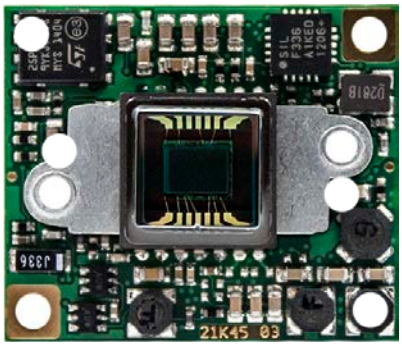
VIDEOLOGY

**IMAGING SOLUTIONS INC.**

*Original Equipment Manufacturer*

# Application Note
# 20K45XDIG/21K45XDIG (Color)
# 20K35XDIG/21K35XDIG (B&W)

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**Videology® Imaging Solutions, Inc.**
37M Lark Industrial Parkway
Greenville, Rhode Island 02828 USA
Tel: (401) 949 – 5332 Fax: (401) 949 – 5276
North/South American Sales: sales@videologyinc.com
***www.videologyinc.com***

**Videology® Imaging Solutions, Europe B.V.**
Neutronenlaan 4
5405 NH Uden, The Netherlands
Tel: +31 (0) 413 256261 Fax: +31 (0) 413 251712
European Sales: info@videology.nl
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# Table of Contents

# 1. Document History

| Revision | Issue Date | Reason | CN# |
|---|---|---|---|
| Rev A | 11-19-2012 | Initial release, European rev 1.1 | 12-0100 |
| Rev B | 07-23-2013 | Technical specs, mechanical drawing, pin out update and B&W options added | N/A |
| Rev C | 07-24-2013 | Several corrections in “I2C Registers” paragraph | 13-0055 |

# 2. Introduction

The 2xK45xDIG is a ¼” CCD based camera family with a digital output (CCIR656 based). It is mechanically identical with Videology’s 21K15DIG CCD camera family and identical dimensions (22x26mm) and mounting holes, and may be seen as its higher end successor.

The digital output is described fully in this document. The camera must be connected via the 30-pin board-to-board connector. This 30-pin board-to-board connector can be used to “piggy-back” an application PCB.

An example of an Application PCB is:

- USB 2.0 Board: Videology product that has the same dimensions (22x26mm). When two boards are stacked together a complete USB 2.0 camera is available.
- 12VDC to 5VDC power conversion board with audio option (Models 20/21K45XV).
- 24VAC power board with DC auto iris and isolation transformer may be available.

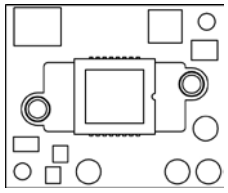
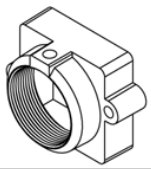
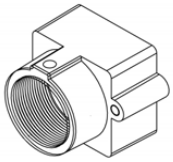
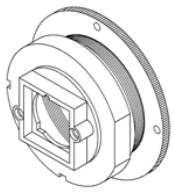
This document is written to give technical background on specific features of these cameras.

**THIS DOCUMENT REFERS TO ALL ASPECTS OF THE COLOR MODEL (20K45X), HOWEVER IT IS RELEVANT TO THE B&W (20K35X) IN ALL OTHER RESPECTS EXCEPT COLOR FEATURES.**

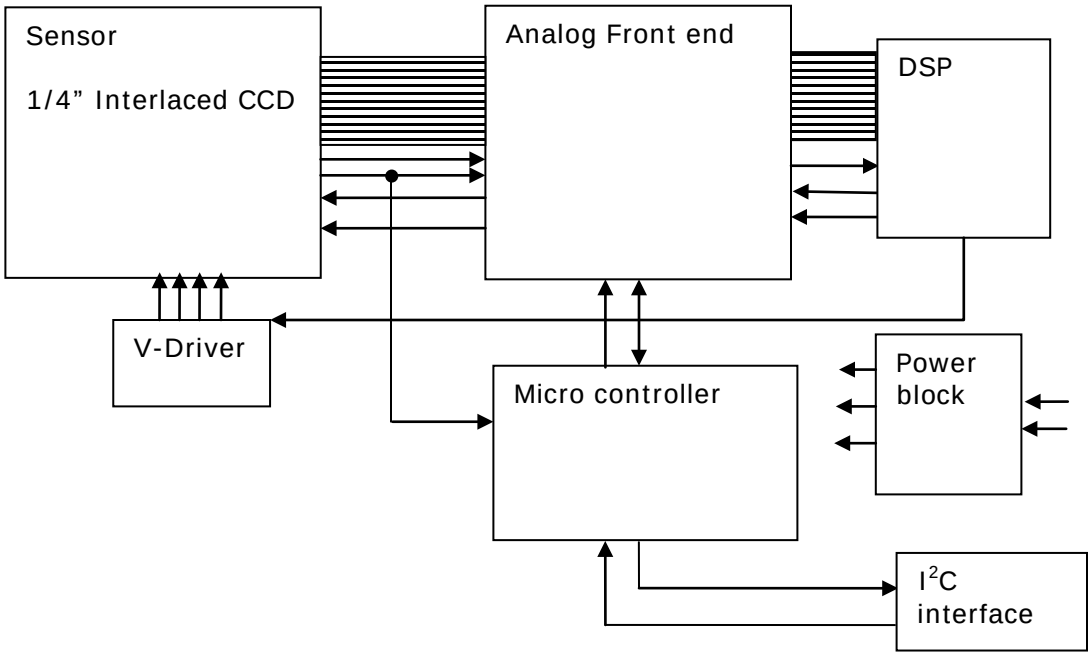
## 3. Specifications

| | **20K45XDIG (NTSC)<br>20K35XDIG (EIA)** | **21K45XDIG (PAL)<br>22K35XDIG (CCIR)** |
|---|---|---|
| CCD sensor | 1/4" Sony IL CCD (Color)<br>1/4" Sony® Ex-View® CCD (B&W) | |
| Active Pixels (HxV) | 768 x 492 | 752 x 582 |
| Resolution | >540 TVL (Color)<br>>600 TVL (B&W) | |
| Frame Rate (max) | 30fps | 25fps |
| Sensitivity | < 0.05 Lux (F1.2) 3200K | |
| Signal to Noise Ratio | >50 dB (AGC off) digital output | |
| Gamma | 0.45 default (1.0 via Software) | |
| Gain Control | Automatic (AGC default)/ Fixed (via software) | |
| Scan Mode | Interlaced | |
| Mirror/Flip Mode | Selectable via software (H & V direction) | |
| Synchronization | Internal | |
| Back Light Compensation | Default off (selectable via software) | |
| White Balance Mode | AWB, Fixed modes selectable via software (Color only) | |
| Contour Enhancement | Default on | |
| Iris control | CCD Iris default | |
| Shutter Speeds | Automatic from 1/60 to 1/100,000 | Automatic from 1/50 to 1/100,000 |
| | 14 fixed speeds via software | |
| Video output | 8-bit digital YUV 4:2:2 @ CCIR656, CMOS output, 3.3V level | |
| | 16-bit digital output CCIR601, CMOS Output, 3.3V Level | |
| Control communication | I²C control | |
| Power supply | 5VDC ± 5% (not polarity protected) | |
| Power consumption | < 1.2 W | |

