Guppy

User Guide

V7.6.0

2022-Aug-19

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Allied Vision

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Read before use

EN - English

Safety

Before using the camera, read these safety instructions. Observe the warnings at all times. Use the camera only as stated in the Intended use on page 39.

CAUTION

Risk of burns

A camera in operation can reach temperature levels which could cause burns.

CAUTION

Injury by falling cameras or lenses

A falling camera or lens can cause injury.

CAUTION

Risk of cuts by sharp edges of lens mounts

The threads of the lens mount can have sharp edges.

Intended use

Intended use of Allied Vision product is the integration into vision systems by professionals. All Allied Vision product is sold in a B2B setting.

DA - Dansk

Sikkerhed

Læs sikkerhedsanvisningerne, før kameraet bruges. Overhold alle advarsler. Brug kun kameraet som anført i Intended use på side 39.

FORSIGTIG

Forbrændingsfare

Når kameraet bruges, kan det blive meget varmt og forårsage forbrændinger.

FORSIGTIG

Kvæstelser, hvis kameraet eller linser falder ned

Falder kameraet eller linsen ned, kan dette forårsage kvæstelser.

FORSIGTIG

Fare for snitsår på linsemodulets skarpe kanter

Linsemodulets gevind kan have skarpe kanter.

Tilsigtet brug

Allied Vision produktets tilsigtede brug er en indbygning i et visionssystem, udført af fagfolk. Alle Allied Vision produkter sælges i B2B.

DE - Deutsch

Sicherheit

Bevor Sie die Kamera benutzen, lesen diese Sicherheitshinweise. Beachten Sie diese Hinweise immer. Verwenden Sie die Kamera nur wie beschrieben in Intended use auf Seite 39.

VORSICHT

Gefahr von Verbrennungen

Im Betrieb kann die Kamera Temperaturen erreichen, die zu Verbrennungen führen.

VORSICHT

Verletzung durch fallende Kameras oder Objektive

Eine fallende Kamera oder ein fallendes Objektiv kann Verletzungen verursachen.

VORSICHT

Schnitte durch scharfkantige Objektivgewinde

Objektivgewinde können scharfe Kanten haben.

Bestimmungsgemäßer Gebrauch

Allied Vision Produkte sind bestimmt für die Integration in Bildverarbeitungssysteme durch Fachpersonal. Alle Allied Vision Produkte werden in einer B2B-Umgebung verkauft.

ES - Español

Seguridad

Antes de utilizar la cámara lea estas instrucciones de seguridad. Observe las advertencias en todo momento. Utilice la cámara solo tal y como se estipula en el Intended use on page 39.

ATENCIÓN

Riesgo de quemaduras

Una cámara en funcionamiento puede alcanzar temperaturas que podrían provocar quemaduras.

ATENCIÓN

Lesiones en caso de que las cámaras o las lentes se caigan

Si una cámara o una lente se cae puede provocar lesiones.

ATENCIÓN

Riesgo de cortes debido a los bordes afilados del objetivo

Las roscas de los objetivos pueden tener bordes afilados.

Uso previsto

El uso previsto del producto Allied Vision es la integración en el sistema de visión por parte de profesionales. Todos los productos Allied Vision se venden dentro de una relación B2B.

FI - Suomi

Turvallisuus

Lue nämä turvallisuusohjeet ennen kameran käyttöä. Noudata varoituksia joka hetki. Käytä kameraa ainoastaan kohdassa Intended use sivulla 39 kuvatulla tavalla.

HUOMIO

Palovammojen vaara

Käytössä olevan kameran saavuttamat lämpötilatasot voivat aiheuttaa palovammoja.

HUOMIO

Putoavien kameroiden tai linssien aiheuttamat vammat

Putoava kamera tai linssi voi aiheuttaa vammoja.

HUOMIO

Linssien kiinnikkeiden terävien reunojen aiheuttamien viiltovammojen vaara

Linssin kiinnikkeiden kierteiden reunat voivat olla teräviä.

Käyttötarkoitus

Allied Vision -tuotteen käyttötarkoitus on integrointi kuvajärjestelmiin ammattilaisten toimesta. Kaikki Allied Vision -tuotteet myydään B2B-ympäristössä.

FR - Français

Sécurité

Veuillez lire ces consignes de sécurité avant d'utiliser la caméra. Respectez continuellement les avertissements. Utilisez la caméra uniquement comme indiqué sous Intended use, page 39.

ATTENTION

Risque de brûlures

Une caméra en service peut atteindre des niveaux de température susceptibles d'entraîner des brûlures.

ATTENTION

Blessures en cas de chute de caméras ou d'objectifs

La chute d'une caméra ou d'un objectif peut entraîner des blessures.

ATTENTION

Risque de coupures sur les bords tranchants des montures d'objectif

Les filetages des montures d'objectif peuvent présenter des bords tranchants.

Utilisation prévue

L'utilisation prévue du produit Allied Vision est son intégration dans des systèmes de vision par le soin de professionnels. Tout produit Allied Vision est vendu dans un cadre B2B.

עברית - HE

בטיחות

לפני השימוש במצלמה, יש לקרוא הוראות בטיחות אלו. יש לשים לב לאזהרות בכל עת.

השימוש במצלמה הוא רק לפי המצוין ב-Intended use בעמוד 39.

זהירות

סכנת כוויה

מצלמה בפעילות עשוייה להגיע לרמות טמפרטורה שעלולות לגרום לכוויות.

זהירות

פציעה מנפילת מצלמות או עדשות

מצלמה או עדשה שנופלות עלולות לגרום לפציעה.

זהירות

סכנה לחתכים מקצוות חדים של תושבת עדשה

בהברגה של תושבת העדשה עשויים להיות קצוות חדים.

שימוש מיועד

השימוש במוצרי AlliedVision הוא לשילוב במערכות ראיה ממוחשבת ע"י מקצוענים.

כל מוצרי AlliedVision נמכרים לשימוש בסביבת B2B.

IT - Italiano

Sicurezza

Leggere queste istruzioni per la sicurezza prima di utilizzare la telecamera. Osservare sempre tutte le avvertenze. Utilizzare la telecamera come descritto alla sezione Intended use a pagina 39.

ATTENZIONE

Pericolo di ustioni

Durante il funzionamento una telecamera può raggiungere temperature elevate che possono essere causa di ustioni.

ATTENZIONE

Lesioni dovute alla caduta di telecamere o lenti

La caduta di una telecamera o di una lente può causare delle lesioni.

ATTENZIONE

Pericolo di tagliarsi sui bordi affilati degli attacchi della lente

I bordi della filettatura dell'attacco della lente possono essere affilati.

Uso previsto

Il prodotto Allied Vision è concepito per essere integrato in sistemi di monitoraggio in campo professionale. Tutti i prodotti Allied Vision sono venduti in uno scenario B2B.

JA – 日本語

安全性

本カメラを使用する前に、この安全の手引きをお読みください。常に、警告事項を守ってください。必ず、Intended use 39 ページの通りに、本カメラを使用してください。

注意

やけどの危険性

作動中のカメラは、やけどを引き起こす温度まで熱くなる恐れがあります。

注意

カメラまたはレンズの落下によるけが

カメラまたはレンズが落下すると、けがをする恐れがあります。

注意

レンズマウントの鋭利な端部で切り傷の危険性

ンズマウントのギザギザの部分が鋭利である可能性があります。

用途

Allied Vision製品は、専門家が視覚装置に統合することを意図したものです。すべてのAllied Vision製品は、企業間取り引き用に販売されています。

NL - Nederlands

Veiligheid

Lees deze veiligheidsinstructies voordat u de camera gaat gebruiken. Neem deze waarschuwingen altijd in acht. Gebruik de camera uitsluitend, zoals aangegeven in het Intended use op pagina 39.

VOORZICHTIG

Risico van verbranding

Een camera die gebruikt wordt, kan temperatuurwaarden bereiken die brandwonden kunnen veroorzaken.

VOORZICHTIG

Letsel door vallende camera's of lenzen

Een vallende camera of lens kan letsel veroorzaken.

VOORZICHTIG

Risico van snijwonden door scherpe randen van lensbevestigingen

Het schroefdraad van de lensbevestiging kan scherpe randen hebben.

Beoogd gebruik

Het beoogde gebruik van het Allied Vision-product is de integratie in optische systemen door professionals. Alle Allied Vision-producten worden verkocht in de B2B-markt.

NO - Norsk

Sikkerhet

Les disse sikkerhetsinstruksene før du bruker kameraet. Følg advarslene til en hver tid. Bruk kun kameraet i samsvar med Intended use på side 39.

FORSIKTIG

Risiko for brannskader

Et kamera i bruk kan nå temperaturnivåer som kan forårsake brannskader.

FORSIKTIG

Skade ved fallende kameraer eller linser

Et fallende kamera eller en fallende linse kan forårsake skade.

FORSIKTIG

Risiko for kutt fra skarpe kanter på linsefester

Sporene på linsefestet kan ha skarpe kanter.

Tiltenkt bruk

Den tiltenkte bruken av Allied Vision-produktet er integrering i visjonssystemer av profesjonelle. Alle Allied Vision-produkter selges i en forretning til forretning-situasjon.

SV - Svenska

Säkerhet

Läs igenom säkerhetsinstruktionerna innan du använder kameran. Var hela tiden särskilt uppmärksam på varningarna. Använd enbart kameran på det sätt som anges i Intended use på sida 39.

VARNING

Risk för brännskada

En kamera i drift kan komma upp i temperaturer som kan orsaka brännskador.

VARNING

Risk för skador från fallande kameror eller objektiv

Fallande kameror eller objektiv kan förorsaka skador.

VARNING

Risk för skärsår från vassa kanter på objektivfattningar

Objektivets gängor kan ha vassa kanter.

Avsedd användning

Den avsedda användningen av Allied Vision-produkter är integrering i visionssystem av fackmän. Samtliga Allied Vision-produkter säljs i en B2B-miljö.

ZH - 简体中文版

安全需知

使用本相机前，请阅读本安全说明书。请务必遵守相关警告 和 Intended use 于第 39 页 .

注意事项

烫伤风险

相机操作过程中温度可能上升并导致烫伤风险。

注意事项

相机或者镜头跌落造成伤害

相机或者镜头可能会跌落并造成伤害。

注意事项

镜头接口的锐利边缘划伤风险

镜头接口螺纹边缘可能较为锐利。

预期用途

Allied Vision 产品的预期用途是由专业人士整合到视觉系统中。所有 Allied Vision 的产品均通过 B2B 渠道销售。

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Introduction

This **Guppy Technical Manual** describes in depth the technical specifications, dimensions, all camera features (IIDC standard and Allied Vision smart features) and their registers, trigger features, all video and color formats, bandwidth and frame rate calculation.

For information on hardware installation, safety warnings, pin assignments on I/O connectors and 1394b connectors read the **1394 Installation Manual.**

Note

Please read through this manual carefully.

We assume that you have read already the **1394 Installation Manual** (see: alliedvision.com/en/support/technical-documentation) and that you have installed the hardware and software on your PC or laptop (FireWire card, cables).

Document history

Version	Date	Remarks
V2.0.0	06.04.2006	New Manual - RELEASE status
V2.0.1	28.06.2006	RoHS conformity; minor corrections
PRE_V3.0.0	30.10.2006	Minor corrections Input characteristics: Added description to input voltage Added Guppy F-036B/C Correction in Chapter Multi-shot on page 114 New CAD drawing in Figure 10: Camera dimensions (new C-Mount) on page 54. New CAD drawing in Figure 13: Guppy C-Mount dimensions on page 57. New CAD drawing in Figure 14: Guppy CS-Mount dimensions on page 58.
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Version	Date	Remarks
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PRE_V3.0.0 [continued]	30.10.2006 [continued]	New CS-Mount and C-Mount adapter in Chapter Guppy cameras on page 37. Added Guppy F-33B/C BL (board level version) Changed camera status register (Table 77: Advanced register: **Camera status** on page 173) Added Guppy F-146
PRE_V4.0.0	26.01.2007	Minor corrections Added Guppy F-080B/C BL (board level version) Added new features Guppy-F036B/C
V4.0.1	02.02.2007	Minor corrections Guppy F-146: new frame rates
PRE_V5.0.0	09.05.2007	Minor corrections Added interlaced Guppys F-038B/C, F038B/C NIR, F-044B/C, F-044B/C NIR Added **Value** field in Table 29: CSR: **Shutter** on page 95 Added detailed description of BRIGHTNESS (800h) in Table 70: **Feature control register** on page 162 Added detailed description of WHITE-BALANCE (80Ch) in Table 70: **Feature control register** on page 162 et seq.
V5.0.1	09.05.2007	RELEASE status
V6.0.0	01.06.2007	Added interlaced Guppys F-025 and Guppy F-029 Added description of sensor readout and color: Chapter Format_7 Mode_0: sensor readout and color on page 76 and Chapter Format_7 Mode_1: sensor readout and color on page 77
V6.0.1	08.06.2007	Corrected image device type and diag. of Guppy F-025B/C and Guppy F-029B/C
to be continued on next page		

Table 1: Document history

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V6.0.2	31.03.2008	**Minimum shutter time** of Guppy F-036B/C is now **180 µs**: see Chapter Guppy F-046B/C on page 45 and Chapter Minimum shutter time of Guppy F-036 on page 159. Added note: Guppy F-036 supports only Trigger_Mode_0. See Chapter Trigger modes on page 104. Corrected drawing in Figure 40: Format_7 Mode_0: Sensor readout on page 76 (lines of the first field are merged above those of the second field) Moved Allied Vision Glossary from Appendix of Guppy Technical Manual to Allied Vision Website. New M3 x 3 (2x) in Figure 10: Camera dimensions (new C-Mount) on page 54
V6.1.0	09.07.2008	New ordering numbers of I/O cables K1200196 (2 m) and K1200197 (5 m) in Chapter Camera I/O connections on page 63 New board level CAD drawing and marked Pin 1 with blue color in Figure 32: Board level camera: IEEE 1394 FireWire connector 1 (view on pins) on page 66 Restructuring of Guppy Technical Manual: • Added Chapter Contact us on page 15 • Added Chapter Manual overview on page 33 • Restructured Chapter Guppy types and highlights to Chapter Guppy cameras on page 37. – Infos from Guppy camera types table moved to Chapter Specifications on page 43 – Safety instructions moved to Hardware Installation Guide, Chapter Safety instructions and Allied Vision camera cleaning instructions – Environmental conditions moved to Guppy Instruction Leaflet and Guppy Board Level Instruction Leaflet – Infos on CS-/C-Mounting moved to Hardware Installation Guide, Chapter Guppy: changing filters safety instructions – Infos on System components moved to Guppy Instruction Leaflet and Guppy Board Level Instruction Leaflet
to be continued on next page		

Table 1: Document history

Version	Date	Remarks
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V6.1.0 [continued]	09.07.2008 [continued]	**Restructuring of Guppy Technical Manual [continued]:** – Infos on *System components* and *Environmental conditions* moved to *Guppy Instruction Leaflet* and *Guppy Board Level Instruction Leaflet* – Infos on *IR cut filter* and *Lenses* moved to Chapter Filter and lenses on page 59 – Removed infos on old CS-/C-Mounting in Chapter Specifications on page 43 – Moved binning explanation from Chapter Specifications on page 43 to Chapter Video formats, modes and bandwidth on page 118 – Binning / sub-sampling modes and color modes are only listed in Chapter Video formats, modes and bandwidth on page 118 – Moved detailed description of the camera interfaces (FireWire, I/O connector), ordering numbers and operating instructions to the *Hardware Installation Guide*. – Revised Chapter Description of the data path on page 80 – Revised Chapter Controlling image capture on page 104; added Table 33: Trigger modes on page 104 – Revised Chapter Video formats, modes and bandwidth on page 118 – Revised Chapter How does bandwidth affect the frame rate? on page 135 – Revised Chapter Configuration of the camera on page 139 – Revised Chapter Firmware update on page 191 – Added Chapter Sensor position accuracy of Guppy cameras on page 192 – Revised Chapter Index on page 193 Changed provisions directive to 2004/108/EG in Chapter Regulations on page 26 Added Chapter Packed 12-Bit Mode on page 98 Added tables Table 22: **Packed 12-Bit Mode (mono and raw) Y12 format from Allied Vision** on page 77 and Table 23: Data structure of **Packed 12-Bit Mode (mono and raw) from Allied Vision** on page 79.
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Version	Date	Remarks
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V6.1.0 [continued]	09.07.2008 [continued]	Added 30 fps as fixed frame rate in Table 6: Guppy F-146B/C on page 47 Added Vendor Unique Color_Coding in Table 72: **Format_7 control and status register** on page 166f Minimum delay time is 1µs in Table 38: Advanced CSR: **trigger delay** on page 110 Added Raw12 and Raw16 frame rates in Chapter Guppy F-146: AOI frame rates on page 134 Added Format_7 Mode_3 in: • Table 68: Video formats Guppy F-038B / Guppy F-038C on page 170 • Table 69: Video formats Guppy F-038B NIR / Guppy F-038C NIR on page 170 • Table 70: Video formats Guppy F-044B / Guppy F-044C on page 171 • Table 71: Video formats Guppy F-044B NIR / Guppy F-044C NIR on page 171 Added Chapter Extended version number (FPGA/µC) on page 191 Added extended version registers (0xF1000014 and 0xF100001C) in Table 73: **Advanced registers summary** on page 167 Added **VERSION_INFOx_EX** registers and description in Chapter Extended version information register on page 168
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Version	Date	Remarks
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V6.2.0	15.08.2008	Added cross-reference from **upload LUT** to **GPDATA_BUFFER** in Chapter Loading an LUT into the camera on page 97 Added Guppy F-146 with Mono8 (8-bit format) and Mono12/16 (12-bit format) in Chapter Pixel data on page 75. In 12-bit mode the data output is MSB aligned (12 significant bits). In 16-bit mode the data output is MSB aligned (also 12 significant bits). Added detailed level values of I/Os in Chapter Guppy (housing) on page 63 and Chapter Guppy (board level) on page 68. Added little endian vs. big endian byte order in Chapter GPDATA_BUFFER on page 190 Added RoHS in Chapter Regulations on page 26 Listed shutter speed with offset in Chapter Specifications on page 43 New measurement of IntEna signals, therefore new offsets in Chapter Exposure time (shutter) and offset on page 111 and in Figure 38: Data flow and timing after end of exposure on page 114. New photo of LED positions in Figure 17: Status LEDs on page 64
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Version	Date	Remarks
continued from previous page		
V7.0.0	31.10.2008	Operating temperature changed from 50 °C to 45 °C for all Guppy types in Chapter Specifications on page 43 New Guppy camera photos with new camera naming font: • Title page New Guppy F-503B/C: Read information in the following sections: • Chapter Regulations on page 26 • Table 8: Focal width vs. field of view (Guppy F-503) on page 45 • Chapter Specification Guppy F-503B/C on page 39 • Chapter White balance on page 82 • Chapter White balance on page 82 • Chapter Manual gain on page 89 • Chapter Brightness (black level or offset) on page 92 • Chapter Look-up table (LUT) and gamma function on page 96 • Chapter on page 100 • Chapter Packed 12-Bit Mode on page 98. This mode is not yet available for Guppy F-503B/C. • Chapter Exposure time (shutter) and offset on page 111 • Table 39: Camera-specific exposure time offset on page 111 • Figure 38: Data flow and timing after end of exposure on page 114 • Table 44: Jitter at exposure start on page 116 • Table 75: Video formats Guppy F-503B / Guppy F-503C on page 175 • Guppy F-503: AOI frame rates on page 194 • Table 75: Camera type ID list on page 170 For Guppy F-503B/C output switching times (tp and min. shutter) see **Hardware Installation Guide**, subsection *Guppy delay*.
to be continued on next page		

Table 1: Document history

Version	Date	Remarks
continued from previous page		
V7.1.0	07.05.2009	All advanced registers in 8-digit format beginning with 0xF1... in Chapter Advanced features (Allied Vision-specific) on page 167 Firing a new trigger while IntEna is still active can result in **missing image** (not image corruption): see Caution on page 74. Revised Chapter White balance on page 82 **New Features: Guppy F-503:** • Defect pixel correction in Chapter Defect pixel correction (only Guppy F-503B/C) on page 95 and Table 91: Advanced register: **Defect pixel correction** on page 187 • More gain steps in Table 25: Manual gain range of the various Guppy types on page 89 • Global reset release shutter in Chapter Electronic rolling shutter (ERS) and global reset release shutter (GRR) (only Guppy F-503) on page 146 • Format_7 mode mapping in Chapter Binning and sub-sampling access (only Guppy F-503) on page 128 and Chapter Format_7 mode mapping (only Guppy F-503) on page 197 • Description of Trigger_Mode_0 with electronic rolling shutter and global reset release shutter in Chapter Trigger modes on page 104 • Changing between electronic rolling shutter (ERS) and global reset release shutter (GRR) in Table 103: Advanced register: **Global reset release shutter** on page 199 • Max. exposure time in Chapter Extended shutter on page 176 Changed sensor name from Micron to **Micron/Aptina** in Table 4: Specification Guppy F-036B/C on page 31 Changed sensor name from Micron to **Micron/Aptina** in Table 12: Specification Guppy F-503B/C on page 39 Changed sensor name from Micron to **Micron/Aptina** in Chapter BAYER pattern (raw data output) on page 98 Changed sensor name from Micron to **Micron/Aptina** in Chapter Controlling image capture on page 104
to be continued on next page		

Table 1: Document history

Version	Date	Remarks
continued from previous page		
V7.1.0 [continued]	07.05.2009 [continued]	[continued] Offset of low noise binning mode changed from 0xF1000580 to 0xF10005B0 in Table 102: Advanced register: **Low noise binning mode** on page 199. Changed *Camera In 1 signal* U_{in}(high) from 2 V to **2.4 V** in Table 9: Guppy (housing): Camera I/O connector pin assignment on page 63 Corrected HUE and SATURATION in *Feature control register* to **Always 0 (for b/w and color cameras)** on page 163 (TestTrack Defect 605) Calculated **effective chip size** for all sensors (with resolution of Format_7 Mode_0) in Chapter Specifications on page 43 Due to discontinuation: removed Guppy F-025/029 cameras in • Chapter Guppy cameras on page 37 • Chapter Regulations on page 26 • Chapter Specifications on page 43 • Chapter Video formats, modes and bandwidth on page 118 • Chapter Description of the data path on page 80 • Chapter Controlling image capture on page 104 Corrected drawing in Figure 50: Delayed integration timing on page 181
V7.1.1	23.02.2010	**Minor corrections:** • Corrected registers for IO_OUTP_PWM2/3/4 in Table 30: PWM configuration registers on page 81 and in Table 73: **Advanced registers summary** on page 167 • Revised Chapter Regulations on page 26. • Corrected Guppy F-503 Format_7 Mode_4 to Mode_6: These are sub-sampling modes: Table 75: Video formats Guppy F-503B / Guppy F-503C on page 175 • Corrected Camera Input 1: U_{in}(high) = 3.8 V...5 V U_{in}(low) = 0 V...1 V in Table 9: Guppy (housing): Camera I/O connector pin assignment on page 63 • Corrected: Board level cameras have also Input_2 ... Input_4/Output_4 in Register 0xF1000044 on page 172 • Corrected: Defect pixel correction: Mono8 for b/w and Raw8 for color cameras: see Chapter Building defect pixel data on page 97
to be continued on next page		

Table 1: Document history

Version	Date	Remarks
continued from previous page		
V7.1.1 [continued]	23.02.2010 [continued]	[continued] **Improved descriptions:** • Defect pixel correction: – Added information on limited block writes (GPData buffer) in Chapter DPC data: storing mechanism on page 100 – DPDataSize divided by 4 gives the number of defect pixels: Table 91: Advanced register: **Defect pixel correction** on page 187 – Organization of DPC data in two 16-bit registers (y and x coordinates) in Chapter Calculate defect pixel coordinates on page 97 – Added improved description in Note on page 99 **Corrections:** • Guppy F-038B and Guppy F-038B NIR don't have F7M3 in Table 68: Video formats Guppy F-038B / Guppy F-038C on page 170 and in Table 69: Video formats Guppy F-038B NIR / Guppy F-038C NIR on page 170. **New storage temperature:** • 70 °C, see Chapter Specifications on page 43 **New links to new Allied Vision website** • Chapter Contact us on page 15 and many others **New measured sensor curves** • Chapter Spectral sensitivity on page 48
V7.2.0	05.07.2010	• Standard IR cut filter for all Guppy color models: IRC Edmund Optics, spectral diagram is similar to Jenofilt 217, see Figure 15: Typical spectral transmission of IR cut filter (type Jenofilt 217) on page 59
to be continued on next page		

Table 1: Document history

Version	Date	Remarks
continued from previous page		
V7.3.0	21.09.2010	**Updated data:** • Corrected trigger diagram (Busy signal), see Figure 20: Output impulse diagram on page 74 • Converted FrameMaker files from FM7 to FM9 • Corrected: mirror function is also available for Guppy F-503, see Chapter Mirror image (only Guppy F-036/F-503) on page 250 • Added Chapter Frame information on page 180 • Added advanced registers FRAMEINFO and FRAMECOUNTER in Table 73: **Advanced registers summary** on page 167
V7.4.0	09.03.2015	**Updated data:** • Corrected hyperlinks to targets on the Allied Vision website • Added information that all color modes in Chapter Specifications on page 43 comply with the IIDC specifications • Corrected information in Chapter Sensor position accuracy of Guppy cameras on page 192 • Adapted addresses in Chapter Contact us on page 15 • Corrected information for binning in **Chapter Definition** on page 115 • Corrected list of cameras supporting Chapter Packed 12-Bit Mode on page 98 • Updated spectral sensor curves in Chapter Spectral sensitivity on page 48 • Deleted information on Guppy board level cameras **Layout changes due to a changed Corporate identity:** • Replaced the previous Allied Vision logo by the current one • Reworded all appropriate contents from AVT and Allied Vision Technologies to Allied Vision
V7.4.1	17.08.2015	**Updated data:** • Exchanged CAD drawings for C and CS mount cameras, after the ground plate label got repositioned. See Chapter Camera dimensions on page 53. • Corrected spectral sensitivity curve for Guppy F-503B, see Figure 19: Spectral sensitivity of Guppy F-503B without cut filter and optics on page 50.

Table 1: Document history

Version	Date	Remarks
V7.4.2	10.01.2018	• Added a note about Hirose I/O connectors in Chapter Camera I/O connections on page 101 • Updated note about accuracy of measurements for quantum efficiency. • Removed options information on optional accessories. • Applied minor changes.
V7.4.3	02.01.2019	• Applied minor changes. • Corrected typos.
V7.5.0	15.02.2019	• Removed contents for discontinued models: Guppy F-036, F-038, F-038NIR, F-044, F-044NIR, F-503. • Added contents for camera EMC compliance in Chapter Camera I/O connections on page 63.
V7.5.1	10.07.2019	Applied editorial changes.
V7.5.2	25.05.2020	• Updated data in Chapter Compliance, safety, and intended use on page 42 and in Chapter Intended use on page 44. • Added data in Chapter Read before use on page 2,Chapter Your safety on page 40, Chapter Avoiding material damage on page 41, and Chapter Warranty note on page 42. • Updated spectral plots in Chapter Spectral sensitivity on page 48. • Applied minor editorial changes.
V7.5.3	13. 07.2021	• Applied minor changes.
V7.5.4	19.08.2021	• Added icon for compliance with UKCA in Chapter Compliance notifications on page 38. • Applied minor changes.
V7.6.0	19.08.2022	• Renamed from Technical Manual to User Guide. • Added Hebrew contents to Chapter Read before use on page 2.

Table 1: Document history

Manual overview

This **manual overview** describes each chapter of this manual shortly.

- Chapter Contact us on page 15 lists Allied Vision contact data for both:
  - technical information / ordering
  - commercial information
- Chapter Introduction on page 21 (this chapter) gives you the document history, a manual overview and conventions used in this manual (styles and symbols). Furthermore you learn how to get more information on **how to install hardware (1394 Installation Manual)**.
- Chapter Guppy cameras on page 37 gives you a short introduction to the Guppy cameras with their FireWire technology. Links are provided to data sheets and brochures on Allied Vision website.
- Chapter Compliance, safety, and intended use on page 38 gives you information about conformity and intended use of Allied Vision cameras.
- Chapter Filter and lenses on page 59 describes the IR cut filter and suitable camera lenses.
- Chapter Specifications on page 43 lists camera details and spectral sensitivity diagrams for each camera type.
- Chapter Camera dimensions on page 53 provides CAD drawings of standard housing (copper) models, tripod adapter, cross sections of CS-Mount and C-Mount.
- Chapter Camera interfaces on page 62 describes in detail the inputs/ outputs of the cameras (incl. trigger features). For a general description of the interfaces (FireWire and I/O connector) see **1394 Installation Manual.**
- Chapter Description of the data path on page 80 describes in detail IIDC conformable as well as Allied Vision-specific camera features.
- Chapter Controlling image capture on page 104 describes shutter and trigger modi, exposure time, one-shot/multi-shot/ISO_Enable features and jitter.
- Chapter Video formats, modes and bandwidth on page 118 lists all available fixed and Format_7 modes (incl. color modes, frame rates, binning/sub-sampling, AOI=area of interest).
- Chapter How does bandwidth affect the frame rate? on page 135 gives some considerations on bandwidth details.
- Chapter Configuration of the camera on page 139 lists standard and advanced register descriptions of all camera features.
- Chapter Firmware update on page 191 explains where to get information on firmware updates.
- Chapter Appendix on page 192 lists the sensor position accuracy of Allied Vision cameras.
- Chapter Index on page 193 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 and notes

CAUTION

Risk of burns

Precautions are described

CAUTION

Injury by falling cameras or lenses

Precautions are described

CAUTION

Risk of cuts by sharp edges of lens mounts

Precautions are described

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:

www.alliedvision.com

More information

For more information on hardware and software read the following:

The **1394 Installation Manual** describes the hardware installation procedures for all 1394 cameras (Marlin, Guppy, Pike, Stingray). Additionally, you get safety instructions and information about camera interfaces (IEEE1394a/b copper and GOF, I/O connectors, input and output).

www

You find the **1394 Installation Manual** here:

www.alliedvision.com/en/support/technical-documentation

www

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

www.alliedvision.com/en/support/software-downloads

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 **1394 Installation Manual** first.

Note

Please read through this manual carefully before operating the camera.

For information on Allied Vision **accessories** and **software** read **1394 Installation Manual**.

Caution

Before operating any Allied Vision camera read **safety instructions** and **ESD warnings** in **1394 Installation Manual**.

Note

To demonstrate the properties of the camera, all examples in this manual are based on the **FirePackage** OHCI API software and the **SmartView** application.

Note

The camera also works with all **IIDC** (formerly DCAM) compatible **IEEE 1394** programs and image processing libraries.

All naming in this document relates to FirePackage, not to GenICam.

www

For downloads see:

Software (Vimba and all other software):
www.alliedvision.com/en/support/software-downloads

Firmware:
www.alliedvision.com/en/support/firmware-downloads

Technical documentation (overview page):
www.alliedvision.com/en/support/technical-documentation

Application notes:
www.alliedvision.com/en/support/faqs-application-notes

Guppy cameras

Guppy
IEEE 1394a

Guppy cameras enable very cost-effective solutions for digital image processing.

With the Guppy, Allied Vision presents a whole series of attractive digital camera entry-level models of the FireWire™ type.

Note

All naming in this document relates to FirePackage, not to GenICam.

www

For further information on the highlights of Guppy types and the Guppy family read the data sheets and brochures on our website:

www.alliedvision.com/en/support/technical-documentation/guppy-documentation

Compliance, safety, and intended use

Compliance notifications

For customers in China and Europe

National regulations on disposal must be followed.

For customers in the USA

FCC Class A digital device

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. 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. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, 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 separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

United States of America: Supplier Declaration of Conformity

Guppy cameras comply with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. this device must accept any interference received, including interference that may cause undesired operation.

Party issuing Supplier's Declaration of Conformity

Allied Vision Technologies GmbH
Taschenweg 2a
07646 Stadtroda

Germany
T// +49 (36428) 677-106
quality@alliedvision.com

Responsible Party - U.S. Contact Information

Allied Vision Technologies, Inc.
102 Pickering Way – Suite 502
Exton, PA 19341
USA

T// +1 978 225 2030

Note: changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

For customers in Canada

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

CAN ICES-3 (A) / NMB-3 (A)

Pour utilisateurs au Canada

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

CAN ICES-3 (A) / NMB-3 (A)

Avoid electromagnetic interferences

For all power and interface connections, only use shielded cables or cables recommended by Allied Vision.

Intended use

Allied Vision's objective is the development, design, production, maintenance, servicing and distribution of digital cameras and components for image processing. We are offering standard products as well as customized solutions.

Intended use of Allied Vision product is the integration into Vision systems by professionals. All Allied Vision product is sold in a B2B setting.

Allied Vision isn't a legal manufacturer of medical product. Instead, Allied Vision cameras and accessories may be used as components for medical product after design-in by the medical device manufacturer and based on a quality assurance agreement (QAA) between Allied Vision (supplier) and medical device manufacturer (customer). Allied Vision's duties in that respect are defined by ISO 13485, clause 7.2 (customer-related processes, equivalent to ISO 9001, clause 8.2).

Copyright and trademarks

Your safety

This section informs about issues related to your personal safety. Descriptions explain how to avoid hazards and operate Guppy cameras safely.

Handling lens mounts

The lens mount thread has sharp edges. Be careful these edges do not cut your skin when mounting or unmounting lenses.

Handling hot cameras

If you hold the camera in your hands during operation, your skin may get hurt. If you touch the camera when it is heated up, we recommend wearing protective gloves.

