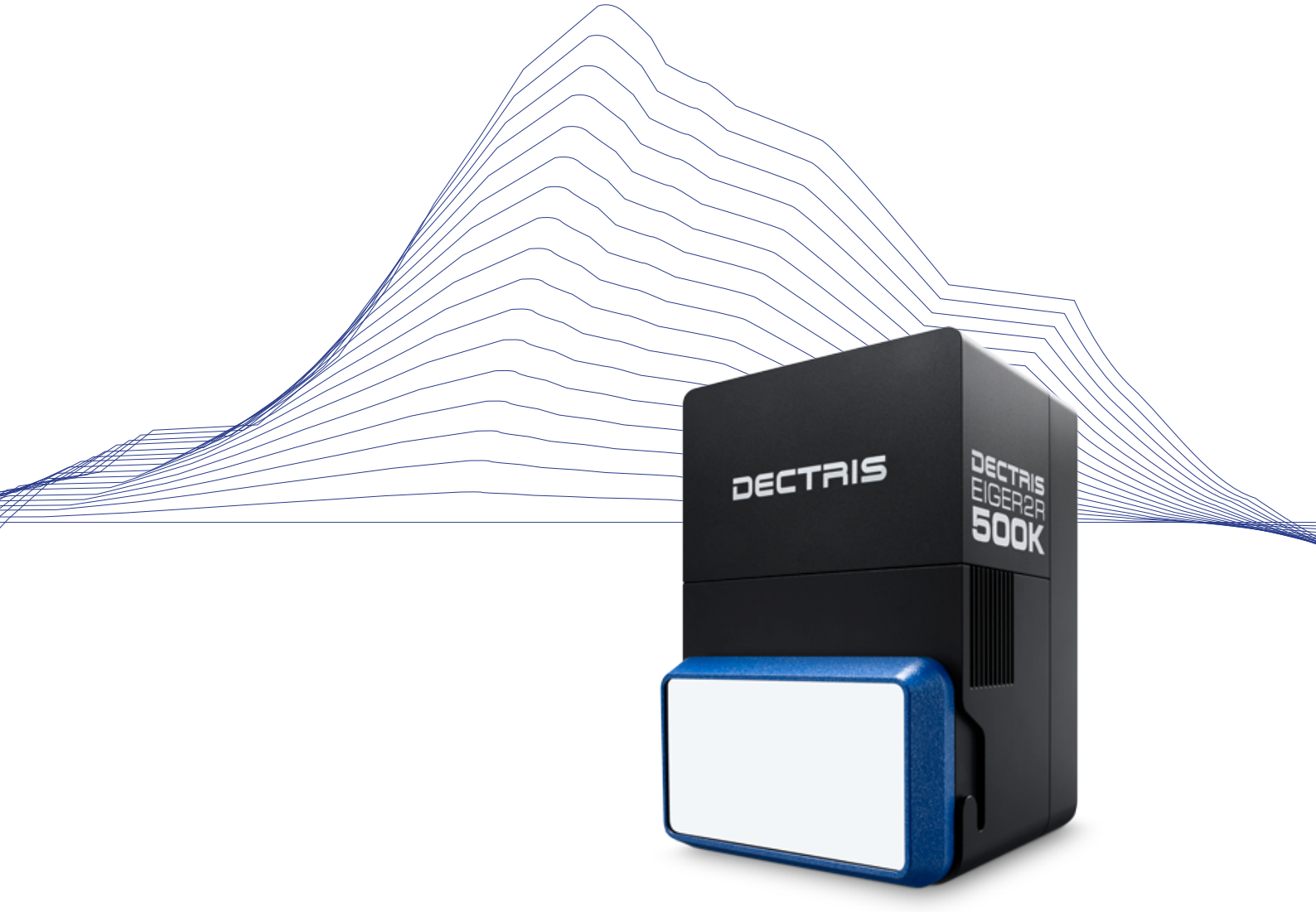
DECTRIS



Technical Specifications
DECTRIS EIGER®2 R 500K

Document Version v1.7.0

DECTRIS Ltd.