**Lens options (X-value)**

| | | | |
|---|---|---|---|
|  |  |  |  |
| 2xK45**7**DIG (color)<br>2xK35**7**DIG (b&w)<br>No lens mount | 2xK45**2**DIG (color)<br>2xK35**2**DIG (b&w)<br>Pin hole lens | 2xK45**5**DIG (color)<br>2xK35**5**DIG (b&w)<br>Board lens (M12 lens) | 2xK45**8**DIG (color)<br>2xK35**8**DIG (b&w)<br>C/CS-mount |

## 4. Block Diagram




## 5. Basic Functions Programmable via Software

### 5.1. White Balance (Color Only)

Via software the user can select several white balance modes:

- Auto white balance
- Manual white balance
- Indoor setting
- Outdoor setting
- Push Set

### 5.2. Shutter Speeds

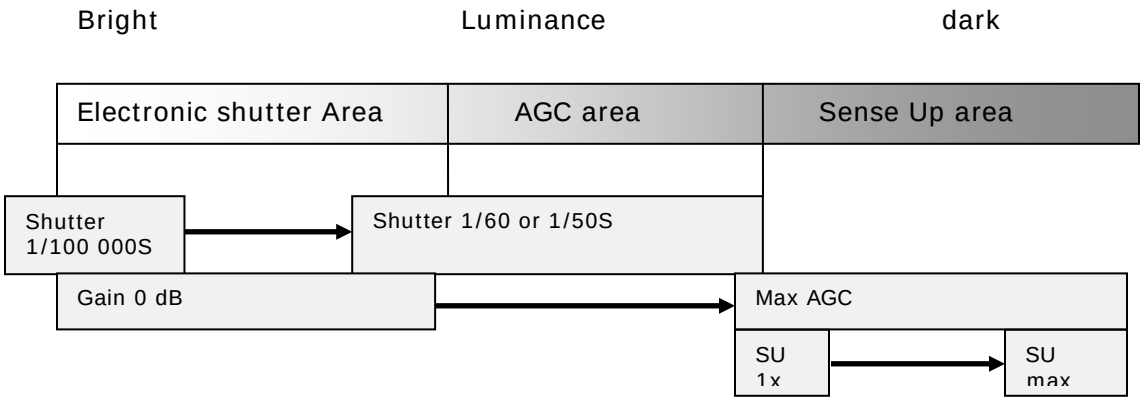
In default mode, the camera operates in the electronic iris mode. This means the CCD output, which is dependent on the light intensity, is controlled by the electronics of the camera and not the mechanics of the lens.

By measuring the output of the CCD and comparing it with an internal reference it is possible to control the level of the signal out of the CCD (within a certain tolerance).

However, users may in some instances prefer that the shutter is fixed and not automatic. For example, a fixed shutter is beneficial is if there is a very fast moving object in the scene. The longer the integration time (the period that no OFD pulse occurs, max 1/50 sec for PAL and max 1/60 sec for NTSC) the less clear the image will appear due to movement of the object during the integration period. To prevent this from occurring the camera has 8 fixed shutter speeds.

Besides the manual mode there is a special auto shutter mode available in the camera. In this mode the camera controls the shutter automatically, but the longest and shortest integration time can be set. This means the control range of the shutter can be limited at both ends.

For additional sensitivity the camera has a so called Sens Up mode. In this mode the camera will extend its integration time at the moment light levels are going down. The result will be an increased sensitivity.




## 5.3. Mirror and Flip Mode

The readout of the camera can be changed to mirrored or even flipped in a vertical direction.

## 5.4. Gamma Function:

Gamma function corrects the non-linear behavior of the CRT monitor. The default gamma curve of the camera is 0.45. With this gamma setting the monitor is able to display the scene as we see it with our eyes.

Via software it is possible to change the gamma curve in steps of 0.05, from 0.05 to 1.

## 5.5. Edge Enhancement

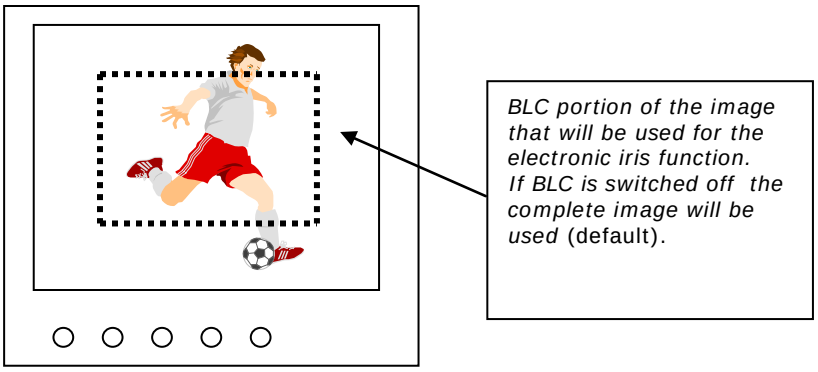
Edge enhancement will increase the sharpness impression of the camera. The level can be controlled via software and can even be switched off.

Further the camera has controls which can reduce the edge enhancement at lower light levels since this will accentuate the noise.

## 5.6. Back Light Compensation

The camera has a default setting of standard back light compensation (BLC) ***OFF***. When ***ON***, a window part inside the scene will get a weight factor so that it gets a higher priority in the AEX control.

The size and position of the window can be set via software.



## 5.7. Dynamic Noise Reduction

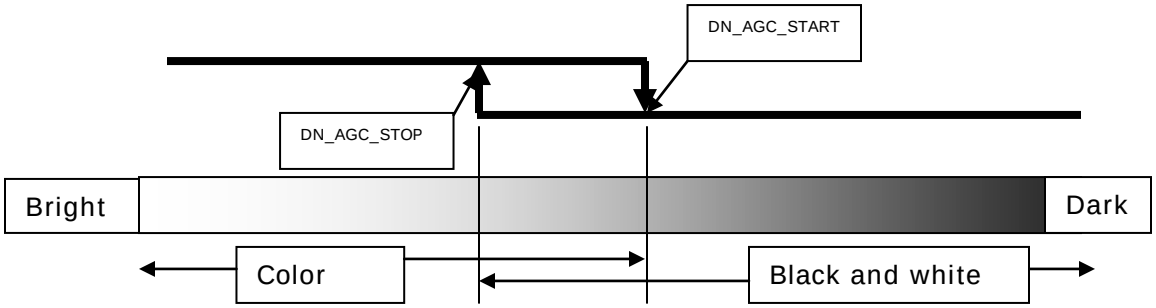
The camera has algorithms internally to reduce noise as much as possible. To do this the camera uses 2D and 3D noise cancellation algorithms.

Especially since the 3D DNR can have an effect on the image over time the user has several controls available to set it so that it fits optimally to the application.

The 3D-DNR function has several control functions like the AGC level were the algorithm will start and or stop. Further if there is motion in the image 3D-DNR will blur the image since it will take several frames together. Therefore a threshold for the motion level can be set.

## 5.8. Day Night Mode

To reduce noise effects at low light and give the possibility to use Near Infrared light sources the camera can be optionally equipped with a special filter (type number will get an extension DN). To optimize the camera electronics we can turn off the color instantly and turn to B/W mode. The parameters for this can be set by the user.




## 5.9. Digital Zoom

The camera offers the possibility of digital zoom and pan and tilt. This can be controlled via $I^2C$.

## 5.10. OSD Menu

For some basic camera functions the camera has an OSD menu. The menu can be activated via $I^2C$. Also the user can scroll through the OSD menu and change settings.

