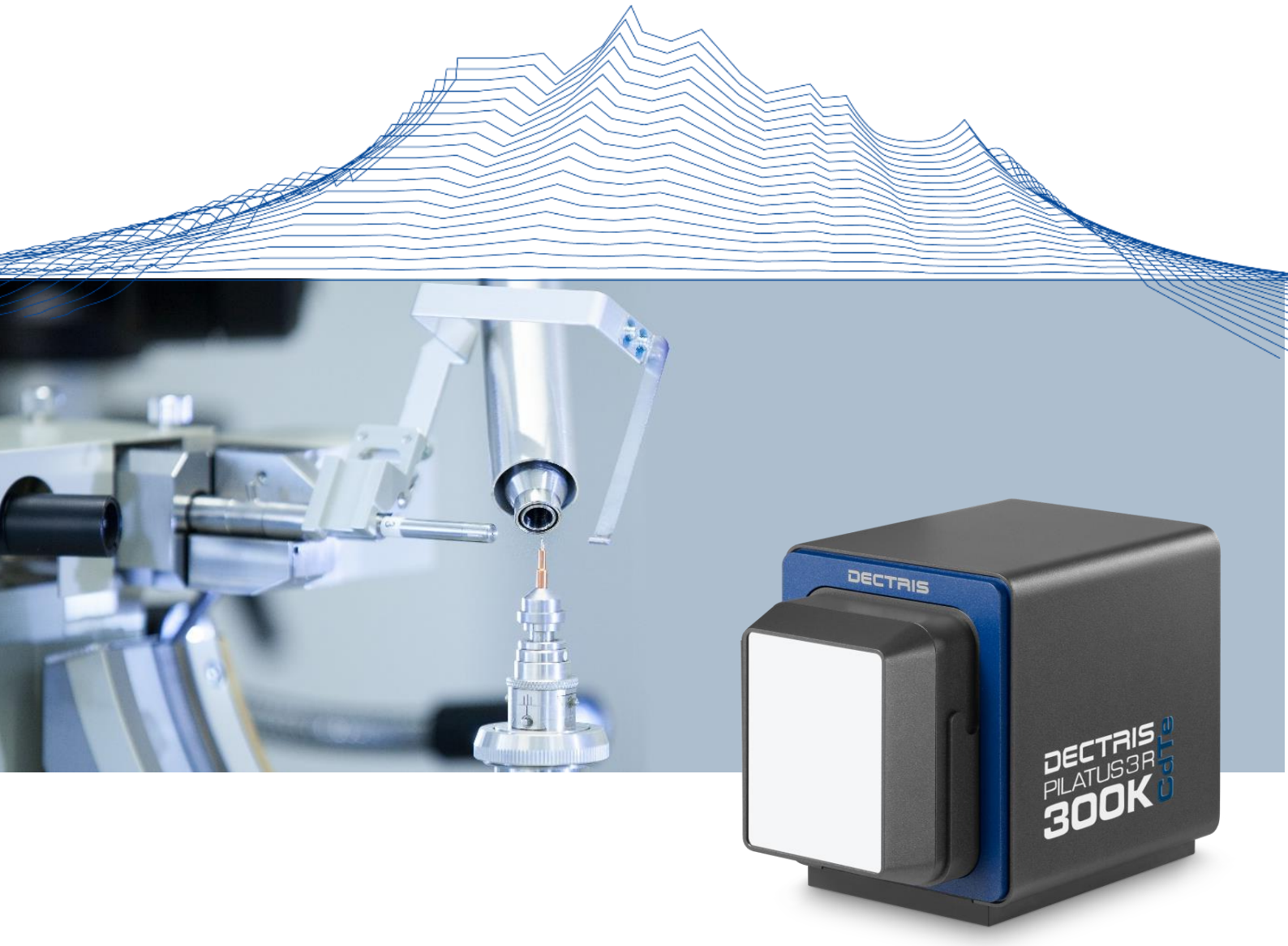
DECTRIS
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# Technical Specifications

## DECTRIS PILATUS®3 R CdTe 300K Detector System

*Document Version v1.2.3*

**DECTRIS Ltd.**

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# DOCUMENT HISTORY

## Current Document

**Table 1:** Current Version of this Document

| Version | Date | Status | Prepared | Checked | Released |
|---|---|---|---|---|---|
| v1.2.3 | 2024-05-31 | release | SV | MM | SV |

## Changes

**Table 2:** Changes to this Document

| Version | Date | Changes |
|---|---|---|
| v1.2.3 | 2024-05-31 | New Linux Distribution |
| v1.2.2 | 2022-02-08 | New Server O. |
| v1.2.1 | 2020-09-15 | Adjustment of Low Energy Options |
| v1.2.0 | 2020-07-09 | New Linux Distribution |
| v1.1.3 | 2020-01-16 | Low Energy Calibration Option |
| v1.1.2 | 2019-12-03 | New Server J. |
| v1.1.1 | 2019-10-03 | New Server O. |
| v1.1.0 | 2019-07-09 | Update of corporate design of PILATUS R, S and X series. |
| v1.0.0 | 2019-06-28 | First Release. |

# 1. GENERAL INFORMATION

## 1.1. Contact and Support


| | |
|---|---|
| Address: | DECTRIS Ltd.<br>Taefernweg 1<br>5405 Baden-Daettwil<br>Switzerland |
| Phone: | +41 56 500 21 02 |
| Fax: | +41 56 500 21 01 |
| Homepage: | http://www.dectris.com/ |
| Email: | support@dectris.com |


Should you have questions concerning the system or its use, please contact us via telephone, e-mail or fax.

## 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 specific information.

## 1.3. Warranty Information

Should your detector require warranty service, contact DECTRIS® for further information. Before shipping the system back, please contact DECTRIS® to receive the necessary transport and shipping information. Make sure that the original packaging is used when returning the system.

| Caution | #1 |
|---|---|



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

When returning the detector system for repair, be sure to fill out and include the service form at the back of this document to provide the support division with the necessary 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.

