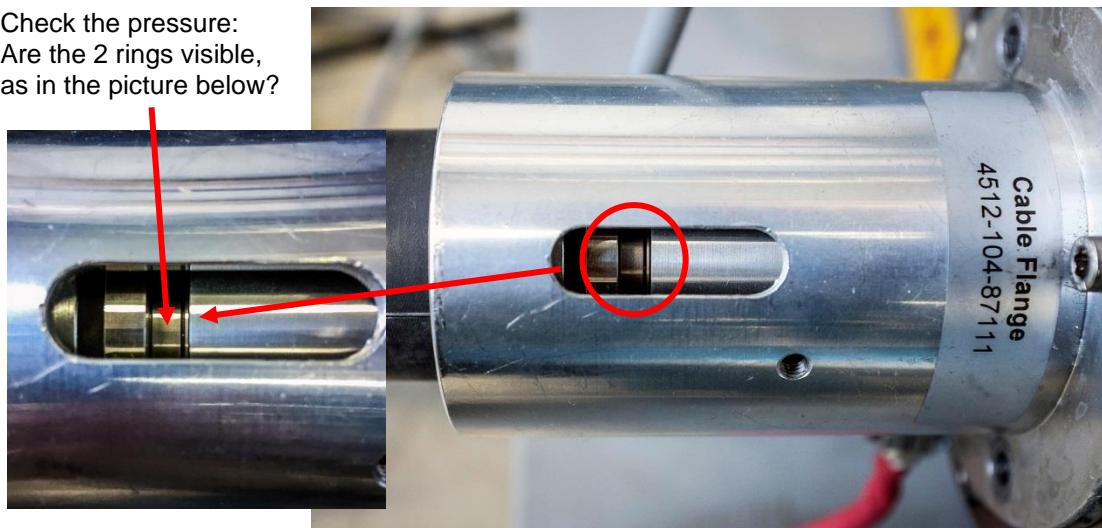
- iVario side (Tank, Powercell and IFC)
- High voltage cable
- Tube

12.2 Visual check

To find out which component of a complete system is the failure origin, it is essential to check:

- the high voltage cable connection(s) at tube AND at generator side
- the cable cones and the receptacles at tube AND at generator side very thoroughly.

Check the pressure:
Are the 2 rings visible,
as in the picture below?



Remove the cone from the receptical.	Visually check if there are traces of arcs or flashovers (bad smell)
Clean plug and receptical	...

This list will be completed in a further version of the Service Manual.

12.3 Dummy Plug test unipolar

If there is no damage or arc trace visible, you will have to proceed with the **Dummy-Plug test**. This is a very useful test of HV generators without load. Basically, the dummy plug (or blanking plug) guarantees the insulation of the high voltage connectors of the generator.

If the system runs on dummy plugs up to the nominal voltage, the chances are very high, that the problem resides either on the tube or the cable.



12.3.1 Step by step procedure

1. Remove the HV cable(s) on the generator side
2. Mount the dummy plug according to the HV mounting procedure (correct greasing & gapping)
3. For bipolar modules, the connected dummy plug has to be mounted on the cathode generator
4. In the WebUI, page "Setup" "Generator", remain the selected and used tube, but set a cable length of 0m



Operation

[Generator Info](#)[HV Operation](#)[Software update](#)[Reports](#)

Setup

[Generator](#)[I/O](#)[Communication](#)[Application](#)

Generator Setup

Date and Time

Generator Time:

Wed, 21 Jul 2021 12:10:03 +0200

Set Time Manually:

YYYY.MM.DD hh:mm:ss Europe/Zurich

Set Time Automatically

 Sync with Computer

This will synchronize the clock of the Generator with the time of your computer.

NOTE: The timezone has to be set manually first.

Tube and Cable

Tube

MXR-225-26

Tube Serial Number

123456

Cable Length

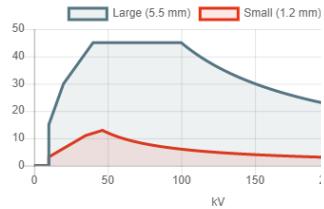
0 m

 Apply

Applied

Reboot required

MXR-225-26



Material Number: 915386.51, Connector Type: R24

Note: Diagram shows limits of tube, not considering tank, cable or other factors.

- Press "Apply" and then "Reboot" for rebooting the system. These settings you will find in "Operation" "Generator Info" after the reboot.



Operation

[Generator Info](#)[HV Operation](#)[Software update](#)[Reports](#)

Setup

[Generator](#)[I/O](#)[Communication](#)[Application](#)

Generator Information

Main Software Version

V.2.5.0.689ff5d

General Settings

Part Setting

Cathode Tank 225-

Anode Tank none

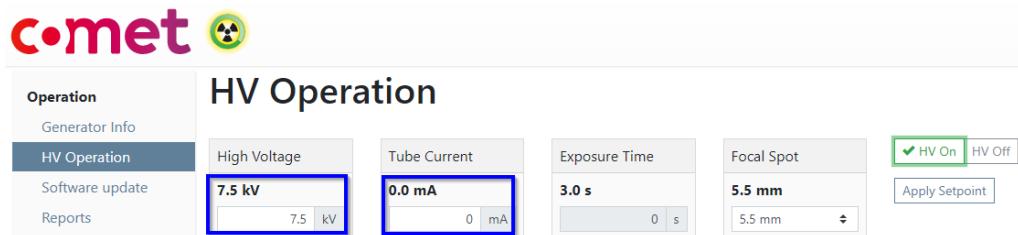
Tube Type MXR-225-26 (mxr-225-26)

Cable Length 0 m

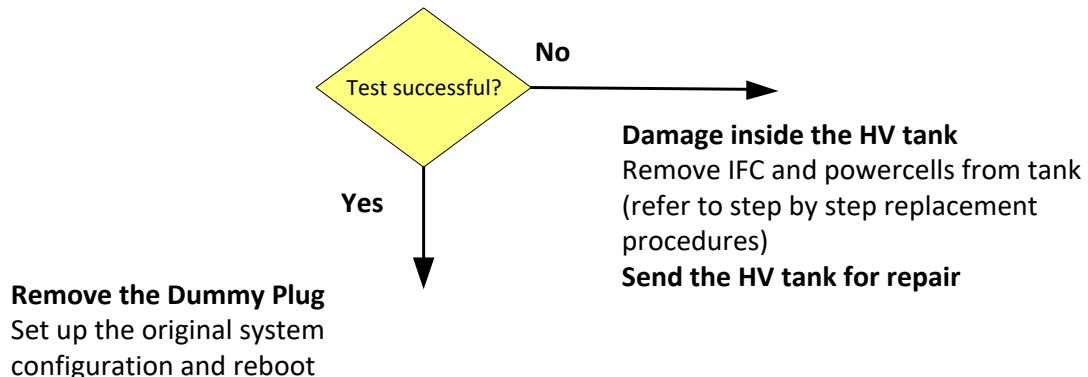
Network IP 192.168.177.199

Network MAC 50:2d:f4:0c:3d:7d

- Set and run 7.5kV (unipolar) or 15kV (if bipolar setup) and 0 mA in the “HV Operation” menu



- If no error occurs, slowly increase the kV up to nominal voltage
- If the nominal voltage is reached without any problem, leave it for at least 10 min. The best test condition is to apply the nominal voltage overnight)



12.4 New technical service-related tests

There is available a technical service page in the WebUI, including several troubleshooting- and stress-tests as:

- Skip filament check on next HV ON
- Tank Operating mode (Cathode only, Anode only)
- Cycle stress test when switching on and off
- HV Range test (Ramp test)
- Value Switching Test (Switching between two operating points)



These features are not available for the user “oem” and therefore are not documented in the Service Manual of software v2.5.0.

13 Spare parts

The spare parts list is available in a separate document. Get it from the Comet Technical Customer Service.

14 Replacements step-by-step procedures

14.1 Replacement High Voltage Plug

This chapter has to be done for a next version of the Service Manual. It is the same procedure as for the MG. Therefore, refer to the MG Service Manual.

14.2 Replacement High Voltage Cable

This chapter has to be done for a next version of the Service Manual. It is the same procedure as for the MG. Therefore, refer to the MG Service Manual.

14.3 Replacement Interface Controller



For the replacement of the Interface Controller, we presently have two use cases

- a) For iVario Software version <v2.1.0
- b) For iVario Software version ≥ v2.1.0

For the use case a) the below step by step replacement is fully valid.

For the use case b) the transfer of the SD Flash card from the broken IFC and import into the new IFC is not supported. This means, it is not possible to import the original system configuration and history logs. These data are lost on a IFC replacement.

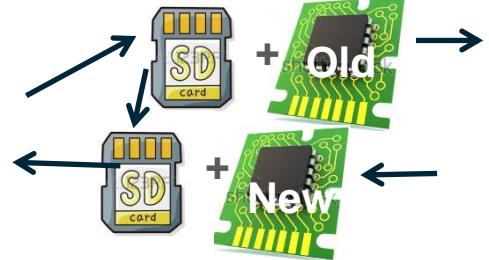
A damaged IFC can be replaced by a spare part consisting of three mounted PCBs. Valid for use case a) and b).



Only valid for use case a)

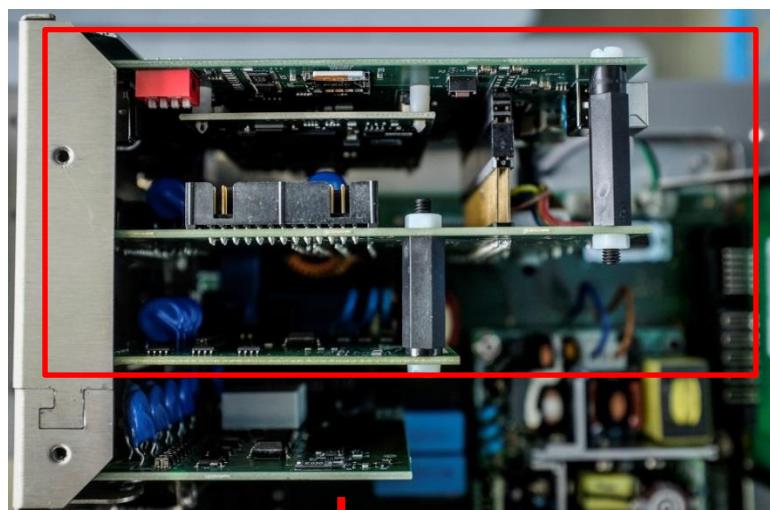
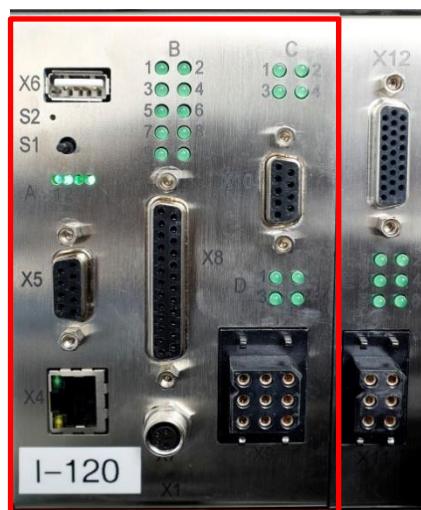
This is a step by step description about replacing the IFC and restoring the original system configuration on the new IFC. The configuration of the whole system setup is periodically stored on the SD flash card mounted on the IFC. The SD flash card also contains the software of all the components of the system. **The SD card belongs to the generator and is transferred from the damaged IFC to the new one.**

- Remove the protection panel
- Remove the damaged IFC and remove its SD Card
- Plug the new IFC and mount the original SD Card
- Restore the original system configuration from the SD Card
- Re-mount the protection panel



The only tool you need is a torx screwdriver of size 10.
All the torx screws have the same length.

This is the IFC board from outside- and inside-view.



Remove all power connections

Unbolt the 6 torx screws of the protection panel

1 on the left side,
1 on the right side,
1 on backside and
3 on the top

Remove the protection panel



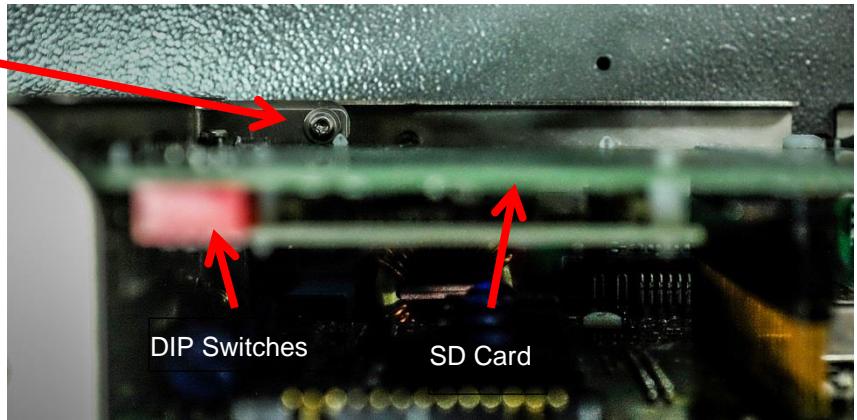
You have now direct access to the IFC board

Only valid for use case a)
Remove the original SD flash card of the damaged IFC board. Keep it at a save place.



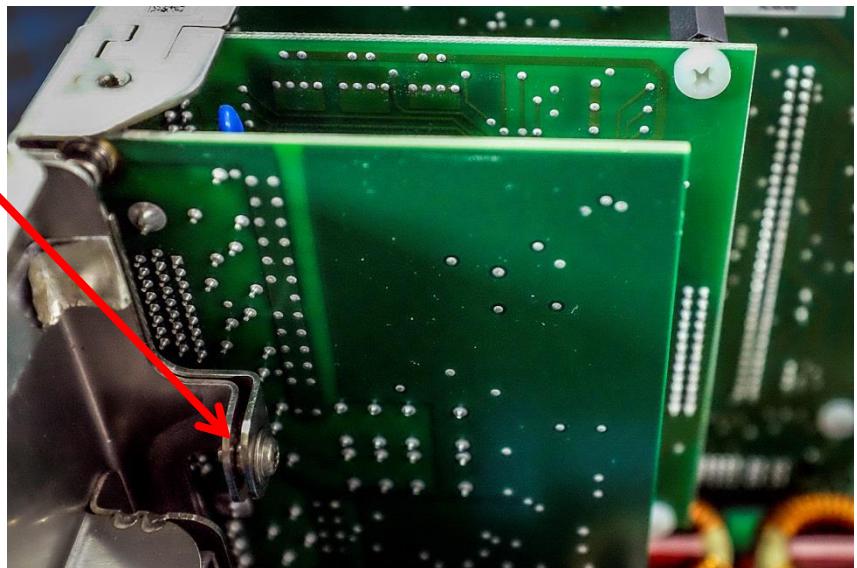
Unbolt 1 torx screw on the IFC side

DIP Switches and SD Card are shown as an orientation reference



Unbolt 1 torx screw on the Safety board side

This is to ease removing the IFC

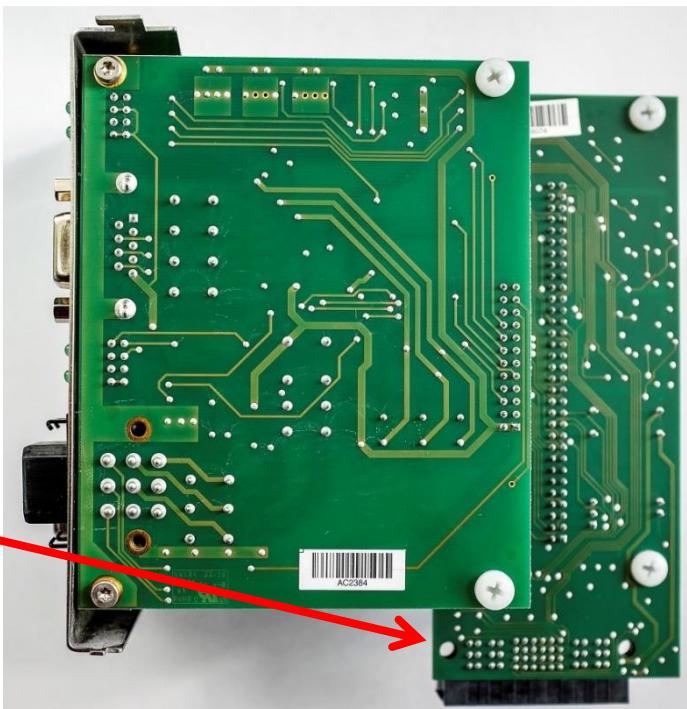


Remove the IFC from its socket by tearing it upwards.

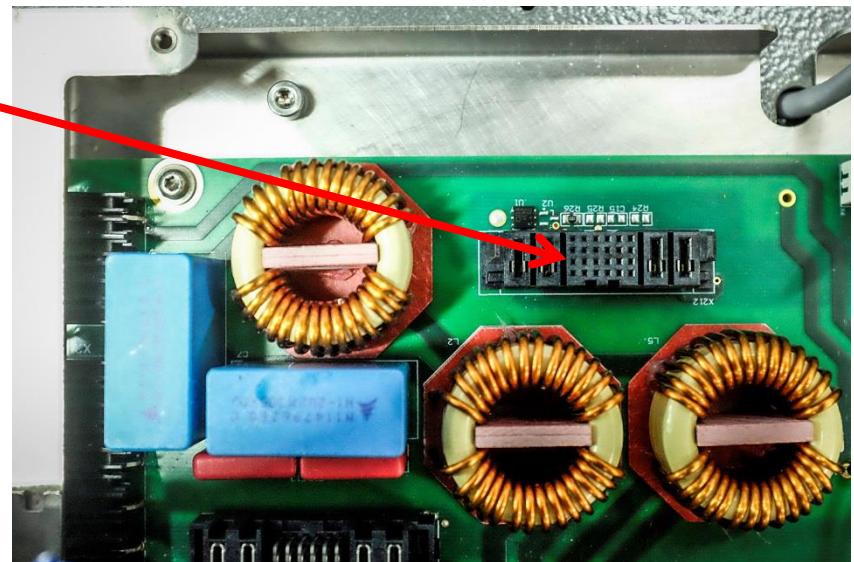
This is the spare IFC board

Only valid for use case a)
Put the original SD flash card into the SD flash card holder of the new IFC

Connector



Plug the spare board into the specific socket



Bolt the 2 torxs screws for IFC and Safety board.

Place the protection panel and bolt the 6 screws.

The system is ready to be powered again.

Only valid for use case a)

You are now able to restore the configuration of the original system onto the new IFC.

Please proceed to the page "Software Update", section "Reset / Restore Generator" of the WebUI and focus on "Restore from MMC".

Reset / Restore Generator

Restore from MMC

Use this option for an IFC replacement where the SD card is plugged into the replacing IFC.

Restore

Restore the new IFC by pressing the "Restore button".

Remark: "MMC" is the designation of the SD flash card in the IFC

The whole system configuration of the original IFC will be restored from the SD card onto the new IFC device. The whole configuration includes all the statistics and all the log files (max. 256 MB).



This procedure can take up to 5 minutes. Please be patient.

You can follow these information screens during the restore procedure

Restore from MMC

Starting IFC replacement
Starting update...
loading software package...
Preparing update...
Identify new version...

Restore from MMC

Starting IFC replacement
Starting update...
loading software package...
Preparing update...
Identify new version...
extract IFC package...
erase kernel partition on nand...
flash new kernel to partition on nand...
format and flash rootfs to partition on nand...

If required, the software version of the new IFC device is automatically adapted to the software version level of the connected system. The software on the SD card will be used to upgrade / downgrade the new IFC.

At the very end, the generator will reboot. After the final boot, your system is ready again with the latest system configuration restored.

14.4 Replacement P-Safety-Interface-PCB



A damaged Safety Board can easily be replaced by a spare part. No specific configuration is required.



This is a step by step description about replacing the Safety Board.

- Remove the protection panel
- Remove the damaged Safety Board
- Plug the new Safety Board on the specific socket
- Re-mount the protection panel



The only tool you need is a torx screwdriver of size 10.
All the torx screws have the same length.

This is the Safety Board board from outside- and inside-view.



Remove all power connections

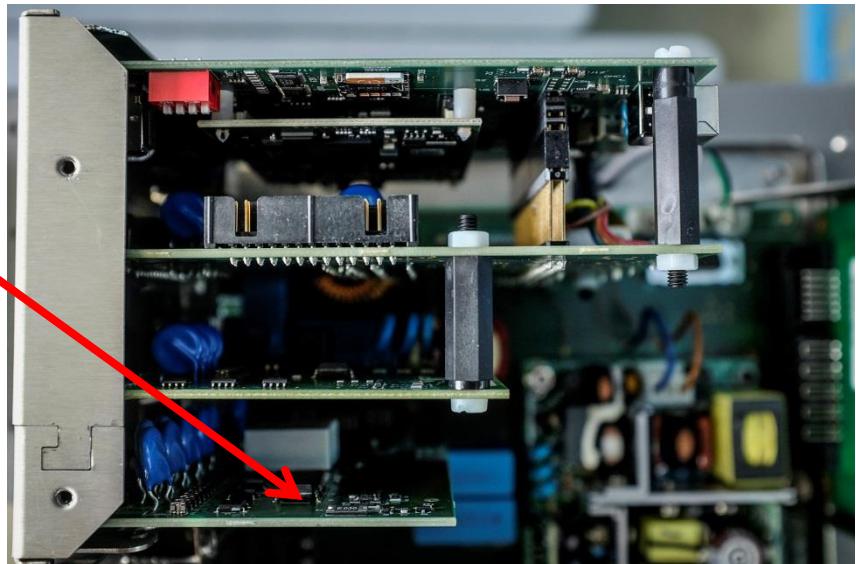
Unbolt the 6 torx screws of the protection panel

1 on the left side,
1 on the right side,
1 on backside and
3 on the top

Remove the protection panel



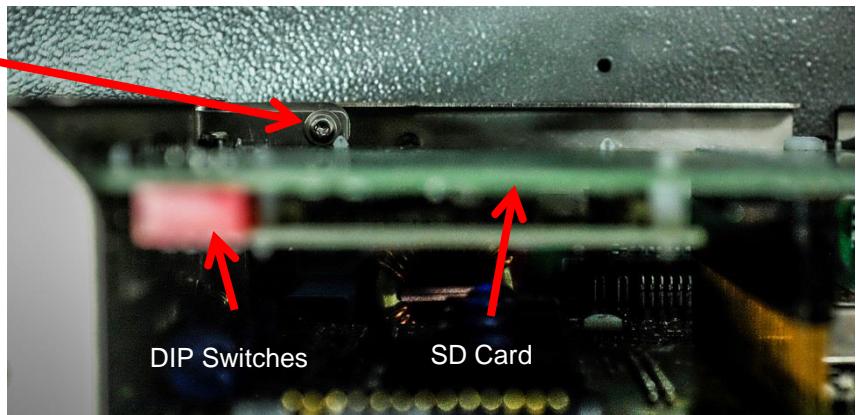
You have now direct access to the Safety Board



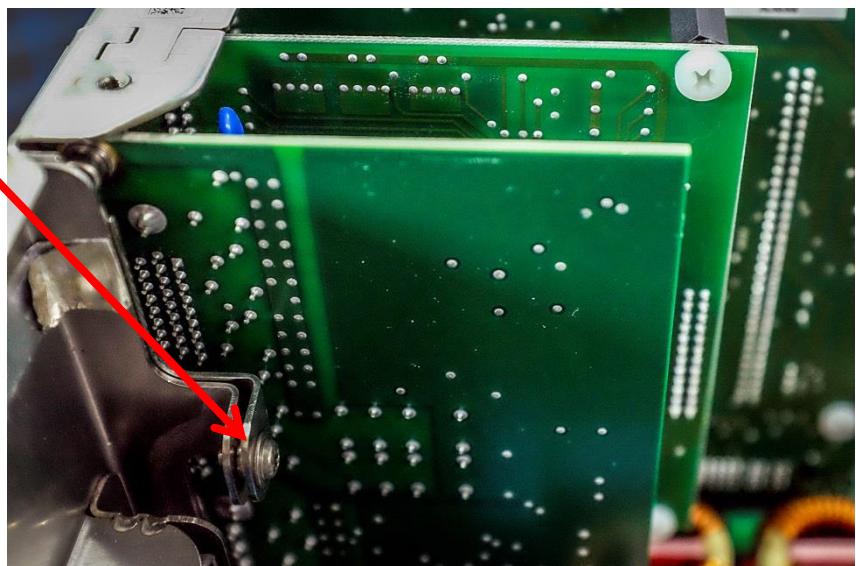
Unbolt 1 torx screw on the IFC side

This is to ease removing the IFC

DIP Switches and SD Card are shown as an orientation reference

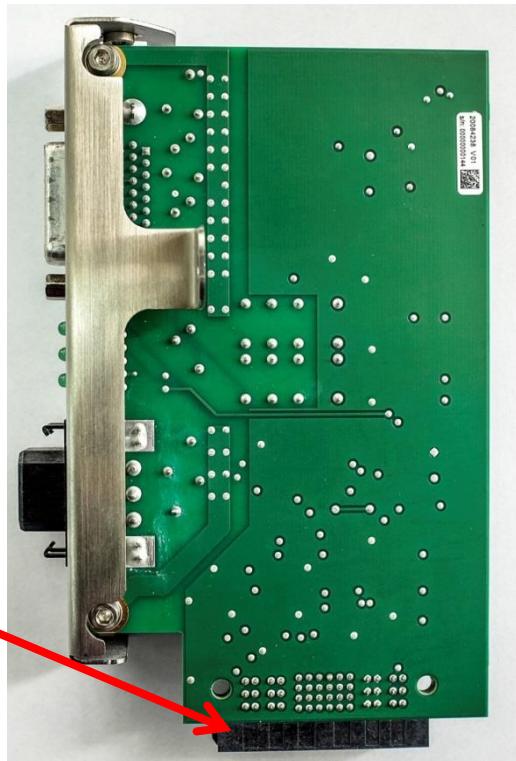


Unbolt 1 torx screw on the Safety Board side



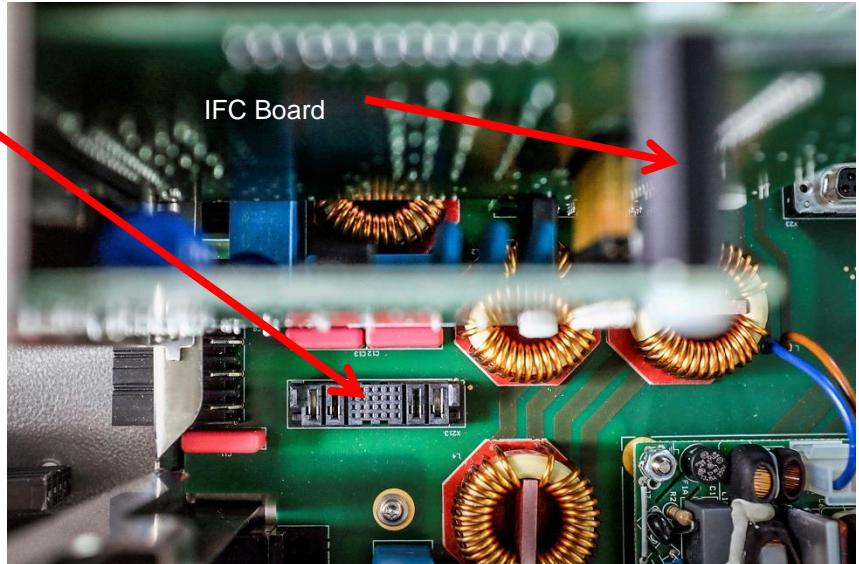
Remove the Safety Board from its socket by tearing it upwards.

This is the spare Safety board



Connector

Plug the spare Safety Board into the specific socket



Bolt the 2 torxs screws for IFC and Safety board.

Place the protection panel and bolt the 6 screws.

The system is ready to be powered again.

14.5 Replacement of a Powercell



A damaged Powercell can be replaced by a spare part Powercell.
This is a step-by-step description of replacing a Powercell and upgrade / downgrade its software version, in order to match the software consistency of the system.