## 6. Software Control

The camera has a serial control interface via three wires:

- Data wire
- Clock wire
- Ground wire

This interface operates similar to the $I^2C$-protocol.
Data, address and registers are all 8-bit words. The graphic interface is shown in the figure below. The maximum speed limitation is 100kHz. The minimum speed should be higher than 100Hz.

Between two $I^2C$ communication strings a delay of at least 125 mSec is required!

A wait time is further required between commands, so that the internal communication has the time to make the required internal communication. The delay time between the commands should be at least 12msec (since with most commands an EEPROM write action is involved).

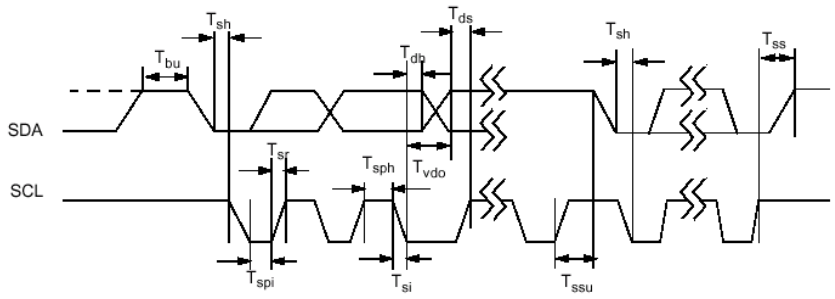



Figure 1. Communication Timing

| $I^2C$ timing basic freq=100KHz | | | | |
|---|---|---|---|---|
| name | | unit | min | max |
| $T_{bu}$ | High stable period data | us | 6 | |
| $T_{sh}$ | Start hold time | us | 2.5 | |
| $T_{db}$ | Data hold time | us | 1 | |
| $T_{ds}$ | Data stable time rising clock | us | 1.5 | |
| $T_{ss}$ | Stop time | us | 2.5 | |
| $T_{sr}$ | Rising time clock | | | 0.5 |
| $T_{sph}$ | Clock high period | us | 4.2 | |
| $T_{spi}$ | Clock low period | | 4.2 | |
| $T_{si}$ | Falling time clock | | | 0.5 |
| $T_{ssu}$ | | | | |
| $F_{clk}$ | Clock frequency | KHz | 1 | 110 |

$I^2C$ address camera: 0x70/71 (write read)
The communication-structure is the standard $I^2C$ protocol with 16 bits data.

A communication string is built up from two blocks. The command block and the data block. The Command block is always 4 bytes and the data block always 2 bytes.

Between a Command and a Data block no additional delay is required.

**Command block:**
**<START> <cam_address>ackn<acces_mode>ackn<device>ackn <register>ackn<STOP>**

| Cam_address | Acces_mode | device |
|---|---|---|
| Standard=0x70* | 00=write to camera<br>01=read to camera | 0x30 = DSP commands<br>0xa0 = EEPROM<br>Special:<br>0xE0: DSP bank 0 reg.<br>0xE2: DSP bank 1 reg<br>0x88: Erase EEpr comm.<br>0xF0: Status reg B0<br>0xF2: Status reg B1 |

**Data block:**
**<START><cam_addressR/W>ack<data>ackn/Nackn***<STOP>**

| **Cam_address** | **Data:** |
|---|---|
| Access mode=00: 0x70<br>Access mode=01: 0x71 | Write data to camera with ***ackn***.<br>Read data from camera with ***Nackn.***** |

****NOT acknowledge means: master sends a clock *low high low* as with a normal acknowledge, but the camera may not respond by pulling data line low. This must be checked, or the number of bits will not be correct!**

**A Data block may follow direct after a command block without additional delays.**

Between the last data block and an eventual next command block a delay of at least 125mS must be taken into account!

**Example 1. Write Action:**
Write DSP 30 register 05 and data 2:
Command-block: <start> 70 ackn 00 ackn 30 ackn 05 ackn <stop>
Data block: <start> 70 ackn 02 ackn <stop>

**Example 2. Read Action**
Command-block: <start> 70 ackn 01 ackn A1 ackn 04 ackn <stop>
Data block: <start> 71 ackn Nackn <stop>

## 6.1. I²C Address

The camera has I²C address 0x70.

## 7. The Digital Output Format

The 8-bit data format is shown in the figure below:

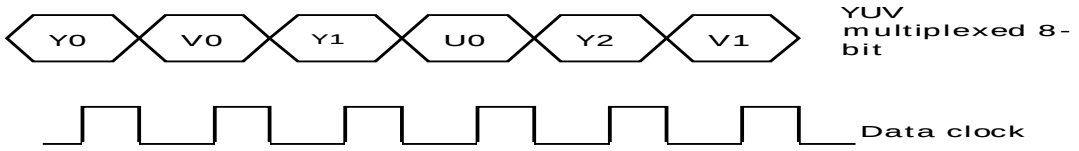



Figure 2. CCIR 656 format

### 7.1. Timing

The camera data clock tolerance is 20ppm. A crystal with the same tolerance is used to generate the camera timing. The data clock frequency is:

| TV-standard | Nominal frequency | Tolerance +/- |
|---|---|---|
| 21K45xDIG: PAL | 28.375 MHz | 560 Hz |
| 20K45xDIG: NTSC | 28.636 MHz | 560 Hz |

The timing is shown in figure below:

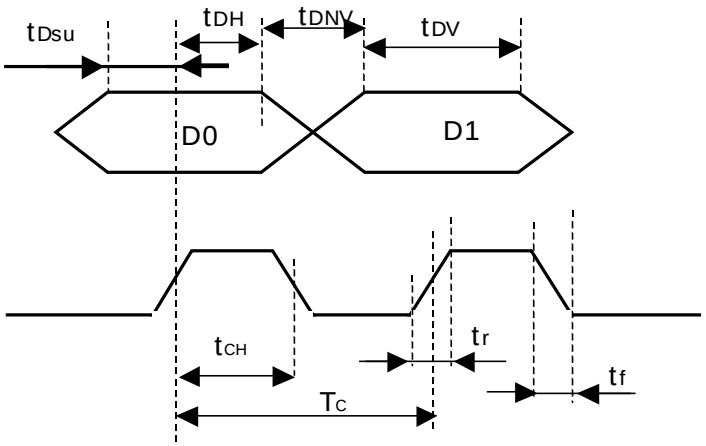



Figure 3. Pixel Timing

| Item | description | 20K45xDIG | | 21K45xDIG | |
|---|---|---|---|---|---|
| | | min(ns) | max(ns) | min(ns) | max(ns) |
| $T_C$ | Clock period | 34.918 | 34.922 | 35.240 | 35.244 |
| $t_{CH}$ | Clock high time | 15 | 19 | 15 | 19 |
| $t_r$ | Rise time | | 3 | | 3 |
| $t_f$ | Fall time | | 3 | | 3 |
| $t_{Dsu}$ | Data setup | 10 | | 10 | |
| $t_{DH}$ | Data Hold | 7 | | 7 | |
| $t_{DNV}$ | Data not valid | | 14 | | 14 |
| $t_{DV}$ | Data valid | 21 | | 21 | |

The timing relationship between HREF, pixel clock and synchronization data is shown in the figure below:

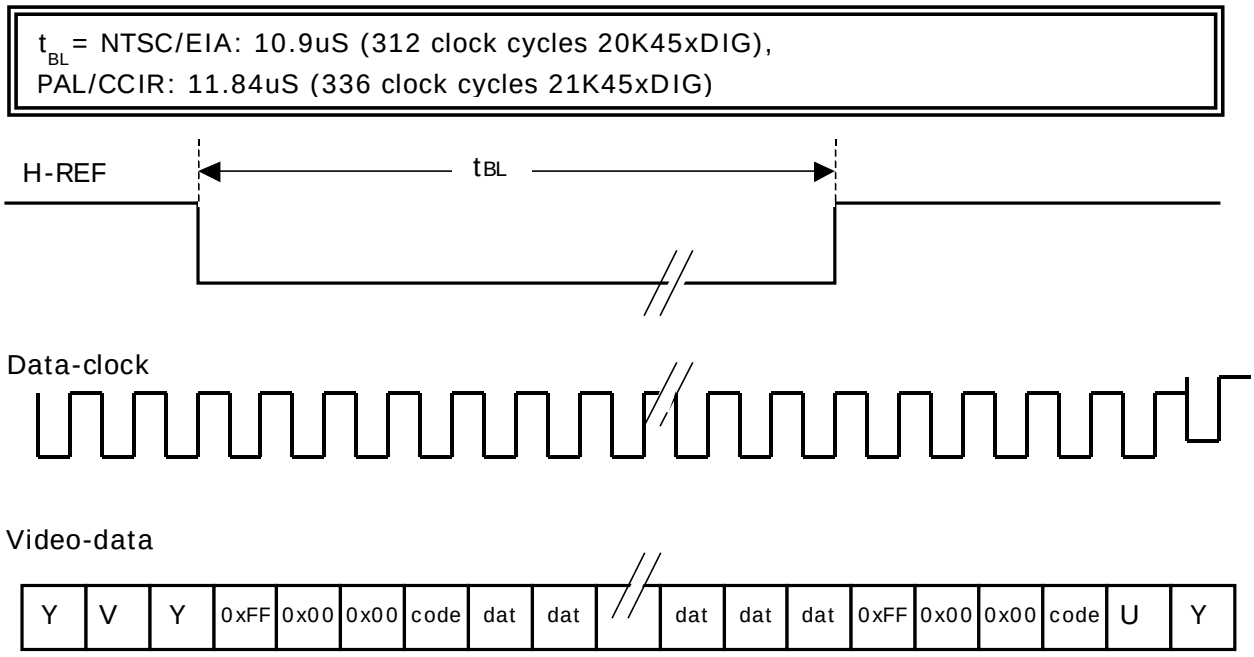



Figure 4. Pixel sequence during the horizontal blanking (8-bit format)

The synchronization code is a combination of 4 bytes. The first three bytes are always the same. The sequence is [0xFF], [0x00] and [0x00]. The values 0xFF and 0x00 will not occur in the normal video. The fourth byte gives the synchronization position. It makes use of 3 different signals: FIELD, VD and HD. The last 4 bits contain a protection code to check if an error occurred during the transfer of this position code's byte.

| **Function** | **Bit 7:** | **Bit 6: FIELD** | **Bit 5: VD** | **Bit 4: HD** | **Bit 3: P3** | **Bit 2: P2** | **Bit 1: P1** | **Bit 0: P0** |
|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 1 |
| 2 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 |
| 3 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 |
| 4 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 |
| 5 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 0 |
| 6 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 |
| 7 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 |

*** Please note: The **HREF** pulse is **Negative** going polarity
The **VREF** pulse in **negative** going polarity

# 8. Connectors

The camera has a board to board connector (J1) to make interconnections as easy as possible.

## 8.1. Board-to-board Connector J1

This connector is made by Molex with type number: MOLEX-501920-3001.
The mating part is MOLEX-52991-0308, and must be used on the application side.

The connector is 30-pole and the pin out can be found in the table below:

| Pin # | Function | Pin # | Function | Pin # | Function |
|---|---|---|---|---|---|
| 1 | GROUND | 11 | YUV4 CCIR656 | 21 | iris out |
| 2 | GROUND | 12 | Not connected | 22 | GROUND |
| 3 | YUV0 CCIR656 | 13 | YUV5 CCIR656 | 23 | HREF |
| 4 | Not connected | 14 | Not connected | 24 | VREF |
| 5 | YUV1 CCIR656 | 15 | YUV6 CCIR656 | 25 | Not connected |
| 6 | Not connected | 16 | Not connected | 26 | Not connected |
| 7 | YUV2 CCIR656 | 17 | YUV7 CCIR656 | 27 | $I^2C$ data |
| 8 | Not connected | 18 | Not connected | 28 | $I^2C$ clock |
| 9 | YUV3 CCIR656 | 19 | Data Clock | 29 | CVBS analogue out |
| 10 | Not connected | 20 | Not connected | 30 | +5V power supply in |