DECTRIS® is the sole owner of all user rights related to the contents of the manual (in particular information, images or materials), unless otherwise indicated. Without the written permission of DECTRIS® it is prohibited to integrate the protected contents in this publication into other programs or other websites or to use them by any other means.

DECTRIS® reserves the right, at its own discretion and without liability or prior notice, to modify and/or discontinue this publication in whole or in part at any time, and is not obliged to update the contents of the manual.

# 2. USE OF THE PILATUS3 R CdTe 300K

The PILATUS3 R CdTe 300K 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. |

## 2.1. Vacuum Option

| Caution | #3 |
|---|---|
| ⚠ | Only detectors purchased with optional vacuum compatibility may be operated in vacuum. Warranty void otherwise! When using the detector in vacuum strictly follow the in-vacuum instructions given in this document. |

For detector systems purchased with the optional vacuum compatibility, the detector can be operated in vacuum. To check if the vacuum compatibility option has been purchased for your detector, please refer to the order confirmation.

Please avoid organic materials and highly out-gassing compounds inside the vacuum chamber as they tend to deposit on sensitive detector components and may affect the functionality of the detector.

A vacuum feedthrough set is optional available. Please contact support@dectris.com for further information.

## 2.2. 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. Quantum Efficiency

**Table 3.1:** Quantum Efficiency

| Sensor thickness | | 1000 µm |
|---|---|---|
| Quantum efficiency at | 20 keV | > 90 % |
| | 40 keV | 81 % |
| | 60 keV | 90 % |
| | 80 keV | 77 % |
| | 100 keV | 56 % |

### 3.1.2. Detector

**Table 3.2:** Technical Specifications

| | |
|---|---|
| Number of modules (W x H) | 1 x 3 = 3 |
| Sensor material | Cadmium Telluride (CdTe) |
| Pixel size (W x H) | 172 µm x 172 µm |
| Module size (W x H) | 83.8 mm x 33.5 mm covered by two CdTe tiles of size 41.6 mm x 33.5 mm |
| Pixel array format (W x H) | 487 pixels x 619 pixels = 301 453 pixels |
| Intermodule gap [pixel], *plus 1 pixel horizontal gap on each module | hor. -*, vert. 17 pixels |
| Image bit depth | 32 bit |
| Readout bit depth | 20 bit |
| Counter overflow state | 1 048 575 |
| Maximum count rate | 1 x $10^7$ photons/s/pixel |
| Energy range | 15 keV to 80 keV |
| Adjustable threshold range | 8 keV to 40 keV |
| Number of thresholds | 1 |
| Maximum frame rate | 20 Hz<br>**Information #1**<br>When using the external trigger or external enable mode, the detector will not acquire an image if the effective frame rate is above 20 Hz. |
| Readout time | 7 ms |

**Table 3.2:** Technical Specifications - continued

| | |
|---|---|
| Point-spread function | 1 pixel (FWHM) |
| Connection to control unit | 1 x 1Gb Ethernet |
| Power supply | External power supply |
| Data format (file writer) | Raw data, TIF, EDF, CBF |
| Software interface | Through socket connection;<br>Clients for EPICS, SPEC and stand-alone operation are available |
| Dimensions (W x H x D) | 158 mm x 193 mm x 262 mm |
| Weight | 7.5 kg |
| Overvoltage category | II |
| Means of protection | I (External TreNew (SINPRO) power supply) |
| Pollution degree | II |
| Maximum operating altitude | 2000 m a.s.l. |
| Cooling | Closed circuit thermal stabilization unit |

### *3.1.3. Power Supply Unit*

The PILATUS3 R CdTe 300K is delivered with the power supply unit TreNew (SINPRO) MPU130-105. It is a switching power supply. Use only the included power supply. Please consult the user documentation of the TreNew (SINPRO) MPU130-105 power supply unit for details.

### *3.1.4. Detector Control Unit*

The PILATUS3 R CdTe 300K is delivered with the detector control unit DELL PowerEdge R240. It is a rack-mounted (1U) server. Please consult the user documentation of the DELL PowerEdge R240 server for details.

### *3.1.5. Thermal Stabilization Unit*

The PILATUS3 R CdTe 300K is delivered with the thermal stabilization unit SMC HEC 002-A5B. It is a closed circuit air-water thermal stabilization unit. Please consult the user documentation of the SMC HEC 002-A5B thermal stabilization unit for details.

## 3.2. Ratings

### 3.2.1. Detector

**Table 3.3:** Power Ratings

| | |
|---|---|
| Detector power input | +12 V DC, 30 W |
| Fuse | 4 A slow-blow fuse.<br>Type: Schurter 5 mm x 20 mm, 4 A, 250 V AC<br>Part No. 0001.2510<br>**Warning #1**<br>⚠ Always replace fuses with the same type. |
| Detector external trigger input | 2.1 V to 5.0 V high level<br>0.0 V to 0.8 V low level<br>**Caution #4**<br>⚠ Absolute maximum is 5 V. Applying a higher voltage will damage the detector. |
| External trigger input impedance | 50 Ω |
| Detector trigger output | 5 V (max. current 100 mA) |

### 3.2.2. Power Supply Unit

**Table 3.4:** Power Supply Unit Ratings

| | |
|---|---|
| Power input | 100 VAC to 240 VAC, 47 Hz to 63 Hz, 1.58 A to 0.64 A |
| Power output | 12 V DC, max. 10.84 A, 130 W |
| AC connector | IEC-320-C14 input inlet |
| Dimensions | 89.5 mm x 49.3 mm x 188.0 mm |
| Weight | 0.8 kg |

### 3.2.3. Detector Control Unit

**Table 3.5:** Detector Control Unit Ratings

| | |
|---|---|
| Power input | 1 x 100 VAC to 240 VAC, 50/60 Hz, 1 A to 3 A, 250 W (Platinum) |
| Dimensions (W x H x D) | 434.0 mm x 42.8 mm x 595.63 mm |
| Weight | 12.2 kg |
| Chassis | 1U |

