AVT Manta

Technical Manual

AVT GigE Vision Cameras

V2.0.3

15 April 2010

Allied Vision Technologies GmbH
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ALLIED Vision Technologies

Legal notice

For customers in the U.S.A.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a residential environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. However there is no guarantee that interferences will not occur in a particular installation. If the equipment does cause harmful interference to radio or television reception, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the distance between the equipment and the receiver.
- Use a different line outlet for the receiver.
- Consult a radio or TV technician for help.

You are cautioned that any changes or modifications not expressly approved in this manual could void your authority to operate this equipment. The shielded interface cable recommended in this manual must be used with this equipment in order to comply with the limits for a computing device pursuant to Subpart B of Part 15 of FCC Rules.

For customers in Canada

This apparatus complies with the Class B limits for radio noise emissions set out in the Radio Interference Regulations.

Pour utilisateurs au Canada

Cet appareil est conforme aux normes classe B pour bruits radioélectriques, spécifiées dans le Règlement sur le brouillage radioélectrique.

Life support applications

These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Allied Vision Technologies customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Allied for any damages resulting from such improper use or sale.

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Contents

Contacting Allied Vision Technologies

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Introduction

This **MANTA Technical Manual** describes in depth the technical specifications, dimensions, all pixel formats, bandwidth and frame rate related subjects.

For information on hardware installation, safety warnings, pin assignments on I/O connectors and GigE port connectors read the **Manta Hardware Installation Guide**.

For information on camera features (camera controls) read the **GigE Camera Controls** document.

Note

Please read through this manual carefully.

We assume that you have read already the Hardware Installation Guide and that you have installed the hardware and software on your PC or laptop (Gigabit Ethernet network card, cables).

Document history

Version	Date	Remarks
V2.0.3	15.04.10	New Manual - RELEASE status

Table 1: Document history

Manual overview

This **manual overview** outlines the contents of each chapter of this manual.

- Chapter *Contacting Allied Vision Technologies* on page 5 lists AVT contact data (phone numbers and URLs) for both:
  - Technical information / ordering
  - Commercial information
- Chapter *Introduction* on page 6 (this chapter) gives you the document history, a manual overview (short description of each chapter) and conventions used in this manual (styles and symbols). Furthermore you learn how to get more information on **how to install hardware (Manta Hardware Installation Guide)**, available **AVT software** (incl. documentation) and where to get it.
- Chapter *MANTA GigE cameras* on page 10 gives you a short introduction to the MANTA cameras with their GigE technology. Links are provided to

information on **GigE Vision and GenICam** and to data sheets and brochures on AVT website.

- Chapter *Conformity* on page 12 gives you information about conformity of AVT cameras (CE, FCC, RoHS).
- Chapter *Filter and lenses* on page 20 describes filter for monochrome and color cameras. For the IR cut filter a spectral transmission diagram is provided. Suitable camera lenses for different focal lengths are provided for different camera models.
- Chapter *Specifications* on page 13 lists camera details and measured spectral sensitivity diagrams for each camera type.
- Chapter *Camera dimensions* on page 23 provides CAD drawings of standard housing models (2D drawings and 3D isometric drawings), tripod adapter and cross sections of CS-Mount and C-Mount. Furthermore you find information on adjustment of C-Mount and CS-Mount.
- Chapter *Camera interfaces* on page 31 describes in general the inputs/outputs of the cameras (incl. trigger features): Gigabit Ethernet port, camera I/O connector pin assignment, schematic input/output block diagrams as well as a general description of trigger (timing diagram, definitions and rules). For a detailed technical description of the interfaces (GigE port and I/O connector) see **Manta Hardware Installation Guide**.
- Chapter *Description of the data path* on page 38 describes the data path of the Manta cameras in block diagrams as well as available Manta camera controls. For a detailed description of all camera controls see the document: AVT GigE Camera Controls. Furthermore the image memory, color interpolation is described.
- Chapter *Resolution and ROI frame rates* on page 48 lists theoretical formulas for the maximum frame rate of CCD (depending on ROI height).
- Chapter *Appendix* on page 49 lists the sensor position accuracy of AVT GigE cameras.
- Chapter *Index* on page 50 gives you quick access to all relevant data in this manual.

Conventions used in this manual

To give this manual an easily understood layout and to emphasize important information, the following typographical styles and symbols are used:

Styles

Style	Function	Example
Bold	Programs, inputs or highlighting important things	**bold**
Courier	Code listings etc.	`Input`
Upper case	Register	REGISTER
Italics	Modes, fields	*Mode*
Parentheses and/or blue	Links	(Link)

Table 2: Styles

Symbols

Note

This symbol highlights important information.

Caution

This symbol highlights important instructions. You have to follow these instructions to avoid malfunctions.

www

This symbol highlights URLs for further information. The URL itself is shown in blue.

Example:

http://www.alliedvisiontec.com

More information

For more information on hardware and software read the following:

- **Manta Hardware Installation Guide** describes the hardware installation procedures for all AVT GigE cameras (Manta). Additionally you get safety instructions and information about camera interfaces (GigE port, I/O connectors, input and output).
- **AVT GigE Camera Controls** describes the camera controls of the AVT GigE SDK (AVT Universal Package) and feature related items.

www

For **downloading the Manta Hardware Installation Guide** and **AVT GigE Camera Controls** go to:

http://www.alliedvisiontec.com/emea/support/downloads/product-literature.html

There is no product CD.

www

All **software packages** (including **documentation** and **release notes**) provided by AVT can be downloaded at:

http://www.alliedvisiontec.com/emea/support/downloads/software.html

There is no product CD.

Before operation

We place the highest demands for quality on our cameras.

Target group This **Technical Manual** is the guide to detailed technical information of the camera and **is written for experts**.

Getting started For a quick guide how to get started read **Manta Hardware Installation Guide** first.

Note

Please read through this manual carefully before operating the camera.

For information on **AVT accessories** and **AVT software** read **Manta Hardware Installation Guide**.

Caution

Before operating any AVT camera read **safety instructions** and **ESD warnings** in **Manta Hardware Installation Guide**.

MANTA GigE cameras

Manta

This **camera family has a Gigabit Ethernet interface.** The Manta is a simple, robust digital camera for industrial imaging applications that makes the advantages of GigE Vision technology, together with AVT quality, completely affordable.

With the Manta, Allied Vision Technologies presents a wide range of cameras with **Gigabit Ethernet interfaces**.

Image applications

Allied Vision Technologies can provide users with a range of products that meet almost all the requirements of a very wide range of image applications.

GigE

GigE is the abbreviation for **Gig**abit **E**thernet.

All AVT Manta cameras are GigE Vision compliant cameras with Gigabit Ethernet interface. AVT Manta cameras work with standard Gigabit Ethernet hardware and cables and can have cable lengths up to 100 m, using conventional Cat5e network cabling.

GigE Vision standard (for Gigabit Ethernet cameras) and IEEE 1394/IIDC (for FireWire cameras) are both the state of the art interfaces for high-performance digital cameras for machine vision and industrial applications.

Gigabit Ethernet with its data rate of 1000 Mbit/s or 1 Gbit/s is capable of handling streaming image data and providing reliable transmission of image data from high performance machine vision cameras such as the MANTA cameras from AVT.

GigE Vision

The GigE Vision standard is an **interface standard for high-performance machine vision cameras** that is widely supported in the industrial imaging industry. GigE (Gigabit Ethernet), on the other hand, is simply the network structure on which GigE Vision is built.

The GigE Vision standard includes both a hardware interface standard (Gigabit Ethernet) and standardized means of communicating with a camera and controlling a camera.

GenICam

The GigE Vision **camera control registers** are based on a command structure called GenICam which is administered through the **E**uropean **M**achine **V**ision **A**ssociation (EMVA). GenICam seeks to establish a **common camera control interface** so that third party software can communicate with cameras from various manufacturers without customization. GenICam is incorporated as part of the GigE Vision standard, so any truly GigE Vision compliant camera also complies with GenICam. GigE Vision is analogous to FireWire's DCAM (IIDC) and has great value for reducing system integration costs and for improving ease of use.

www

For further information on **GigE Vision and GenICam** read:

http://www.alliedvisiontec.com/emea/support/application-notes.html

www

For further information on the highlights of Manta **types**, the Manta **family** and the whole range of **AVT GigE cameras** read the data sheets and brochures on the website of Allied Vision Technologies:

http://www.alliedvisiontec.com/emea/support/downloads/product-literature.html

Conformity

Allied Vision Technologies declares under its sole responsibility that all standard cameras of the **AVT Manta** family to which this declaration relates are in conformity with the following standard(s) or other normative document(s):

- CE, following the provisions of 2004/108/EG directive
  (**Manta** board level cameras do not have CE)
- FCC Part 15 Class B
  (**Manta** board level cameras: prepared for FCC Class B)
- RoHS (2002/95/EC)

CE

We declare, under our sole responsibility, that the previously described **AVT Manta** cameras conform to the directives of the CE.

FCC – Class B Device

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense. You are cautioned that any changes or modifications not expressly approved in this manual could void your authority to operate this equipment.

Specifications

Manta G-032B/C

Feature	Specification
Image device	Type 1/3 (diag. 6 mm) progressive scan SONY IT CCD ICX424AL/AQ with HAD microlens
Effective chip size	**4.9 mm x 3.7 mm**
Cell size	7.4 µm x 7.4 µm
Picture size (max.)	656 x 492 pixels
Lens mount	Adjustable C-Mount: 17.526 mm (in air); Ø 25.4 mm (32 tpi) maximum protrusion: 9.7 mm (see *Figure 8: Manta C-Mount dimensions* on page 25) Adjustable CS-Mount: 12.526 mm (in air); Ø 25.4 mm (32 tpi) maximum protrusion: 5.1 mm (see *Figure 9: Manta CS-Mount dimensions* on page 26) **Note** **Maximum protrusion** means the distance from lens flange to the glass filter in the camera.
ADC	12 bit
Pixel format	**Only b/w:** Mono8, Mono16 **Only color:** Bayer8, Bayer16, RGB24, YUV411, YUV422, YUV444, BGR24, RGBA24, BGRA24
Frame rates	Up to 80 fps
Gain control	Manual: 0-24 dB (1 dB/step); auto gain (select. ROI)
Exposure time	25.8 µs ... 60 s; auto shutter (select. ROI)
External trigger event	**Rising edge, falling edge, any edge, level high, level low**
External trigger delay	**0 to 60 seconds in 1 µs increments**
Fixed rate control	**1 fps ... max. frame rate (steps of 0.1 fps)**
Imaging modes	Free-running, external trigger, fixed rate, software trigger
Sync Out modes	Trigger ready, trigger input, exposing, readout, imaging, strobe, GPO
Internal image memory	32 MByte, up to 49 frames **Note** The number of frames depends on resolution and pixel format. Listed number of frames is typical for full resolution and Mono8/Bayer8.