Providing optimum heat dissipation

Keep the operating temperature in the specified range to enable best image quality and to protect the camera from damage. Temperature values apply to a relative humidity of 0 to 80 percent that is non-condensing.
For your safety and to improve camera performance, operate the camera:

- Mounted to a base with a high thermal conductivity
- With lens or other optical components mounted
- With a heat sink mounted that has large surface areas (closed housing cameras include a heat sink)
- Using conductive media for camera and heat sink mounting
- With active cooling of camera, mounting base, and heat sink, such as by ventilation

Camera mounting

Cameras must be mounted using the mounting threads. If vibration is very high, cameras can disconnect from the mounting. Falling cameras can hurt you.

For heavy or long lenses, we recommend you to use a lens support and apply additional tests.

Avoiding material damage

Electronics maintenance

There are no switches or parts inside the camera housing that require adjustment. The warranty becomes void upon opening the camera casing.

Cable connections

Powering cameras

Operating the camera beyond the specified range damages the camera.

The camera does not generate dangerous voltages internally. However, because the IEEE 1394 standard permits cable power distribution at voltages higher than 24 V DC, various international safety standards apply.

Cameras can be powered using the I/O connector at an input range of 8 to 36 VDC, using a limited power source (LPS), according to IEC 62368-1 with maximum 2 A. The camera is not intended to be connected to a DC distribution network. The maximum length for I/O cables must not exceed 30 meters.

Only use power supplies that meet the insulation requirement according to PELV or SELV. For details, please refer to IEC 61140.

If using external power supplies by third-party manufacturers, observe polarity to avoid damage to the camera electronics.

If you feel uncomfortable with the following advice or if you have no knowledge about the connectivity of an installation, we strongly recommend powering down all systems before connecting or disconnecting a camera.

No hot plugging

Although FireWire devices can theoretically be hot-plugged without powering down equipment, we strongly recommend turning the computer power off before connecting a digital camera to it via a FireWire cable.

Static electricity or slight plug misalignment during insertion may short-circuit and damage components.

Avoiding electrostatic discharge (ESD)

The physical ports may be damaged by excessive ESD when connected under powered conditions. It is good practice to ensure proper grounding of computer case and camera case to the same ground potential before plugging the camera cable into the port of the computer. This ensures that no excessive difference of electrical potential exists between computer and camera.

Make sure not to touch the shield of the camera cable connected to a computer and the ground terminal of the lines at the same time. If you are charged: before touching the shield of the camera cable, make sure to discharge first (by touching the ground terminal of the lines).

Maximum inrush current

It is very important not to exceed an inrush current of 18 mJoule in 3 ms. (This means that a device, when powered via 12 VDC bus power, must never draw more than 1.5 A, even not in the first 3 ms.)

Higher inrush current may damage the physical interface chip of the camera and/or the phy chip in your PC.

Whereas inrush current is not a problem for a single 1394b camera, daisy chaining multiple cameras or supplying bus power via (optional) HIROSE power out to circuitry with unknown inrush currents needs careful design considerations to be on the safe side.

Suitable accessories

All Allied Vision 1394b camera and cables have industrial screw-lock fasteners to insure a tight electrical connection that is resistant to vibration and gravity.

We strongly recommend using only 1394b adapter cards with screw-locks.

Use only DC power supplies with insulated cases. These are identified by having only two power connectors.

Cleaning cameras

Mount/remove lenses and filters in a dust-free environment. Use only quality optical tissue/cloth if you must clean a lens or filter. Read the 1394 Installation Manual, Chapter Cleaning instructions.

Warranty note

If the product is disassembled, reworked, repaired or cleaned by unauthorized service personnel, Allied Vision or its suppliers cannot be held liable for any subsequent performance decrease of the camera or quality decrease of the camera output.

Specifications

Note

- For information on bit/pixel and byte/pixel for each color mode see Table 54: ByteDepth on page 135.
- **Maximum protrusion** means the **distance from lens flange to the glass filter in the camera**.

Guppy F-033B/C

Feature	Specification
Image device	Type 1/3 (diag. 6 mm) progressive scan SONY IT CCD ICX424AL/AQ w HAD microlens
Effective chip size	**4.9 mm x 3.7 mm**
Cell size	7.4 µm x 7.4 µm
Lens mount	C-Mount: 17.526 mm (in air), Ø 25.4 mm (32 tpi), mechanical flange back to filter distance: 9.5 mm (see Figure 13: Guppy C-Mount dimensions on page 57) CS-Mount: 12.526 mm (in air), Ø 25.4 mm (32 tpi), mechanical flange back distance: 8 mm (see Figure 14: Guppy CS-Mount dimensions on page 58)
Picture size (max.)	656 x 494 pixels (Format_7 Mode_0)
ADC	10 bit
Frame rates	3.75 fps; 7.5 fps; 15 fps; 30 fps; 60 fps variable frame rates in Format_7 up to 58 fps
Gain control	Manual: 0-24 dB (0.035 dB/step); auto gain (select. AOI)
Shutter speed	**129** µs ... 67,108,864 µs (~67s); auto shutter (select. AOI)
External trigger shutter	Trigger_Mode_0, Trigger_Mode_1, advanced feature: Trigger_Mode_15 (bulk); trigger delay
Look-up table	One, user programmable (10 bit → 8 bit); gamma (0.5)
Smart functions	• AGC (auto gain control), AEC (auto exposure control), LUT (look-up table) **only color:** AWB (auto white balance) • one configurable input, three configurable outputs, RS-232 port (serial port, IIDC V1.31)
Transfer rate	100 Mbit/s, 200 Mbit/s, 400 Mbit/s
Digital interface	IEEE 1394a IIDC V1.3, single port
Power requirements	DC 8 V - 36 V via IEEE 1394 cable or 8-pin HIROSE
Power consumption	Less than 2 watt (@ 12 V DC)
Dimensions	48.2 mm x 30 mm x 30 mm (L x W x H); w/o tripod and lens
Mass	50 g (without lens)
Operating temperature	+ 5 °C ... + 45 °C housing temperature (without condensation)
Storage temperature	- 10 °C ... + 70 °C ambient temperature (without condensation)
Standard accessories	• **b/w:** C/CS-Mount with built-in protection glass • **color:** C/CS-Mount with built-in IR cut filter
Software packages	www.alliedvision.com/en/support/software-downloads (free of charge)

Table 3: Specification Guppy F-033B/C

Guppy F-046B/C

Feature	Specification
Image device	Type 1/2 (diag. 8 mm) progressive scan SONY IT CCD ICX415AL/AQ with HAD micro-lens
Effective chip size	**6.5 mm x 4.8 mm**
Cell size	8.3 µm x 8.3 µm
Lens mount	C-Mount: 17.526 mm (in air), Ø 25.4 mm (32 tpi), mechanical flange back to filter distance: 9.5 mm (see Figure 13: Guppy C-Mount dimensions on page 57) CS-Mount: 12.526 mm (in air), Ø 25.4 mm (32 tpi), mechanical flange back distance: 8 mm (see Figure 14: Guppy CS-Mount dimensions on page 58)
Picture size (max.)	780 x 582 pixels (Format_7 Mode_0)
ADC	12 bit
Frame rates	3.75 fps; 7.5 fps; 15 fps; 30 fps; 60 fps variable frame rates in Format_7 up to 49.4 fps
Gain control	Manual: 0-24 dB (0.035 dB/step); auto gain (select. AOI)
Shutter speed	**42** µs ... 67,108,864 µs (~67s); auto shutter (select. AOI)
External trigger shutter	Trigger_Mode_0, Trigger_Mode_1, advanced feature: Trigger_Mode_15 (bulk); trigger delay
Look-up table	One, user programmable (10 bit → 8 bit); gamma (0.5)
Smart functions	• AGC (auto gain control), AEC (auto exposure control), LUT (look-up table) **only color:** AWB (auto white balance) • one configurable input, three configurable outputs • RS-232 port (serial port, IIDC V1.31)
Transfer rate	100 Mbit/s, 200 Mbit/s, 400 Mbit/s
Digital interface	IEEE 1394a IIDC V1.3, single port
Power requirements	DC 8 V - 36 V via IEEE 1394 cable or 8-pin HIROSE
Power consumption	Less than 2 watt (@ 12 V DC)
Dimensions	48.2 mm x 30 mm x 30 mm (L x W x H); w/o tripod and lens
Mass	50 g (without lens)
Operating temperature	+ 5 °C ... + 45 °C housing temperature (without condensation)
Storage temperature	- 10 °C ... + 70 °C ambient temperature (without condensation)
Standard accessories	• **b/w:** C/CS-Mount with built-in protection glass • **color:** C/CS-Mount with built-in IR cut filter
Software packages	www.alliedvision.com/en/support/software-downloads (free of charge)

Table 4: Specification Guppy F-046B/C

Guppy F-080B/C

Feature	Specification
Image device	Type 1/3 (diag. 6 mm) progressive scan SONY IT CCD ICX204AL/AK with HAD micro-lens
Effective chip size	**4.8 mm x 3.6 mm**
Cell size	4.65 µm x 4.65 µm
Lens mount	C-Mount: 17.526 mm (in air), Ø 25.4 mm (32 tpi), mechanical flange back to filter distance: 9.5 mm (see Figure 13: Guppy C-Mount dimensions on page 57) CS-Mount: 12.526 mm (in air), Ø 25.4 mm (32 tpi), mechanical flange back distance: 8 mm (see Figure 14: Guppy CS-Mount dimensions on page 58)
Picture size (max.)	1032 x 778 (Format_7 Mode_0)
ADC	12 bit
Frame rates	3.75 fps; 7.5 fps; 15 fps; 30 fps variable frame rates in Format_7 up to 30 fps
Gain control	Manual: 0-24 dB (0.035 dB/step); auto gain (select. AOI)
Shutter speed	**54** µs ...67,108,864 µs (~67s); auto shutter (select. AOI)
External trigger shutter	Trigger_Mode_0, Trigger_Mode_1, advanced feature: Trigger_Mode_15 (bulk); image transfer by command; trigger delay
Look-up table	One, user programmable (10 bit → 8 bit); gamma (0.5)
Smart functions	• AGC (auto gain control), AEC (auto exposure control), LUT (look-up table) **only color:** AWB (auto white balance) • one configurable input, three configurable outputs, RS-232 port (serial port, IIDC V1.31)
Transfer rate	100 Mbit/s, 200 Mbit/s, 400 Mbit/s
Digital interface	IEEE 1394a IIDC V1.3
Power requirements	DC 8 V - 36 V via IEEE 1394 cable or 8-pin HIROSE
Power consumption	Less than 2 watt (@ 12 V DC)
Dimensions	48.2 mm x 30 mm x 30 mm (L x W x H); without tripod and lens
Mass	50 g (without lens)
Operating temperature	+ 5 °C ... + 45 °C housing temperature (without condensation)
Storage temperature	- 10 °C ... + 70 °C ambient temperature (without condensation)
Standard accessories	• **b/w:** C/CS-Mount with built-in protection glass • **color:** C/CS-Mount with built-in IR cut filter
Software packages	www.alliedvision.com/en/support/software-downloads (free of charge)

Table 5: Guppy F-080B/C

Guppy F-146B/C

Feature	Specification
Image device	Type 1/2 (diag. 8 mm) progressive scan SONY IT CCD ICX267AL/AK with HAD micro-lens
Effective chip size	**6.5 mm x 4.8 mm**
Cell size	4.65 µm x 4.65 µm
Lens mount	C-Mount: 17.526 mm (in air), Ø 25.4 mm (32 tpi), mechanical flange back to filter distance: 9.5 mm (see Figure 13: Guppy C-Mount dimensions on page 57) CS-Mount: 12.526 mm (in air), Ø 25.4 mm (32 tpi), mechanical flange back distance: 8 mm (see Figure 14: Guppy CS-Mount dimensions on page 58)
Picture size (max.)	1392 x 1040 (Format_7 Mode_0)
ADC	12 bit
Frame rates	3.75 fps; 7.5 fps; 15 fps; 30 fps variable frame rates in Format_7 up to 17.7 fps
Gain control	Manual: 0-24 dB (0.035 dB/step); auto gain (select. AOI)
Shutter speed	**40** µs ...67,108,864 µs (~67s); auto shutter (select. AOI)
External trigger shutter	Trigger_Mode_0, Trigger_Mode_1, advanced feature: Trigger_Mode_15 (bulk); image transfer by command; trigger delay
Look-up table	One, user programmable (10 bit → 8 bit); gamma (0.5)
Smart functions	• AGC (auto gain control), AEC (auto exposure control), LUT (look-up table) **only color:** AWB (auto white balance) • one configurable input, three configurable outputs • RS-232 port (serial port, IIDC V1.31)
Transfer rate	100 Mbit/s, 200 Mbit/s, 400 Mbit/s
Digital interface	IEEE 1394a IIDC V1.3
Power requirements	DC 8 V - 36 V via IEEE 1394 cable or 8-pin HIROSE
Power consumption	Less than 2 watt (@ 12 V DC)
Dimensions	48.2 mm x 30 mm x 30 mm (L x W x H); without tripod and lens
Mass	50 g (without lens)
Operating temperature	+ 5 °C ... + 45 °C housing temperature (without condensation)
Storage temperature	- 10 °C ... + 70 °C ambient temperature (without condensation)
Standard accessories	• **b/w:** C/CS-Mount with built-in protection glass • **color:** C/CS-Mount with built-in IR cut filter
Software packages	www.alliedvision.com/en/support/software-downloads (free of charge)

Table 6: Guppy F-146B/C

Spectral sensitivity

Absolute quantum efficiency (QE)

Note

Measurements for color cameras were done with IR cut filter, measurements for monochrome and S-Mount cameras were done without optical filters. With optical filters, QE decreases by approximately 10 percent. The uncertainty in measurement of the QE values is ±10 percent. This is mainly due to uncertainties in the measuring apparatus itself (such as Ulbricht sphere and optometer).

Manufacturing tolerance of the sensor increases overall uncertainty.

Note

Sony provides relative response curves in their sensor data sheets. To create the absolute QE plots shown in this chapter, the relative response was converted to a normalized QE response and then adjusted as per three measured QE values (at 448 nm, 529 nm, 632 nm) for color sensors and one measured QE value (at 529 nm) for monochrome sensors.

Note

The wavelength range in the absolute QE plots reflects the information available in the sensor manufacturer data sheet at the time of publishing. For additional wavelength information, contact the sensor manufacturer.

Spectral response plots

Note

The curves in the spectral response plots shown in this chapter were calculated from measured quantum efficiencies at 448 nm, 529 nm, and 632 nm. The shape of the curve is taken from the sensor data sheet but the values have been adjusted based on these measured values. The uncertainty in measurement of the spectral response values is ±10 percent.

Guppy F-033B, F-033C

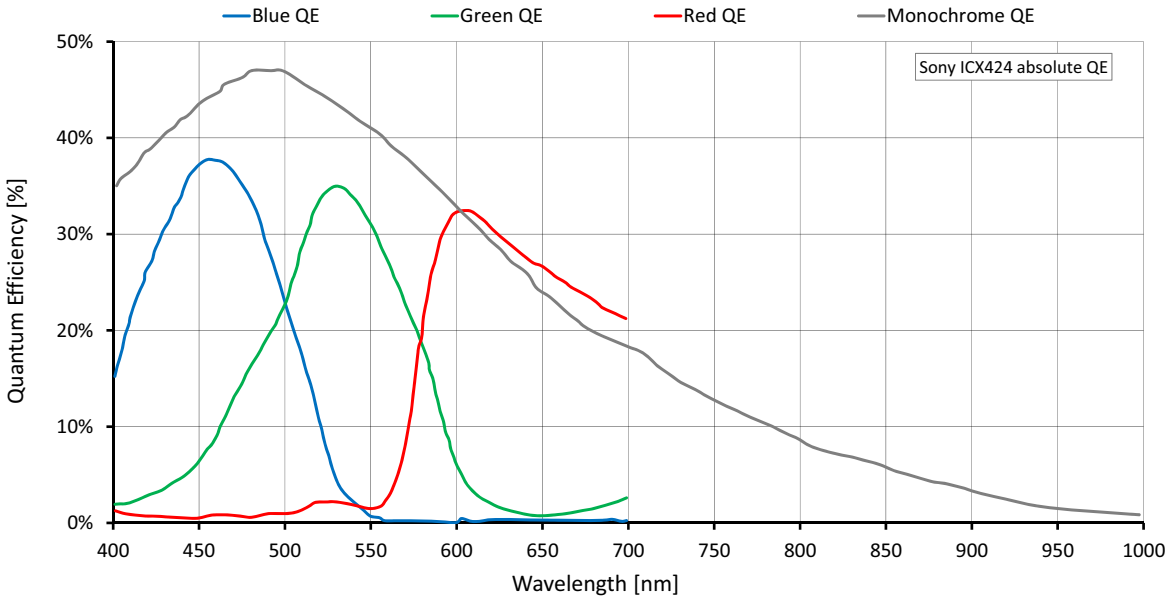


Figure 1: Absolute quantum efficiency of Guppy F-033B without IR cut filter and optics

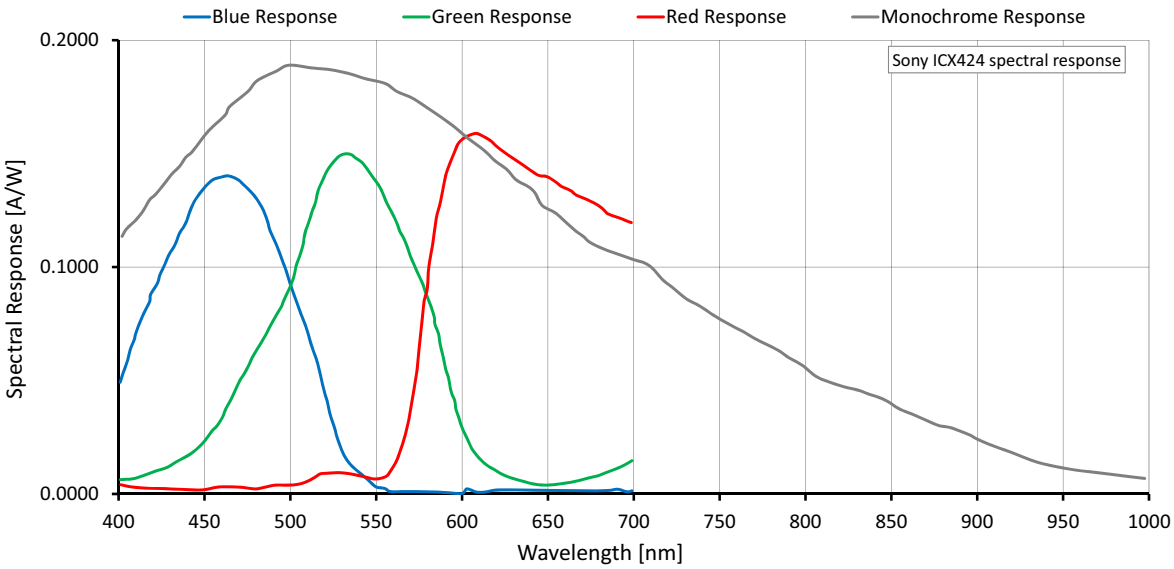


Figure 2: Spectral response of Guppy F-033C without IR cut filter and optics

Guppy F-046B, F-046C

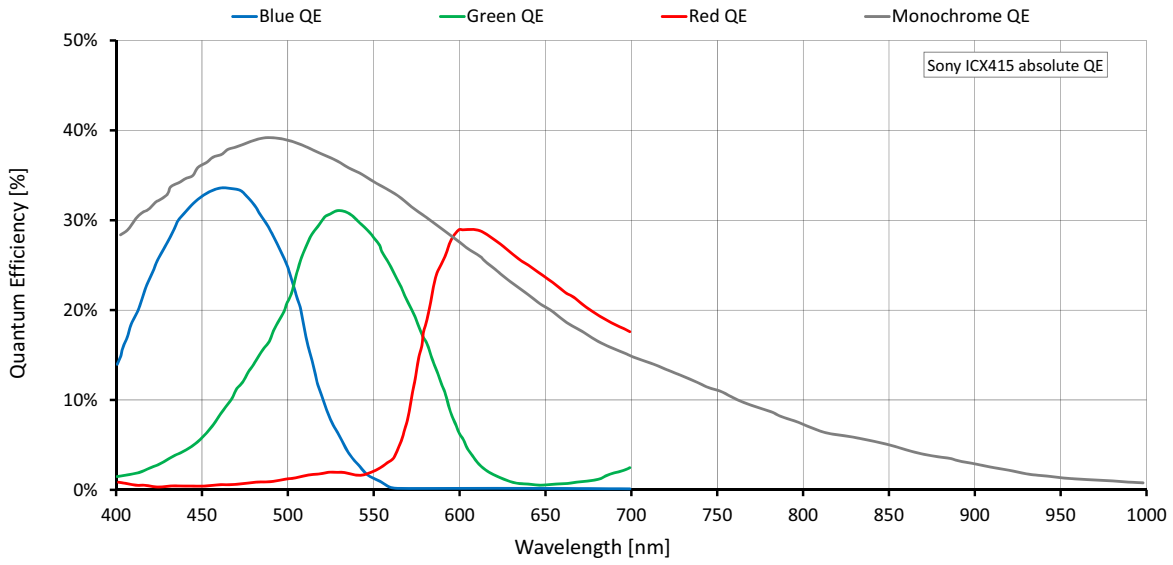


Figure 3: Absolute quantum efficiency of Guppy F-046B without IR cut filter and optics

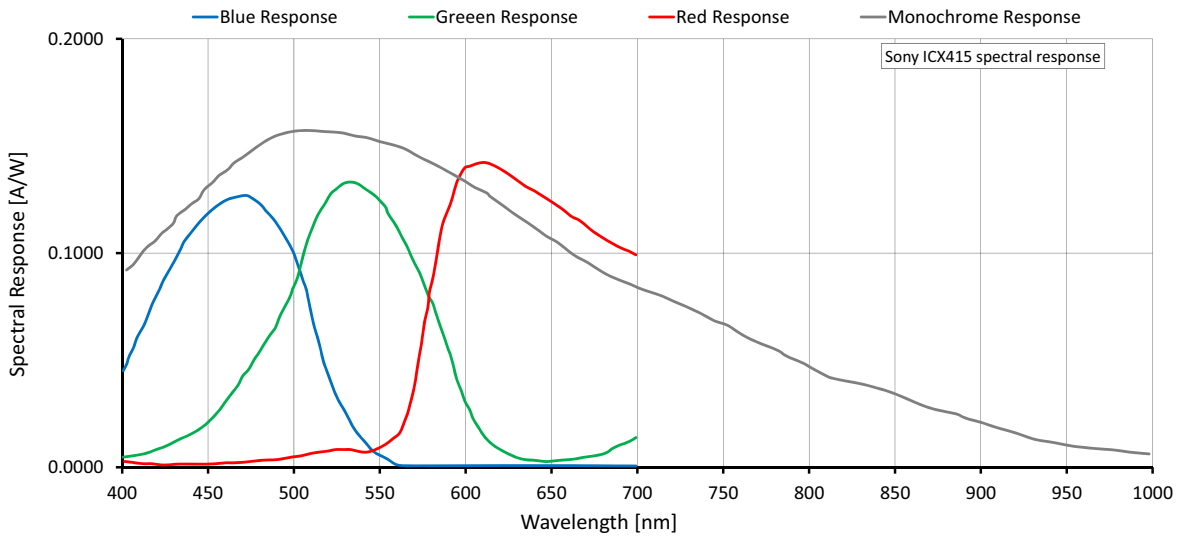


Figure 4: Spectral response of Guppy F-046C without IR cut filter and optics

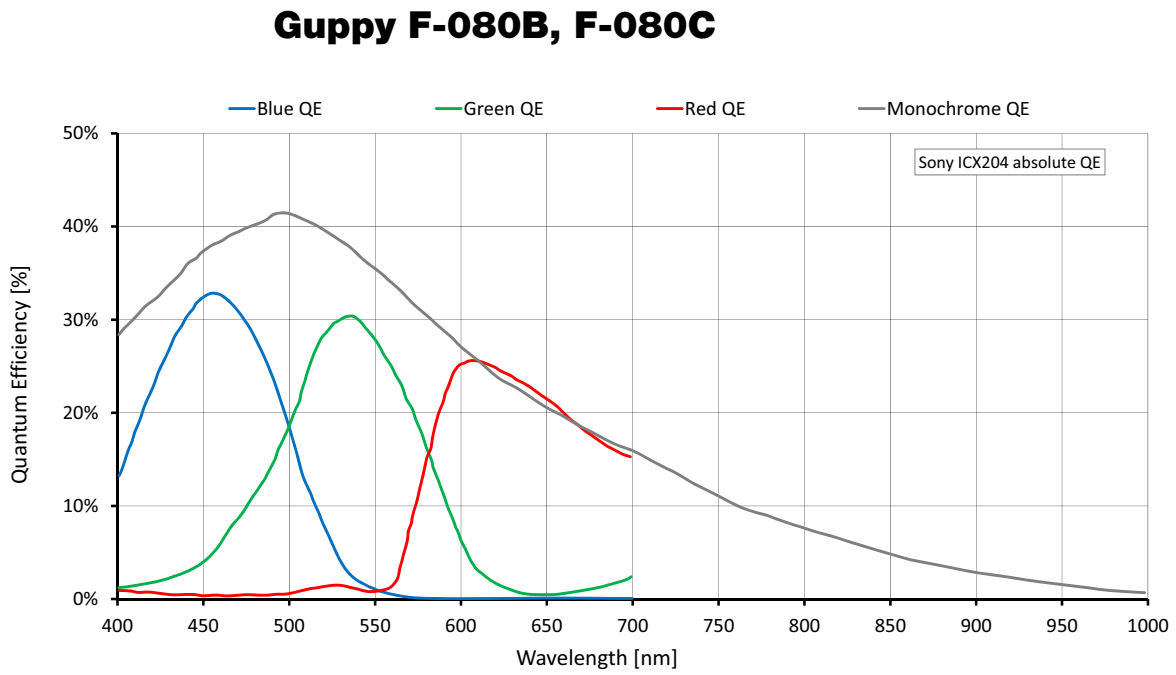


Figure 5: Absolute quantum efficiency of Guppy F-080B without IR cut filter and optics

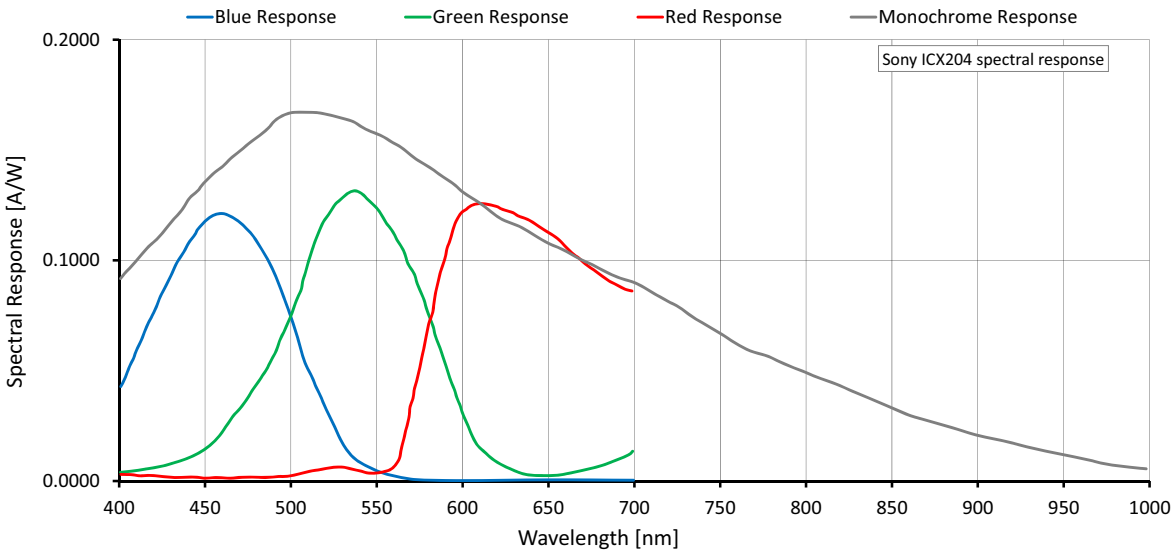


Figure 6: Spectral response of Guppy F-080C without IR cut filter and optics

Guppy F-146B, F-146C

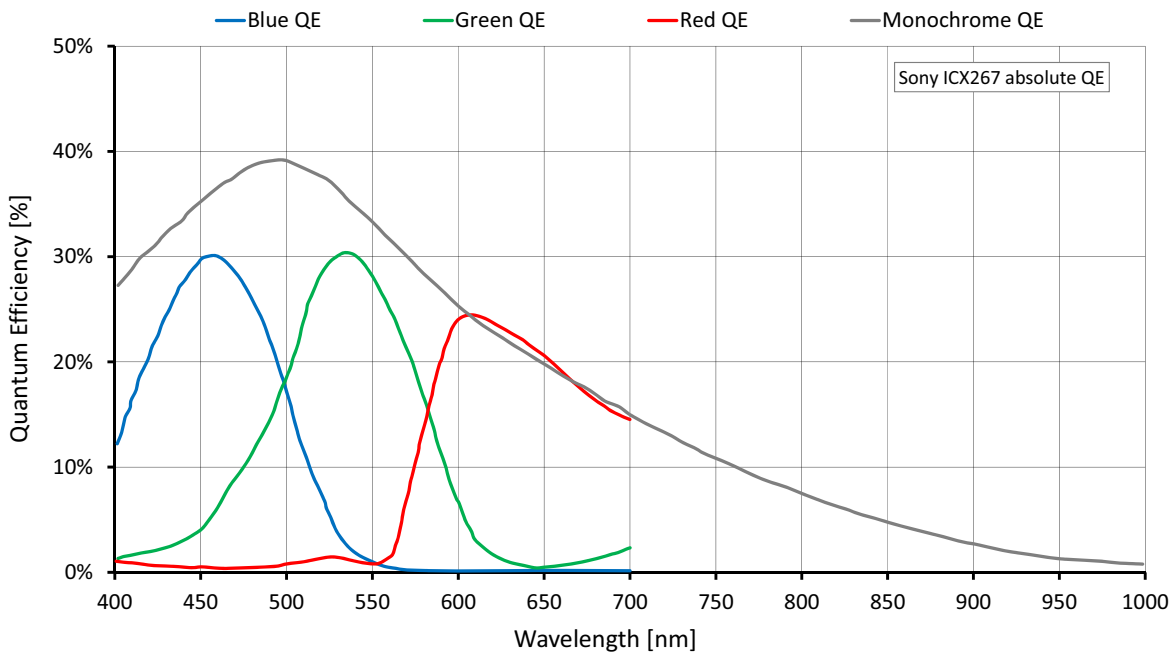


Figure 7: Absolute quantum efficiency of Guppy F-146B without IR cut filter and optics

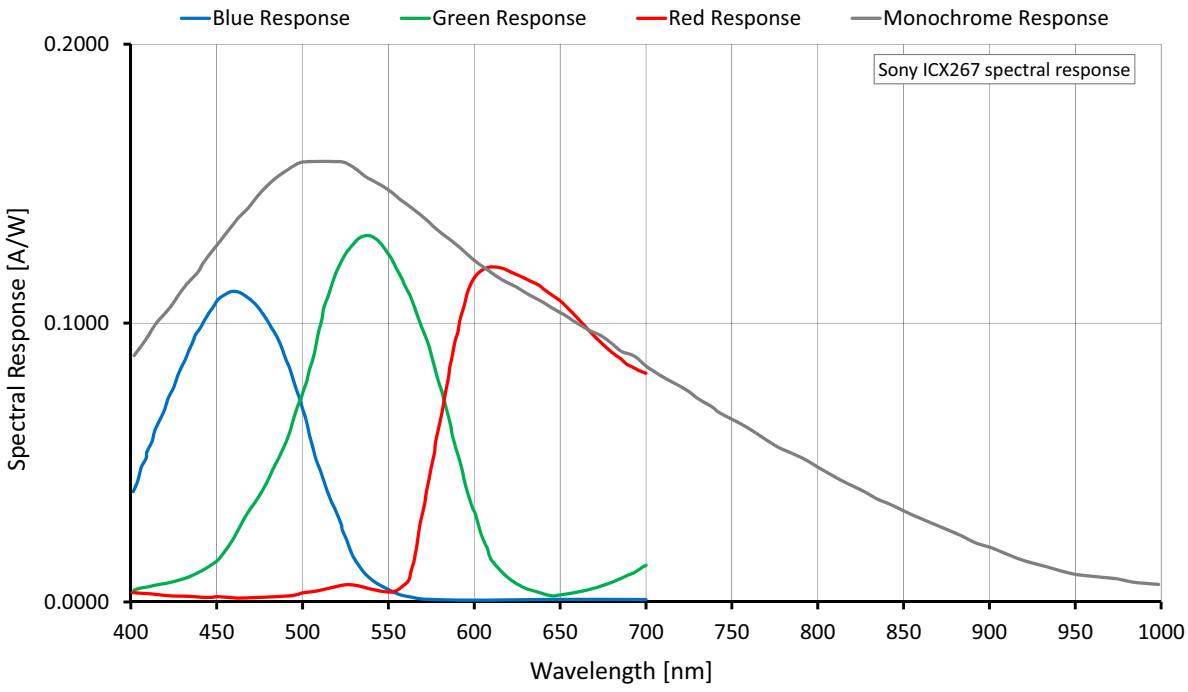


Figure 8: Spectral response of Guppy F-146C without IR cut filter and optics

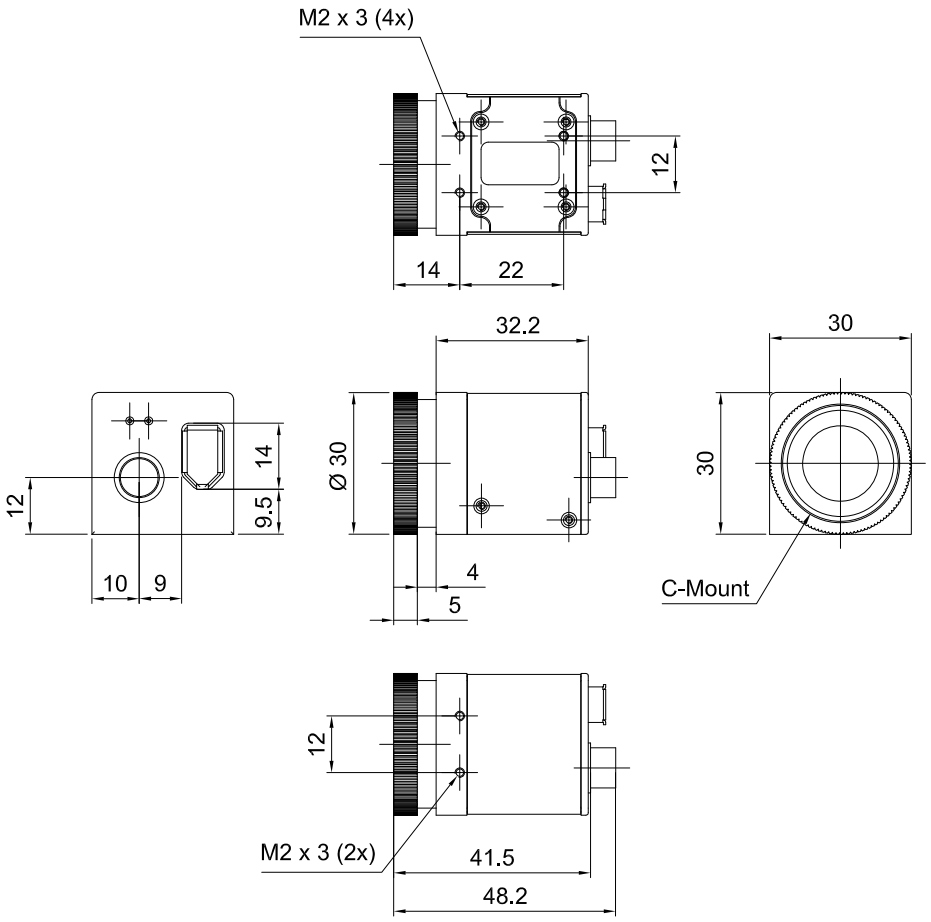
Camera dimensions

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 Guppy cameras on page 192.