### *3.2.4. Thermal Stabilization Unit*

**Table 3.6:** Thermal Stabilization Unit Ratings

| | |
|---|---|
| Power input | Single phase 100 VAC to 240 VAC, allowable voltage range ±10 %, 50/60 Hz, 8 A (100 VAC) to 3 A (240 VAC) |
| Dimensions (W x H x D) | 270 mm x 393 mm x 436 mm |
| Weight | 17.5 kg |
| Typical flow | 3 L $min^{-1}$ |
| Maximum operation pressure | 3 bar |

## *3.3. Ambient Conditions*

The PILATUS3 R CdTe 300K detector is equipped with a temperature and a humidity sensor. When either sensor detects that the operating conditions are not met, the detector will shut off. However, as the sensors may not prevent damage, temperature and humidity should be monitored to avoid breaching the operation limits.

| Information | #2 |
|---|---|
| The relative humidity within the module chamber must be lower than 30 % during operation and lower than 25 % during start up (use of dry air or nitrogen advised). | |

The PILATUS3 R CdTe 300K detector is designed for indoor use only. The ambient conditions shown in table 3.7 must be satisfied. The stated values are for the ambient conditions.
Values inside the detector, in particular due to the dry-air or nitrogen supply, are different. These are described in section 5.4 and chapter 6.

**Table 3.7:** Detector operating ambient conditions

| Ambient Condition | Value |
|---|---|
| Operating temperature | +20 °C to +35 °C |
| Operating humidity | <30 % at + 20 °C, non-condensing |
| Storage temperature | +15 °C to +40 °C |
| Storage humidity | <40 % at +20 °C, non-condensing |

Please consider following points when storing the detector:

- Make sure the temperature and the humidity inside the transport box do 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.

## 3.4. Vacuum Conditions for Detectors with Optional Vacuum Compatibility

DECTRIS® detectors can be provided for vacuum operation. The typical reachable vacuum is $10^{-3}$ mbar (read-out electronics in vacuum) or $10^{-6}$ mbar (only detector head in vacuum). The out-gassing 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 the conditions mentioned in section 2.1

| Warning | #2 |
|---|---|

Only systems with a vacuum compatibility option are allowed to be operated in vacuum. Please contact support@dectris.com for information regarding vacuum compatibility upgrade.

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

**Table 3.8:** 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 | 10 °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) |

# 4. DETECTOR DIMENSIONS AND CONNECTORS

## 4.1. PILATUS3 R CdTe 300K Detector

### 4.1.1. Technical Drawing

**Information** #3

3D step files of the PILATUS3 R CdTe 300K detector are available on request. Please contact DECTRIS® technical support for more information.