Table 3: Specification Manta G-032B/C

Feature	Specification
Smart functions	AGC (auto gain control), auto exposure control, 32 MByte image memory, binning (monochrome binning, also for color cameras; but no color binning), 3 user sets **only color:** auto white balance, color correction, edge filter (sharpness), hue, saturation
I/O	Two configurable inputs, two configurable outputs RS-232 port (serial port)
Digital interface	IEEE 802.3 1000BASE-T (GigE Vision V1.0)
Camera control interface	GenICam V1.0 compliant
Power requirements	DC 8 V - 30 V only via 12-pin HIROSE: **external power supply needed**
Power consumption	Typical <3.6 watt (@ 12 V DC); (full resolution and maximal frame rates)
Dimensions	86.4 mm x 44 mm x 29 mm (L x W x H); incl. connectors, without tripod and lens
Mass	<200 g (without lens)
Operating temperature	+ 5 °C ... + 45 °C ambient temperature (without condensation)
Storage temperature	- 10 °C ... + 70 °C ambient temperature (without condensation)
Regulations	CE, FCC Class B, RoHS (2002/95/EC)
Standard accessories	**b/w:** protection glass **color:** IR cut filter
Optional accessories	**b/w:** IR cut filter, IR pass filter **color:** protection glass
On request	Gigabit Ethernet network card, Gigabit Ethernet network cables
Software packages	AVT Universal Package, PvAPI (no charge for either package)

Table 3: Specification Manta G-032B/C

Note

The design and specifications for the products described above may change without notice.

Caution

Due to the small packaging and high speed of the Manta cameras, take special care to maintain a reasonable operating temperature.

If the camera is to be operated in a warm environment:

- **Mount the camera on a heat sink such as a metal bracket.**
- Take care that there is **sufficient air flow.**

Manta G-125B/C

Feature	Specification
Image device	Type 1/3 (diag. 6 mm) progressive scan SONY IT CCD ICX445ALA/AQA with EXview HAD microlens
Effective chip size	**4.8 mm x 3.6 mm**
Cell size	3.75 µm x 3.75 µm
Picture size (max.)	1292 x 964 pixels
Lens mount	Adjustable C-Mount: 17.526 mm (in air); Ø 25.4 mm (32 tpi) maximum protrusion: 9.7 mm (see *Figure 8: Manta C-Mount dimensions* on page 25) Adjustable CS-Mount: 12.526 mm (in air); Ø 25.4 mm (32 tpi) maximum protrusion: 5.1 mm (see *Figure 9: Manta CS-Mount dimensions* on page 26) **Note** **Maximum protrusion** means the distance from lens flange to the glass filter in the camera.
ADC	14 bit
Pixel format	**Only b/w:** Mono8, Mono16 **Only color:** Bayer8, Bayer16, RGB24, YUV411, YUV422, YUV444, BGR24, RGBA24, BGRA24
Frame rates	Up to 30 fps
Gain control	Manual: 0-24 dB (1 dB/step); auto gain (select. ROI)
Exposure time	28.5 µs ... 60 s; auto shutter (select. ROI)
External trigger event	**Rising edge, falling edge, any edge, level high, level low**
External trigger delay	**0 to 60 seconds in 1 µs increments**
Fixed rate control	**1 fps ... max. frame rate (steps of 0.1 fps)**
Imaging modes	Free-running, external trigger, fixed rate, software trigger
Sync Out modes	Trigger ready, trigger input, exposing, readout, imaging, strobe, GPO
Internal image memory	32 MByte, up to 12 frames **Note** The number of frames depends on resolution and pixel format. Listed number of frames is typical for full resolution and Mono8/Bayer8.

Table 4: Specification Manta G-125B/C

Feature	Specification
Smart functions	AGC (auto gain control), auto exposure control, 32 MByte image memory, binning (monochrome binning, also for color cameras; but no color binning), 3 user sets **only color:** auto white balance, color correction, edge filter (sharpness), hue, saturation
I/O	Two configurable inputs, two configurable outputs RS-232 port (serial port)
Digital interface	IEEE 802.3 1000BASE-T (GigE Vision V1.0)
Camera control interface	GenICam V1.0 compliant
Power requirements	DC 8 V - 30 V only via 12-pin HIROSE: **external power supply needed**
Power consumption	Typical <3.6 watt (@ 12 V DC); (full resolution and maximal frame rates)
Dimensions	86.4 mm x 44 mm x 29 mm (L x W x H); incl. connectors, without tripod and lens
Mass	<200 g (without lens)
Operating temperature	+ 5 °C ... + 45 °C ambient temperature (without condensation)
Storage temperature	- 10 °C ... + 70 °C ambient temperature (without condensation)
Regulations	CE, FCC Class B, RoHS (2002/95/EC)
Standard accessories	**b/w:** protection glass **color:** IR cut filter
Optional accessories	**b/w:** IR cut filter, IR pass filter **color:** protection glass
On request	Gigabit Ethernet network card, Gigabit Ethernet network cables
Software packages	AVT Universal Package, PvAPI (no charge for either package)

Table 4: Specification Manta G-125B/C

Note

The design and specifications for the products described above may change without notice.

Caution

Due to the small packaging and high speed of the Manta cameras, take special care to maintain a reasonable operating temperature.

If the camera is to be operated in a warm environment:

- **Mount the camera on a heat sink such as a metal bracket.**
- Take care that there is **sufficient air flow.**

Spectral sensitivity

Note

All measurements were done without protection glass / without filter.

The uncertainty in measurement of the QE values is ±10%.

This is due to:

- Manufacturing tolerance of the sensor
- Uncertainties in the measuring apparatus itself (Ulbricht-Kugel/Ulbricht sphere, optometer, etc.)

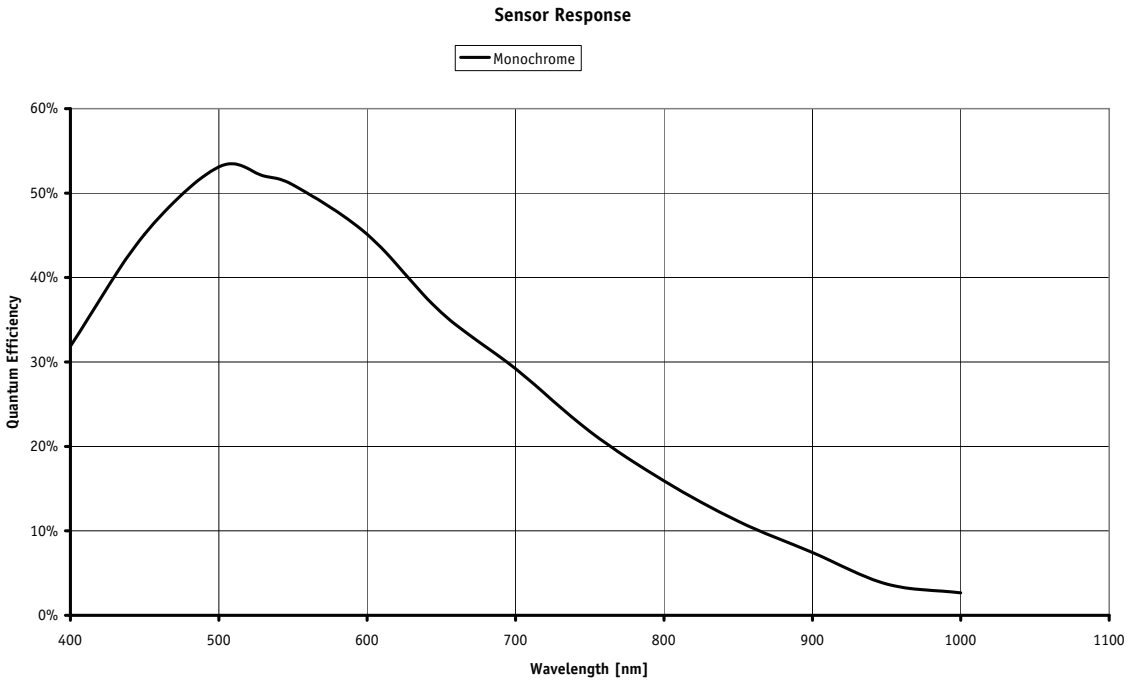


Figure 1: Spectral sensitivity of Manta G-032B

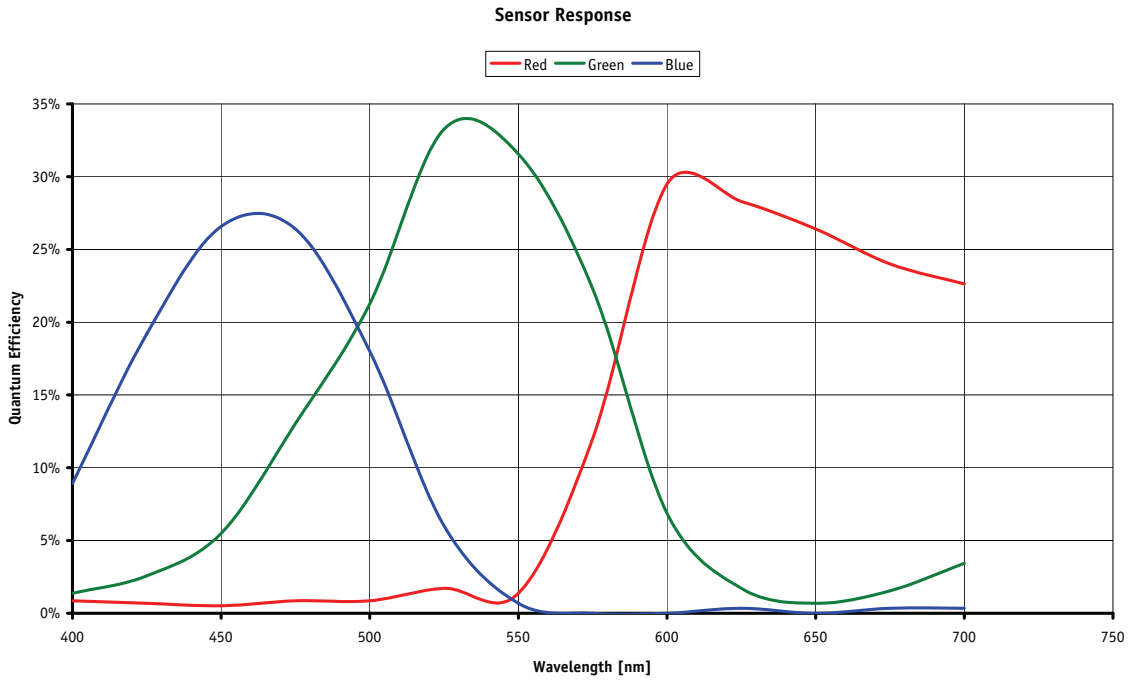


Figure 2: Spectral sensitivity of Manta G-032C (without IR cut filter)

