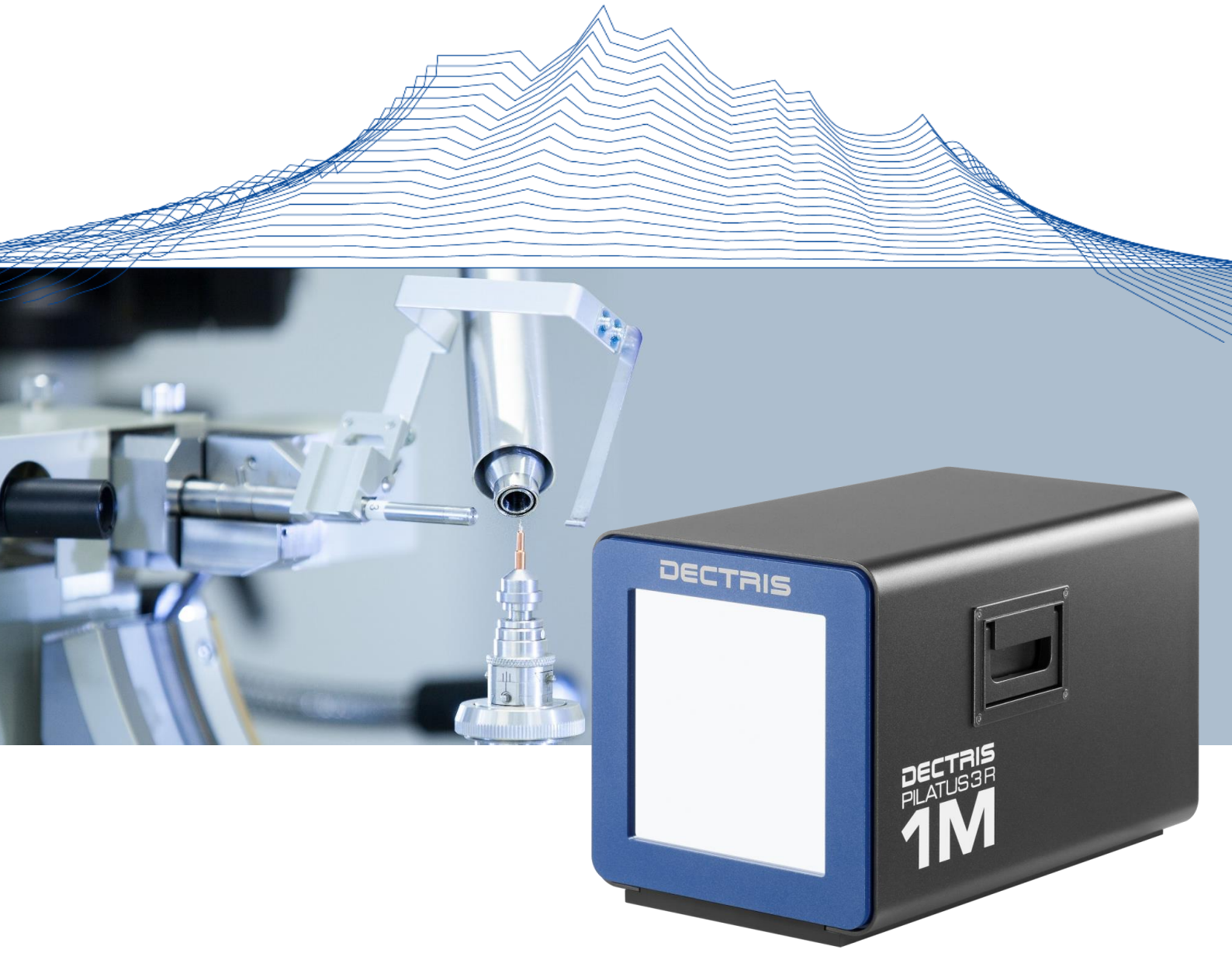
DECTRIS
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# Technical Specifications