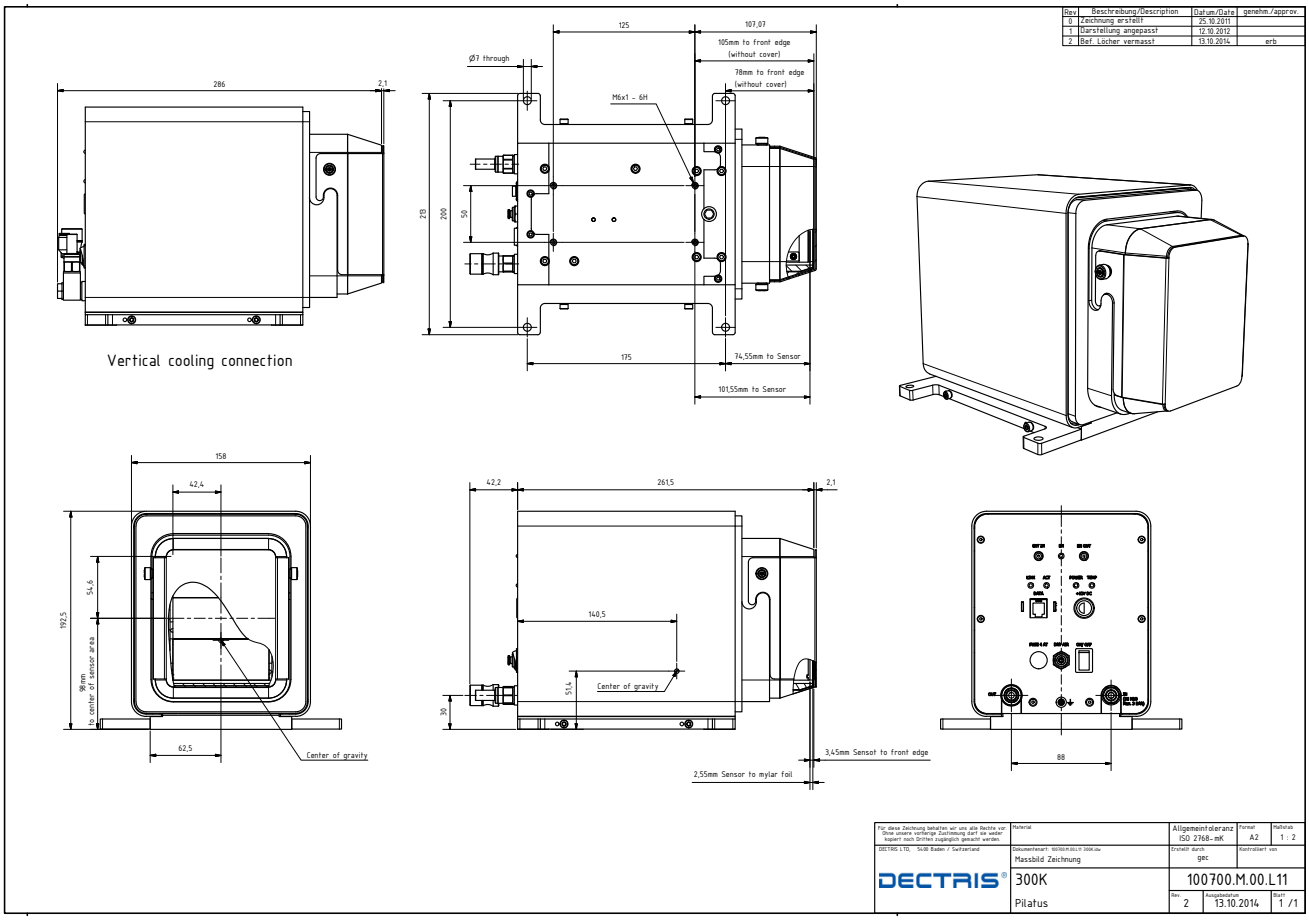



**Figure 4.1:** Drawing of the PILATUS3 R CdTe 300K Detector (also printed separately in the user documentation folder.)

### 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** #3

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

| Caution | #5 |
|---|---|

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




**Figure 4.2:** The PILATUS3 R CdTe 300K detector with the cover in place (front view).

The detector comes with a protective cover (2 mm low carbon steel sheet metal) for the front window, which should only be removed during operation. The sensors are behind a 12 µm thick Mylar® (PET) foil coated with 100 nm aluminium to protect them from humidity and ambient light.




**Figure 4.3:** The PILATUS3 R CdTe 300K detector with the cover removed (front view).

### *4.1.3. Back Side of the Detector*




**Figure 4.4:** The PILATUS3 R CdTe 300K detector (back view).

### 4.1.4. Status LEDs

**Table 4.1:** The meaning of the status LEDs on the detector back plane

| LED | Description |
|---|---|
| LINK | Glowing green if detector and DCU are powered and connected via the RJ45 data cable. |
| ACT | Flashing green if there is activity on the data line between detector and DCU. |
| EN | Orange to indicate the detector is in counting mode, but is otherwise off. |
| TEMP | Red at power-on, when the detector is not initialized, or if the detector temperature or humidity is out of the limits. Turns green on detector initialization if temperature and humidity are within the allowed limits. |
| POWER | Green when the power supply is functioning. Red is an indication of power failure or if the detector temperature or humidity is out of the operating limits. |

### 4.1.5. Connectors and Connecting Cables/Pipes

**Table 4.2:** Electric Connectors and Connecting Cables

| Connector | Description |
|---|---|
| DATA | 1 x RJ45 Ethernet connector<br>DATA → detector control unit port 1<br>Use Cat 6A S/FTP Ethernet cable(s).<br>**Caution #6**<br>⚠ There must be a 1 x 1Gb Ethernet point-to-point connection between detector and detector control unit. |
| POWER | DC power connector (see tables 3.3 and 3.4) |
| EXT IN | External trigger input (see table 3.3)<br>Use a Lemo® Type 00 (NIM/CAMAC) cable. |
| EN OUT | Output signal 5 V (max. current 100 mA) (see table 3.3)<br>High when counting is enabled.<br>Use a Lemo® Type 00 (NIM/CAMAC) cable. |
| ⏚ | Functional ground<br>**Information #4**<br>Although the detector might be already grounded via the mounting bolts, the detector should be grounded additionally via the functional ground connector at the back to establish a defined grounding. |
| FUSE | Fuse (see table 3.3) |

**Table 4.3:** Air Connectors

| Connector | Description |
|---|---|
| $N_2$/Dry Air | Nitrogen or dry air for humidity control. Use a hose/pipe with an outer diameter of 4 mm.<br>To release the tube press and hold the blue ring before pulling at the tube. |

**Table 4.4:** Coolant Connectors

| Connector | Description |
|---|---|
| IN | Coolant inlet |
| OUT | Coolant outlet |

Caution #7

Use only the included thermal stabilization unit.

## 4.2. Detector Control Unit

### 4.2.1. Configuration of the Detector Control Unit

Please do not install or run any other software on the computer, except tools and software which are necessary for configuring your data acquisition protocol.
The detector control unit is set up with a standard installation of the Rocky Linux 9.x distribution. Regular system updates can be made. However, to avoid operational deterioration do not update the system while the detector is taking data.

Caution #8

Do not remove the symbolic link in the directory `~/p2_det/images`, which points to the `images` directory.

The detector control unit has to be connected point-to-point to the detector via 1 x 1Gb Ethernet. The detector control unit can be integrated into the site network infrastructure using one of the interfaces described in section 4.2.2. The detector control unit is optimised 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.



**Figure 4.5:** PILATUS3 R CdTe 300K detector control unit as seen from the front.

Caution #9

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 | #5 |
|---|---|

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




**Figure 4.6:** PILATUS3 R CdTe 300K detector control unit as seen from the back.

### *4.2.2. Connectors*

**Table 4.5:** Detector Control Unit Connectors

| Connector | Description |
|---|---|
| EM1 (Embedded, figure 4.6) | 1 GBase-T adapter<br>labeled as LAN<br>User configurable GbE Network Interface<br>Preconfiguration: DHCP |
| EM2 (Embedded, figure 4.6) | 1 GBase-T adapter<br>Detector Interface Port1<br>labeled as Data<br>Static 10.0.11.1<br>The start-up script /etc/rc.local disables ARP. Do not change this! |
| Power (figure 4.6) | AC Connector |

See DELL owner's manual for further details.
Note: ARP is re-enabled if the network service has been restarted. In this case execute the startup script /etc/rc.local as super user or reboot the system. To assure stable operation of the detector system the configuration file /etc/sysctl.conf is changed such that the Ethernet rx and tx buffers are larger than the standard setting.