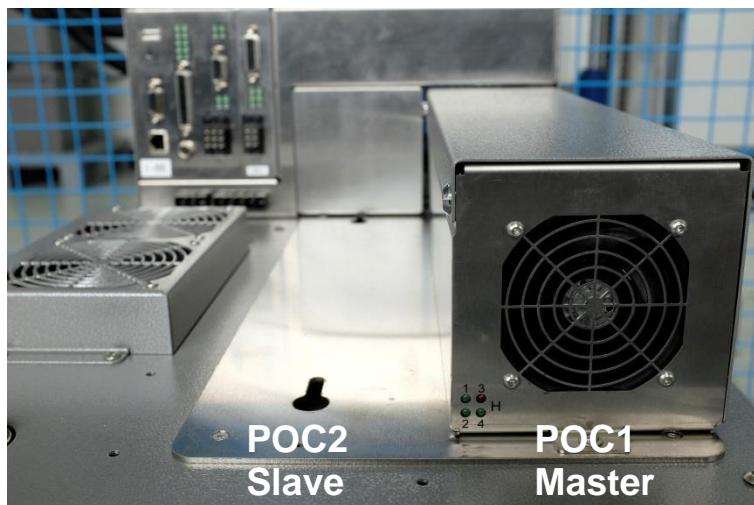


The only tool you need is a torx screwdriver of size 10.

The Master slot always has to be equipped to run a system.

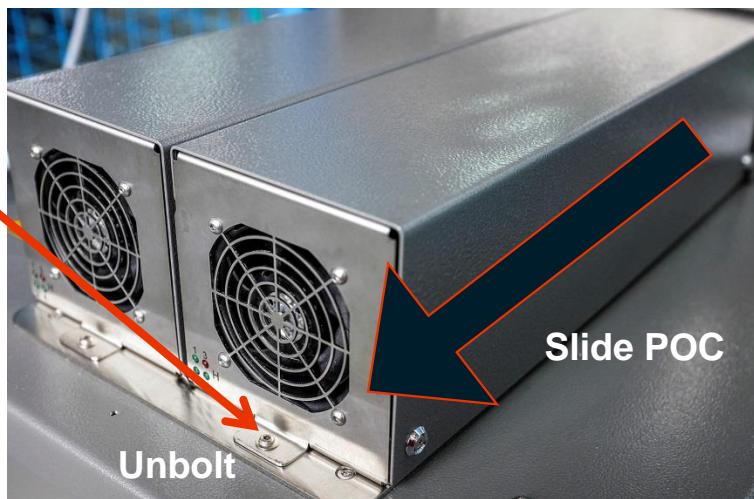
Therefore, systems with only 1 Powercell have to be equipped with the Master Powercell.
The slot on the left side is for the Slave Powercell.
If both Powercells are plugged and used, the load is distributed symmetrically.

You can mutually swap the Powercells.
Unpack the new Powercell and check that



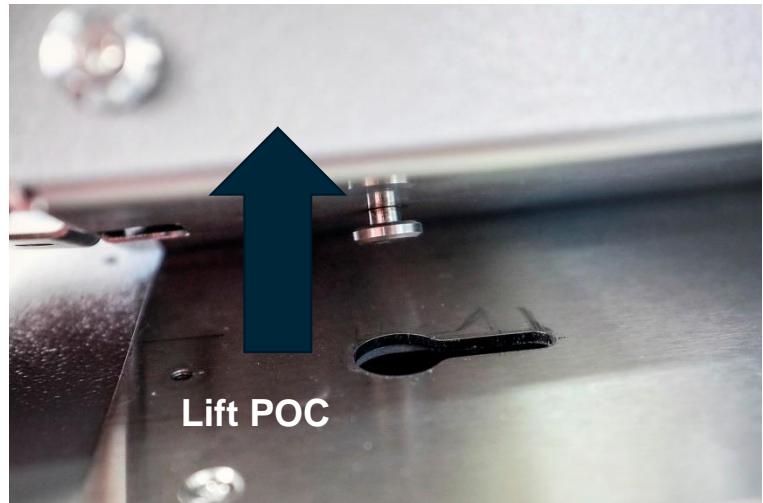
Unbolt and slide Powercell

Unbolt one single torx 10 screw.
Slide the Powercell towards the described direction, away from the generator's connector.



Lift Powercell

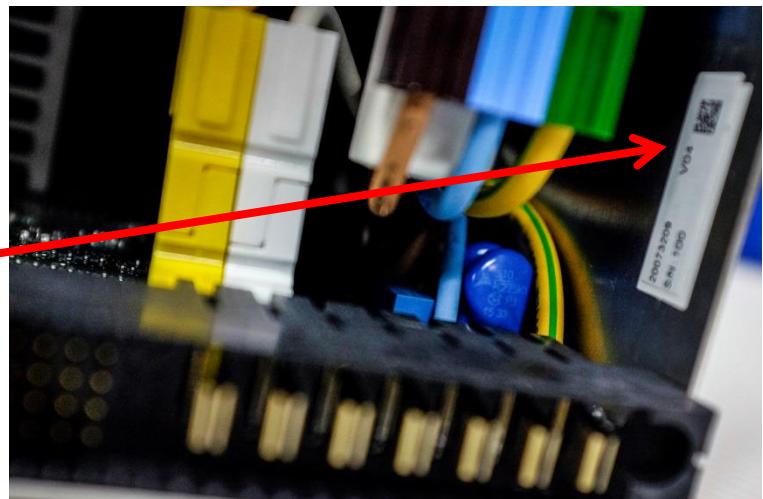
If the circular aperture is reached, just lift the Powercell out of the steering and move it away from the generator.



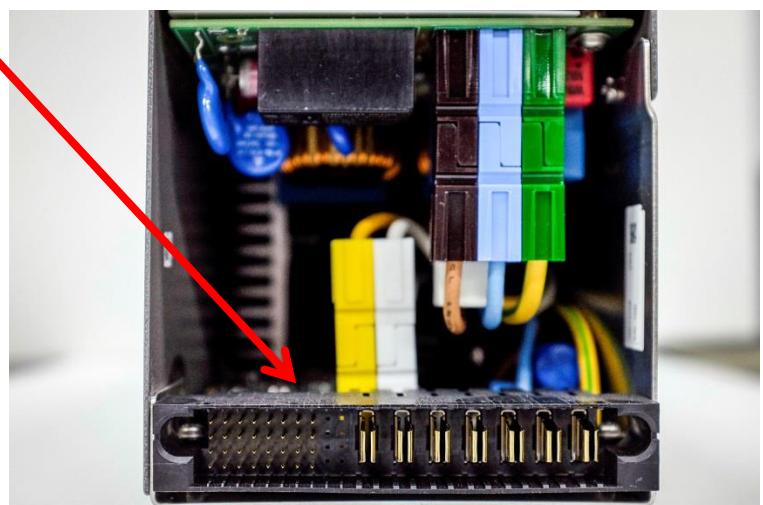
Unpack the new Powercell. On the sticker are labelled the:

- SAP number
- PoC's serial number
- Hardware version

The sticker is pasted, here, inside the Powercell.



Before you plug the new Powercell, check that none of the small pins of the connector are bent.



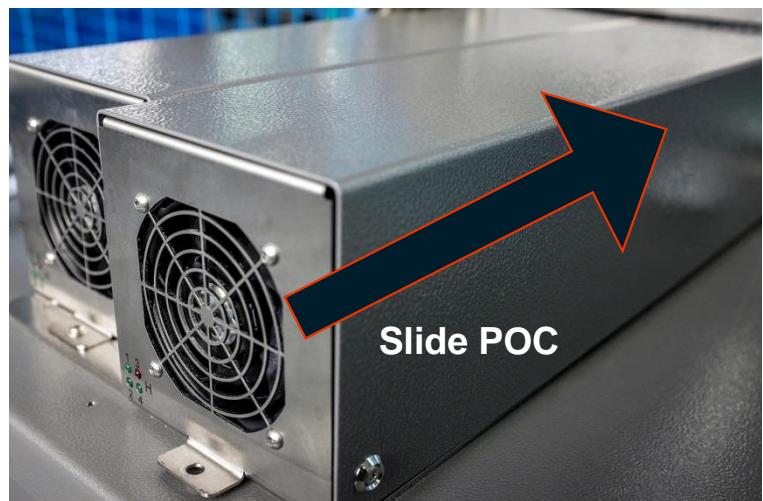
This is the empty plug generator's side to connect

the spare Powercell. Be careful with the small pins on the right side



Place the new Powercell in the circular aperture and slide it to the right side into the generator's connector. Finally, tighten the torx 10 screw.

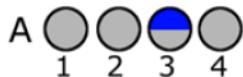
The system is ready to be powered and run again.



If the software version of the Powercell needs to be aligned regarding the software version of the IFC, the software equalize is performed automatically at the first power on of AUX after the Powercell replacement. With iVario software v2.4.1 and newer, there is no manual software alignment necessary for the Powercell.

Just be aware that the first boot up, after a Powercell replacement, will take significantly more time.

You can follow the automatic software update during the initial boot on the:
- IFC's leds (led A3 is blinking blue)



- On the popup window in the WebUI

System Update (Initial)...

Starting update of external device(s)...
Stopping services...
updating poc2...

14.6 Replacement of a tank

Before starting the transformation work, remove all power connections X1 & X2.



A damaged tank can be replaced by a spare part tank.
This is a step by step description about replacing a tank and upgrade /
downgrade its software version to match the software consistency of the
system.

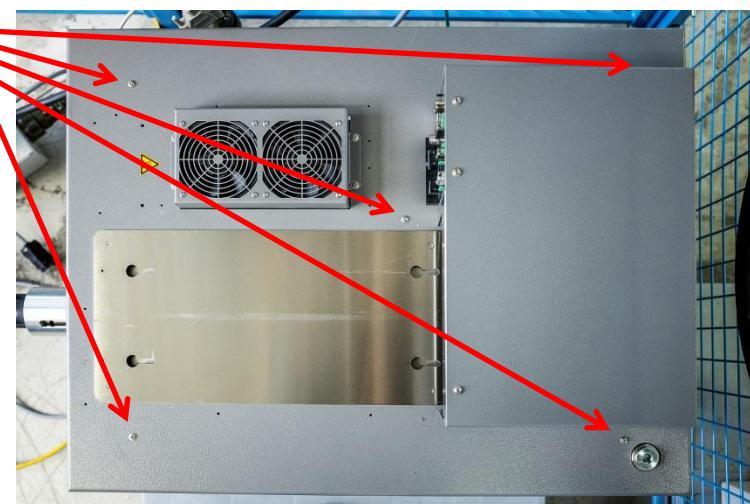


The only tool you need is a torx screwdriver of size 10. All the 5 screws to
unscrew have the same length.

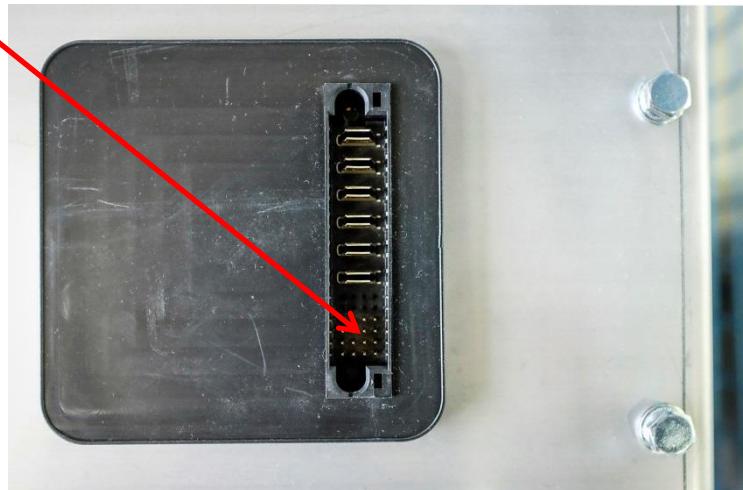
First of all remove the
powercell(s) on top of the
tank. Refer to beside
picture and the step by step
description of the above
chapter.



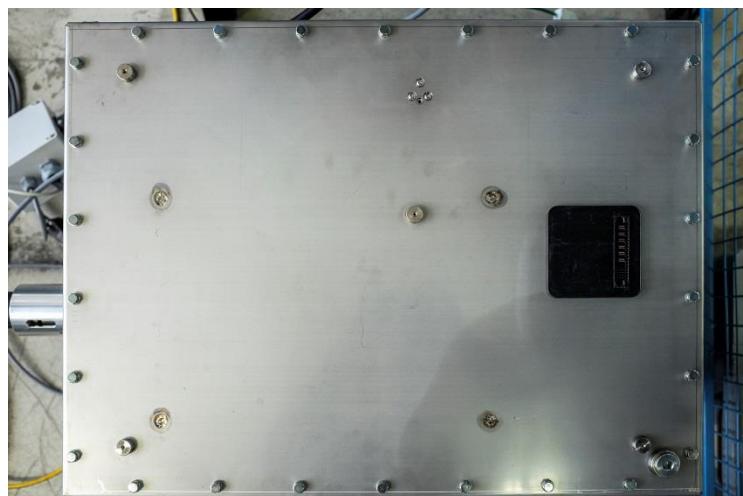
Unbolt the 5 torx screws.



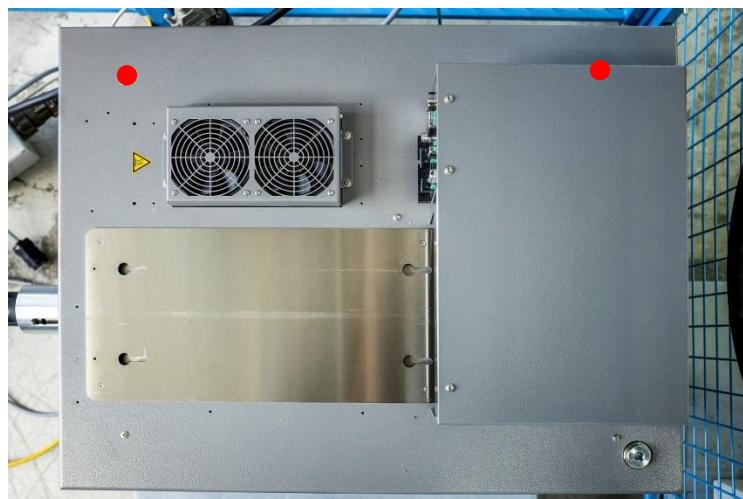
Remove the tank cover very carefully to no damage the pins of the connector on the tank.



The tank is now isolated and can be shipped for reparation



Re-place the tank cover on the new tank very carefully to not damage the pins of the connector on the tank. Observe the 2 indicated holes to adjust the placement of the tank.



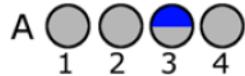
The system is ready to be powered and run again.



If the software version of the Tank needs to be aligned regarding the software version of the IFC, the software equalize is performed automatically at the first power on of AUX after the Tank replacement. With iVario software v2.5.0 and newer, there is no manual software alignment necessary for the Tank.

Just be aware that the first boot up, after a Tank replacement, will take significantly more time.

You can follow the automatic software update during the initial boot on the:
- IFC's leds (led A3 is blinking blue)



- On the popup window in the WebUI you can observe that the software upgrade / downgrade takes place

14.7 Replacement backframe

This chapter has to be done for a next version of the Service Manual.

15 Transformations bipolar ↔ unipolar

15.1 Transformation iVario bipolar → unipolar

Before starting the transformation work, remove all power connections X1 & X2.

15.1.1 Remove the anode tank plug

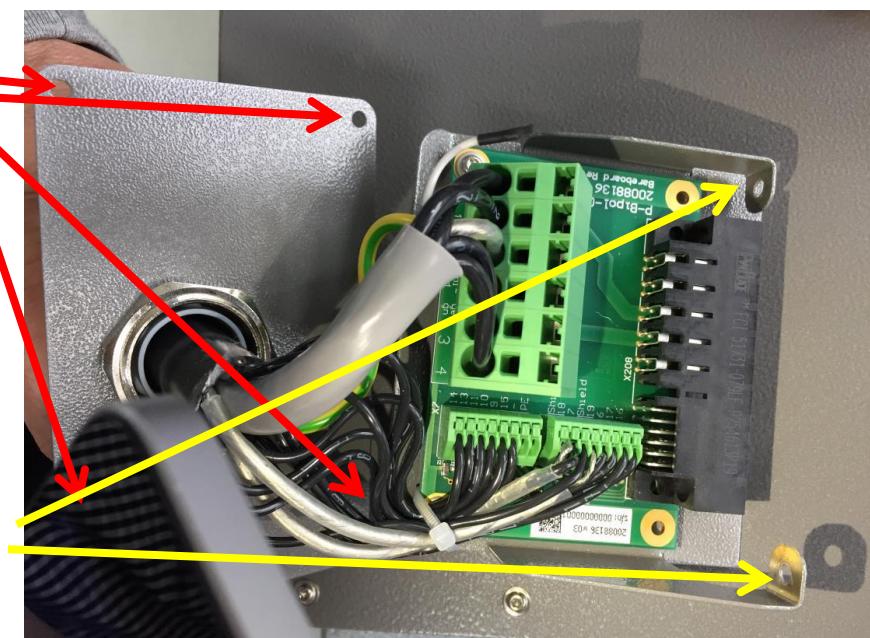
Unbolt the 6 torx screws of the protection panel
1 on the left side,
1 on the right side,
1 on backside and
3 on the top

Remove the protection panel



Unscrew the 4 screws of the lid

Unscrew the 2 fixation screws of the plug



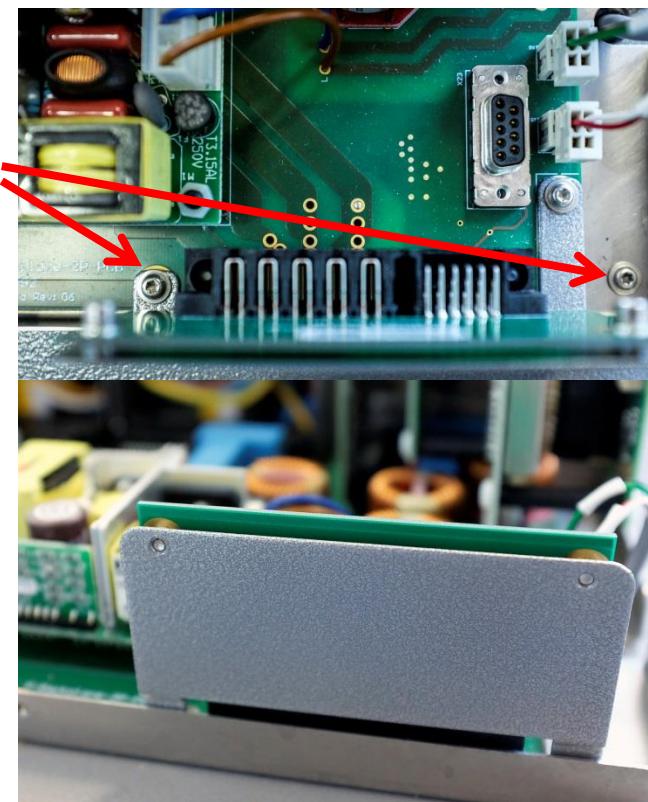
**Cover it in a ESD protection bag
and fix it to the
anode tank using
a tie wrap**



15.1.2 Plug in the unipolar-con (part no 20088494)



**Fix the
unipolar
-con
plug
with two
screws**



15.1.3 Mount the blind cover (part no 20089011)



View from the outside.

The picture is of a prototype version.



15.1.4 Setup the unipolar system

**Plug in mains
and AUX plugs
and boot with
the WebUI**

Important!
First of all, the correct configuration of tube and HV cable length has to be set on the WebUI "Setup" "Generator" page.

Apply the settings.

Generator Setup

Date and Time

Generator Time:

Tue, 04 Sep 2018 10:23:06 +0200

Set Time Manually:

YYYY.MM.DD hhmmss Europe/Zurich Apply

Set Time Automatically

Sync with Computer

This will synchronize the clock of the Generator with the time of your computer.
NOTE: The timezone has to be set manually first.

Tube and Cable

Tube

MXR-225/26

Tube Serial Number

123456

Cable Length

5 m

Apply

MXR-225/26



Tank Types in Use

Cathode

225-

Anode

none

Then reboot the system with the "Reboot" button

Reboot

A reboot of the device is necessary to apply the configuration.

Reboot

Run a WarmUp

iVario is again ready for operation

15.2 Transformation iVario unipolar → bipolar

This chapter has to be done for a next version of the Service Manual. It is the opposite transformation to the previous described chapter.

16 Software Update



For software consistency reason, all components (IFC, Powercell(s) and Tank(s)) have to be on the same software version. A working system consists of all components on the same software version (except BSP). This chapter is a step-by-step description about performing software updates / downgrades.



With the IFC software version v2.5.0, the Powercells and Tanks are upgraded / downgraded automatically to the IFC software version if a software incompatibility is detected. Valid for systems older than v2.5.0: If the system detects an inconsistency of the software versions of a single device, the system will block during the boot process with the message:

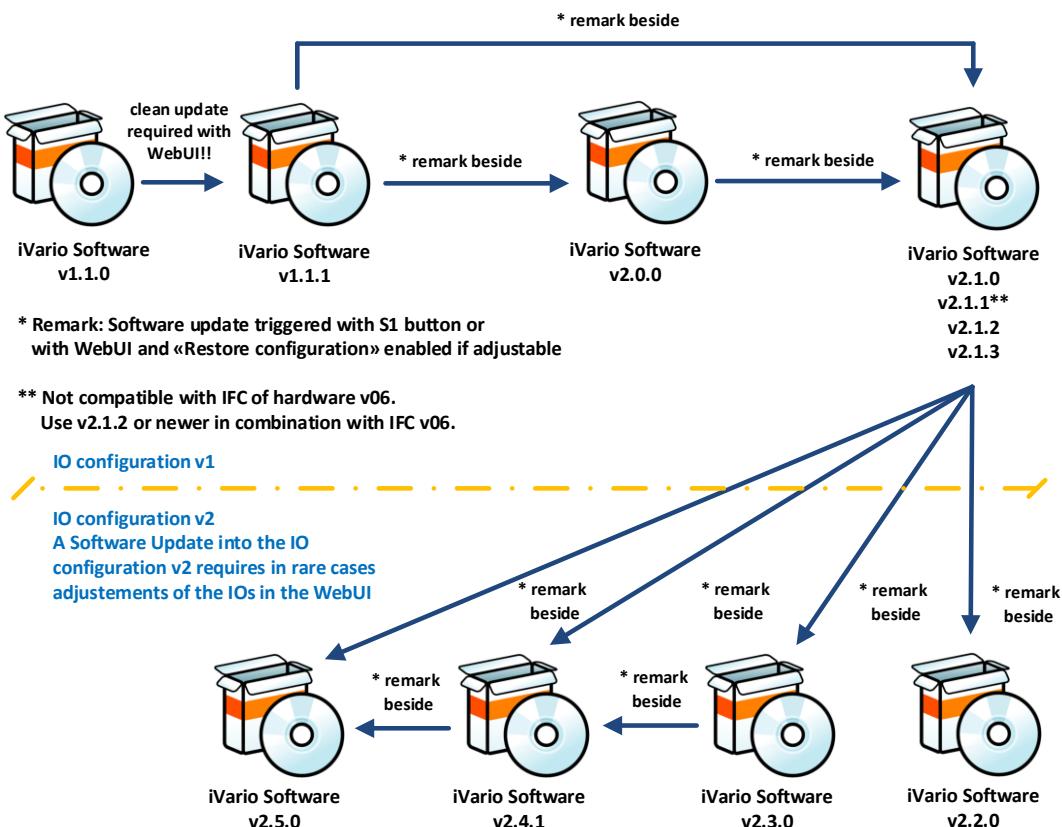


⚠ Compatibility error

With the v2.5.0, there is a prevention of downgrade over the normal update mechanism. Downgrading needs the workaround over the rescue system, which does physically only exist on v2.3.0 or newer. On older versions without rescue system, only a rollback to the one previously installed version is possible.

The officially released IFC Software v2.5.0 is: t3-release_V.2.5.0.689ff5d.fw
The software is distributed by Comet Technical Customer Service.

The iVario software update strategy is described in the graphic below. Please make sure to always follow this strategy.



The Software update of the entire system can be performed in 2 ways:

- Through the WebUI, page “Operation”, section “Software update”
- By pressing for more than 5 seconds the button “S1” and having the Software version ready on the root folder of the connected USB stick on “X6”

16.1 Software upgrade through WebUI

The page “Software update” in the “Operation” section of the WebUI provides the update features for all the different components of the present system. The software update process is guided by an overlay window where the details about the update status are displayed.

Installed Version	Part	SW Version
	IFC	V.2.5.0.689ff5d

Installed Versions	Part	SW Version
	POC1	V.2.5.0.689ff5d
	POC2	
	Cathode tank	V.2.5.0.689ff5d
	Anode tank	
	FGU	

There are two different use cases:

- Update the entire system (new software on the USB stick or on the locally connected computer)
- Equalize the connected components to the software of the IFC

16.1.1 Software update of the entire system

The screenshot shows the 'Software Update' section of the comet software. On the left, there's a sidebar with 'Operation', 'Generator Info', 'HV Operation', 'Software update' (which is selected), 'Reports', 'Setup' (with sub-options: Generator, I/O, Communication, Application), and 'System'. The main area has a title 'Software Update' and 'Generator Main Software'. It shows an 'Installed Version' table with one row for 'IFC' at 'V.2.5.0.689ff5d'. Below this is a 'System Update' section with a dropdown 'Source' set to 'USB' and a blue-bordered 'Start system update' button.

You can update the entire system having the new software version either on the connected USB stick (X6) or locally on your connected computer.

Software v2.5.0 on the USB stick



The software file “t3-release.fw” must be used
Place this file on the root folder of the USB stick and plug the stick on “X6”.
Choose “USB” in the drop-down menu of the source and press “Start system update”.



Software Update

Generator Main Software

This is a screenshot of the 'Software Update' screen for a 'USB' source. It shows the same basic layout as the previous screenshot, with an 'Installed Version' table and a 'System Update' section where the 'Source' dropdown is explicitly set to 'USB'.

Software v2.5.0 on the locally connected computer

The software file “t3-release_V.2.5.0.689ff5d.fw” or “t3-release.fw” can be used
Choose “File” in the drop down menu of the source and browse for the specific file on your computer. Then, click “Start system update”.



Software Update

Generator Main Software

This screenshot shows the 'Software Update' screen with a 'File' selected in the 'Source' dropdown. A file browser window is open, showing a single file named 't3-release_V.2.5.0.689ff5d.fw'. The 'Start system update' button is visible at the bottom.

16.1.2 Equalize the software of the IFC on the attached components



Since with the IFC software version v2.5.0 the Powercells and Tanks are upgraded / downgraded automatically to the IFC software version if a software incompatibility is detected, the “Equalize” feature drastically lost its importance.

The actually running and installed software version of the IFC is stored locally as a backup. This software can easily be spread on the other components by “equalizing” the software version of the IFC to Powercell(s) and Tank(s) if required.

The screenshot shows the comet software interface with the following details:

- Left Sidebar:** Operation (Generator Info, HV Operation, Software update, Reports), Setup (Generator, I/O, Communication, Application).
- Main Header:** Software Update
- Section: Generator Main Software**
 - Installed Version:** IFC SW Version: V.2.5.0.689ff5d
 - System Update:** Updates the whole generator including its components. Source: File (t3-release_V.2.5.0.689ff5d/fw). Start system update button.
- Section: Components**
 - Installed Versions:** POC1 SW Version: V.2.5.0.689ff5d, POC2, Cathode tank SW Version: V.2.5.0.689ff5d, Anode tank, FGU.
 - Equalize Versions:** Equalizes each component with the same software version as the IFC if they do not match. Equalize button.

Restart the system after the “Equalize” process.

16.1.3 Software update progress status

Once the software update has started, an overlay window will prompt you about the actual progress of the software update.

System Update (USB)

Starting update...
loading software package...
start software package decryption...
Verifying signature of software package...
Extract decrypted software package...
Decrypting software package...
Preparing update...
Identify new version...
extract IFC package...

As explained below, a system software update can take up to five minutes and requires several re-boots of the generator. You will be guided and informed in the overlay window and the software update process will re-synchronize automatically after a re-boot of the generator.

Generator is booting

System shutting down...



HVPS disconnected

Connection lost, waiting for automatic reconnection!



HVPS disconnected

Trying to reconnect..