## DECTRIS PILATUS®3 R 1M Detector System

*Document Version v1.2.3*

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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 1M

The PILATUS3 R 1M 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. 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[1] | | 450 µm | 1000 µm |
|---|---|---|---|
| Quantum efficiency at | 5.4 keV (Cr) | 94 % | > 80 % |
| | 8.0 keV (Cu) | 98 % | 96 % |
| | 17.5 keV (Mo) | 47 % | 76 % |

### 3.1.2. Detector

**Table 3.2:** Technical Specifications

| | |
|---|---|
| Number of modules (W x H) | 2 x 5 = 10 |
| Sensor | Reverse-biased diode array |
| Sensor material | Silicon (Si) |
| Pixel size (W x H) | 172 µm x 172 µm |
| Module size (W x H) | 83.8 mm x 33.5 mm |
| Pixel array format (W x H) | 981 pixels x 1043 pixels = 1 023 183 pixels |
| Intermodule gap [pixel] | hor. 7 pixels, vert. 17 pixels |
| Image bit depth | 32 bit |
| Readout bit depth | 20 bit |
| Counter overflow state | 1 048 575 |
| Maximum count rate | $1 \times 10^7$ photons/s/pixel |
| Energy range[2] | 4.5 keV to 36 keV |
| Adjustable threshold range[2] | 2.7 keV to 18 keV |
| Number of thresholds | 1 |
| Maximum frame rate | 5 Hz |

Information #1

When using the external trigger or external enable mode, the detector will not acquire an image if the effective frame rate is above 5 Hz.

[1] The sensor thickness of your actual system can be found in the order confirmation and in the file header of recorded images
[2] Extended low energy and ultra low energy calibrations offering lower minimal thresholds (1.9 keV and 1.6 keV respectively) are optionally available. The energy calibration of your actual system can be found in the order confirmation and in the factory acceptance test sheet. Please read carefully the "Low Energy Calibration" technical specification add-on before using thresholds lower than 2.7 keV.

**Table 3.2:** Technical Specifications - continued

| | |
|---|---|
| Readout time | 7 ms |
| Point-spread function | 1 pixel (FWHM) |
| Connection to control unit | 1 x 10GBase-T Ethernet |
| Power supply | Internal 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) | 265 mm x 286 mm x 455 mm |
| Weight | 25 kg |
| Overvoltage category | II |
| Means of protection | - |
| Pollution degree | II |
| Maximum operating altitude | 2000 m a.s.l. |
| Cooling | Closed circuit thermal stabilization unit |

### *3.1.3. Detector Control Unit*

The PILATUS3 R 1M 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.

### *3.1.4. Thermal Stabilization Unit*

The PILATUS3 R 1M 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 | 100 VAC to 240 VAC, 50 Hz to 60 Hz, 165 W<br>Can be connected to all common supply voltages. |
| 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 #3**<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. Detector Control Unit

**Table 3.4:** 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 |

### 3.2.3. Thermal Stabilization Unit

**Table 3.5:** 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 1M 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 1M detector is designed for indoor use only. The ambient conditions shown in table 3.6 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 3.6:** 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.

# 4. DETECTOR DIMENSIONS AND CONNECTORS

## 4.1. PILATUS3 R 1M Detector

### 4.1.1. Technical Drawing

**Information** #3

3D step files of the PILATUS3 R 1M detector are available on request. Please contact DECTRIS® technical support for more information.