The firewall and SE Linux are disabled by default (otherwise the following ports must be open for UDP: 52010, 52011, 52012). The following firewall port must be open if you want to connect to Camserver with a TCP/IP socket connection from the outside: 41234

### *4.2.3. Samba Share*

There is a Samba share configured on the DCU. The Samba service is enabled by default and running after the system boots.
The storage directory for the images, /home/det/p2_ det/images, which is a symbolic link to /home/det/images, can be accessed from a Samba client. You need the same user name and password as for the normal console or ssh login.
From a Linux or Mac OSX terminal window issue the following command:

**smbclient**

**server-ip-or-hostname/images -U det**

To browse the Samba share from Windows, type
**server-ip-or-hostname/images** in the Windows Explorer address bar.

## 4.3. Thermal Stabilization Unit

A thermal stabilization unit is required for the operation of the PILATUS3 R CdTe 300K detector system. The hoses and the detector are equipped with self-sealing valves to avoid dripping when connecting or disconnecting the tubes. There is no fixed limitation on the length of the tubing, but it should be kept as short as possible to ensure the best flow.

**Table 4.6:** In-air operating conditions

| Condition | Definition |
|---|---|
| Operating temperature | The thermal stabilization unit has to be set to a temperature of 25 °C for normal operation. |
| Maximum operating pressure | 3 bar |
| Coolant | 66 % distilled water and 34 % ethylene glycol.<br>**Danger #2**<br>**Ethylene glycol can be seriously harmful to your health or fatal if handled incorrectly. Consider the packaging and safefty instructions provided by your local supplier.** |

Information #6

Before operating the thermal stabilization unit, please read the User Manual of the thermal stabilization unit.

Please consider the following points for installation and usage of the thermal stabilization unit:

- When connecting or disconnecting the cooling hoses, turn off the detector and the thermal stabilization unit.
- When operating the detector, the thermal stabilization unit must always be turned on and the pump has to be activated (see user documentation of thermal stabilization unit).
- Use opaque hoses to avoid the growth of algae.
- Do not set the temperature of the thermal stabilization unit below the recommended operating temperature. Condensing moisture can develop and damage the detector.

### 4.3.1. In-Vacuum Operation for Detectors with Optional Vacuum Compatibility

For in-vacuum operation unscrew the self-sealing valves from the detector and use vacuum-compatible fittings and o-rings. Before opening the cooling circuit always remove the coolant to avoid dripping.

**Table 4.7:** In-vacuum operating conditions

| Condition | Definition |
|---|---|
| Operating temperature | Before and during pumping down and venting the thermal stabilization unit has to be set to a temperature of 25 °C for at least 30 min.<br>Prior to powering up and operating the detector in-vacuum the thermal stabilization unit has to be set to a temperature of 10 °C for at least 30 min. |
| Max.Operating Pressure | 2 bar |

# 5. INSTALLING THE DETECTOR SYSTEM

## 5.1. Transport Considerations

| Warning | #4 |
|---|---|

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

The detector can be mounted in the ways which are described below.

### 5.2.1. Mounting from Above

Use the mounting brackets as depicted in figure 5.1. These mounting brackets have to be mounted on the base plate of the detector. The detector should be mounted using all four outer 7 mm holes (indicated with yellow circles).

| Caution | #10 |
|---|---|

Make sure the mounting brackets are mounted and properly tightened using the screws provided.

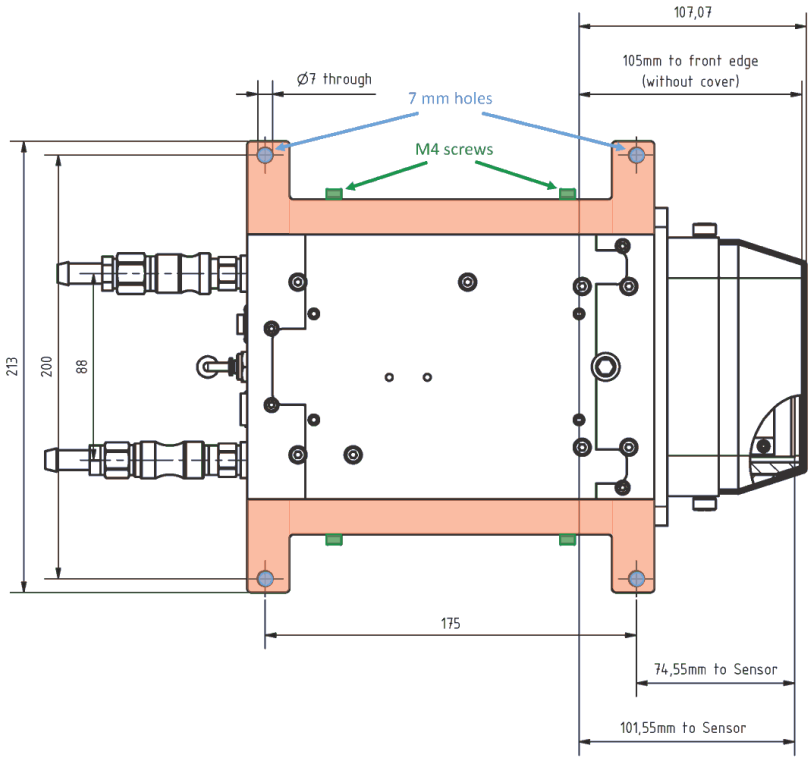



**Figure 5.1:** Drawing of the PILATUS3 R CdTe 300K detector base plate with mounting brackets (bottom view).

### 5.2.2. Mounting from Below

| Warning | #5 |
|---|---|

It is strictly forbidden to add any threads to the detector base plate or to the detector housing.

The detector should be mounted using the four internal M6x1 threads as shown in figure 5.2 (indicated with yellow circles).