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1. GENERAL INFORMATION

1.1. Contact and Support

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1.2. Explanation of Symbols

Danger **#0**

Danger blocks are used to indicate immediate danger or risk to personnel or equipment.

Warning **#0**

Warning blocks are used to indicate danger or risk to personnel or equipment.

Caution **#0**

Caution blocks are used to indicate danger or risk to equipment.

Information **#0**

Information blocks are used to highlight important information.

1.3. Warranty Information

Caution	#1



Do not ship the system back before you receive the necessary transport and shipping information.

1.4. Disclaimer

DECTRIS® has carefully compiled the contents of this manual according to the current state of knowledge. Damage and warranty claims arising from missing or incorrect data are excluded.

DECTRIS® bears no responsibility or liability for damage of any kind, also for indirect or consequential damage resulting from the use of this system.

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2. USAGE OF THE EIGER2 R 500K

The EIGER2 R 500K hybrid-photon-counting (HPC) detector system has been designed for the detection of X-rays produced by synchrotrons or laboratory sources. It is intended for indoor use only. For other applications, please contact DECTRIS® technical support for additional information.

Caution	#2
⚠	Improper use of the DECTRIS® detector system can compromise its safety and its functionality is no longer guaranteed.

Caution	#3
⚠	When using the detector in vacuum strictly follow the in-vacuum instructions given in this document.

2.1. Product Return and Recycling

We recycle DECTRIS® detector systems that are no longer suitable for use. If you are not using your DECTRIS® detector system any more, send it back to us. We will make sure that your system is responsibly and safely recycled. This is free for customers who purchased a new DECTRIS® detector system.

3. TECHNICAL SPECIFICATIONS

3.1. Specifications

3.1.1. Detector

Table 3.1: Technical Specifications

Detector technology	Hybrid Photon Counting (HPC)
Number of modules (W x H)	1 x 1 = 1
Sensor material	Silicon (Si)
Sensor thickness	450 µm
Pixel size (W x H)	75 µm x 75 µm = 5625 µm^2
Pixel array format (W x H)	1028 pixel x 512 pixel = 526 336 pixel
Active area (W x H)	77.1 mm x 38.4 mm = 2961 mm^2
Image bit depth	32 or 16 bit
Readout bit depth	16 bit
Maximum count rate [1]	3.8 × 10^6 photons/s/pixel
Adjustable threshold range	3.5 keV to 30 keV
Energy range	5.4 keV to 22.2 keV
Number of thresholds	two independent thresholds
Readout time	continuous readout, with zero dead time
Maximum frame rate [2]	50 Hz
Point-spread function	1 pixel (FWHM)
Connection to detector control unit	1 x 1GBase-T Ethernet
Power supply	External power supply unit
Software interface	HTTP REST interface (via network connection)
Dimensions (W x H x D)	100 mm x 140 mm x 92.4 mm
Weight	1.9 kg
Overvoltage category	II
Means of protection	Class I
Pollution degree	II
Maximum operating altitude	2000 m a.s.l.

[1] Values are for Cu radiation
[2] One frame per exposure, i.e. single-threshold or difference image

3.2. Ratings

3.2.1. Detector

Table 3.2: Power Ratings

Detector power input	+12 V DC, 30 W Connector: PWR Jack 2.1mm x 5.5mm x 9.5mm high current
Detector external trigger input	High level: 3.5 - 5V Low level: <1.5 V **Caution #4** ⚠ Absolute maximum is 5 V. Applying a higher voltage will damage the detector.
External trigger input impedance	High Impedance: 500 kΩ Connector: LEMO EPY.00.250.NTN Appropriate plug: LEMO FFA.00.250.NTAC22
Detector trigger output	High level: >4.5 V Low level: <1.5 V Impedance: 10 - 40 Ω Connector: LEMO EPY.00.250.NTN Appropriate plug: LEMO FFA.00.250.NTAC22

3.2.2. Power Supply Unit

Information #1

Please consult the user documentation of the Mean Well GSM40A12-P1J power supply unit for details.