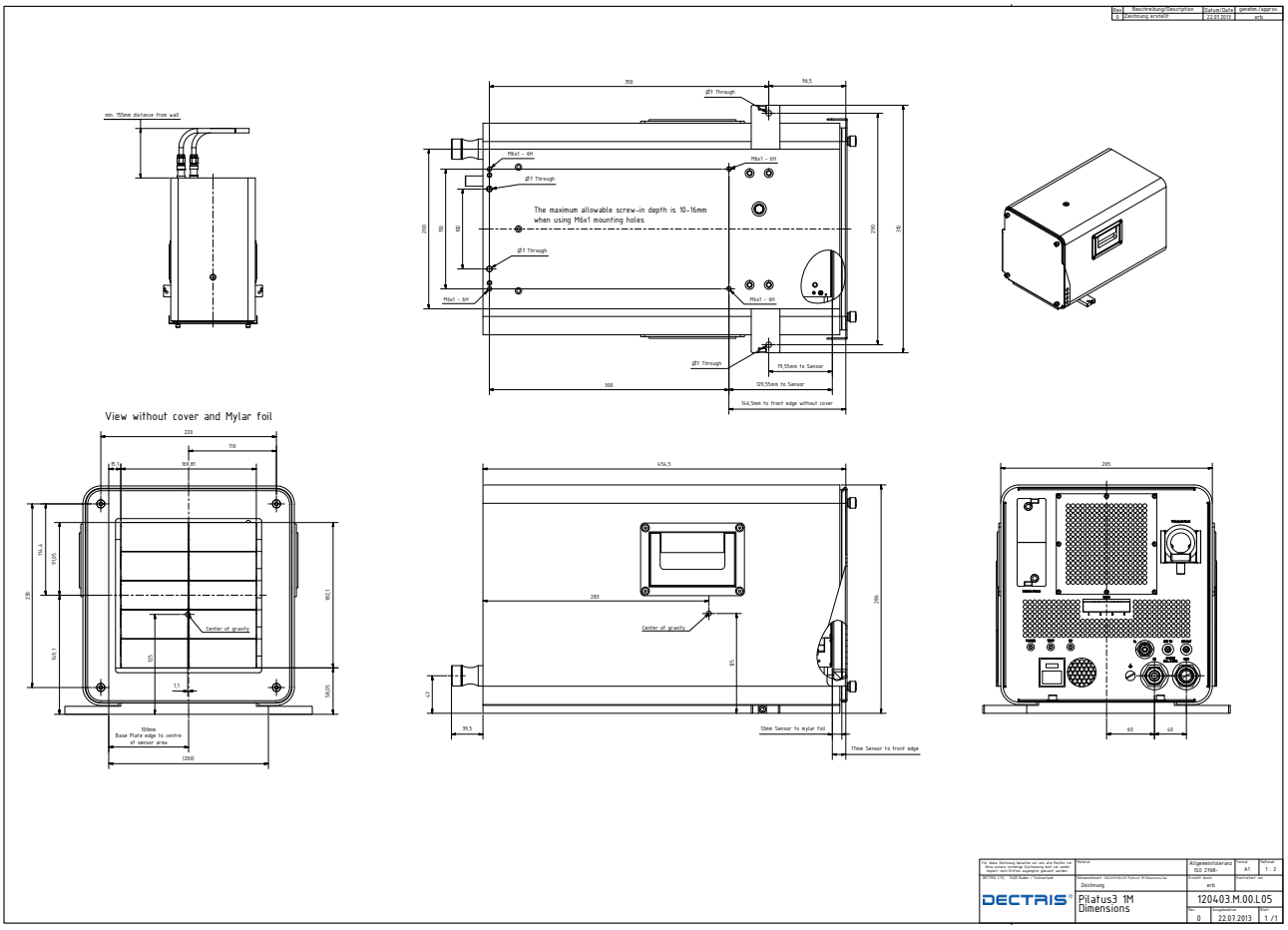



**Figure 4.1:** Drawing of the PILATUS3 R 1M Detector (also printed separately in the user documentation folder.)

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

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




**Figure 4.2:** The PILATUS3 R 1M 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.

The cover has a mounting edge on top and can be removed by carefully pulling at the bottom (see figure 4.2) and lifting it away. When mounting the cover, make sure it is first hooked on the mounting edge centred and then slowly lowered.