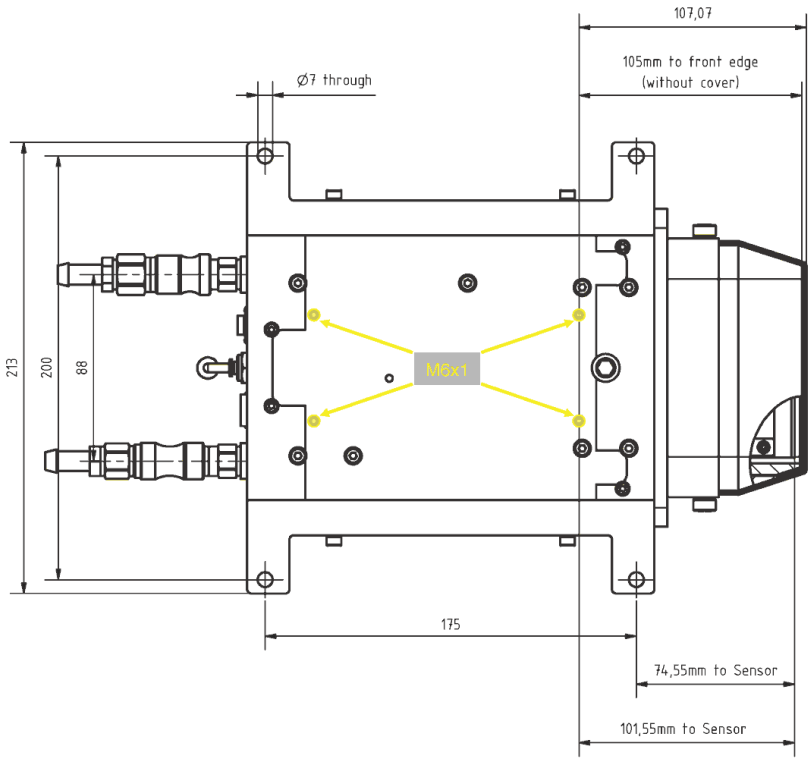



**Figure 5.2:** Drawing of the PILATUS3 R CdTe 300K detector base plate (also printed separately in the user documentation folder).

| Caution | #11 |
|---|---|

The four M6 screws must not intrude into the detector more than 10 mm.

## 5.3. Grounding of the Detector

| Caution | #12 |
|---|---|

The main plug of the detector control unit and the power supply of the detector have to be connected to a grounded power outlet.

Although the detector might be already grounded via the mounting bolts, the detector should be grounded additionally via the functional ground connector at the back in order to establish a defined grounding.

## 5.4. Connection to Dry Air or Nitrogen

| Caution | #13 |
|---|---|

Humidity might damage the detector. Make sure that the detector is operated within the allowed ambient conditions (see section 3.3).

The PILATUS3 R CdTe 300K detector has to be connected to a dry air (or nitrogen) source to avoid humidity and condensation damage when it is outside of the storage box. For information on system connections, refer to section 4.1.5 and for storage of the detector system refer to section 7.5.

Please consider the following points for the application of dry air or nitrogen:

- Oil free, dry air of <20 % relative humidity or nitrogen must be used.
- The recommended flow is 5 L $h^{-1}$ to 10 L $h^{-1}$ (at 2 bar).
- For reliable operation we recommend dry air of <5 % relative humidity.
- The gas pressure must not exceed 2 bar.
- The minimum gas pressure is 1 bar.
- The humidity control shuts down the power of the detector modules when the humidity is too high (see chapter 6).

### 5.4.1. In-Vacuum Use for Detectors with Optional Vacuum Compatibility

The temperature and humidity control cannot prevent condensation issues and resulting damage to the sensor due to improper use. Always make sure that the detector is warmed up (thermal stabilization unit temperature set to 25 °C) prior to pumping down, venting, and opening the chamber. Only use dry air or nitrogen for venting. For in-vacuum operation no nitrogen or dry air flow is necessary.

| Warning | #6 |
|---|---|

When venting with nitrogen, take proper precaution against the risk of asphyxiation caused by oxygen displacement from nitrogen. Ensure sufficient ventilation and oxygen level monitoring. Use compressed dry air for venting large vessels or in confined spaces.

## 5.5. Connection to Thermal Stabilization Unit

The PILATUS3 R CdTe 300K detector is water-cooled and must be connected to a dedicated thermal stabilization unit. Use only the provided thermal stabilization unit.

| Warning | #7 |
|---|---|

For the maximum allowed coolant pressure in the cooling circuit of the detector see table 4.6.

| Warning | #8 |
|---|---|

Use only the supplied hose couplings (RECTUS 204KL series).

| Warning | #9 |
|---|---|

For in-vacuum operation unscrew the supplied hose couplings (RECTUS 204KL series) from the detector and use vacuum-compatible fittings (1/8 inch ISO parallel thread) and o-rings.

Using the optional aluminium adapter and the two eye-screws it is possible to vertically connect the hoses to the detector back. The vertical cooling connectionis shown in figure 5.4. The red marked aluminium adapter together with two eye-screws are optionally supplied with the detector.
The detector is delivered for horizontal connection of the hoses. If you change the configuration, make sure that the couplings are properly mounted and sealed.