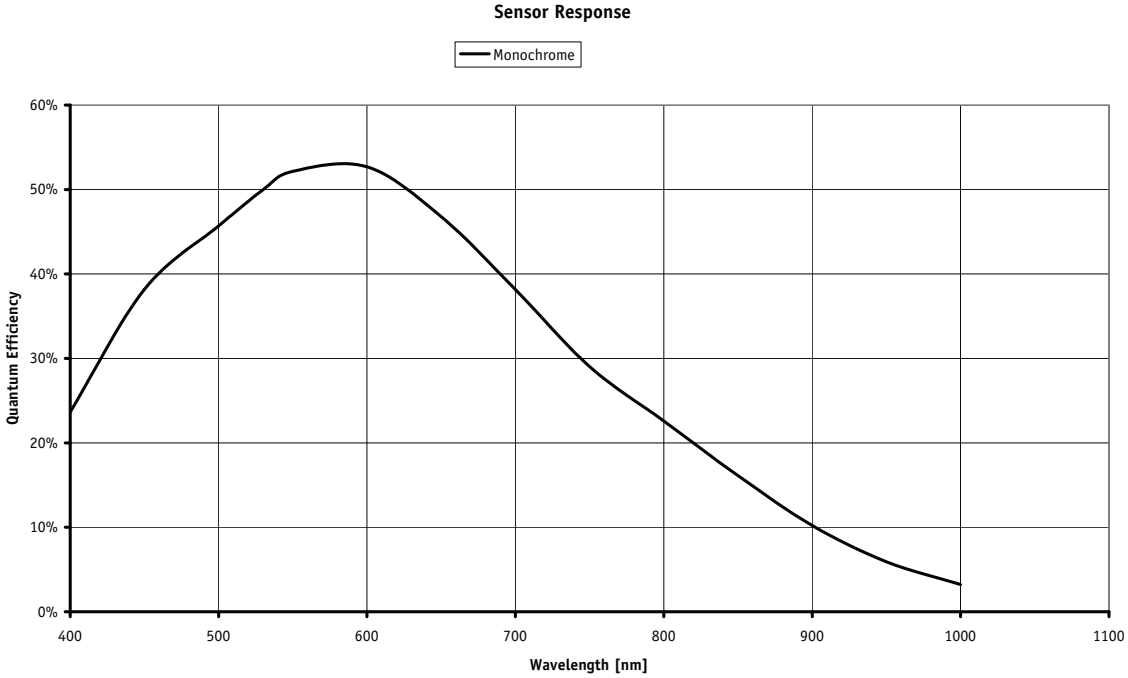


Figure 3: Spectral sensitivity of Manta G-125B

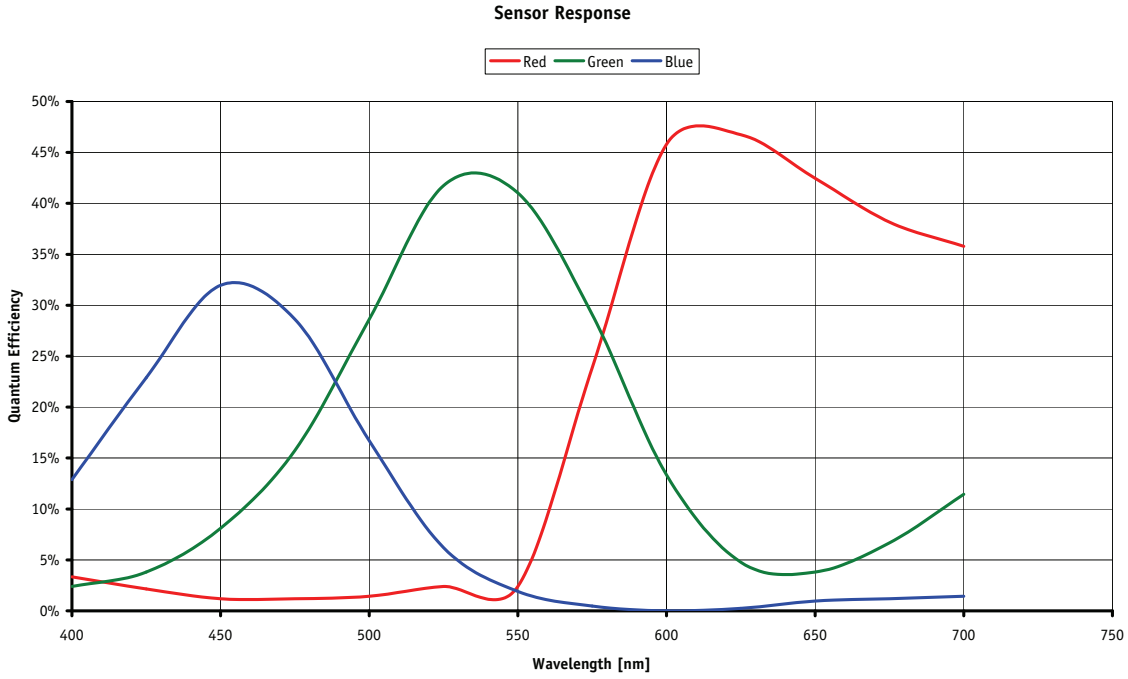


Figure 4: Spectral sensitivity of Manta G-125C (without IR cut filter)

Filter and lenses

- **Monochrome** cameras are equipped with **protection glass.**
- **Color** cameras are equipped with **IR cut filter.**

IR cut filter: spectral transmission

The following illustration shows the spectral transmission of the IR cut filter:

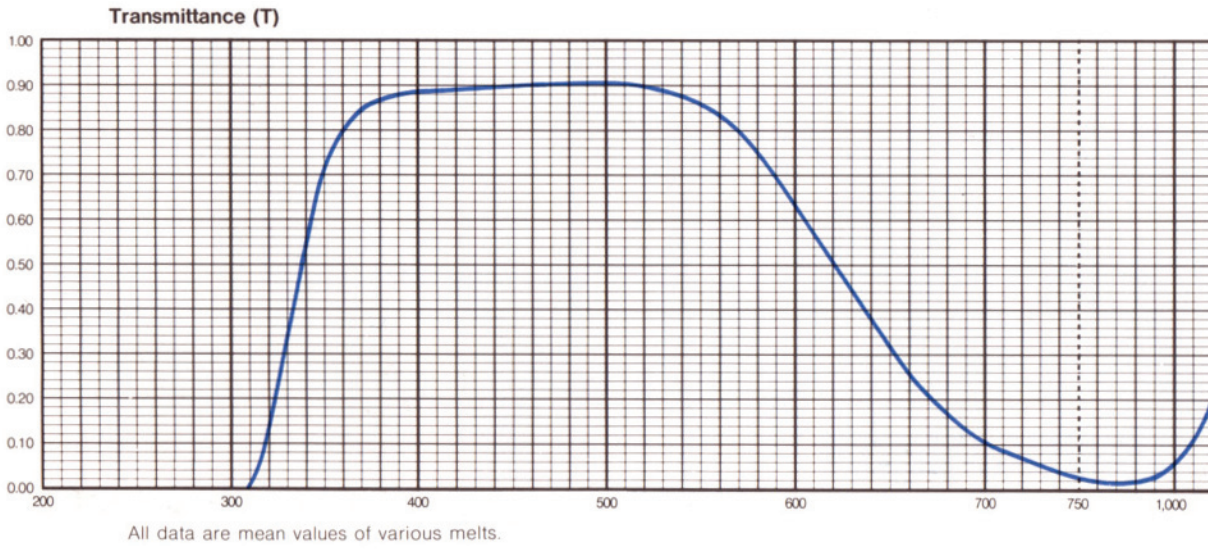


Figure 5: Spectral transmission of Hoya C5000

Camera lenses

AVT offers different lenses from a variety of manufacturers.

www

For more information go to:

http://www.alliedvisiontec.com/emea/products/accessories/lenses.html

Here you find suitable lenses for AVT camera families and models.

The following table lists selected image formats in **width x height** depending on camera type, distance and the focal length of the lens.

Note

Lenses with focal lengths < 8 mm may show shading in the edges of the image due to microlenses on the sensor's pixel.

Ask your dealer if you require non C-Mount lenses.

Focal length for type 1/3 sensors Manta G-032/125	Distance = 500 mm	Distance = 1000 mm
4.8 mm	495 mm x 371 mm	995 mm x 746 mm
8 mm	295 mm x 221 mm	595 mm x 446 mm
12 mm	195 mm x 146 mm	395 mm x 296 mm
16 mm	145 mm x 109 mm	295 mm x 221 mm
25 mm	91 mm x 68 mm	187 mm x 140 mm
35 mm	64 mm x 48 mm	132 mm x 99 mm
50 mm	43 mm x 32 mm	91 mm x 68 mm

Table 5: Focal length vs. field of view (Manta G-032/125)

Focal length for type 1/2 sensors Manta G-046/146	Distance = 500 mm	Distance = 1000 mm
4.8 mm	660 mm x 495 mm	1327 mm x 995 mm
8 mm	394 mm x 295 mm	794 mm x 595 mm
12 mm	260 mm x 195 mm	527 mm x 395 mm
16 mm	194 mm x 145 mm	394 mm x 295 mm
25 mm	122 mm x 91 mm	250 mm x 187 mm
35 mm	85 mm x 64 mm	176 mm x 132 mm
50 mm	58 mm x 43 mm	122 mm x 91 mm

Table 6: Focal length vs. field of view (Manta G-046/146)

Focal length for type 1/1.8 sensors Manta G-201	Distance = 500 mm	Distance = 1000 mm
4.8 mm	740 mm x 549 mm	1488 mm x 1103 mm
8 mm	441 mm x 327 mm	890 mm x 660 mm
12 mm	292 mm x 216 mm	591 mm x 438 mm
16 mm	217 mm x 161 mm	441 mm x 327 mm
25 mm	136 mm x 101 mm	280 mm x 207 mm
35 mm	95 mm x 71 mm	198 mm x 147 mm
50 mm	65 mm x 48 mm	136 mm x 101 mm

Table 7: Focal length vs. field of view (Manta G-201)

Focal length for type 2/3 sensors Manta G-145	Distance = 500 mm	Distance = 1000 mm
4.8 mm	908 mm x 681 mm	1825 mm x 1368 mm
8 mm	541 mm x 406 mm	1091 mm x 818 mm
12 mm	358 mm x 268 mm	725 mm x 543 mm
16 mm	266 mm x 200 mm	541 mm x 406 mm
25 mm	167 mm x 125 mm	343 mm x 257 mm
35 mm	117 mm x 88 mm	243 mm x 182 mm
50 mm	79 mm x 59 mm	167 mm x 125 mm

Table 8: Focal length vs. field of view (Manta G-145)

Camera dimensions

Note

For information on **sensor position accuracy:**

(sensor shift x/y, optical back focal length z and sensor rotation α) see Chapter *Sensor position accuracy of AVT GigE cameras* on page 49.

