



# DFK 42BUC03

## Technical Reference Manual



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## 1 Quick Facts

| General                       |                  |
|-------------------------------|------------------|
| Dynamic Range                 | 8 bit            |
| Resolution                    | 1280x960         |
| Frame Rate at Full Resolution | 76               |
| Pixel Formats                 | 8-Bit Bayer (GR) |

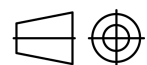
| Optical Interface |                    |
|-------------------|--------------------|
| IR-Cut filter     | Yes                |
| Sensor Type       | Aptina MT9M021     |
| Shutter Type      | Global             |
| Sensor Format     | 1/3 inch           |
| Pixel Size        | 3.75 $\mu\text{m}$ |
| Lens Mount        | C/CS               |

| Electrical Interface |                                                                        |
|----------------------|------------------------------------------------------------------------|
| Interface            | USB 2.0                                                                |
| Supply voltage       | 4.75 VDC to 5.25 VDC                                                   |
| Current consumption  | approx 250 mA @ 5 VDC                                                  |
| I/O Connector        | 4-pin connector for trigger and strobe or general purpose input/output |

| Mechanical Data |                              |
|-----------------|------------------------------|
| Dimensions      | H: 36 mm, W: 36 mm, L: 25 mm |
| Mass            | 70 g                         |

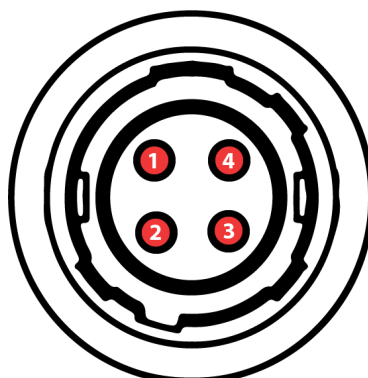
| Adjustments |                           |
|-------------|---------------------------|
| Shutter     | 100 $\mu\text{s}$ to 30 s |
| Gain        | 34 to 255                 |

| Environmental           |                               |
|-------------------------|-------------------------------|
| Temperature (operating) | -5 °C to 45 °C                |
| Temperature (storage)   | -20 °C to 60 °C               |
| Humidity (operating)    | 20 % to 80 % (non-condensing) |
| Humidity (storage)      | 20 % to 95 % (non-condensing) |



### 3 I/O Connector

#### 3.1 4-pin I/O Connector



Rear view of camera

| Pin | Signal         | I/O            | Remarks            | Characteristics  |     |                   |      |
|-----|----------------|----------------|--------------------|------------------|-----|-------------------|------|
|     |                |                |                    | Min              | Typ | Max               | Unit |
| 1   | GND_I/O        | G <sup>3</sup> | External Ground    | -                | -   | -                 | -    |
| 2   | STROBE_OUT     | O <sup>3</sup> | Open drain         | -                | -   | 24.0 <sup>1</sup> | V    |
| 3   | TRIGGER_IN (-) | I <sup>3</sup> | Optocoupler ground | -                | -   | -                 | -    |
| 4   | TRIGGER_IN (+) | I <sup>3</sup> | Optocoupler signal | 3.3 <sup>2</sup> | -   | 24.0 <sup>2</sup> | V    |

<sup>1</sup> max. 0.2A (ID) for open drain MOSFET!

<sup>2</sup> min. 3.5 mA driver strength required!

<sup>3</sup> G: Ground O: Output I: Input

The part number of this Hirose connector is HR10A-7R-4P. To create an I/O cable you need a Hirose connector HR10A-7P-4S.

##### 3.1.1 TRIGGER\_IN

The *TRIGGER\_IN* line can be used to synchronize the start of the exposure time with external events. The [Trigger](#) section describes in detail how the image sensor's behavior can be controlled.

The current input signal can also be read directly through the [General Purpose Input](#) feature.