Guppy standard housing (old C-Mount)



Body size: 48.2 mm x 30 mm x 30 mm (L x W x H), Mass: 50 g (without lens)

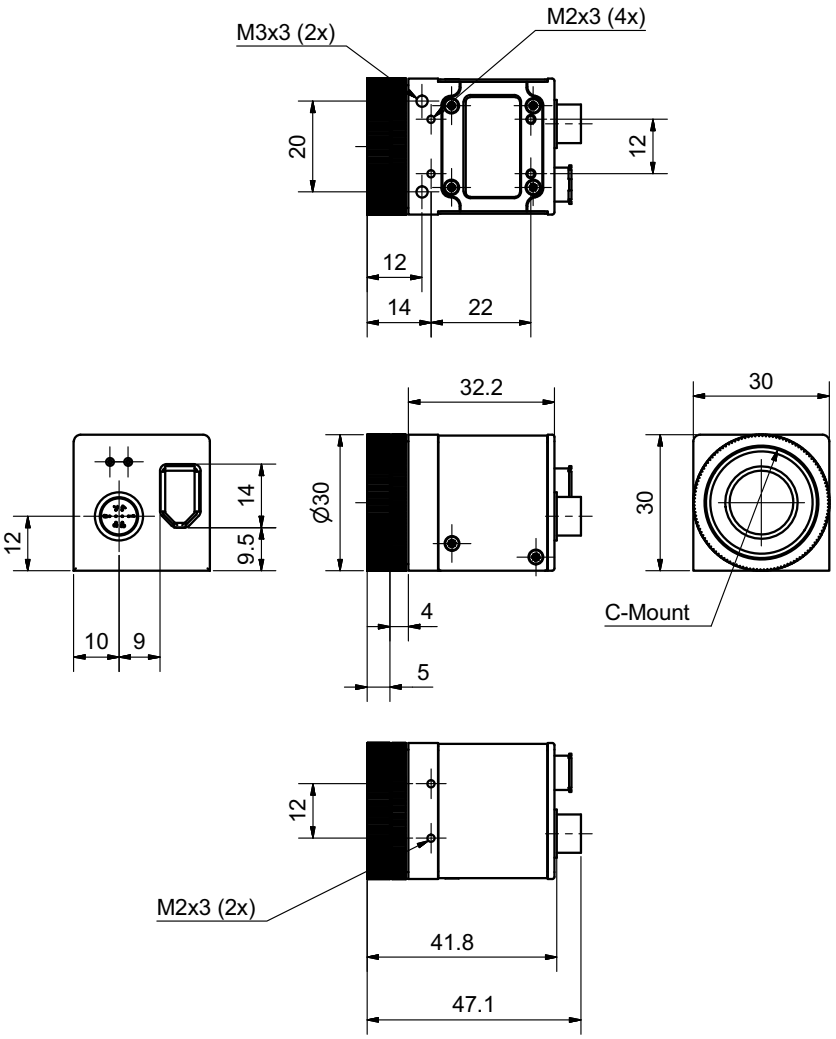
Figure 9: Camera dimensions (old C-Mount)

Note

CS-Mount

The old Guppy camera can be equipped with CS-Mount lenses, too. To change from C-Mount to CS-Mount, screw off the 5 mm font ring from the front flange.

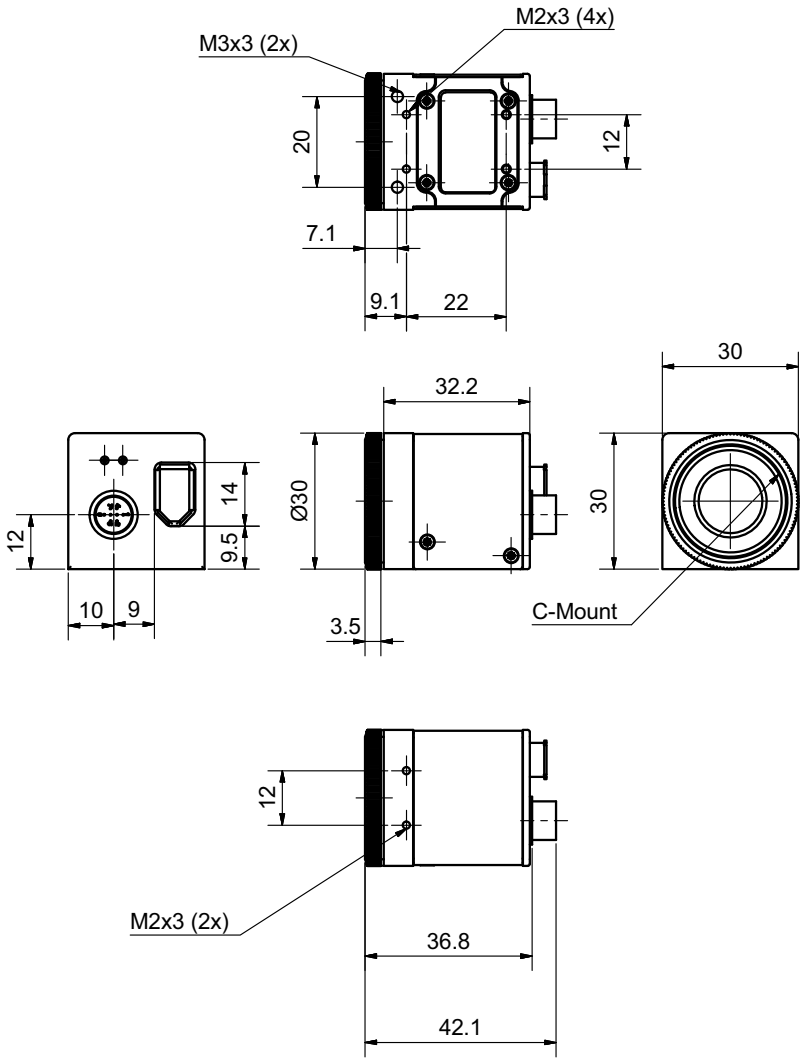
Guppy standard housing (new C-Mount)



Body size: 47.1 mm x 30 mm x 30 mm (L x W x H), Mass: 50 g (without lens)

Figure 10: Camera dimensions (new C-Mount)

Guppy standard housing (new CS-Mount)



Body size: 42.1 mm x 30 mm x 30 mm (L x W x H), Mass: 50 g (without lens)

Figure 11: Camera dimensions (new CS-Mount)

Note

CS-Mount

The new mount Guppy camera can be equipped with CS-Mount lenses, too. The C-Mount consists of two screwed in rings. To change from C-Mount to CS-Mount, screw off the 5mm front ring.

Tripod adapter

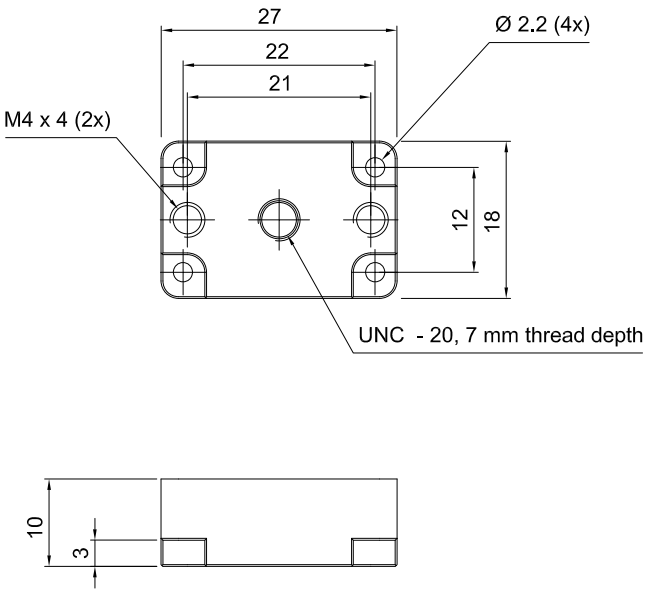


Figure 12: Tripod dimensions

Cross section: C-Mount

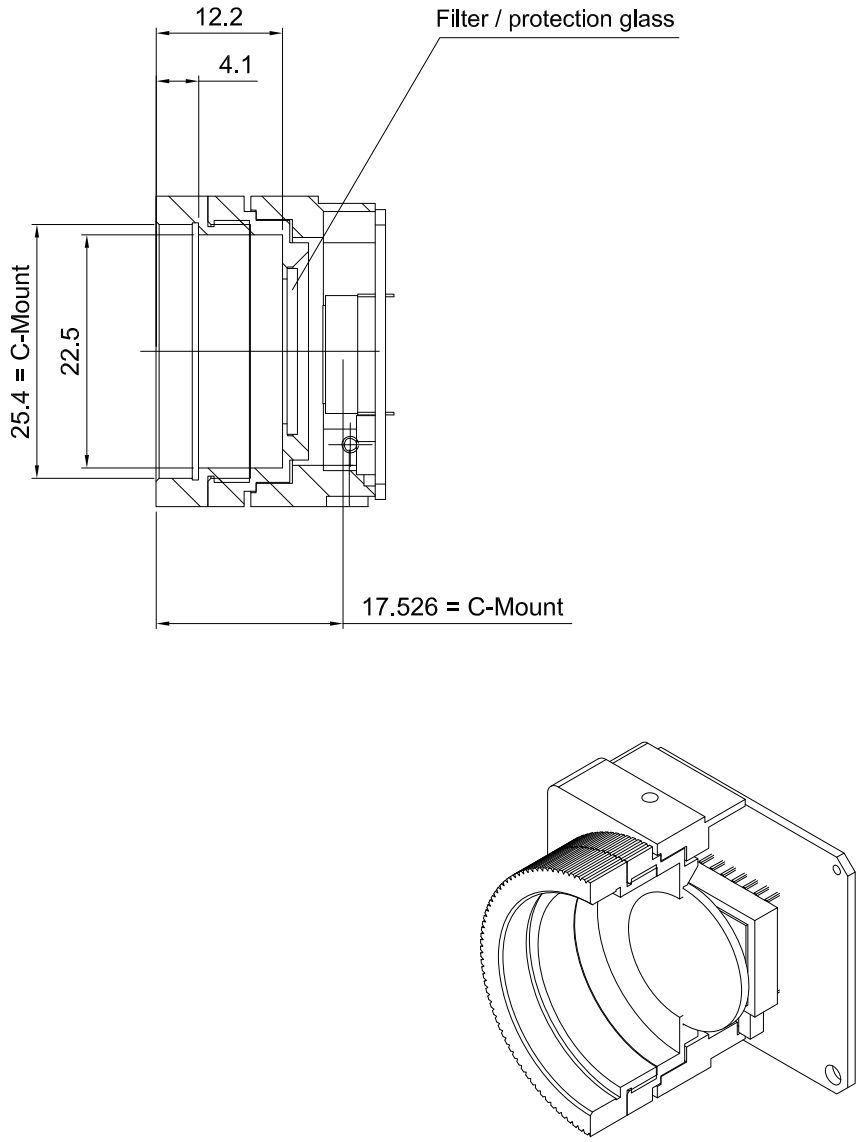
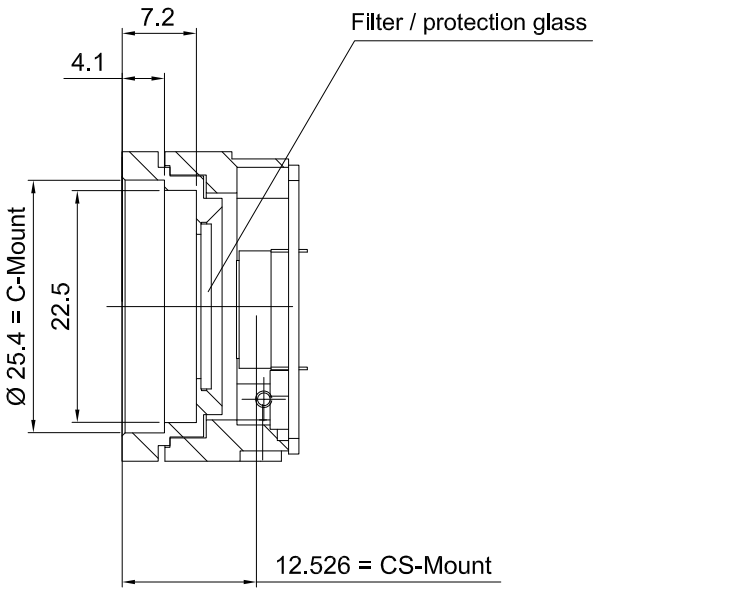


Figure 13: Guppy C-Mount dimensions

Cross section: CS-Mount



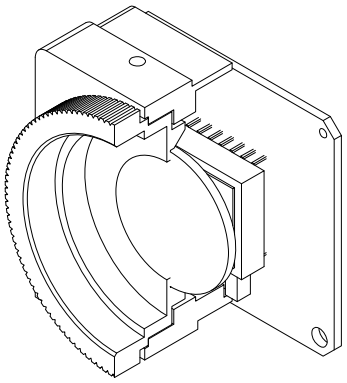


Figure 14: Guppy CS-Mount dimensions

Filter and lenses

IR cut filter

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

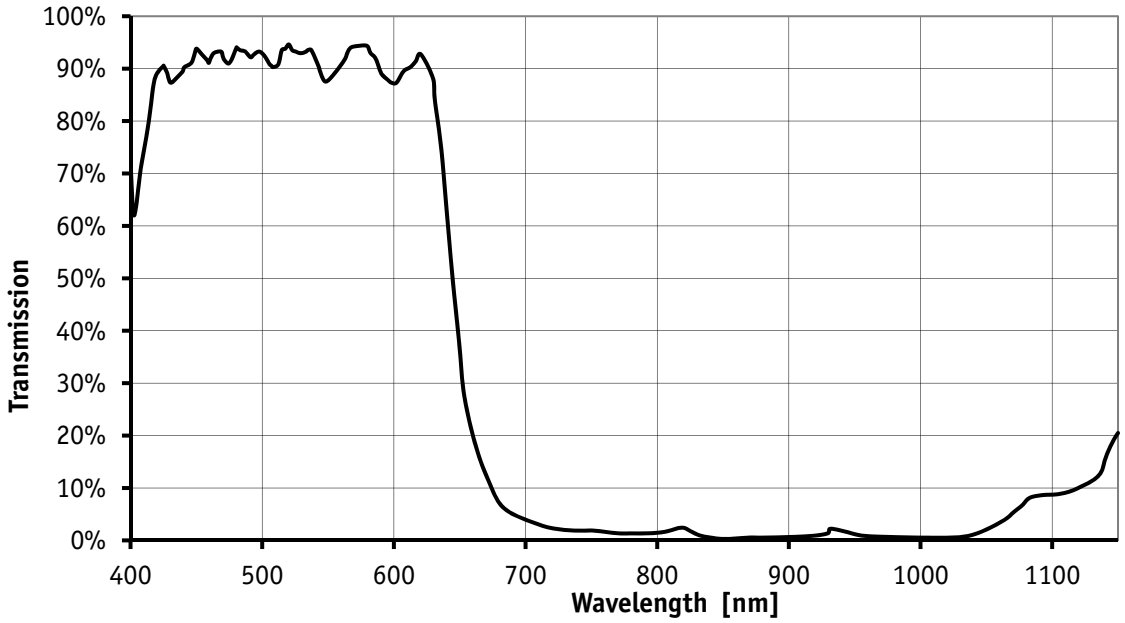


Figure 15: Typical spectral transmission of IR cut filter (type Jenofilt 217)

Camera lenses

Allied Vision offers different lenses from a variety of manufacturers. The following table lists selected image formats depending on camera type, distance and the focal width of the lens.

Focal Width for type 1/2 sensors Guppy F-046/146	Distance = 0.5 m	Distance = 1 m
4.8 mm	0.5 m x 0.67 m	1.0 m x 1.33 m
8 mm	0.3 m x 0.4 m	0.6 m x 0.8 m
12 mm	0.195 m x 0.26 m	0.39 m x 0.58 m
16 mm	0.145 m x 0.19 m	0.29 m x 0.38 m
25 mm	9.1 cm x 12.1 cm	18.2 cm x 24.2 cm
35 mm	6.4 cm x 8.51 cm	12.8 cm x 17.02 cm
50 mm	4.4 cm x 5.85 cm	8.8 cm x 11.7 cm

Table 7: Focal width vs. field of view (Guppy F-046)

Focal Width for type 1/3 sensors Guppy F-033/080	Distance = 0.5 m	Distance = 1 m
4.8 mm	0.375 m x 0.5 m	0.75 m x 1 m
8 mm	0.22 m x 0.29 m	0.44 m x 0.58 m
12 mm	0.145 m x 0.19 m	0.29 m x 0.38 m
16 mm	11 cm x 14.7 cm	22 cm x 29.4 cm
25 mm	6.9 cm x 9.2 cm	13.8 cm x 18.4 cm
35 mm	4.8 cm x 6.4 cm	9.6 cm x 12.8 cm
50 mm	3.3 cm x 4.4 cm	6.6 cm x 8.8 cm

Table 8: Focal width vs. field of view (Guppy F-033/080)

Camera interfaces

This chapter gives you detailed information on status LEDs, inputs and outputs, trigger features and transmission of data packets.

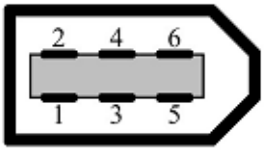
Note

For a detailed description of the **camera interfaces (FireWire, I/O connector), ordering numbers and operating instructions** see the **1394 Installation Manual**.

Read all **Notes** and **Cautions** in the **1394 Installation Manual**, before using any interfaces.

IEEE 1394a port pin assignment

The IEEE 1394a plug is designed for industrial use and has the following pin assignment as per specification:



Pin	Signal
1	Cable power
2	Cable GND
3	TPB-
4	TPB+
5	TPA-
6	TPA+

Figure 16: IEEE 1394 connector

Note

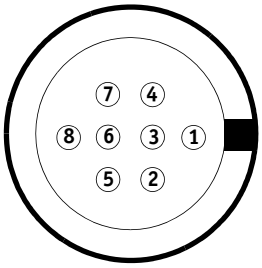
Cables with latching connectors on one or both sides can be used and are available with various lengths of 4.5 m or up to 17.5 m. Ask your local dealer for more details.

Camera I/O connections

Note

The camera is not intended to be connected to a DC distribution network. The maximum length for I/O cables must not exceed 30 m.

Guppy (housing)



Pin	Signal	Direction	Level	Description
1	Camera Out 1	Out	U_{out}(high) = 2.4 V...5 V U_{out}(low) = 0 V...0.4 V	Camera Output 1 (GPOut1) default: IntEna
2	Camera Out 2	Out	U_{out}(high) = 2.4 V...5 V U_{out}(low) = 0 V...0.4 V	Camera Output 2 (GPOut2) default: -
3	Camera Out 3	Out	U_{out}(high) = 2.4 V...5 V U_{out}(low) = 0 V...0.4 V	Camera Output 3 (GPOut3) default: Busy
4	Camera In 1	In	U_{in}(high) = 3.8 V...5 V U_{in}(low) = 0 V...1 V	Camera Input 1 (GPIn1) default: Trigger
5	RxD RS232	In	RS232	Terminal Receive Data
6	TxD RS232	Out	RS232	Terminal Transmit Data
7	External Power		+8 ... +36 V DC	Power supply
8	External GND		GND for RS232, GPIOs and ext. power	External Ground for RS232, GPIOs and external power

Table 9: Guppy (housing): Camera I/O connector pin assignment

Note

8-pin Hirose I/O cables

The General Purpose I/O port uses a Hirose HR25-7TR-8PA(73) connector on the camera side. The mating cable connector is:

- Hirose HR25-7TP-8S(72) for soldering
- Hirose HR25-7TP-8SC(72) for crimping

Note

GP = General Purpose

For a detailed description of the **I/O connector and its operating instructions** see the **1394 Installation Manual, Chapter *Guppy input description***.

Read all **Notes** and **Cautions** in the **1394 Installation Manual**, before using the I/O connector.

www

For **more information on cables** and on **ordering cables online** (by clicking the article and sending an inquiry) go to:

www.alliedvision.com/en/about-us/contact-us/

Status LEDs

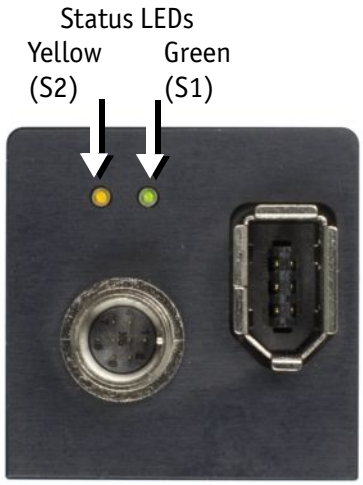


Figure 17: Status LEDs

On LED (green)

The green power LED indicates that the camera is being supplied with sufficient voltage and is ready for operation.

Status LED

The following states are displayed via the LED:

State	Description
S1 (green)	LED on - power on LED off - power off
S2 (yellow)	Asynchronous and isochronous data transmission active (indicated asynchronously to transmission over the 1394 bus)

Table 10: LED indication

Blink codes are used to signal warnings or error states:

Class S1 → / Error codes S2 ↓	Warning 1 blink	DCAM 2 blinks	MISC 3 blinks	FPGA 4 blinks	Stack 5 blinks
FPGA Boot error				1-5 blinks	
Stack setup					1 blink
Stack start					2 blinks
No FLASH object			1 blink		
No DCAM object		1 blink			
Register mapping		3 blinks			
VMode_ERROR_STATUS	1 blink				
FORMAT_7_ERROR_1	2 blinks				
FORMAT_7_ERROR_2	3 blinks				

Table 11: Error codes

The following sketch illustrates the series of blinks for a Format_7_error_1:

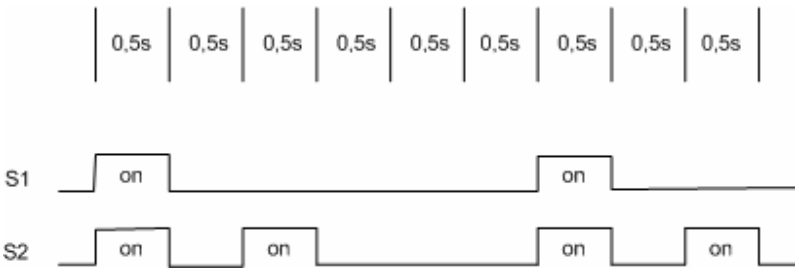


Figure 18: Warning and error states

You should wait for at least 2 full cycles because the display of blinking codes starts asynchronously - e.g. on the second blink from S2.

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 **1394 Installation Manual**.

Triggers

The signal can be inverted. The camera must be set to **external triggering** to trigger image capture by the trigger signal.

Input/output pin control

All input and output signals running over the camera I/O connector are controlled by an advanced feature register.

Register	Name	Field	Bit	Description
0xF1000300	IO_INP_CTRL1	Presence_Inq	[0]	Indicates presence of this feature (read only)
		---	[2..6]	Reserved
		Polarity	[7]	0: Signal not inverted 1: Signal inverted
		---	[8..10]	Reserved
		InputMode	[11..15]	Mode see Table 13: Input routing on page 67
		---	[16..30]	Reserved
		PinState	[31]	RD: Current state of pin

Table 12: Input configuration register

The **TiedToOutput** field indicates that an output and the corresponding input share the same physical connector pin. Pins with **TiedToOutput** set to 1 can be used as an output or input.

Note

Make sure that output and input are not enabled at the same time. In order to use a pin as an input (e.g. for external trigger), its output driver (e.g. IntEna) needs to be switched off.

IO_INP_CTRL 1

The **Polarity** field determines whether the input is inverted (0) or not (1). See Table 12: Input configuration register on page 66.

The **InputMode** field can be seen in the following table.

The **PinState** field is used to query the current status of the input.

Input modes

ID	Mode	Default
0x00	Off	
0x01	Reserved	
0x02	Trigger input	Input 1
0x03	Reserved	
0x04	Reserved	
0x05	Reserved	
0x06..0x0F	Reserved	
0x10..0x1F	Reserved	

Table 13: Input routing

Trigger delay

The cameras feature various ways to delay image capture based on external trigger.

With IIDC V1.31 there is a standard CSR at register F0F00534/834h to control a delay up to FFFh x timebase value. The following table explains the Inquiry register and the meaning of the various bits.

Register	Name	Field	Bit	Description
0xF0F00534	TRIGGER_DELAY_INQUIRY	Presence_Inq	[0]	Indicates presence of this feature (read only)
		Abs_Control_Inq	[1]	Capability of control with absolute value
		---	[2]	Reserved
		One_Push_Inq	[3]	One-push auto mode (Controlled automatically by the camera once)
		Readout_Inq	[4]	Capability of reading out the value of this feature
		ON_OFF	[5]	Capability of switching this feature ON and OFF
		Auto_Inq	[6]	Auto Mode (Controlled automatically by the camera)
		Manual_Inq	[7]	Manual Mode (Controlled by user)
		Min_Value	[8..19]	Min. value for this feature (1 µs)
		Max_Value	[20..31]	Max. value for this feature

Table 14: Trigger_Delay_Inquiry register

Register	Name	Field	Bit	Description
0xF0F00834	TRIGGER_DELAY	Presence_Inq	[0]	Presence of this feature: 0: Not available 1: Available
		Abs_Control	[1]	Absolute value control 0: Control with value in the value field 1: Control with value in the absolute value CSR. If this bit= 1 the value in the value field has to be ignored.
		---	[2..5]	Reserved
		ON_OFF	[6]	Write ON or OFF this feature ON=1 Read: Status of the feature OFF=0
		----	[7..19]	Reserved
		Value	[20..31]	Value

Table 15: Trigger Delay CSR

The cameras also have an advanced register which allows even more precise delay of image capture after receiving a hardware trigger.

Trigger delay advanced register

Register	Name	Field	Bit	Description
0xF1000400	TRIGGER_DELAY	Presence_Inq	[0]	Indicates presence of this feature (read only)
		---	[1..5]	-
		ON_OFF	[6]	Trigger delay on/off
		---	[7..10]	-
		DelayTime	[11..31]	Delay time in µs

Table 16: Trigger Delay Advanced CSR

The advanced register allows the start of the integration to be delayed by max. 2^{21} µs, which is max. 2.1 s after a trigger edge was detected.

Note

- This feature works with external Trigger_Mode_0 only.

Outputs

Note

For a general description of the **outputs** and **warnings** see the **1394 Installation Manual**.

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
IntEna (Integration Enable) signal	This signal displays the time in which exposure was made. By using a register this output can be delayed up to 1.05 seconds.
Fval (Frame valid) signal	This feature signals readout from the sensor. This signal Fval follows IntEna.
Busy signal	This signal appears when: • the exposure is being made or • the sensor is being read out or • data transmission is active. The camera is busy.

Table 17: Output signals

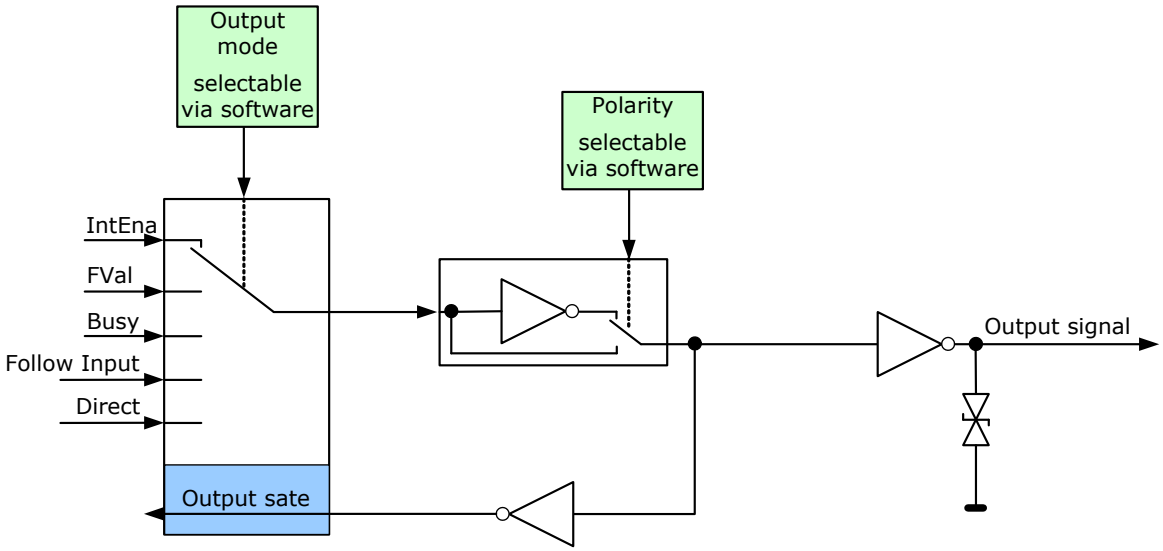


Figure 19: Output block diagram

Note

The following signals are high active: IntEna, FVal, Busy, Follow Input, Direct.

IO_OUTP_CTRL 1-3

The outputs are controlled via 3 advanced feature registers (see Table 18: Advanced register: **Output control** on page 72).

The **Polarity** field determines whether the output is inverted (1) or not (0). The **Output mode** can be viewed in the table below. The current status of the output can be queried and set via the **PinState**.

It is possible to read back the status of an output pin regardless of the output mode. This allows for example the host computer to determine if the camera is busy by simply polling the BUSY output.

Register	Name	Field	Bit	Description
0xF1000320	IO_OUTP_CTRL1	Presence_Inq	[0]	Indicates presence of this feature (read only)
		---	[2..6]	Reserved
		Polarity	[7]	0: Signal not inverted 1: Signal inverted
		---	[8..10]	Reserved
		Output mode	[11..15]	Mode See Table 19: Output routing on page 73.
		---	[16..30]	Reserved
		PinState	[31]	RD: Current state of pin WR: New state of pin
0xF1000324	IO_OUTP_CTRL2	Same as IO_OUTP_CTRL1		
0xF1000328	IO_OUTP_CTRL3	Same as IO_OUTP_CTRL1		

Table 18: Advanced register: **Output control**

Output modes

ID	Mode	Default
0x00	Off	
0x01	Output state follows **PinState** bit	
0x02	Integration enable	Output 1
0x03	Reserved	
0x04	Reserved	
0x05	Reserved	
0x06	FrameValid	
0x07	Busy	Output 2
0x08	Follow corresponding input (Inp1 → Out1)	
0x0A..0x1F	Reserved	

Table 19: Output routing

Note

The output mode 0x08 is not available for output pins directly tied to an input pin.

The **Polarity** setting refers to the input side of the inverting driver.