MANTA standard housing (1 x GigE)

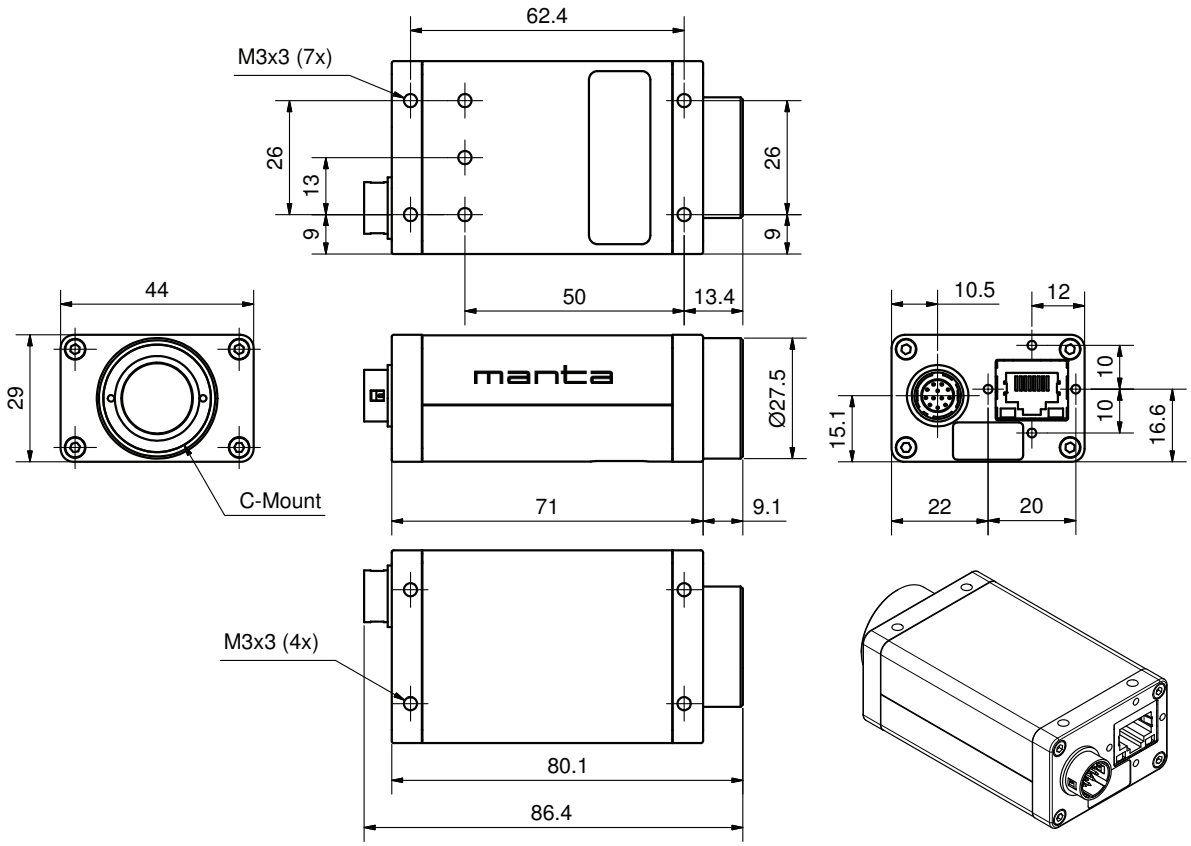
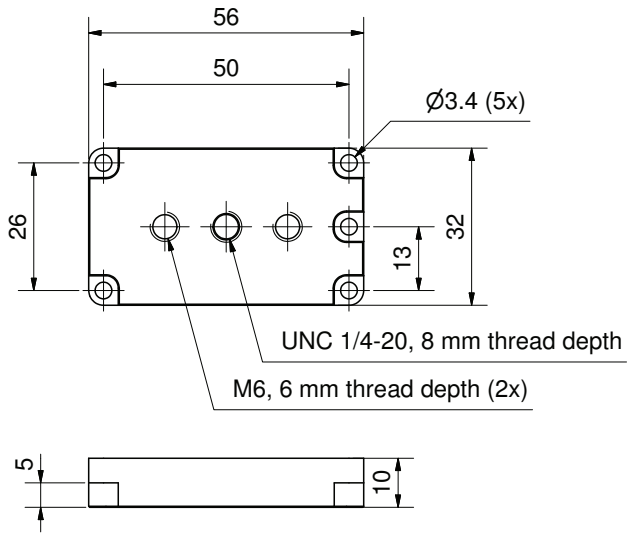


Figure 6: Camera dimensions

Tripod adapter

This five hole tripod adapter (AVT order number E 5000007) ...

- ... can be used for Manta as well as for Stingray and Marlin.
- ... is only designed for standard housings.



Body size: 56 mm x 32 mm x 10 mm (L x W x H)

Figure 7: Tripod dimensions

Cross section: C-Mount

- All monochrome Manta cameras are equipped with a protection glass.
- All color Manta cameras are equipped with the same model of IR cut filter.

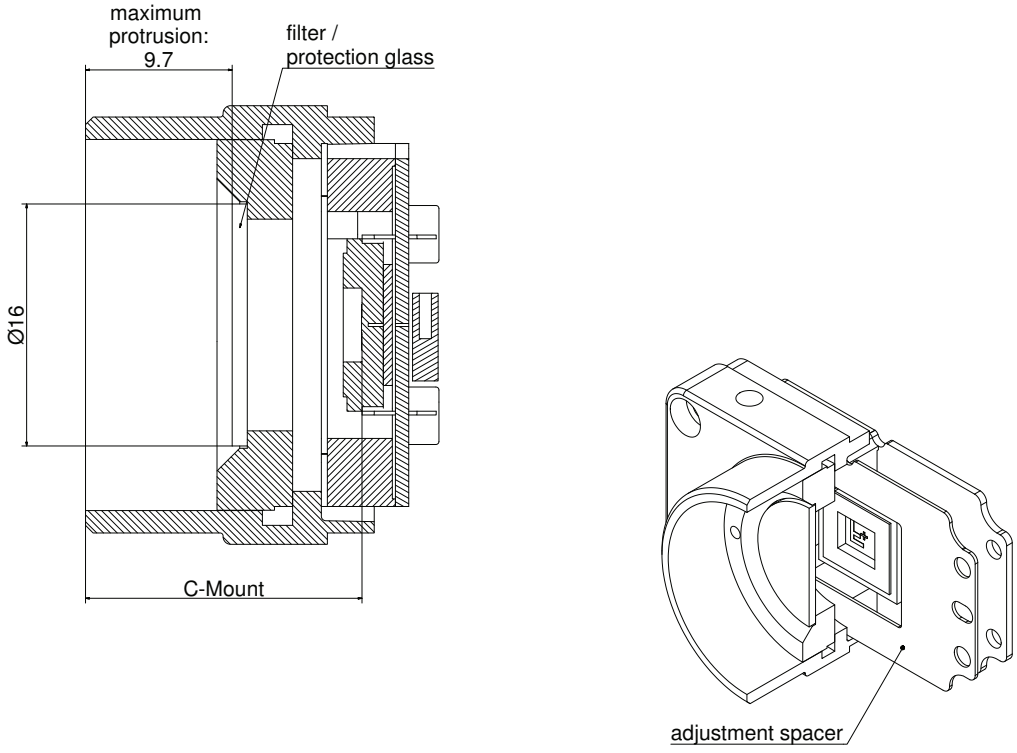


Figure 8: Manta C-Mount dimensions

Adjustment of C-Mount

The dimensional adjustment cannot be done by the customer. All adjustments have to be done by the AVT factory.

If you need any adjustments, please contact Customer Care: For phone numbers and e-mail: See Chapter *Contacting Allied Vision Technologies* on page 5.

Cross section: CS-Mount

Choose protection glass or filter according to the
AVT Modular Camera Concept.
http://www.alliedvisiontec.com/emea/support/downloads/product-literature.html

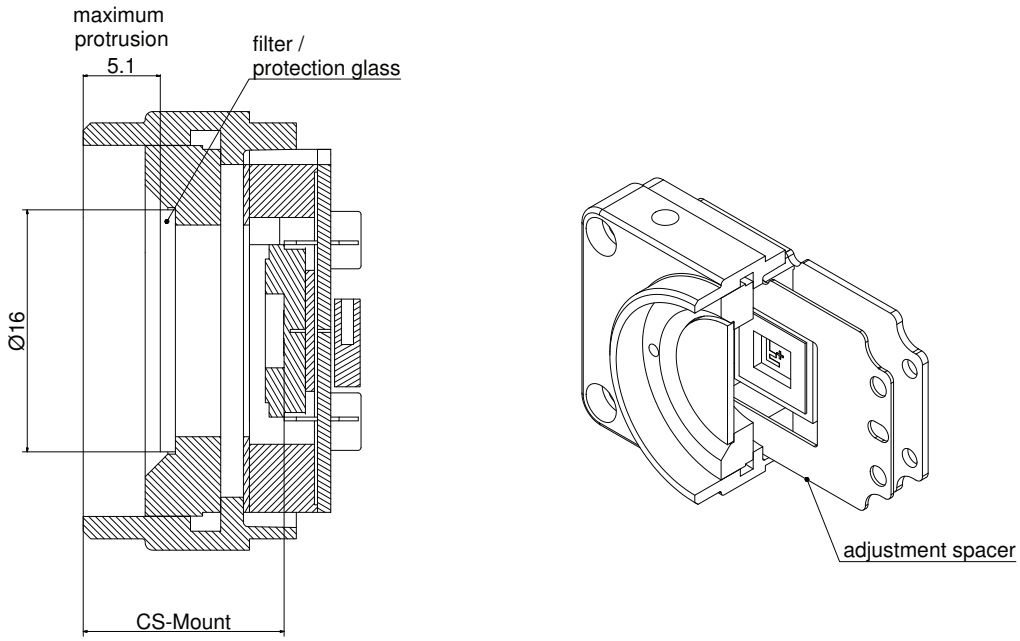


Figure 9: Manta CS-Mount dimensions

Ajustment of CS-Mount

The dimensional adjustment cannot be done by the customer. All adjustments have to be done by the AVT factory.