Pin placement can be found in Figure 5 Camera Dimensions

## 8.2. Dimensions

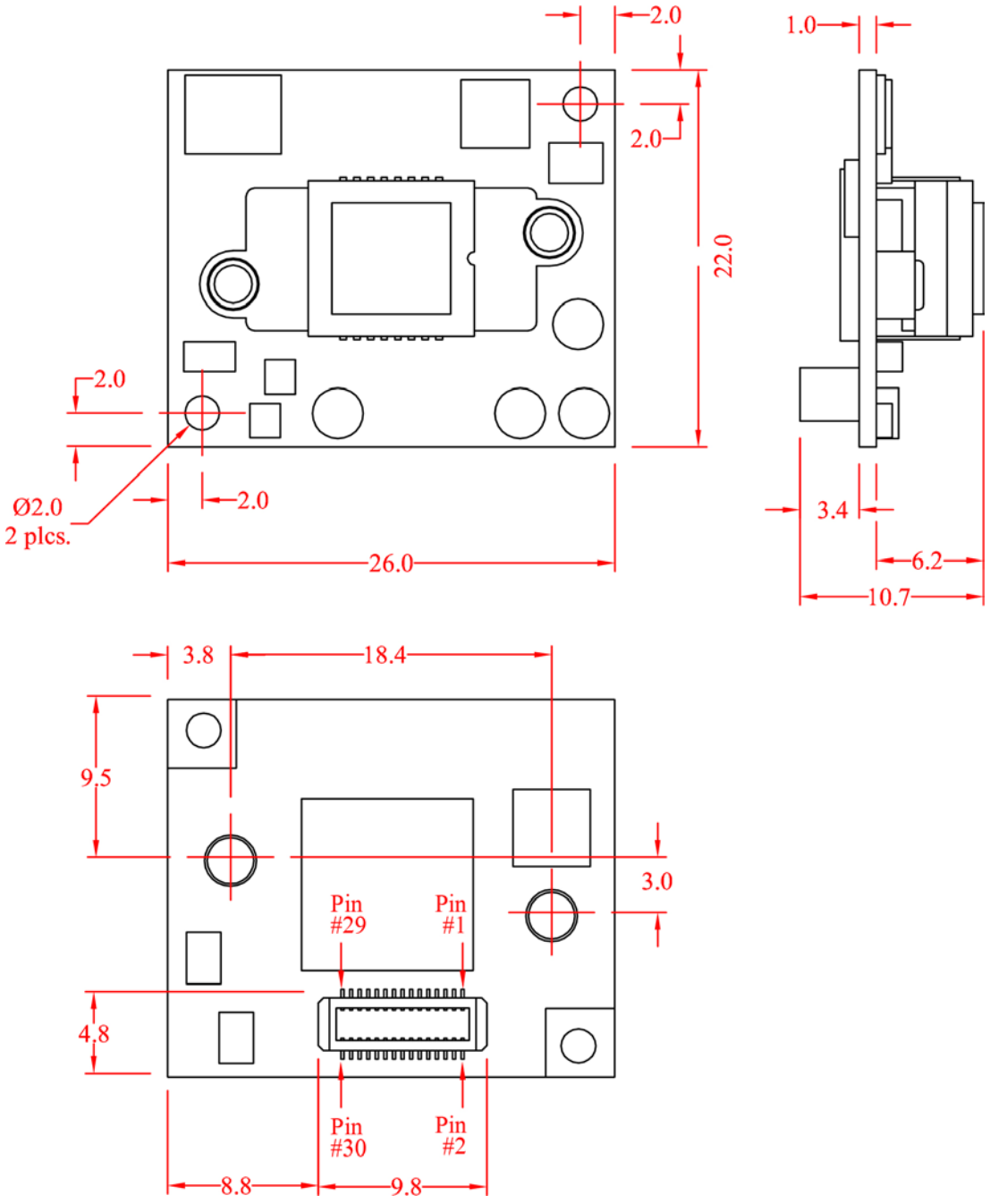



Figure 5. Camera Dimensions

# 9. I²C Registers

The I²C registers are listed below. In paragraph one a table is placed with the registers in a numeric order. In paragraph 9.2 Detailed Register Information a more detailed description can be found.

## 9.1. Registers Overview

| Device address | Register address | Function |
|---|---|---|
| 0x30 | 0x02 | Manual gain on/off |
| 0x30 | 0x04 | Control register, mirror, shutter, white balance |
| 0x30 | 0x13 | BLC mode and weight factor |
| 0x30 | 0x14 | BLC window position |
| 0x30 | 0x15 | BLC window size |
| 0x30 | 0x1D | Manual Fixed gain |
| 0x30 | 0x42 | Manual White Balance Red gain |
| 0x30 | 0x43 | Manual White Balance Blue gain |
| 0x30 | 0x51 | Sens Up mode |
| 0x30 | 0x52 | Digital Y gain |
| 0x30 | 0x53 | Digital C gain |
| 0x30 | 0x54 | Offset (Brightness) |
| 0x30 | 0x55 | Mirror mode extension |
| 0x30 | 0x56 | One push auto white Balance |
| 0x30 | 0x57 | Analog gain control (Y gain) |
| 0x30 | 0x58 | 3DNR mode |
| 0x30 | 0x59 | 3DNR level value |
| 0x30 | 0x5a | 3DNR AGC start level |
| 0x30 | 0x5B | 3DNR AGC stop Level |
| 0x30 | 0x5c | 3DNR weight factor |
| 0x30 | 0x5D | 3DNR Motion Level |
| 0x30 | 0x60 | DN selection |
| 0x30 | 0x61 | DN burst on |
| 0x30 | 0x62 | DN Delay |
| 0x30 | 0x63 | DN auto start level |
| 0x30 | 0x64 | DN auto stop level |
| 0x30 | 0x65 | Special shutter mode: min value |
| 0x30 | 0x66 | Special shutter mod: max value |
| 0x30 | 0x67 | AEX reference offset |
| 0x30 | 0x68 | Low luminance color suppresion |
| 0x30 | 0x69 | Digital zoom on/off |
| 0x30 | 0x6a | Digital zoom magnification value |
| 0x30 | 0x6b | Pan position (zoom mode) |
| 0x30 | 0x6c | Tilt position (zoom mode) |
| 0x30 | 0x7B | Sharpness on/off |
| 0x30 | 0x7c | Sharpness Level |
| 0x30 | 0x80 | OSD menu |
| 0x30 | 0x81 | Auto blemish correction |
| 0x30 | 0x82 | Auto blemish correction |
| 0x30 | 0x83 | Auto blemish correction |
| 0x30 | 0x84 | Auto blemish correction |
| 0x30 | 0x88 | Manual blemish correction |
| 0x30 | 0x89 | Manual blemish correction |
| 0x30 | 0x8a | Manual blemish correction |
| 0x30 | 0x8b | Manual blemish correction |
| 0x30 | 0x8c | Manual blemish correction |
| 0x30 | 0x8d | Manual blemish correction |

| | | |
|---|---|---|
| 0x30 | 0x8e | Manual blemish correction |
| 0x88 | 0x11 | Erase NVR user page 1 |
| 0x88 | 0x13 | Save register Command |
| 0xE0 | 0x50 | Y offset |
| 0xE0 | 0x51 | Y gain2 |
| 0xE0 | 0x52 | Y clipper |
| 0xE0 | 0x5b | Horizontal aperture slice |
| 0xE0 | 0x5c | Vertical aperture slice/ vertical aperture gain |
| 0xE0 | 0x5d | Horizontal aperture gain 1 |
| 0xE0 | 0x5e | Horizontal aperture gain 2 |
| 0xE0 | 0x61 | Y clip threshold |
| 0xE0 | 0x63 | Horizontal edge suppress |
| 0xE0 | 0x64 | Y gain1 |
| 0xE0 | 0x8c | HUE1 Magenta |
| 0xE0 | 0x8d | HUE2 Red |
| 0xE0 | 0x8e | HUE3 Yellow |
| 0xE0 | 0x8f | HUE4 Green |
| 0xE0 | 0x90 | HUE5 Cyan |
| 0xE0 | 0x91 | HUE6 Blue |
| 0xE0 | 0x92 | UVgain1 Magenta |
| 0xE0 | 0x93 | UVgain 2 Red |
| 0xE0 | 0x94 | UVgain 3 Yellow |
| 0xE0 | 0x95 | UVgain 4 Green |
| 0xE0 | 0x96 | UVgain 5 Cyan |
| 0xE0 | 0x97 | UVgain 6 Blue |
| 0xE0 | 0xa2 | Sync level adjustment |
| 0xE0 | 0xa3 | AGC level to start edge suppression low light |
| 0xE0 | 0xa4 | Set ratio color suppression low light |
| 0xE0 | 0xa5 | Set AGC level for start color suppression low light |
| 0xE0 | 0xa6 | Set Y level HLC suppression dark range |
| 0xE0 | 0xa7 | Set gain high light color/edge suppression |
| 0xE0 | 0xa8 | Set ratio edge suppression |
| 0xE2 | 0x49 | Set Y level HLC suppression dark range |
| | | |
| 0xF0 | 0x01 | AGC mode |
| 0xF0 | 0x11 | Max AGC level in low mode |
| 0xF0 | 0x12 | Max AGC level in middle mode |
| 0xF0 | 0x13 | Max AGC level in high mode |
| 0xF0 | 0x14 | General AGC min value (for all modes) |
| 0xF0 | 0xB1 | Gamma user mode, gamma curve selection |
| 0xF0 | 0xF0 | Monitor mode |
| | | |

## 9.2. Detailed Register Information

### 9.2.1. Exposure Control

Manual gain on/off

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0x30 | 0x02 | [1] | 0x29 |
| If bit[1] = 0 camera runs in auto gain mode.<br>If bit[1] = 1 manual gain mode the gain can be set via register 0x1d of device address 0x30. (Remaining bits are don't care). | | | |

Control register, mirror, shutter, white balance

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0x30 | 0x04 | [7:0] | 0x78 |

Bit[7] mirror mode (horizontal) 0=off, 1=on (via register 0x55 flip and rotate mode can be set).