##### 3.1.2 STROBE\_OUT

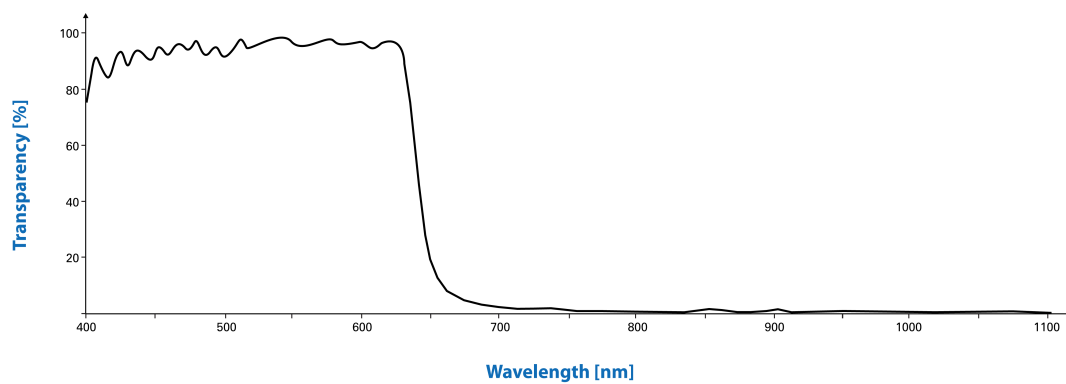
The *STROBE\_OUT* line's main usage is to indicate the integration time of the image sensor which allows flashes, strobos or other light sources to be synchronized with camera operation. The line's behavior can be controlled through the [Strobe](#) controls.



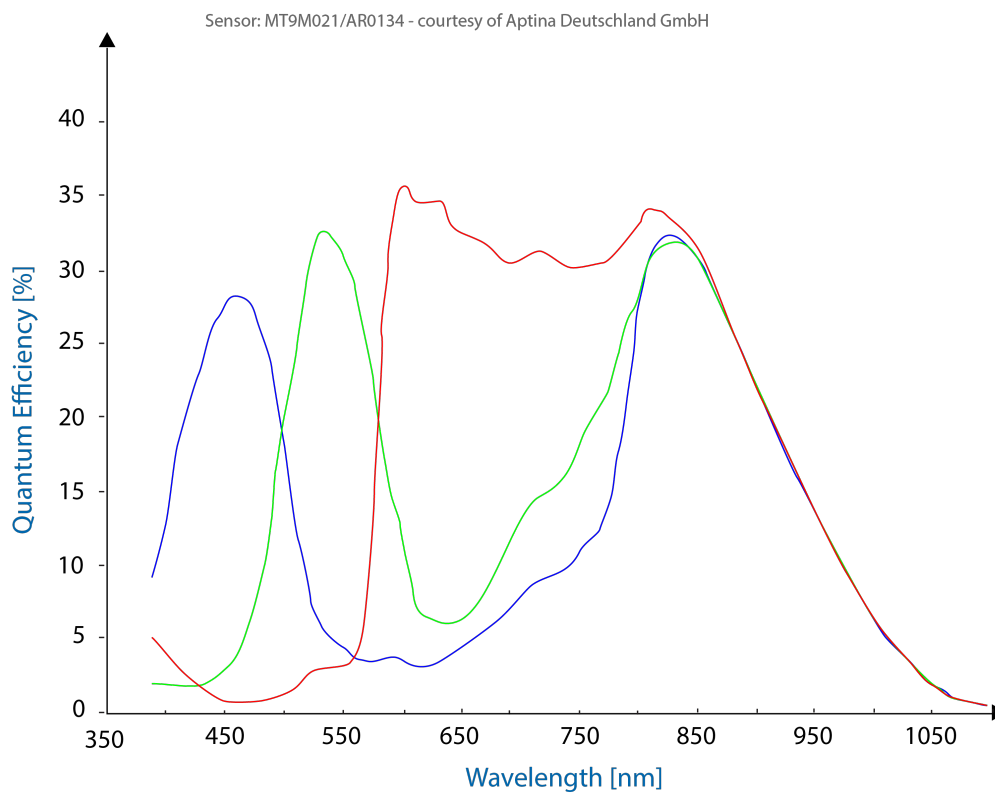
The output signal can also be directly controlled through the [General Purpose Output](#) feature.

## 4 Spectral Characteristics

### 4.1 IR-Cut Filter



### 4.2 Spectral Sensitivity - MT9M021





## 5 Camera Controls

This section describes the parameters available for the DFK 42BUC03 camera.

The actual name of the parameter depends on the driver technology used to access the camera. Parameter names are listed for the most common ways to access the cameras:

- UVC/V4L2 (on Linux, via `uvcdvideo`)
- *IC Imaging Control* (on Windows, via *Device Driver for USB Cameras*)

### 5.1 Sensor Readout Control

#### 5.1.1 Pixel Format

The pixel format defines the data type of the pixels transmitted to the computer. The bits per pixel needed for a particular pixel format influence the required bandwidth.