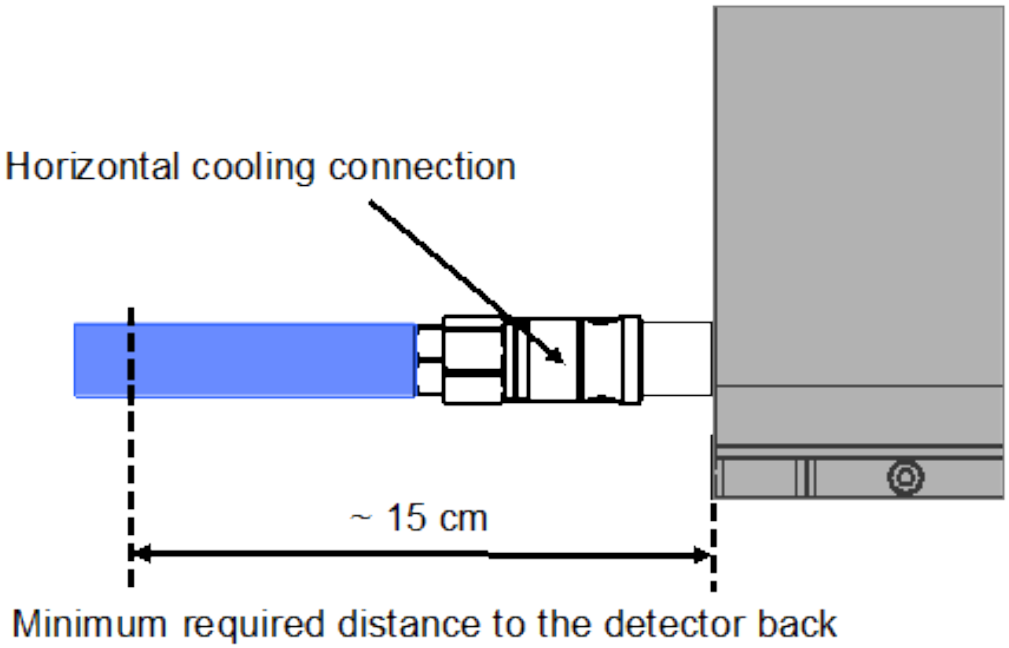



**Figure 5.3:** Horizontal Coolant Connection

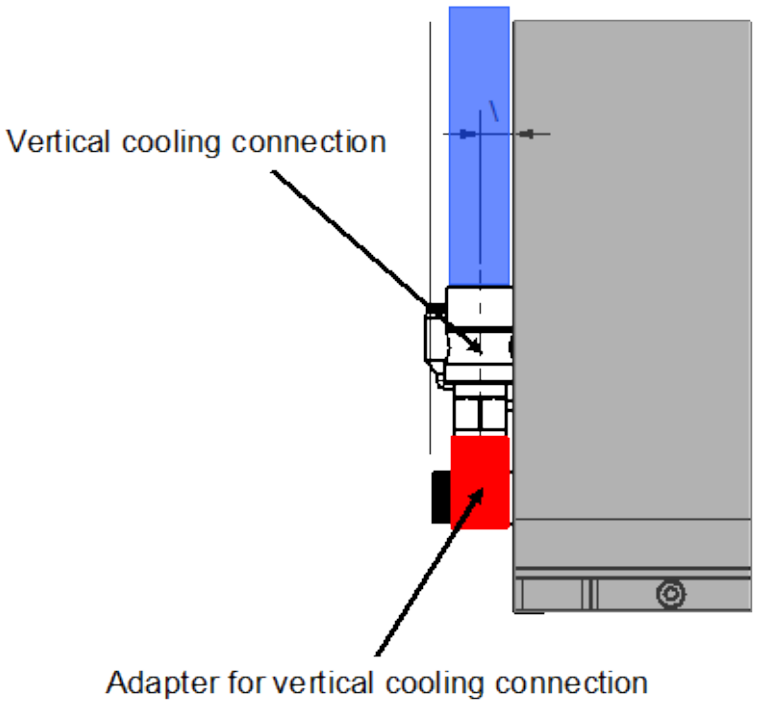



**Figure 5.4:** Vertical Coolant Connection

## 5.6. Mounting the Detector Control Unit

| Caution | #14 |
|---|---|

Make sure that the detector control unit has adequate ventilation.

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 PILATUS3 R CdTe 300K detector has two combined temperature and relative humidity sensor. The temperature and humidity control shuts down the detector when the relative humidity or the temperature of the sensor exceeds the limits in table 6.1.

**Table 6.1:** Temperature and relative humidity limits

| Channel | Location | Shutdown Temperature | | Shutdown Relative Humidity |
|---|---|---|---|---|
| | | Lower Limit | Upper Limit | Upper Limit |
| 1 | Module frame | 5 °C | 50 °C | 30 % at operation / 25 % at start-up |
| 2 | Cooling plate | 5 °C | 35 °C | 70 % at operation / 65 % at start-up |

The communication with the detector control unit will remain active after a temperature shut down. To start the detector correctly, please refer to chapter 7 and execute the correct start-up procedure.
If the temperature or humidity is out of range, the following error message appears:

[]$_ Camserver Output

```
*** ERROR - temperature too high: 31.1C (channel #2)
Bad return from dcbe_initialize()
Camera initialization error -- press <enter> to exit
```

Make sure that the cooling unit is running at the specified temperature and that nitrogen or dry air flow is turned on at the specified flow rate, given in section 5.4. Then restart the Camserver software.

The command *THread* in camserver displays the actual temperature and humidity of the sensors as shown below.

[]$_ Camserver Output

```
THread
Channel 1: Temperature = 25.7C, Rel. Humidity = 4.4 %
Channel 2: Temperature = 23.1C, Rel. Humidity = 8.2 %
```

# 7. OPERATION PROCEDURE

Before operating the detector, make sure you have read the Technical Specifications and the User Manual of the PILATUS3 R CdTe 300K detector.

## 7.1. Getting Started

Before switching on:

- Mount the detector properly.
- Connect the detector to ground potential, using the functional ground connector (see section 5.3).
- Connect detector to power; make sure the detector power switch is OFF.
- Connect the detector to a nitrogen or dry air source, capable of supplying at least the minimum recommended flow rate (see section 5.4).
- Connect the coolant hoses. Make sure they are properly mounted on both sides.
- Set the temperature to 25 °C on the thermal stabilization unit and turn it on. If the detector was not at room temperature, wait until the thermal stabilization unit has reached stable operation.
- Connect the power cable, the local network cable, and the detector data cable to the detector control unit. If more than one Ethernet cable is required, please pay attention to the numbering of the cables as described in table 4.2.
- Attach a monitor, keyboard and mouse to the detector control unit.

