APPLICATION NOTE


```
// Create an instant camera object with the firs
Camera_t camera( CTlFactory::GetInstance().Creat

// Register an image event handler that accesses
camera.RegisterImageEventHandler( new CSampleIma
Ownership_TakeOwnership);

// Open the camera.
camera.Open();
```

Temperature Behavior and Heat Generation of dart Cameras

BASLER
the power of sight

Contacting Basler Support Worldwide

Europe, Middle East, Africa

Basler AG
An der Strusbek 60–62
22926 Ahrensburg
Germany

Tel. +49 4102 463 515
Fax +49 4102 463 599

support.europe@baslerweb.com

The Americas

Basler, Inc.
855 Springdale Drive, Suite 203
Exton, PA 19341
USA

Tel. +1 610 280 0171
Fax +1 610 280 7608

support.usa@baslerweb.com

Asia-Pacific

Basler Asia Pte. Ltd.
35 Marsiling Industrial Estate Road 3
#05–06
Singapore 739257

Tel. +65 6367 1355
Fax +65 6367 1255

support.asia@baslerweb.com

www.baslerweb.com

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1   Introduction

This application note provides information about the temperature behavior of dart camera modules. It shows what causes high camera temperature, but also explains possible ways to decrease the temperature if it exceeds the limits.

Generally speaking, the lower the temperature, the better the image quality. At higher temperatures, dark noise increases and degrades image quality, which is a physical effect independent of the camera. In practice, this effect becomes noticeable at temperatures above 40–50 °C sensor temperature, depending on the sensor and other factors.

Furthermore, high temperature can damage electronic components of the camera. Therefore, it is important to frequently check the device temperature. At a given temperature, the camera will stop acquiring images to protect itself.

For more information, see the Basler Product Documentation:

- https://docs.baslerweb.com/temperature-state
- https://docs.baslerweb.com/device-temperature
- https://docs.baslerweb.com/safety-instructions-(dart)#intended-use
- https://docs.baslerweb.com/providing-heat-dissipation-(dart)

ℹ	Basler dart camera modules are intended for operation in an embedded system or in a machine. Heat dissipation is only ensured when the camera modules are attached, screwed, or mounted somewhere within the system. Operating a dart camera at your desk, attached only via cable, will result in high camera temperatures, as this is an uncommon use case. Any kind of heat sink is mandatory.

2   Heat Generation

Heat can be generated at several locations in the camera, e.g., at the imaging sensor, at the controllers for booting and data transfer, and especially at the image signal processor, which is needed for image pre-processing (color calculation, image enhancements and others) and system control.

2.1   Impact of the Frame Rate

As high frame rates increase the load on the sensor and image processor, they also increase power consumption and generated heat by a certain degree. This is shown in figure 1 below.

However, the frame rate is only a single and minor factor in heat generation. Even if no images are acquired, there's a certain amount of power consumption. This is due to the fact that many electronic components have a given base load and show a certain activity even at zero frame rate, e.g., to control data transfer to the host system, but also to control the imaging sensor and the processor.

Furthermore, mono cameras have lower power consumption than their corresponding color version. This is mainly due to color calculations (Debayering).
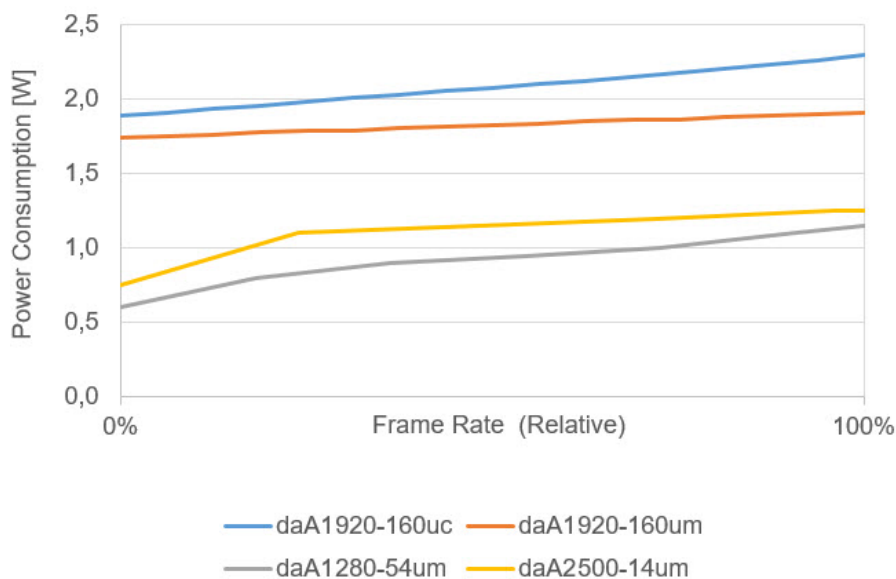

Figure 1: Exemplary Power Consumption

ℹ	The given numbers may vary depending on your system setup, environment, and other factors.

3 Providing Heat Dissipation

ℹ	Since each installation is unique, Basler can't make general statements or provide absolute numbers concerning temperature behavior.
	Every system behaves differently and every detail on how heat sinks are applied influences the temperature behavior. Even under same technical conditions, many factors influence heat dissipation, e.g., humidity and external air flow.
	Furthermore, the camera settings and even the objects to be captured influence heat generation, as more or less image processing is performed.

3.1 General Guidelines

- Mount a lens on the camera module.
- Monitor the temperature of the camera module using the appropriate temperature measurement point.
- On all dart camera modules, there are four holes at the corners of the board, designed for installing the module. You can also use the holes to dissipate heat.