**Figure 4.3:** The PILATUS3 R 1M detector with the cover removed (front view).

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




**Figure 4.4:** The PILATUS3 R 1M detector (back view).

### 4.1.4. Status LEDs

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

| LED | Description |
|---|---|
| EN | Orange indicates 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 1 → detector control unit port 1<br><br>Use Cat 6A S/FTP Ethernet cable(s).<br><br>**Caution #5**<br>⚠ There must be a 1 x 10GBase-T Ethernet point-to-point connection between detector and detector control unit. |
| POWER | AC power connector (see table 3.3) |
| 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><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. |

**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 6 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 #6

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 #7

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 10GBase-T 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 1M detector control unit as seen from the front.

Caution #8

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 1M 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>Unused |
| P2P1 (Slot 1, figure 4.6) | 10GBase-T Ethernet adapter<br>Detector Interface Port1<br>labeled as Data<br>Static 10.0.10.1<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 1M 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 23 °C for normal operation. |
| Maximum operating pressure | 3 bar |
| Coolant | 66 % distilled water and 34 % ethylene glycol. |

**Danger #2**

**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.

# 5. INSTALLING THE DETECTOR SYSTEM

## 5.1. Transport Considerations

| Warning | #2 |
|---|---|
| Avoid vibration and shock when moving the detector. | |

| Caution | #9 |
|---|---|
| Use the included transport hook for transporting the detector where applicable. | |

The detector has a transport hook which has to be used for lifting the detector. When using the transport hook, make sure it is properly tightened. Only use an appropriate lifting device with a carrying capacity of at least 150 kg to move the detector. Make sure two persons always move the detector. When moving the detector, make sure the protection cover is mounted and all cables and hoses are disconnected.

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

## 5.2. Mounting

Do not place the detector near heat sources or in a place subject to direct sunlight, excessive dust or mechanical shock. Make sure that the detector has adequate ventilation.

- Do not cover any air intakes or outlets.
- Place the detector in a location with adequate air circulation.
- Make sure the detector has enough space for proper ventilation (minimum wall distance: 170 mm).
- Do not operate the detector in a closed environment.

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. | |

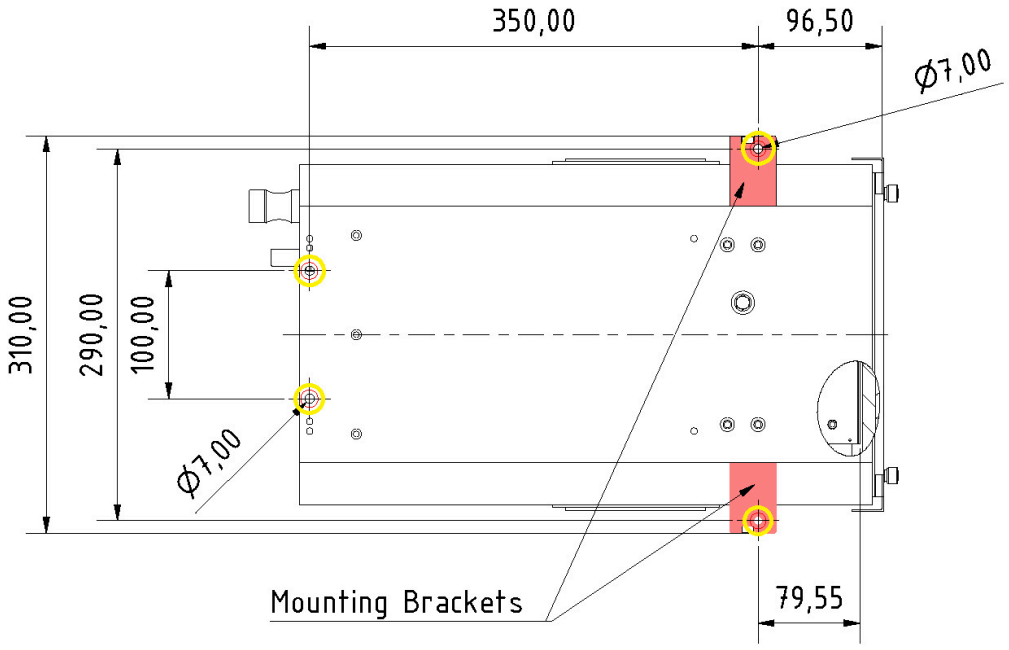



**Figure 5.1:** Drawing of the PILATUS3 R 1M detector base plate with mounting brackets (bottom view).

### *5.2.2. Mounting from Below*

| Warning | #3 |
|---|---|
| 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).