## 7.2. Start-up Procedure

Please use the following start-up procedure:

- Turn on the dry air or nitrogen at least 30 min before turning on the detector. Then turn ON the power switch at the back of the detector.
- Turn on the detector control unit. Wait at least till the detector control unit is booted ( about 5 min) before trying to connect.
- Start a shell.
- The default path is: */home/det*.
- Change the directory to: *p2_det/*.
- Type: *./runtvx* (it starts a script which initializes the detector system and opens the Camserver and TVX windows).
- Let the detector reach its operation temperature (see section 3.3). This will take between 30 min to 60 min. The operation temperature can be determined by typing the command THread in Camserver (compare chapter 6).
- The power LED on the back of the detector will turn green after around 10 min. Wait at least 15 min to 30 min for the detector bias voltage to completely stabilize.

| Information | #7 |
|---|---|
| If you want to control the detector with a TCP/IP client, type *./camonly* in the directory *p2_det/*. It starts a script which initializes the detector system and opens the Camserver window. Please refer to the User Manual for further information. | |

The detector should now be ready to use.

| Information | #8 |
|---|---|
| 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 detector power switch.
- Do not remove the nitrogen/dry air connection. It is a requirement that it is left at the recommended flow rate, according to section 5.4.

If you turn off the detector while Camserver is running you will get error messages after a few minutes because Camserver cannot communicate with the detector. You may want exit Camserver.

| Caution | #15 |
|---|---|
| You must restart Camserver after the detector has turned on! Otherwise the detector is not initialized. | |

## 7.4. Vacuum Operation for Detectors with Optional Vacuum Compatibility

Make sure the vacuum conditions in table 3.8 are met and follow below procedures for venting and pumping down the vacuum chamber.

| Warning | #10 |
|---|---|
| Prior to pumping down (and venting):<br>Always make sure the detector is SWITCHED OFF and 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 back of the detector is ON and the power switch on the detector power supply is OFF (i.e. the detector can be powered up later from outside the vacuum chamber).
- Close the vacuum chamber and start to pump down.
- Once the pressure inside the vacuum chamber is below $1 \times 10^{-2}$ mbar set the temperature on the thermal stabilization unit to 10 °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, switch on the external power supply unit.

**Venting the Vacuum Chamber**

- Turn OFF the power switch on the detector power supply.
- Set the temperature to 25 °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

| Information | #9 |
|---|---|

Even if the detector is not in operation, it is recommended that the dry air or nitrogen flow is maintained to reduce the risk of humidity damage to 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 | #16 |
|---|---|

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

The housing can be cleaned with a soft tissue.

Please refer to the user documentation of the thermal stabilization unit for detailed information about the maintenance of your thermal stabilization unit.
The following procedures related to the thermal stabilization unit have to be done periodically by the user:

**Table 7.1:** Cleaning and maintenance procedures

| What | When | Who |
|---|---|---|
| Check the tightness of the cooling hoses | Every week | User |
| Replace the coolant | Every 12 months | User |

he PILATUS3 R CdTe 300K detector does not require any maintenance.

## 7.7. Safety Instructions Cadmium Telluride

The sensor material is built up from Cadmium Telluride (CdTe). In order to prevent injuries, please follow these safety precautions:

| Danger | #3 |
|---|---|

- **Do not inhale CdTe dust when sensor is broken or burnt**
- **Do not ingest CdTe**
- **Avoid skin contact**

For recycling and product return see section 2.2.

# 8. TROUBLESHOOTING

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

**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 3.1.4). Check the power cable; depending on the type of detector control unit, there are switches on the back and on the front panel of the detector control unit, which have to be in the correct position. |
| Communication error, the detector is not found at start-up. | 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.<br><br>Avoid tangling or strong bending of the Ethernet data cable.<br><br>Check the status of the LINK LED. If the detector control unit and the detector are powered and correctly connected, the LINK LED should be green (Takes up to 30 s after power up) |
| | The configuration of the Ethernet adapter is wrong. | Check configuration of the Ethernet adapter, see section 4.2.1. |

**Table 8.1:** Troubleshooting - continued

| Problem | Cause | Solution |
|---|---|---|
| Detector shuts down. | Temperature or humidity error. | Check that the detector is properly supplied with coolant.<br><br>Check the flow of nitrogen or dry air.<br><br>Check the temperature of the coolant at the front panel of the thermal stabilization unit.<br><br>Check the temperature of the detector with the command in Camserver: type *THread*.<br><br>Wait until the detector cools down.<br><br>Restart the detector again.<br><br>Check the LEDs at the back of the detector: If the TEMP and the POWER LEDs are red, a temperature or humidity error has occurred. |
| | Module over current:<br><br>The energy threshold level is set too low and the detector starts oscillating. | Increase the threshold level. In Camserver type: *setCu*. |
| 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 green POWER LED. |
| | The fuse is blown. | Replace the fuse, see table 3.3. |
| | The temperature is over the critical limit. The thermal protection was triggered. | Check the thermal stabilization unit. The detector will power on again, as soon as the temperature is within the allowed operating conditions. |
| Image acquisition is not possible. | Detector is not properly initialized. | Run the following commands in TVX:<br>- *setdac*<br>- *calibdet*<br>- *expose 1*<br><br>Check the status of the POWER LED. If it is red and the TEMP LED is green, there is a problem with the electronics – contact support@dectris.com. |
| 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. |

# 9. CERTIFICATION TESTS

The product is in conformity with the following standards:

**Table 9.1:** Certification Tests for PILATUS3 R CdTe 300K

| |
|---|
| EN 61010-1: 2010 / IEC 61010-1: 2010 |
| EN 61326-1: 2013 / IEC 61326-1: 2012 |

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# 10. SERVICE FORM

Model No.: _____ Serial No.: _____ Date: _____

Name and phone No.: _____

Company: _____

List of all control settings. Describe the problem and check boxes below that apply to the problem.

_____

_____

_____

_____

_____

_____

_____

_____

☐ Checked all cables

☐ Problem on power-up

☐ Detector system is unstable

What power line is used? _____

Ambient temperature? _____

Relative humidity? _____

Add additional information. If the user has made special modifications, please describe. _____

_____

_____

_____

_____

_____

_____

_____

_____