If you need any adjustments, please contact Customer Care: For phone numbers and e-mail: See Chapter *Contacting Allied Vision Technologies* on page 5.

Manta board level: dimensions

13-pole I/O connector:
Molex PicoBlade
Vertical Header 53047-1310
Receptacle Housing 51021-1300
Crimp Terminal 13 x 50079-8000

1 = GND (for RS232, Ext PWR)
2 = Ext PWR input (PWR output on demand)
3 = PWM-Out
4 = Input 1
5 = not used
6 = Output 1
7 = GND (for Inputs)
8 = RxD 9 = TxD
10 = Power Input (for Output ports)
11 = Input 2
12 = Output 2
13 = Chassis GND

FFC45 cable length:

FFC45 L = 56 mm K7500307
FFC45 L = 110 mm K7500318

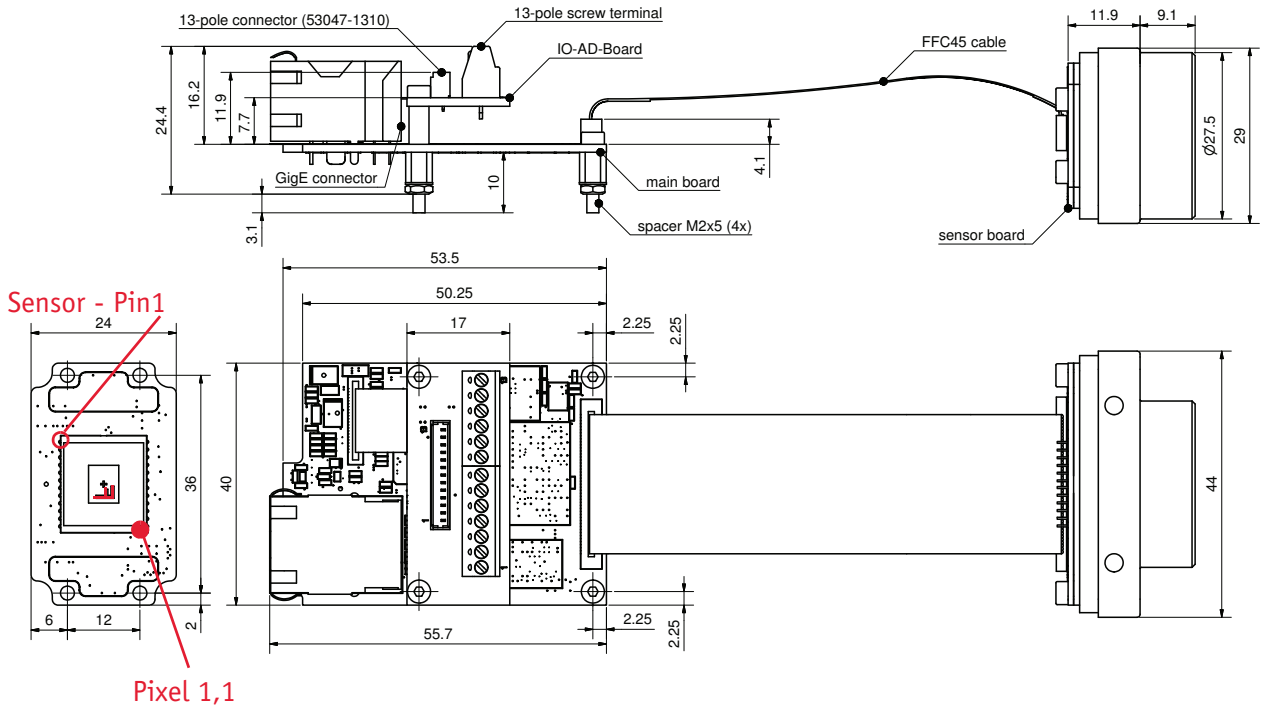


Figure 10: Manta board level dimensions

Manta board level: C-Mount

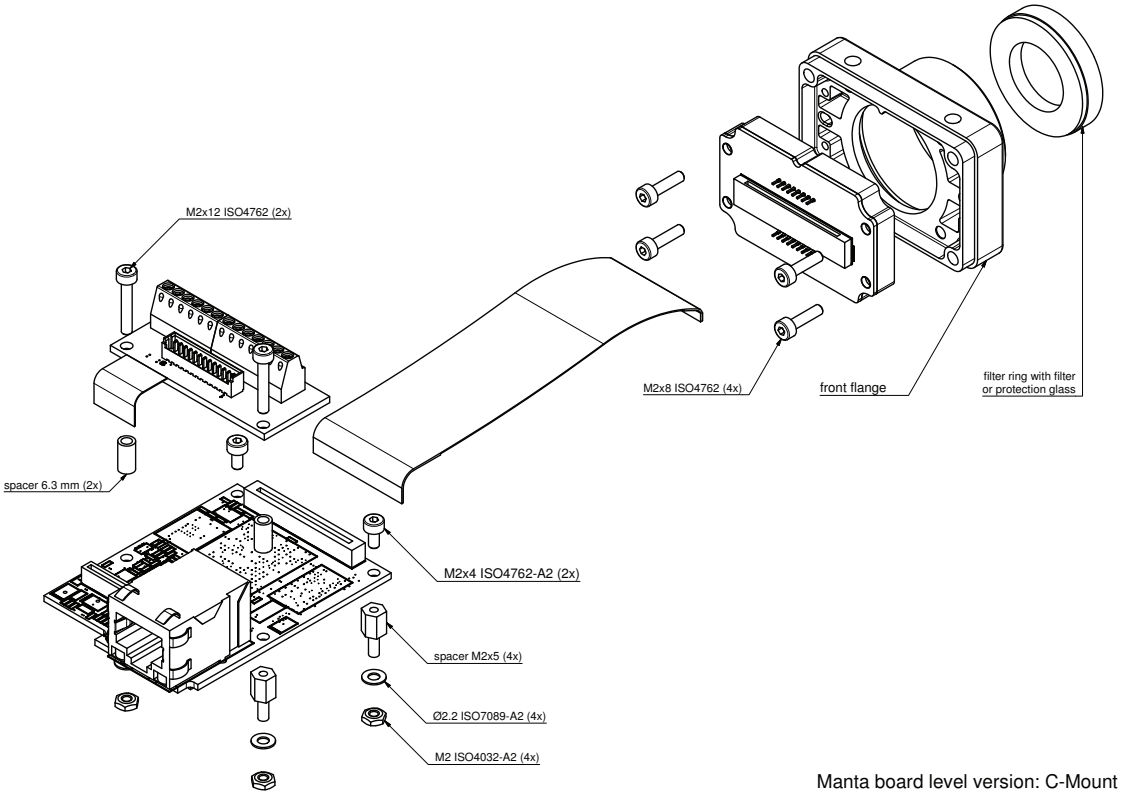


Figure 11: Manta board level: C-Mount

The dimensional adjustment cannot be done by the customer. All adjustments have to be done by the AVT factory.

If you need any adjustments, please contact Customer Care: For phone numbers and e-mail: See Chapter *Contacting Allied Vision Technologies* on page 5.

Manta board level: CS-Mount

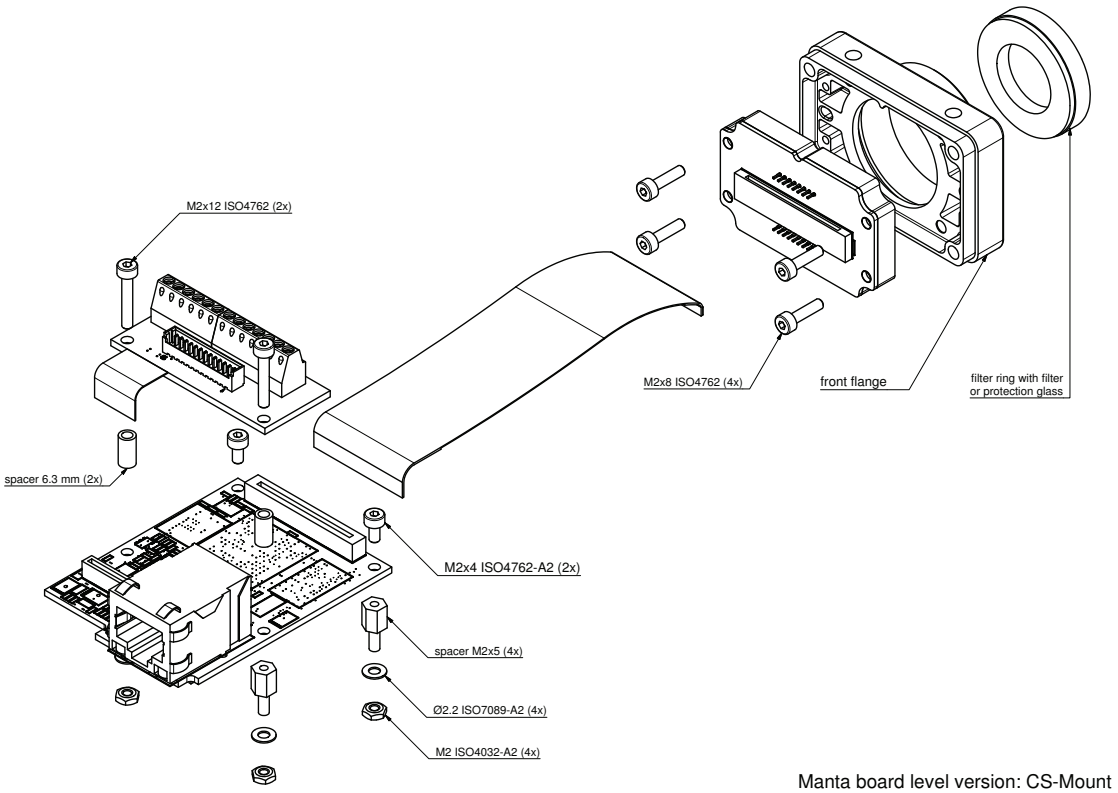


Figure 12: Manta board level: CS-Mount

The dimensional adjustment cannot be done by the customer. All adjustments have to be done by the AVT factory.

If you need any adjustments, please contact Customer Care: For phone numbers and e-mail: See Chapter *Contacting Allied Vision Technologies* on page 5.