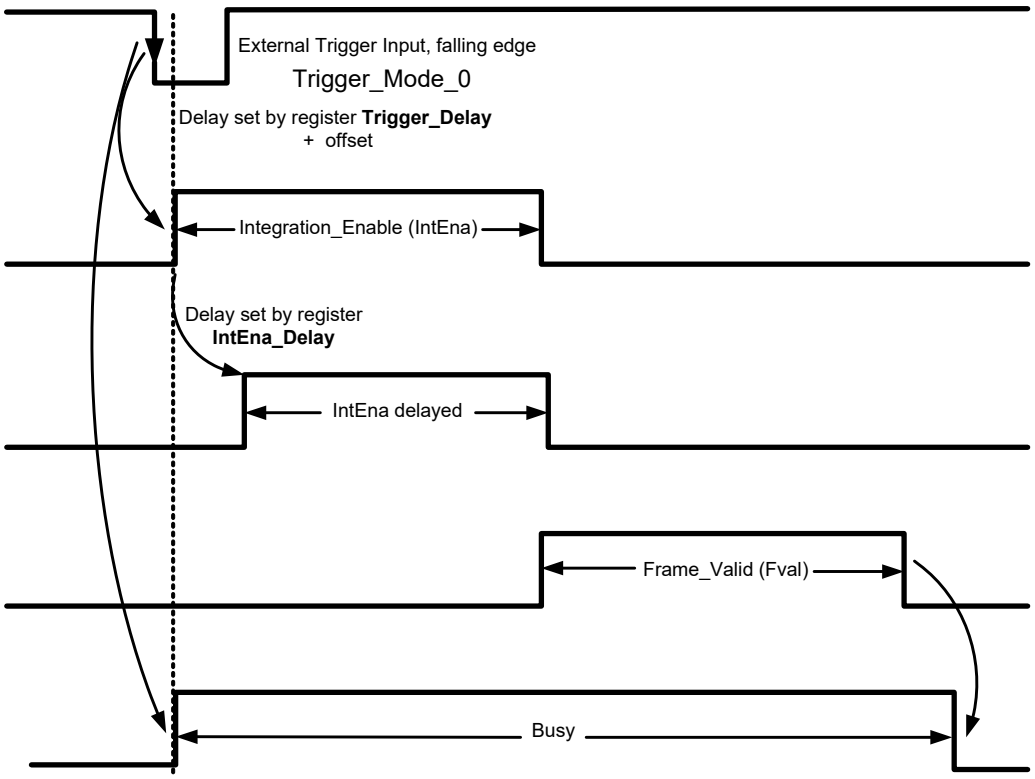


Figure 20: Output impulse diagram

See also Chapter Jitter at start of exposure on page 116.

Offsets are camera specific. For more information read Chapter Exposure time offset on page 111.

Note The signals can be inverted.

Caution Firing a new trigger while **IntEna** is still active can result in **missing image**.

Note

- Trigger delay in fact delays the image capture whereas the IntEna_Delay only delays the leading edge of the IntEna output signal but does not delay the image capture.
- As mentioned before, it is possible to set the outputs by software. Doing so, the achievable maximum frequency is strongly dependent on individual software capabilities. As a rule of thumb, the camera itself will limit the toggle frequency to not more than 700 Hz.

Pixel data

Pixel data are transmitted as isochronous data packets in accordance with the 1394 interface described in IIDC V1.3. The first packet of a frame is identified by the **1** in the **sync bit** (sy) of the packet header.

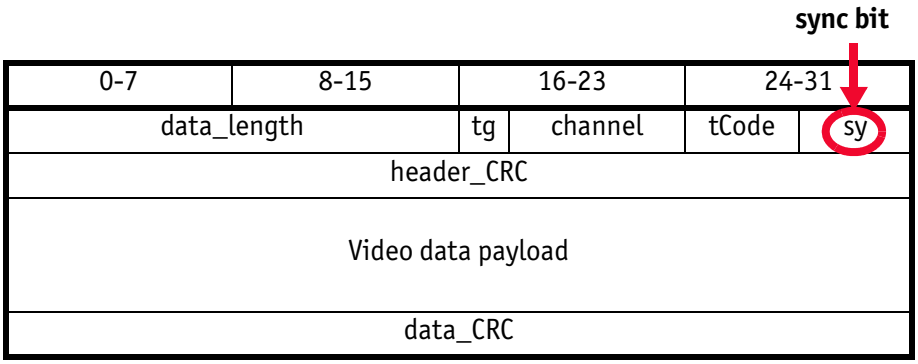


Table 20: Isochronous data block packet format. Source: IIDC V1.3

Field	Description
data_length	Number of bytes in the data field
tg	**Tag field** shall be set to zero
channel	**Isochronous channel number**, as programmed in the iso_channel field of the cam_sta_ctrl register
tCode	**Transaction code** shall be set to the isochronous data block packet tCode

Table 21: Description of data block packet format

Field	Description
sy	**Synchronization value (sync bit)** This is one single bit. It indicates the start of a new frame. It shall be set to 0001h on the first isochronous data block of a frame, and shall be set to zero on all other isochronous blocks
Video data payload	Shall contain the digital video information

Table 21: Description of data block packet format

- The video data for each pixel are output in 8-bit format (**Packed 12-Bit Mode**: 12-bit format). Exception: Guppy F-146 (Mono8: 8-bit format, Mono12/16: 12-bit format)
- Each pixel has a range of 256 (**Packed 12-Bit Mode**: 4096) shades of gray.
- The digital value 0 is black and 255 (**Packed 12-Bit Mode**: 4095) is white.
- In 12-bit mode the data output is MSB aligned (12 significant bits).
- In 16-bit mode the data output is MSB aligned (also 12 significant bits).

Video data formats (IIDC V1.3 and Allied Vision)

The following tables provide a description of the video data format for the different modes:

Y (Mono) and Y (Mono16) format
⇨ Source: IIDC V1.3 specification

Y (Mono12) format
⇨ Allied Vision own format (**Packed 12-Bit Mode**)

<Y (Mono) format>

Y-(K+0)	Y-(K+1)	Y-(K+2)	Y-(K+3)
Y-(K+4)	Y-(K+5)	Y-(K+6)	Y-(K+7)
Y-(K+Pn-8)	Y-(K+Pn-7)	Y-(K+Pn-6)	Y-(K+Pn-5)
Y-(K+Pn-4)	Y-(K+Pn-3)	Y-(K+Pn-2)	Y-(K+Pn-1)

Figure 21: **Y8 format** [Source: IIDC V1.3]

<Y (Mono16) format>

High byte	Low byte

Y-(K+0)	Y-(K+1)
Y-(K+2)	Y-(K+3)
Y-(K+Pn-4)	Y-(K+Pn-3)
Y-(K+Pn-2)	Y-(K+Pn-1)

Figure 22: **Y16 format** [Source: IIDC V1.3]

<Y (Mono12) format> (Allied Vision)

Y-(K+0) [11..4]	Y-(K+1) [3..0] Y-(K+0) [3..0]	Y-(K+1) [11..4]	Y-(K+2) [11..4]
Y-(K+3) [3..0] Y-(K+2)[3..0]	Y-(K+3) [11..4]	Y-(K+4) [11..4]	Y-(K+5) [3..0] Y-(K+4)[3..0]
Y-(K+5) [11..4]	Y-(K+6) [11..4]	Y-(K+7) [3..0] Y-(K+6) [3..0]	Y-(K+7) [11..4]

Table 22: **Packed 12-Bit Mode** (mono and raw) Y12 format from Allied Vision

Data structure (IIDC V1.3 and Allied Vision)

The following tables provide a description of the data structure for the different modes
⇨ Source: IIDC V1.3 specification

<Y, R, G, B>

Each component has 8-bit data. The data type is *Unsigned Char*.

	Signal level (decimal)	Data (hexadecimal)
Highest	255	0xFF
	254	0xFE
	.	.
	.	.
	1	0x01
Lowest	0	0x00

Figure 23: Data structure of Y, R, G, B [Source: IIDC V1.3]

<U, V>

Each component has 8-bit data. The data type is *Straight Binary*.

	Signal level (decimal)	Data (hexadecimal)
Highest (+)	127	0xFF
	126	0xFE
	.	.
	.	.
	1	0x81
Lowest	0	0x80
	-1	0x7F
	.	.
	.	.
	-127	0x01
Highest (-)	-128	0x00

Figure 24: Data structure of U, V [Source: IIDC V1.3]

<Y (Mono16>

Y component has 16-bit data. The data type is *Unsigned Short (big endian)*.

Y	Signal level (decimal)	Data (hexadecimal)
Highest	65535	0xFFFF
	65534	0xFFFE
	.	.
	.	.
	1	0x0001
Lowest	0	0x0000

Figure 25: Data structure of Y (Mono16) [Source: IIDC V1.3]

<Y (Mono12)> (Allied Vision)

Y component has 12-bit data. The data type is *Unsigned*.

Y	Signal level (decimal)	Data (hexadecimal)
Highest	4095	0x0FFF
	4094	0x0FFE
	.	.
	.	.
	1	0x0001
Lowest	0	0x0000

Table 23: Data structure of **Packed 12-Bit Mode** (mono and raw) from Allied Vision

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 sensor chip in the camera. The individual blocks are described in more detail in the following paragraphs. For sensor data see Chapter Specifications on page 43.

Note

The following drawings are examples of Guppy cameras with 10-bit ADCs.

For cameras with different ADCs see the comments with asterisks below (* and **):

* Cameras with 10-bit ADC: 10 bit
Cameras with 12-bit ADC: 12 bit

** e.g. Guppy F-146 (CCD),
with activated LUT: 8 bit
without LUT: 12 bit

Black and white cameras

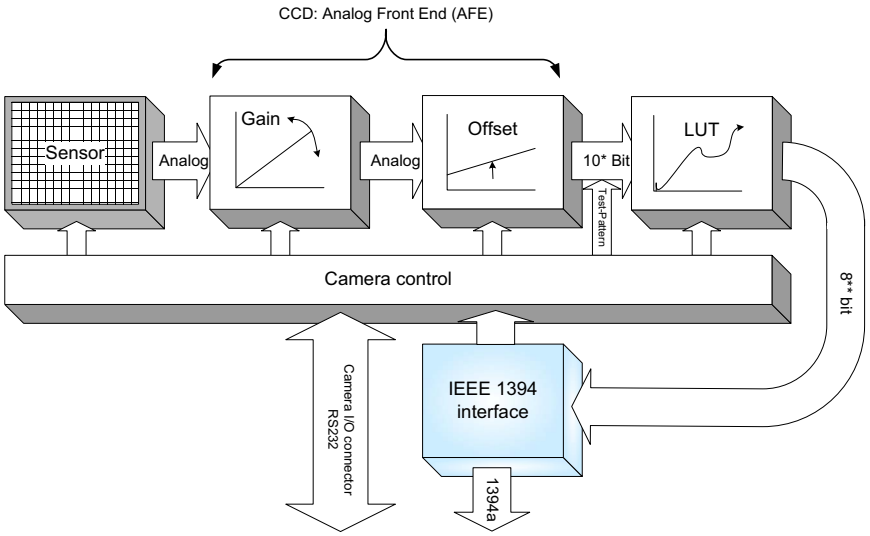


Figure 26: Block diagram b/w camera (CCD)

Color cameras

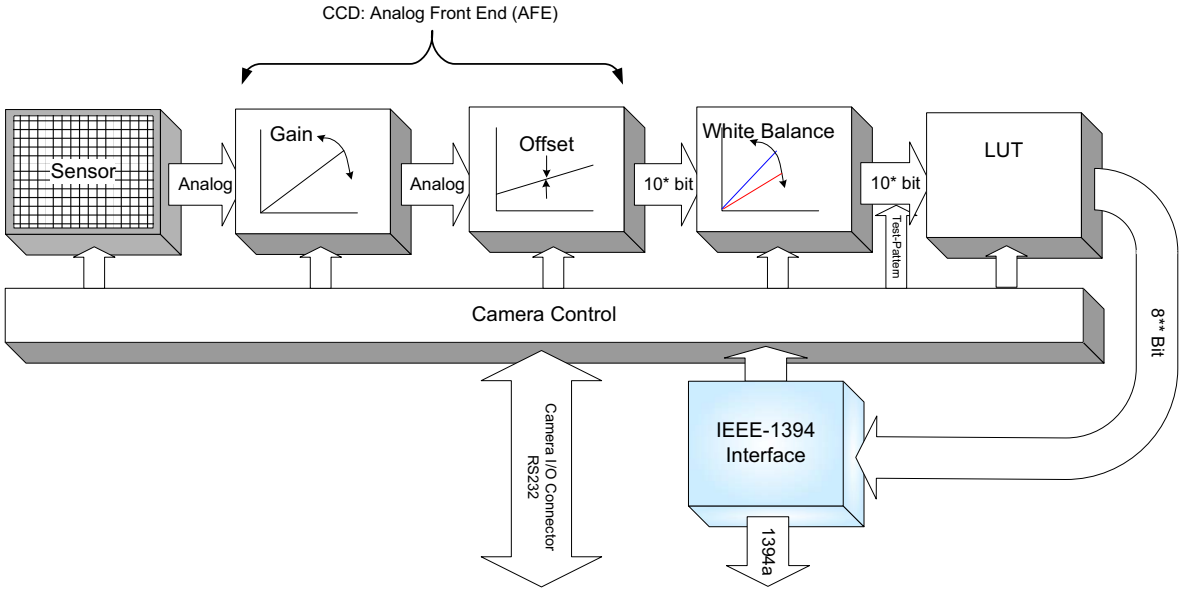


Figure 27: Block diagram color camera (CCD)

White balance

There are two types of white balance:

- **one-push white balance**: white balance is done only once (not continuously)
- **auto white balance** (AWB): continuously optimizes the color characteristics of the image

Guppy color cameras have both **one-push white balance** and **auto white balance**.

White balance is applied so that non-colored image parts are displayed non-colored.

White balance does **not** use the so-called PxGA® (Pixel Gain Amplifier) of the analog front end (AFE) but a digital representation in the FPGA in order to modify the gain of the two channels with lower output by +9.5 dB (in 512 steps) relative to the channel with highest output.

The following screenshot is taken from the datasheet of the AFE and illustrates the details:

The analog color signal, coming in pulse amplitude modulation from the sensor, is in the form of the BAYER™ color pattern sequence. It is initially processed in the CDS (correlated double sampler) then bypasses the PxGA before further amplification and digitization.

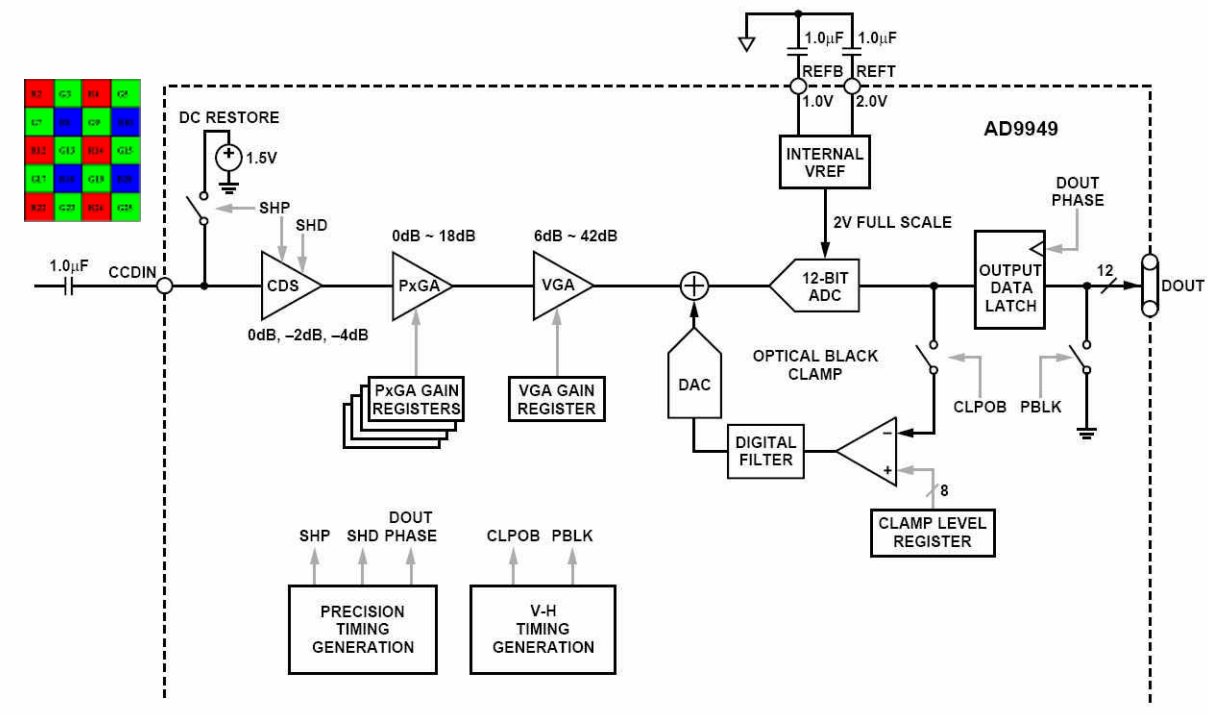


Figure 28: Block diagram of AFE (Source: Analog Devices)

From the user's point of view, the white balance settings are made in register 80Ch of IIDC V1.3. This register is described in more detail on the next page.

Register	Name	Field	Bit	Description
0xF0F0080C	WHITE_BALANCE	Presence_Inq	[0]	Presence of this feature: 0: N/A; 1: Available
		Abs_Control	[1]	Absolute value control 0: Control with value in the **Value** field 1: Control with value in the **Absolute** value CSR If this bit= 1 the value in the **Value** field has to be ignored
		-	[2..4]	Reserved
		One_Push	[5]	Write: Set bit high to start Read: Status of the feature: Bit high: WIP Bit low: Ready
		ON_OFF	[6]	Write: ON or OFF this feature Read: read a status 0: OFF 1: ON
		A_M_MODE	[7]	Set bit high for Auto feature Read for Mode; 0= MANUAL; 1= AUTO
		U/B_Value	[8..19]	U/B value; Write if not Auto; Read
		V/R_Value	[20..31]	V/R Value

Table 24: White balance register

The values in the **U/B_Value** field produce changes from green to blue; the **V/R_Value** field from green to red as illustrated below.

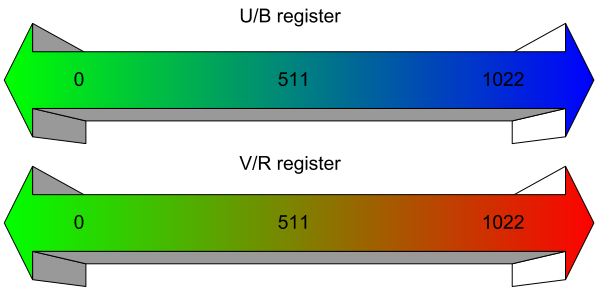


Figure 29: U/V slider range

One-push white balance

Note **Configuration**

To configure this feature in control and status register (CSR):
See Table 70: **Feature control register** on page 162.

The camera automatically generates frames, based on the current settings of all registers (GAIN, OFFSET, SHUTTER, etc.).

For white balance, in total **eight** frames are processed and a grid of at least **65536 samples** is equally spread over the whole image area. The R-G-B component values of the samples are added and are used as actual values for the **one-push white balance**.

This feature uses the assumption that the R-G-B component sums of the samples are equal; i.e., it assumes that the average of the sampled grid pixels is to be monochrome.

Note

The following ancillary conditions should be observed for successful white balance:

- There are no stringent or special requirements on the image content, it requires only the presence of equally weighted RGB pixels in the image.

If the image capture is active (e.g. **IsoEnable** set in register 614h), the frames used by the camera for white balance are also output on the 1394 bus. Any previously active image capture is restarted after the completion of white balance.

The following flow diagram illustrates the **one-push white balance** sequence.

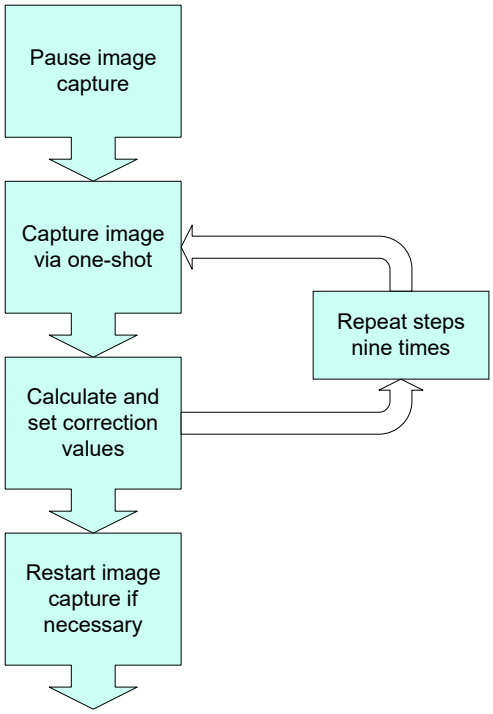


Figure 30: **One-push white balance** sequence

Finally, the calculated correction values can be read from the WHITE_BALANCE register 80Ch.

Auto white balance (AWB)

The **auto white balance** feature continuously optimizes the color characteristics of the image.

As a reference, it uses a grid of at least 65535 (2^{16}) samples equally spread over the area of interest or a fraction of it.

Auto white balance (AWB) can also be enabled by using an external trigger. However, if there is a pause of >10 seconds between capturing individual frames this process is aborted.

Note

The following ancillary conditions should be observed for successful white balance:

- There are no stringent or special requirements on the image content, it requires only the presence of equally weighted RGB pixels in the image.
- **Auto white balance** can be started both during active image capture and when the camera is in idle state.

Note **Configuration**

To set position and size of the control area (Auto_Function_AOI) in an advanced register: see Table 88: Advanced register: **Autofunction AOI** on page 184.

AUTOFNC_AOI affects the auto shutter, auto gain and auto white balance features and is independent of the Format7 AOI settings. If this feature is switched off, the work area position and size represent the current active image size.

The camera automatically adjusts the settings to the permitted values.

Due to the fact that the active image size might not be divisible by 4 without a remainder, the autofunction AOI work-area size might be greater.

This allows for the positioning of the work area to be at the bottom of the active image.

Another case is for outdoor applications: the sky will be excluded from the generation of the reference levels when the autofunction AOI is placed at the bottom of the image.

Note

If the adjustment fails and the work area size and/or position becomes invalid, this feature is automatically switched off – make sure to read back the **ON_OFF** flag if this feature doesn't work as expected.

Within this area, the R-G-B component values of the samples are added and used as actual values for the feedback.

The following drawing illustrates the AUTOFNC_AOI settings in greater detail.

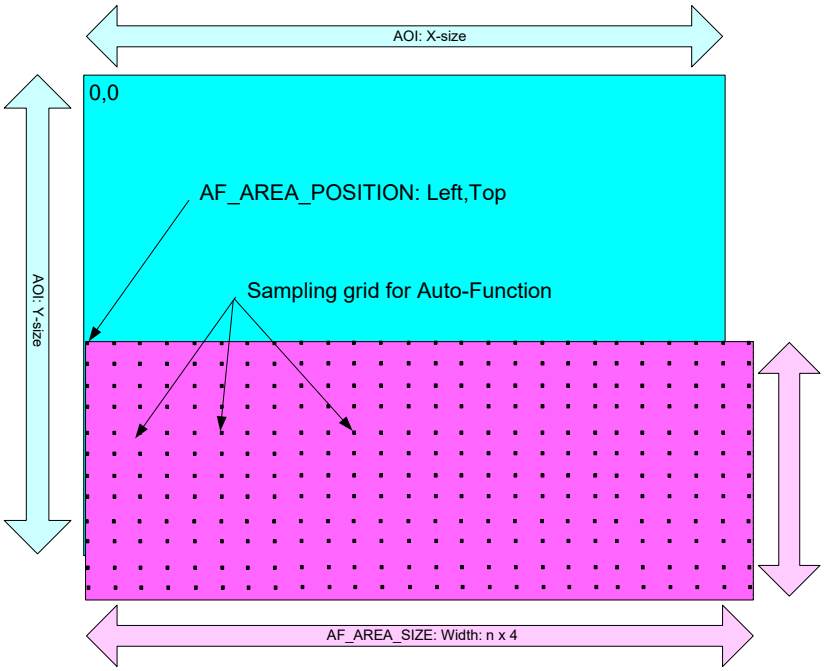


Figure 31: AUTOFNC_AOI positioning

The algorithm is based on the assumption that the R-G-B component sums of the samples shall be equal, i.e., it assumes that the mean of the sampled grid pixels is to be monochrome.

Visualization of the AUTOFNC_AOI is carried out with the help of the graphics overlay (see: block diagram) function of the camera. This area is highlighted when the **Show work area** bit is set high.

Note The algorithm will try to create an uncolored image when looking at an area that is completely colored with **auto white balance ON**.

Manual gain

As shown in:

- Figure 28: Block diagram of AFE (Source: Analog Devices) on page 83

... all cameras are equipped with a gain setting, allowing the gain to be **manually** adjusted on the fly by means of a simple command register write.

The following ranges can be used when manually setting the gain for the analog video signal:

Type	Range	Range in dB	Increment length
CCD cameras	0 ... 680	0 ... 24 dB	~0.035 dB/step

Table 25: Manual gain range of the various Guppy types

Note

- Setting the gain does not change the offset (black value) for CCD models.
- A higher gain also produces greater image noise. This reduces image quality. For this reason, try first to increase the brightness, using the aperture of the camera optics and/or longer shutter settings.

Auto gain

In combination with auto white balance, all Guppy models are equipped with auto gain feature.

When enabled auto gain adjusts the gain within the default gain limits or within the limits set in advanced register F1000370h in order to reach the brightness set in auto exposure register as reference.

Increasing the auto exposure value (aka target grey value) increases the average brightness in the image and vice versa.

The applied algorithm uses a proportional plus integral controller (PI controller) to achieve minimum delay with zero overshot.

The following table shows the gain and auto exposure CSR.

Register	Name	Field	Bit	Description
0xF0F00820	GAIN	Presence_Inq	[0]	Presence of this feature: 0: N/A 1: Available
		Abs_Control	[1]	Absolute value control 0: Control with value in the value field 1: Control with value in the absolute value CSR If this bit= 1 the value in the value field has to be ignored
		-	[2..4]	Reserved
		One_Push	[5]	Write: Set bit high to start Read: Status of the feature: Bit high: WIP Bit low: Ready
		ON_OFF	[6]	Write: ON or OFF this feature Read: read a status 0: OFF 1: ON
		A_M_MODE	[7]	Write: set mode Read: read current mode 0: MANUAL 1: AUTO
		-	[8..19]	Reserved
		Value	[20..31]	Read/Write Value This field is ignored when writing the value in Auto or OFF mode. If readout capability is not available, reading this field has no meaning.

Table 26: CSR: **Gain**

Register	Name	Field	Bit	Description
0xF0F00804	AUTO_EXPOSURE	Presence_Inq	[0]	Presence of this feature: 0: N/A 1: Available
		Abs_Control	[1]	Absolute value control 0: Control with value in the value field 1: Control with value in the absolute value CSR If this bit= 1 the value in the value field has to be ignored
		-	[2..4]	Reserved
		One_Push	[5]	Write: Set bit high to star Read: Status of the feature: Bit high: WIP Bit low: Ready
		ON_OFF	[6]	Write: ON or OFF this feature Read: read a status 0: OFF 1: ON
		A_M_MODE	[7]	Write: set mode Read: read current mode 0: MANUAL 1: AUTO
		-	[8..19]	Reserved
		Value	[20..31]	Read/Write Value This field is ignored when writing the value in Auto or OFF mode. If readout capability is not available, reading this field has no meaning.

Table 27: Auto_Exposure CSR

Note

Configuration

To configure this feature in an advanced register: See Table 87: Advanced register: **Auto gain control** on page 183.

Note

- Values can only be changed within the limits of gain CSR.
- Changes in auto exposure register only have an effect when auto gain is active.
- Auto exposure limits are 50..205. (**SmartView→Ctrl1 tab**: **Target grey level**)

Brightness (black level or offset)

It is possible to set the black level in the camera within the following ranges:

CCD models : 0...+16 gray values (@ 8 bit)

Increments are in 1/16 LSB (@ 8 bit)

CCD models: The formula for gain and offset setting is: Y` = G x Y + Offset

Note

- Setting the gain does not change the offset (black value) for CCD models.

The IIDC register brightness at offset 800h is used for this purpose.

The following table shows the BRIGHTNESS register.

Register	Name	Field	Bit	Description
0xF0F00800	BRIGHTNESS	Presence_Inq	[0]	Presence of this feature: 0: N/A 1: Available
		Abs_Control	[1]	Absolute value control 0: Control with value in the value field 1: Control with value in the absolute value CSR If this bit= 1 the value in the value field has to be ignored
		---	[2..4]	Reserved
		One_Push	[5]	Write: Set bit high to start Read: Status of the feature: Bit high: WIP Bit low: Ready
		ON_OFF	[6]	Write: ON or OFF this feature Read: read a status 0: OFF 1: ON
		A_M_MODE	[7]	Write: set mode Read: read current mode 0: MANUAL 1: AUTO
		---	[8..19]	Reserved
		Value	[20..31]	Read/Write Value; this field is ignored when writing the value in Auto or OFF mode; if readout capability is not available reading this field has no meaning

Table 28: CSR: **Brightness**

Auto shutter

In combination with auto white balance, all Guppy progressive CCD models are equipped with auto shutter feature.

When enabled, the auto shutter adjusts the shutter within the default shutter limits or within those set in advanced register F1000360h in order to reach the reference brightness set in auto exposure register.

Note

Target grey level parameter in SmartView corresponds to **Auto_exposure** register 0xF0F00804 (IIDC).

Increasing the auto exposure value increases the average brightness in the image and vice versa.

The applied algorithm uses a proportional plus integral controller (PI controller) to achieve minimum delay with minimum overshot.

To configure this feature in control and status register (CSR):

Register	Name	Field	Bit	Description
0xF0F0081C	SHUTTER	Presence_Inq	[0]	Presence of this feature: 0: N/A 1: Available
		Abs_Control	[1]	Absolute value control 0: Control with value in the **Value** field 1: Control with value in the **Absolute** value CSR If this bit=1, the value in the **Value** field will be ignored.
		-	[2..4]	Reserved
		One_Push	[5]	Write 1: begin to work (self-cleared after operation) Read: 1: in operation 0: not in operation If A_M_Mode = 1, this bit will be ignored.
		ON_OFF	[6]	Write: ON or OFF this feature Read: read a status 0: OFF 1: ON
		A_M_MODE	[7]	Write: set mode Read: read current mode 0: MANUAL 1: AUTO
		-	[8..19]	Reserved
		Value	[20..31]	Read/Write Value This field is ignored when writing the value in Auto or OFF mode. If readout capability is not available, reading this field has no meaning.

Table 29: CSR: **Shutter**

Note

Configuration

To configure this feature in an advanced register: See Table 86: Advanced register: **Auto shutter control** on page 182.

Look-up table (LUT) and gamma function

The Guppy camera provides one user-defined look-up table (LUT). The use of this LUT allows any function (in the form Output = F(Input)) to be stored in the camera's RAM and applied to the individual pixels of an image at run-time.

The address lines of the RAM are connected to the incoming digital data, these in turn point to the values of functions which are calculated offline, e.g. with a spreadsheet program.

This function needs to be loaded into the camera's RAM before use.

One example of using a LUT is the gamma LUT:

$Output = (Input)^{0.5}$

This gamma LUT is used with all Guppy CCD models. This is known as compensation for the nonlinear brightness response of many displays e.g. CRT monitors. The look-up table converts the 10 bits from the digitizer to 8 bits.

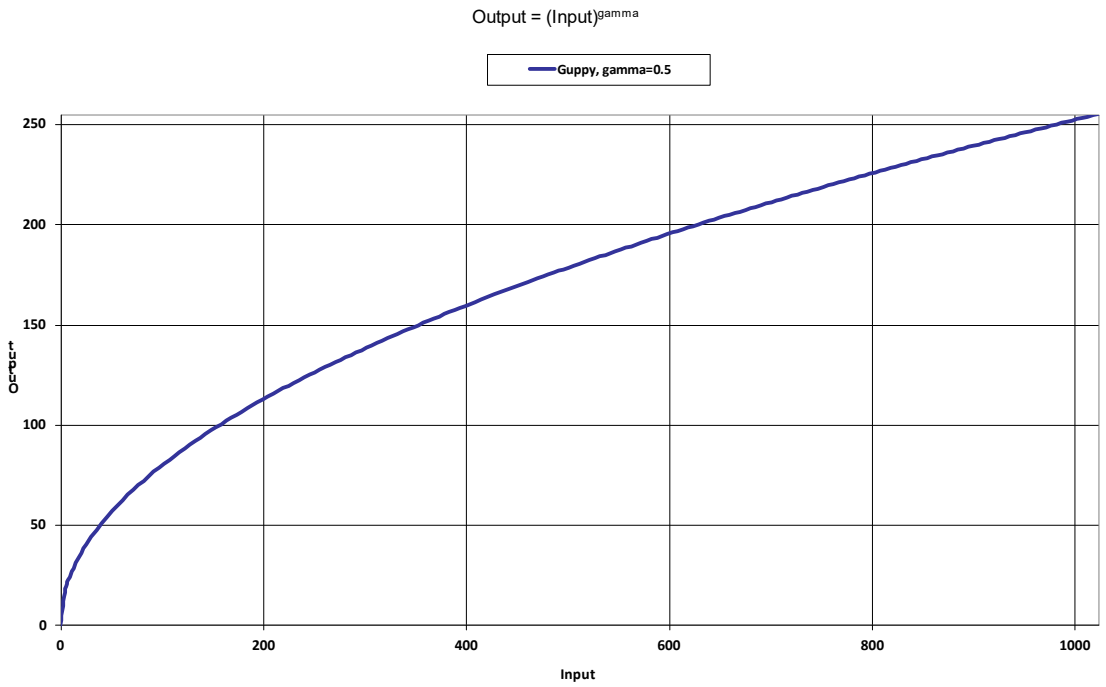


Figure 32: LUT with gamma=0.5

Note

- The input value is the 10-bit value from the digitizer. The gamma LUT of the CCD models outputs the most significant 8 bit as shown above.
- As gamma correction for the CCD models is also implemented via the look-up table, it is not possible to use a different LUT when gamma correction is enabled.
- With all CCD models, the user LUT will be overridden when gamma is enabled.
- LUT content is volatile.