Caution #5

Only use the power supply delivered with the EIGER2 R 500K.

Table 3.3: Power Supply Unit Ratings

Power supply unit power input	100 VAC to 240 VAC, 50 Hz to 60 Hz, 1 A max.
Power supply unit power output	12 VDC, 3.34 A max., 40 W max.
AC connector	IEC-320-C14 input inlet
Case dimensions (W x H x D)	125 mm x 50 mm x 31.5 mm
Weight	290 g

3.2.3. Detector Control Unit

Information #2

Please consult the user documentation of the DELL PowerEdge R260 for details.

Table 3.4: Detector Control Unit Ratings

Detector control unit power input	450W Platinum 100 VAC to 240 VAC, non redundant
Dimensions (W x H x D)	482.0 mm x 42.8 mm x 461.14 mm without bezel
Weight	<9.61 kg
Chassis	1U

3.3. Ambient Conditions

The EIGER2 R 500K detector is designed for indoor use only. The ambient conditions shown in table 3.5 must be satisfied.
Values inside the detector are different.

Table 3.5: Detector Operating Ambient Conditions

Ambient Condition	Value
Operating temperature	+20 °C to +30 °C
Extended operating temperature	+20 °C to +45 °C **Information #3** When operating in expanded temperature range, data quality may be impacted.
Operating humidity	<80 % at 20 °C, non-condensing
Storage temperature	+15 °C to +40 °C
Storage humidity	<40 % at 20 °C, non-condensing

Caution #6

Please consider the following points when storing the detector

- Make sure the temperature and the humidity inside the transport box does not exceed the specified range (use of a drying agent is required).
- Ensure that no condensation moisture develops if the detector is stored at low temperature.

4. DETECTOR COMPONENTS AND CONNECTORS

4.1. EIGER2 R 500K Detector

4.1.1. Technical Drawing

Information #4

3D step files of the EIGER2 R 500K detector are available on request. Please contact DECTRIS® technical support for more information.