After an automatic reconnect and a manual login the update of the Powercell will be done.

System update

Starting update...
Stopping services...
updating poc1...
Re-trying to update poc1 with compatibility mode for old hardware revisions...
Updating POC finished
Starting update...
Stopping services...
updating poc2...

Afterwards, update of tank

System update

```
updating poc2...
Re-trying to update poc2 with compatibility mode for old hardware revisions...
Update of poc2 failed, system may have only 1 POC available.
Updating POC finished
Starting update...
Stopping services...
updating ctank...
Updating TANK finished
Starting update...
Stopping services...
updating atank...
Updating TANK finished
```

Once the software update is performed and the generator did the final reboot, the software versions on the IFC, Powercell(s) and Tank(s) are equal.

Component Software	Part	SW Version
	IFC	V.2.5.0.689ff5d
	BSP	V.2.5.0.eb0f71c
	POC1	V.2.5.0.689ff5d
	s-cpu POC1	V.2.2.0.S.0.1.LAS.0.1.T06
	POC2	
	s-cpu POC2	
	Cathode tank	V.2.5.0.689ff5d
	Anode tank	
	FGU	



An entire Software update can take up to 5 minutes and maybe requires several reboots of the system.

16.2 Software upgrade through the push-button “S1”

You can update the Software of the entire system by pressing for **more than 5 seconds** the button “S1” on the IFC.

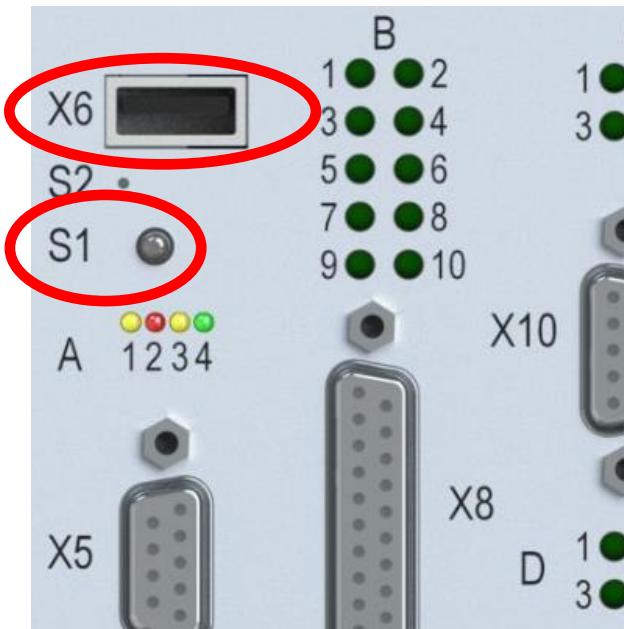


**The software file
“t3-release.fw” must be
used**

Copy the file on the root folder
of a USB stick and plug
the stick on “X6”.



Press for at least 5 seconds the button
“S1” and release it



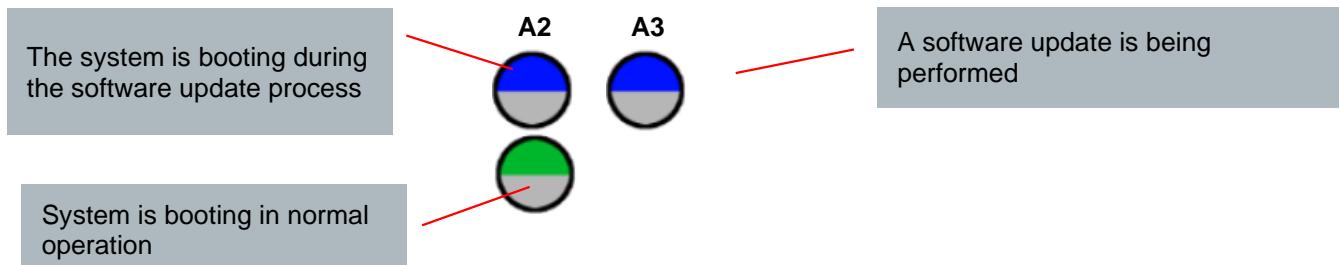
Follow the LED status described in the chapter below to understand the progress in the software update.



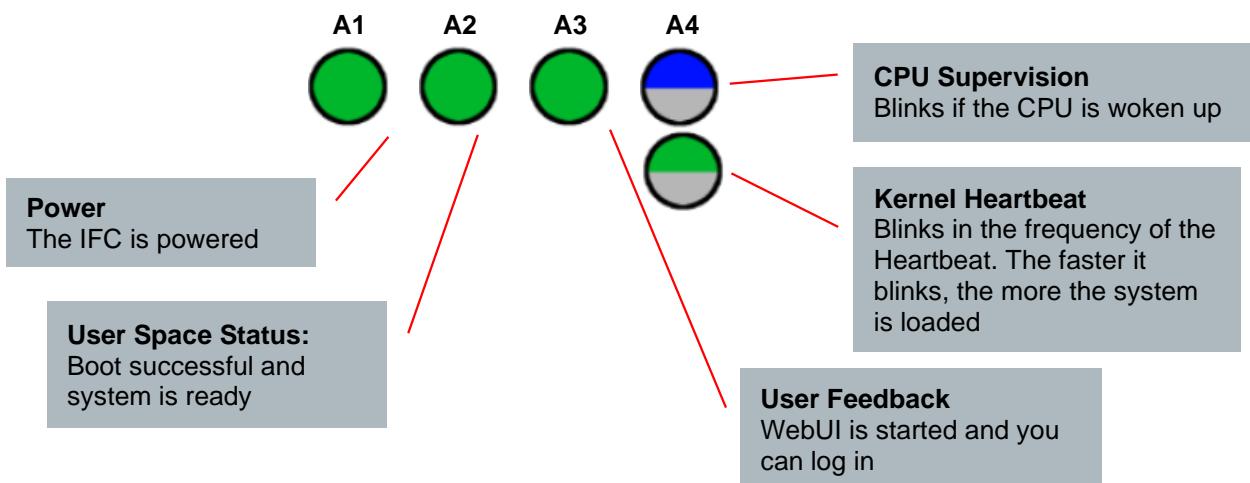
An entire Software update can take up to 5 minutes and maybe requires
several reboots of the generator.

16.3 LED status during the Software upgrade

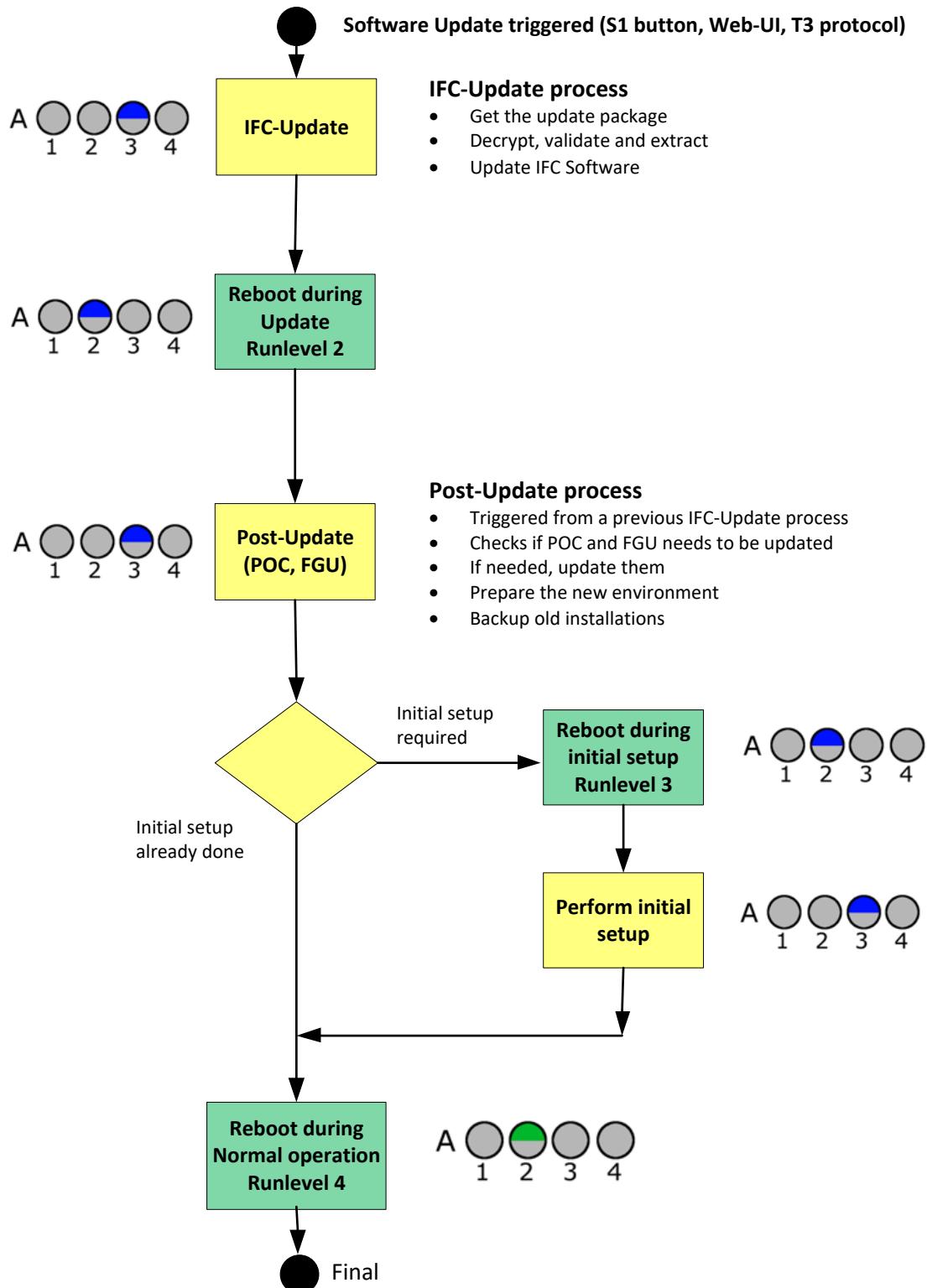
During a successful software update, the LEDs A2 (User Space Status) and A3 (User Feedback) are relevant



After the final reboot, the system is back in regular operation mode and the LEDs of the IFC A1..4 are in following state



In the picture below is described the software update sequence.



16.4 What actions to take if a software upgrade fails?

If an update process fails, the LED A3 of the IFC is blinking red



Software update failed

The LED blinks red when a Software update failed.

A software update can fail because of following reasons:

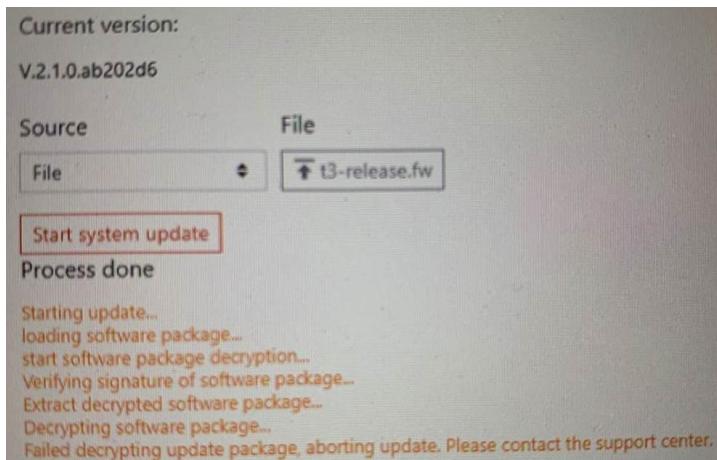
- Not enough available free memory on the IFC to install the new software
- The power fails during the IFC / Linux update (uncritical)
- Missing or not working Powercell 1
- Missing or not working Cathode Tank
- The power fails during the Powercell or Tank update
- Act of nature beyond control

There are several reasons why updates of sub systems are skipped:

- Powercell 2 (Slave) not available (it could be a 2.25kW system)
- Anode tank not available (it could be a unipolar system)

16.4.1 Actions to perform after any erroneous Software update process

- **If there is not enough available free memory on the IFC to install the new software.** This issue generally comes along with the below error messages on the “Software update” page of the WebUI. Please directly contact Comet’s Technical Customer Service and attach the diagnostic report of the generator to your e-mail.



- **If some components are not updated.** Enter the WebUI on the section “Software update” and update the components manually using the “Equalize” button. If the manually triggered “Equalize” doesn’t work, re-perform the entire software update from the USB stick or your connected computer. If these actions don’t work, please directly contact Comet’s Technical Customer Service and attach the diagnostic report of the generator to your e-mail.

16.5 Software Upgrade / Downgrade using the Rescue System

What is the Comet Rescue System?

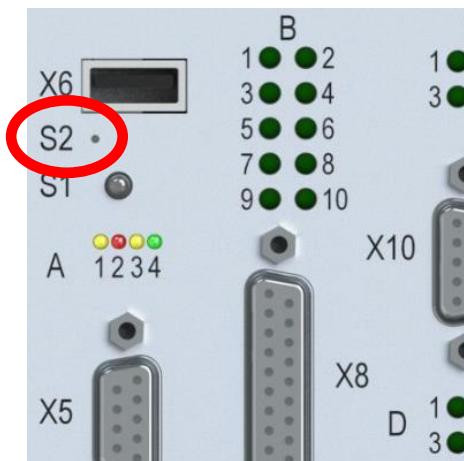
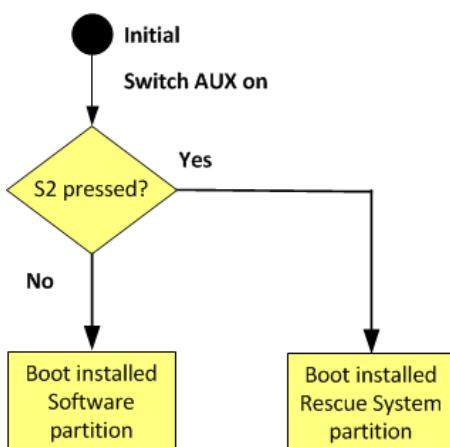
- The Rescue System is pre-installed on the Flash Memory of the IFC. It is available on Comet produced iXRS's with iVario Software v2.3.0 and newer. The first produced iXRS with the Rescue System was serial number 1093683 on November 26th in 2019
- The Rescue System is a completely working package intended for setting up a productive iXRS
- The Rescue System is the secure base to start installing / upgrading / downgrading any iVario Software version.
It will always install the default configuration of the selected version. The default configuration needs to be adapted.
- The Rescue System is a new partition on the Flash Card of the IFC
- Any iXRS already on the field will not / never be enabled with the Rescue System

The three basic OEM use cases:

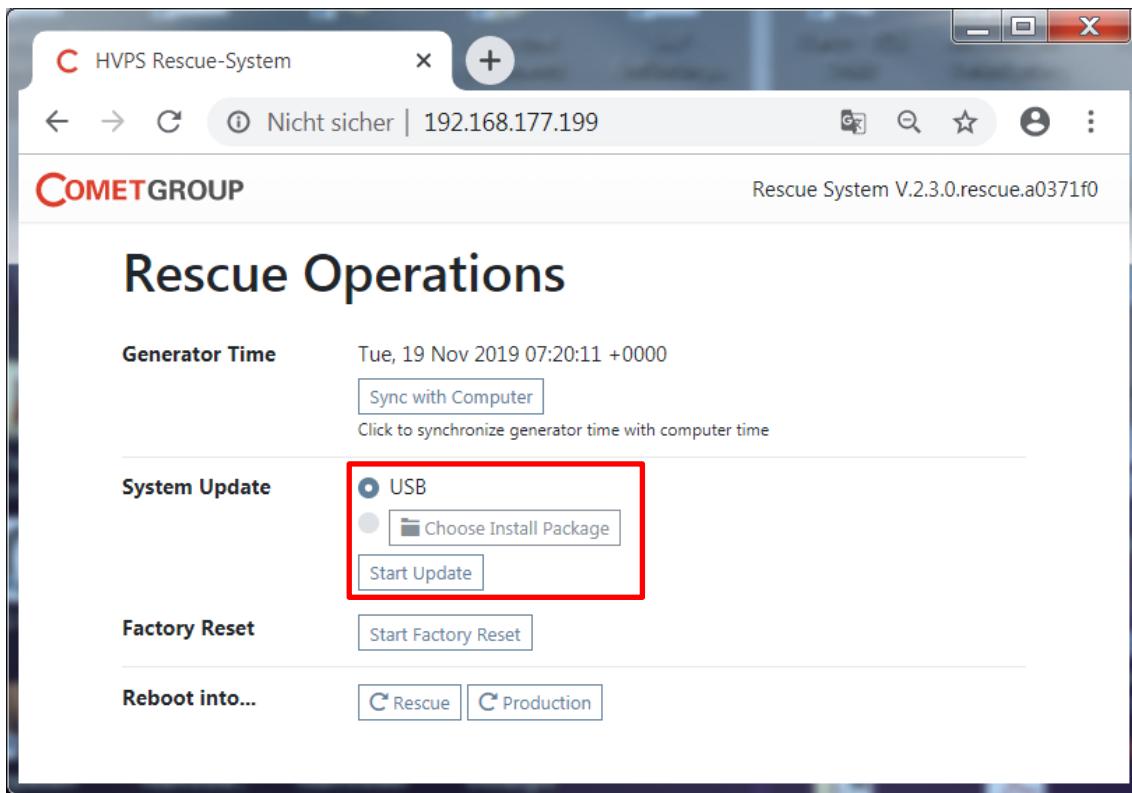
- Install from scratch the specific Software version without respecting the Software Update strategy
- Downgrade the iXRS when it is not possible to do it by Rollback
- If the iXRS doesn't boot anymore. Re-install the software from the Rescue System and load the previously back-upped configuration

How to access the Rescue system

- Switch off AUX power
- Softly press the S2 push button with a fine needle (a paper clip does it well) until you can feel the trigger point
- Switch on AUX power with the S2 push button pressed
- Wait approximately 6 seconds (until LEDs A1, A2 and A4 are for the first time lightened) and release the push button S2



Navigate with your browser on the IP address of your generator and you will land on the Rescue System web interface



This is the starting point to install the new Software.

Select the source of your iVario software you want to install:

- Make sure the file "t3-release.fw" is on the root of the USB stick if you install from USB
- Use the file "t3-release_V.2.5.0.689ff5d.fw" or "t3-release.fw" if you install from the local computer

Press "Start Update".

System Update (USB)

```
System update - verifying options and boot location switch...
Mount var partitions...
preparing flash...
Mount var partitions...
Loading the software package...
Verify update package signature...
Verifying signature of package...
```

16.6 Rollback to previously installed release

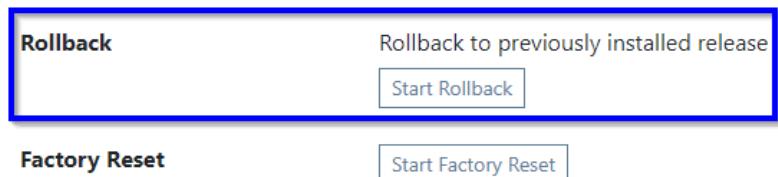
This feature in the section “Software Update” is only available for WebUI user level “ser”. Please contact Comet’s Technical Customer Service for support.

In case of an occurring problem after a software update, it is possible to go back one step and reload the previous software version before the last update was performed.

The following parameters are set back to previous configuration:

- COM configuration (IP, serial configuration)
- I/O configuration
- Application configuration
- *Report history (is not available for ≥ v2.1.x)*
- Tube selection
- Cable selection

Reset / Restore Generator



Press the “Start Rollback” button and the software rollback will start.

System Update (Rollback)

Starting update...
loading software package...
start software package decryption...
Verifying signature of software package...
Extract decrypted software package...
Decrypting software package...
Preparing update...
Identify new version...
extract IFC package...



An entire Software rollback can take up to 5 minutes and maybe requires several reboots of the system. It is possible to go ONE step back with the rollback feature.

16.7 Software upgrade for special purpose (rare)

By default, for regular Software updates, the feature “Restore Configuration” is always enabled, but not visible for the “oem” user level of the WebUI. Please contact Comet’s Technical Customer Service for support.

System Update	Current version: V.2.1.0.ab202d6
Source	<input type="button" value="USB"/>
<input type="button" value="Start system update"/>	

If you want to access this feature you will have to log into the WebUI as user “ser”.

System Update	Current version: V.2.1.0.ab202d6
<input checked="" type="checkbox"/> Restore Configuration	
Source	<input type="button" value="USB"/>
<input type="button" value="Start system update"/>	

If this box remains unchecked, your system configuration will not be restored and you will have to re-configure your system afterwards.

Independent of the selected source, the option “Restore Configuration” can remain unchecked for specific Software updates.

System Update	Current version: V.2.1.0.ab202d6
<input type="checkbox"/> Restore Configuration	
Source	<input type="button" value="USB"/>
<input type="button" value="Start system update"/>	

Check this box only for special updates (i.e. clean updates). It will cause the system configurations being restored to default values and configuration files/parameters will be generated from scratch.

There are conditions where a so called “Clean” software update is required and the box “Restore Configuration” must remain unchecked. This “Clean update” is for example mandatory for huge software updates when the configuration table is dramatically modified.

16.8 Factory reset

This feature is only available for WebUI user level “ser”. Please contact Comet’s Technical Customer Service for support.

Performing a Factory Reset will trigger an update/downgrade to the software version as the generator was delivered from the factory.

In addition it will set following data from the iVario generator back to the factory default values:

- COM configuration (IP, serial configuration)
- I/O configuration
- Application configuration
- Report history (all the user-history is cleared)
- Tube selection
- Cable selection
- Parameters (cable, tank, tube)

Reset / Restore Generator

Rollback	Rollback to previously installed release <input type="button" value="Start Rollback"/>
Factory Reset	<input type="button" value="Start Factory Reset"/>
Factory Reset	<input type="button" value="Start Factory Reset"/> Process done Starting update... loading software package... start software package decryption... Verifying signature of software package... Failed decrypting update package, aborting update. Please contact the support center.

17 Backup and restore of the configuration

Once the commissioning task is finished, it makes sense to back-up the configuration of the system in a backup file that is stored at a save place. This backup is performed through WebUI in the section “Setup” → “Generator” → “Configuration”. You will be able to restore your configuration at any time.



The iVario Software version of the backup configuration and of the restore configuration must be the same to guarantee a consistent configuration.

comet ☀

Generator Setup

Operation

- Generator Info
- HV Operation
- Software update
- Reports

Setup

- Generator** (selected)
- I/O
- Communication
- Application

Date and Time

Generator Time:

Set Time Manually: Europe/Zurich

Set Time Automatically:

This will synchronize the clock of the Generator with the time of your computer.
NOTE: The timezone has to be set manually first.

Tube and Cable

Tube:

Tube Serial Number:

Cable Length:

MXR-225/26

mA

Large (5.5 mm) Small (1.2 mm)

0 100 200 300 KV

Material Number: 915386.51, Connector Type: R24
Note: Diagram shows limits of tube, not considering tank, cable, application, ...

Tube Data-Set Install

Upload and install a tube data-set package

Reset Tubes to Release

Resets the tube data-set to the software release state

Configuration

Export

Exports the current generator configuration to a file that is directly downloadable.

Import

Importing a configuration will stop the generator and is rebooting at the end.

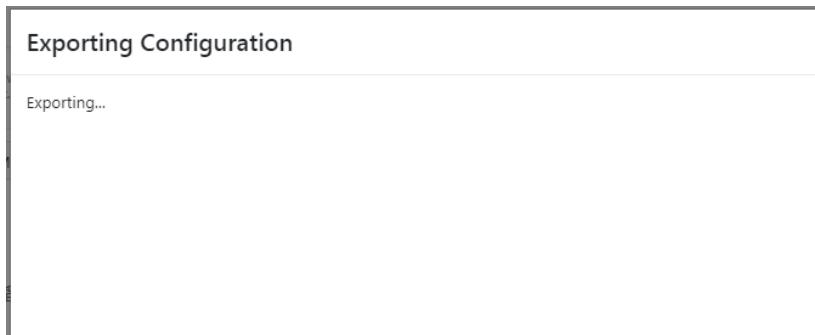
17.1 Backup of a configuration

To perform a backup, simply press the “Export” button “Export” ...

Configuration

Export	Exports the current generator configuration to a file that is directly downloadable. Export
Import	Importing a configuration will stop the generator and is rebooting at the end.  iVario-Config-Export-V.2.5.0.eb0f71c.tar.gz Import

... and a page overlay will appear.



After less than one minute, you will find the binary file ...

 [iVario-Config-Export-V.2.5.0.eb0f71c.tar.gz](#)

... in your download folder. The file is named with the Software version of the configuration backup. This file is nor readable, nor editable by yourself.

It contains following system data:

- I/O configuration
- Generator setup settings
- Communication
- Serial numbers
- Tube files
- Tank files
- Cable file
- Application configuration
- Serial numbers
- Installed Tube Data Set

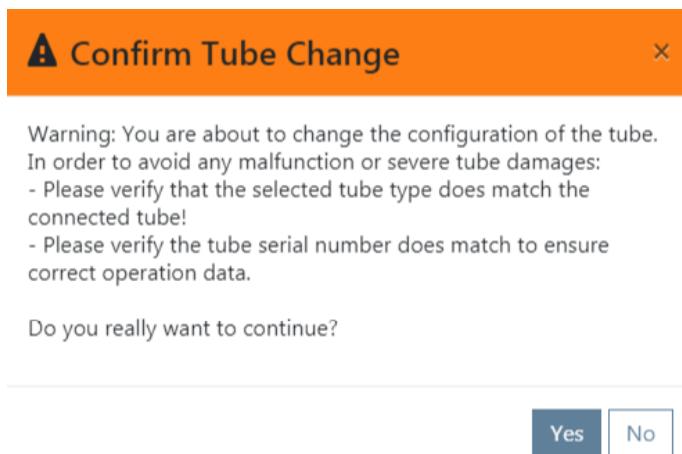
17.2 Restore of a configuration

To restore or import a previously back upped configuration, choose the binary file “iVario-Config-Export.tar.gz” through “Choose Config File” and press “Import”.

Configuration

Export	Exports the current generator configuration to a file that is directly downloadable. <input type="button" value="Export"/>
Import	Importing a configuration will stop the generator and is rebooting at the end. <input type="file" value="iVario-Config-Export-V.2.5.0.eb0f71c.tar.gz"/> <input type="button" value="Import"/>

If it occurs that your system is already configured with another type of tube than the one contained in the backup, you will have to apply following confirmation:



At the end of the restore process, the system will restart automatically.

Generator is booting

System shutting down...

And your system is restored and you can log into the WebUI again.

18 Operation information and statistics

All the operation information relevant data can be downloaded with the “Operation Report” in PDF format from the WebUI page “Reports”.

The screenshot shows the 'Reports' section of the comet WebUI. On the left, there's a sidebar with 'Operation' (Generator Info, HV Operation, Software update), 'Reports' (selected), and 'Setup' (Generator, I/O, Communication, Application). The main area has a heading 'Download' and three items:

- Download all reports**: If you press "Download all reports" all reports will be created in sequence. Up to 3 download pop-ups will be generated. This can take up to 10 minutes. [Download all reports](#)
- Diagnostic Report**: If you press "Download Diagnostic Report" the report (incl. the operational-report) will be created first. This can take up to 5 minutes. [Download Diagnostic Report](#)
- Operational Report**: If you press "Download Operational Report" the report will be created first. This can take up to 30 seconds. [Download Operational Report](#)

The 'Operational Report' item is highlighted with a blue border.

The report is named with date and time of execution:

[operational-report-SN123456-IFC309-2021.07.26_11.57.07.pdf](#)

Table of Contents
▶ 1 Information
▶ 2 Configuration
▶ 3 Generator Status
▶ 4 Statistics

The chapter 4 covers the statistics about the generator and its components including “Generator operation information”, “Component operation information”, “Exposure history” and “Component history data”.

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4 Statistics

Total HV-Off Time	Cumulate the time when the HVPS is in the HV OFF state (operating sub state).
Relative HV-Off Time	Cumulate the time when the HVPS is in the HV OFF state (operating sub state) since the last HV OFF request.
Total HV-On Time	Cumulate the time when the HVPS is not in the HV OFF state (operating sub state).
HV Enable Counter	Received HV ON requests through any external interface.
Total number of Arcs	The sum of arcs in total during lifetime of generator.
Next Warm-Up	Shows the time until the next warm-up is triggered by the system, if the automatic mode (warm-up) is enabled.