- Depending on the dart variant, different components are used to dissipate heat:

  - **Bare board variants**: The metallic borders of the holes are designed to dissipate heat to connecting metallic components (see Figure 3).

  - **S-mount and CS-mount variants**: Rivets are placed in the four holes. These rivets can be used to dissipate heat towards connected metallic components. How to use the holes or rivets depends on your system design. In all cases, make sure that the holes or rivets have good contact with metallic components in your system. This way, the heat can dissipate towards the metallic components.

- For more information, see the Basler Product Documentation: https://docs.baslerweb.com/providing-heat-dissipation-(dart)

3.2   Attaching Cooling Elements

Cooling elements can be attached to the rear side of the camera. Small cooling elements which fit to the dart's dimensions provide good heat dissipation at low prices.

As the figure below shows, there is a significant temperature drop when a heat sink is installed.
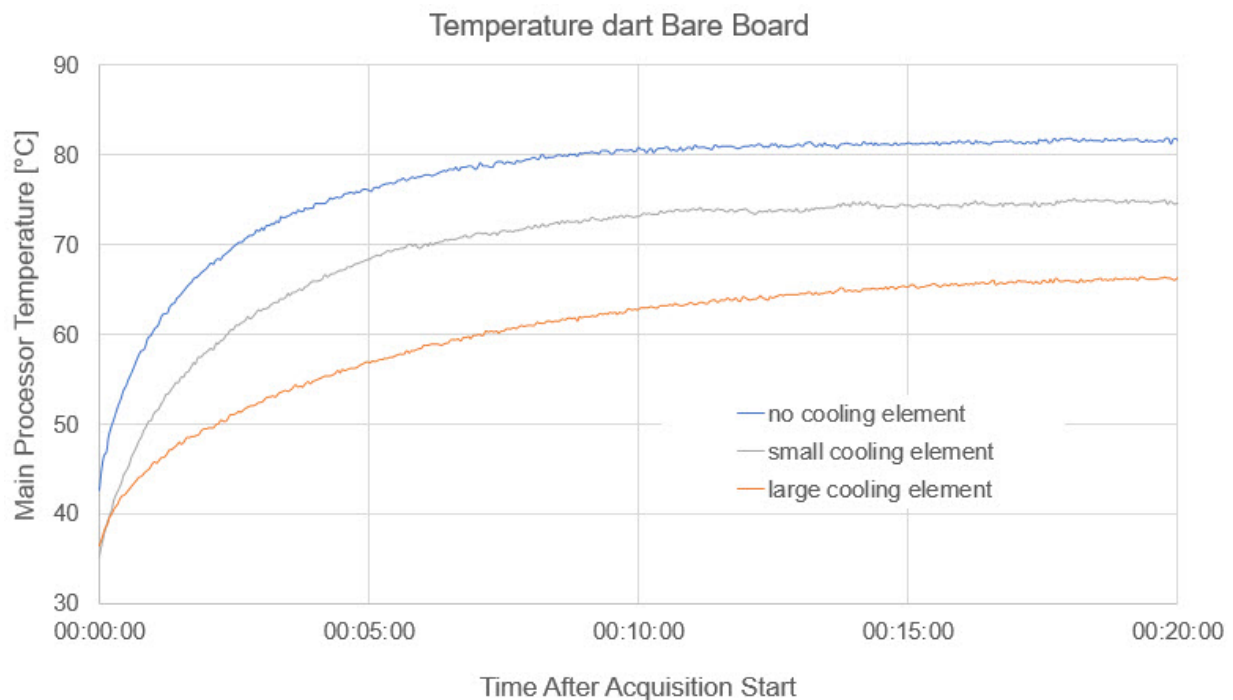

Figure 2: Exemplary Temperature Evaluation (measured directly at the processor; no heat dissipation measures; camera connected only via USB cable; full frame rate)

3.3   Using Heat Conduction Mats

In order to improve heat transfer, heat conduction mats are a simple and rather cheap solution. They are especially useful if a heat sink is already installed and the heat transfer from the module to the heat sink is a critical factor.

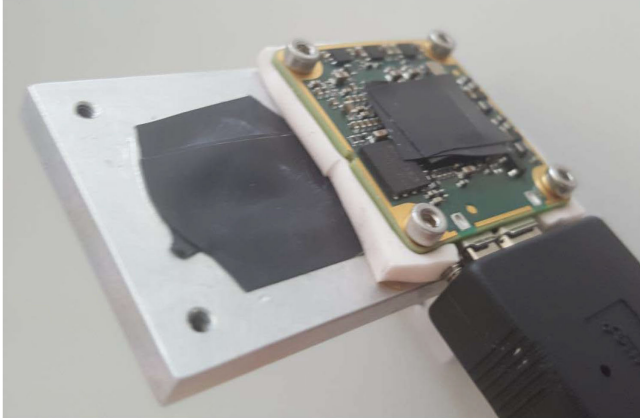Directly attach the heat conduction mat to the dart's main processor (rear side of the camera module).

Figure 3: Mounted dart USB Camera Module with Heat Conduction Mat (Lab Test Setup, Sensor Covered)

3.4   Installing a Fan

Under demanding conditions, the installation of a fan can be useful. Though this is a relatively elaborated setup, this greatly improves heat dissipation.

Revision History

Document Number	Date	Changes
AW00163001000	21 September 2020	Initial version of this document.