Loading an LUT into the camera

Loading the LUT is carried out through the data exchange buffer called GPDATA_BUFFER. As this buffer can hold a maximum of 2 kB, and a complete LUT at 1024 x 8 bit is 1 kB, programming can take place in a one block write step. The flow diagram below shows the sequence required to load data into the camera.

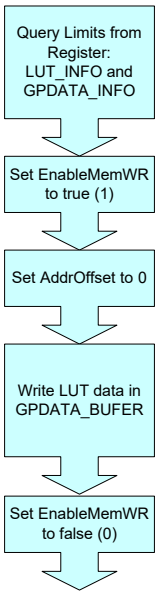


Figure 33: Loading an LUT

Note

Configuration

- To configure this feature in an advanced register: See Table 83: Advanced register: **LUT** on page 178.
- Information on GPDATA_BUFFER: See Chapter GPDATA_BUFFER on page 190.

Packed 12-Bit Mode

Definition Guppy F-146B has the so-called **Packed 12-Bit Mode**. This means: two 12-bit pixel values are packed into 3 bytes instead of 4 bytes.

B/w cameras	Color cameras
Packed 12-Bit MONO camera mode SmartView: MONO12	**Packed 12-Bit RAW** camera mode SmartView: RAW12
Mono and raw mode have the same implementation.	

Table 30: **Packed 12-Bit Mode**

Note

For data block packet format see Table 22: **Packed 12-Bit Mode (mono and raw) Y12 format from Allied Vision** on page 77.

For data structure see Table 23: Data structure of **Packed 12-Bit Mode (mono and raw) from Allied Vision** on page 79.

The color codings are implemented via Vendor Unique Color_Coding according to IIDC V1.31: COLOR_CODING_INQ @ 024h...033h, IDs=128-255)

See Table 72: **Format_7 control and status register** on page 166.

Mode	Color_Coding	ID
Packed 12-Bit MONO	ECCID_MONO12	ID=132
Packed 12-Bit RAW	ECCID_RAW12	ID=136

Table 31: **Packed 12-Bit Mode**: color coding

BAYER pattern (raw data output)

Definition The color sensors capture the color information via so-called primary color (R, G, B) or complementary color (G, Mg, Cy, Ye) filters placed over the individual pixels in a **BAYER mosaic** layout.

No color interpolation Guppy color cameras have no color interpolation, **so the BAYER demosaicing has to be done outside the camera in the PC (raw mode)**.

- For Guppy cameras with SONY progressive scan sensors the first pixel of the sensor is **RED**. (Guppy F-033C, Guppy F-046C, Guppy F-080C)

Serial interface

All Guppy cameras are equipped with the SIO (serial input/output) feature as described in IIDC V1.31. This means that the Guppys serial interface which is used for firmware upgrades can also be used as a general RS232 interface.

Data written to a specific address in the IEEE 1394 address range will be sent through the serial interface. Incoming data of the serial interface is put in a camera buffer and can be polled via simple read commands from this buffer. Controlling registers enable the settings of baud rates and the check of buffer sizes and serial interface errors.

Note

- Hardware handshaking is not supported.
- Typical PC hardware does not usually support 230400 bps.

Base address for the function is: F0F02100h.

To configure this feature in access control register (CSR):

Offset	Name	Field	Bit	Description
000h	SERIAL_MODE_REG	Baud_Rate	[0..7]	Baud rate setting WR: Set baud rate RD: Read baud rate 0: 300 bps 1: 600 bps 2: 1200 bps 3: 2400 bps 4: 4800 bps 5: 9600 bps 6: 19200 bps 7: 38400 bps 8: 57600 bps 9: 115200 bps 10: 230400 bps Other values reserved
		Char_Length	[8..15]	Character length setting WR: Set data length (7 or 8 bit) RD: Get data length 7: 7 bits 8: 8 bits Other values reserved
		Parity	[16..17]	Parity setting WR: Set parity RD: Get parity setting 0: None 1: Odd 2: Even
		Stop_Bit	[18..19]	Stop bits WR: Set stop bit RD: Get stop bit setting 0: 1 1: 1.5 2: 2
		-	[20..23]	Reserved
		Buffer_Size_Inq	[24..31]	Buffer Size (RD only) This field indicates the maximum size of receive/transmit data buffer. If this value=1, Buffer_Status_Control and SIO_Data_Register Char 1-3 should be ignored.

Table 32: Serial input/output control and status register (SIO CSR)

Offset	Name	Field	Bit	Description
0004h	SERIAL_CONTROL_REG	RE	[0]	Receive enable RD: Current status WR: 0: disable 1: Enable
		TE	[1]	Transmit enable RD: Current status WR: 0: disable 1: Enable
		-	[2..7]	Reserved
	SERIAL_STATUS_REG	TDRD	[8]	Transmit data buffer ready Read only 0: not ready 1: ready
		-	[9]	Reserved
		RDRD	[10]	Receive data buffer ready Read only 0: not ready 1: ready
		-	[11]	Reserved
		ORER	[12]	Receive data buffer overrun error Read: current status 0: no error WR: 0 to clear status (1: Ignored)
		FER	[13]	Receive data framing error Read: current status 0: no error WR: 0 to clear status (1: Ignored)
		PER	[14]	Receive data parity error Read: current status 0: no error WR: 0 to clear status (1: Ignored)
		-	[15..31]	Reserved

Table 32: Serial input/output control and status register (SIO CSR)

Offset	Name	Field	Bit	Description
008h	RECEIVE_BUFFER_STATUS_CONTRL	RBUF_ST	[0..7]	SIO receive buffer status RD: Number of bytes pending in receive buffer WR: Ignored
		RBUF_CNT	[8..15]	SIO receive buffer control WR: Number of bytes to be read from the receive FIFO RD: Number of bytes left for readout from the receive FIFO
		-	[16..31]	Reserved
00Ch	TRANSMIT_BUFFER_STATUS_CONTRL	TBUF_ST	[0..7]	SIO output buffer status RD: Space left in TX buffer WR: Ignored
		TBUF_CNT	[8..15]	SIO output buffer control RD: Number of bytes written to transmit FIFO WR: Number of bytes to transmit
		-	[16..31]	Reserved
010h .. 0FFh		-		Reserved
100h	SIO_DATA_REGISTER	CHAR_0	[0..7]	Character_0 RD: Read char. from receive buffer WR: Write char. to transmit buffer
	SIO_DATA_REGISTER	CHAR_1	[8..15]	Character_1 RD/WR
	SIO_DATA_REGISTER	CHAR_2	[16..23]	Character_2 RD/WR
	SIO_DATA_REGISTER	CHAR_3	[24..31]	Character_3 RD/WR

Table 32: Serial input/output control and status register (SIO CSR)

To read data:

1. Query RDRD flag (buffer ready?) and write the number of bytes the host wants to read to RBUF_CNT.
2. Read the number of bytes pending in the receive buffer RBUF_ST (more data in the buffer than the host wanted to read?) and the number of bytes left for reading from the receive FIFO in RBUF_CNT (the host wanted to read more data than were in the buffer?).
3. Read received characters from SIO_DATA_REGISTER, beginning at char 0.
4. To input more characters, repeat from step 1.

To write data:

1. Query TDRD flag (buffer ready?) and write the number of bytes to send (copied from SIO register to transmit FIFO) to TBUF_CNT.
2. Read the available data space left in TBUF_ST (if the buffer can hold more bytes than are to be transmitted) and number of bytes written to transmit buffer in TBUF_CNT (if more data are to be transmitted than fit in the buffer).
3. Write character to SIO_DATA_REGISTER, beginning at char 0.
4. To output more characters, repeat from step 1.

Note

- Contact your local dealer if you require further information or additional test programs or software.
- Allied Vision recommends the use of Hyperterminal™ or other communication programs to test the functionality of this feature. Alternatively use SmartView to try out this feature.

Controlling image capture

Global shutter

Shutter modes The cameras support the SHUTTER_MODES specified in IIDC V1.3. For all Guppy models, this shutter is a **global shutter**; meaning that all pixels are exposed to the light at the same moment and for the same time span.

Continuous mode In continuous modes the shutter is opened shortly before the vertical reset happens, thus acting in a frame-synchronous way.

External trigger Combined with an external trigger, it becomes asynchronous in the sense that it occurs whenever the external trigger occurs. Individual images are recorded when an external trigger impulse is present. This ensures that even fast-moving objects can be grabbed with no image lag and with minimal image blur.

Camera I/O The external trigger comes in as a TTL signal through **Pin 4** of the camera I/O connector.

Trigger modes

The cameras support IIDC conforming Trigger_Mode_0 and Trigger_Mode_1 and special Trigger_Mode_15 (bulk trigger).

Trigger_Mode_x ...	...also known as	Description
Trigger_Mode_0	Edge mode	Sets the shutter time according to the value set in the **shutter** (or extended shutter) **register**
Trigger_Mode_1	Level mode	Sets the shutter time according to the **active low time** of the pulse applied (or active high time in the case of an inverting input)
Trigger_Mode_15	Programmable mode	Is a **bulk trigger**, combining one external trigger event with continuous or one-shot or multi-shot internal trigger

Table 33: Trigger modes

Trigger_Mode_0 (edge mode) and Trigger_Mode_1 (level mode)

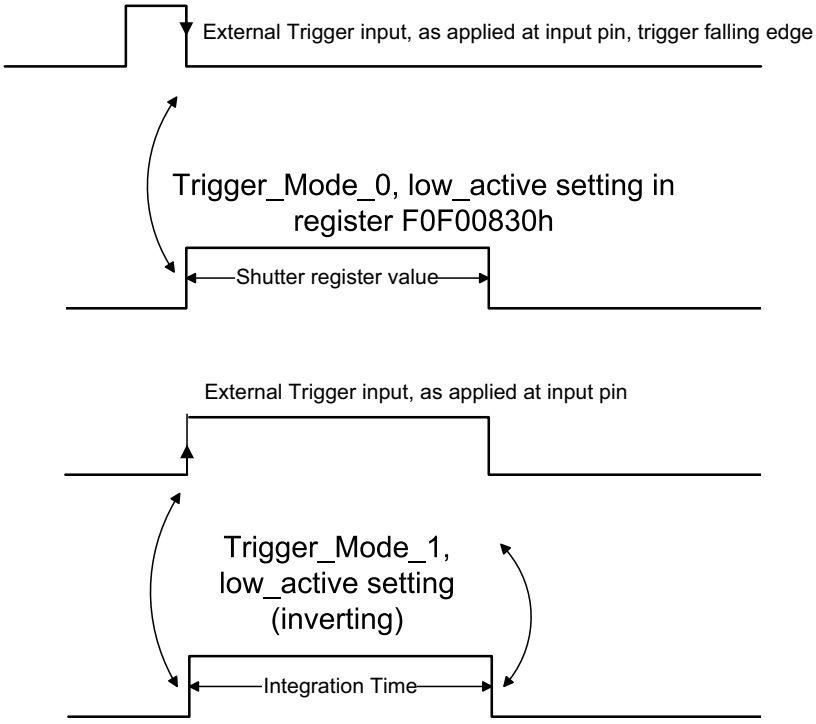


Figure 34: Trigger_Mode_0 and 1: global shutter

Trigger_Mode_15 (bulk trigger)

Note Trigger_Mode_15 is only available for Guppy CCD cameras.

Trigger_Mode_15 is a bulk trigger, combining one external trigger event with continuous or one-shot or multi-shot internal trigger.

It is an extension to the IIDC trigger modes. One external trigger event can be used to trigger a multitude of internal image intakes.

This is especially useful for:

- Grabbing exactly one image based on the first external trigger.
- Filling the camera's internal image buffer with one external trigger without overriding images.
- Grabbing an unlimited number of images after one external trigger (surveillance)

The next diagram shows this mode in detail.

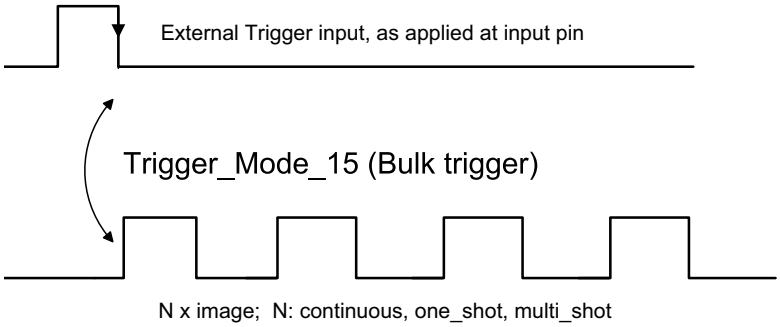


Figure 35: Trigger_Mode_15

The functionality is controlled via bit [6] and bitgroup [12-15] of the IIDC register:

Register	Name	Field	Bit	Description
0xF0F00830	TRIGGER_MODE	Presence_Inq	[0]	Presence of this feature: 0: N/A 1: Available
		Abs_Control	[1]	Absolute value control 0: Control with value in the **Value** field 1: Control with value in the **Absolute** value CSR If this bit = 1 the value in the **Value** field has to be ignored
		---	[2..5]	Reserved
		ON_OFF	[6]	Write: ON or OFF this feature Read: read a status 0: OFF 1: ON If this bit = 0, other fields will be read only.
		Trigger_Polarity	[7]	Select trigger polarity (Except for software trigger) If Polarity_Inq is 1: Write to change polarity of the trigger input. Read to get polarity of the trigger input. If Polarity_Inq is 0: Read only. 0: Low active (inverting) input 1: High active input
		Trigger_Source	[8..10]	Select trigger source Set trigger source ID from trigger source ID_Inq
		Trigger_Value	[11]	Trigger input raw signal value read only 0: Low 1: High
		Trigger_Mode	[12..15]	Trigger_Mode (Trigger_Mode_0..15)
		---	[16..19]	Reserved
		Parameter	[20..31]	Parameter for trigger function, if required (optional)

Table 34: Trigger_Mode_15

The screenshots below illustrate the use of Trigger_Mode_15 on a register level:

- The first line switches continuous mode off, leaving viewer in listen mode.
- The second line prepares 830h register for external trigger and Mode_15.

Left = continuous	Middle = one-shot	Right = multi-shot
The last line switches camera back to **continuous** mode. Only one image is grabbed precisely with the first external trigger. To repeat rewrite line three.	Toggle **one-shot** bit [0] of the One_Shot register 61C so that only one image is grabbed, based on the first external trigger. To repeat rewrite line three.	Toggle **multi-shot** bit [1] of the One_Shot register 61C so that Ah images are grabbed, starting with the first external trigger. To repeat rewrite line three.

Table 35: Description: using Trigger_Mode_15: continuous, one-shot, multi-shot

Figure 36: Using Trigger_Mode_15: continuous, one-shot, multi-shot

Note Shutter for the images is controlled by shutter register.

Trigger delay

As already mentioned earlier, the cameras feature various ways to delay image capture based on external trigger.

With IIDC V1.31 there is a standard CSR at register F0F00534/834h to control a delay up to FFFh x timebase value.

The following table explains the inquiry register and the meaning of the various bits.

Register	Name	Field	Bit	Description
0xF0F00534	TRIGGER_DLY_INQUIRY	Presence_Inq	[0]	Indicates presence of this feature (read only)
		Abs_Control_Inq	[1]	Capability of control with absolute value
		---	[2]	Reserved
		One_Push_Inq	[3]	One-push auto mode (controlled automatically by the camera once)
		Readout_Inq	[4]	Capability of reading out the value of this feature
		ON_OFF	[5]	Capability of switching this feature ON and OFF
		Auto_Inq	[6]	Auto Mode (controlled automatically by the camera)
		Manual_Inq	[7]	Manual Mode (controlled by user)
		Min_Value	[8..19]	Minimum value for this feature (1 µs)
		Max_Value	[20..31]	Maximum value for this feature

Table 36: Trigger delay inquiry register

Register	Name	Field	Bit	Description
0xF0F00834	TRIGGER_DELAY	Presence_Inq	[0]	Presence of this feature: 0: N/A 1: Available
		Abs_Control	[1]	Absolute value control 0: Control with value in the **Value** field 1: Control with value in the **Absolute** value CSR If this bit = 1, the value in the **Value** field has to be ignored
		---	[2..5]	Reserved
		ON_OFF	[6]	Write ON or OFF this feature, ON=1 Read: Status of the feature OFF=0
		---	[7..19]	Reserved
		Value	[20..31]	Value If you write the value in OFF mode, this field will be ignored. If **ReadOut** capability is not available, then the read value will have no meaning.

Table 37: CSR: **trigger delay**

Trigger delay advanced register

In addition, the cameras have an advanced register which allows even more precise delay of image capture after receiving a hardware trigger.

Register	Name	Field	Bit	Description
0xF1000400	TRIGGER_DELAY	Presence_Inq	[0]	Indicates presence of this feature (read only)
		---	[1..5]	Reserved
		ON_OFF	[6]	Trigger delay on/off
		---	[7..10]	Reserved
		DelayTime	[11..31]	Delay time in µs (only with microcontroller firmware greater V2.10: minimum = 1 µs)

Table 38: Advanced CSR: **trigger delay**

The advanced register allows the start of the integration to be delayed by max. 2^{21} µs, which is max. 2.1 s after a trigger edge was detected.

Note

- Switching trigger delay to ON also switches external Trigger_Mode_0 to ON.
- This feature works with external Trigger_Mode_0 only.

Exposure time (shutter) and offset

The exposure (shutter) time for continuous mode and Trigger_Mode_0 is based on the following formula:

Shutter register value x timebase + offset

The register value is the value set in the corresponding IIDC register (SHUTTER [81Ch]). This number is in the range between 1 and 4095.

The shutter register value is multiplied by the time base register value (see Table 80: Time base ID on page 175). The default value here is set to 20 µs.

Exposure time offset

A camera-specific offset is also added to this value. It is different for the camera models:

Camera model	Exposure time offset
Guppy F-033	109 µs
Guppy F-046	22 µs
Guppy F-080	34 µs
Guppy F-146	20 µs

Table 39: Camera-specific exposure time offset

Example Guppy F-033

Camera	Register value	Timebase
Guppy F-033	100	20 µs

Table 40: Register value and Timebase for Guppy F-033

100 x 20 µs + 109 µs = 2109 µs exposure time

The minimum adjustable exposure time set by register is 20 µs. → The real minimum exposure time of Guppy F-033 is then 20 µs + 109 µs = 129 µs.

Extended shutter

The exposure time for long-term integration of:

- up to 67 seconds for the CCD models

can be extended via the EXTENDED_SHUTTER register.

Register	Name	Field	Bit	Description
0xF100020C	EXTD_SHUTTER	Presence_Inq	[0]	Indicates presence of this feature (read only)
		---	[1..5]	Reserved
		ExpTime	[6..31]	Exposure time in µs

Table 41: Extended shutter configuration

The longest exposure time, 3FFFFFFh, corresponds to 67.11 sec.

Note

- Exposure times entered via the 81Ch register are mirrored in the extended register, but not vice versa.
- Longer integration times not only increase sensitivity, but may also increase some unwanted effects such as noise and pixel-to-pixel non-uniformity. Depending on the application, these effects may limit the longest usable integration time.
- Changes in this register have immediate effect, even when the camera is transmitting.
- Extended shutter becomes inactive after writing to a format/mode/frame rate register.

One-Shot

The camera can record an image by setting the **one-shot bit** in the 61Ch register. This bit is automatically cleared after the image is captured. If the camera is placed in Iso_Enable mode (see Chapter ISO_Enable / free-run on page 115), this flag is ignored.

If **one-shot mode** is combined with the external trigger, the **one-shot** command is used to arm it. The following screenshot shows the sequence of commands needed to put the camera into this mode. It enables the camera to grab exactly one image with an external trigger edge.

If there is no trigger impulse after the camera has been armed, **one-shot** can be cancelled by clearing the bit.

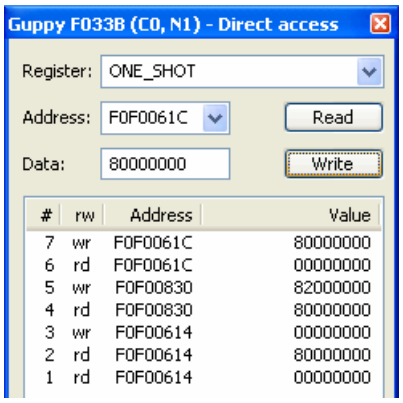


Figure 37: One-shot control (SmartView)

#	Read/Write	Address	Value	Description
7	wr	F0F0061C	80000000	Do one-shot.
6	rd	F0F0061C	00000000	Read out one-shot register.
5	wr	F0F00830	82000000	Switch on external trigger mode 0.
4	rd	F0F00830	80000000	Check trigger status.
3	wr	F0F00614	00000000	Stop free-run.
2	rd	F0F00614	80000000	Check Iso_Enable mode (→free-run).
1	rd	F0F00614	00000000	This line is produced by SmartView.

Table 42: One-shot control: descriptions

One-shot command on the bus to start of exposure

The following sections describe the time response of the camera using a single frame (one-shot) command. As set out in the IIDC specification, this is a software command that causes the camera to record and transmit a single frame.

The following values apply only when the camera is idle and ready for use. Full resolution must also be set.

Feature	Value
One-shot → Microcontroller-Sync	≤ 250 µs (processing time in the microcontroller)
µC-Sync/ExSync → Integration-Start	8 µs

Table 43: Values for one-shot

Microcontroller-Sync is an internal signal. It is generated by the microcontroller to initiate a trigger. This can either be a direct trigger or a release for ExSync if the camera is externally triggered.

End of exposure to first packet on the bus

After the exposure, the CCD sensor is read out; some data is written into a small FIFO buffer before being transmitted to the bus.

The time from the end of exposure to the start of transport on the bus is:

500 µs ± 62.5 µs

This time 'jitters' with the cycle time of the bus (125 µs).

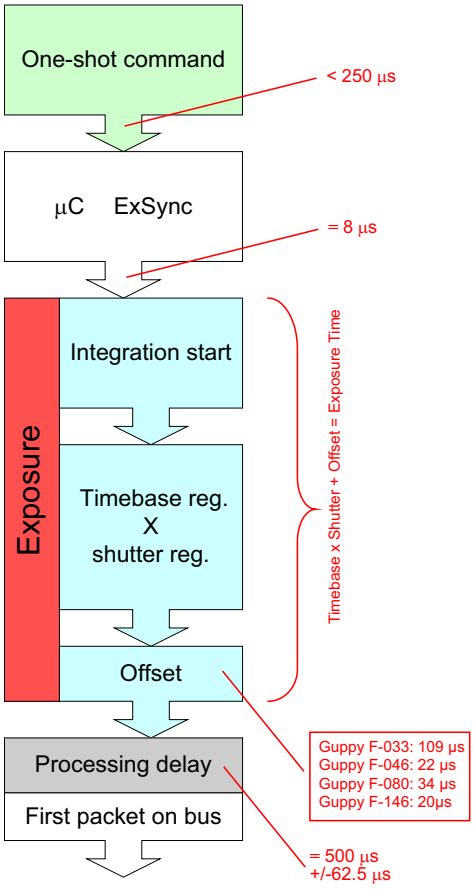


Figure 38: Data flow and timing after end of exposure

Multi-shot

Setting **multi-shot** and entering a quantity of images in **Count_Number** in the 61Ch register enables the camera to record a specified number of images.

The number is indicated in bits 16 to 31. If the camera is put into **Iso_Enable** mode (see Chapter ISO_Enable / free-run on page 115), this flag is ignored and deleted automatically once all the images have been recorded.

If **multi-shot** mode is activated and the images have not yet all been captured, it can be cancelled by resetting the flag. The same result can be achieved by setting the number of images to **0**.

Multi-shot can also be combined with the external trigger in order to grab a certain number of images based on an external trigger.

ISO_Enable / free-run

Setting the MSB (bit 0) in the 614h register (ISO_ENA) puts the camera into ISO_Enable mode or Continuous_Shot. The camera captures an infinite series of images. This operation can be quit by deleting the **0** bit.

Asynchronous broadcast

The camera accepts asynchronous broadcasts. This involves asynchronous write requests that use node number 63 as the target node with no acknowledge.

This makes it possible for all cameras on a bus to be triggered by software simultaneously - e.g. by broadcasting a **one-shot**. All cameras receive the **one-shot** command in the same IEEE 1394 bus cycle. This creates uncertainty for all cameras in the range of 125 µs.

Inter-camera latency is described in Chapter Jitter at start of exposure on page 116.

The following screenshot shows an example of broadcast commands sent with the Firedemo example of FirePackage (version 1V51 or newer):

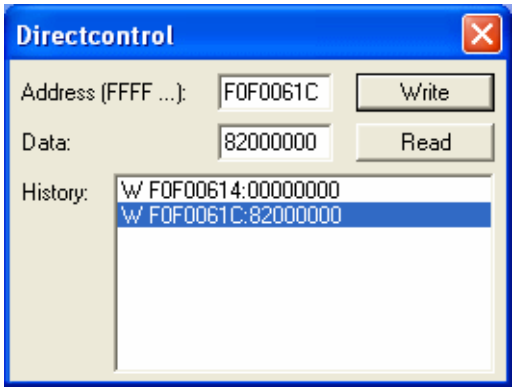


Figure 39: Broadcast one-shot

- Line 1 shows the broadcast command, which stops all cameras connected to the same IEEE 1394 bus. It is generated by holding the **Shift** key down while clicking on **Write**.
- Line 2 generates a **broadcast one-shot** in the same way, which forces all connected cameras to simultaneously grab one image.

Jitter at start of exposure

The following chapter discusses the latency time which exists for all models when either a hardware or software trigger is generated, until the actual image exposure starts.

Owing to the well-known fact that an **Interline Transfer CCD** sensor has both a light sensitive area and a separate storage area, it is common to interleave image exposure of a new frame and output that of the previous one. It makes continuous image flow possible, even with an external trigger.

For the CCDs the uncertainty time delay before the start of exposure depends on the state of the sensor. A distinction is made as follows:

FVal is active → the sensor is reading out, the camera is busy

In this case the camera must not change horizontal timing so that the trigger event is synchronized with the current horizontal clock. This introduces a max. uncertainty which is equivalent to the line time. The row time depends on the sensor used and therefore can vary from model to model.

FVal is inactive → the sensor is ready, the camera is idle

In this case the camera can resynchronize the horizontal clock to the new trigger event, leaving only a very short uncertainty time of the master clock period.

Model	Camera idle	Camera busy
Guppy F-033	40.69 ns	32.29 µs
Guppy F-046	33.34 ns	31.73 µs
Guppy F-080	30.30 ns	40.45 µs
Guppy F-146	30.30 ns	42.18 µs

Table 44: Jitter at exposure start

Note

Jitter at the beginning of an exposure has no effect on the length of exposure, i.e. it is always constant.

User profiles

User profiles are also known as memory channels from the IIDC specifications.

The feature is described in Chapter User profiles on page 186.

Video formats, modes and bandwidth

The different Guppy models support different video formats, modes and frame rates.

These formats and modes are standardized in the IIDC (formerly DCAM) specification.

Resolutions smaller than the generic sensor resolution are generated from the center of the sensor and without binning.

Note

- The maximum frame rates can only be achieved with shutter settings lower than 1/framerate. This means that with default shutter time of 40 ms, a camera will not achieve frame rates higher than 25 frames/s. In order to achieve higher frame rates, please reduce the shutter time proportionally.
- **The following tables assume that bus speed is 400 Mbit/s.** With lower bus speeds (e.g. 200 or 100 Mbit/s) not all frame rates may be achieved.
- For information on bit/pixel and byte/pixel for each color mode see Table 54: ByteDepth on page 135.

Note

H-binning means horizontal binning.

V-binning means vertical binning.

Full binning means horizontal + vertical binning

2 x binning means: 2 neighboring pixels are combined.

4 x binning means: 4 neighboring pixels are combined.

Binning average means: signals form adjacent pixels are combined by averaging. Binning increases signal-to-noise ratio (SNR), but decreases resolution.

Guppy F-033B / Guppy F-033C

Format	Mode	Resolution	Color mode	60 fps	30 fps	15 fps	7.5 fps	3.75 fps	1.875 fps
0	0	160 x 120	YUV444						
	1	320 x 240	YUV422						
	2	640 x 480	YUV411						
	3	640 x 480	YUV422						
	4	640 x 480	RGB8						
	5	640 x 480	MONO8	x x*	x x*	x x*	x x*	x x*	
	6	640 x 480	MONO16						
7	0	656 x 494	MONO8	@58 fps					
		656 x 494	Raw8	@58 fps					
	1								
	2								
	3								

Table 45: Video formats Guppy F-033B / Guppy F-033C

*: Color camera outputs RAW image, which needs to be converted outside of camera.

Guppy F-046B / Guppy F-046C

Format	Mode	Resolution	Color mode	60 fps	30 fps	15 fps	7.5 fps	3.75 fps	1.875 fps
0	0	160 x 120	YUV444						
	1	320 x 240	YUV422						
	2	640 x 480	YUV411						
	3	640 x 480	YUV422						
	4	640 x 480	RGB8						
	5	640 x 480	MONO8	x x*	x x*	x x*	x x*	x x*	
	6	640 x 480	MONO16						
7	0	780 x 582	MONO8	@49.4 fps					
		780 x 582	Raw8	@49.4 fps					
	1								
	2								
	3								

Table 46: Video formats Guppy F-046B / Guppy F-046C

*: Color camera outputs RAW image, which needs to be converted outside of camera.

Guppy F-080B / Guppy F-080C

Format	Mode	Resolution	Color mode	60 fps	30 fps	15 fps	7.5 fps	3.75 fps	1.875 fps
0	0	160 x 120	YUV444						
	1	320 x 240	YUV422						
	2	640 x 480	YUV411						
	3	640 x 480	YUV422						
	4	640 x 480	RGB8						
	5	640 x 480	MONO8		x x*	x x*	x x*	x x*	
	6	640 x 480	MONO16						
1	0	800 x 600	YUV422						
	1	800 x 600	RGB8						
	2	800 x 600	MONO8		x x*	x x*	x x*		
	3	1024 x 768	YUV422						
	4	1024 x 768	RGB8						
	5	1024 x 768	MONO8		x x*	x x*	x x*	x x*	
	6	800 x 600	MONO16						
	7	1024 x 768	MONO16						
7	0	1032 x 778	MONO8	@30 fps					
		1032 x 778	Raw8	@30 fps					
	1								
	2								
	3								

Table 47: Video formats Guppy F-080B / Guppy F-080C

*: Color camera outputs RAW image, which needs to be converted outside of camera.

Guppy F-146B / Guppy F-146C

Format	Mode	Resolution	Color mode	60 fps	30 fps	15 fps	7.5 fps	3.75 fps	1.875 fps
0	0	160 x 120	YUV444						
	1	320 x 240	YUV422						
	2	640 x 480	YUV411						
	3	640 x 480	YUV422						
	4	640 x 480	RGB8						
	5	640 x 480	MONO8		x x*	x x*	x x*	x x*	
	6	640 x 480	MONO16		x	x	x	x	
1	0	800 x 600	YUV422						
	1	800 x 600	RGB8						
	2	800 x 600	MONO8			x x*	x x*		
	3	1024 x 768	YUV422						
	4	1024 x 768	RGB8						
	5	1024 x 768	MONO8			x x*	x x*	x x*	x x*
	6	800 x 600	MONO16			x	x		
	7	1024 x 768	MONO16			x	x	x	x
2	0	1280 x 960	YUV422						
	1	1280 x 960	RGB8						
	2	1280 x 960	Mono8			x x*	x x*	x x*	x x*
	3	1600 x1200	YUV422						
	4	1600 x1200	RGB8						
	5	1600 x1200	Mono8						
	6	1280 x 960	Mono16				x	x	x
	7	1600 x1200	Mono16						
7	0	1392 x 1040 1392 x 1040	Mono8 Mono12 Mono16 Raw8,Mono8 Raw12 Raw16	@17.7 fps @15.0 fps @11.3 fps @17.7 fps @15.0 fps @11.3 fps					
	1								
	2								
	3								

Table 48: Video formats Guppy F-146B / Guppy F-146C

*: Color camera outputs RAW image, which needs to be converted outside of camera.

Area of interest (AOI)

The camera's image sensor has a defined resolution. This indicates the maximum number of lines and pixels per line that the recorded image may have.

However, often only a certain section of the entire image is of interest. The amount of data to be transferred can be decreased by limiting the image to a section when reading it out from the camera. At a lower vertical resolution the sensor can be read out faster and thus the frame rate is increased.

Note The setting of AOIs is supported only in video Format_7.

While the size of the image read out for most other video formats and modes is fixed by the IIDC specification, thereby determining the highest possible frame rate, in Format_7 mode the user can set the **upper left corner** and **width and height** of the section (Area of Interest = AOI) he is interested in to determine the size and thus the highest possible frame rate.

Setting the AOI is done in the IMAGE_POSITION and IMAGE_SIZE registers.

Note Attention should be paid to the increments entered in the UNIT_SIZE_INQ and UNIT_POSITION_INQ registers when configuring IMAGE_POSITION and IMAGE_SIZE.

IMAGE_POSITION and IMAGE_SIZE contain the respective bits values for the column and line of the upper left corner and values for the width and height.

Note

For more information see Table 72: **Format_7 control and status register** on page 166.