4.1 Generator operating information

4.2 Component operating information

4.2.1 Component ifc

Description	Value
Serial Number	I.187
Component ID	ifc
Total HV-Off Time	15245:40:14
Total HV-On Time	1259:05:27
Relative HV-On Time	00:00:00
HV Enable Counter	8493
Total number of Arcs	14



4.2.2 Component poc1

Description	Value
Serial Number	P.325
Component ID	poc1
Total HV-Off Time	15245:40:14
Total HV-On Time	1259:05:27
Relative HV-On Time	00:00:00
HV Enable Counter	8493
Total number of Arcs	14

4.2.3 Component ctank

Description	Value
Serial Number	T.863542
Component ID	ctank
Total HV-Off Time	15245:40:14
Total HV-On Time	1259:05:27
Relative HV-On Time	00:00:00
HV Enable Counter	8493
Total number of Arcs	14

4.2.4 Component atank

Description	Value
Serial Number	T.783827
Component ID	atank
Total HV-Off Time	15245:40:14
Total HV-On Time	1259:05:27
Relative HV-On Time	00:00:00
HV Enable Counter	8493
Total number of Arcs	14

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19.1 How can I communicate with my iVario over Ethernet?

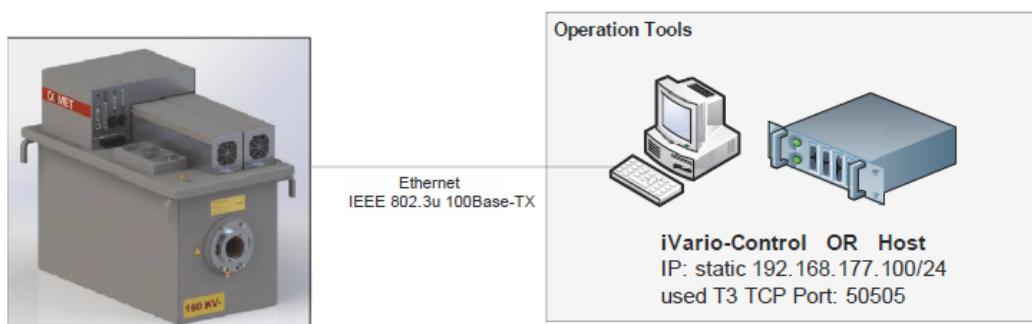


I want to establish the communication with my iVario over Ethernet.



The communication with the iVario is established over IP. Each iVario is delivered by default with the IP address 192.168.177.199. By factory defaults, the iVario is a device in a class C network.

So, be sure to set your computer on the same network as the iVario to setup the communication with the device. Setting up the IP address of your computer will require at least local admin rights. In the example below was chosen the static address 192.168.177.177.



iVario Generator
Standard network component
IP:
- static 192.168.177.199/24

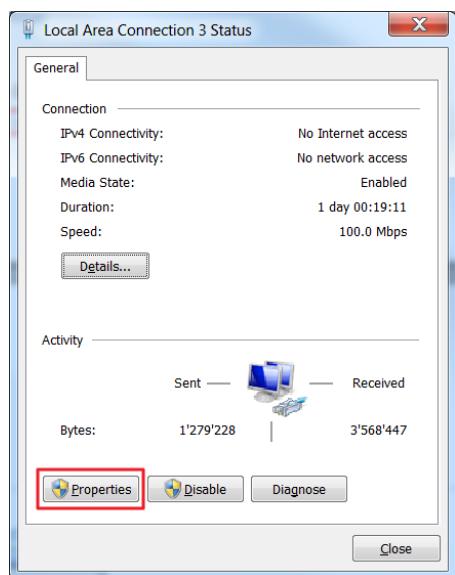
Plug your computer with an Ethernet Patch cable CAT5 (a cross cable will also work) to the iVario "X4" Ethernet connector.

You can define the IP address of your computer in the "Control Panel" under "Network and Sharing Center". Look for one of your "Local Area Connection" and click it to select.

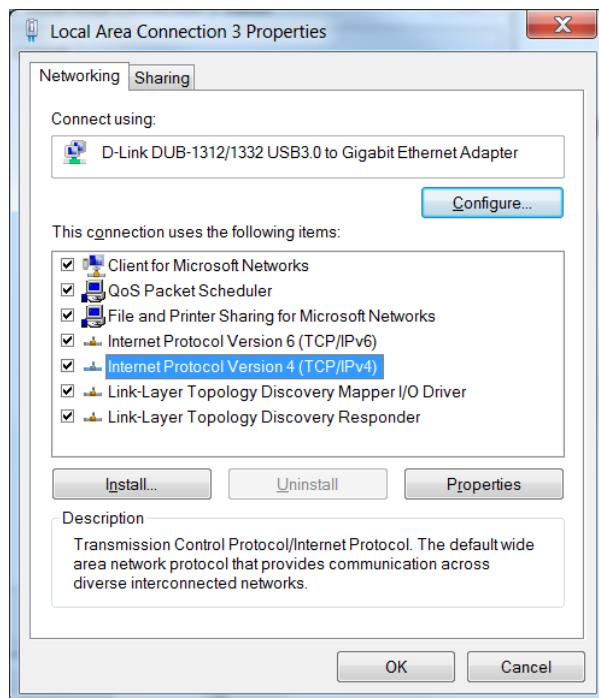
Access type: Internet
Connections: Local Area Connection
 Wireless Network Connection (wififla)

Access type: No Internet access
Connections: Local Area Connection 3

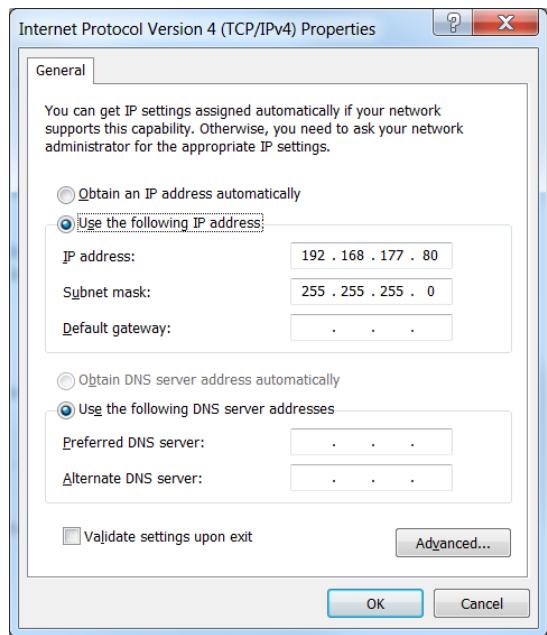
Then, choose "Properties" (here you will at least need local admin rights on your computer)



Select “Internet Protocol Version 4 (TCP/IPv4) and click “Properties”

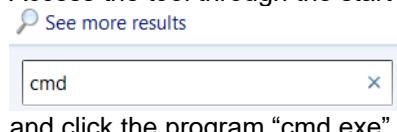


Next you can adjust your computers local IP address and press “OK”.



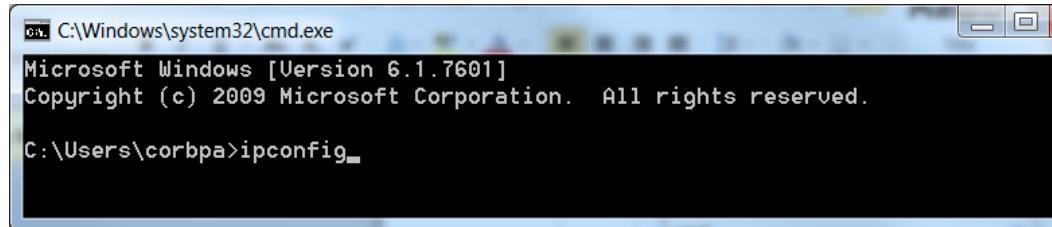
Keep in mind that you have to configure your computer on the same network as the iVario. By default, the iVario is configured on 192.168.177.199.

You can verify your configured IP address using the DOS prompt "cmd.exe" tool. Access the tool through the start menu and search for "cmd".

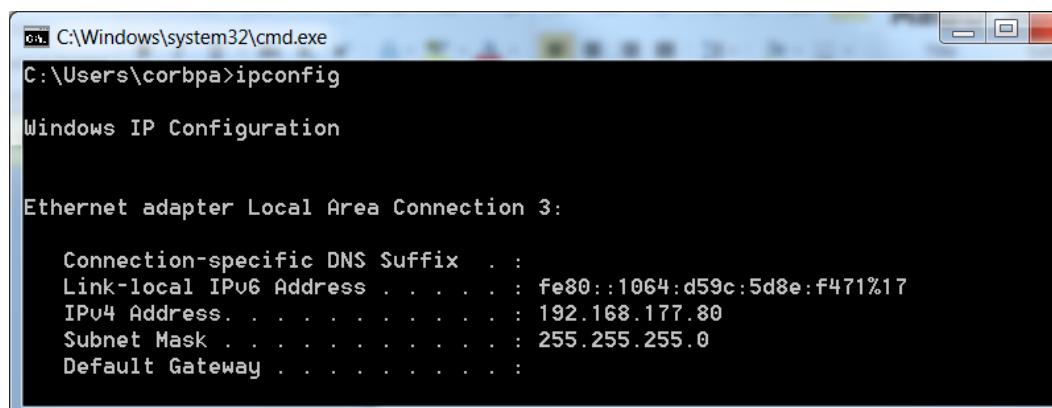


and click the program “cmd.exe”.

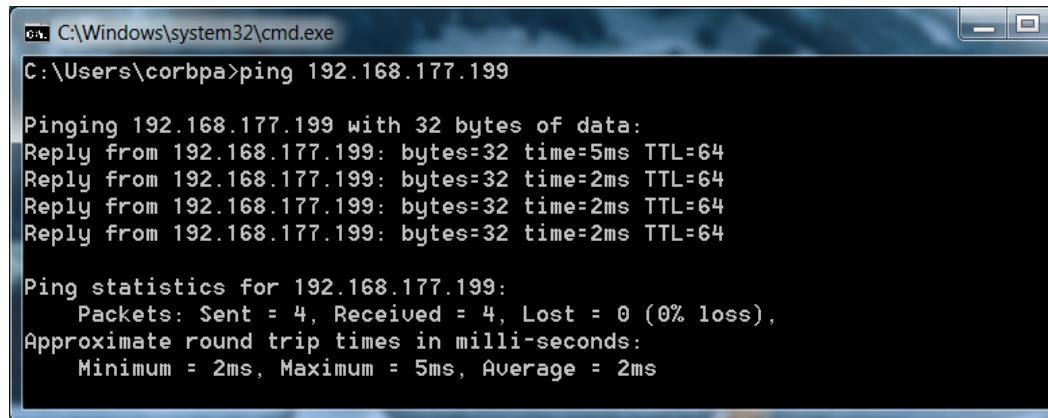
With the command “ipconfig” and <CR> you will be able to display the IP configuration of your computer.



The IP address 192.168.177.80 must be listed now.



To test the Ethernet communication between your computer and the iVario, a simple “Ping” command to the address of the iVario will do it.



```
C:\Windows\system32\cmd.exe
C:\Users\corbpa>ping 192.168.177.199

Pinging 192.168.177.199 with 32 bytes of data:
Reply from 192.168.177.199: bytes=32 time=5ms TTL=64
Reply from 192.168.177.199: bytes=32 time=2ms TTL=64
Reply from 192.168.177.199: bytes=32 time=2ms TTL=64
Reply from 192.168.177.199: bytes=32 time=2ms TTL=64

Ping statistics for 192.168.177.199:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 2ms, Maximum = 5ms, Average = 2ms
```

On the above picture are listed four successive and successful echoes to a “Ping” command.

If this command is successful, the IP communication between your computer and the iVario is established.

19.2 Guarded Communication

This feature is available since iVario software v2.1.0.

There is the possibility to supervise and monitor the communication with the iVario generator. This feature is implemented to detect a client connection loss (Control cable unplugged, Control Software freeze, ...). If the client fails to write the specific key in the required time, the generator will react according to the guard mode set for this interface.

One can enable a “guard mode” for the given four interfaces:

- TCP Port 50505
- TCP Port 50506
- Serial (RS-232 serial line)

19.2.1 Setup the Guarded Communication in the WebUI

The screenshot shows the 'Communication Configuration' page in the iVario WebUI. The left sidebar has 'Communication' selected. The main area has sections for Network, Remote Control, and Guarded Communication. In the Guarded Communication section, there is a checkbox labeled 'Enable the watchdog feature on the communication level'. Below it is a note about the feature requiring periodic keys to keep the generator alive. A table at the bottom lists three interfaces: TCP port 50505 (Mode: Restrictive, Timeout: 5s), TCP port 50506 (Mode: Disabled), and Serial Port (Mode: Disabled). A green 'Apply' button is at the bottom of the table.

On guarded interfaces, the client (iVario Control Software, Controller, OEM Frontend) has to send the T3 keep-alive key (GRDKA) on regular base and within the configured timeout. If the iVario generator doesn't get the regular keep alive an action is performed depending on the severity mode set for the specific interface.

There are three severity modes available:

Severity mode	Description
DISABLED	The feature „Guarded Communication“ is disabled for the this interface
RESTRICTIVE	<p>The connected client has to send the keep-alive T3 protocol key (GRDKA) periodically. Otherwise, the generator will</p> <ul style="list-style-type: none"> - set a not-ready condition and will not be able to generate High Voltage. - shut down and set the not-ready condition, if already in “HV-Operation” mode. <p>The system will be ready again, as soon as all the required clients are back online.</p>
TOLERANT	<p>As soon as a client starts sending the keep-alive key (GRDKA) periodically, the communication will be guarded.</p> <p>If the generator is generating High Voltage, it switches off when the client stops sending the keep-alive.</p> <p>But the generator will not require the client to send the keep-alive key again, to switch on the next time.</p>

19.2.2 Set up the keep alive telegram

There are several ways to generate the keep alive telegrams on a selected port. The iVario Control Software and the optional Controller do this job automatically, if the specific port is configured on the generator side.

19.2.2.1 With the iVario Control Software

There is no need to setup the keep alive signal on the iVario Control Software side. The software automatically detects if a keep alive is required and acts accordingly. By default, the port 50505 is used.



Restrictive Mode should be the default mode if the guard is enabled. When using the guarded communication on the serial interface, make sure the serial protocol is set to T3. If the MG protocol is set, the guarded communication setting for the serial port is ignored.

19.2.2.2 With the optional Controller

There is no need to setup the keep alive signal on the iVario Control Software side. The software automatically detects if a keep alive is required and acts accordingly. By default, the port 50506 is used.



Restrictive Mode should be the default mode if the guard is enabled. When using the guarded communication on the serial interface, make sure the serial protocol is set to T3. If the MG protocol is set, the guarded communication setting for the serial port is ignored.

19.2.2.3 With the T3 protocol

Read:

No

Write:

Yes, Port 0x10

AMSG allowed: No

This command resets the Interfaces Guard timeout. If guarded communication is enabled on this interface, this key has to be written by the client periodically. The send interval has to be faster than the guard timeout set for this interface.

This is for detection of client connection loss. If the client fails to write this key in the needed time, the generator will react according to the guard mode set for this interface, resulting in a shutdown and/or a not ready condition set.

	Port	Request Value	Response Value
Write	0x10	-	#0

Example:

TX →	TA10S0006-- GRDKA;	Resets the Interfaces Guard timeout
RX ←	TA10R0009-- GRDKA=#0;	Get back the positive acknowledge

19.2.3 Troubleshoot an event caused by guarded communication

You are noticed about an event caused by guarded communication in the not-ready-conditions. If a shutdown of the generator was forced, you will get noticed by a shutdown reason as well.

19.2.3.1 Notification in the WebUI

The best is to check the page “HV Operation” which contains all the necessary information.

The status turns into not-ready and you get a notice about the Guarded Communication



You get a not-ready notice in the device “IFC” in the subsystem “COM”

Not-Ready Conditions	
HVPS: 0x80000001	
● IFC	0x80000004
I/O	0x0
OP	0x0
CAN	0x0
LI	Guarded Communication
COM	0x2
● POC(s)	0x0
master	0x0
slave	0x0
● iDevice(s)	0x0
cTank	0x0
aTank	0x0
● FGU	0x0

You get a shutdown reason indication which port was causing the Guarded Communication shutdown

comet  COM Guarded client missing

HV Operation

Operation

- Generator Info
- HV Operation**
- Software update
- Reports

Setup

- Generator
- I/O
- Communication
- Application

High Voltage: 0.0 kV (40 kV) | Tube Current: 0.0 mA (5 mA) | Exposure Time: 3.0 s (0 s) | Focal Spot: 5.5 mm (5.5 mm)

HV On | HV Off | Apply Setpoint

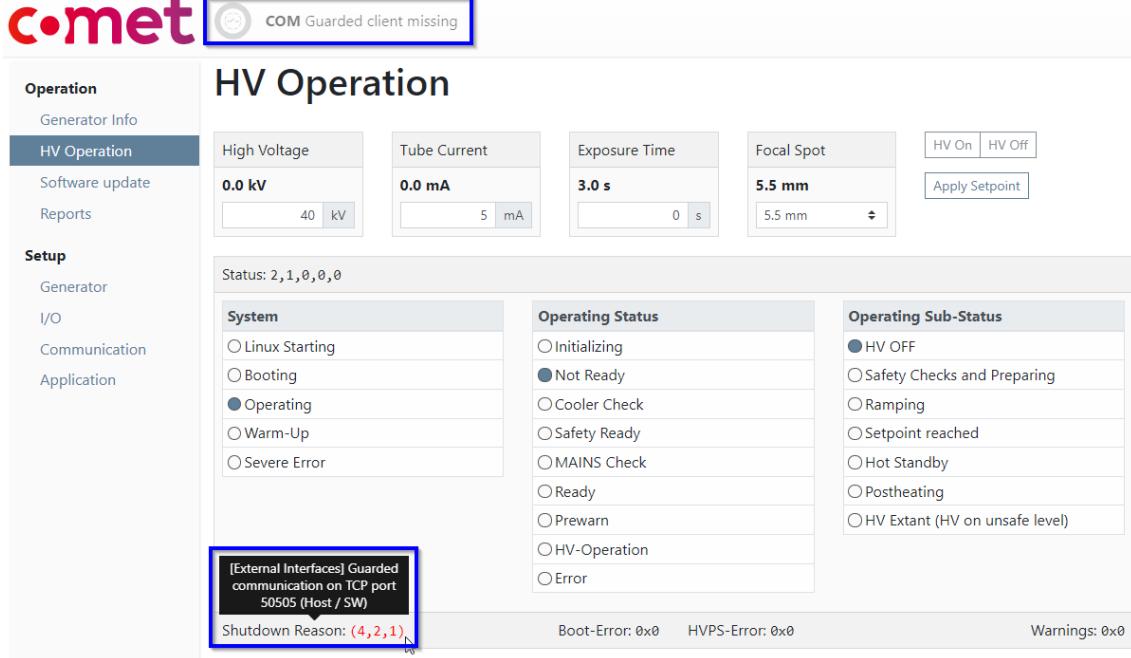
Status: 2,1,0,0,0

System	Operating Status	Operating Sub-Status
<input type="radio"/> Linux Starting	<input type="radio"/> Initializing	<input type="radio"/> HV OFF
<input type="radio"/> Booting	<input checked="" type="radio"/> Not Ready	<input type="radio"/> Safety Checks and Preparing
<input checked="" type="radio"/> Operating	<input type="radio"/> Cooler Check	<input type="radio"/> Ramping
<input type="radio"/> Warm-Up	<input type="radio"/> Safety Ready	<input type="radio"/> Setpoint reached
<input type="radio"/> Severe Error	<input type="radio"/> MAINS Check	<input type="radio"/> Hot Standby
	<input type="radio"/> Ready	<input type="radio"/> Postheating
	<input type="radio"/> Prewarn	<input type="radio"/> HV-Operation
	<input type="radio"/> HV-Operation	<input type="radio"/> Error
		<input type="radio"/> HV Extant (HV on unsafe level)

[External Interfaces] Guarded communication on TCP port 50505 (Host / SW)

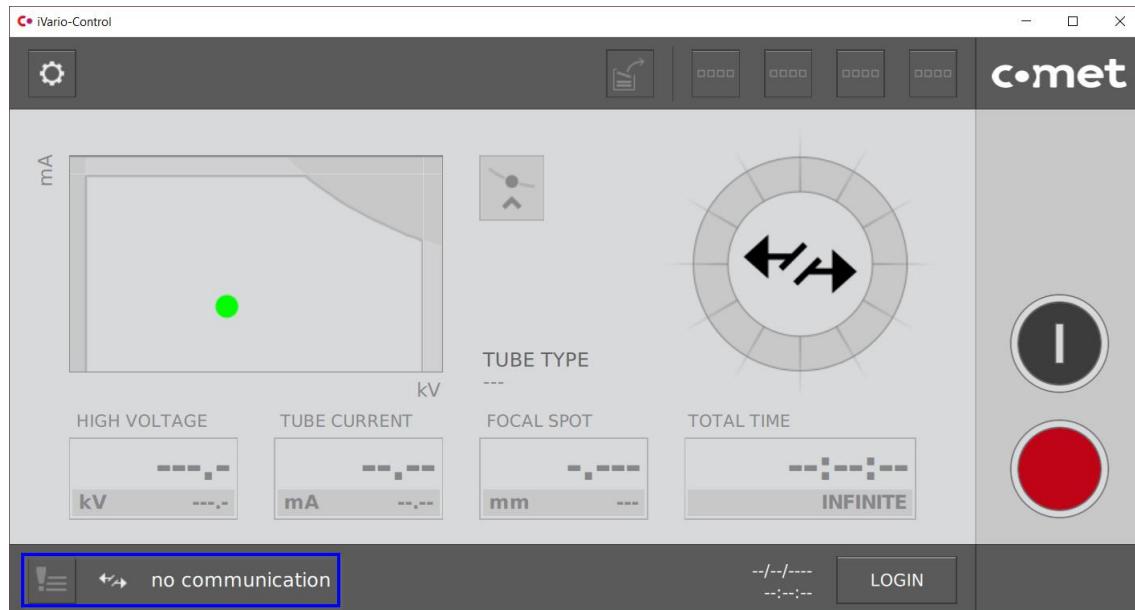
Shutdown Reason: (4,2,1)

Boot-Error: 0x0 HVPS-Error: 0x0 Warnings: 0x0

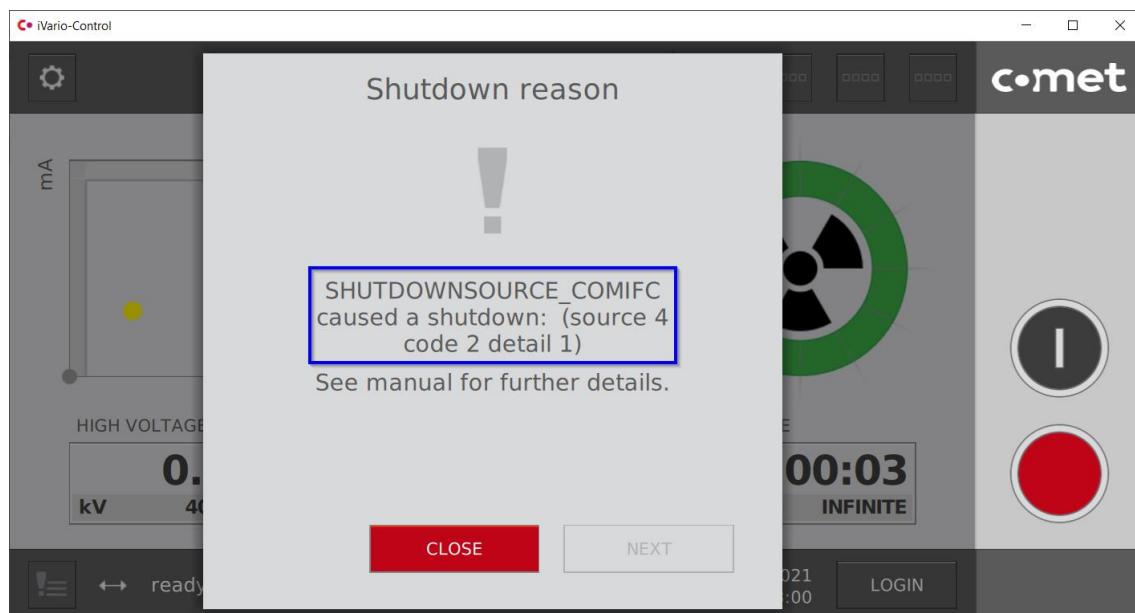


19.2.3.2 Notification in the iVario Control Software

You get a not-ready notice that your generator is not safe anymore.



First of all, there is no more communication to the generator.



Once the communication is re-established, you get a shutdown reason with source 4, code 2 and detail 1. Refer to the annex of the Service Manual.

21.2.3 Source 4: Shutdown code and detail of "external interfaces" (COM/ITF)

The following table shows the possible shutdown code and detail of this part.

Code #	Detail #	Description	Why does it occur?	How to get rid of it?	If it is still there, then ...
1	0	OFF command. COM service, "Stop" command received	Regular There was a HV OFF command over Control Software or software protocol	Regular	Regular
2	0	It's all about the Guarded communication			
		Guarded port 50506	Communication lost on TCP port 50506	Check the device on TCP port 50506	
		1 Guarded port 50505	Communication lost on TCP port 50505	Check the device on TCP port 50505	
		2 Guarded port 50507	Communication lost on TCP port 50507	Check the device on TCP port 50507	
	3	Guarded port serial	Communication lost on serial line port	Check the device on the serial port	

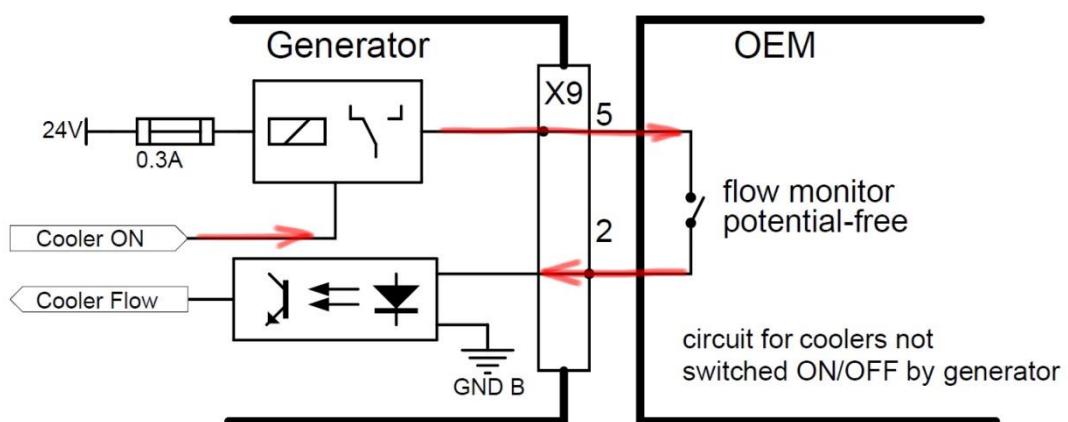
19.3 Monitoring the cooler flow for transition at boot up

With iVario software v2.4.1 we introduced an additional monitoring feature for the cooling of the tube. At the boot up of the generator, the cooler flow is checked for a transition. With this feature, the system operator will be notified if the flow switch is blocked.

This feature is configurable in the WebUI. It is automatically enabled with v2.4.1 and newer software versions.

The screenshot shows the 'Application Configuration' section of the comet software interface. On the left, a sidebar lists 'Operation', 'Setup' (with 'Generator', 'I/O', 'Communication', and 'Application' options), and 'Reports'. The 'Application' option is selected and highlighted with a blue box. The main area is titled 'Application Configuration' and contains a 'Settings' section. A note states: 'The following topics are treated as settings and are independent of the generator wide configuration calculation.' Below this, under 'Prewarning', there are fields for 'Regular prewarn time' (2 s) and 'Prolonged prewarning' (customer interlock 1 or 2 was open). Under 'Cooler', there are fields for 'Regular post-cooling time' (60 s), 'Emergency post-cooling time' (5 s), and 'Cooler flow timeout' (10 s). A checkbox labeled 'Check cooler flow transition' is checked and highlighted with a blue box. Under 'Warm-Up', there is a checkbox for 'Automatic switching'.