Manta board level: M12-Mount

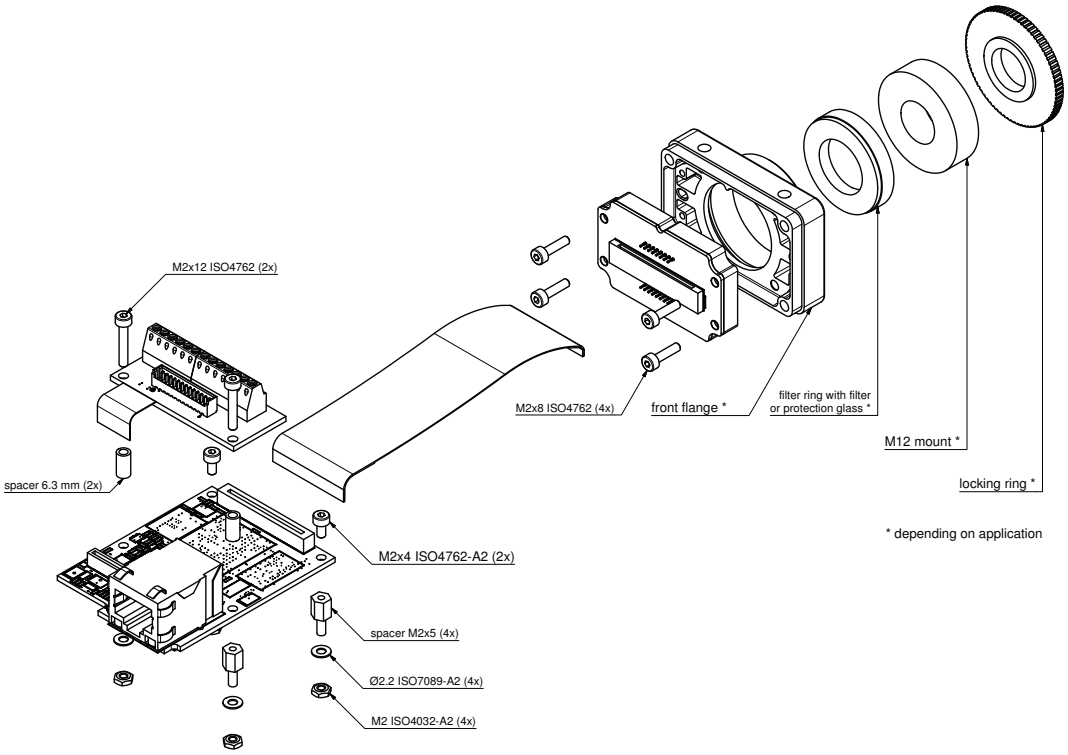


Figure 13: Manta board level: M12-Mount

The dimensional adjustment cannot be done by the customer (depending on application). All adjustments have to be done by the AVT factory.

If you need any adjustments, please contact Customer Care: For phone numbers and e-mail: See Chapter *Contacting Allied Vision Technologies* on page 5.

Camera interfaces

This chapter gives you information on Gigabit Ethernet port, inputs and outputs and trigger features.

Note

For a detailed description of the **camera interfaces (GigE, I/O connector), and operating instructions** see the **Manta Hardware Installation Guide,** Chapter ***Camera interfaces***.

Read all ***Notes*** and ***Cautions*** in the **Manta Hardware Installation Guide**, before using any interfaces.

www

For accessories like cables see:

http://www.alliedvisiontec.com/emea/products/accessories/gige-accessories.html

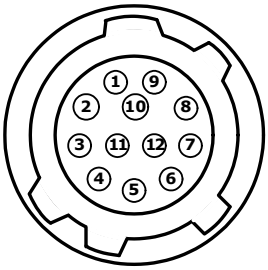
Gigabit Ethernet port

The Gigabit Ethernet port conforms to the IEEE 802.3 1000BASE-T standard for Gigabit Ethernet over copper. We recommend using Category 5e or Category 6 compatible cabling and connectors for best performance.

Note

- Cable lengths up to 100 m are supported.
- The 8-pin RJ-45 jack has the pin assignment according to the Ethernet standard (IEEE 802.3 1000BASE-T).
- Cables with screw-lock connectors are available from AVT:
  http://www.alliedvisiontec.com/emea/products/accessories/gige-accessories.html
- Ask your local dealer for more details.

Camera I/O connector pin assignment



Pin	Signal	Direction	Level	Description
1	External GND		GND for RS232 and ext. power	External Ground for RS232 and external power
2	External Power		+8 ... +30 V DC	Power supply
3	---	---	---	---
4	Camera In 1	In	U_{in}(high) = 2.5 V...6.0 V U_{in}(low) = 0 V...0.8 V	Camera Input 1 (GPIn1)
5	---	---	---	---
6	Camera Out 1	Out	Open emitter, max. 20 mA	Camera Output 1 (GPOut1)
7	Camera In GND	In	Common GND for inputs	Camera Common Input Ground (In GND)
8	---	---	---	---
9	---	---	---	---
10	Camera Out Power	In	Common VCC for outputs max. 30 V DC	Camera Output Power for digital outputs (OutVCC)
11	Camera In 2	In	U_{in}(high) = 2.5 V...6.0 V U_{in}(low) = 0 V...0.8 V	Camera Input 2 (GPIn2)
12	Camera Out 2	Out	Open emitter, max. 20 mA	Camera Output 2 (GPOut2)

Figure 14: Camera I/O connector pin assignment

Note

GP = **G**eneral **P**urpose

For a detailed description of the **I/O connector and its operating instructions** see the **Manta Hardware Installation Guide, Chapter *MANTA input description***.

Read all ***Notes*** and ***Cautions*** in the **Manta Hardware Installation Guide**, before using the I/O connector.

Control and video data signals

The inputs and outputs of the camera can be configured by software. The different modes are described below.

Inputs

Note

For a general description of the **inputs** and **warnings** see the **Hardware Installation Guide,** Chapter ***MANTA input description*.**

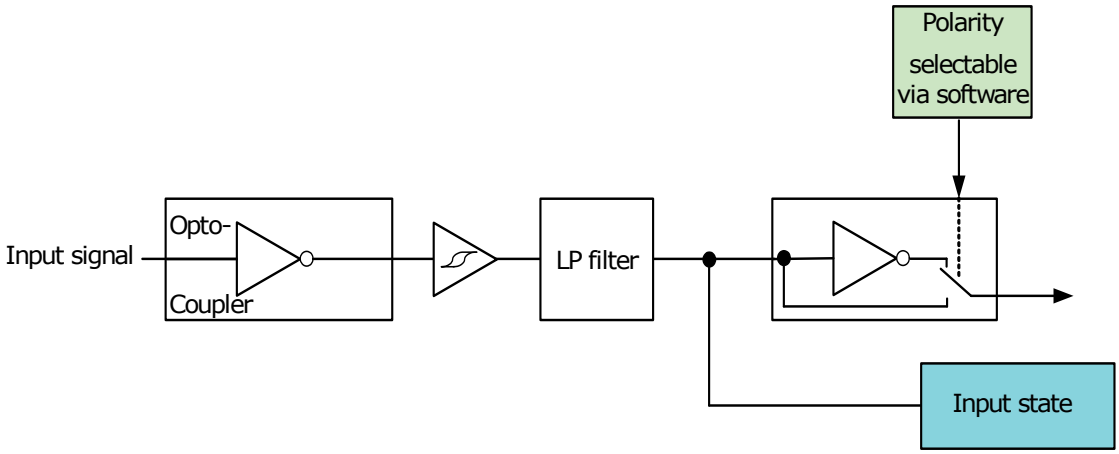


Figure 15: Input block diagram

Input/output pin control

All input and output signals running over the camera I/O connector are controlled by the I/O strobe commands. See **AVT GigE camera controls**.

Outputs

Note

For a general description of the **outputs** and **warnings** see the **Manta Hardware Installation Guide**, Chapter ***MANTA output description*.**

Output features are configured by software. Any signal can be placed on any output.

The main features of output signals are described below:

Signal	Description
GPO	Configured to be a general purpose output, control of which is assigned to SyncOutGpoLevels
AcquisitionTriggerReady	Active once the camera has been recognized by the host PC and is ready to start acquisition.
FrameTriggerReady	Active when the camera is in a state that will accept the next frame trigger.
FrameTrigger	Active when an image has been initiated to start. This is a logic trigger internal to the camera, which is initiated by an external trigger or software trigger event.
Exposing	Exposing – Active for the duration of sensor exposure.
FrameReadout	Active at during frame readout, i.e. the transferring of image data from the CCD to camera memory.
Acquiring	Active during an acquisition stream.
SyncIn1	Active when there is an external trigger at SyncIn1
SyncIn2	Active when there is an external trigger at SyncIn2
Strobe1	The output signal is controlled according to Strobe1 settings.

Table 9: Output signals

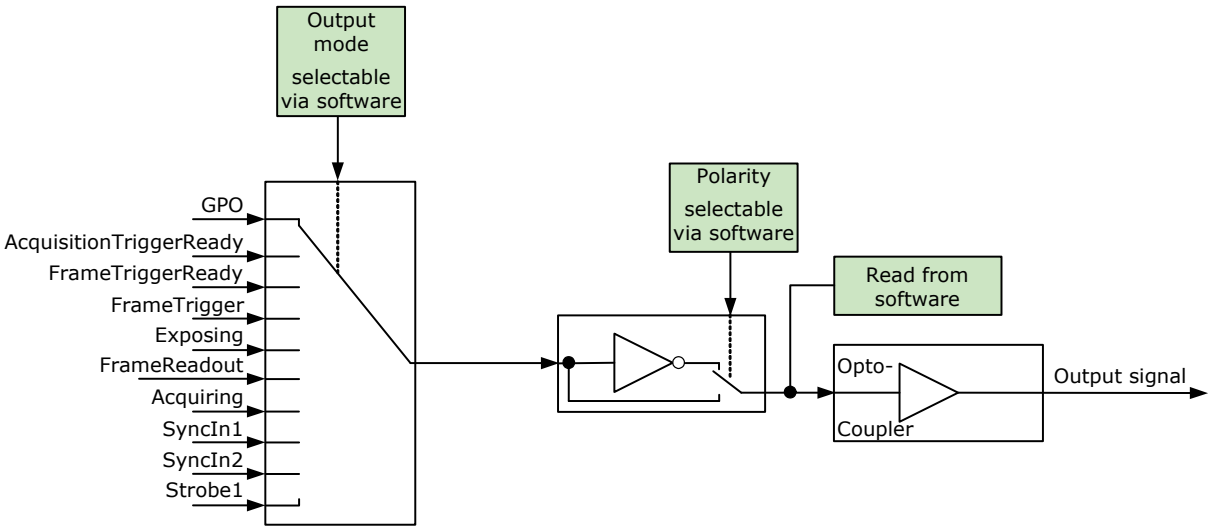


Figure 16: Output block diagram

Trigger timing diagram

The following diagram explains the trigger concept in general.

Note For trigger description on camera control basis see **AVT GigE camera control**.