Bit[6:3] Shutter Selection (PAL/NTSC)
- 0000 = 1/50 - 1/60
- 0001 = Flickerless (1/100 - 1/120)
- 0010 = 1/250
- 0011 = 1/500
- 0100 = 1/1000
- 0101 = 1/2000
- 0110 = 1/5000
- 0111 = 1/10000
- 1011 = 1/100000
- 1110 = Special AUTO Mode (Auto 1)
  (see reg 0x65 and 0x66 for the shutter range)
- 1111 = AUTO Mode (Auto 2)

Bit[1:0] White Balance
- 0 = AWB (Auto White Balance)
- 1 = WB-mode 1 (Manual); use manual RED & BLUE gain
- 2 = WB-mode 2 (Indoor);
- 3 = WB-mode 3 (Outdoor)

Via register 0x42 and 0x43 of device address 0x30 the manual red and blue gain can be set.
The push to white mode can be addressed via reg 0x56 of device address 0x30.

BLC mode and weight factor

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0x30 | 0x13 | [6:0] | 0x30 |
| Bit[6] BLC on/off. 0= off.<br>Bits[5-0] BLC weight factor. | | | |

BLC window position

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0x30 | 0x14 | [5:3], [2:0] | 0x12 |
| Bits[5:3] Y position<br>Bits[2:0] X position | | | |

BLC window size

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0x30 | 0x15 | [5:0] | 0x15 |
| 0x00=1H-1V, 0x01=1H-2V, 0x03=1H-4V,0x07=1H-8V<br>0x08=2H-1V, 0x09=2H-2V, 0x0B=2H-4V,0x0F=2H-8V<br>0x18=4H-1V, 0x19=4H-2V, 0x1B=4H-4V,0x1F=4H-8V<br>0x38=8H-1V, 0x39=8H-2V, 0x3B=8H-4V | | | |

Manual fixed gain

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0x30 | 0x1d | [7:0] | 0x00 |
| Gain value: 0x00~0x7f | | | |

Manual Red gain

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0x30 | 0x42 | [6:0] | 0x67 |
| Gain value: 0x00~0x64<br>Value is active if camera is in manual white balance mode (dev0x30 reg 0x04) | | | |

Manual Blue gain

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0x30 | 0x43 | [6:0] | 0xA0 |
| Gain value: 0x00~0x64<br>Value is active if camera is in manual white balance mode (dev0x30 reg 0x04) | | | |

Sense up mode

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0x30 | 0x51 | [3:0] | 0x0 |
| 0 = OFF; 1 = X2; 2 = X4; 3 = X8, 4 = X16; 5 = X32; 6 = X64; 7 = X128; 8 = X256 | | | |

Digital Y gain

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0x30 | 0x52 | [7:0] | 0x6c |
| Gain value: 0x00~0xff | | | |

Digital C gain

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0x30 | 0x53 | [7:0] | 0x5e |
| Gain value: 0x00~0xff | | | |

Offset (brightness)

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0x30 | 0x54 | [7:0] | 0x09 |
| Value 0x00-0xff (-128 ~ +127 (2's complement) ) | | | |

Mirror mode extension

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0x30 | 0x55 | [1:0] | 0x00 |
| 0 = OFF; 1 = MIRROR; 2 = V_FLIP; 3 = both mirror and flip (rotate).<br>Remark: if OFF, control mirror mode as defined in Reg 0x04 bit 7 | | | |

One Push White Balance

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0x30 | 0x56 | [0] | 0x00 |
| set to 1 = ONE PUSH White Balance Function[1]<br>Remark: the White Balance setting as defined in Reg 0x04 bits[1:0]1will be overruled. | | | |

Analog Y gain (CVBS)

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0x30 | 0x57 | [7:0] | 0x7c |

[1] The PUSH White Balance Function takes about 5 seconds to process. During this time no I2C-communication is possible. This is only effective for the DSP (device address 0x30), not for the EEPROM (device address 0xA0).

| Gain value: 0x00~0xff |
|---|

3D Dynamic noise reduction mode

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0x30 | 0x58 | [0] | 0x01 |
| 3DNR on/off, 1 = on. | | | |

3D Dynamic noise reduction level

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0x30 | 0x59 | [6:0] | 0x32 |
| Value from 0x00 ~0x64 | | | |

3D Dynamic noise reduction AGC start level

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0x30 | 0x5a | [7:0] | 0x00 |
| Level as function from AGC where 3DNR start working (light to dark) | | | |

3D Dynamic noise reduction AGC stop level

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0x30 | 0x5b | [7:0] | 0x00 |
| Level as function from AGC where 3DNR stops working (dark to light) | | | |

3D Dynamic noise reduction weight factor

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0x30 | 0x5c | [7:0] | 0x80 |
| 0x00~0xff | | | |

3D Dynamic noise reduction motion level

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0x30 | 0x5d | [7:0] | 0xB5 |
| 0x00~0xff | | | |

Day&Night Mode

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0x30 | 0x60 | [1:0] | 0x01 |
| Bit[1:0] : 00 = Black and white, 01= color, 11=auto mode | | | |

Day&Night burst on/off (CVBS analog output)

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0x30 | 0x61 | [0] | 0x00 |
| 0=Burst off, 1 = burst on | | | |

Day&Night delay

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0x30 | 0x62 | [5:0] | 0x05 |
| Time in seconds before D&N becomes active after reaching required AGC level<br>Range 0x00-0x3f | | | |

Day&Night start level

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0x30 | 0x63 | [6:0] | 0x4b |
| AGC Level were Day&Night becomes active (light to dark). Note that stop level must be smaller then start level, otherwise oscillation might occur, also when start and stop are too close together. | | | |

| |
|---|
| Range 0x00-0x64 |

Day&Night stop level

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0x30 | 0x64 | [6:0] | 0x2d |
| AGC Level were Day&Night is turned off(dark to light). Note that stop level must be smaller then start level, otherwise oscillation might occur, also when start and stop are too close together.<br>Range 0x00-0x64 | | | |

Special shutter mode: min Value

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0x30 | 0x65 | [2:0] | 0x00 |
| If Electric Iris 1 mode is selected in reg 0x04 this setting is used to determine the longest integration time.<br>0:1/60, 1:FLK(1/120, 1/100), 2:1/250, 3:1/500, 4:1/1000, 5:1/2000, 6:1/5000, 7:1/10000. | | | |

Special shutter mode: max Value

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0x30 | 0x66 | [5:0] | 0x07 |
| If Electric Iris 1 mode is selected in reg 0x04 this setting is used to determine the shortest integration time.<br>0:FLK(1/120, 1/100), 1:1/250, 2:1/500, 3:1/1000,4:1/2000,5:1/5000, 6:1/10000, 7:1/100000. | | | |

Auto exposure reference offset

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0x30 | 0x67 | [7:0] | 0x4f |
| Range 0x00-0xff, this is the reference level for the shutter and gain control. The AEX will be controlled so that the average value of the internal Y signal matches the reference level. This means a lower value will make the image darker, a higher value brighter. | | | |

Low luminance color suppression

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0x30 | 0x68 | [7:0] | 0xff |
| Range 0x00-0xff. When the AGC goes up to keep the output level of the camera constant even in darker situations, noise will be created. Special the color noise is rather noticeable. The reduce this effect the camera will reduce slowly the color gain when the AGC reaches the LLCS level. | | | |

Digital zoom mode

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0x30 | 0x69 | [0] | 0x00 |
| 0= digital zoom off, 1= digital zoom on. | | | |