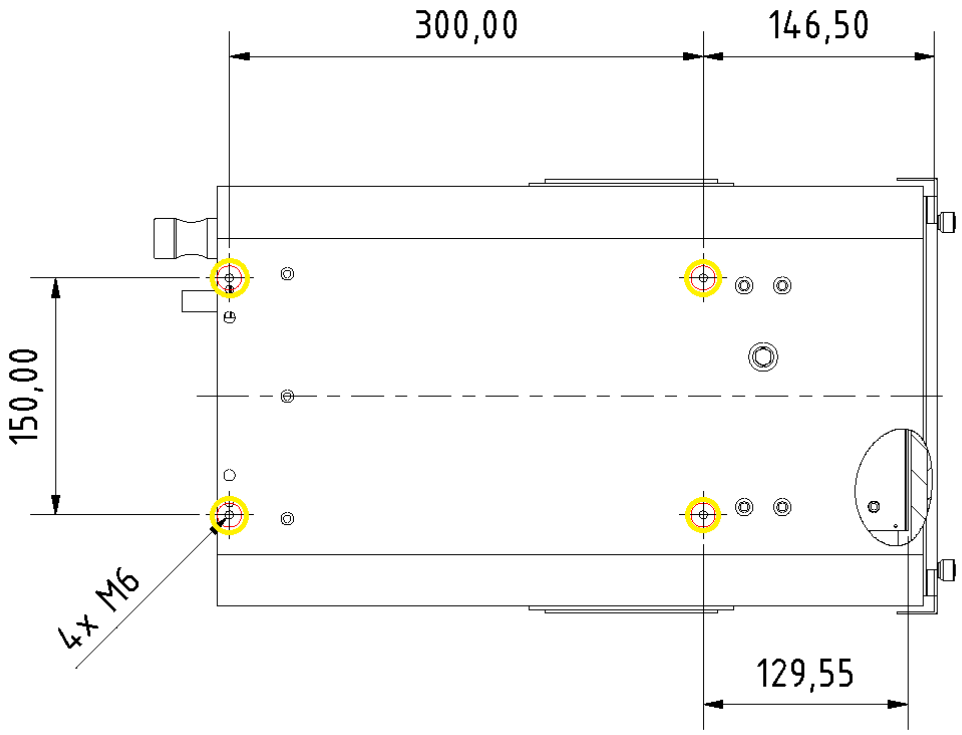



**Figure 5.2:** Drawing of the PILATUS3 R 1M detector base plate (also printed separately in the user documentation folder).

| Caution | #11 |
|---|---|
| The four M6 screws must not intrude into the detector more than 16 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 1M 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 7.4.

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).

## 5.5. 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 1M detector has a 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

| Shutdown Temperature | | Shutdown Relative Humidity |
|---|---|---|
| **Lower Limit** | **Upper Limit** | **Upper Limit** |
| 5 °C | 35 °C | 30 % at operation / 25 % 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 1M 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 23 °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).

| 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. 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.

## 7.5. 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 have to be done periodically by the user:

**Table 7.1:** Cleaning and maintenance procedures

| What | When | Who |
|---|---|---|
| Check and, if necessary, clean the air filter on the back of the PILATUS3 R 1M | Every month | User |
| Replace the air filter on the back of the PILATUS3 R 1M | Every 12 months | User |
| Check the tightness of the cooling hoses | Every week | User |
| Replace the coolant | Every 12 months | User |

# 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 3.1.3). 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. |
| 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 1M

| |
|---|
| 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. _____

_____

_____

_____

_____

_____

_____

_____

_____