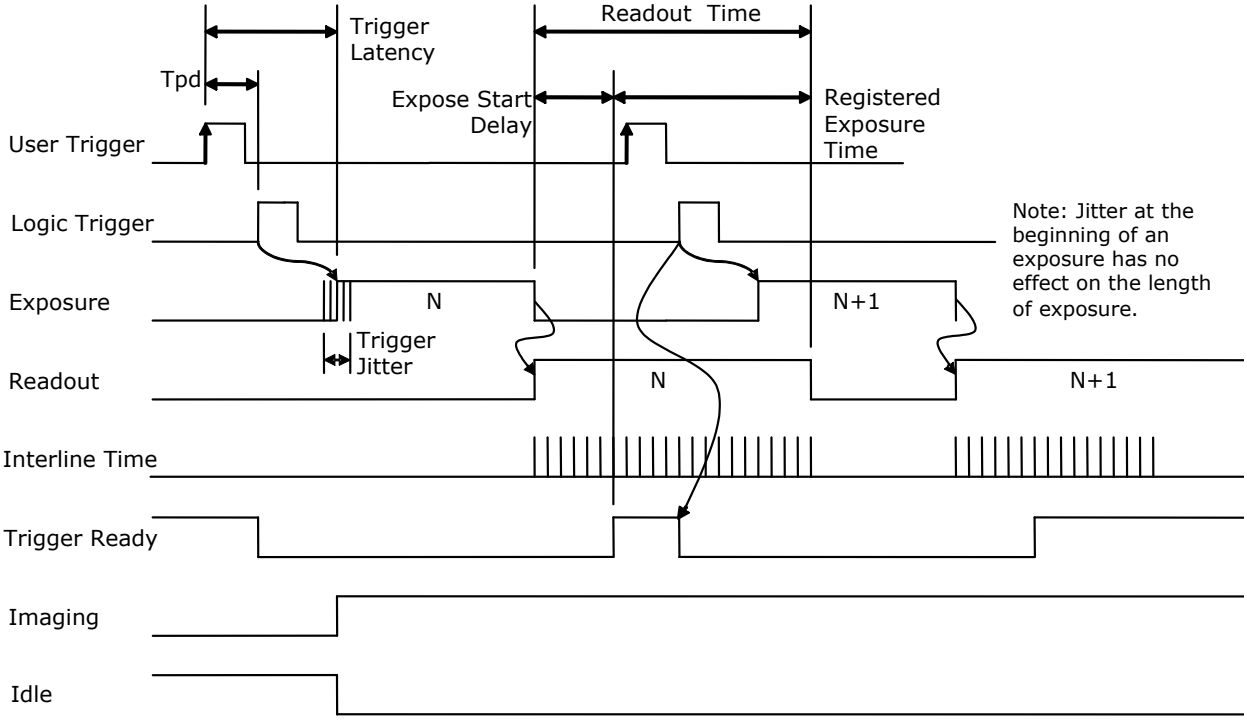


Figure 17: Trigger timing diagram

Notes on Triggering

Trigger definitions

Term	Definition
User Trigger	Trigger signal applied by the user (hardware trigger, software trigger)
Logic Trigger	Trigger signal seen by the camera internal logic (not visible to the user)

Table 10: Trigger definitions

Term	Definition
Tpd	Propagation delay between the User Trigger and the Logic Trigger
Exposure	... is high when the camera image sensor is integrating light.
Readout	... is high when the camera image sensor is reading out data.
Trigger Latency	Time delay between the User Trigger and the start of Exposure
Trigger Jitter	Error in the Trigger Latency Time
Trigger Ready	... indicates to the user that the camera will accept the next trigger.
Registered Exposure Time	... is the Exposure Time value currently stored in the camera memory.
Expose Start Delay	... is the Registered Exposure Time subtracted from the Readout time and indicates when the next Exposure cycle can begin such that the Exposure will end after the current Readout.
Interline Time	... is the time between sensor row readout cycles.
Imaging	... is high when the camera image sensor is either exposing and/or reading out data.
Idle	... is high if the camera image sensor is not exposing and/or reading out data.

Table 10: Trigger definitions

Trigger rules

Note

The **User Trigger pulse width** should be at least three times the width of the Trigger Latency as indicated in Chapter *Specifications* on page 13ff.

- The **end of Exposure** will always trigger the next Readout.
- The **end of Exposure** must always end after the current Readout.
- The **start of Exposure** must always correspond with the Interline Time if Readout is true.
- **Expose Start Delay** equals the Readout time minus the Registered Exposure Time.

Triggering during the Idle State

For applications requiring the shortest possible Trigger Latency and the smallest possible Trigger Jitter the User Trigger signal should be applied when Imaging is false and Idle is true.

In this case, Trigger Latency and Trigger Jitter are as indicated in Chapter *Specifications* on page 13ff.

Triggering during the Readout State

For applications requiring the fastest triggering cycle time whereby the camera image sensor is exposing and reading out simultaneously, then the User Trigger signal should be applied as soon as a valid Trigger Ready is detected.

In this case, Trigger Latency and Trigger Jitter can be up to 1 line time since Exposure must always begin on an Interline boundary.

Note

For a more detailed description of the trigger concept for **advanced users** and special scenarios see **AVT GigE Camera Controls**, chapter *Trigger concept for advanced users*.

Description of the data path

Block diagrams of the cameras

The following diagrams illustrate the data flow and the bit resolution of image data after being read from the CCD sensor chip in the camera. The individual blocks are described in more detail in the following manual: **AVT GigE Camera Controls**. For sensor data see Chapter *Specifications* on page 13.

Black and white cameras

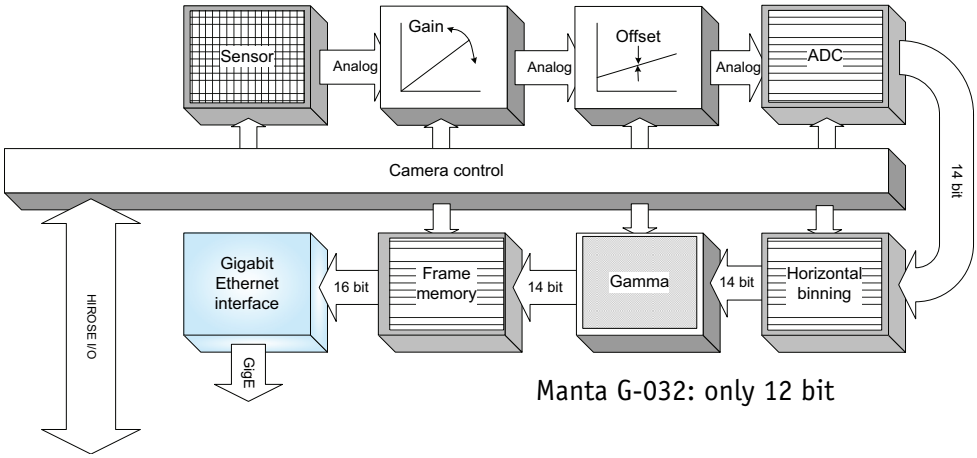


Figure 18: Block diagram b/w and color camera

Color cameras

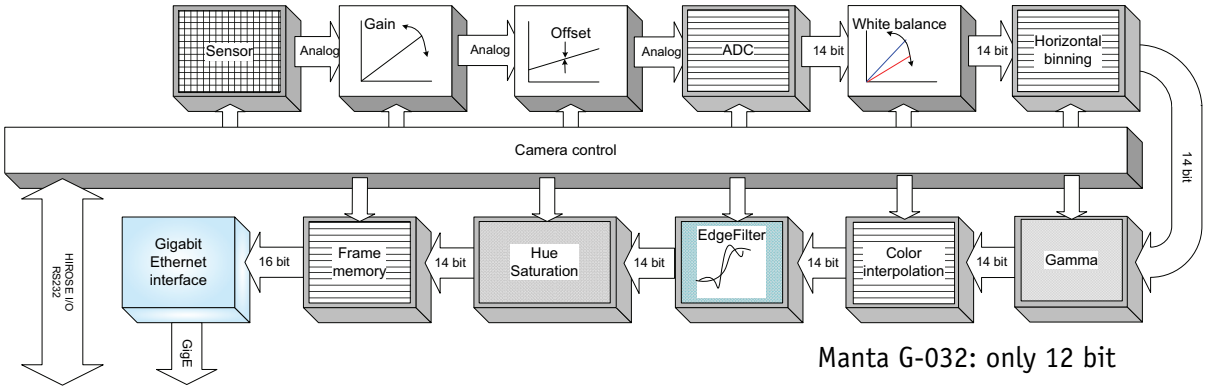


Figure 19: Block diagram color camera

Available Manta camera controls

Some camera controls are not always available (Example: Color interpolation is implemented in Manta cameras, but is not available in RAW mode).

Note

For a detailed description of the camera controls see the manual: **AVT Manta Camera Controls, Chapter *Standard features* and Chapter *Advanced features*.**

http://www.alliedvisiontec.com/emea/support/downloads/product-literature.html

The following camera controls are available:

Advanced features are marked with an **asterisk***.

Hierarchy level 1	Hierarchy level 2	Hierarchy level 3	Hierarchy level 4
Info			
	CameraName		
	DeviceFirmwareVersion		
	DeviceModelName		
	DevicePartNumber		
	DeviceScanType		
	DeviceSerialNumber		
	DeviceVendorName		
	Firmware		
		FirmwareVerBuild	
		FirmwareVerMajor	
		FirmwareVerMinor	
	Part		
		SerialNumber	
	Sensor		
		SensorBits	
		SensorHeight	
		SensorType	
		SensorWidth	
	UniqueId		
ImageMode			
	BinningX		
	BinningY		

Table 11: Available Manta camera controls

Hierarchy level 1	Hierarchy level 2	Hierarchy level 3	Hierarchy level 4
Acquisition			
	Trigger		
		AcqEnd	
			AcqEndTriggerEvent
			AcqEndTriggerMode
		AcqRec	
			AcqRecTriggerEvent
			AcqRecTriggerMode
		AcqStart	
			AcqStartTriggerEvent
			AcqStartTriggerMode
		FrameRate	
		FrameStart	
			FrameStartTriggerDelay
			FrameStartTriggerEvent
			FrameStartTriggerMode
			FrameStartTriggerSoftware
	AcquisitionAbort		
	AcquisitionFrameCount		
	AcquisitionMode		
	AcquisitionStart		
	AcquisitionStop		
	RecorderPreEventCount		
ImageFormat			
	ROI		
		Height	
		RegionX	
		RegionY	
		Width	
	PixelFormat		
	TotalBytesPerFrame		