If you are running a third party cooler or if the cooling circuit is continuously on, the flow contact can be implemented as shown in the diagram below. This picture is an extract of the OEM Manual.



19.4 High Voltage Start and Stop with external hardware signals

The iVario Generator can be switched ON and OFF with external, potential free, signals on its interface. The external signals can be applied with Start or Stop push buttons or with an external control device, for example a PLC.

There are several requirements to fulfill to be able to switch ON and OFF the iVario generator with external signals.

19.4.1 Configuration in the WebUI

The two settings “Optional panel active” and “Auto start cycle active” of the WebUI page “Setup” “I/O” must both be enabled. Don’t forget to “Apply”.

The monitoring of the “Optional light” must be disabled and all states must be set to “Off”. Don’t forget to “Apply” and reboot the generator.

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"/>								
NOT-READY	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
COOLER CHECK	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
SAFETY READY	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
MAINS CHECK	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
READY	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
PREWARN	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
HV ON	<input type="radio"/>								
SETPT REACHED	<input type="radio"/>								

And in the advanced configurator

Operation

Generator Info

HV Operation

Software update

Reports

Setup

Generator

I/O

Communication

Application

I/O configuration

General

Use Optional Controller

Ignore HV Enable Button of X8

Apply

Output Configuration

Step 1: Allocation

Allocate warning lights and outputs to either system states or system information.

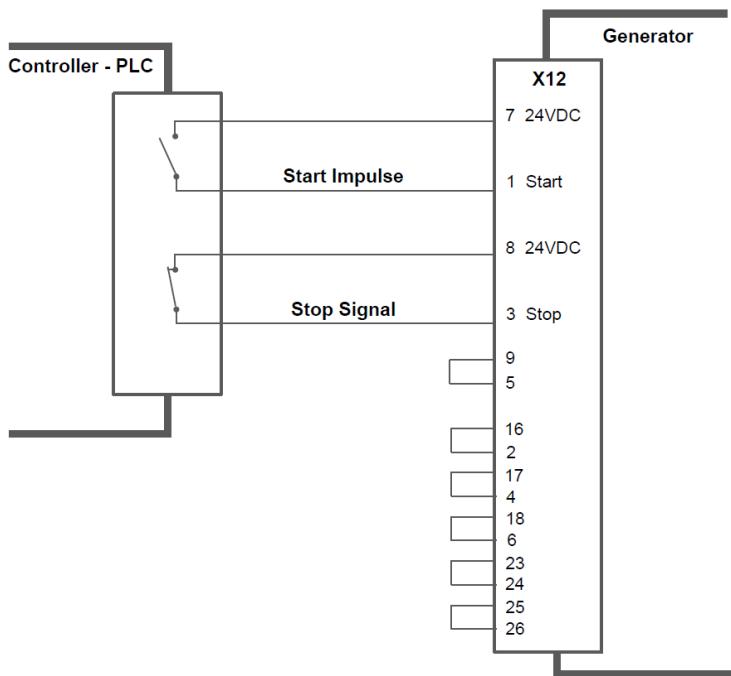
- **Disabled** (Do not use this output)
Disabled Warning Lights and Outputs will not appear below for configuration.
- **System Information** (e.g. imminent)
- **System States** (e.g. HV-on, Prewarn etc.)

Output 1	<input type="radio"/>	<input type="checkbox"/>	<input type="button"/>
Output 2	<input type="radio"/>	<input type="checkbox"/>	<input type="button"/>
Output 3	<input type="radio"/>	<input type="checkbox"/>	<input type="button"/>
Output 4	<input type="radio"/>	<input type="checkbox"/>	<input type="button"/>
Output 5	<input type="radio"/>	<input type="checkbox"/>	<input type="button"/>
Output 6	<input type="radio"/>	<input type="checkbox"/>	<input type="button"/>

Warning Light 1	<input type="radio"/>	<input type="checkbox"/>	<input type="button"/>
Warning Light 2	<input type="radio"/>	<input type="checkbox"/>	<input type="button"/>
Warning Light 3	<input type="radio"/>	<input type="checkbox"/>	<input type="button"/>
Warning Light 4	<input type="radio"/>	<input type="checkbox"/>	<input type="button"/>
Dynamic Monitoring	<input type="radio"/>	<input type="checkbox"/>	<input type="button"/>

19.4.2 Wiring the Start and Stop signals on connector X12 and dynamic behavior

The external Start and Stop signals are connected to the interface X12 as described below.



Wiring

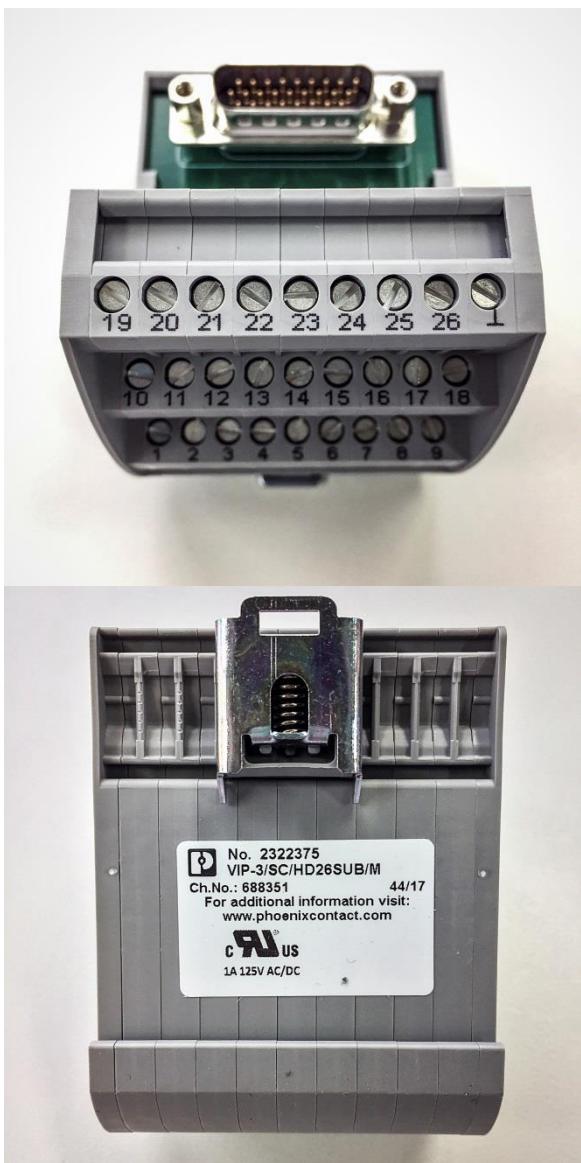
The Start and Stop signals are provided by potential free contacts from an external controller. The contacts are supplied by the 24VDC of the iVario generator on the connector X12 pins 7 and 8. Input for the Start signal is pin 1. Input for the Stop signal is pin 3. The maximum current between pins 7 and 1 or between pins 8 and 3 is 5mA. Prepare all the other pins of X12 to be shortened as described above.

Useful hardware are the iVario controller cables (it is a bundle including the 26 pins X12 and Ethernet cable) and the 26 pins socket.

The cable bundle is available in six different lengths directly from Comet

Cable length	Ordering number
5m	20106693
10 m	20089506
15 m	20106694
20 m	20106704
25 m	20106705
30 m	20089505

The 26 pin socket is available from Phoenix Contact



Dynamic behavior of Start signal

To start the iVario generator, the Stop button must be closed. The Start button is normally open (NO) and must transit from open to close to start the iVario generator (pulse detection, must remain in the closed status for at least 500ms).

Typical sequence diagram:

- Close the Stop button
- Wait 1s, system will be READY
- Apply the Start pulse by closing at least for 500ms the Start button

Dynamic behavior of Stop signal

To stop the iVario generator, simply open the Stop button, whatever is the status of the Start button. The Stop button is normally closed (NC) and must transit from close to open to stop the iVario generator (pulse detection).

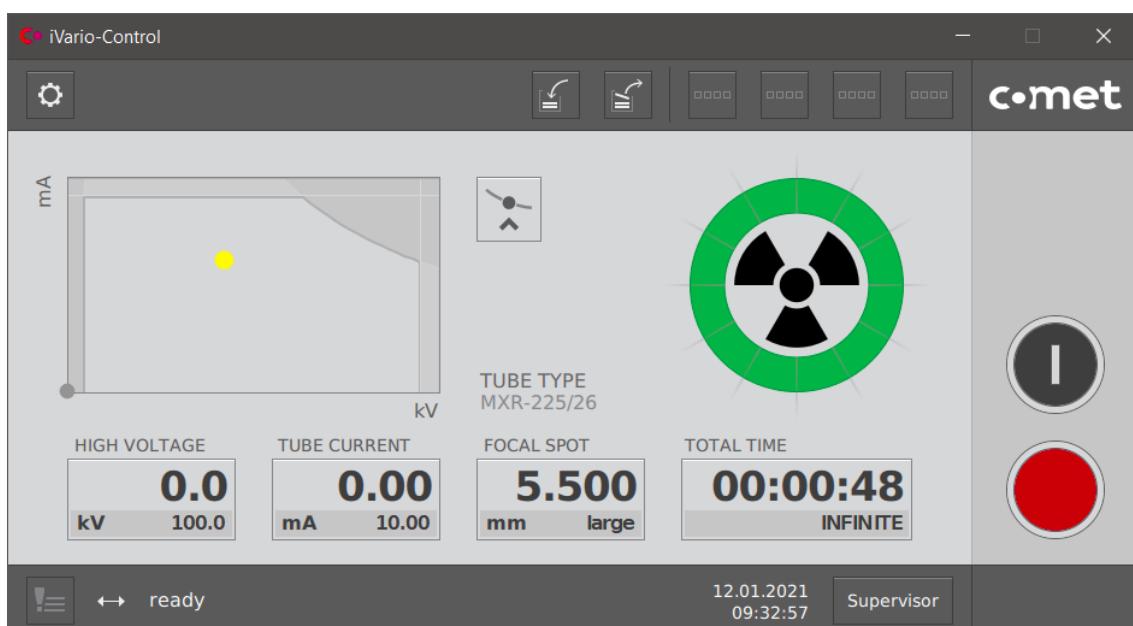
Before you can start the generator over X12, it must be in ready state.

19.4.3 Check the generator for READY state

The generator must be in READY state. Refer to the OEM Manual and the Service Manual about how to set the generator into READY state.

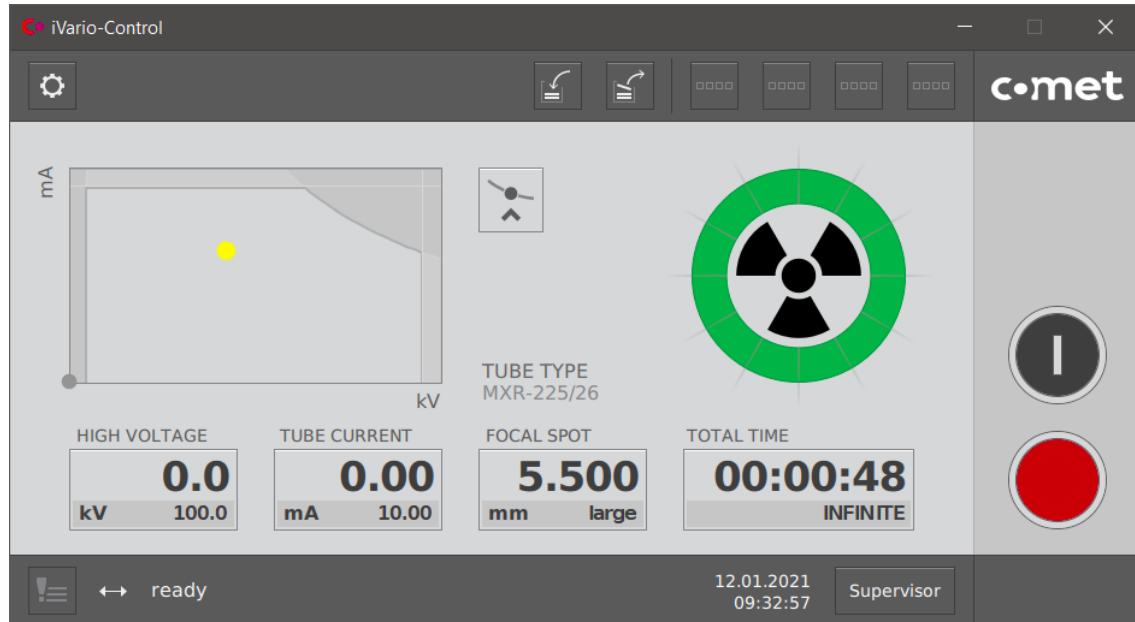
Status: 2,5,0,0,0		
System	Operating Status	Operating Sub-Status
<input type="radio"/> Linux Starting <input type="radio"/> Booting <input checked="" type="radio"/> Operating <input type="radio"/> Warm-Up <input type="radio"/> Severe Error	<input type="radio"/> Initializing <input type="radio"/> Not Ready <input type="radio"/> Cooler Check <input type="radio"/> Safety Ready <input type="radio"/> MAINS Check <input checked="" type="radio"/> Ready <input type="radio"/> Prewarn <input type="radio"/> HV-Operation <input type="radio"/> Irregular Shutdown	<input checked="" type="radio"/> HV OFF <input type="radio"/> Safety Checks and Preparing <input type="radio"/> Ramping <input type="radio"/> HV reached <input type="radio"/> Hot Standby <input type="radio"/> Postheat <input type="radio"/> HV Extant (Unsafe HV Level)
Shutdown Reason: (0,0,0) Boot-Error: 0x0 HVPS-Error: 0x0 Warnings: 0x0		

Not-Ready Conditions			
HVPS: 0x0			
<input checked="" type="radio"/> IFC 0x0 I/O 0x0 OP 0x0 CAN 0x0 LIN 0x0 COM 0x0	<input checked="" type="radio"/> POC(s) 0x0 master 0x0 slave 0x0	<input checked="" type="radio"/> iDevice(s) 0x0 cTank 0x0 aTank 0x0	<input checked="" type="radio"/> FGU 0x0



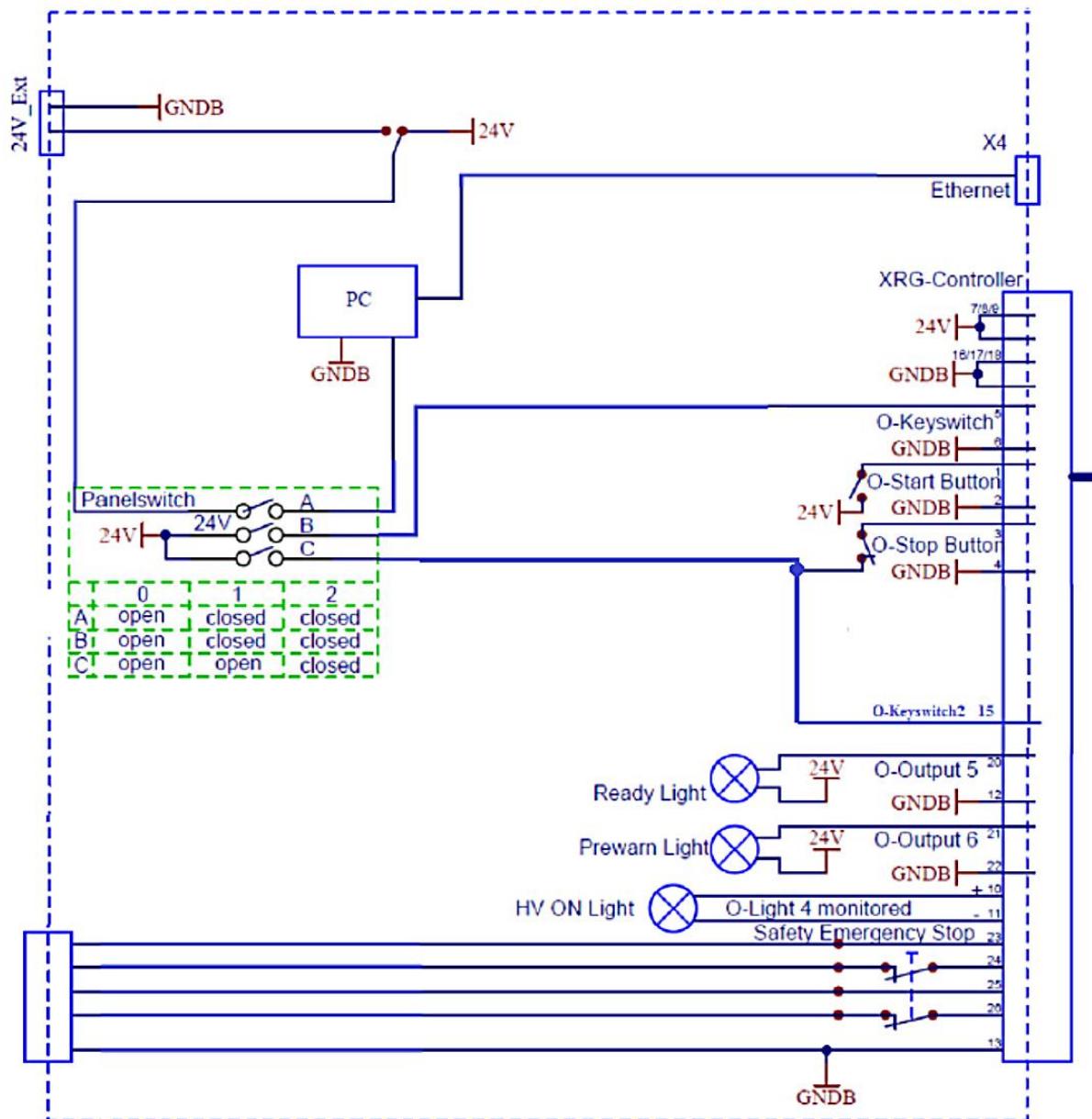
19.4.4 Setpoint

Define a reasonable setpoint before switching on the generator with the Start signal on connector X12. In the below example it is a 100kV and 3mA for the MXR-225/26 tube.



19.5 How is connected and wired the optional Controller on the connector X12?

Without going into deep details, that's how the optional Controller is connected and wired on the connector X12. This FAQ should give a small trouble shooting help if required.



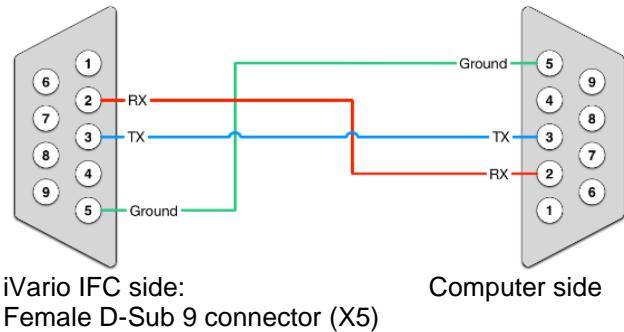
19.6 How can I communicate with my iVario over the serial line MG protocol?



I want to establish the communication with my iVario over the serial line MG protocol.



For the serial communication with the iVario, a "one to one" (straight-through) cable is required.



The communication over the serial port has to be configured in the WebUI in the section “Setup” “Communication”.

Remote Control

<input type="checkbox"/> Single Master	
<input checked="" type="checkbox"/> Default Master	
Serial Port	
<input type="button" value="Apply"/>	

If active, the write type commands (i.e. setpoints mA, kV, and ON/OFF commands) are only allowed by the below defined master device. All other devices can only be used for monitoring.

Serial

Configure

Bitrate	<input type="text" value="9600 bit/s"/>
Protocol	<input type="text" value="MG"/>
<input type="button" value="Apply"/>	

Legacy MG Protocol

Set the persisted voltage for UU/UD fast voltage steps on MG (the ominous “Programmplatz 99”)

Configure

P99	<input type="text" value="0"/>
<input type="checkbox"/> PE	
<input checked="" type="checkbox"/> PF	
<input type="checkbox"/> PM	
<input type="checkbox"/> PN	
<input checked="" type="checkbox"/> PQ	
<input type="button" value="Apply"/>	

Automatic return of “ready to switch X-Ray On” with M938

Automatic focus return with M938

Automatic modus return with M938

Automatic “mains on” return with M938

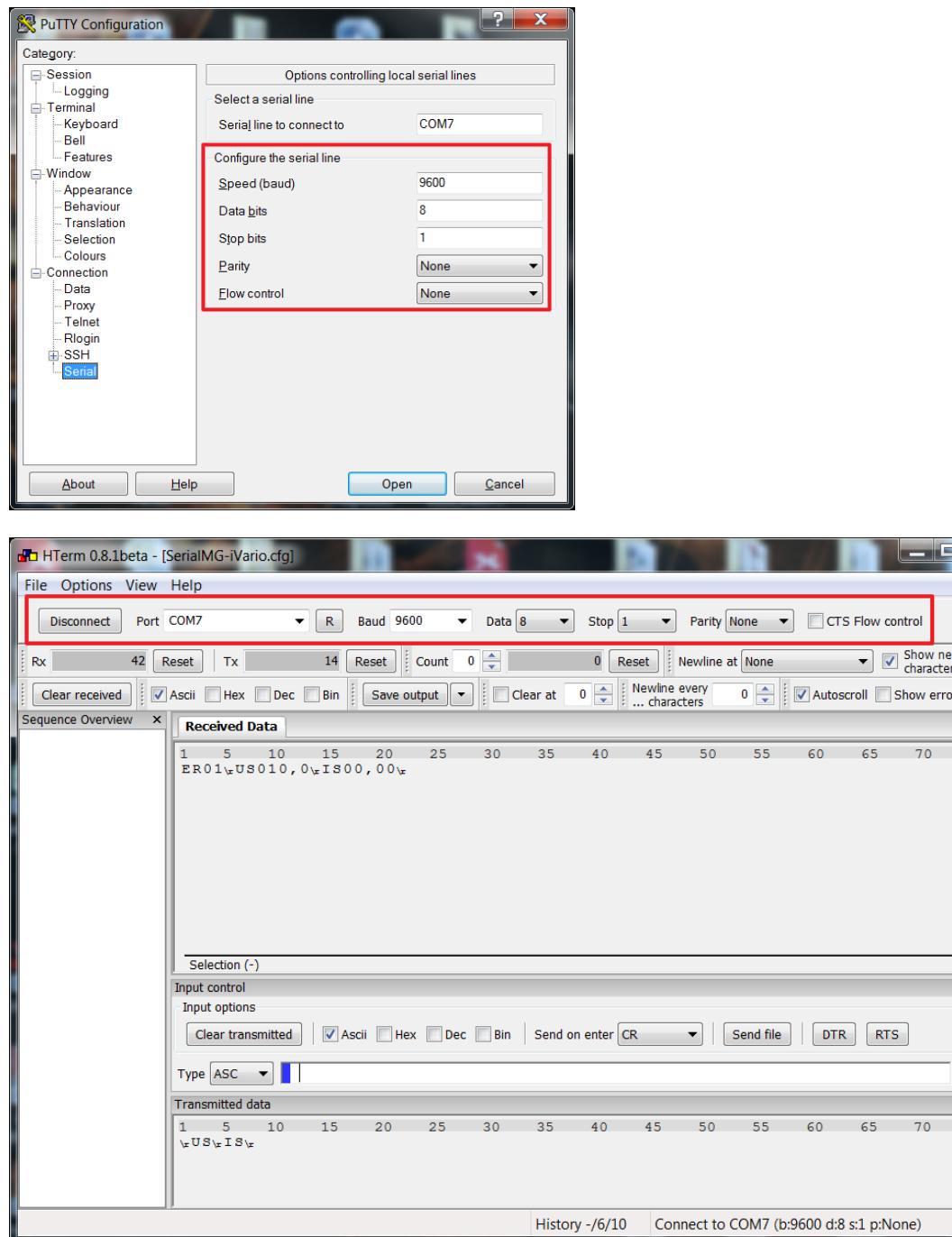
Reboot

Reboot

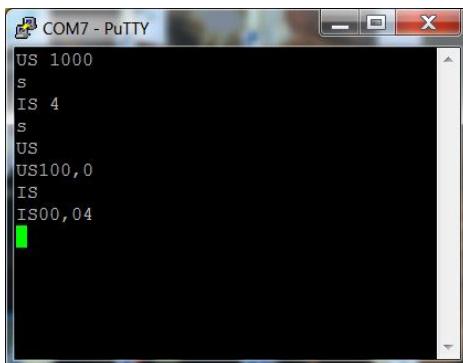
A reboot of the device is necessary to apply the configuration.

Return of the success-reply with M938

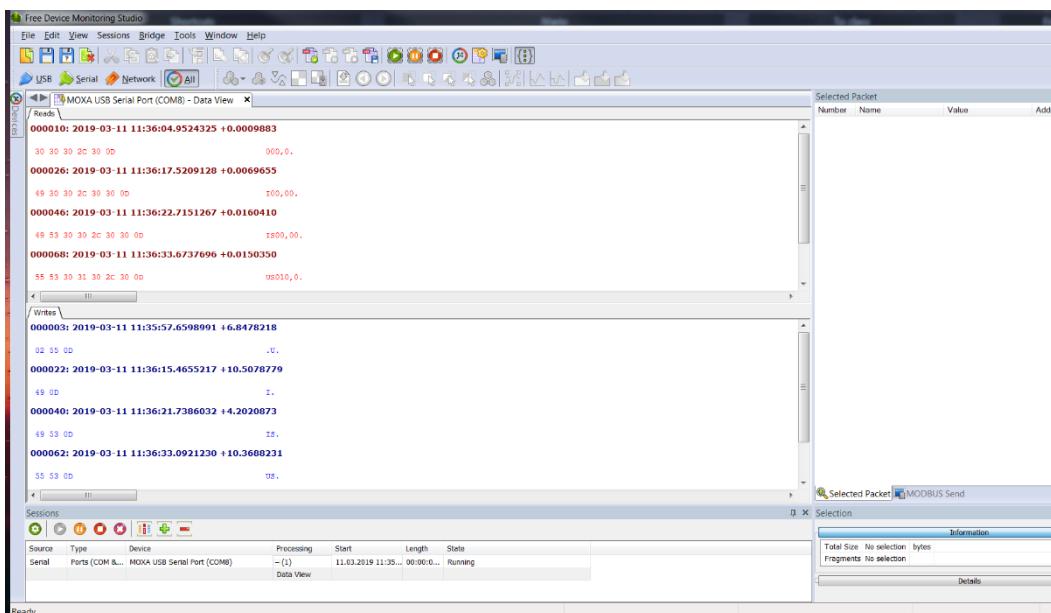
After a successful „Apply“, the iVario must be rebooted with the „Reboot“ button.
 After the reboot of the iVario you are able to communicate with the generator over the serial line, i.e. using a terminal tool like PuTTY or HTerm, in the below setup configuration



A start text command <Ctrl> is necessary to enable the communication. Afterwards you are able to send “MG”-commands as for example “US”, “IS” etc.



Note: Since less and less computers offer serial ports, we have tested several USB-to-serial converters. We can recommend: MOXA UPort 1150
A „Device Monitoring Tool“ is very helpful to analyze the serial communication.



In this specific example we were using the software “Free Device Monitoring Studio”



We observed a situation where the boot process of the iVario is stopped if the RX Pin on X5 (Pin 3) is active (set at +5VDC) during the boot up of IFC. Please get in contact with the Comet Technical Service.

19.7 How can I configure my iVario?



I want to configure all the necessary settings of my XRS in the iVario.



To be able to configure all the relevant settings of the iVario you will have to access the local Webserver of the iVario. Therefore, the IP communication, described in FAQ "How can I communicate with my iVario over Ethernet?", must be established between your computer and the iVario.

To enable the access to the iVario over the WebUI, it is mandatory to plug a USB stick (dongle) with a specific startup file on the X6 connector. By default, this file is **not delivered**. OEM customers can obtain this key file during a training session, after being exposed to the facts of:

- understanding and having the technical knowledge to set up a generator
- running a system with an open web server port and the security impact for the IT infrastructure of the company

This startup file must be present at the very beginning of the iVario boot-up process. It is named "t3-startup" without file extension. The file **MUST** be copied in the root of the USB stick. A software key enables the WebUI.