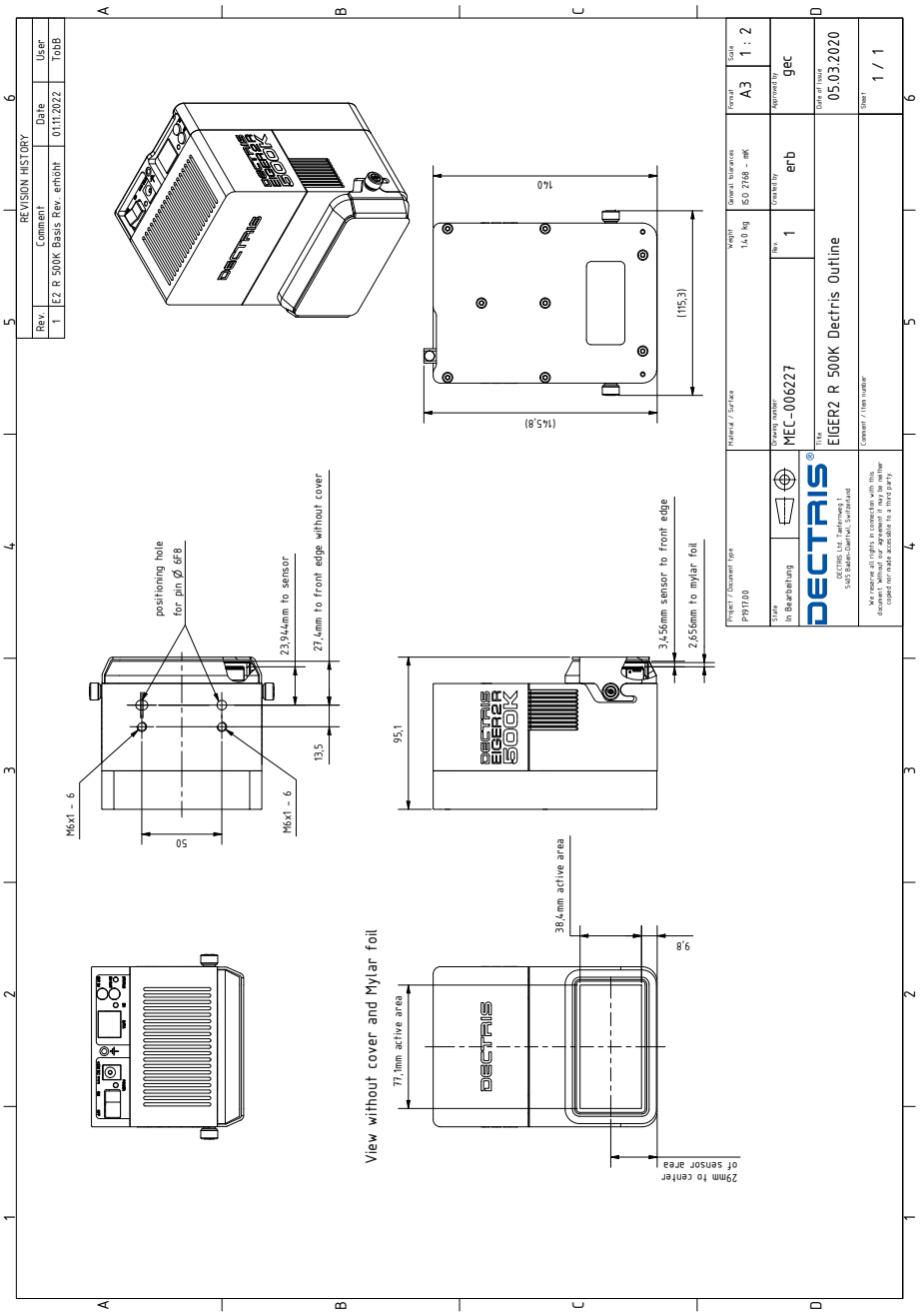


Figure 4.1: Drawing of the EIGER2 R 500K Detector (also printed separately in the user documentation folder)

4.1.2. Front Side of the Detector

Danger	#1
Danger of electric shock. Do not touch the Mylar® foil. The sensors behind the Mylar® foil are operated at high voltages. Touching the Mylar® foil can cause an electrical shock.	

Warning	#1
Do not touch the Mylar® foil to avoid damage of the sensors.	

Caution	#7
The cover may not protect the detector from a direct beam.	

The detector comes with a protective cover (1.5 mm, steel) for the front window, which should only be removed during operation. The sensors are behind a 12 µm thick Mylar® (PET) foil coated with aluminium to protect them from humidity, dust and from being touched.



Figure 4.2: The EIGER2 R 500K Detector with the Cover Removed (front view)

4.1.3. Top Side of the Detector



Figure 4.3: The EIGER2 R 500K Detector (top view)

4.1.4. Status LEDs

Table 4.1: The Meaning of the Status LEDs on the Detector Top Plane

LED	Description
EN	Orange to indicate the detector is in counting mode.
POWER	Green when the power supply is functioning.
STATUS	Red when an internal communication error occurs.

4.1.5. Connectors and Connecting Cables/Pipes

Table 4.2: Electric Connectors and Connecting Cables

Connector	Description
DATA	1 x 1GBase-T Ethernet DATA -> detector control unit DATA 1 Use Cat 6A S/FTP Ethernet cable(s). **Caution #8** ⚠ There must be a 1 x 1GBase-T Ethernet point-to-point connection between detector and detector control unit.
POWER	DC power connector (see tables 3.2 and 3.3)
EXT IN	External trigger input (see table 3.2) Use a LEMO® Type 00 (NIM/CAMAC) cable.
EN OUT	Enable out, high when counting is enabled. Use a LEMO® Type 00 (NIM/CAMAC) cable.
⏚	Functional ground **Information #5** ⓘ Although the detector may already be grounded via the mounting bolts, it must also be grounded through the functional ground connector at the top to establish a defined and reliable ground reference. Make sure not to create unintended ground loops.

4.2. Detector Control Unit

4.2.1. Configuration

Caution **#9**

Do not access or modify the operating system of the detector control unit.