Digital zoom magnification value

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0x30 | 0x6a | [7:0] | 0xff |
| Digital zoom factor. Zoom factor goes from 1x-32x.<br>0xff = 1x, 0x80 = 2x, 0x40 = 4x, 0x20 = 8x, 0x10 = 16x, 0x08 = 32x (do not go lower than 0x08) | | | |

Pan position in digital zoom mode

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0x30 | 0x6b | [7:0] | 0x64 |
| value: effective range = -100 ~100. Setting range is: 0x00(= -100) ~ 0xC8(= +100) | | | |

Tilt position in digital zoom mode

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0x30 | 0x6c | [7:0] | 0x64 |
| value: effective range = -100 ~100. Setting range is: 0x00(= -100) ~ 0xC8(= +100) | | | |

OSD key control

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0x30 | 0x80 | [2:0] | 0x0 |
| Data=0: STOP (no change)<br>Data=1: cursor LEFT or decrement value<br>Data=2: cursor RIGHT or increment value<br>Data=3: cursor UP<br>Data=4: cursor DOWN<br>Data=5: SET (return/enter)<br>Remark: to make the OSD-Menu pop-up, set the SET command. | | | |

Save register Command

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0x0x88 | 0x13 | [7:0] | Don't care |
| This command must be used if settings with a device address other than 30 must be stored in the camera. If you use this, the current settings in the DSP will be stored. After this there is no reset option!<br><br>If you don't use this, settings inside the DSP will be restored to the last stored (factory) settings after re-powering the camera. If you use this command the factory settings are overwritten! | | | |

Y-cliper

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0xE0 | 0x52 | [6:0] | |
| Assigns maximum value for Y output signal | | | |

HUE1 control Magenta

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0xE0 | 0x8c | [7:0] | |
| Sets the hue of the color in the magenta area. Control range is from -45$^{o}$ to +45$^{o}$. Value range is from 0x00 ~ 0xff. | | | |

HUE2 control Red

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0xE0 | 0x8d | [7:0] | |
| Sets the hue of the color in the red area. Control range is from -45$^{o}$ to +45$^{o}$. Value range is from 0x00 ~ 0xff. | | | |

HUE3 control Yellow

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0xE0 | 0x8e | [7:0] | |
| Sets the hue of the color in the yellow area. Control range is from -45$^{o}$ to +45$^{o}$. Value range is from 0x00 ~ 0xff. | | | |

HUE4 control Green

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0xE0 | 0x8f | [7:0] | |
| Sets the hue of the color in the green area. Control range is from -45° to +45°. Value range is from 0x00 ~ 0xff. | | | |

HUE5 control Cyan

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0xE0 | 0x90 | [7:0] | |
| Sets the hue of the color in the cyan area. Control range is from -45° to +45°. Value range is from 0x00 ~ 0xff. | | | |

HUE6 control blue

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0xE0 | 0x91 | [7:0] | |
| Sets the hue of the color in the blue area. Control range is from -45° to +45°. Value range is from 0x00 ~ 0xff. | | | |

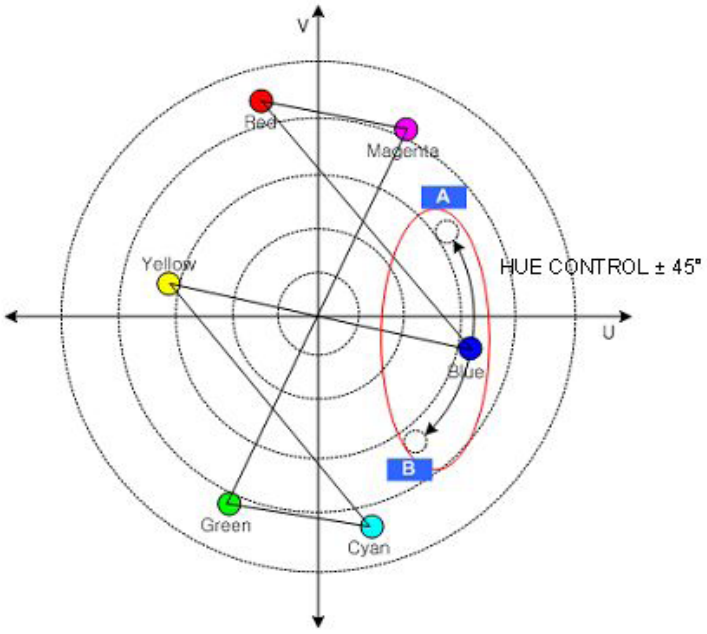



Figure 6. HUE Control

GAIN1 control Magenta

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0xE0 | 0x92 | [7:0] | |
| Sets the gain of the color in the magenta area. Control range is from 0-2x. Value range is from 0x00 ~ 0xff. | | | |

GAIN2 control Red

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0xE0 | 0x93 | [7:0] | |
| Sets the gain of the color in the red area. Control range is from 0-2x. Value range is from 0x00 ~ 0xff. | | | |

GAIN3 control Yellow

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0xE0 | 0x94 | [7:0] | |
| Sets the gain of the color in the yellow area. Control range is from 0-2x. Value range is from 0x00 ~ 0xff. | | | |

GAIN4 control Green

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0xE0 | 0x95 | [7:0] | |
| Sets the gain of the color in the green area. Control range is from 0-2x. Value range is from 0x00 ~ 0xff. | | | |

GAIN5 control Cyan

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0xE0 | 0x96 | [7:0] | |
| Sets the gain of the color in the cyan area. Control range is from 0-2x. Value range is from 0x00 ~ 0xff. | | | |

GAIN6 control blue

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0xE0 | 0x97 | [7:0] | |
| Sets the gain of the color in the blue area. Control range is from 0-2x. Value range is from 0x00 ~ 0xff. | | | |