We recommend not to leave the dongle with this file in the generator. But, perform your task you have to do with WebUI and remove the dongle afterwards.

You can access the webserver by opening any recommended browser (Firefox version 48 or newer, Chrome version 53 or newer, Internet Explorer version 11 or newer or Edge) and type in the ip-address of the iVario in the navigation bar. You should be able to log in on the landing page 45 seconds after you powered on auxiliary supply.

For more details please refer to the section "Webserver GUI" at the very beginning of this manual.

19.8 High Voltage cable length and maximum voltage rating in kV

The iVario generator reduces automatically the allowed maximum voltage rate if the High Voltage cable length exceeds the standard lengths allowing maximum kV. High-voltage cables must not exceed the lengths shown in the below table for their maximum recommended voltage.

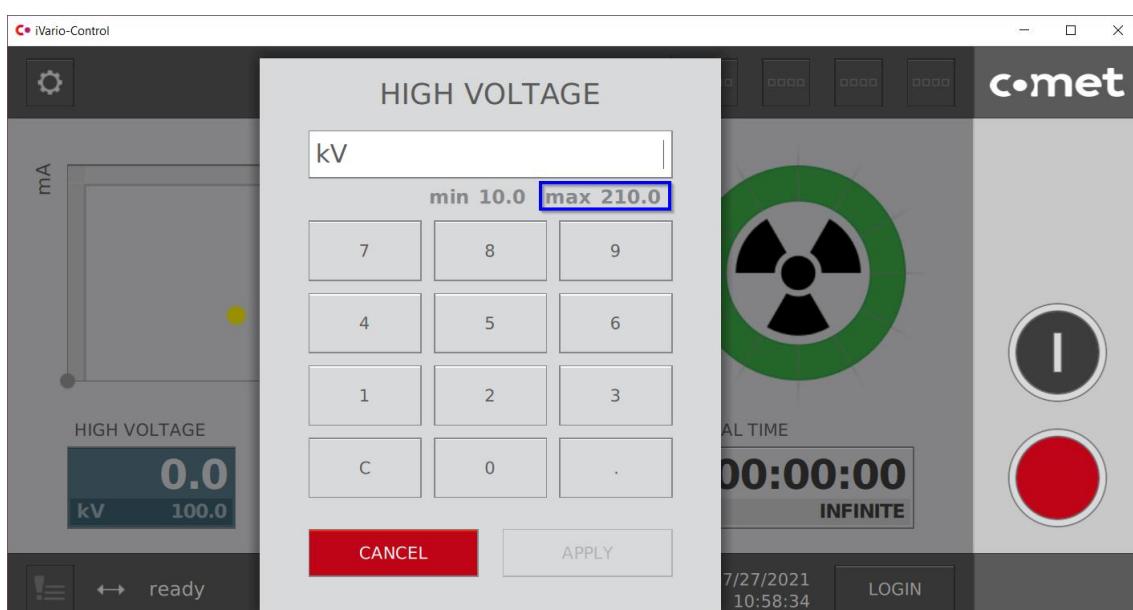
Maximum voltage rating in kV					
High Voltage cable length	iXRS-100	iXRS-160	iXRS-225	iXRS-320	iXRS-450
5 m	100	160	225	320	450
10 m	100	160	225	320	450
15 m	100	160	225	320	450
≥ 20 m	100	160	220	315	440
≥ 25 m	100	160	210	310	420
≥ 30 m	95	155	200	310	400
≥ 35 m	95	155	200	310	400

Standard length Overlength

Below is an example with a High Voltage cable length of 25m on an iXRS-225:



The High Voltage maximum is reduced to 210 kV.



Also the High Voltage end point of the WarmUp is reduced to 210 kV.

Warm-Up

Warm-Up Mode	disabled	
HV End	210	kV
<input type="button" value="Apply"/>		
Next Warm-Up in	12:19:26	
Warm-Up Duration	00:00:00	
Warm-Up Countdown	00:00:00	

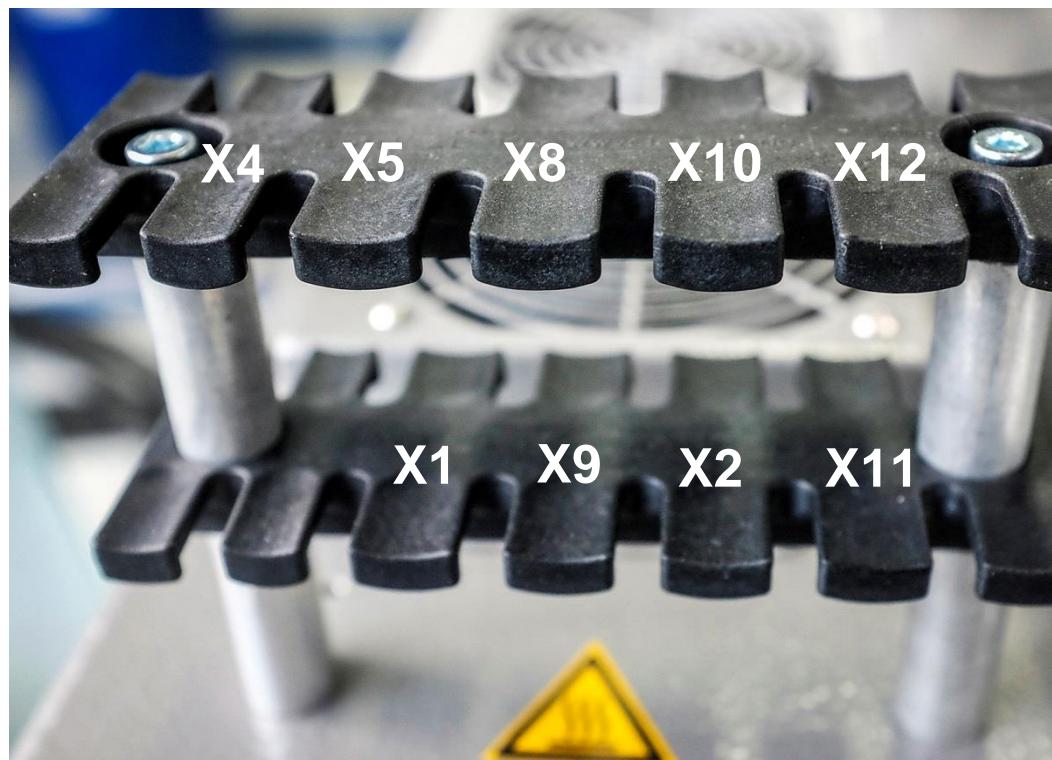
19.9 What's the best method to fix my iVario cables on the strain-relief?



I want to fix my iVario cables with tie wraps on the strain-relief.



This schematic describes the best order how to fix the cables of your iVario



The best order to plug and fix the cables is from left to right:

- X1 AUX AC Input for Control
- X9 Cooler Interface
- X2 MAINS AC Input for Power HV
- X11 Input signals for Safety Interlocks
- X4 Ethernet
- X5 RS-232
- X8 Digital IN/OUT signals
- X10 Monitored Warning Lights
- X12 Input signals for Safety Emergency Stop

19.10 How to realize on iVario the equivalent characteristics as in “Automatic Systems (207, 208)” of MG in modes 4—, 5—, 6—, 7—

 I want to run my iVario system with equivalent characteristics as I am used to run the MG in “Automatic Systems (207, 208)”.

 To run the iVario in the “Automatic system” mode of MG, you will have to set up the iVario as following:

Check “Auto start cycle active” in the WebUI “Setup” “I/O” configuration page

I/O configuration



Don't forget to “Apply” the configuration.

Therefore, the system will ignore the signal “HV Enable Button” on X8 and will directly be ready for HV emission when safety status is reached.

In operation, when the safety circuit is interrupted, high Voltage will be switched off:

- Customer Interlock 1 & 2, Stop Button on X8
- Monitored Warning Lights on X10
- Cooler control signals

If the safety circuit is re-established, the High Voltage can simply be switched on via an external computer / interface without pressing the “HV Enable Button” applied on connector X8

19.11 How do I get with the iVario the same behavior of the warning lights as for MG controller

-  I want to have the same behavior of my iVario warning lights as I am used to have on the MG system
-  On the iVario we can configure three monitored warning lights for the status "imminent", "not-ready", "safety ready", "ready", "prewarn" and "HV on". With below settings we can emulate the warning lights of the MG controller.

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"/>						
NOT-READY	<input checked="" type="radio"/>	Off ↓	Off ↓	Off ↓					
COOLER CHECK	<input checked="" type="radio"/>	Off ↓	Off ↓	Off ↓					
SAFETY READY	<input checked="" type="radio"/>	Off ↓	Off ↓	Off ↓	Off ↓	Blink	Off ↓	Off ↓	Off ↓
MAINS CHECK	<input checked="" type="radio"/>	Off ↓	Off ↓	Off ↓					
READY	<input checked="" type="radio"/>	Off ↓	Off ↓	Off ↓	Off ↓	On	Off ↓	Off ↓	Off ↓
PREWARN	<input checked="" type="radio"/>	Off ↓	Off ↓	Off ↓	Off ↓	On	Off ↓	On	Off ↓
HV ON	<input checked="" type="radio"/>	Off ↓	Off ↓	Off ↓	Off ↓	On	Blink	Off ↓	Blink
SETPT REACHED	<input checked="" type="radio"/>	Off ↓	Off ↓	Off ↓	Off ↓	On ↓	Blink↓	Off ↓	Blink↓



Note: The status "Safety-Ready" is not existing on MG.

19.12 About standard Prewarning and Prolonged Prewarn

The “Prewarning” defines the time [s] between the HV is switched on and iVario is physically ramping up the voltage and current.

Standard prewarning

These are the settings in the WebUI, section “Application Configuration” for standard “Prewarn” of 5 seconds.

Prewarning

Prewarning mode [-]:

0
5
10

Regular prewarn time [s]:

Prolonged prewarn time [s]:

With “Prewarning mode” = 0, the “Prolonged prewarn” is disabled.

Prolonged prewarning

Additionally to the standard “Prewarn” time can be defined a “Prolonged Prewarn” time. This “Prolonged Prewarn” substitutes the normal “Prewarn” if Customer interlocks 1 or 2 (or both) have been opened between the last HV ON and the actual request to switch the iVario to an operational state. Once the HV state could be reached successfully, the regular “Prewarn” time is valid again. This is valid until the next opening of the customer interlock.

The “Prolonged prewarning” can be attached to:

- Customer interlock 1 or
- Customer interlock 2 or
- Customer interlock 1 and Customer interlock 2

Prewarning

Prewarning mode [-]:

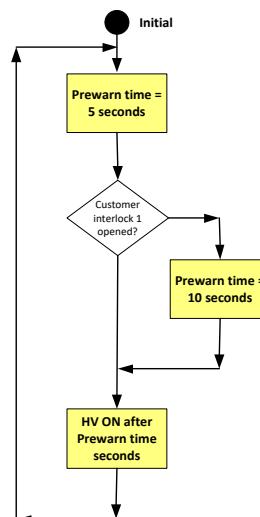
1
5
10

Regular prewarn time [s]:

Prolonged prewarn time [s]:

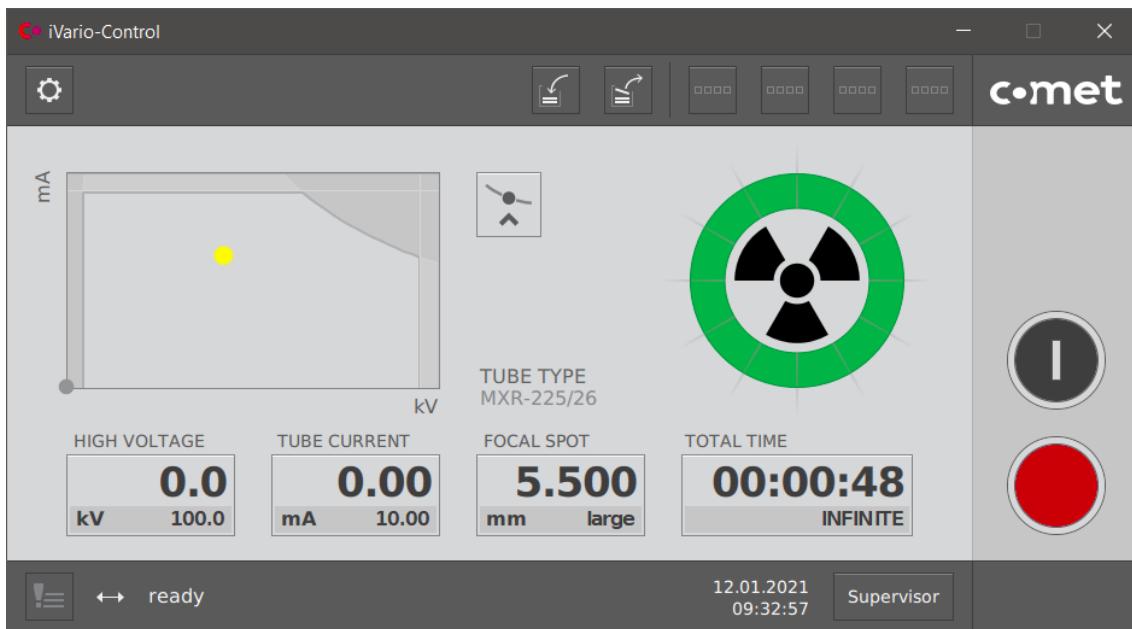
Prewarning mode:

- 0 = Prolonged prewarn disabled
- 1 = Prolonged prewarn enabled for customer interlock 1
- 2 = Prolonged prewarn enabled for customer interlock 2
- 3 = Prolonged prewarn enabled for customer interlock 1&2

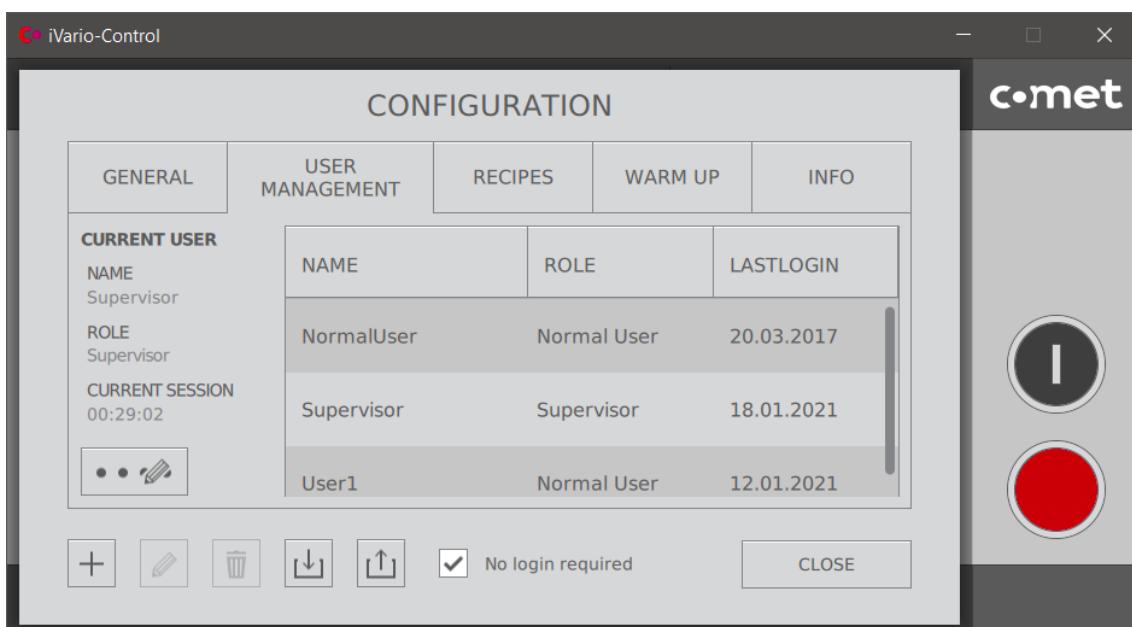


19.13 How can I modify the set points, the focal spot size and the exposure time on the Control Software without being logged in?

By default it is not possible to modify the set points (high voltage and tube current), the focal spot size and the exposure time without being logged in. All these fields are greyed out and are inactive.



The “Supervisor” is able to set the Control Software into a “No login required” working mode.



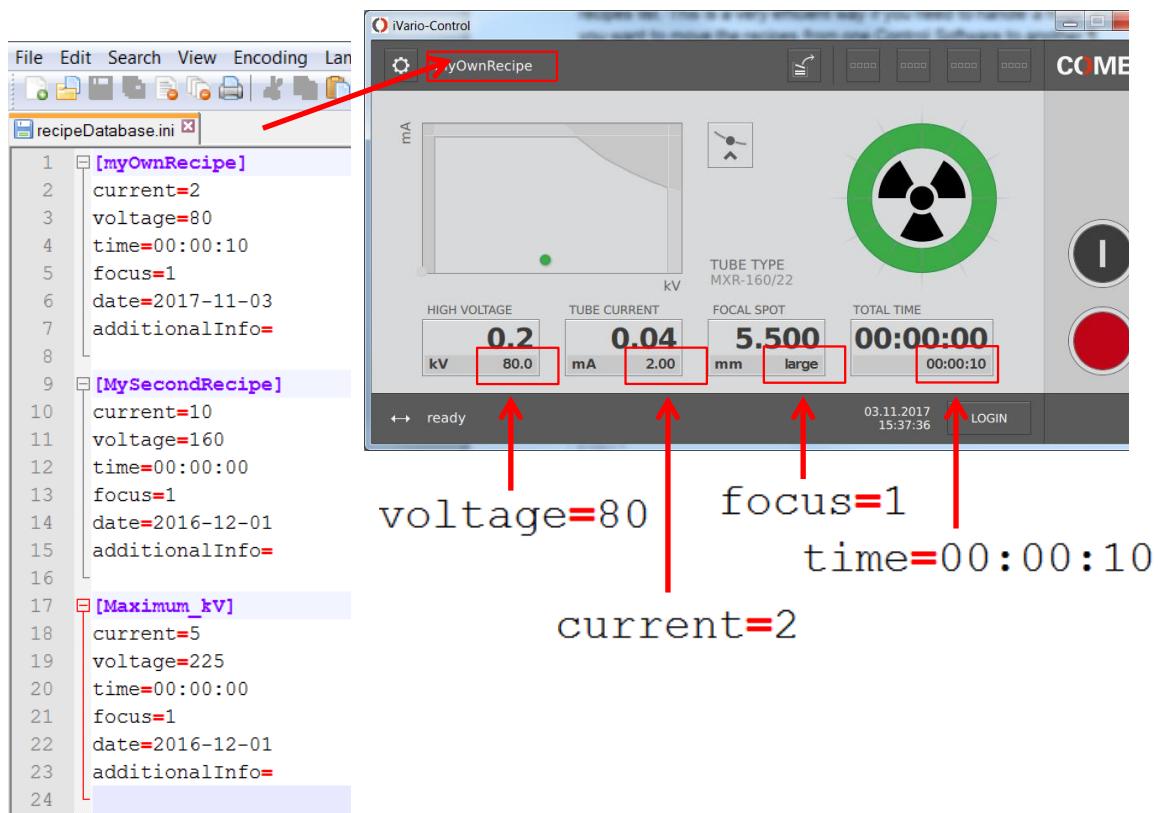
Once logged in as “Supervisor”, you reach the “Configuration” page through this icon



19.14 How can I handle and administer my recipes of the Control Software in a very efficient way?

Instead of editing the recipes in the Control Software itself, you can edit directly the entire recipes list. This is a very efficient way if you need to handle a huge amount of recipes or if you want to move the recipes from one Control Software to another.

The recipes list is located in the “bin” folder of the Control Software and is named “recipeDatabase.ini”. Open the file with a text editor (preferably a tool like Notepad++).



You can create a recipe by duplicating the entire block and editing the values. But you are NOT ALLOWED to change the structure of a recipe.

When you're done, save the file and restart the Control Software.

19.15 About “Message 1” and “Message2”

There are two digital input signals you can apply on connector X8 (pins 21/22 and 23/24). You can check the status of these digital inputs over the T3 protocol in the client application and act accordingly to the status 0 or 1. The telegram with the key CMSG1/2 to check the status is read only.

4.2 CMSGx – Custom Message 1 and 2

Key	CMSG1 CMSG2	
SW Version	V.1.0.0 (changed)	
Group	SystemInfo	
AMSG allowed	On change: Yes, Periodical: Yes	
Description	Check the custom message digital input of the IFC.	
Ports	Read	Write
	0x60	-
Request Value	-	-
Response Value	Boolean	-
Examples TCP Read	Read Custom Message Input 1 [TX] - TA60S0006-- CMSG1; [RX] - TA60R0008-- CMSG1=0; Read Custom Message Input 2 [TX] - TA60S0006-- CMSG2; [RX] - TA60R0008-- CMSG2=1;	

Table 10 : Key CMSGx

19.16 How can I limit my system in high voltage?

This adjustment needs to be done in the WebUI for restricting the generator and not in the Control Software. Therefore, this restriction must be set on the system itself. It should not be set on the software that commands the generator.

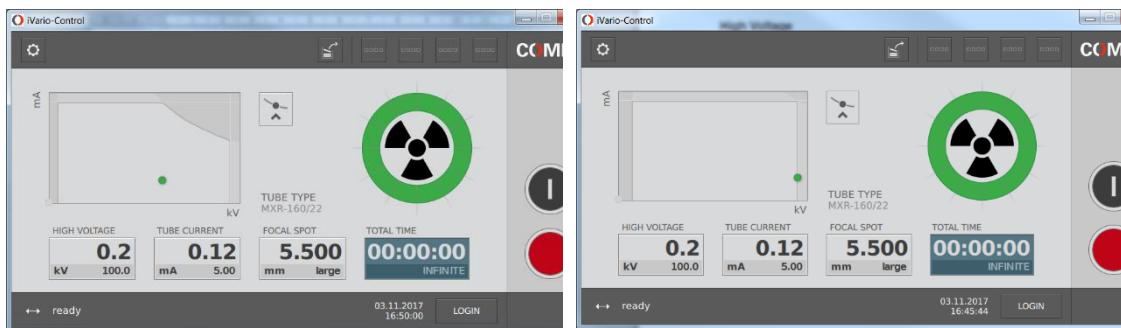
In the example below (picture on the right hand side) we limited the generator at 100 kV (HV max). Navigate to the section “Setup” “Application”.

Additional Limits

The following topics are treated as additional limits and are included in the system wide configuration calculation. Be aware that the most restrictive limit is used.

High Voltage	HV Max <input type="text" value="100"/> kV Actual Limit: 100.00,100.00 kV	HV Min <input type="text" value="7.5"/> kV Actual Limit: 7.50,7.50 kV
Apply Limits	Apply Limits Applied	

Modify the maximum value for HV Max and don't forget to press “Apply” and “Reboot” to apply the new setting.



System limited at 160 kV

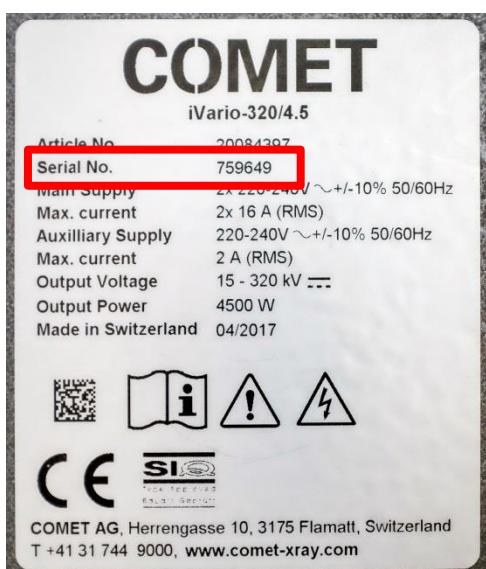
System limited at 100 kV

19.17 I can't anymore access my iVario device over IP because I forgot the configured IP address



Valid for Win7 computers

You always can access the iVario over the WebUI using its iXRS serial number printed on the sticker on the tank. In the below example it is "759649".



Simply type "sn759649.local" in your browser and you will be directed to the WebUI login landing page.



Valid for newer computers than Win7

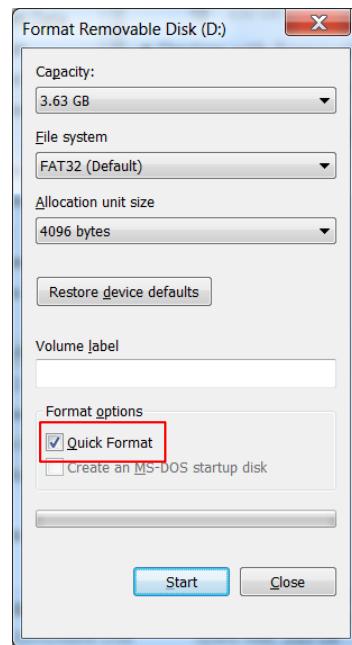
Generate all the reports using the "S1" button. In the "Operational Report", PDF format, you will find the configured IP Address in clear text. Use this IP Address in your browser to access the WebUI.

19.18 What are the requirements for a USB stick to plug into iVario?

Minimum requirement

Quick format FAT32 of the USB stick on a computer.
Right-mouse-click on the USB medium → “Format”.
Choose “Quick Format”

There is no maximum limit for the memory size of the stick. The FAT32 system limits the file size to 4GB.



19.19 Which are the recommendations for a monitored warning light?

Our recommendation for warning lights that can be connected and monitored on X10

- You should select and install warning lights with a nominal current between 20mA and 150mA.
- A maximum current of 250mA is detected by the system as short-circuit. You shouldn't use warning lights working close to this limit.
- We recommend not to overpass 600mA for the three monitored channels totalized

Some explanations about the configurable thresholds

The state of the warning light is monitored by measuring the current to the light. Three different current levels can be configured in the WebUI, section "I/O Configuration":

- Threshold current for a light in OFF state
- Threshold current for a light in ON state
- Threshold current for a short circuit (the maximum current)

Light	off threshold	on threshold	shortcircuit threshold
Warning light 1	20 mA	40 mA	220 mA
Warning light 2	20 mA	40 mA	220 mA
Warning light 3	20 mA	40 mA	220 mA

The ON and OFF thresholds can be adjusted from 10mA to 100mA. These thresholds should be set to the mean current consumption value for the lights. It is possible to set the two thresholds to the same value. By default, the thresholds for ON and OFF are set to 40mA.

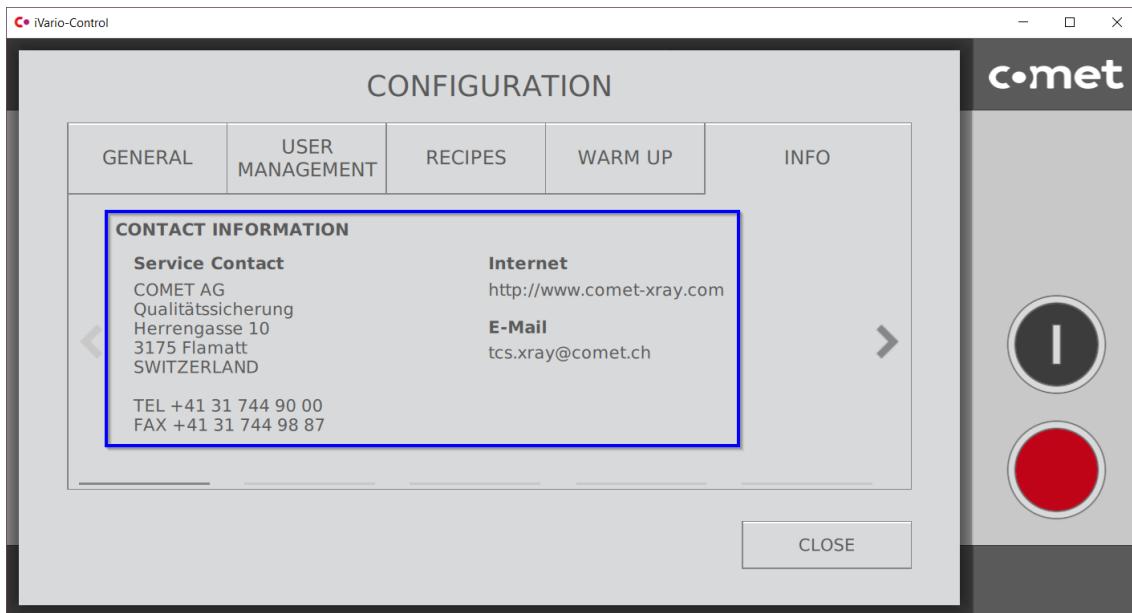
The short circuit threshold can be configured between 50mA and 250mA. By default, the threshold for short circuit is set to 220mA.