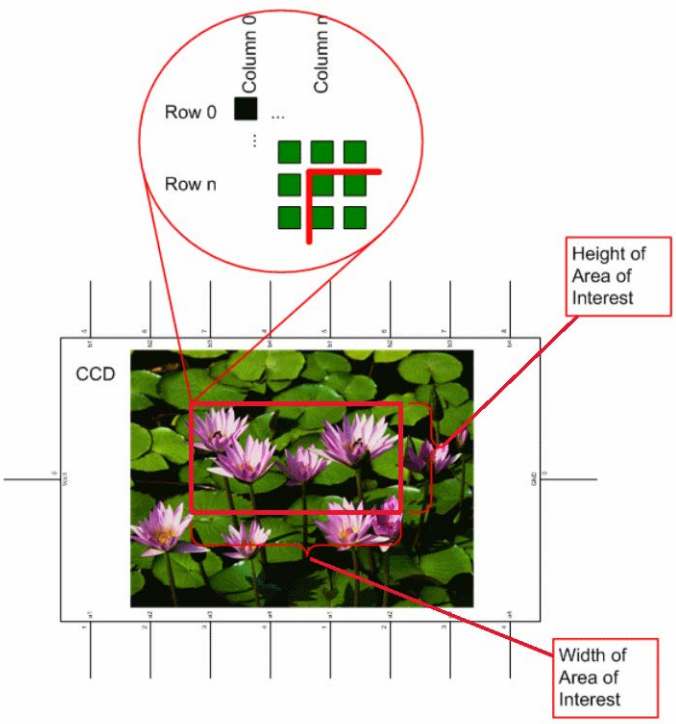


Figure 40: Area of interest (AOI)

Note

- The left position + width and the upper position + height may not exceed the maximum resolution of the sensor.
- The coordinates for width and height must be divisible by 4.

In addition to the area of interest (AOI), some other parameters have an effect on the maximum frame rate:

- The time for reading the image from the sensor and transporting it into the FRAME_BUFFER
- The time for transferring the image over the FireWire™ bus
- The length of the exposure time.

Autofunction AOI

Use this feature to select the image area (work area) on which the following autofunctions work:

- Auto shutter
- Auto gain
- Auto white balance

In the following screenshot you can see an example of the autofunction AOI:

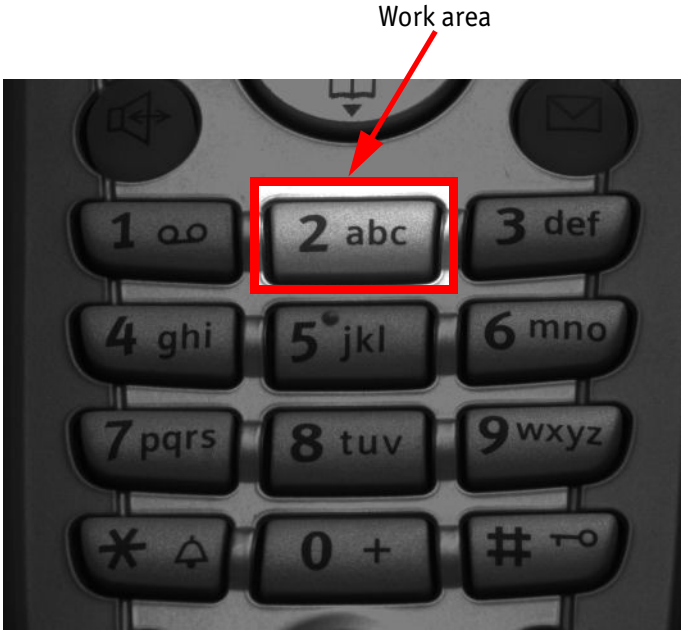


Figure 41: Example of autofunction AOI (Show work area is on)

Note

For more information see Chapter Autofunction AOI on page 184.

Note

Autofunction AOI is independent from Format_7 AOI settings.

If you switch off autofunction AOI, work area position and work area size follow the current active image size.

To switch off autofunctions, carry out following actions in the order shown:

1. Uncheck **Show AOI** check box (SmartView **Ctrl2** tab).
2. Uncheck **Enable** check box (SmartView **Ctrl2** tab).
   Switch off Auto modi (e.g. **Shutter** and/or **Gain**) (SmartView **Ctrl2** tab).

As a reference it uses a grid of up to 65534 sample points (in 2^n steps) equally spread over the AOI.

Frame rates

An IEEE 1394 camera requires bandwidth to transport images.

The IEEE 1394a bus has very large bandwidth of at least 32 MByte/s for transferring (isochronously) image data. Per cycle up to 4096 bytes (or around 1000 quadlets = 4 bytes@ 400 Mbit/s) can thus be transmitted.

Note

All bandwidth data is calculated with:

1 MByte = 1024 kByte

Depending on the video format settings and the configured frame rate, the camera requires a certain percentage of maximum available bandwidth. Clearly, the bigger the image and the higher the frame rate, the more data requires transmission.

The following tables indicate the volume of data in various formats and modes to be sent within one cycle (125 µs) at 400 Mbit/s of bandwidth.

The tables are divided into three formats:

Format	Resolution	Max. video format
Format_0	up to VGA	640 x 480
Format_1	up to XGA	1024 x 768
Format_2	up to UXGA	1600 x 1200

Table 49: Overview fixed formats

They enable you to calculate the required bandwidth and to ascertain the number of cameras that can be operated independently on a bus and in which mode.

Note

- If the cameras are operated with an external trigger the maximum trigger frequency may not exceed the highest continuous frame rate, thus preventing frames from being dropped or corrupted.
- IEEE 1394 adapter cards with PCILynx™ chipsets have a limit of 4000 bytes per cycle.

The frame rates in video modes 0 to 2 are specified, and settings are fixed by IIDC V1.3.

Frame rates Format_7

In video Format_7 frame rates are no longer fixed.

Note

- Different values apply for the different sensors.
- Frame rates may be further limited by longer shutter times and/or bandwidth limitation from the IEEE 1394 bus.

Frame rates may be further limited by bandwidth limitation from the IEEE 1394 bus.

Details are described in the next chapters:

- Max. frame rate of CCD (theoretical formula)
- Diagram of frame rates as function of AOI by constant width: the curves describe RAW8
- Table with max. frame rates as function of AOI by constant width

Guppy F-033 and board level versions: AOI frame rates

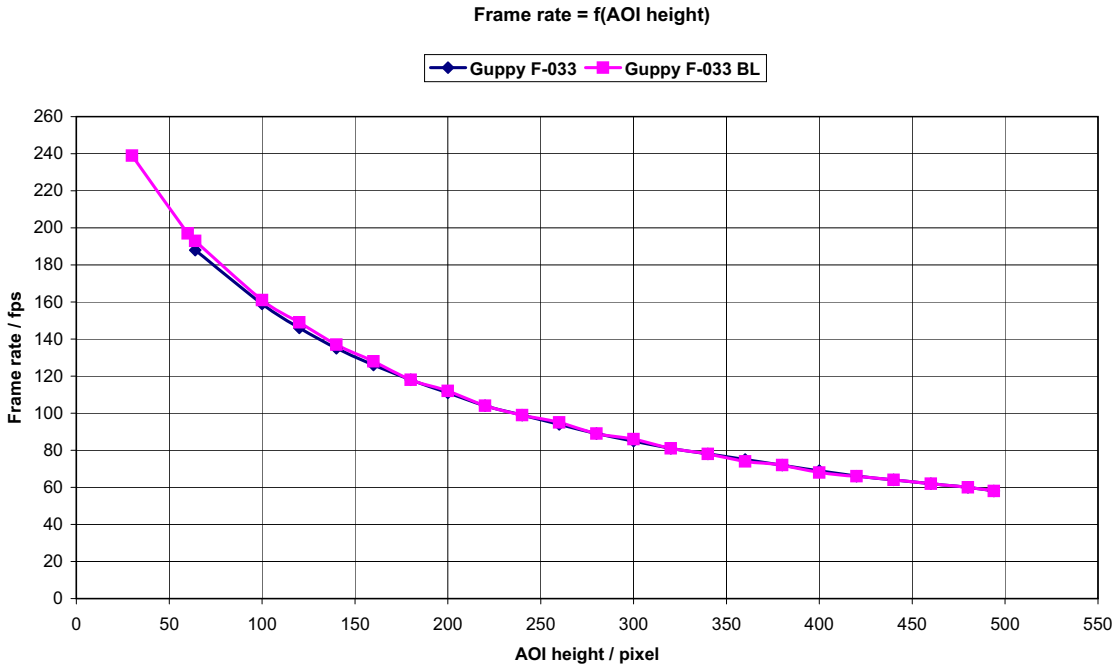


Figure 42: Frame rates Guppy F-033 and board level versions

AOI height / pixel	Frame rate / fps Guppy F-033	Frame rate / fps Guppy F-033 BL
494	58	58
480	60	60
460	62	62
440	64	64
420	66	66
400	69	68
380	72	72
360	75	74
340	78	78
320	81	81
300	85	86
280	89	89

Table 50: Frame rates Guppy F-033 and board level versions

AOI height / pixel	Frame rate / fps Guppy F-033	Frame rate / fps Guppy F-033 BL
260	94	95
240	99	99
220	104	104
200	111	112
180	118	118
160	126	128
140	135	137
120	146	149
100	159	161
64	188	193
60	not available	197
30	not available	239

Table 50: Frame rates Guppy F-033 and board level versions

Guppy F-046: AOI frame rates

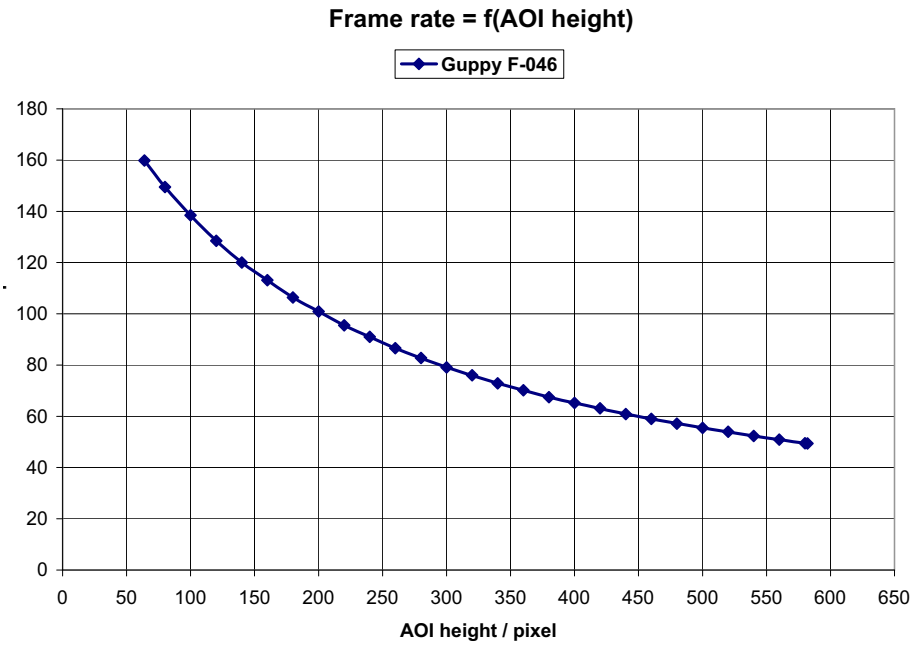


Figure 43: Frame rates Guppy F-046 as function of AOI height

AOI height / pixel	Frame rate / fps
582	49.4
580	49.5
560	50.9
540	52.3
520	54.0
500	55.5
480	57.1
460	59.0
440	60.9
420	63.1
400	65.2
380	67.5
360	70.2
340	72.9
320	76.0

Table 51: Frame rates Guppy F-046

AOI height / pixel	Frame rate / fps
300	79.1
280	82.8
260	86.6
240	91.0
220	95.5
200	100.9
180	106.4
160	113.1
140	120.0
120	128.5
100	138.5
80	149.5
64	159.8

Table 51: Frame rates Guppy F-046

Guppy F-080 and board level versions: AOI frame rates

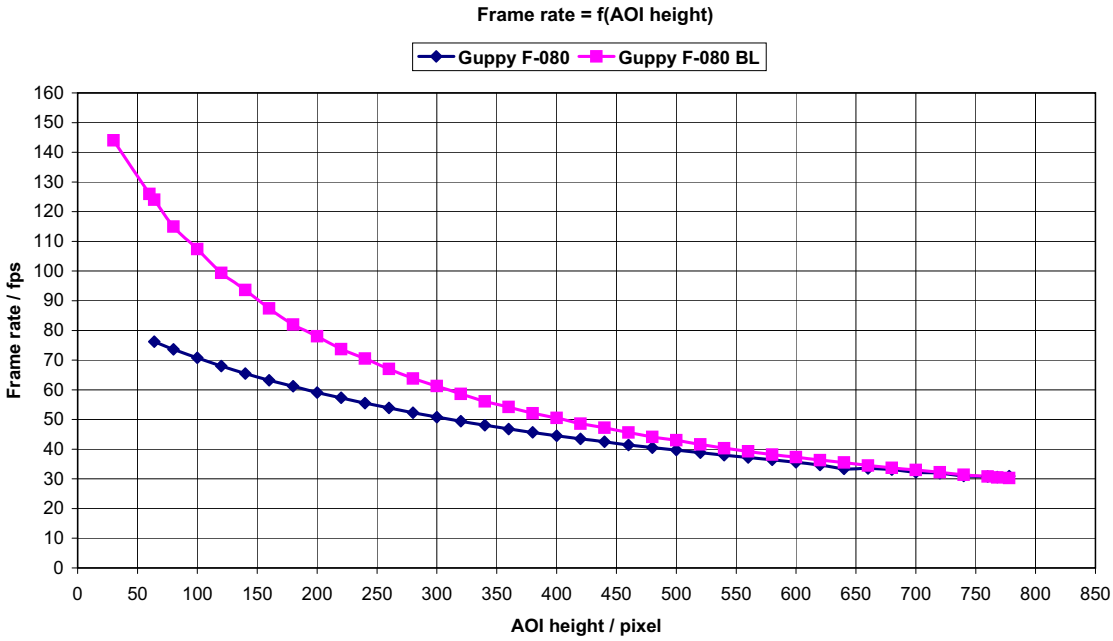


Figure 44: Frame rates Guppy F-080 and board level versions

AOI height / pixel	Frame rate / fps Guppy F-080	Frame rate / fps Guppy F-080 BL
778	30.9	30.3
768	30.6	30.5
760	30.8	30.8
740	31.0	31.4
720	31.9	32.2
700	32.2	33.0
680	33.1	33.7
660	33.5	34.5
640	33.4	35.5
620	34.7	36.3
600	35.6	37.3
580	36.4	38.2

Table 52: Frame rates Guppy F-080 and board level versions

AOI height / pixel	Frame rate / fps Guppy F-080	Frame rate / fps Guppy F-080 BL
560	37.2	39.3
540	38.0	40.3
520	38.8	41.6
500	39.7	43.0
480	40.5	44.1
460	41.4	45.6
440	42.5	47.2
420	43.5	48.6
400	44.5	50.5
380	45.7	52.1
360	46.8	54.2
340	48.1	56.1
320	49.4	58.6
300	50.8	61.3
280	52.3	63.8
260	53.9	67.0
240	55.5	70.5
220	57.3	73.7
200	59.1	78.0
180	61.2	82.0
160	63.2	87.4
140	65.5	93.6
120	68.0	99.4
100	70.8	107.4
80	73.6	115.0
64	76.2	124.0
60	not available	126.0
30	not available	144.0

Table 52: Frame rates Guppy F-080 and board level versions

Guppy F-146: AOI frame rates

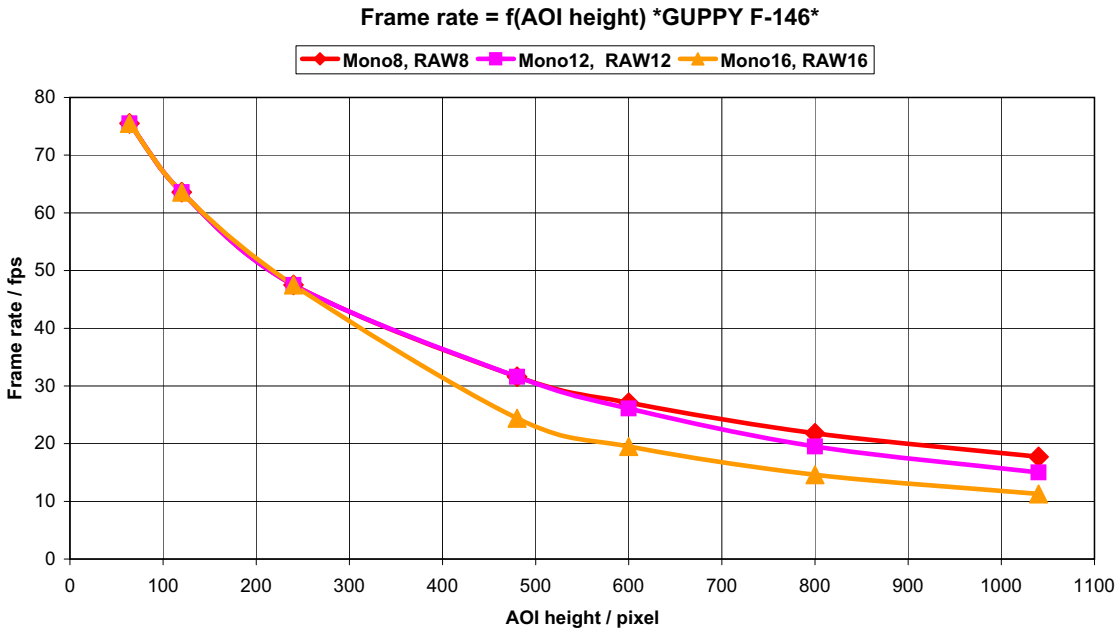


Figure 45: Frame rates Guppy F-146

AOI height / pixel	Mono8/Raw8	Mono12/Raw12	Mono16/Raw16
1040	17.7	15.0	11.3
800	21.8	19.5	14.6
600	27.1	26.1	19.5
480	31.6	31.6	24.4
240	47.5	47.5	47.5
120	63.6	63.6	63.6
64	75.5	75.5	75.5

Table 53: Frame rates (fps) of **Guppy F-146** as a function of AOI height

How does bandwidth affect the frame rate?

In some modes the IEEE 1394a bus limits the attainable frame rate. According to the 1394a specification on isochronous transfer, the largest data payload size of 4096 bytes per 125 µs cycle is possible with bandwidth of 400 Mbit/s. In addition, there is a limitation, only a maximum number of 65535 (2^{16}-1) packets per frame are allowed. For example, Guppy F-036 (discontinued) supports a maximum number of 800 packets due to the sensor limitation.

The following formula establishes the relationship between the required Byte_Per_Packet size and certain variables for the image. It is valid only for Format_7.

$$BYTE\_PER\_PACKET = \text{frame rate} \times AOIWidth \times AOIHEIGHT \times ByteDepth \times 125\mu s$$

Formula 1: Byte_per_Packet calculation (only Format_7)

If the value for **BYTE_PER_PACKET** is greater than 4096 (the maximum data payload), the sought-after frame rate cannot be attained. The attainable frame rate can be calculated using this formula:

(Provision: **BYTE_PER_PACKET** is divisible by 4):

$$framerate_{max} \approx \frac{BYTE\_PER\_PACKET}{AOIWidth \times AOIHeight \times ByteDepth \times 125\mu s}$$

Formula 2: Maximum frame rate calculation

ByteDepth based on the following values:

Mode	Bits/pixel	Byte per pixel
Mono8	8	1
RAW8	8	1

Table 54: ByteDepth

Example formula for the b/w camera
Mono8, 1024 x 768, 15 fps desired

$$BYTE\_PER\_PACKET = 15 \times (1024 \times 768) \times 125\mu s = 1474 < 4096$$

$$\Rightarrow \text{frame rate}_{reachable} \approx \frac{4096}{1024 \times 768 \times 125\mu s} = 41.6 \text{ Hz}$$

Formula 3: Example max. fps calculation

A Frame rate of 15 fps can be achieved. Frame $rate_{reachable}$ is not possible due to the sensor limit.

Test images

Loading test images

FirePackage	Direct FirePackage	Fire4Linux
1. Start **SmartView**. 2. Click the **Edit settings** button.  3. Click **Adv1** tab. 4. In combo box **Test images** choose **Image 1** or another test image.	1. Start **SmartView for WDM**. 2. In **Camera** menu click **Settings**. 3. Click **Adv1** tab. 4. In combo box **Test images** choose **Image 1** or another test image.	1. Start **cc1394** viewer. 2. In **Adjustments** menu click on **Picture Control**. 3. Click **Main** tab. 4. Activate Test image check box **on**. 5. In combo box **Test images** choose **Image 1** or another test image.

Table 55: Loading test images in different viewers

Test images b/w cameras

The b/w cameras have two test images that look the same. Both images show a gray bar running diagonally. One test image is static, the other moves upwards by 1 pixel/frame.

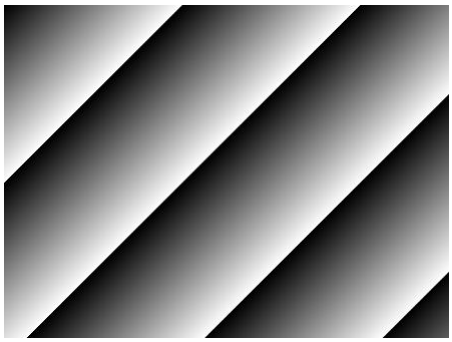


Figure 46: Gray bar test image

$$\text{Gray value} = (x + y) \text{MOD} 256 \qquad \text{(8-bit mode)}$$

Formula 4: Calculating the gray value

Test images for color cameras

The color cameras have 2 test images.

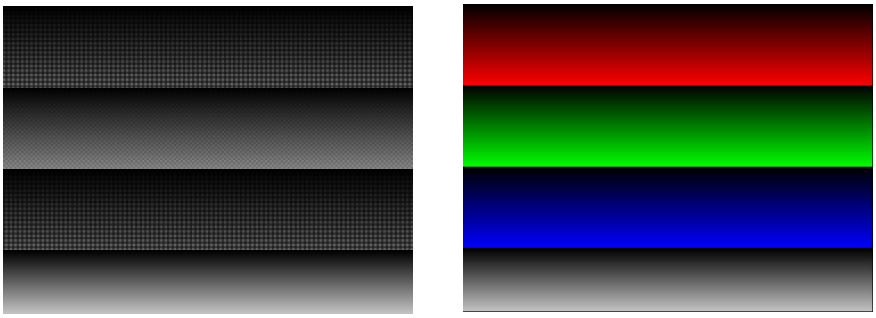
Test image	Description
Test image 1	Mono8 (raw data) static see screenshot below
Test image 2	Available with FPGA 1.05 and higher Mono8 (raw data) moving see screenshot below

Table 56: Test images color cameras

Note

The color camera outputs Bayer-coded raw data in Mono8 instead of a real Y signal (as described in IIDC V1.3).

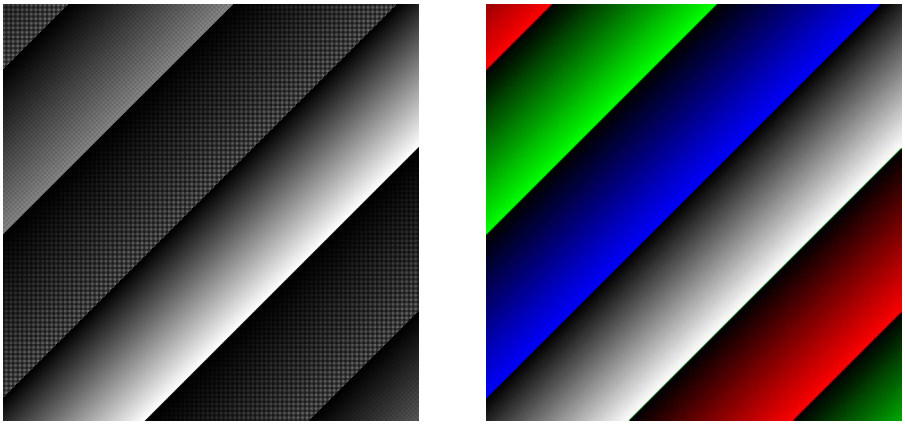
Test image 1 (Mono8 mode) progressive



without Debayering | with Debayering

Figure 47: Test image 1 progressive

Test image 2 (Mono8 mode) progressive



without Debayering | with Debayering

Figure 48: Test image 2 progressive

Note

- Test images show correct colors only in Format_7 Mode_1.

Configuration of the camera

All camera settings are made by writing specific values into the corresponding registers.

This applies to:

- values for general operating states such as video formats and modes, exposure times, etc.
- extended features of the camera that are turned on and off and controlled via corresponding registers (so-called advanced registers).

Camera_Status_Register

The interoperability of cameras from different manufacturers is ensured by IIDC, formerly DCAM (Digital Camera Specification), published by the IEEE 1394 Trade Association.

IIDC is primarily concerned with setting memory addresses (e.g. CSR: Camera_Status_Register) and their meaning.

In principle all addresses in IEEE 1394 networks are 64 bits long.

The first 10 bits describe the Bus_Id, the next 6 bits the Node_Id.

Of the subsequent 48 bits, the first 16 are is always FFFFh, leaving the description for the Camera_Status_Register in the last 32 bits.

If a CSR F0F00600h is mentioned below this means in full:

Bus_Id, Node_Id, FFFF F0F00600h

Writing and reading to and from the register can be done with programs such as **FireView** or by other programs developed using an API library (e.g. **FirePackage**).

Every register is 32 bit (big endian) and implemented as follows (MSB = Most Significant Bit; LSB = Least Significant Bit):

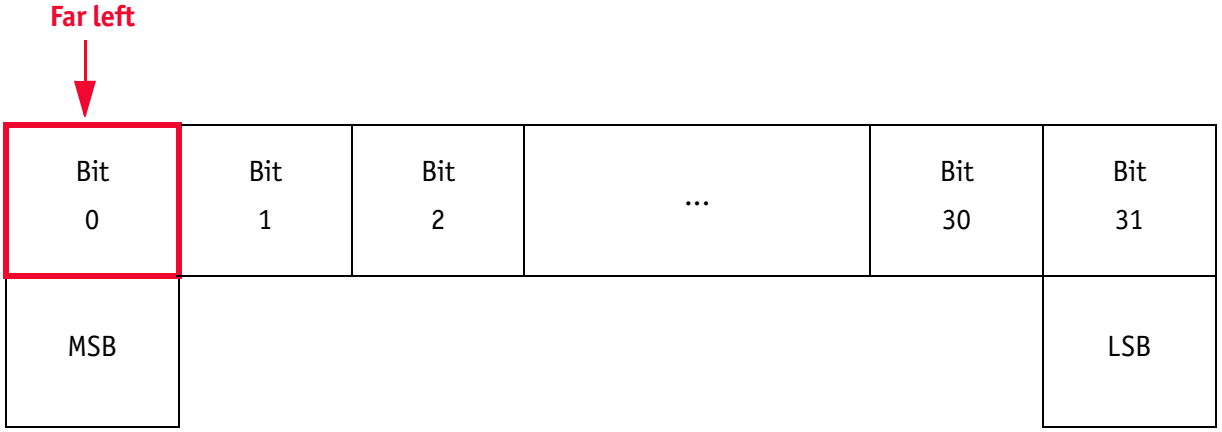


Table 57: 32-bit register

Example

This requires, for example, that to enable **ISO_Enabled mode** (see Chapter ISO_Enable / free-run on page 115), (bit 0 in register 614h), the value 80000000 h must be written in the corresponding register.

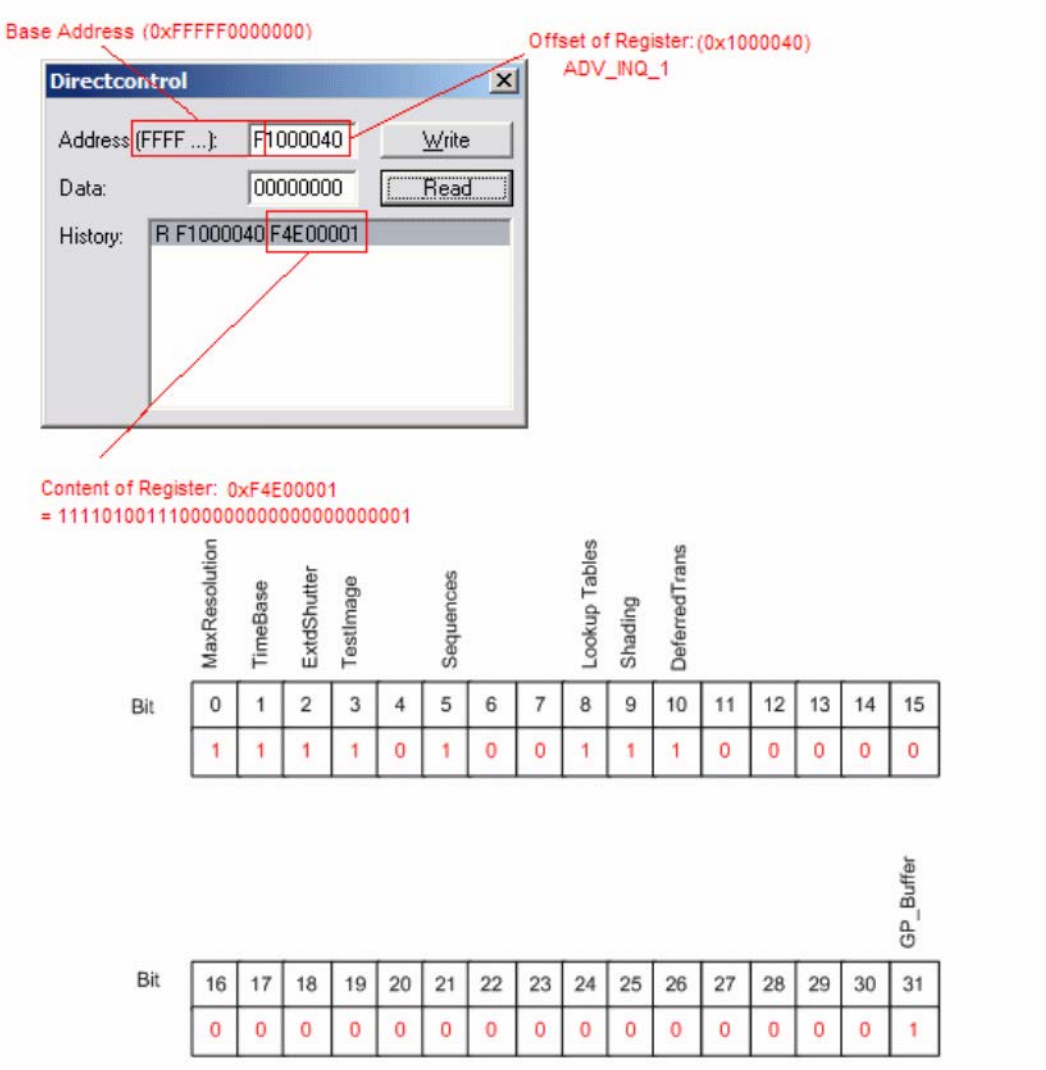


Figure 49: Configuration of the camera

Sample program

The following sample code in C shows how the register is set for frame rate, video mode/format and trigger mode using the **FireCtrl DLL** from the **FirePackage API**. How the camera is switched into **ISO_Enabled** mode is also shown below:

```
…
WriteQuad(m_cmdRegBase + CCR_FRAME-RATE, Frame-Rate << 29);
WriteQuad(m_cmdRegBase + CCR_VMODE, mode << 29);
WriteQuad(m_cmdRegBase + CCR_VFORMAT, format << 29);
WriteQuad(m_cmdRegBase + CCR_TRGMODE, extTrigger ? 0x82000000 : 0);
Sleep(100);
WriteQuad(m_cmdRegBase + CCR_ISOENABLE, 0x80000000);
…
```

Configuration ROM

The information in the Configuration ROM is needed to identify the node, its capabilities and which drivers are required.

The base address for the **configuration ROM** for all registers is FFFF F0000000h.

Note

If you want to use the **Direct access** program to read or write to a register, enter the following value in the Address field:

F0F00000h + Offset

The ConfigRom is divided into the

- Bus info block: providing critical information about the bus-related capabilities
- Root directory: specifying the rest of the content and organization, such as:
  - Node unique ID leaf
  - Unit directory and
  - Unit dependant info

Note

The following assignments are only an example.

Because the key code can describe the roll of a register, the order of some registers is not mandatory.

The base address of the camera control register is calculated as follows based on the camera-specific base address:

	Offset	0-7	8-15	16-23	24-31	
Bus info block	400h	04	29	C3	17	
	404h	31	33	39	34	.... ASCII for 1394
	408h	20	00	A2	02	.... Bus capabilities
	40Ch	00	0A	47	01	.... Node_Vendor_Id, Chip_id_hi
	410h	Serial number				.... Chip_id_lo
Root directory	414h	00	04	CRC		According to IEEE 1212, the root directory length may vary. The keys (e.g. 8D) point to the offset factors rather than the offset (e.g.420h) itself.
	418h	03	00	0A	47	
	41Ch	0C	00	83	C0	
	420h	8D	00	00	02	
	424h	D1	00	00	04	

Table 58: Config ROM

The entry with key 8D in the root directory (420h in this case) provides the offset for the Node unique ID leaf node as follows:

420h + 000002 * 4 = 428h

	Offset	0-7	8-15	16-23	24-31
Node unique ID leaf →	428h	00	02	CRC	
	42Ch	00	0A	47	01
	430h	Serial number			

Table 59: Config ROM

The entry with key D1 in the root directory (424h in this case) provides the offset for the unit directory as follows:

424h + 000004 * 4 = 434h

	Offset	0-7	8-15	16-23	24-31
→	434h	00	03	CRC	
Unit directory	438h	12	00	A0	2D
	43Ch	13	00	01	02
	440h	D4	00	00	01

Table 60: Config ROM

The entry with key D4 in the unit directory (440h in this case) provides the offset for unit dependent info:

440h + 000001 * 4 = 444h

	Offset	0-7	8-15	16-23	24-31
→	444h	00	0B	CRC	
Unit dependent info	448h	40	3C	00	00
	44Ch	81	00	00	0A
	450h	82	00	00	0E
	454h	38	00	00	00
	458h	39	00	00	00
	45Ch	3A	00	00	00
	460h	3B	00	00	00
	464h	3C	00	00	00
	468h	3D	00	00	00
	46Ch	3E	00	00	00
	470h	3F	00	00	00

Table 61: Config ROM

And finally, the entry with key 40 (448h in this case) provides the offset for the camera control register:

FFFF F0000000h + 3C0000h * 4 = FFFF F0F00000h

The base address of the camera control register is thus:

FFFF F0F00000h

The offset entered in the table always refers to the base address of F0F00000h.