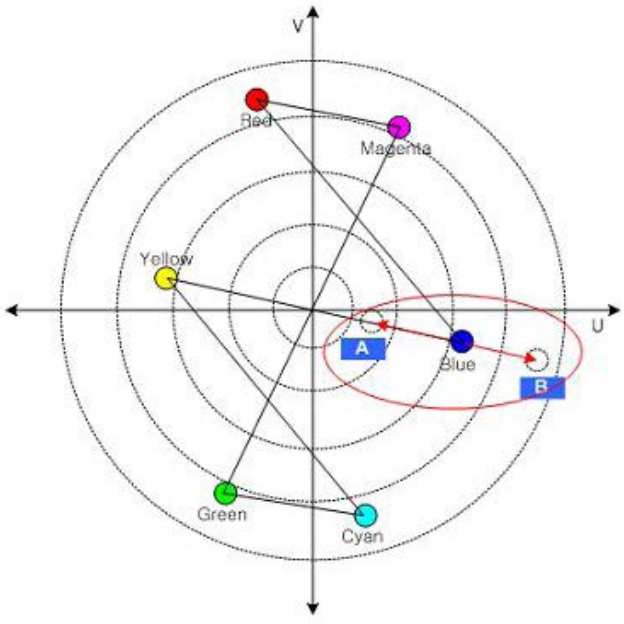
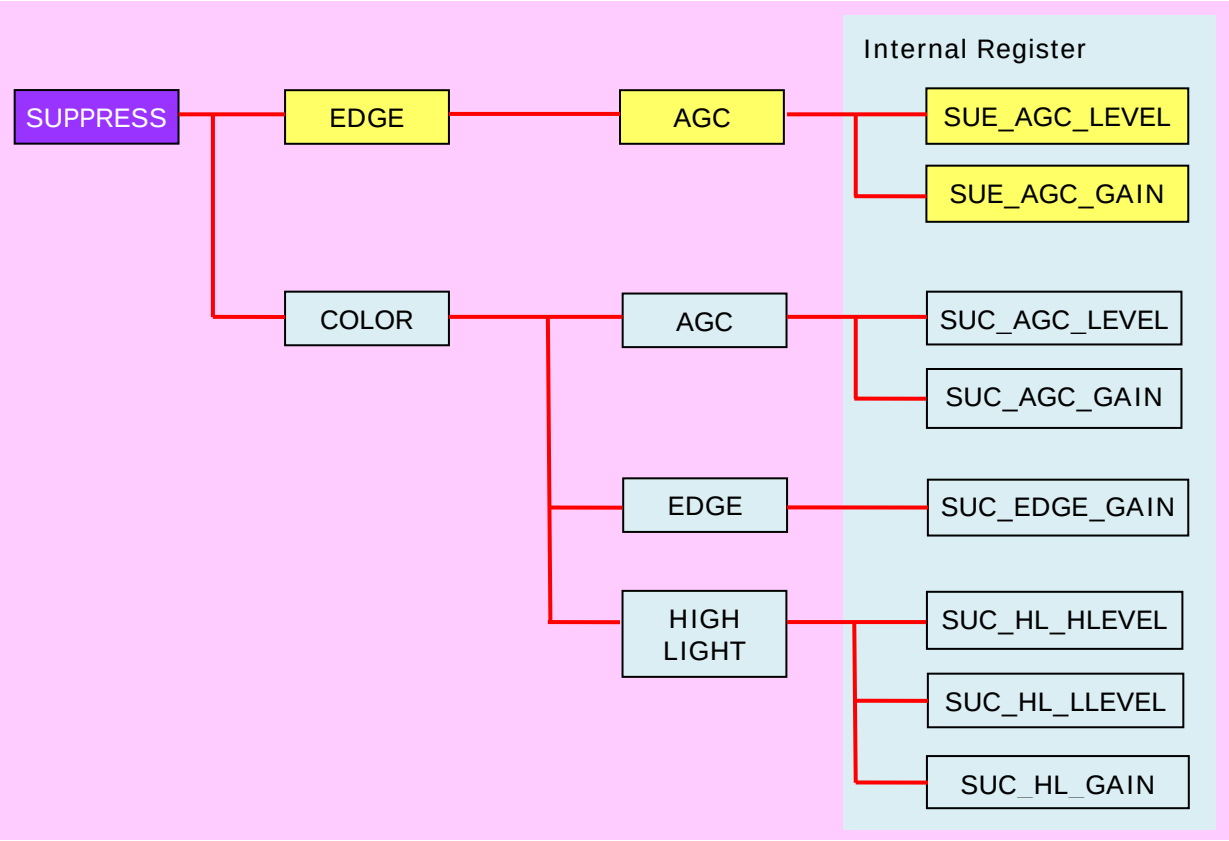



Figure 7. Color Gain (saturation)

Suppress Structure




AGC level to start Edge suppression low light

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0xE0 | 0xA3 | [7:0] | |
| Set AGC level for the start of edge suppress in low illumination<br>If AGC value is above the value set, edge suppress will be applied. | | | |

Set ratio color suppression low light

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0xE0 | 0xA4 | [3:0] | |
| Set ratio for color suppress in low illumination. | | | |

Set AGC level for start color suppression low light

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0xE0 | 0xA5 | [7:0] | |
| Set AGC level for the start of color suppress in low illumination. | | | |

Set Y level HLC suppression dark range

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0xE0 | 0xA6 | [7:0] | |
| Set Y level for the start of highlight color suppress (dark range) | | | |

Set gain high light color/edge suppression

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0xE0 | 0xA7 | [7:0] | |
| Bits[7:0]: Set ratio for highlight color suppress.<br>Bits[3:0]: Set ratio for the suppression of color component at edge. | | | |

Set gain high light color/edge suppression

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0xE0 | 0xA8 | [5:0] | |
| Set ratio for edge suppress in low illumination. | | | |

Set Y level HLC suppression dark range

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0xE2 | 0x49 | [7:1] | |
| Set Y level for the start of highlight color suppress (bright range) | | | |

AGC mode

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0xF0 | 0x01 | [1:0] | 0x03 |
| 0x00 = AGC off<br>0x01 = AGC low mode<br>0x02 = AGC middle mode<br>0x03 = AGC high mode | | | |

AGC max value low mode

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0xF0 | 0x11 | [7:0] | |
| Max AGC value. Valid range 0x00-0xff | | | |

AGC max value middle mode

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0xF0 | 0x12 | [7:0] | |
| Max AGC value. Valid range 0x00-0xff | | | |

AGC max value high mode

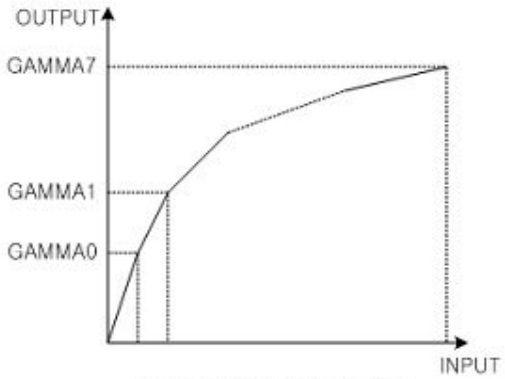
| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0xF0 | 0x13 | [7:0] | |
| Max AGC value. Valid range 0x00-0xff | | | |

AGC minimum value

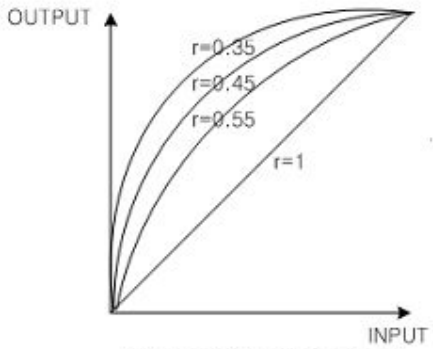
| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0xF0 | 0x11 | [7:0] | |
| Minimum AGC value for all modes. Valid range 0x00-0xff | | | |

Gamma user mode

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0xF0 | 0xB1 | [4:0] | 0x09 |
| Range from 0x01 to 0x13. Value 0x09 means gamma curve 0x45 (default).<br>Gamma goes from 0.05 to 1 in steps of 0.05 | | | |




a. Internal Gamma Register




b. pre defined gamma graph

Monitor gamma mode

| Device addr | Register addr | Bits: | Default value |
|---|---|---|---|
| 0xF0 | 0xF0 | [1:0] | 0x00 |
| The DSP has 3 different mode for different display's:<br>0x00 = CRT display (default mode)<br>0x01 = LCD display<br>0x02 = User mode, in this mode user can select gamma curve via register 0xF0 and register address 0xB1. | | | |

## 10.Contact Information

**For technical assistance with this product, please contact the supplier from whom the product was purchased.**

For OEM inquiries, contact Videology® Imaging Solutions:


**Americas, Middle East, Far East & Australia:**
Videology® Imaging Solutions Inc.
37M Lark Industrial Parkway
Greenville, RI 02828
USA

Tel: (401) 949-5332
Fax: (401) 949-5276

**Europe & N. Eurasia:**
Videology® Imaging Solutions Europe B.V.
Neutronenlaan 4
5405 NH Uden
The Netherlands

Tel: +31 (0) 413-256261
Fax: +31 (0) 413-251712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