- Light is off: current in light is below threshold for OFF (off threshold)
- Light is on: current in light is above threshold for ON (on threshold)
- 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.

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

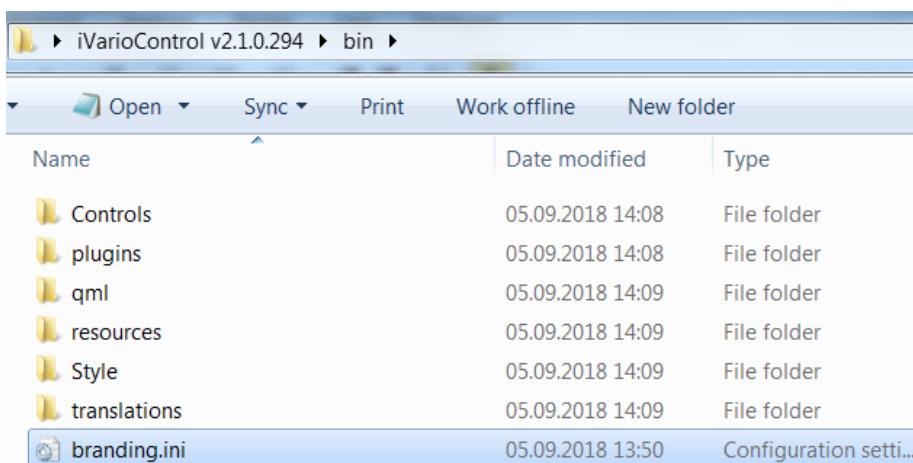
19.20 How can I customize the contact address in the iVario Control Software?

You are able to customize the contact information of the iVario Control Software as shown in the picture below.

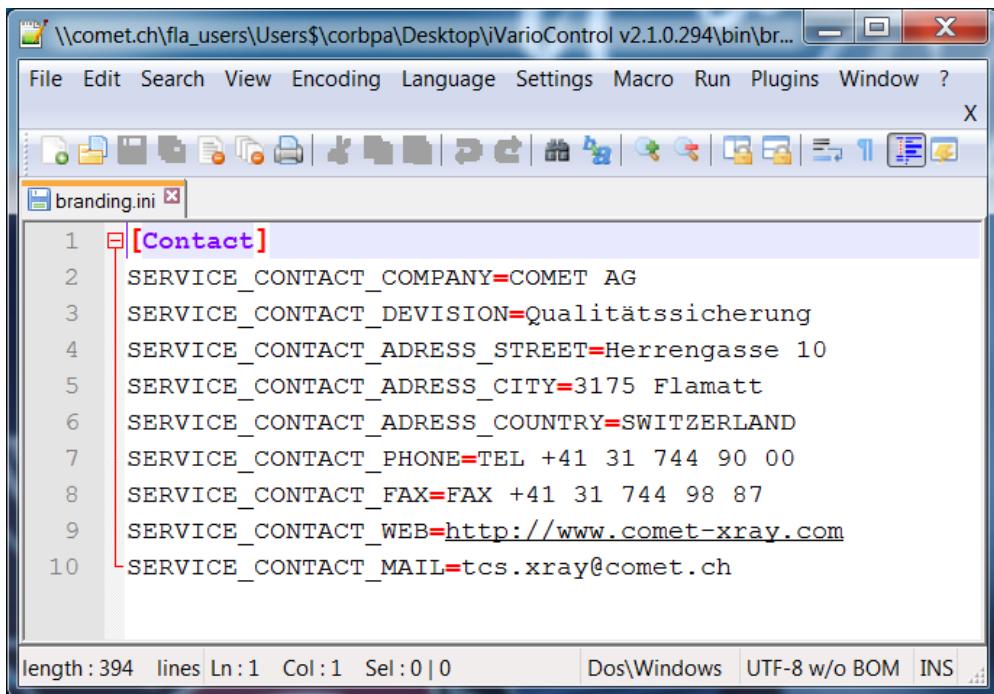


You get this screen if you log in as “Supervisor”, browse to the “Settings” icon and chose the tab “INFO”.

This contact information is customizable through the “branding.ini” file, located in the root folder of the iVario Control Software. The “branding.ini” file is located in the “bin” folder.



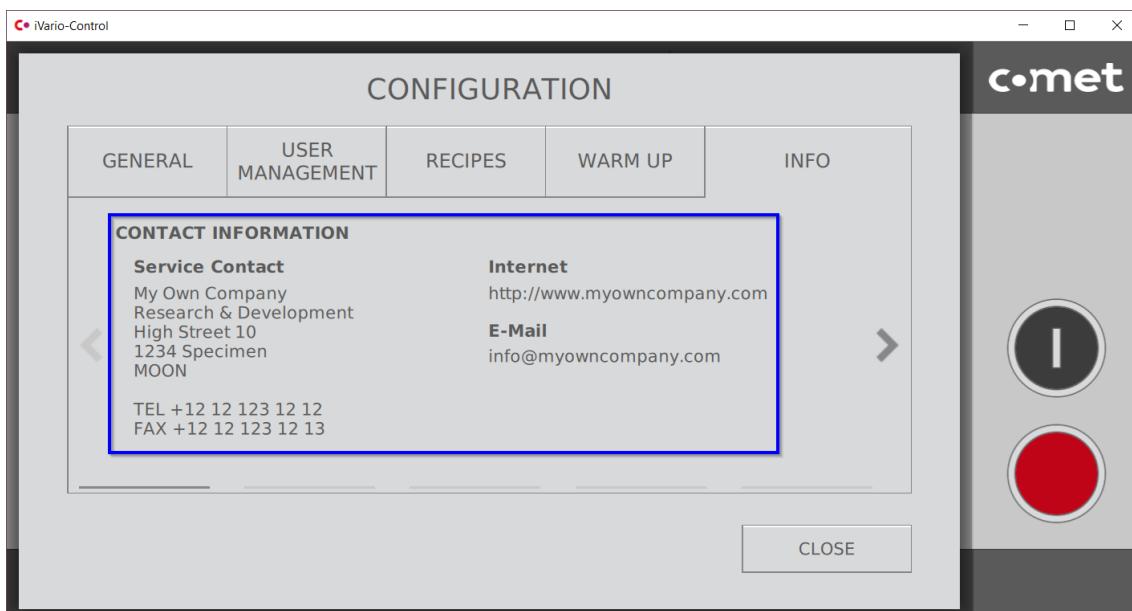
The best way to edit this file is to open it with an intelligent text editor (i.e. Notepad++).



```
\\comet.ch\fla_users\Users$\corbpa\Desktop\iVarioControl v2.1.0.294\bin\br...
File Edit Search View Encoding Language Settings Macro Run Plugins Window ?
X
branding.ini
1 [Contact]
2 SERVICE_CONTACT_COMPANY=COMET AG
3 SERVICE_CONTACT_DEVISION=Qualitätssicherung
4 SERVICE_CONTACT_ADRESS_STREET=Herrengasse 10
5 SERVICE_CONTACT_ADRESS_CITY=3175 Flamatt
6 SERVICE_CONTACT_ADRESS_COUNTRY=SWITZERLAND
7 SERVICE_CONTACT_PHONE=TEL +41 31 744 90 00
8 SERVICE_CONTACT_FAX=FAX +41 31 744 98 87
9 SERVICE_CONTACT_WEB=http://www.comet-xray.com
10 SERVICE_CONTACT_MAIL=tcs.xray@comet.ch

length: 394 lines Ln:1 Col:1 Sel:0 | 0 Dos\Windows UTF-8 w/o BOM INS A
```

Customize your contact details, save the “branding.ini” file and re-open the iVario Control Software.



19.21 Current consumption comparison at 50 Hz and 60 Hz

The following measures have been performed on a bipolar iVario 450 kV (two Powercells). The system ran at maximum power (450 kV, 10 mA).

		50 Hz	60 Hz
	AC Input set [V]	AC input measured [A]	AC input measured [A]
L1	230 ±10%	0.3 - 0.4	0.3 - 0.5
L2	230 ±10%	10.6 - 14.5	10.6 - 14.4
L3	230 ±10%	10.9 - 14.7	10.8 - 14.5

Where:

- L1 is the phase of the AUX power for the IFC
- L2 & L3 are the phases of the Powercells



The current consumption at 50 Hz is equal to the consumption at 60 Hz.
The highest load is 14.7 A at 198 V-50Hz.

20 Appendix

20.1 Not ready conditions

20.1.1 “System” Not-ready conditions

The not-ready code of the system signals which devices are not ready.

Not-Ready Conditions			
HVPS: 0x80000001			
<input checked="" type="radio"/> IFC 0x80000008	<input checked="" type="radio"/> POC(s) 0x0	<input checked="" type="radio"/> iDevice(s) 0x0	<input checked="" type="radio"/> FGU 0x0
I/O 0x1	master 0x0	cTank 0x0	
OP 0x0	slave 0x0	aTank 0x0	
CAN 0x0			
LIN 0x0			
COM 0x0			

Bitcode	Device	Description	Action
0x00000001	IFC	The IFC is not ready	Check the not ready conditions of the IFC
0x00000002	POC1	The POC1 is not ready	Check the not ready conditions of the POC1
0x00000004	POC2	The POC2 is not ready	Check the not ready conditions of the POC2
0x00000008	POC3	Not used	
0x00000010	ECU	The ECU is not ready	Check the not ready conditions of the ECU
0x00000040	Cathode iTank	The cathode tank is not ready	Check the not ready conditions of the cathode tank
0x00000080	Anode iTank	The anode tank is not ready	Check the not ready conditions of the anode tank
0x80000000	General	General not-ready flag	The general not-ready flag is set when at least one of the other flags is set.

Example:

The device IFC is not ready. → the system not-ready code would be 0x80000001
(general not-ready flag is set when at least one of the other flags is set)

20.1.2 “Device IFC” Not-ready conditions

Not-Ready Conditions	
HVPS: 0x80000001	
● IFC 0x80000008	● POC(s) 0x0
I/O 0x1	master 0x0
OP 0x0	cTank 0x0
CAN 0x0	slave 0x0
LIN 0x0	aTank 0x0
COM 0x0	

Bit-Code	Subsystem	Description	Action
0x00000001	Sub-system CAN	The CAN sub-system is not ready	Check the not ready conditions of the CAN subsystem
0x00000002	Sub-system LIN	The LIN sub-system is not ready	Check the not ready conditions of the LIN subsystem
0x00000004	Sub-system COM	The COM sub-system is not ready	Check the not ready conditions of the COM subsystem
0x00000008	Sub-system IO	The Input/Output sub-system is not ready	Check the not ready conditions of the I/O subsystem
0x00000010	Sub-system OP	The Operation sub-system is not ready	Check the not ready conditions of the OP subsystem
0x80000000	General	General not-ready flag	The general not-ready flag is set when at least one of the other flags is set.

20.1.3 “Device Powercell” Not-ready conditions

Not-Ready Conditions	
HVPS: 0x80000001	
● IFC 0x80000008	● POC(s) 0x0
I/O 0x1	master 0x0
OP 0x0	slave 0x0
CAN 0x0	cTank 0x0
LIN 0x0	aTank 0x0
COM 0x0	FGU 0x0

The following table shows the not-ready conditions available for the Powercells 1 and 2. These codes are logically ORable, i.e. when the circuits *safety interlock* and *emergency stop* are open, the not-ready code would be 0x000000030.

Bitcode	Failure description	Why does it occur?	How to get rid of it?	If it is still there, then ...
0x00000001	FLASH Test not OK	PoC memory corrupt	Re-boot	Replace PoC
0x00000002	RAM Test not OK	0.5 not implemented	Re-boot	Replace PoC
0x00000004	Mains power not available	Always in combination with other not ready codes	Switch mains ON	Check voltage on external connector (X2) Check external safety
0x00000008	Power factor correction module error	HW defect in PoC	Re-boot	Replace PoC
0x00000010	Safety Interlock circuit open	Check X11 both circuits (within 300ms)	Check wiring of X11. Close the safety circuit simultaneously	Check wiring Check correct seat of safety PCB
0x00000020	Emergency Stop circuit open	Check X12 contacts	Close circuit	Check correct wiring (each circuit separately)
0x00000040	Real time operating system error	Only internal error R&D code	Re-Boot	SW update of the PoC If still there, call support
0x00000100	Real time OS initialization error	Only internal error R&D code	Re-Boot	SW update of the PoC If still there, call support
0x00000400	EEPROM data error	Internal error	Re-Boot Repeat EB training mode	Replace PoC
0x00000800	Safety CPU in error state	Check X11. Close and open both circuits within 300ms	Open and close simultaneously	Replace PoC

Bitcode	Failure description	Why does it occur?	How to get rid of it?	If it is still there, then ...
0x00001000	Global safety error	1 of the 2 safety redundant channels mismatch	Check wiring (X11&X12). Open Replace Safety-Interface and close simultaneously	If still persisting, replace PoC
0x00002000	Drop C signal active	Not used		
0x00004000	Temperature Powercell too high	Fan inlet air temperature over 55°C	Check fan, ambient temp, filters	
0x00010000	Bridge ready not available	Normally combined with missing mains (missing DC line)	Check mains	Replace PoC
0x00020000	Operating mode reset	Not used		
0x00040000	Operating mode changed	Not used		
0x00080000	Fan motor not turning	When fan is not rotating	Check mains. Check obstruction in fan	Replace PoC
0x00100000	Configuration Error	POC can't accept configuration data from IFC (internal error)	Re-boot	Roll back to previous version Factory reset Replace IFC
0x00800000	CAN Bus not started	General CAN bus error	Disconnect, reconnect PoC	Replace PoC Replace IFC Replace Backplane
0x01000000	Heartbeat from IFC is missing	Communication problem between IFC - PoC	Re-Boot Disconnect, reconnect PoC	Replace complete power supply (ebeam: complete generator)
0x80000000	System is booting OR no communication (IFC <-> POC)	System is booting and not yet ready	Wait until the system has booted.	Re-Boot Disconnect, reconnect PoC

20.1.4 “Device Tank” Not-ready conditions



The following table shows the not-ready conditions available for the Tanks 1 and 2. These codes are logically ORable.

Bitcode	Failure description	Why does it occur?	How to get rid of it?	If it is still there, then ...
0x00000001	Problem during initializing	Problem during initializing	Re-boot	Send diagnostic report to Comet TCS
0x80000000	Error state	Error state	Re-boot	Send diagnostic report to Comet TCS

20.1.5 “Device ECU” Not-ready conditions

Remark: Not available for iVario

The following table shows the not-ready register for the ECU with the detailed flag definition. These flags are logically OR-ed, i.e. when the ‘+24V supply out of Range’ and ‘Grid Voltage out of range error’ are set, the not-ready code would be 0x00000028.

Bit-Code	Failure Description	Why does it occur?	How to get rid of it?	If it is still there, then ...
0x00000001	-5V supply out of Range	Problem with the supply for ECU	Reboot	Diagn Report to TCS
0x00000002	+5V supply out of Range	Problem with the supply for ECU	Reboot	Diagn Report to TCS
0x00000004	+12V out of Range	Problem with the supply for ECU	Reboot	Diagn Report to TCS
0x00000008	+24V supply out of Range	Problem with the supply for ECU	Reboot	Diagn Report to TCS
0x00000010	ECU Heater lost	Problem with the ECU	Reboot	Diagn Report to TCS
0x00000020	Grid Voltage out of range error	Problem with the ECU	Reboot	Diagn Report to TCS
0x00000040	Grid Voltage too high	Problem with the ECU	Reboot	Diagn Report to TCS
0x00000080	Error Reading EEPROM	Internal error	Reboot	Diagn Report to TCS
0x00000100	CAN Heartbeat of IFC missing error	Communication problem between IFC - ECU	Reboot	Diagn Report to TCS
0x00000200	Oil Temperature out of Range	Temp > 79°C	Shutdown the system, wait and cool down the tank	Check airflow around the tank
0x00000400	ECU Temperature out of range	Temp > 79°C	Shutdown the system, wait and cool down the tank	Check airflow around the tank

0x00000800	Emission current [mA] value out of tolerance compared to setpoint during emission	More than +/- 2% of allowed tolerance	Reboot	Diagn Report to TCS
0x00001000	Severe error	Internal error	Reboot	Diagn Report to TCS
0x00004000	CRC error	Internal error	Reboot	Diagn Report to TCS
0x80000000	System is booting OR no communication (IFC <-> ECU)	System is booting and not yet ready	Wait until the system has booted.	Reboot

20.1.6 “IFC Subsystem I/O” Not-ready conditions

Not-Ready Conditions					
HVPS: 0x80000001					
● IFC	0x80000008	● POC(s)	0x0	● iDevice(s)	0x0
I/O	0x1	master	0x0	cTank	0x0
OP	0x0	slave	0x0	aTank	0x0
CAN	0x0				
LIN	0x0				
COM	0x0				

The sub-system IO comprises information about inputs and outputs connected to the IFC, i.e. start-, stop buttons, cooler, etc.

Bit-Code	Description	Additional Comment	Why does it occur?	How to get rid of it?	If it is still there, then ...
0x00000001	Cooler flow missing	Sub-system IO	Check cooler (X9 ... open or no change at start up)	Switch off/on cooler Check 24V	Check flow switch on cooler
0x00000002	Cooler temperature not available	Sub-system IO	Check cooler (X9 ... open)	Cool down	Check correct function of thermostat in cooler
0x00000004	Stop button active	Sub-system IO	Check if X8 pin 3 24V and pin 4 ground	Check wiring of X8	Check button
0x00000008	Customer interlock 1 open	Sub-system IO	Check if X8 pin 17 24V and pin 18 ground	Check wiring of X8	
0x00000010	Customer interlock 2 open	Sub-system IO	Check if X8 pin 19 24V and pin 20 ground	Check wiring of X8	

0x00000040	Press start button	Sub-system IO	Start button cycling not done (occurs after each irregular shut-down)	Press start button to enable HV. X8 pin 1 24V and pin 2 ground	Check wiring of X8
0x00000100	O_Key not available (only with optional control panel)	Sub-system IO. Optional Panel	Key switch on optional control panel (X12...)	Check correct wiring	Replace Panel
0x00000200	O_Stop button active (only with optional control panel)	Sub-system IO. Optional Panel	Stop button on optional panel pressed.	Check if "Optional panel active" in "I/O configuration" of WebUI is set. Check correct wiring with the external panel.	Replace Panel
0x00000400	O_Start button cycle needed (only with optional control panel)	Sub-system IO. Optional Panel	Press the start button on optional panel	Check if "Optional panel active" in "I/O configuration" of WebUI is set. Check correct wiring with the external panel.	Replace Panel
0x00000800	Shortcut detected in light monitoring	Sub-system IO	One of the activated warning light is shorted	Check warning light configuration. Check all warning lights and reboot the system	Replace defective warning light

0x20000000	Configuration failure	Sub-system IO	Configuration for I/O handling not valid	Check configuration (tube, tank)	Factory reset and reconfigure
0x40000000	Initializing	Sub-system IO	During the initialization of the device	Wait until initialization is finished	
0x80000000	Error state (needs R&D logs for details)	Sub-system IO	Internal error	Software update	Factory reset and reconfigure. If still persistent, contact COMET TCS and send the diagnostic report.

20.1.7 “IFC Subsystem OP” Not-ready conditions

Not-Ready Conditions					
HVPS: 0x80000001					
● IFC 0x80000008	● POC(s) 0x0	● iDevice(s) 0x0	● FGU 0x0		
I/O 0x1	master 0x0	cTank 0x0			
OP 0x0	slave 0x0	aTank 0x0			
CAN 0x0					
LIN 0x0					
COM 0x0					

The sub-system OP comprises information about top level operation, i.e. temperature limit exceeding, etc.

Bit-Code	Description	Additional Comment	Why does it occur?	How to get rid of it?	If it is still there, then ...
0x00000001	Initializing	Sub-system OP	During boot	Wait until boot completed	Reboot
0x00000002	Temperature too low	Sub-system OP			
0x00000004	Temperature too high	Sub-system OP		Refer to the warnings	
0x40000000	Error during start-up	Sub-system OP			
0x80000000	Error state	Sub-system OP			

20.1.8 “IFC Subsystem CAN” Not-ready conditions

Not-Ready Conditions					
HVPS: 0x80000001					
● IFC	0x80000008	● POC(s)	0x0	● iDevice(s)	0x0
I/O	0x1	master	0x0	cTank	0x0
OP	0x0	slave	0x0	aTank	0x0
CAN	0x0				
LIN	0x0				
COM	0x0				

The sub-system CAN comprises information about the CAN communication, i.e. the communication to the POC(s) and ECU if available.

Bit-Code	Description	Additional Comment	Why does it occur?	How to get rid of it?	If it is still there, then ...
0x00000001	Initialization (including the configuration of the CAN devices)	Sub-system CAN	During boot	Wait until boot completed	Reboot and if still persistent, contact COMET TCS and send the diagnostic report.
0x00000002	IPC Connection Test Not ready of CAN device	Sub-system CAN	During boot	Wait until boot completed	Reboot and if still persistent, contact COMET TCS and send the diagnostic report.
0x00000004	Missing CAN device	Sub-system CAN	During boot	Wait until boot completed	Reboot and if still persistent, contact COMET TCS

				and send the diagnostic report.
0x40000000	Terminating Service	Sub-system CAN	A Service was terminated	Reboot and if still persistent, contact COMET TCS and send the diagnostic report.
0x80000000	Error state (needs R&D logs for details)	Sub-system CAN		Contact COMET TCS and send the diagnostic report.

20.1.9 “IFC Subsystem LIN” Not-ready conditions

Not-Ready Conditions	
HVPS: 0x80000001	
● IFC 0x80000008	● POC(s) 0x0
I/O 0x1	master 0x0
OP 0x0	cTank 0x0
CAN 0x0	slave 0x0
LIN 0x0	aTank 0x0
COM 0x0	

The sub-system LIN comprises information about the LIN communication, i.e. the communication to the iDevices (such as iTank(s)).

Bit-Code	Description	Additional Comment	Why does it occur?	How to get rid of it?	If it is still there, then ...
0x00000001	Initializing	Sub-system LIN	During boot	Wait until boot completed	Reboot
0x80000000	Error state (needs R&D logs for details)	Sub-system LIN			Contact COMET TCS and send the diagnostic report.

20.1.10 “IFC Subsystem COM” Not-ready conditions

Not-Ready Conditions					
HVPS: 0x8000001					
● IFC 0x8000008	● POC(s) 0x0	● iDevice(s) 0x0	● FGU 0x0		
I/O 0x1	master 0x0	cTank 0x0			
OP 0x0	slave 0x0	aTank 0x0			
CAN 0x0					
LIN 0x0					
COM 0x0					

The sub-system COM comprises information about the external communication, i.e. the communication over Ethernet and RS232.

Bit-Code	Description	Additional Comment	Why does it occur?	How to get rid of it?	If it is still there, then ...
0x00000001	Initialization	Sub-system COM	During booting up	Wait until boot completed	Reboot and if still persistent, contact COMET TCS and send the diagnostic report.
0x00000002	COM-Guard not ready	Sub-system COM	A restrictively configured guarded client is missing	Check if all the required clients are connected	
0x80000000	Error state (needs R&D logs for details)	Sub-system COM. External communication over IP and RS-232		Check communication settings (Host, serial, ...) Reboot	Contact COMET TCS and send the diagnostic report.

20.2 Shutdown reasons

The screenshot shows the comet software interface with the following details:

- Left Sidebar:** Operation, Generator Info, HV Operation (selected), Software update, Reports, Setup, Generator, I/O, Communication, Application.
- Main Area - HV Operation:**
 - High Voltage: 0.0 kV (40 mA)
 - Tube Current: 0.0 mA (5 mA)
 - Exposure Time: 4.0 s (0 s)
 - Focal Spot: 5.5 mm (5.5 mm)
 - HV On / HV Off buttons
 - Apply Setpoint button
- Status Section:**
 - Status: 2,5,0,0,0
 - System: Operating (radio button selected)
 - Operating Status: Ready (radio button selected)
 - Operating Sub-Status: HV OFF (radio button selected)
- Bottom Status Bar:**
 - Shutdown Reason: (4,1,8) (highlighted with a red box)
 - Boot-Error: 0x0 HVPS-Error: 0x0
 - Warnings: 0x0

20.2.1 Sources of the shutdown reason

With the information about the source causing the shutdown, it is possible to determine where the trigger of the shutdown is coming.

Source	Name	Description
1	POC1	Shutdown triggered by the POC1 (Master powercell, number 1)
2	POC2	Shutdown triggered by the POC2 (Slave powercell, number 2)
3	POC3	Reserved for a future POC3
4	ITF	Shutdown triggered by an external interface
5	IO	Shutdown triggered by an I/O
6	OP	Shutdown triggered by operation
7	INT	Shutdown triggered by internal communication (CAN/LIN)
8	ECU	Shutdown triggered by the ECU

20.2.2 Source 1 & 2: Shutdown code and detail of Powercell

The source of the Powercell can be 1, 2 or 3 depending on the number of available Powercells and depending on their position on the HVPS. The following table shows the possible shutdown code and detail of a Powercell.