The driver technology used to access the camera significantly impacts the way the pixel format is controlled:

- When using the `uvcdvideo` driver on Linux, the pixel format is defined by `video4linux2`.
- When using *IC Imaging Control*, the pixel format is part of the video format - a parameter which combines pixel format, resolution and readout mode. For more information, refer to the *IC Imaging Control* documentation sections on `VideoFormat` and `VideoFormatDesc`.

The DFK 42BUC03 color camera supports multiple pixel formats with variable bits-per-pixel settings. The names of the pixel formats and the way to select them depends on the driver used to control the camera. The following table contains a short overview of all possible formats followed by a more detailed description.

| Pixel Format     | Bits Per Pixel | UVC  | TIS UVC Driver |
|------------------|----------------|------|----------------|
| 8-Bit Bayer (GR) | 8              | GRBG | RGB32, Y800    |

##### 5.1.1.1 8-Bit Bayer Raw

This format transmits data using one byte for each pixel.

UVC drivers see it with the *FourCC* GRBG, RGGB, GBRG or BA81.

The *Device Driver for USB Cameras* simplifies this variety of possible pixel formats and offers two video formats instead: RGB32 and Y800. The RGB32 format results from the driver's automatic debayering of the raw image data, while the Y800 format contains the raw data which is reinterpreted as monochrome.

#### 5.1.2 Frame Rate

The frame rate is specified in frames per second and determines the camera's operating speed.

The way the frame rate is controlled depends greatly upon which driver technology is used to access the camera:

- When using `uvcdvideo` on Linux, the frame rate is selected from a list of available frame rates.
- When using IC Imaging Control, the frame rate is selected from a list of available frame rates through APIs such as `Grabber::setFPS` or `ICImagingControl.DeviceFrameRate`.

The range of available frame rates depends upon other camera settings such as well, pixel format, resolution and readout modes.

| Parameter | Frame Rate                                              |
|-----------|---------------------------------------------------------|
| Minimum   | Depending on Pixel Format, Resolution, and Readout Mode |
| Maximum   | Depending on Pixel Format, Resolution, and Readout Mode |

The following tables show the maximum frame rate for some combinations of pixel format and resolution.

## 8-Bit Bayer Raw

| Width | Height | Maximum Frame Rate |
|-------|--------|--------------------|
| 1280  | 960    | 25                 |
| 640   | 480    | 48                 |

### 5.1.3 Partial Scan Offset

If the selected resolution is smaller than the sensor size, the part of the sensor that is actually read out can be specified by the *Partial Scan Offset X* and *Partial Scan Offset Y* parameters. By default, the camera automatically positions the offsets so that the center of the sensor is used.

| Parameter    | Partial Scan Offset X                                     |
|--------------|-----------------------------------------------------------|
| Minimum      | 0                                                         |
| Maximum      | 1280                                                      |
| Video4Linux2 | X Offset                                                  |
| VCD Property | VCDID_PartialScanOffset<br>\VCDElement_PartialScanOffsetX |

| Parameter    | Partial Scan Offset Y                                     |
|--------------|-----------------------------------------------------------|
| Minimum      | 0                                                         |
| Maximum      | 960                                                       |
| Video4Linux2 | Y Offset                                                  |
| VCD Property | VCDID_PartialScanOffset<br>\VCDElement_PartialScanOffsetY |

## 5.2 Image Sensor Control

### 5.2.1 Exposure Time

The *Exposure Time* parameter defines the time the camera opens its (electronic) shutter when it is taking an image.

| Parameter    | Exposure Time                                                   |
|--------------|-----------------------------------------------------------------|
| Minimum      | 100 $\mu$ s                                                     |
| Maximum      | 30 s                                                            |
| Default      | auto                                                            |
| Video4Linux2 | Exposure (Absolute)                                             |
|              | The V4L2 Exposure (Absolute) control is using 100 $\mu$ s units |
| VCD Property | VCDID_Exposure\VCDElement_Value                                 |

### 5.2.2 Gain

The *Gain* parameter defines the amplification that is applied to the image at sensor level.

| Parameter    | Gain                        |
|--------------|-----------------------------|
| Minimum      | 34                          |
| Maximum      | 255                         |
| Default      | auto                        |
| Video4Linux2 | Gain                        |
| VCD Property | VCDID_Gain\VCDElement_Value |

## 5.3 Trigger

The trigger mode can be used to take images at very specific points in time which are specified by an electrical signal connected to the [TRIGGER\\_IN](#) pin of the I/O connector of the camera.