The user interface of the detector control unit is accessible using a web browser. The detector control unit does not need any connections other than the power and Ethernet cables.

The detector control unit has to be connected point-to-point to the detector via 1 x 1GBase-T Ethernet. The detector control unit can be integrated into the site network infrastructure using one of the interfaces described in table 4.3. The detector control unit is optimized for performance and stability of operation. In order to achieve these goals we deliver the detector control unit with fixed firmware (BIOS etc.) and software (OS) version. The detector control unit must not be operated in an environment where unauthorized access is possible. The detector control unit does not provide authentication mechanisms and is not protected against malicious acts by unauthorized third parties.

Using the web front end, it is possible to restart the EIGER2 control service, trigger an update, and to shut down and to reboot the detector control unit. Any further control of the detector is carried out via the SIMPLON API (see separate documentation).



Figure 4.4: Front view of detector control unit.

Caution **#10**

Pushing the power button on the front panel longer than 2 seconds will immediately halt the detector control unit. All image data on the detector control unit will be permanently lost.

Information **#6**

Briefly pushing the power button on the front panel will shut down the detector control unit. May take up to 1 min.

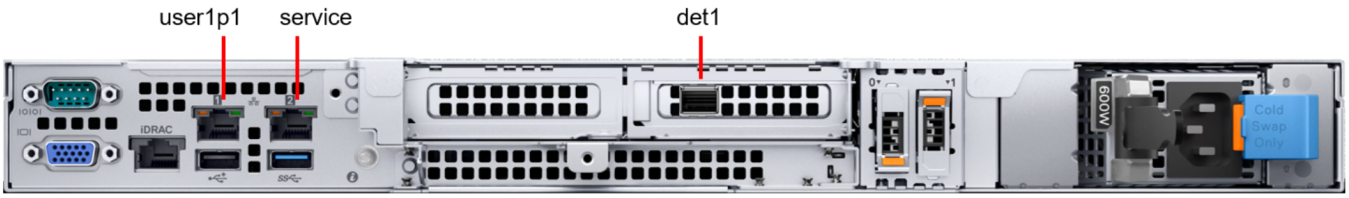


Figure 4.5: Back view of detector control unit with network interfaces.

4.2.2. Connectors

Table 4.3: Detector Control Unit Connectors

Connector	Description
user1p1 (Embedded)	Interface Name: user1p1 (1 GBase-T) User configurable GbE Network Interface Preconfiguration: DHCP
service (Embedded)	Interface Name: service (1 GBase-T) Fallback GbE Network Interface Preconfiguration: Static 169.254.254.1 (Netmask 255.255.255.0)
det1	DATA Detector Interface Port1
Power	AC Connector

See DELL owner's manual for further details.

5. INSTALLING THE DETECTOR SYSTEM

5.1. Transport Considerations

Warning **#2**



Avoid vibration and shock when moving the detector.

The detector has been delivered in a robust transport box. Please keep this transport box for transport or storage purpose.

5.2. Mounting

Caution **#11**



Do not place the detector and the power supply near heat sources or in a place subject to direct sunlight, excessive dust or mechanical shock.

Warning **#3**



Do not use the power supply in vacuum.

Caution **#12**



Make sure that the power supply has adequate ventilation.

- Do not cover any air intakes or outlets.
- Place the power supply in a location with adequate air circulation.
- Make sure the power supply has enough space for proper ventilation (minimum wall distance: 100 mm).
- Do not operate the power supply in a closed environment.

5.3. Grounding of the Detector

Warning **#4**



The mains plug of the power supply has to be connected to a grounded power outlet.

Although the detector may already be grounded via the mounting bolts, it must also be grounded through the functional ground connector at the top to establish a defined and reliable ground reference. Additionally, the detector's power plug must always be connected to a socket that guarantees proper engagement of the protective earth (PE) contact.

To avoid ground loops—which can lead to electrical noise, signal interference, or safety hazards—care must be taken not to create multiple unintended ground paths. The grounding scheme should ensure a single, well-defined connection to ground.