Note

If you want to use the **Direct access** program to read or write to a register, enter the following value in the Address field:

F0F00000h + Offset

Implemented registers (IIDC V1.3)

The following tables show how standard registers from IIDC V1.3 are implemented in the camera. Base address is F0F00000h. Differences and explanations can be found in the third column.

Camera initialize register

Offset	Name	Notes
000h	INITIALIZE	Assert MSB = 1 for Init.

Table 62: Camera initialize register

Inquiry register for video format

Offset	Name	Field	Bit	Description
100h	V_FORMAT_INQ	Format_0	[0]	Up to VGA (non compressed)
		Format_1	[1]	SVGA to XGA
		Format_2	[2]	SXGA to UXGA
		Format_3	[3..5]	Reserved
		Format_6	[6]	Still Image Format
		Format_7	[7]	Partial Image Format
		-	[8..31]	Reserved

Table 63: **Format** inquiry register

Inquiry register for video mode

Offset	Name	Field	Bit	Description	Supported
180h	V_MODE_INQ (Format_0)	Mode_0	[0]	160 x 120 YUV 4:4:4	
		Mode _1	[1]	320 x 240 YUV 4:2:2	
		Mode _2	[2]	640 x 480 YUV 4:1:1	
		Mode _3	[3]	640 x 480 YUV 4:2:2	
		Mode _4	[4]	640 x 480 RGB	
		Mode _5	[5]	640 x 480 MONO8	x
		Mode _6	[6]	640 x 480 MONO16	
		Mode _X	[7]	Reserved	
		-	[8..31]	Reserved (zero)	
184h	V_MODE_INQ (Format_1)	Mode_0	[0]	800 x 600 YUV 4:2:2	
		Mode _1	[1]	800 x 600 RGB	
		Mode _2	[2]	800 x 600 MONO8	x
		Mode _3	[3]	1024 x 768 YUV 4:2:2	
		Mode _4	[4]	1024 x 768 RGB	
		Mode _5	[5]	1024 x 768 MONO8	x
		Mode _6	[6]	800 x 600 MONO16	
		Mode _7	[7]	1024 x 768 MONO16	
		-	[8..31]	Reserved (zero)	
188h	V_MODE_INQ (Format_2)	Mode_0	[0]	1280 x 960 YUV 4:2:2	
		Mode _1	[1]	1280 x 960 RGB	
		Mode _2	[2]	1280 x 960 MONO8	x
		Mode _3	[3]	1600 x 1200 YUV 4:2:2	
		Mode _4	[4]	1600 x 1200 RGB	
		Mode _5	[5]	1600 x 1200 MONO8	x
		Mode _6	[6]	1280 x 960 MONO16	
		Mode _7	[7]	1600 x 1200 MONO16	
		-	[8..31]	Reserved (zero)	
18Ch ... 197h	Reserved for other V_MODE_INQ_x for Format_x.			Always 0	
198h	V_MODE_INQ_6 (Format_6)			Always 0	

Table 64: **Video mode** inquiry register

Offset	Name	Field	Bit	Description	Supported
19Ch	V_MODE_INQ (Format_7)	Mode_0	[0]	Format_7 Mode_0	Mono8 RAW8
		Mode _1	[1]	Format_7 Mode_1	
		Mode _2	[2]	Format_7 Mode_2	
		Mode _3	[3]	Format_7 Mode_3	
		Mode _4	[4]	Format_7 Mode_4	
		Mode _5	[5]	Format_7 Mode_5	
		Mode _6	[6]	Format_7 Mode_6	
		Mode _7	[7]	Format_7 Mode_7	
		-	[8..31]	Reserved (zero)	

Table 64: **Video mode** inquiry register

Note

Guppy cameras do not deliver color formats. Therefore Mono8 corresponds to RAW8.

Both formats are supported to allow compatibility with IIDC V1.31 and with other camera models.

Inquiry register for video frame rate and base address

Offset	Name	Field	Bit	Description
200h	V_RATE_INQ (Format_0, Mode_0)	FrameRate_0	[0]	Reserved
		FrameRate _1	[1]	Reserved
		FrameRate _2	[2]	7.5 fps
		FrameRate _3	[3]	15 fps
		FrameRate _4	[4]	30 fps
		FrameRate _5	[5]	60 fps
		FrameRate _6	[6]	120 fps (v1.31)
		FrameRate _7	[7]	240 fps (v1.31)
		-	[8..31]	Reserved (zero)

Table 65: **Frame rate** inquiry register

Offset	Name	Field	Bit	Description
204h	V_RATE_INQ (Format_0, Mode_1)	FrameRate_0	[0]	1.875 fps
		FrameRate _1	[1]	3.75 fps
		FrameRate _2	[2]	7.5 fps
		FrameRate _3	[3]	15 fps
		FrameRate _4	[4]	30 fps
		FrameRate _5	[5]	60 fps
		FrameRate _6	[6]	120 fps (v1.31)
		FrameRate _7	[7]	240 fps (v1.31)
		-	[8..31]	Reserved (zero)
208h	V_RATE_INQ (Format_0, Mode_2)	FrameRate_0	[0]	1.875 fps
		FrameRate _1	[1]	3.75 fps
		FrameRate _2	[2]	7.5 fps
		FrameRate _3	[3]	15 fps
		FrameRate _4	[4]	30 fps
		FrameRate _5	[5]	60 fps
		FrameRate _6	[6]	120 fps (v1.31)
		FrameRate _7	[7]	240 fps (v1.31)
		-	[8..31]	Reserved (zero)
20Ch	V_RATE_INQ (Format_0, Mode_3)	FrameRate_0	[0]	1.875 fps
		FrameRate _1	[1]	3.75 fps
		FrameRate _2	[2]	7.5 fps
		FrameRate _3	[3]	15 fps
		FrameRate _4	[4]	30 fps
		FrameRate _5	[5]	60 fps
		FrameRate _6	[6]	120 fps (v1.31)
		FrameRate _7	[7]	240 fps (v1.31)
		-	[8..31]	Reserved (zero)

Table 65: **Frame rate** inquiry register

Offset	Name	Field	Bit	Description
210h	V_RATE_INQ (Format_0, Mode_4)	FrameRate_0	[0]	1.875 fps
		FrameRate _1	[1]	3.75 fps
		FrameRate _2	[2]	7.5 fps
		FrameRate _3	[3]	15 fps
		FrameRate _4	[4]	30 fps
		FrameRate _5	[5]	60 fps
		FrameRate _6	[6]	120 fps (v1.31)
		FrameRate _7	[7]	240 fps (v1.31)
		-	[8..31]	Reserved (zero)
214h	V_RATE_INQ (Format_0, Mode_5)	FrameRate_0	[0]	1.875 fps
		FrameRate _1	[1]	3.75 fps
		FrameRate _2	[2]	7.5 fps
		FrameRate _3	[3]	15 fps
		FrameRate _4	[4]	30 fps
		FrameRate _5	[5]	60 fps
		FrameRate _6	[6]	120 fps (v1.31)
		FrameRate _7	[7]	240 fps (v1.31)
		-	[8..31]	Reserved (zero)
218h	V_RATE_INQ	(Format_0, Mode_6) FrameRate_0	[0]	1.875 fps
		FrameRate _1	[1]	3.75 fps
		FrameRate _2	[2]	7.5 fps
		FrameRate _3	[3]	15 fps
		FrameRate _4	[4]	30 fps
		FrameRate _5	[5]	60 fps
		FrameRate _6	[6]	120 fps (v1.31)
		FrameRate _7	[7]	240 fps (v1.31)
		-	[8..31]	Reserved (zero)
21Ch ... 21Fh	Reserved V_RATE_INQ_0_x (for other Mode_x of Format_0)			Always 0

Table 65: **Frame rate** inquiry register

Offset	Name	Field	Bit	Description
220h	V_RATE_INQ (Format_1, Mode_0)	FrameRate_0	[0]	Reserved
		FrameRate _1	[1]	3.75 fps
		FrameRate _2	[2]	7.5 fps
		FrameRate _3	[3]	15 fps
		FrameRate _4	[4]	30 fps
		FrameRate _5	[5]	60 fps
		FrameRate _6	[6]	120 fps (v1.31)
		FrameRate _7	[7]	240 fps (v1.31)
		-	[8..31]	Reserved (zero)
224h	V_RATE_INQ (Format_1, Mode_1)	FrameRate_0	[0]	Reserved
		FrameRate _1	[1]	Reserved
		FrameRate _2	[2]	7.5 fps
		FrameRate _3	[3]	15 fps
		FrameRate _4	[4]	30 fps
		FrameRate _5	[5]	60 fps
		FrameRate _6	[6]	120 fps (v1.31)
		FrameRate _7	[7]	240 fps (v1.31)
		-	[8..31]	Reserved (zero)
228h	V_RATE_INQ (Format_1, Mode_2)	FrameRate_0	[0]	Reserved
		FrameRate _1	[1]	Reserved
		FrameRate _2	[2]	7.5 fps
		FrameRate _3	[3]	15 fps
		FrameRate _4	[4]	30 fps
		FrameRate _5	[5]	60 fps
		FrameRate _6	[6]	120 fps (v1.31)
		FrameRate _7	[7]	240 fps (v1.31)
		-	[8..31]	Reserved (zero)

Table 65: **Frame rate** inquiry register

Offset	Name	Field	Bit	Description
22Ch	V_RATE_INQ (Format_1, Mode_3)	FrameRate_0	[0]	1.875 fps
		FrameRate _1	[1]	3.75 fps
		FrameRate _2	[2]	7.5 fps
		FrameRate _3	[3]	15 fps
		FrameRate _4	[4]	30 fps
		FrameRate _5	[5]	60 fps
		FrameRate _6	[6]	120 fps (v1.31)
		FrameRate _7	[7]	240 fps (v1.31)
		-	[8..31]	Reserved (zero)
230h	V_RATE_INQ (Format_1, Mode_4)	FrameRate_0	[0]	1.875 fps
		FrameRate _1	[1]	3.75 fps
		FrameRate _2	[2]	7.5 fps
		FrameRate _3	[3]	15 fps
		FrameRate _4	[4]	30 fps
		FrameRate _5	[5]	60 fps
		FrameRate _6	[6]	120 fps (v1.31)
		FrameRate _7	[7]	240 fps (v1.31)
		-	[8..31]	Reserved (zero)
234h	V_RATE_INQ (Format_1, Mode_5)	FrameRate_0	[0]	1.875 fps
		FrameRate _1	[1]	3.75 fps
		FrameRate _2	[2]	7.5 fps
		FrameRate _3	[3]	15 fps
		FrameRate _4	[4]	30 fps
		FrameRate _5	[5]	60 fps
		FrameRate _6	[6]	120 fps (v1.31)
		FrameRate _7	[7]	240 fps (v1.31)
		-	[8..31]	Reserved (zero)

Table 65: **Frame rate** inquiry register

Offset	Name	Field	Bit	Description
238h	V_RATE_INQ (Format_1, Mode_6)	FrameRate_0	[0]	1.875 fps
		FrameRate _1	[1]	3.75 fps
		FrameRate _2	[2]	7.5 fps
		FrameRate _3	[3]	15 fps
		FrameRate _4	[4]	30 fps
		FrameRate _5	[5]	60 fps
		FrameRate _6	[6]	120 fps (v1.31)
		FrameRate _7	[7]	240 fps (v1.31)
		-	[8..31]	Reserved (zero)
23Ch	V_RATE_INQ (Format_1, Mode_7)	FrameRate_0	[0]	1.875 fps
		FrameRate _1	[1]	3.75 fps
		FrameRate _2	[2]	7.5 fps
		FrameRate _3	[3]	15 fps
		FrameRate _4	[4]	30 fps
		FrameRate _5	[5]	60 fps
		FrameRate _6	[6]	120 fps (v1.31)
		FrameRate _7	[7]	Reserved
		-	[8..31]	Reserved (zero)
240h	V_RATE_INQ (Format_2, Mode_0)	FrameRate_0	[0]	1.875 fps
		FrameRate _1	[1]	3.75 fps
		FrameRate _2	[2]	7.5 fps
		FrameRate _3	[3]	15 fps
		FrameRate _4	[4]	30 fps
		FrameRate _5	[5]	60 fps
		FrameRate _6	[6]	Reserved
		FrameRate _7	[7]	Reserved
		-	[8..31]	Reserved (zero)

Table 65: **Frame rate** inquiry register

Offset	Name	Field	Bit	Description
244h	V_RATE_INQ (Format_2, Mode_1)	FrameRate_0	[0]	1.875 fps
		FrameRate _1	[1]	3.75 fps
		FrameRate _2	[2]	7.5 fps
		FrameRate _3	[3]	15 fps
		FrameRate _4	[4]	30 fps
		FrameRate _5	[5]	60 fps
		FrameRate _6	[6]	Reserved
		FrameRate _7	[7]	Reserved
		-	[8..31]	Reserved (zero)
248h	V_RATE_INQ (Format_2, Mode_2)	FrameRate_0	[0]	1.875 fps
		FrameRate _1	[1]	3.75 fps
		FrameRate _2	[2]	7.5 fps
		FrameRate _3	[3]	15 fps
		FrameRate _4	[4]	30 fps
		FrameRate _5	[5]	60 fps
		FrameRate _6	[6]	120 fps (v1.31)
		FrameRate _7	[7]	Reserved
		-	[8..31]	Reserved (zero)
24Ch	V_RATE_INQ (Format_2, Mode_3)	FrameRate_0	[0]	1.875 fps
		FrameRate _1	[1]	3.75 fps
		FrameRate _2	[2]	7.5 fps
		FrameRate _3	[3]	15 fps
		FrameRate _4	[4]	30 fps
		FrameRate _5	[5]	60 fps
		FrameRate _6	[6]	Reserved
		FrameRate _7	[7]	Reserved
		-	[8..31]	Reserved (zero)

Table 65: **Frame rate** inquiry register

Offset	Name	Field	Bit	Description
250h	V_RATE_INQ (Format_2, Mode_4)	FrameRate_0	[0]	1.875 fps
		FrameRate _1	[1]	3.75 fps
		FrameRate _2	[2]	7.5 fps
		FrameRate _3	[3]	15 fps
		FrameRate _4	[4]	30 fps
		FrameRate _5	[5]	Reserved
		FrameRate _6	[6]	Reserved
		FrameRate _7	[7]	Reserved
		-	[8..31]	Reserved (zero)
254h	V_RATE_INQ (Format_2, Mode_5)	FrameRate_0	[0]	1.875 fps
		FrameRate _1	[1]	3.75 fps
		FrameRate _2	[2]	7.5 fps
		FrameRate _3	[3]	15 fps
		FrameRate _4	[4]	30 fps
		FrameRate _5	[5]	60 fps
		FrameRate _6	[6]	Reserved
		FrameRate _7	[7]	Reserved
		-	[8..31]	Reserved (zero)
258h	V_RATE_INQ (Format_2, Mode_6)	FrameRate_0	[0]	1.875 fps
		FrameRate _1	[1]	3.75 fps
		FrameRate _2	[2]	7.5 fps
		FrameRate _3	[3]	15 fps
		FrameRate _4	[4]	30 fps
		FrameRate _5	[5]	60 fps
		FrameRate _6	[6]	Reserved
		FrameRate _7	[7]	Reserved
		-	[8..31]	Reserved (zero)

Table 65: **Frame rate** inquiry register

Offset	Name	Field	Bit	Description
25Ch	V_RATE_INQ (Format_2, Mode_7)	FrameRate_0	[0]	1.875 fps
		FrameRate _1	[1]	3.75 fps
		FrameRate _2	[2]	7.5 fps
		FrameRate _3	[3]	15 fps
		FrameRate _4	[4]	30 fps
		FrameRate _5	[5]	60 fps
		FrameRate _6	[6]	Reserved
		FrameRate _7	[7]	Reserved
		-	[8..31]	Reserved
260h ... 2BFh	Reserved V_RATE_INQ_y_x (for other Format_y, Mode_x)			
2C0h	V_REV_INQ_6_0 (Format_6, Mode0)			Always 0
2C4h .. 2DFh	Reserved V_REV_INQ_6_x (for other Mode_x of Format_6)			Always 0
2E0h	V-CSR_INQ_7_0		[0..31]	CSR_quadlet offset for Format_7 Mode_0
2E4h	V-CSR_INQ_7_1		[0..31]	CSR_quadlet offset for Format_7 Mode_1
2E8h	V-CSR_INQ_7_2		[0..31]	CSR_quadlet offset for Format_7 Mode_2
2ECh	V-CSR_INQ_7_3		[0..31]	CSR_quadlet offset for Format_7 Mode_3
2F0h	V-CSR_INQ_7_4		[0..31]	CSR_quadlet offset for Format_7 Mode_4
2F4h	V-CSR_INQ_7_5		[0..31]	CSR_quadlet offset for Format_7 Mode_5
2F8h	V-CSR_INQ_7_6		[0..31]	CSR_quadlet offset for Format_7 Mode_6
2FCh	V-CSR_INQ_7_7		[0..31]	CSR_quadlet offset for Format_7 Mode_7

Table 65: **Frame rate** inquiry register

Inquiry register for basic function

Offset	Name	Field	Bit	Description
400h	BASIC_FUNC_INQ	Advanced_Feature_Inq	[0]	Inquiry for advanced features (Vendor unique Features)
		Vmode_Error_Status_Inq	[1]	Inquiry for existence of Vmode_Error_Status register
		Feature_Control_Error_Status_Inq	[2]	Inquiry for existence of Feature_Control_Error_Status
		Opt_Func_CSR_Inq	[3]	Inquiry for Opt_Func_CSR
		-	[4..7]	
		1394b_mode_Capability	[8]	Inquiry for 1394b_mode_-Capability
		-	[9..15]	Reserved
		Cam_Power_Cntl	[16]	Camera process power ON/OFF capability
		-	[17..18]	Reserved
		One_Shot_Inq	[19]	One Shot transmission capability
		Multi_Shot_Inq	[20]	Multi Shot transmission capability
		-	[21..27]	Reserved
		Memory_Channel	[28..31]	Maximum memory channel number (N) If 0000, no user memory available

Table 66: **Basic function** inquiry register

Inquiry register for feature presence

Offset	Name	Field	Bit	Description
404h	FEATURE_HI_INQ	Brightness	[0]	Brightness Control
		Auto_Exposure	[1]	Auto_Exposure Control
		Sharpness	[2]	Sharpness Control
		White_Balance	[3]	White balance Control
		Hue	[4]	Hue Control
		Saturation	[5]	Saturation Control
		Gamma	[6]	Gamma Control
		Shutter	[7]	Shutter Control
		Gain	[8]	Gain Control
		Iris	[9]	Iris Control
		Focus	[10]	Focus Control
		Temperature	[11]	Temperature Control
		Trigger	[12]	Trigger Control
		Trigger_Delay	[13]	Trigger delay Control
		White_Shading	[14]	White Shading Control
		Frame_Rate	[15]	Frame Rate Control
			[16..31]	Reserved
408h	FEATURE_LO_INQ	Zoom	[0]	Zoom Control
		Pan	[1]	Pan Control
		Tilt	[2]	Tilt Control
		Optical_Filter	[3]	Optical Filter Control
			[4..15]	Reserved
		Capture_Size	[16]	Capture Size for Format_6
		Capture_Quality	[17]	Capture Quality for Format_6
			[16..31]	Reserved
40Ch	OPT_FUNCTION_INQ	-	[0]	Reserved
		PIO	[1]	Parallel Input/Output control
		SIO	[2]	Serial Input/Output control
		Strobe_out	[4..31]	Strobe signal output
410h .. 47Fh	Reserved			Address error on access

Table 67: **Feature presence** inquiry register

Offset	Name	Field	Bit	Description
480h	Advanced_Feature_Inq	Advanced_Feature_Quadlet_Offset	[0..31]	Quadlet offset of the advanced feature CSR's from the base address of initial register space (Vendor unique) This register is the offset for the Access_Control_Register and thus the base address for Advanced Features. Access_Control_Register does not prevent access to advanced features. In some programs it should still always be activated first. **Advanced Feature Set Unique Value** is 7ACh and **CompanyID** is A47h.
484h	PIO_Control_CSR_Inq	PIO_Control_Quadlet_Offset	[0..31]	Quadlet offset of the PIO_Control CSR's from the base address of initial register space (Vendor unique)
488h	SIO_Control_CSR_Inq	SIO_Control_Quadlet_Offset	[0..31]	Quadlet offset of the SIO_Control CSR's from the base address of initial register space (Vendor unique)
48Ch	Strobe_Output_CSR_Inq	Strobe_Output_Quadlet_Offset	[0..31]	Quadlet offset of the Strobe_Output signal CSR's from the base address of initial register space (Vendor unique)

Table 67: **Feature presence** inquiry register

Inquiry register for feature elements

Register	Name	Field	Bit	Description
0xF0F00500	BRIGHTNESS_INQUIRY	Presence_Inq	[0]	Indicates presence of this feature (read only)
		Abs_Control_Inq	[1]	Capability of control with absolute value
		-	[2]	Reserved
		One_Push_Inq	[3]	One-push auto mode (Controlled automatically by the camera once)
		Readout_Inq	[4]	Capability of reading out the value of this feature
		ON_OFF	[5]	Capability of switching this feature ON and OFF
		Auto_Inq	[6]	Auto Mode (Controlled automatically by the camera)
		Manual_Inq	[7]	Manual Mode (Controlled by user)
		Min_Value	[8..19]	Min. value for this feature
		Max_Value	[20..31]	Max. value for this feature
504h	AUTO_EXPOSURE_INQ	Same definition as Brightness_inq.		
508h	SHARPNESS_INQ	Same definition as Brightness_inq.		
50Ch	WHITE_BAL_INQ	Same definition as Brightness_inq.		
510h	HUE_INQ	Same definition as Brightness_inq.		
514h	SATURATION_INQ	Same definition as Brightness_inq.		
518h	GAMMA_INQ	Same definition as Brightness_inq.		
51Ch	SHUTTER_INQ	Same definition as Brightness_inq.		
520h	GAIN_INQ	Same definition as Brightness_inq.		
524h	IRIS_INQ	Always 0		
528h	FOCUS_INQ	Always 0		
52Ch	TEMPERATURE_INQ	Same definition as Brightness_inq.		

Table 68: **Feature elements** inquiry register

Register	Name	Field	Bit	Description
530h	TRIGGER_INQ	Presence_Inq	[0]	Indicates presence of this feature (read only)
		Abs_Control_Inq	[1]	Capability of control with absolute value
		-	[2..3	Reserved
		Readout_Inq	[4]	Capability of reading out the value of this feature
		ON_OFF	[5]	Capability of switching this feature ON and OFF
		Polarity_Inq	[6]	Capability of changing the polarity of the rigger input
		-	[7..15]	Reserved
		Trigger_Mode0_Inq	[16]	Presence of Trigger_Mode 0
		Trigger_Mode1_Inq	[17]	Presence of Trigger_Mode 1
		Trigger_Mode2_Inq	[18]	Presence of Trigger_Mode 2
		Trigger_Mode3_Inq	[19]	Presence of Trigger_Mode 3
		-	[20..30]	Reserved
		Trigger_-Mode15_Inq	[31]	Presence of Trigger_Mode 15
534h	TRIGGER_DELAY_INQUIRY	Presence_Inq	[0]	Indicates presence of this feature (read only)
		Abs_Control_Inq	[1]	Capability of control with absolute value
		-	[2]	Reserved
		One_Push_Inq	[3]	One-push auto mode Con-trolled automatically by the camera once)
		Readout_Inq	[4]	Capability of reading out the value of this feature
		ON_OFF	[5]	Capability of switching this feature ON and OFF
		Auto_Inq	[6]	Auto Mode (Controlled auto-matically by the camera)
		Manual_Inq	[7]	Manual Mode (Controlled by user)
		Min_Value	[8..19]	Min. value for this feature
		Max_Value	[20..31]	Max. value for this feature
538 .. 57Ch	Reserved for other FEATURE_HI_INQ			

Table 68: **Feature elements** inquiry register

Register	Name	Field	Bit	Description
580h	ZOOM_INQ			Always 0
584h	PAN_INQ			Always 0
588h	TILT_INQ			Always 0
58Ch	OPTICAL_FILTER_INQ			Always 0
590 .. 5BCh	Reserved for other FEATURE_LO_INQ			Always 0
5C0h	CAPTURE_SIZE_INQ			Always 0
5C4h	CAPTURE_QUALITY_INQ			Always 0
5C8h .. 5FCh	Reserved for other FEATURE_LO_INQ			Always 0
600h	CUR-V-Frm_RATE/Revision	Bits [0..2] for the frame rate		
604h	CUR-V-MODE	Bits [0..2] for the current video mode		
608h	CUR-V-FORMAT	Bits [0..2] for the current video format		
60Ch	ISO-Channel	Bits [0..3] for channel, [6..7] for ISO speed		
610h	Camera_Power			Always 0
614h	ISO_EN/Continuous_Shot	Bit 0: 1 for continuous shot; 0 for stop		
618h	Memory_Save			Always 0
61Ch	One_Shot, Multi_Shot, Count Number			See text
620h	Mem_Save_Ch			Always 0
624	Cur_Mem_Ch			Always 0
628h	Vmode_Error_Status	Error in combination of Format/Mode/ISO Speed: Bit(0): No error; Bit(0)=1: error		

Table 68: **Feature elements** inquiry register

Inquiry register for absolute value CSR offset address

Offset	Name	Notes
700h	ABS_CSR_HI_INQ_0	Always 0
704h	ABS_CSR_HI_INQ_1	Always 0
708h	ABS_CSR_HI_INQ_2	Always 0
70Ch	ABS_CSR_HI_INQ_3	Always 0
710h	ABS_CSR_HI_INQ_4	Always 0
714h	ABS_CSR_HI_INQ_5	Always 0
718h	ABS_CSR_HI_INQ_6	Always 0
71Ch	ABS_CSR_HI_INQ_7	Always 0
720h	ABS_CSR_HI_INQ_8	Always 0
724h	ABS_CSR_HI_INQ_9	Always 0
728h	ABS_CSR_HI_INQ_10	Always 0
72Ch	ABS_CSR_HI_INQ_11	Always 0
730h	ABS_CSR_HI_INQ_12	Always 0
734 .. 77Fh	Reserved	Always 0
780h	ABS_CSR_LO_INQ_0	Always 0
784h	ABS_CSR_LO_INQ_1	Always 0
788h	ABS_CSR_LO_INQ_2	Always 0
78Ch	ABS_CSR_LO_INQ_3	Always 0
790h .. 7BFh	Reserved	Always 0
7C0h	ABS_CSR_LO_INQ_16	Always 0
7C4h	ABS_CSR_LO_INQ_17	Always 0
7C8h .. 7FFh	Reserved	Always 0

Table 69: **Absolute value** inquiry register

Status and control register for feature

The **OnePush** feature, WHITE_BALANCE, is currently implemented. If this flag is set, the feature becomes immediately active, even if no images are being input.

Offset	Name	Field	Bit	Description
800h	BRIGHTNESS	Presence_Inq	[0]	Presence of this feature 0: N/A 1: Available
		Abs_Control	[1]	Absolute value control 0: Control with value in the Value field 1: Control with value in the Absolute value CSR If this bit = 1, value in the Value field is ignored.
			[2-4]	Reserved
		One_Push	[5]	Write '1': begin to work (Self cleared after operation) Read: Value='1' in operation Value='0' not in operation If A_M_Mode =1, this bit is ignored.
		ON_OFF	[6]	Write: ON or OFF this feature Read: read a status 0: OFF, 1: ON If this bit =0, other fields will be read only.
		A_M_Mode	[7]	Write: set the mode Read: read a current mode 0: Manual 1: Auto
			[8-19]	Reserved
		Value	[20-31]	Value. Write the value in Auto mode, this field is ignored. If ReadOut capability is not available, read value has no meaning.
804h	AUTO-EXPOSURE			See above Note: **Target grey level** parameter in SmartView corresponds to Auto_exposure register 0xF0F00804 (IIDC).
808h	SHARPNESS			See above

Table 70: **Feature** control register

Offset	Name	Field	Bit	Description
80Ch	WHITE-BALANCE	Presence_Inq	[0]	Presence of this feature 0: N/A 1: Available Always 0 for Mono
		Abs_Control	[1]	Absolute value control 0: Control with value in the Value field 1: Control with value in the Absolute value CSR If this bit = 1, value in the Value field is ignored.
			[2-4]	Reserved
		One_Push	[5]	Write '1': begin to work (Self cleared after operation) Read: Value='1' in operation Value='0' not in operation If A_M_Mode =1, this bit is ignored.
		ON_OFF	[6]	Write: ON or OFF this feature, Read: read a status 0: OFF 1: ON If this bit =0, other fields will be read only.
		A_M_Mode	[7]	Write: set the mode Read: read a current mode 0: Manual 1: Auto
		U_Value / B_Value	[8-19]	U Value / B_Value Write the value in AUTO mode, this field is ignored. If ReadOut capability is not available, read value has no meaning.
		V_Value / R_Value	[20-31]	V value / R value Write the value in AUTO mode, this field is ignored. If ReadOut capability is not available, read value has no meaning.
810h	HUE			Always 0

Table 70: **Feature** control register

Offset	Name	Field	Bit	Description
814h	SATURATION			Always 0
818h	GAMMA			See above
81Ch	SHUTTER			see Advanced Feature Timebase Chapter CSR: **Shutter** on page 95
820h	GAIN			See above
824h	IRIS			Always 0
828h	FOCUS			Always 0
82Ch	TEMPERATURE			Always 0
830h	TRIGGER-MODE			Can be effected via advanced feature IO_INP_CTRLx.
834h .. 87C	Reserved for other FEATURE_HI			Always 0
880h	Zoom			Always 0
884h	PAN			Always 0
888h	TILT			Always 0
88Ch	OPTICAL_FILTER			Always 0
890 .. 8BCh	Reserved for other FEATURE_LO			Always 0
8C0h	CAPTURE-SIZE			Always 0
8C4h	CAPTURE-QUALITY			Always 0
8C8h .. 8FCh	Reserved for other FEATURE_LO			Always 0

Table 70: **Feature** control register

Feature control error status register

Offset	Name	Notes
640h	Feature_Control_Error_Status_HI	Always 0
644h	Feature_Control_Error_Status_LO	Always 0

Table 71: **Feature control** error register

Video mode control and status registers for Format_7

Quadlet offset Format_7 Mode_0

The quadlet offset to the base address for **Format_7 Mode_0**, which can be read out at F0F002E0h (according to Table 65: **Frame rate inquiry register** on page 146) gives 003C2000h.

4 x 3C2000h = F08000h so that the base address for the latter (Table 72: **Format_7 control and status register** on page 166) equals to F0000000h + F08000h = F0F08000h.

Quadlet offset Format_7 Mode_1

The quadlet offset to the base address for **Format_7 Mode_1**, which can be read out at F0F002E4h (according to Table 65: **Frame rate inquiry register** on page 146) gives 003C2400h.

4 x 003C2400h = F09000h so that the base address for the latter (Table 72: **Format_7 control and status register** on page 166) equals to F0000000h + F09000h = F0F09000h.

Format_7 control and status register (CSR)

Offset	Name	Notes
000h	MAX_IMAGE_SIZE_INQ	Acc. to IIDC V1.3
004h	UNIT_SIZE_INQ	Acc. to IIDC V1.3
008h	IMAGE_POSITION	Acc. to IIDC V1.3
00Ch	IMAGE_SIZE	Acc. to IIDC V1.3
010h	COLOR_CODING_ID	See note
014h	COLOR_CODING_INQ	Acc. to IIDC V1.3
024h . . 033h	COLOR_CODING_INQ	Vendor Unique Color_Coding 0-127 (ID=128-255) **ID=132 ECCID_MONO12** **ID=136 ECCID_RAW12** ID=133 Reserved ID=134 Reserved ID=135 Reserved See Chapter Packed 12-Bit Mode on page 98.
034h	PIXEL_NUMBER_INQ	Acc. to IIDC V1.3
038h	TOTAL_BYTES_HI_INQ	Acc. to IIDC V1.3
03Ch	TOTAL_BYTES_LO_INQ	Acc. to IIDC V1.3
040h	PACKET_PARA_INQ	See note
044h	BYTE_PER_PACKET	Acc. to IIDC V1.3

Table 72: **Format_7** control and status register

Note

- For all modes in Format_7, **ErrorFlag_1** and **ErrorFlag_2** are refreshed on each access to the Format_7 Register.
- Contrary to IIDC V1.3, registers relevant to Format_7 are refreshed on each access. The **Setting_1** bit is automatically cleared after each access.
- When **ErrorFlag_1** or **ErrorFlag_2** are set and Format_7 is configured, no image capture is started.
- Contrary to IIDC V1.3, COLOR_CODING_ID is set to a default value after an INITIALIZE or **reset**.
- Contrary to IIDC V1.3, the **UnitBytePerPacket** field is already filled in with a fixed value in the PACKET_PARA_INQ register.