Table 11: Available Manta camera controls

Hierarchy level 1	Hierarchy level 2	Hierarchy level 3	Hierarchy level 4
Controls			
	ColorTransformationControl*		
		ColorTransformationMode*	
		ColorTransformationValueBB*	
		ColorTransformationValueBG*	
		ColorTransformationValueBR*	
		ColorTransformationValueGB*	
		ColorTransformationValueGG*	
		ColorTransformationValueGR*	
		ColorTransformationValueRB*	
		ColorTransformationValueRG*	
		ColorTransformationValueRR*	
	DSP		
		DSPSubregionBottom	
		DSPSubregionLeft	
		DSPSubregionRight	
		DSPSubregionTop	
	EdgeFilter*		
	Exposure		
		Auto	
			ExposureAutoAdjustTol
			ExposureAutoAlg
			ExposureAutoMax
			ExposureAutoMin
			ExposureAutoOutliers
			ExposureAutorRate
			ExposureAutoTarget
		ExposureMode	
		ExposureValue	
	Gain		
		Auto	
			GainAutoAdjustTol
			GainAutoMax
			GainAutoMin
			GainAutoOutliers
			GainAutoRate
			GainAutoTarget
		GainMode	
		GainValue	

Table 11: Available Manta camera controls

Hierarchy level 1	Hierarchy level 2	Hierarchy level 3	Hierarchy level 4
Controls	Gamma*		
	Hue*		
	Offset*		
		OffsetValue	
	Saturation*		
	WhiteBalance		
		Auto	
			WhitebalAutoAdjustTol
			WhitebalAutoRate
		WhitebalMode	
		WhitebalValueBlue	
		WhitebalValueRed	
ConfigFile			
	ConfigFileIndex		
	ConfigFileLoad		
	ConfigFilePowerUp		
	ConfigFileSave		

Table 11: Available Manta camera controls

Hierarchy level 1	Hierarchy level 2	Hierarchy level 3	Hierarchy level 4
GigE			
	BandwidthCtrlMode		
	Ethernet		
		DeviceEthAdress	
		HostEthAddress	
	IP		
		DeviceIPAddress	
		HostIPAddress	
	GvcpRetries		
	Gvsp		
		GvspLookbackWindow	
		GvspResendPercent	
		GvspRetries	
		GvspSocketBuffersCount	
		GvspTimeout	
	HeartbeatInterval		
	HeartbeatTimeout		
	Multicast		
		MulticastEnable	
		MulticastIPAddress	
	PacketSize		
	StreamBytesPerSecond		
	StreamHold		
		StreamHoldCapacity	
		StreamHoldEnable	
	Timestamp		
		TimeStampFrequency	
		TimeStampReset	
		TimeStampValueHi	
		TimeStampValueLatch	
		TimeStampValueLo	

Table 11: Available Manta camera controls

Hierarchy level 1	Hierarchy level 2	Hierarchy level 3	Hierarchy level 4
IO			
	Strobe		
		1	
			Strobe1ControlledDuration
			Strobe1Delay
			Strobe1Duration
			Strobe1Mode
	SyncIn		
		SyncInLevels	
	SyncOut		
		1	
			SyncOut1Invert
			SyncOut1Mode
		2	
			SyncOut2Invert
			SyncOut2Mode
		SyncOutGpoLevels	
Stats			
	StatDriverType		
	StatFilterVersion		
	StatFrameRate		
	StatFramesCompleted		
	StatFramesDropped		
	StatPacketsErroneous		
	StatPacketsMissed		
	StatPacketsReceived		
	StatPacketsRequested		
	StatPacketsResent		

Table 11: Available Manta camera controls

Frame memory

An image is normally captured and transported in consecutive steps. The image is taken, read out from the sensor, digitized and sent over the Gigabit Ethernet network.

Manta cameras are equipped with 32 MByte of RAM. The table below shows how many frames can be stored by each model.

Note

The number of frames depends on resolution and pixel format. Listed number of frames is typical for full resolution and Mono8/Bayer8.

The memory operates according to the FIFO (first in, first out) principle. This makes addressing for individual images unnecessary.

Model	Memory size	Pixel format/resolution
Manta G-032B/C	32 MB memory: 49 frames	Mono8/full resolution
Manta G-046B/C	32 MB memory: 35 frames	
Manta G-125B/C	32 MB memory: 12 frames	
Manta G-145B/C	32 MB memory: 10 frames	
Manta G-146B/C	32 MB memory: 10 frames	
Manta G-201B/C	32 MB memory: 8 frames	

Table 12: Image memory size (typical; see note above)

Color interpolation (BAYER demosaicing)

The color sensors capture the color information via so-called primary color (R-G-B) filters placed over the individual pixels in a **BAYER mosaic** layout. An effective BAYER → RGB color interpolation already takes place in all Manta color version cameras.

In color interpolation a red, green or blue value is determined for each pixel. An AVT proprietary BAYER demosaicing algorithm is used for this interpolation (2x2), optimized for both sharpness of contours as well as reduction of false edge coloring.

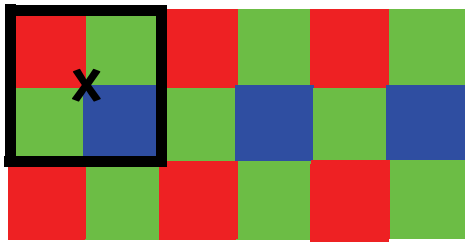


Figure 20: BAYER demosaicing (example of 2x2matrix)

Color processing can be bypassed by using so-called RAW image transfer.

RAW mode is primarily used to

- save bandwidths on the Gigabit Ethernet network
- achieve higher frame rates
- use different BAYER demosaicing algorithms on the PC
  - for Manta the first pixel of the sensor is RED

Note

If the PC does not perform BAYER to RGB post-processing, the b/w image will be superimposed with a checkerboard pattern.

In color interpolation a red, green or blue value is determined for each pixel (P1= first pixel; P2= second pixel; etc). Only two lines are needed for this interpolation:

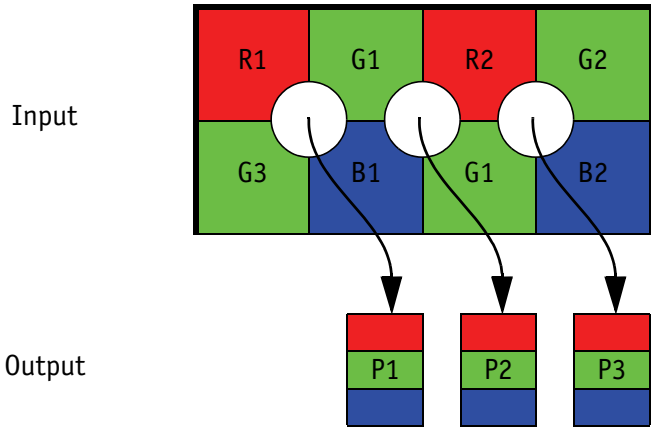


Figure 21: BAYER demosaicing (interpolation)

$$P1_{red} = R1 \qquad P2_{red} = R2 \qquad P3_{red} = R2$$

$$P1_{green} = \frac{G1 + G3}{2} \qquad P2_{green} = \frac{G1 + G4}{2} \qquad P3_{green} = \frac{G2 + G4}{2}$$

$$P1_{blue} = B1 \qquad P2_{blue} = B1 \qquad P3_{blue} = B2$$

Formula 1: BAYER demosaicing

Note

- Please note that on the color camera, a wrongly colored border of one or two pixel wide forms on the left and right image borders. This is also a consequence of BAYER demosaicing as the image width displayed on the color camera is **not** scaled down.
- Using ROI, x and y resolutions must be even-numbered.

Resolution and ROI frame rates

Manta G-032B/C: ROI frame rates

$$\text{max. frame rate of CCD} = \frac{1}{24.34\mu s \times \text{ROI height} + 3.01\mu s \times (492 - \text{ROI height}) + 495.50\mu s}$$

Formula 2: **Manta G-032**: theoretical max. frame rate of CCD

Max. frame rate at full resolution: 80.17 fps

Manta G-125B/C: ROI frame rates

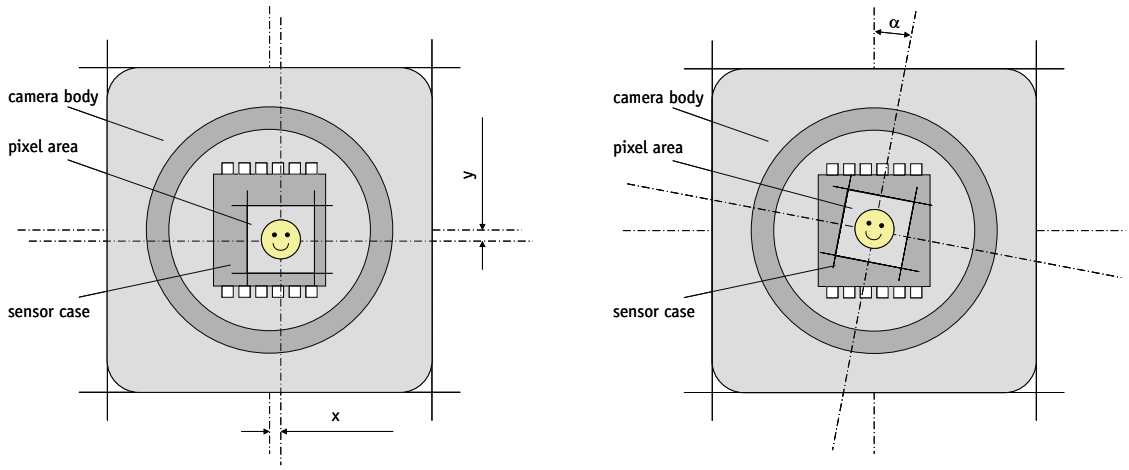
$$\text{max. frame rate of CCD} = \frac{1}{33.21\mu s \times \text{ROI height} + 5.04\mu s \times (964 - \text{ROI height}) + 226.52\mu s}$$

Formula 3: **Manta G-125**: theoretical max. frame rate of CCD

Max. frame rate at full resolution: 30.92 fps

Appendix

Sensor position accuracy of AVT GigE cameras



AVT Manta series

Method of Positioning:	Optical alignment of photo sensitive sensor area into camera front module. (lens mount front flange)		
Reference points:	Sensor: Center of pixel area (photo sensitive cells). Camera: Center of camera front flange (outer case edges).		
Accuracy:	x/y:	+/- 150 µm	(Sensor shift)
	z:	+0 / -150 µm	(Optical back focal length)
	α:	+/- 0.5°	(Sensor rotation)

Note: x/y - tolerances between C-Mount hole and pixel area may be higher.

Figure 22: AVT sensor position accuracy

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