5.4. Mounting the Detector Control Unit

Caution **#13**



Make sure that the detector control unit has adequate ventilation.

Caution **#14**



The mains plug of the detector control unit has to be connected to a grounded power outlet.

The detector control unit can be mounted in a standard 19 inch rack, which has to be properly grounded.

6. TEMPERATURE AND HUMIDITY CONTROL

The EIGER2 R 500K detector has a combined temperature and humidity sensor.
To start the detector correctly, please refer to section 7.1 and execute the correct startup procedure.

For stable operation, a constant detector temperature is recommended. After switching on the detector, its temperature will reach a constant value after about 30 min to 60 min. For stable long term measurements, we recommend to control the ambient temperature within a range of ±1 °C.

Information	#7
A free-flowing air stream is mandatory in order to properly cool the electronics inside the detector. Do not cover any ventilation holes.	

7. OPERATION PROCEDURE

Before operating the detector, make sure you have read the Technical Specifications and the User Manual.

7.1. Getting Started

Before switching on:

- Mount the detector properly.
- Connect the detector to ground potential, using the functional ground connector.
- Connect the detector to the power supply.
- Connect the power cable, the local network cable, and the detector data cable to the detector control unit. (If more than one data cable is required, please pay attention to the numbering of the cables as described in table 4.2)

Warning **#5**

A vacuum compatible EIGER2 R 500K detector is not air cooled, but requires external cooling for both in-air and in-vacuum operation. An energy transfer of 30 W via the bottom of the EIGER2 R 500K detector is imperative for stable operation.

Information **#8**

For operation of a vacuum compatible EIGER2 R 500K detector, DECTRIS® offers the suitable EIGER2 Water Cooling Set (111667) with included chiller and cooling plate and the suitable EIGER2 Vacuum Feedthrough Set SC (202564). For more information, please contact DECTRIS®.

Information **#9**

Solutions provided by the user are also possible, but not fully supported by DECTRIS®. Please make sure that the required energy transfer is guaranteed.

7.2. Startup Procedure

Please use the following startup procedure:

- Turn ON the power switch at the top of the detector.
- Turn ON the detector control unit. Wait at least 5 min before trying to connect.

The detector is now ready to use.

Information **#10**

The software start-up procedure is described in detail in the User Manual.

7.3. Turning Off the Detector

To turn off the detector:

- Turn OFF the power switch at the top of the detector.
- Turn OFF the detector control unit.

Warning **#6**

As long as the detector power cable is connected, the detector has to be considered under power.

7.4. Vacuum Operation

DECTRIS® detectors can be provided for vacuum operation. The typical reachable vacuum is 10^{-3} mbar. The outgassing rate and content are not specified. The vacuum compatibility option guarantees that the detector will operate in the mentioned vacuum range. Detectors ordered with a vacuum compatibility option have been tested in vacuum.

To see if a detector is vacuum compatible, check whether the vacuum compatibility option is included in the order confirmation received from DECTRIS®.

Warning **#7**

A vacuum compatible EIGER2 R 500K Detector is not air cooled, but requires external cooling for both in-air and in-vacuum operation. An energy transfer of 30 W via the bottom of the EIGER2 R 500K Detector is imperative for stable operation.

Information **#11**

For operation of a vacuum compatible EIGER2 R 500K Detector, DECTRIS® offers the suitable EIGER2 Water Cooling Set (111667) with included chiller and cooling plate and the suitable EIGER2 Vacuum Feedthrough Set SC (202564). For more information, please contact DECTRIS®.

Information **#12**

Solutions provided by the user are also possible, but not fully supported by DECTRIS®. Please make sure that the required energy transfer is guaranteed.

7.4.1. Ambient Conditions for In-Vacuum Use

Warning **#8**

Only systems with a vacuum compatibility option are allowed to be operated in vacuum.