Advanced features (Allied Vision-specific)

The camera has a variety of extended features going beyond the possibilities described in IIDC V1.3. The following chapter summarizes all available (Allied Vision-specific) advanced features in ascending register order.

Note

This chapter is a **reference guide for advanced registers** and does not explain the advanced features itself. For detailed description of the theoretical background see

- Chapter Description of the data path on page 80
- Links given in the table below

Advanced registers summary

The following table gives an overview of **all available registers**:

Register	Register name	Remarks
0xF1000010	VERSION_INFO	see Table 74: Advanced register: **Extended version information** on page 169
0xF1000014	VERSION_INFO1_EX	
0xF1000018	VERSION_INFO3	
0xF100001C	VERSION_INFO3_EX	
0xF1000040	ADV_INQ_1	Table 76: Advanced register: **Advanced feature inquiry** on page 171
0xF1000044	ADV_INQ_2	
0xF1000048	ADV_INQ_3	
0xF100004C	ADV_INQ_4	
0xF1000100	CAMERA_STATUS	see Table 77: Advanced register: **Camera status** on page 173
0xF1000200	MAX_RESOLUTION	see Table 78: Advanced register: **Max. resolution inquiry** on page 174
0xF1000208	TIMEBASE	see Table 79: Advanced register: **Timebase** on page 174
0xF100020C	EXTD_SHUTTER	see Table 81: Advanced register: **Extended shutter** on page 176
0xF1000210	TEST_IMAGE	see Table 82: Advanced register: **Test image** on page 177
0xF1000240	LUT_CTRL	see Table 83: Advanced register: **LUT** on page 178
0xF1000244	LUT_MEM_CTRL	
0xF1000248	LUT_INFO	
0xF1000270	FRAMEINFO	See Table 84: Advanced register: **Frame information** on page 180
0xF1000274	FRAMECOUNTER	
0xF1000300	IO_INP_CTRL1	see Table 12: Input configuration register on page 66

Table 73: **Advanced registers** summary

Register	Register name	Remarks
0xF1000320	IO_OUTP_CTRL1	see Table 18: Advanced register: **Output control** on page 72
0xF1000324	IO_OUTP_CTRL2	
0xF1000328	IO_OUTP_CTRL3	
0xF1000340	IO_INTENA_DELAY	see Table 85: Advanced register: **Delayed Integration Enable (IntEna)** on page 182
0xF1000360	AUTOSHUTTER_CTRL	see Table 86: Advanced register: **Auto shutter control** on page 182
0xF1000364	AUTOSHUTTER_LO	
0xF1000368	AUTOSHUTTER_HI	
0xF1000370	AUTOGAIN_CTRL	see Table 87: Advanced register: **Auto gain control** on page 183
0xF1000390	AUTOFNC_AOI	see Table 88: Advanced register: **Autofunction AOI** on page 184
0xF1000394	AF_AREA_POSITION	
0xF1000398	AF_AREA_SIZE	
0xF1000400	TRIGGER_DELAY	see Table 89: Advanced register: Trigger Delay Advanced CSR on page 185
0xF1000510	SOFT_RESET	see Table 90: Advanced register: **Soft reset** on page 185
0xF1000550	USER PROFILES	see Table 91: Advanced register: user profiles on page 186
0xF1000FFC	GPDATA_INFO	see Table 94: Advanced register: GPData buffer register on page 190
0xF1001000 ... 0xF10017FC	GPDATA_BUFFER	

Table 73: **Advanced registers** summary

Note

Advanced features should always be activated before accessing them.

Note

- Currently all registers can be written without being activated. This makes it easier to operate the camera using **Directcontrol**.
- Allied Vision reserves the right to require activation in future versions of the software.

Extended version information register

The presence of each of the following features can be queried by the **0** bit of the corresponding register.

Register	Name	Field	Bit	Description
0xF1000010	VERSION_INFO1	µC type ID	[0..15]	Always 0
		µC version	[16..31]	Bcd-coded version number
0xF1000014	VERSION_INFO1_EX	µC version	[0..31]	Bcd-coded version number
0xF1000018	VERSION_INFO3	Camera type ID	[0..15]	See Table 75: Camera type ID list on page 170
		FPGA version	[16..31]	Bcd-coded version number
0xF100001C	VERSION_INFO3_EX	FPGA version	[0..31]	Bcd-coded version number
0xF1000020		---	[0..31]	Reserved
0xF1000024		---	[0..31]	Reserved
0xF1000028		---	[0..31]	Reserved
0xF100002C		---	[0..31]	Reserved
0xF1000030		OrderIDHigh	[0..31]	8 Byte ASCII Order ID
0xF1000034		OrderIDLow	[0..31]	

Table 74: Advanced register: **Extended version** information

The µC version and FPGA firmware version numbers are bcd-coded, which means that e.g. firmware version 0.85 is read as 0x0085 and version 1.10 is read as 0x0110.

The newly added **VERSION_INFOx_EX** registers contain extended bcd-coded version information formatted as *special.major.minor.patch*.

So reading the value **0x00223344** is decoded as:

- special: 0 (decimal)
- major: 22 (decimal)
- minor: 33 (decimal)
- patch: 44 (decimal)

This is decoded to the human readable version **22.33.44** (leading zeros are omitted).

Note

If a camera returns the register set to all zero, that particular camera does not support the extended version information.

The FPGA type ID (= camera type ID) identifies the camera type with the help of the following list:

ID (decimal)	Camera type
201	Guppy F-033B
202	Guppy F-033C
205	Guppy F-046B
206	Guppy F-046C
207	Guppy F-080B
208	Guppy F-080C
209	Guppy F-146B
210	Guppy F-146C
215	
216	
217	
218	

Table 75: Camera type ID list

Advanced feature inquiry

This register indicates with a named bit if a feature is present or not. If a feature is marked as not present the associated register space might not be available and read/write errors may occur.

Note

Ignore unnamed bits in the following table: these bits might be set or not.

Register	Name	Field	Bit	Description
0xF1000040	ADV_INQ_1	MaxResolution	[0]	
		TimeBase	[1]	
		ExtdShutter	[2]	
		TestImage	[3]	
		FrameInfo	[4]	
		---	[5]	Reserved
		VersionInfo	[6]	
		---	[7]	Reserved
		Look-up tables	[8]	
		---	[9]	Reserved
		---	[10]	Reserved
		---	[12]	Reserved
		---	[13]	Reserved
		TriggerDelay	[14]	
		Soft Reset	[16]	
		---	[17]	Reserved
		Color Correction	[18]	Reserved
		---	[19..20]	Reserved
		User Sets	[21]	
		---	[22..30]	Reserved
		GP_Buffer	[31]	

Table 76: Advanced register: **Advanced feature** inquiry

Register	Name	Field	Bit	Description
0xF1000044	ADV_INQ_2	Input_1	[0]	
		---	[4..7]	
		Output_1	[8]	
		Output_2	[9]	
		Output_3	[10]	
		---	[12..15]	Reserved
		IntEnaDelay	[16]	
		---	[17..23]	Reserved
		---	[28..31]	Reserved
0xF1000048	ADV_INQ_3	Camera Status	[0]	
		Max Isosize	[1]	
		---	[2]	Reserved
		Format_7 Mode Mapping	[3]	
		Auto Shutter	[4]	
		Auto Gain	[5]	
		Auto FNC AOI	[6]	
		---	[7..8]	Reserved
		Low Noise Binning	[9]	
		AFE References	[10]	
		Global Reset Release Shutter	[11]	
		Defect Pixel Correction	[12]	
		---	[13..31]	Reserved
0xF100004C	ADV_INQ_4	---	[0..3]	Reserved

Table 76: Advanced register: **Advanced feature** inquiry

Camera status

This register allows to determine the current status of the camera. The most important flag is the **Idle** flag.

If the **Idle** flag is set the camera does not capture any images and the camera does not send any images (but images might be present in the image FIFO).

The **ExSyncArmed** flag indicates that the camera is set up for external triggering. Even if the camera is waiting for an external trigger event the **Idle** flag might get set.

Other bits in this register might be set or toggled: just ignore these bits.

Note

- Excessive polling of this register may slow down the operation of the camera. Therefore the time between two polls of the status register should not be less than 5 milliseconds. If the time between two read accesses is lower than 5 milliseconds the response will be delayed.
- Depending on shutter and isochronous settings the status flags might be set for a very short time and thus will not be recognized by your application.

Register	Name	Field	Bit	Description
0xF1000100	CAMERA_STATUS	Presence_Inq	[0]	Indicates presence of this feature (read only)
		---	[1..23]	Reserved
		ID	[24..31]	Implementation ID = 0x01
0xF1000104		---	[0..14]	Reserved
		ExSyncArmed	[15]	External trigger enabled
		---	[16..27]	Reserved
		ISO	[28]	Isochronous transmission
		---	[29..30]	Reserved
		Idle	[31]	Camera idle

Table 77: Advanced register: **Camera status**

Maximum resolution

This register indicates the highest resolution for the sensor and is read-only.

Note

This register normally outputs the MAX_IMAGE_SIZE_INQ Format_7 Mode_0 value.

This is the value given in the specifications tables under **Picture size (max.)** in Chapter Specifications on page 43.

Register	Name	Field	Bit	Description
0xF1000200	MAX_RESOLUTION	MaxHeight	[0..15]	Sensor height (read only)
		MaxWidth	[16..31]	Sensor width (read only)

Table 78: Advanced register: **Max. resolution** inquiry

Time base

Corresponding to IIDC, exposure time is set via a 12-bit value in the corresponding register (SHUTTER_INQ [51Ch] and SHUTTER [81Ch]).

This means that a value in the range of 1 to 4095 can be entered.

Guppy cameras use a time base which is multiplied by the shutter register value. This multiplier is configured as the time base via the TIMEBASE register.

Register	Name	Field	Bit	Description
0xF1000208	TIMEBASE	Presence_Inq	[0]	Indicates presence of this feature (read only)
		---	[1..7]	Reserved
		ExpOffset	[8..19]	Exposure offset in µs
		---	[20..27]	Reserved
		Timebase_ID	[28..31]	See Table 80: Time base ID on page 175.

Table 79: Advanced register: **Timebase**

The time base IDs 0-9 are in bits 28 to 31. See Table 80: Time base ID on page 175. Refer to the following table for code.

Default time base is 20 µs: This means that the integration time can be changed in 20 µs increments with the shutter control.

Note

Time base can only be changed when the camera is in idle state and becomes active only after setting the shutter value.

The **ExpOffset** field specifies the camera specific exposure time offset in micro-seconds (µs). This time (which should be equivalent to Table 39: Camera-specific exposure time offset on page 111) has to be added to the exposure time (set by any shutter register) to compute the real exposure time.

The **ExpOffset** field might be zero for some cameras: this has to be assumed as an unknown exposure time offset (according to former software versions).

ID	Time base in µs	
0	1	
1	2	
2	5	
3	10	
4	**20**	**Default value**
5	50	
6	100	
7	200	
8	500	
9	1000	

Table 80: Time base ID

Note

The ABSOLUTE VALUE CSR register, introduced in IIDC V1.3, is not implemented.

Extended shutter

- For **CCD** models:
  The exposure time for long-term integration can be entered with µs precision via the EXTENDED_SHUTTER register.
  – max. exposure time up to 67 seconds (3FFFFFFh)

Register	Name	Field	Bit	Description
0xF100020C	EXTD_SHUTTER	Presence_Inq	[0]	Indicates presence of this feature (read only)
		---	[1.. 5]	
		ExpTime	[6..31]	Exposure time in µs

Table 81: Advanced register: **Extended shutter**

The minimum allowed exposure time depends on the camera model. To determine this value write **1** to the **ExpTime** field and read back the minimum allowed exposure time.

Note

- Exposure times entered via the 81Ch register are mirrored in the extended register, but not vice versa.
- Changes in this register have immediate effect, even when camera is transmitting.
- Extended shutter becomes inactive after writing to a format / mode / frame rate register.
- Extended shutter setting will thus be overwritten by the normal time base/shutter setting after Stop/Start of FireView or FireDemo.

Test images

Bits **8-14** indicate which test images are saved. Setting bits **28-31** activates or deactivates existing test images.

By activating any test image the following auto features are automatically disabled:

- auto gain
- auto shutter
- auto white balance

Register	Name	Field	Bit	Description
0xF1000210	TEST_IMAGE	Presence_Inq	[0]	Indicates presence of this feature (read only)
		---	[1..7]	Reserved
		Image_Inq_1	[8]	Presence of test image 1 0: N/A 1: Available
		Image_Inq_2	[9]	Presence of test image 2 0: N/A 1: Available
		Image_Inq_3	[10]	Presence of test image 3 0: N/A 1: Available
		Image_Inq_4	[11]	Presence of test image 4 0: N/A 1: Available
		Image_Inq_5	[12]	Presence of test image 5 0: N/A 1: Available
		Image_Inq_6	[13]	Presence of test image 6 0: N/A 1: Available
		Image_Inq_7	[14]	Presence of test image 7 0: N/A 1: Available
		---	[15..27]	Reserved
		TestImage_ID	[28..31]	0: No test image active 1: Image 1 active 2: Image 2 active ...

Table 82: Advanced register: **Test image**

Look-up tables (LUT)

Load the look-up tables to be used into the camera and choose the look-up table number via the **LutNo** field. Now you can activate the chosen LUT via the LUT_CTRL register.

The LUT_INFO register indicates how many LUTs the camera can store and shows the maximum size of the individual LUTs.

The possible values for **LutNo** are 0..n-1, whereas n can be determined by reading the field **NumOfLuts** of the LUT_INFO register.

Register	Name	Field	Bit	Description
0xF1000240	LUT_CTRL	Presence_Inq	[0]	Indicates presence of this feature (read only)
		---	[1..5]	Reserved
		ON_OFF	[6]	Enable/disable this feature
		---	[7..25]	Reserved
		LutNo	[26..31]	Use look-up table with **LutNo** number
0xF1000244	LUT_MEM_CTRL	Presence_Inq	[0]	Indicates presence of this feature (read only)
		---	[1..4]	Reserved
		EnableMemWR	[5]	Enable write access
		---	[6..7]	Reserved
		AccessLutNo	[8..15]	Reserved
		AddrOffset	[16..31]	byte
0xF1000248	LUT_INFO	Presence_Inq	[0]	Indicates presence of this feature (read only)
		---	[1..2]	Reserved
		BitsPerValue	[3..7]	Bits used per table item
		NumOfLuts	[8..15]	Maximum number of look-up tables
		MaxLutSize	[16..31]	Maximum look-up table size (bytes)

Table 83: Advanced register: **LUT**

Note

The **BitsPerValue** field indicates how many bits are read from the LUT for any gray-value read from the sensor. To determine the number of bytes occupied for each gray-value round-up the **BitsPerValue** field to the next byte boundary.

Examples:

- BitsPerValue = 8 → 1 byte per gray-value
- BitsPerValue = 14 → 2 byte per gray-value

Divide **MaxLutSize** by the number of bytes per gray-value in order to get the number of bits read from the sensor.

Note

Guppy cameras have the gamma feature implemented via a built-in look-up table. Therefore you can not use gamma and your own look-up table at the same time. Nevertheless you may combine a gamma look-up table into your own look-up table.

Note

When using the LUT feature and the gamma feature pay attention to the following:

- gamma ON → look-up table is switched ON also
- gamma OFF → look-up table is switched OFF also
- look-up table OFF → gamma is switched OFF also
- look-up table ON → gamma is switched OFF

Frame information

This register can be used to double-check the number of images received by the host computer against the number of images which were transmitted by the camera. The camera increments this counter with every FrameValid signal. This is a mirror of the frame counter information found at 0xF1000610.

Register	Name	Field	Bit	Description
0xF1000270	FRAMEINFO	Presence_Inq	[0]	Indicates presence of this feature (read only)
		ResetFrameCnt	[1]	Reset frame counter
		---	[2..31]	Reserved
0xF1000274	FRAMECOUNTER	FrameCounter	[0..31]	Number of captured frames since last reset

Table 84: Advanced register: **Frame information**

The **FrameCounter** is incremented when an image is read out of the sensor.

The **FrameCounter** does not indicate whether an image was sent over the IEEE 1394 bus or not.

Input/output pin control

All input and output signals running over the HIROSE plug are controlled by this register.

Note

- See Chapter Inputs on page 66.
- See Table 12: Input configuration register on page 66.
- See Table 13: Input routing on page 67.
- See Chapter IO_OUTP_CTRL 1-3 on page 72.

Delayed Integration Enable (IntEna)

A delay time between initiating exposure on the sensor and the activation edge of the **IntEna** signal can be set using this register. The **on/off** flag activates/ deactivates integration delay. The time can be set in µs in **DelayTime**.

Note

- Only one edge is delayed.
- If **IntEna_Out** is used to control an exposure, it is possible to have a variation in brightness or to precisely time a flash.

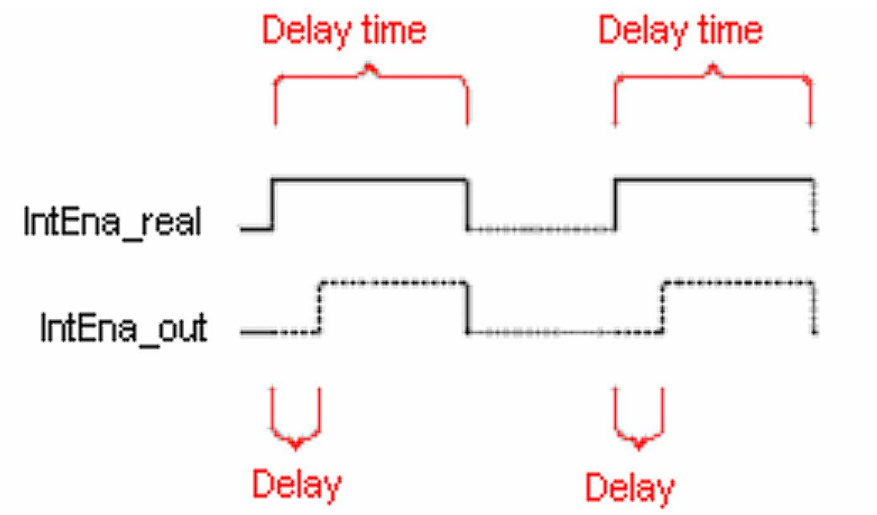


Figure 50: Delayed integration timing

Register	Name	Field	Bit	Description
0xF1000340	IO_INTENA_DELAY	Presence_Inq	[0]	Indicates presence of this feature (read only)
		---	[1..5]	Reserved
		ON_OFF	[6]	Enable/disable integration enable delay
		---	[7..11]	Reserved
		DELAY_TIME	[12..31]	Delay time in µs

Table 85: Advanced register: **Delayed Integration Enable (IntEna)**

Auto shutter control

The table below illustrates the advanced register for **auto shutter control**. The purpose of this register is to limit the range within which auto shutter operates.

Register	Name	Field	Bit	Description
0xF1000360	AUTOSHUTTER_CTRL	Presence_Inq	[0]	Indicates presence of this feature (read only)
		---	[1..31]	Reserved
0xF1000364	AUTOSHUTTER_LO	---	[0..5]	Reserved
		MinValue	[6..31]	Minimum auto shutter value
0xF1000368	AUTOSHUTTER_HI	---	[0..5]	Reserved
		MaxValue	[6..31]	Maximum auto shutter value

Table 86: Advanced register: **Auto shutter control**

Note

- Values can only be changed within the limits of shutter CSR.
- Changes in auto exposure register only have an effect when auto shutter is enabled.
- Auto exposure limits are: 50..205 (**SmartView→Ctrl1 tab**: **Target grey level**)

When both **auto shutter** and **auto gain** are enabled, priority is given to increasing shutter when brightness decreases. This is done to achieve the best image quality with lowest noise.

For increasing brightness, priority is given to lowering gain first for the same purpose.

MinValue and **MaxValue** limits the range the auto shutter feature is allowed to use for the regulation process. Both values are initialized with the minimum and maximum value defined in the standard SHUTTER_INQ register (multiplied by the current active timebase).

If you change the **MinValue** and/or **MaxValue** and the new range exceeds the range defined by the SHUTTER_INQ register, the standard SHUTTER register will not show correct shutter values. In this case you should read the EXTENDED_SHUTTER register for the current active shutter time.

Changing the auto shutter range might not affect the regulation, if the regulation is in a stable condition and no other condition affecting the image brightness is changed.

If both **auto gain** and **auto shutter** are enabled and if the shutter is at its upper boundary and gain regulation is in progress, increasing the upper auto shutter boundary has no effect on auto gain/shutter regulation as long as auto gain regulation is active.

Note

As with the Extended Shutter the value of **MinValue** and **MaxValue** must not be set to a lower value than the minimum shutter time.

Auto gain control

The table below illustrates the advanced register for **auto gain control**.

Register	Name	Field	Bit	Description
0xF1000370	AUTOGAIN_CTRL	Presence_Inq	[0]	Indicates presence of this feature (read only)
		---	[1..3]	Reserved
		MaxValue	[4..15]	Maximum auto gain value
		---	[16..19]	Reserved
		MinValue	[20..31]	Minimum auto gain value

Table 87: Advanced register: **Auto gain control**

Note

- Values can only be changed within the limits of gain CSR.
- Changes in auto exposure register only have an effect when auto gain is active.
- Auto exposure limits are 50..205.

MinValue and **MaxValue** limits the range the auto gain feature is allowed to use for the regulation process. Both values are initialized with the minimum and maximum value defined in the standard GAIN_INQ register.

Changing the **auto gain range** might not affect the regulation, if the regulation is in a stable condition and no other condition affecting the image brightness is changed.

If both auto gain and auto shutter are enabled and if the gain is at its lower boundary and shutter regulation is in progress, decreasing the lower auto gain boundary has no effect on auto gain/shutter regulation as long as auto shutter regulation is active.

Both values can only be changed within the range defined by the standard GAIN_INQ register.

Autofunction AOI

The table below illustrates the advanced register for **autofunction AOI**.

Register	Name	Field	Bit	Description
0xF1000390	AUTOFNC_AOI	Presence_Inq	[0]	Indicates presence of this feature (read only)
		---	[1..3]	Reserved
		ShowWorkArea	[4]	Show work area
		---	[5]	Reserved
		ON_OFF	[6]	Enable/disable AOI (see note above)
		---	[7]	Reserved
		YUNITS	[8..19]	Y units of work area/pos. beginning with 0 (read only)
		XUNITS	[20..31]	X units of work area/pos. beginning with 0 (read only)
0xF1000394	AF_AREA_POSITION	Left	[0..15]	Work area position (left coordinate)
		Top	[16..31]	Work area position (top coordinate)
0xF1000398	AF_AREA_SIZE	Width	[0..15]	Width of work area size
		Height	[16..31]	Height of work area size

Table 88: Advanced register: **Autofunction AOI**

The possible increment of the work area position and size is defined by the YUNITS and XUNITS fields. The camera automatically adjusts your settings to permitted values.

Note

If the adjustment fails and the work area size and/or work area position becomes invalid, then this feature is automatically switched off.

Read back the ON_OFF flag, if this feature does not work as expected.

Trigger delay

Register	Name	Field	Bit	Description
0xF1000400	TRIGGER_DELAY	Presence_Inq	[0]	Indicates presence of this feature (read only)
		---	[1..5]	Reserved
		ON_OFF	[6]	Trigger delay on/off
		---	[7..10]	Reserved
		DelayTime	[11..31]	Delay time in µs

Table 89: Advanced register: Trigger Delay Advanced CSR

The advanced register allows to delay the start of the integration via **DelayTime** by max. 2^{21} µs, which is max. 2.1 s after a trigger edge was detected.

Note

Trigger delay woks with external trigger modes only.

Soft reset

Register	Name	Field	Bit	Description
0xF1000510	SOFT_RESET	Presence_Inq	[0]	Indicates presence of this feature (read only)
		---	[1..5]	Reserved
		Reset	[6]	Initiate reset
		---	[7..19]	Reserved
		Delay	[20..31]	Delay reset in 10 ms steps

Table 90: Advanced register: **Soft reset**

The SOFT_RESET feature is similar to the INITIALIZE register, with the following differences:

- 1 or more bus resets will occur

- the FPGA will be rebooted

The reset can be delayed by setting the **Delay** to a value unequal to 0 - the delay is defined in 10 ms steps.

Note

When SOFT_RESET has been defined, the camera will respond to further read or write requests but will not process them.

User profiles

Within the IIDC specification user profiles are called memory channels. Often they are called user sets. In fact these are different expressions for the following: storing camera settings into a non-volatile memory inside the camera.

Register	Name	Field	Bit	Description
0xF1000550	USER_PROFILE	Presence_Inq	[0]	Indicates presence of this feature (read only)
		Error	[1]	An error occurred
		---	[2..7]	Reserved
		SaveProfile	[8]	Save settings to profile
		RestoreProfile	[9]	Load settings from profile
		SetDefault	[10]	Set default user profile
		---	[11..19]	Reserved
		ErrorCode	[20..23]	Error code See Table 92: User profile: Error codes on page 187.
		---	[24..27]	Reserved
		ProfileID	[28..31]	User profile ID (memory channel)

Table 91: Advanced register: user profiles

In general this advanced register is a wrapper around the standard memory channel registers with some extensions. In order to query the number of available user profiles please check the **Memory_Channel** field of the **BASIC_FUNC_INQ** register at offset **0x400** (see IIDC V1.3x for details).

The **ProfileID** is equivalent to the memory channel number and specifies the profile number to store settings to or to restore settings from. In any case profile #0 is the hard-coded factory profile and cannot be overwritten.

After an initialization command, startup or reset of the camera, the **ProfileID** also indicates which profile was loaded on startup, reset or initialization.

Note

- The default profile is the profile that is loaded on power-up or an INITIALIZE command.
- A save or load operation delays the response of the camera until the operation is completed. At a time only one operation can be performed.

Store To store the current camera settings into a profile:

1. Write the desired **ProfileID** with the **SaveProfile** flag set
2. Read back the register and check the **ErrorCode** field

Restore. To restore the settings from a previous stored profile:

1. Write the desired **ProfileID** with the **RestoreProfile** flag set
2. Read back the register and check the **ErrorCode** field

Set default. To set the default profile to be loaded on startup, reset or initialization:

1. Write the desired **ProfileID** with the **SetDefaultID** flag set
2. Read back the register and check the **ErrorCode** field

To go back to the factory default profile:

1. Select ProfileID= 0 and toggle the **SetDefaultID** flag set
2. Read back the register and check the **ErrorCode** field

Error codes

ErrorCode #	Description
0x00	No error
0x01	Profile data corrupted
0x02	Camera not idle during restore operation
0x03	Feature not available (feature not present)
0x04	Profile does not exist
0x05	ProfileID out of range
0x06	Restoring the default profile failed
0x07	Loading LUT data failed
0x08	Storing LUT data failed

Table 92: User profile: Error codes

Reset of error codes

The **ErrorCode** field is set to zero on the next write access.

You may also reset the **ErrorCode**

- by writing to the **USER_PROFILE** register with the **SaveProfile**, **Restore-Profile** and **SetDefaultID** flag not set.
- by writing 00000000h to the **USER_PROFILE** register.

Stored settings

The following table shows the settings stored inside a profile:

Standard registers	Standard registers (Format_7)	Advanced registers
Cur_V_Frm_Rate Cur_V_Mode Cur_V_Format ISO_Channel ISO_Speed BRIGHTNESS AUTO_EXPOSURE (Target grey level) SHARPNESS WHITE_BALANCE (+ auto on/off) GAMMA (+ gamma on) SHUTTER (+ auto on/off) GAIN TRIGGER_MODE TRIGGER_POLARITY TRIGGER_DELAY ABS_GAIN	IMAGE_POSITION (AOI) IMAGE_SIZE (AOI) COLOR_CODING_ID BYTES_PER_PACKET	TIMEBASE EXTD_SHUTTER IO_INP_CTRL IO_OUTP_CTRL IO_INTENA_DELAY AUTOSHUTTER_CTRL AUTOSHUTTER_LO AUTOSHUTTER_HI AUTOGAIN_CTRL AUTOFNC_AOI (+ on/off) TRIGGER_DELAY MIRROR_IMAGE LUT_CTRL (LutNo; ON_OFF is not saved)

Table 93: User profile: stored settings

The user can specify which user profile will be loaded upon startup of the camera.

This frees the user software from having to restore camera settings, that differ from default, after every cold start. This can be especially helpful if third party software is used which may not give easy access to certain advanced features or may not provide efficient commands for quick writing of data blocks into the camera.

Note

- A profile save operation automatically disables capturing of images.
- A profile save or restore operation is an uninterruptable (atomic) operation. The write response (of the asynchronous write cycle) will be sent after completion of the operation.
- Restoring a profile will not overwrite other settings than listed above.
- If a restore operation fails or the specified profile does not exist, all registers will be overwritten with the hard-coded factory defaults (profile #0).
- Data written to this register is not reflected in the standard memory channel registers.

GPDATA_BUFFER

GPDATA_BUFFER is a register that regulates the exchange of data between camera and host for programming the LUT.

GPDATA_INFO Buffer size query

GPDATA_BUFFER Indicates the actual storage range.

Register	Name	Field	Bit	Description
0xF1000FFC	GPDATA_INFO	---	[0..15]	Reserved
		BufferSize	[16..31]	Size of GPDATA_BUFFER (byte)
0xF1001000 ... 0xF10017FC	GPDATA_BUFFER			

Table 94: Advanced register: GPData buffer register

Note

- Read the BufferSize before using.
- GPDATA_BUFFER can be used by only one function at a time.

Little endian vs. big endian byte order

- Read/WriteBlock accesses to GPDATA_BUFFER are recommended, to read or write more than 4 byte data. This increases the transfer speed compared to accessing every single quadlet.
- The big endian byte order of the 1394 bus is unlike the little endian byte order of common operating systems (Intel PC). Each quadlet of the local buffer, containing the LUT data or shading image for instance, has to be swapped bytewise from little endian byte order to big endian byte order before writing on the bus.

Bit depth	little endian ⇨	big endian	Description
8 bit	L0 L1 L2 L3	⇨ L3 L2 L1 L0	L: low byte
16 bit	L0 H0 L1 H1	⇨ H1 L1 H0 L0	H: high byte

Table 95: Swapped first quadlet at address offset 0

Firmware update

Firmware updates can be carried out via FireWire cable without opening the camera.

Note

For further information:

- Read the application note:
  How to update Guppy/Pike/Stingray firmware
  at Allied Vision website or
- Contact your local dealer.

Extended version number (FPGA/µC)

The new extended version number for microcontroller and FPGA firmware has the following format (4 parts separated by periods; each part consists of two digits):

Special.Major.Minor.Bugfix

or

xx.xx.xx.xx

Digit	Description
1st part: Special	Omitted if zero Indicates customer specific versions (OEM variants). Each customer has its own number.
2nd part: Major	Indicates big changes Old: represented the number before the dot
3rd part: Minor	Indicates small changes Old: represented the number after the dot
4th part: Bugfix	Indicates bugfixing only (no changes of a feature) or build number

Table 96: New version number (microcontroller and FPGA)

Appendix

Sensor position accuracy of Guppy cameras

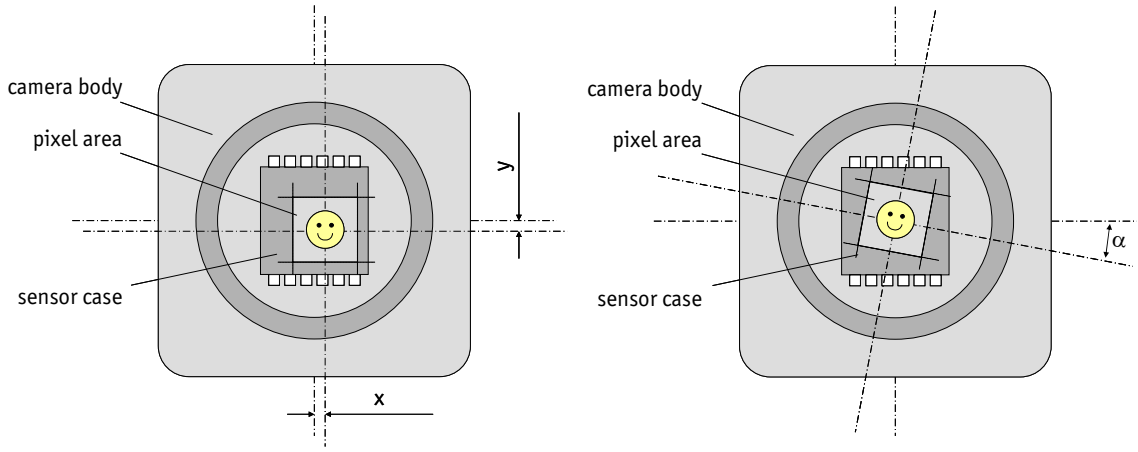


Figure 51: Sensor position accuracy

Criteria	Subject	Properties
Method of Positioning		Optical alignment of the photo sensitive sensor area into the camera front module (lens mount front flange)
Reference Points	Sensor	Center of the pixel area (photo sensitive cells)
	Camera	Center of the lens mount
Accuracy	x/y	+/- 0.25 mm (sensor shift)
	z	+50/-100 µm for SN > 84254727 (optical back focal length)
	z	+0/-100 µm for SN > 252138124 (optical back focal length)
	α	+/-0.5° (center rotation as the deviation from the parallel to the camera bottom)

Table 97: Criteria of Allied Vision sensor position accuracy

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

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