Code #	Detail #	Description	Why does it occur?	How to get rid of it?	If it is still there, then ...
1	1 = OFF Command 2 = Exposure Time elapsed 3 = ebeam Training finished 4 = ebeam filament heating finished	Off Command from host communication interface (used for signaling) Exposure time expired ebeam training finished	Regular Regular Regular Regular	Regular Regular Regular Regular	Regular Regular Regular Regular
4	0	Runtime Operating System (RTOS) error	Corruption	Reboot the system to get into a proper state, software Update	Replace POC
6	0	RTOS initialization failure	Corruption	Reboot the system to get into a proper state, software Update	Replace POC
8	0	Missing data or failure in EEPROM	Corruption, EEPROM failure	Reboot the system to get into a proper state	Replace POC

Code #	Detail #	Description	Why does it occur?	How to get rid of it?	If it is still there, then ...
10	1 = too high (out of upper tolerance) 2 = too low (out of lower tolerance)	HV [kV] value out of tolerance compared to setpoint during emission (+/- 2%)	Continuous ARCs. Could come from tube, tank, cable, POC	Reboot the system to get into a proper state	Install dummy plug and test which component causes the problem. Refer to Service Manual
11	1 = too high (out of upper tolerance) 2 = too low (out of lower tolerance)	Emission current [mA] value out of tolerance compared to setpoint during emission.			
12	1 = too high (out of upper tolerance) 2 = too low (out of lower tolerance)	Filament current out of tolerance during emission	Continuous ARCs, ... Could come from tube, tank, cable, POC	Reboot the system to get into a proper state	
13	1 = too high (out of upper tolerance) 2 = too low (out of lower tolerance)	Grid voltage out of tolerance	Only ebeam application	Reboot the system to get into a proper state	
20	0	Ambient temperature out of range	Ambient temperature > 45°C or ambient temperature < -5°C	Take precautions, check filter and installation	
22	0	Fan current out of tolerance		Check fan if there are obstacles	
30	0 1	Main power out of tolerance or missing Main power drop/inconstant or bridge not ready		Switch mains ON	Check voltage on external connector X2. Check external safety
31	0	Power factor (PFC) voltage failure		Reboot the system to get into a proper state	Replace POC

Code #	Detail #	Description	Why does it occur?	How to get rid of it?	If it is still there, then ...
32	0	Powercell overcurrent		Reboot the system to get into a proper state	Install dummy plug and test which component causes the problem. Refer to Service Manual
40	0	Tube failure		Install dummy plug and test which component causes the problem. Refer to Service Manual	
41	1	CAN communication timeout	CAN bus communication error due to timeout	Reboot the system to get into a proper state	
42	0	CAN service, IFC heartbeat missing (due to communication loss)	Communication problem between IFC and Powercell	Re-Boot Disconnect, reconnect Powercell	Replace complete power supply (ebeam: complete generator)
43	0	CAN service, Communication reset while operation	ARC, perturbations	Reboot the system to get into a proper state	
44	1	Operating mode changed	Special condition in test mode	Restart the generator	
45	1	Filament test failed	Filament of tube damaged or tube not good installed	Check connection of tube, gapping, contacts	Install dummy plug and test which component causes the problem. Most probably it's the tube. Refer to Service Manual

Code #	Detail #	Description	Why does it occur?	How to get rid of it?	If it is still there, then ...
46	10 = HV test pulse check timed out (HV value not reached) 11 = HV pulse voltage too high 12 = HV pulse and ARC active	Cancelled kV-loop check. High voltage value not reached. iVario takes too much time HV pulse too high There was an ARC during the HV pulse	Tube/cable in short circuit, tank damaged, POC damaged Same as above Same as above	Install dummy plug and test which component causes the problem. Refer to Service Manual.	If the generator works with the dummy plug, the most probable issue part is the high voltage cable.
48	0	Ramping down failure (HV and current out of range) kV/mA not zero after X-Ray off	HV not below threshold 5kV after 15 seconds timeout	Reboot the system to get into a proper state	Check not ready conditions, replace POC
49	0	The slave POC is not available	Slave POC, POC 2 not present	Reboot the system to get into a proper state	Swap the POC to check if the problem is related to the POC or the POC plug. Replace POC
50	0	Fast HW/Safety protection (DROP_C Error)			

Code #	Detail #	Description	Why does it occur?	How to get rid of it?	If it is still there, then ...
51	1	Primary current out of tolerance 1,51,1 → POC 1 primary current is out of tolerance. Problem with POC1 or cathode tank.	ARCs in the tube, tank, cable	Reboot the system to get into a proper state	Install dummy plug and test which component causes the problem. Refer to Service Manual
	2	2,51,1 → POC 2 primary current is out of tolerance. Problem with POC2 or anode tank. Primary current of remote POC is asynchronous to this POC	The two POC don't work synchronously	Reboot the system. Swap the POCs and check if error code follows the swapping. Replace the POC.	Send Diagnostic Report to Comet TCS
52	1	Overcurrent limit failure (clear of ILIM failed)	Problem with POC	Reboot the system	Replace POC
60	1	Safety interlock circuit is open	Check X11. Both Safety Interlock circuits have to be closed within 300ms.	Check wiring of X11. Close the safety circuit simultaneously	Check wiring Check correct seat of safety PCB
61	1	Safety emergency circuit is open	Check X12 contacts	Close circuit	Check correct wiring (each circuit separately)
63	0	Only with integrated safety: Safe HV (not yet implemented)			

Code #	Detail #	Description	Why does it occur?	How to get rid of it?	If it is still there, then ...
64	0	Communication issue between Powercell and safety CPU			
70	0	Configuration error (verified at runtime in HV ON)	Corruption in runtime	Reboot to get into a proper state	Replace POC
80	0	It's all about Arcs Undefined/unknown arc	Arc Handling in WebUI section "Application" Overvoltage detected Problem with POC Problem with POC Same as 10 Problem with POC	Problem with tube, do warmup	Dummy plug test, if persists change POC
	10	Too many arcs within time interval		Reboot to get system into a proper state	Replace POC
	11	Overvoltage protection while generating HV pulse		Reboot to get system into a proper state	Replace POC
	13	Arc processing state-machine entered error state		Reboot to get system into a proper state	Replace POC
	14	Overvoltage protection failure (clear failed)		Reboot to get system into a proper state	Replace POC
	15	POCs arc synchronization timed out		Reboot to get system into a proper state	Replace POC
	20	Arc duration too long. Arc recovery timed out		Same as 10	Same as 10
		Overcurrent limitation failure (clear failed)		Replace POC	Replace POC
	30			Replace POC	Replace POC

Code #	Detail #	Description	Why does it occur?	How to get rid of it?	If it is still there, then ...
90	1 2 3	It's all about plausibility checks Too many repeated High Voltage plausibility-check replacements Too many repeated Tube Current plausibility-check replacements Too many plausibility-check replacements per second	Internal electronic device produced wrong values	Reboot the system	Reboot and if still persistent, contact COMET TCS and send the diagnostic report.
100	1 2	Flash memory checksum failed RAM check failed	Corruption Corruption	Reboot Reboot	Replace Powercell Replace Powercell
150	1	Slave Powercell not ready	Slave Powercell not ready	Reboot	Replace slave Powercell
160	0	Error in physical CAN communication (CAN bus error)		Reboot	Replace POC

20.2.3 Source 4: Shutdown code and detail of “external interfaces” (COM/ITF)

The following table shows the possible shutdown code and detail of this part.

Code #	Detail #	Description	Why does it occur?	How to get rid of it?	If it is still there, then ...
1	0	OFF command. COM service, “Stop” command received	Regular There was a HV OFF command over Control Software or software protocol	Regular	Regular
2	0	It's all about the Guarded communication Guarded port 50506	Communication lost on TCP port 50506	Check the device on TCP port 50506	
	1	Guarded port 50505	Communication lost on TCP port 50505	Check the device on TCP port 50505	
	3	Guarded port serial	Communication lost on serial line port	Check the device on the serial port	

20.2.4 Source 5: Shutdown code and detail of “I/O” (IO)

The following table shows the possible shutdown code and detail of this part.

Code #	Detail #	Description	Why does it occur?	How to get rid of it?	If it is still there, then ...
1	1	Stop button pressed on pins 3+4 of X8	Regular	Regular	Regular
	2	Stop button pressed on optional controller panel	Regular	Regular	Regular
2	1	Cooler flow not available	Check cooler (X9, pins 1+2), if open or no change at start up	Switch off/on the cooler	Check flow switch on cooler
	2	Cooler temperature not available	Check cooler (X9, pins 3+4)	Cool down	Check correct function of thermostat in cooler
3	1	Customer interlock 1 opened	Check X8, pin 17 24V and pin 18 ground	Check wiring of X8	
	2	Customer interlock 2 opened	Check X8, pin 19 24V and pin 20 ground	Check wiring of X8	
4	1	Current of warning light 1 incorrect / out of range	The current of the warning light is out of the measured and configured threshold value.	Check the warning light	Adapt manually the threshold in the WebUI section I/O Configuration. Refer to the explanation in the OEM manual
	2	Current of warning light 2 incorrect / out of range			
	3	Current of warning light 3 incorrect / out of range			
	4	Current of optional controller warning light incorrect / out of range			

5	0	Dynamic monitoring contact is incorrect	State of contact was not okay during the check	Check the wiring on X10 pins 4+9	
6	0	Optional controller panel key switch is incorrect	Modified Key switch position during emission on optional panel (X12)	Don't switch during emission	Check correct wiring with the external panel. Check configuration in WebUI.

20.2.5 Source 6: Shutdown code and detail of “operation” (OP)

The following table shows the possible shutdown code and detail of this part.

Code #	Detail #	Description	Why does it occur?	How to get rid of it?	If it is still there, then ...
1	1	Warm up finished	Regular	Regular	Regular
2	2	IFC temperature too low	Temp < -5°C	Check airflow	
	3	IFC temperature too high	Temp > 75°C	Check airflow	Check filter
3	2	Cathode tank temperature too low	Temp < -5°C	Check airflow	
	3	Cathode tank temperature too high	Temp > 79°C	Check fans of active cooling	Check airflow around the tank
4	2	Anode tank temperature too low	Temp < -5°C	Check airflow	
	3	Anode tank temperature too high	Temp > 79°C	Check fans of active cooling	Check airflow around the tank
5	2	POC1 temperature too low	Temp < -5°C		
	3	POC1 temperature too high	Temp > 50°C	Check filter and check if fans are jammed	Check airflow around the POC
6	2	POC2 temperature too low	Temp < -5°C		
	3	POC2 temperature too high	Temp > 50°C	Check filter and check if fans are jammed	Check airflow around the POC
8	0	Focal spot changed while generating HV	Manually changed the focal spot over the software protocol		
9	3	ECU oil temperature too high	Temp > 79°C	Stop the system and cool it down	Contact TCS with Diagnostic Report
10	0	Exposure time timeout	Regular	Regular	Regular

20.2.6 Source 7: Shutdown code and detail of “internal communication” (INT)

The following table shows the possible shutdown code and detail of this part.

Code #	Detail #	Description	Why does it occur?	How to get rid of it?	If it is still there, then ...
1	1	CAN service, master Powercell heartbeat missing (due to communication loss)	Communication problem between IFC - POC1	Reboot	Replace POC
	2	CAN service, slave Powercell heartbeat missing (due to communication loss)	Communication problem between IFC - POC2	Reboot	Replace POC
	4	CAN service, ECU heartbeat missing (due to communication loss)	Communication problem between IFC - ECU	Reboot	Contact Comet TCS with Diagnostic Report
2	1	CAN service, boot and restart while operating of master Powercell	Due to strong interferences	Check ground connection	Check the tube
	2	CAN service, boot and restart while operating of slave Powercell	Due to strong interferences	Check ground connection	Check the tube
	4	CAN service, boot and restart while operating of ECU	Due to strong interferences	Check ground connection	Check the tube
3	0	CAN service, runtime reconfiguration triggered while operating	Due to interferences	Check ground connection	Check the tube

20.2.7 Source 8: Shutdown code and detail of “ECU unit” (ECU)

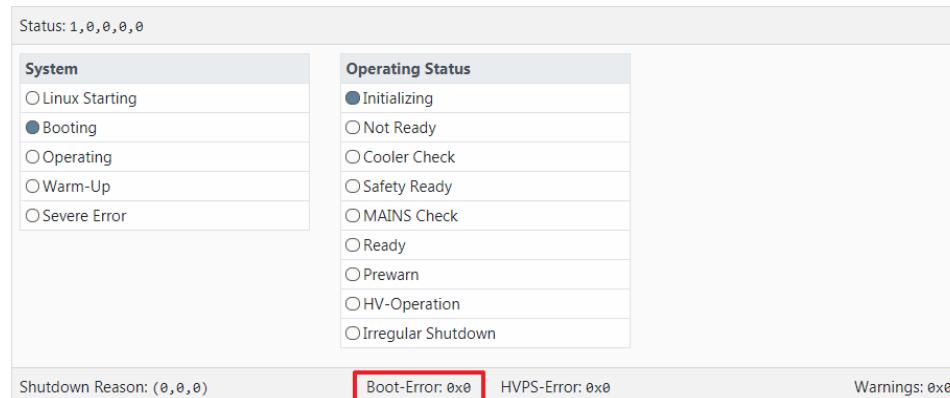
Code #	Detail #	Description	Why does it occur?	How to get rid of it?
2	Always „0“.	A not ready condition appeared during operation on ECU.	A not ready condition appeared during operation on ECU.	If this Shutdown occurs, always refer to the section about the not ready conditions of the ECU.



If the Shutdown Reason (8,2,0) occurs, we have to check the Not Ready Conditions of the ECU. For further details please refer to the document “T3-Status.pdf”

Limitation in v3.1.0: the detail is always “0”. In further versions, the HEX code of the related Not Ready Condition will maybe be displayed in the detail's tab.

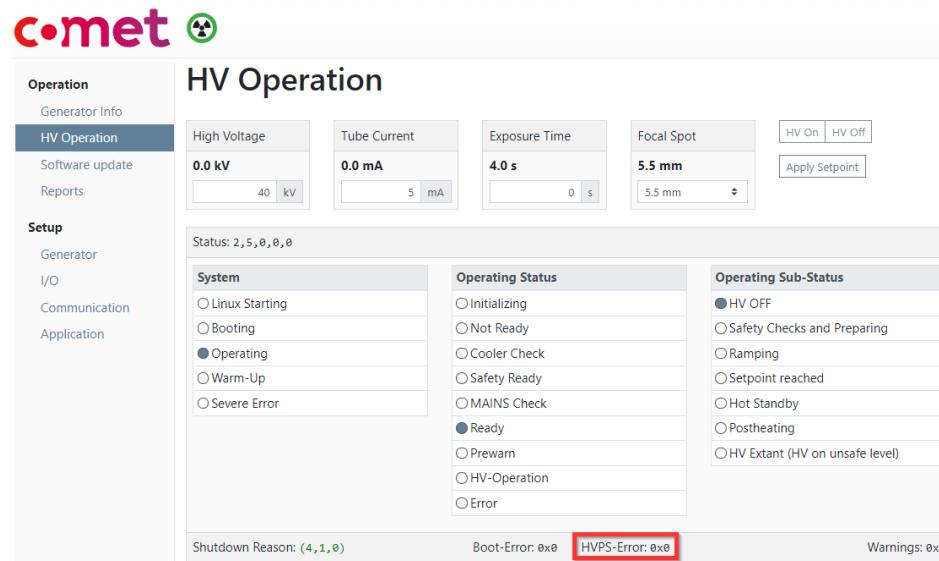
20.3 Boot and start errors



Error Code	Description	Why?	Action to do
0x00000001	Incomplete system, e.g. no Powercells found/available	For example, a bipolar system requires two Powercells, but only one was detected	Reboot the system. If the problem persists, update to iVario software >= v2.2.0. If still persistent, contact COMET TCS and send the diagnostic report.
0x00000002	Erroneous or not written device information (Serial number, part number, ...)	For example, a device was not correctly recognized on boot up and the iXRS is not allowed to start.	Reboot the system. If still persistent, contact COMET TCS and send the diagnostic report.
0x00000004	Communication to the tank failed or its data is corrupt		Reboot the system. If still persistent, contact COMET TCS and send the diagnostic report.
0x00000008	Tube data corrupt or inconsistent	Triggered if wrong tube polarity is configured or ebeam tube configured in x-ray generator	Check carefully your configuration

0x000000010	Cable data corrupt or inconsistent	Triggered if a bipolar system is configured but no Anode cable configured	Check carefully your configuration
0x000000020	Software version mismatch	Mismatch of the software version of at least one component	Update this component to match the software version of the IFC
0x000000040	Configuration error	For example, a bipolar tube is selected on a unipolar system (cathode tank only)	Check precisely your configuration
0x000000080	Hardware compatibility error	One of the hardware components doesn't fit the hardware compatibility check	Contact COMET TCS and send the diagnostic report.
0x000000100	Genesis time detected, i.e. Real Time Clock can't be read	The real time clock of the system is set to 01/01/1970. This time is not allowed. Real-time clock not available	Reboot the generator. If still persistent, set the correct system time in the WebUI section "Generator". If still persistent, contact COMET TCS and send the diagnostic report.
0x000000200	Special Operating mode mismatch		Contact COMET TCS and send the diagnostic report.
0x000000400	IFC replacement case detected		Contact COMET TCS and send the diagnostic report.
0x000000800	Internal error (unexpected or unknown reason)	An internal error occurred	Reboot the system. If still persistent, contact COMET TCS and send the diagnostic report.
0x00001000	Software compatibility error	Mismatch of the software version of at least one component	Update this component to match the software version of the IFC
0x00002000	HV transformer type of tank(s) incompatible with current setup		Contact COMET TCS and send the diagnostic report.

20.4 Severe operating errors



Error Code	Description	Why?	Action to do
0x00000001	Configuration error	For example, a bipolar tube is selected on a unipolar system (cathode tank only)	Check precisely your configuration
0x00000002	Unsupported device detected		Reboot the system. If still persistent, contact COMET TCS and send the diagnostic report.
0x00000004	Lost a device (communication loss)	Due to instability on CAN bus	Reboot the system
0x00000008	Re-announced device while already operating	Due to instability on CAN bus	Reboot the system

0x000000010	Lost service/application (missing process)	Due to software instability	Reboot the system
0x000000020	Software version mismatch	Mismatch of the software version of at least one component	Update this component to match the software version of the IFC
0x000000030	Statistics-persist mainloop synchronization	Due to software instability	Reboot the system
0x000000040	Internal error		Reboot the system. If still persistent, contact COMET TCS and send the diagnostic report.
0x000000080	System unstable (Data-server load too high)	Due to software instability	Reboot the system
0x000000100	System unstable (CPU utilization too high)	Due to software instability	Reboot the system
0x000000200	System unstable (Memory load too high)	Due to software instability	Reboot the system

20.5 Warnings

HV Operation

High Voltage: 0.0 kV (40 kV)

Tube Current: 0.0 mA (5 mA)

Exposure Time: 4.0 s (0 s)

Focal Spot: 5.5 mm (5.5 mm)

HV On | HV Off

Apply Setpoint

Status: 2,5,0,0,0

System	Operating Status	Operating Sub-Status
<input type="radio"/> Linux Starting	<input type="radio"/> Initializing	<input type="radio"/> HV OFF
<input type="radio"/> Booting	<input type="radio"/> Not Ready	<input type="radio"/> Safety Checks and Preparing
<input checked="" type="radio"/> Operating	<input type="radio"/> Cooler Check	<input type="radio"/> Ramping
<input type="radio"/> Warm-Up	<input type="radio"/> Safety Ready	<input type="radio"/> Setpoint reached
<input type="radio"/> Severe Error	<input type="radio"/> MAINS Check	<input type="radio"/> Hot Standby
	<input checked="" type="radio"/> Ready	<input type="radio"/> Postheating
	<input type="radio"/> Prewarn	<input type="radio"/> HV-Operation
	<input type="radio"/> HV-Operation	<input type="radio"/> Error

Shutdown Reason: (4,1,0) Boot-Error: 0x0 HVPS-Error: 0x0 Warnings: 0x0

Warning Code	Description	Why?	Action to do
0x00000001	Arc active	Arc handling process ongoing	
0x00000002	HV too high	Mesured HV is more than 102% of the setpoint	
0x00000004	HV too low	Mesured HV is less than 98% of the setpoint	
0x00000008	Emission current too high	Mesured current is more than 102% of the setpoint	
0x00000010	Emission current too low	Mesured current is less than 98% of the setpoint	

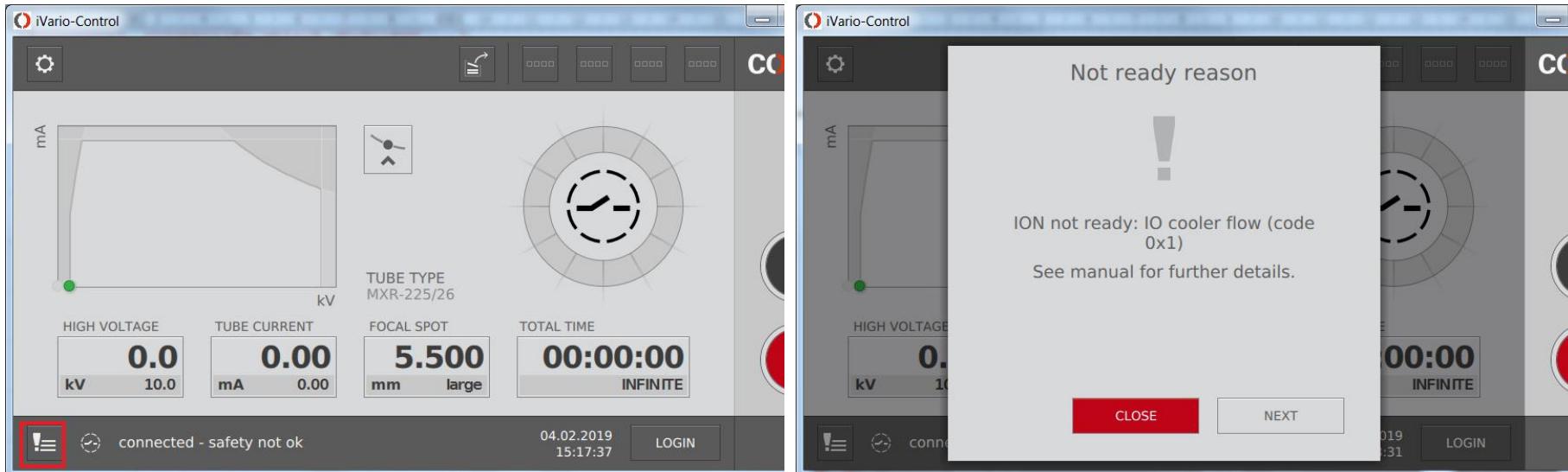
0x000000020	ebeam grid voltage too high	Not implemented	
0x000000040	ebeam grid voltage too low	Not implemented	
0x000000080	POC1 temp. critical	Temp > 45°C	Check filter and check if fans are jammed
0x000000100	POC2 temp. critical	Temp > 45°C	Check filter and check if fans are jammed
0x000000200	POC3 temp. critical	Not implemented	
0x000000400	IFC temp. critical	Temp > 70°C	Check filter. Risk of Shutdown reason 6.2.2
0x000000800	Cathode tank temp. critical	Temp > 74°C	Check fans of active cooling
0x000001000	Anode tank temp. critical	Temp > 74°C	Check fans of active cooling
0x000002000	ECU temperature critical	Temp > 74°C	Stop the system and cool it down
0x000004000	HV too high after postheating	HV not below threshold 5kV after 15 seconds timeout	Reboot the system to get into a proper state. Risk of shutdown reason 1/2.48.0
0x000008000	Short warm-up required	Precaution for tube	Do the short warmup (20 minutes) in order to protect the tube
0x000010000	Medium warm-up required	Precaution for tube	Do the medium warmup (40 minutes) in order to protect the tube
0x000020000	Long warm-up required	Precaution for tube	Do the long warmup (60 minutes) in order to protect the tube
0x000080000	System unstable	Triggered when the system state is unstable. There are several reasons.	Reboot the system. Observe if reproductive. If the problem persists, generate a diagnostic report and contact Comet's customer support
0x001000000	Power supply voltage reached critical level	Detected level of the power supply is too low	Reboot the system. Observe if reproductive. If the problem persists, generate a diagnostic report and contact Comet's customer support

The warning code is a 32-bit register from where each bit is OR-able (one or more bits can be signalized).

Below are two interpreted examples:

0x000000001	An arc is active and the HVPS is running the arc handling process
0x000001800	Code is split into the two described codes. Both warnings are active 0x00000800 Cathode tank temperature critical 0x00001000 Anode tank temperature critical

20.6 Not ready condition tags in the Control Software



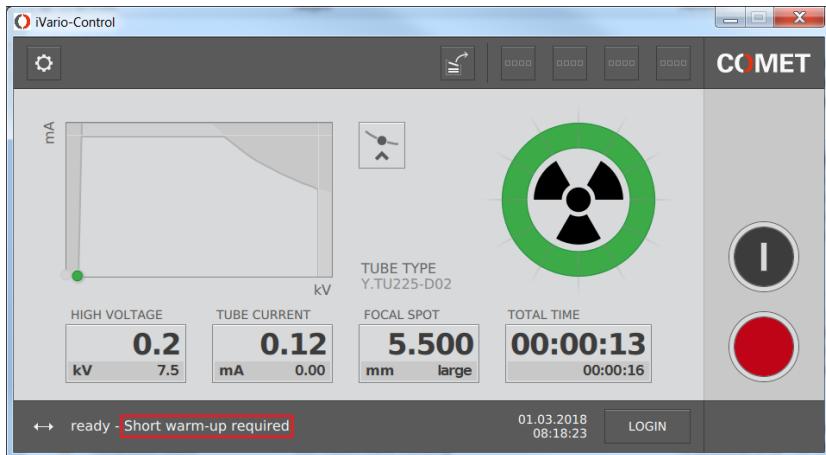
In the Control Software, the not ready conditions are displayed as tags in the style of a ticker on the left bottom.

If you click on the tag, the details about the not ready condition are displayed in a popup window.



If the not-ready condition in the iVario Control Software is not self-explaining, please refer to the annex of the not-ready condition with the delivered not-ready condition code.

20.7 Warning tags in the Control Software



In the Control Software, the warnings are displayed as tags in the style of a ticker on the left bottom.

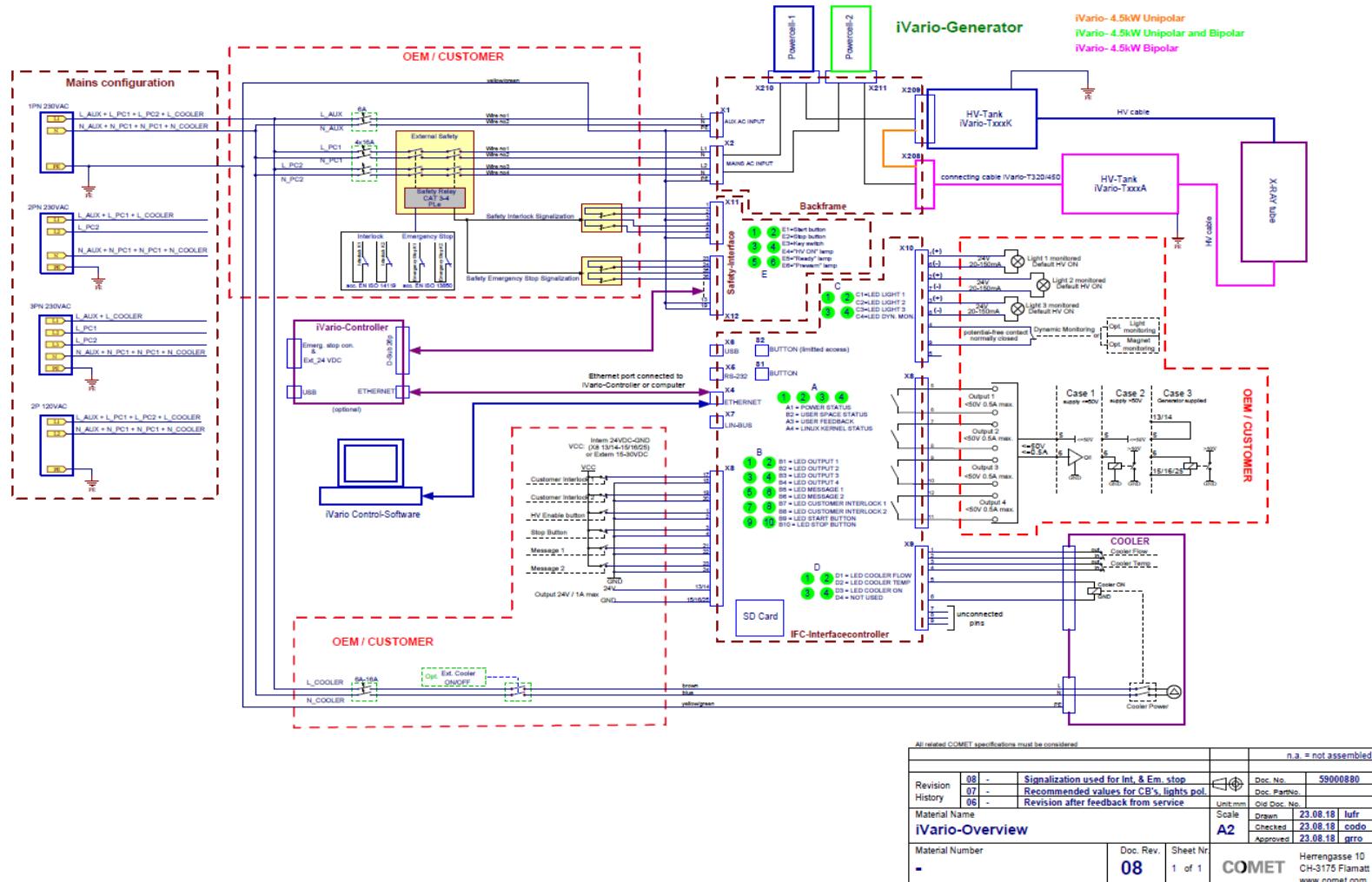


If you click on the tag, the details about the warning is displayed in a popup window.



If the warning description in the iVario Control Software is not self-explaining, please refer to the annex of the warnings with the delivered warning code.

Schematics



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2.4	09.07.2020	copa	Official document for iVario SW v2.4.1	Official
2.3	30.10.2019	copa	Official document for iVario SW v2.3.0/1	Official

References

[1]	iVario-series OEM-Handbook	V7.0	30.01.2020
[2]	T3-Status-LED-Description	v2.5.0	30.06.2021
[3]	WebUI Manual public	V2.5	30.06.2021
[4]	T3-Status	V2.5	30.06.2021
[5]	HVPS-Development-Manual	v0.8	12.05.2017
[6]	Definitions-Abbreviations	v2.0	23.11.2018