For in-vacuum operation of the detector following conditions must be fulfilled:

Table 7.1: In-Vacuum Operating Conditions

In-Vacuum Condition	Definition
Pressure during operation	atmospheric pressure or less than 0.01 mbar 
Detector mounting plate temperature during operation	10 °C to 25 °C
Thermal stabilization unit set temperature in vacuum	24 °C
Chamber temperature during ”bake-out” (detector unpowered)	max. +60 °C (for temperatures > 40 °C make sure the thermal stabilization unit is set to +40 °C and running)

7.4.2. Operation Procedure In-Vacuum

Make sure the vacuum conditions in table 7.1 are met and follow below procedures for venting and pumping down the vacuum chamber.

Warning **#9**

Prior to pumping down (and venting):
Always make sure the detector has NO POWER and is WARMED UP to room temperature. Otherwise it could be damaged through electrical discharge or condensation.

Pumping Down the Vacuum Chamber

- Mount the detector properly inside the vacuum chamber.
- Connect the detector power, data, trigger, and coolant lines inside and outside the vacuum chamber.
- Connect the detector control unit and the detector data cables.
- Make sure the power switch on the top of the detector is ON.
- Make sure the detector is POWERED OFF by DISCONNECTING THE POWER SUPPLY outside the vacuum chamber.
- Close the vacuum chamber and start to pump down.
- Once the pressure inside the vacuum chamber is below 1×10^{-2} mbar set the temperature on the thermal stabilization unit to 24 °C and turn on the thermal stabilization unit (pumping down a warm detector prevents condensation issues).
- After the thermal stabilization unit has reached the set value and the pressure inside the vacuum chamber is sufficiently low to meet the operating conditions, power up the detector.

Venting the Vacuum Chamber

- Turn OFF the power to the detector, either by disconnecting the power supply outside the vacuum chamber or by switching OFF the detector power supply.
- Set the temperature to 23 °C on the thermal stabilization unit and let the detector warm up at least 30 min to prevent condensation inside the vacuum chamber.
- Use dry air or nitrogen to vent the chamber.

7.5. Storing the Detector

Please follow these instructions:

- Put the detector in a plastic bag, add at least 200 g of drying agent (i.e. silica gel) into the bag and seal it air-tight.
- Check the humidity and change the drying agent frequently for compliance with the storage requirements in section 3.3.

7.6. Cleaning and Maintenance

Caution **#15**



The Mylar® foil must not be touched or cleaned. If it is damaged, please contact DECTRIS® technical support.

The detector housing can be cleaned with a soft tissue. The EIGER2 R 500K detector does not require any maintenance.

8. TROUBLESHOOTING

Table 8.1 provides an overview of possible problems with the detector system and instructions in order to solve the problems. If the problem you are experiencing is not listed below or if the instructions do not help, please contact support@dectris.com.

The LEDs at the top of the detector can provide valuable information for troubleshooting. Check section 4.1.4 for further information.

Table 8.1: Troubleshooting

Problem	Cause	Solution
Detector control unit does not start properly.	Detector control unit is not powered.	Check the User Documentation of the detector control unit (see section 3.2.3).
Communication error, the detector is not found at startup.	Data cable is not connected or defective.	Check the connection between detector control unit and detector. Make sure that there is a direct, peer-to-peer connection between the detector control unit and the detector. Check that all cables are properly inserted and the fiber connectors are clean. Avoid tangling or strong bending of the data cables. Use the "Check Connections" function on the Web Interface to inspect the quality of the data connections. See the User Manual for details.
Detector shuts down.	Temperature or humidity error.	Check the temperature of the detector using the SIMPLON API and wait until the detector cools down. Restart the detector again.
The detector fails to turn on.	The power cord is not connected or the plug is incompletely inserted.	Connect the power cord firmly. Check the LED on the external power supply.
Image acquisition not possible.	Detector is not properly initialized.	Initialize the detector via the SIMPLON API. (See API Reference)
Detector housing is humid.	Ambient humidity around the detector exceeds the operating conditions.	Shut down the detector immediately and check the humidity. Power up the detector only when the ambient humidity has been reduced.

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EIGER2: EP2734861B1, JP6264615B2, US9081103B2
PILATUS4: EP2734861B1, JP6264615B2, US9081103B2

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