### 5.3.1 Trigger Mode

The *Trigger Mode* parameter enables the trigger mode.

| Parameter    | Trigger Mode                   |
|--------------|--------------------------------|
| On           | Enable Trigger Mode            |
| True         |                                |
| Off          | Disable Trigger Mode           |
| False        |                                |
| Video4Linux2 | Trigger Mode                   |
| VCD Property | VCDID_Trigger\VCDElement_Value |

### 5.3.2 Software Trigger

The *Software Trigger* function can be used to simulate a trigger pulse, in turn causing one image to be exposed and delivered to the host computer.

| Parameter    | Software Trigger                         |
|--------------|------------------------------------------|
| Execute      | Simulate one trigger pulse               |
| Video4Linux2 | Software Trigger                         |
| VCD Property | VCDID_Trigger\VCDElement_SoftwareTrigger |

## 5.4 Digital I/O

The One4All series has one digital input and one digital output. The digital input can be used as a [Trigger](#) input but the current status can also be examined directly.

The digital output can be configured as a [Strobe](#) output to signal the exact moment when the image sensor is sensitive to light so that external light sources can be synchronized to its operation cycle.

### 5.4.1 General Purpose Input

The *General Purpose Input* parameter allows the current status of the [TRIGGER\\_IN](#) pin.

| Parameter    | General Purpose Input                                          |
|--------------|----------------------------------------------------------------|
| True         | TRIGGER_IN line status is low                                  |
| 1            |                                                                |
| False        | TRIGGER_IN line status is high                                 |
| 0            |                                                                |
| Video4Linux2 | ExtIO[1]                                                       |
| VCD Property | VCDID_GPIO\VCDElement_GPIORead<br>VCDID_GPIO\VCDElement_GPIOIn |

## 5.4.2 General Purpose Output

The *General Purpose Output* parameter controls the status of the [STROBE\\_OUT](#) pin.

| Parameter    | General Purpose Output                                           |
|--------------|------------------------------------------------------------------|
| True         | Drive the STROBE_OUT line high                                   |
| 1            |                                                                  |
| False        | Drive the STROBE_OUT line low                                    |
| 0            |                                                                  |
| Video4Linux2 | ExtIO[0]                                                         |
| VCD Property | VCDID_GPIO\VCDElement_GPIOWrite<br>VCDID_GPIO\VCDElement_GPIOOut |

## 5.5 Strobe

The strobe function controls the automatic generation of output pulses on the [STROBE\\_OUT](#) pin which is synchronized to the image sensor's exposure time.

### 5.5.1 Strobe Enable

The *Strobe Enable* parameter enables the automatic generation of strobe pulses.

| Parameter    | Strobe Enable                 |
|--------------|-------------------------------|
| On           | Strobe enabled                |
| True         |                               |
| Off          | Strobe disabled               |
| False        |                               |
| Video4Linux2 | Strobe[0]                     |
| VCD Property | VCDID_Strobe\VCDElement_Value |

## 5.5.2 Strobe Polarity

The *Strobe Polarity* parameter can be used to invert the strobe pulse output.

| Parameter    | Strobe Polarity                                               |
|--------------|---------------------------------------------------------------|
| ActiveHigh   | The STROBE_OUT pin is logically high during the exposure time |
| True         |                                                               |
| ActiveLow    | The STROBE_OUT pin is logically low during the exposure time  |
| False        |                                                               |
| Video4Linux2 | Strobe[1]                                                     |
| VCD Property | VCDID_Strobe\VCDElement_StrobePolarity                        |



## 6 Revision History

| Date       | Version | Description                      |
|------------|---------|----------------------------------|
| 2018/12/07 |         | Initial release of this document |



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Last update: April 2019

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### Headquarters:

*The Imaging Source Europe GmbH  
Überseetor 18, D-28217 Bremen, Germany  
Phone: +49 421 33591-0*

### North & South America:

*The Imaging Source, LLC  
6926 Shannon Willow Rd, S 400, Charlotte, NC 28226, USA  
Phone: +1 704-370-0110*

### Asia Pacific:

*The Imaging Source Asia Co., Ltd.  
2F., No.8, Xinhua 1st Road  
Taipei City 114, Neihu District, Taiwan  
Phone: +886 2-2792-3153*

[www.theimagingsource.com](http://www.theimagingsource.com)