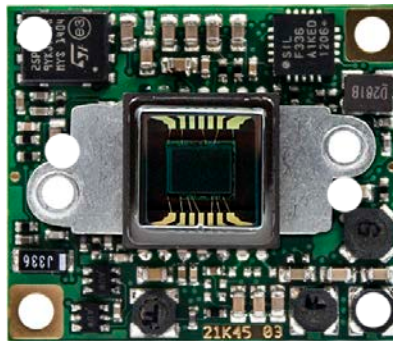


VIDEOLOGY

IMAGING SOLUTIONS INC.
Original Equipment Manufacturer

Application Note 20K45X / 21K45X (Color) 20K35X / 21K35X (B&W)



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1. Document History

Revision	Issue Date	Reason	CN#
Rev D	10-31-2014	Section 8.2 Register change	14-0099
Rev C	07-24-2013	Several corrections in "I2C Registers" paragraph, Default value DN burst corrected.	13-0054
Rev B	07-23-2013	Technical specs, mechanical drawing, pin out update and B&W options added	N/A
Rev A	11-19-2012	Initial release, European rev a	12-0100

2. Introduction

The 2xK45x is a 1/4" CCD based camera family with a digital output (CCIR656 based). It is mechanically identical with Videology's 21K15X CCD camera family and identical dimensions (22x26mm) and mounting holes, and may be seen as its higher end successor.

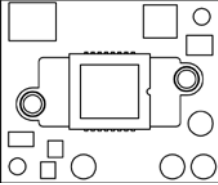
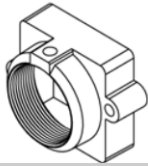
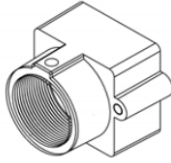
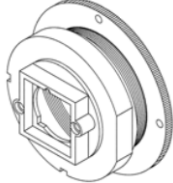
This document is written to give technical background on specific features of these cameras.

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.

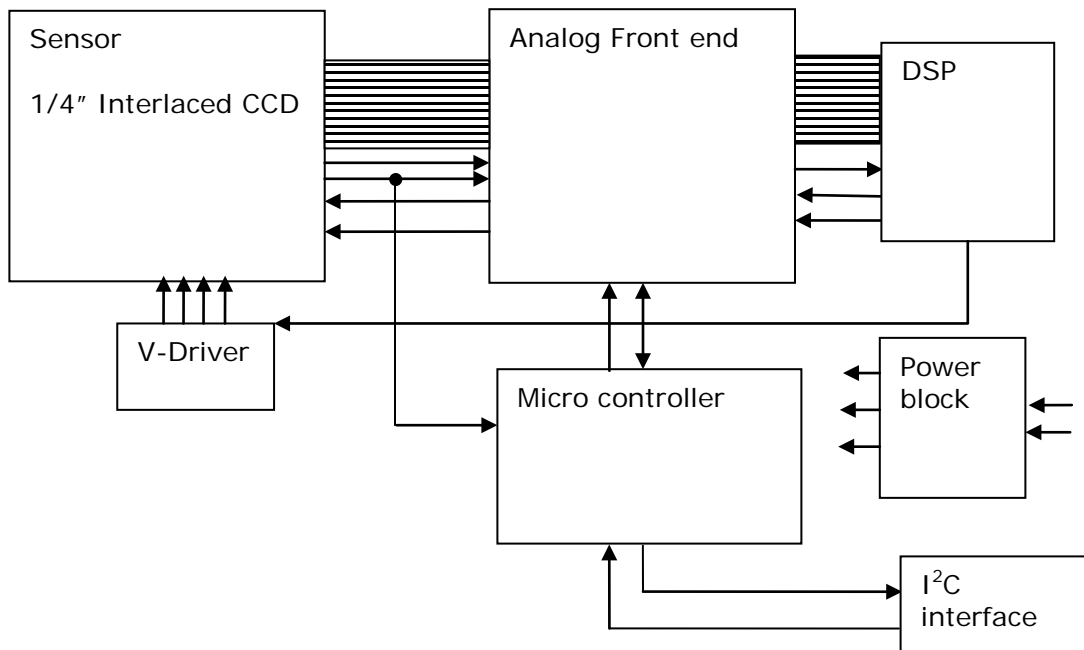
3. Specifications

	20K45X (NTSC) 20K35X (EIA)	21K45X (PAL) 21K35X (CCIR)
Image Sensor	1/4" Sony IL CCD (Color) 1/4" Sony® Ex-View® CCD (B&W)	
Active Pixels (HxV)	768 x 492	752 x 582
Resolution	>540 TVL (Color) >600 TVL (B&W)	
Frame Rate (max)	30fps	25fps
Sensitivity	< 0.05 Lux (F1.2) 3200K (Color) < 0.005 lux, near IR sensitive (B&W)	
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	Composite video output – color (20/21K45X) Composite video output – monochrome (20/21K35X)	
Control Communication	I ² C control	
Power supply	5VDC +/- 5% (not polarity protected)	
Power consumption	< 1.2W	

Lens options (X-value)

			
2xK457 (color) 2xK357 (b&w) No lens mount	2xK452 (color) 2xK352 (b&w) Pin hole lens	2xK455 (color) 2xK355 (b&w) Board lens (M12 lens)	2xK458 (color) 2xK358 (b&w) 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

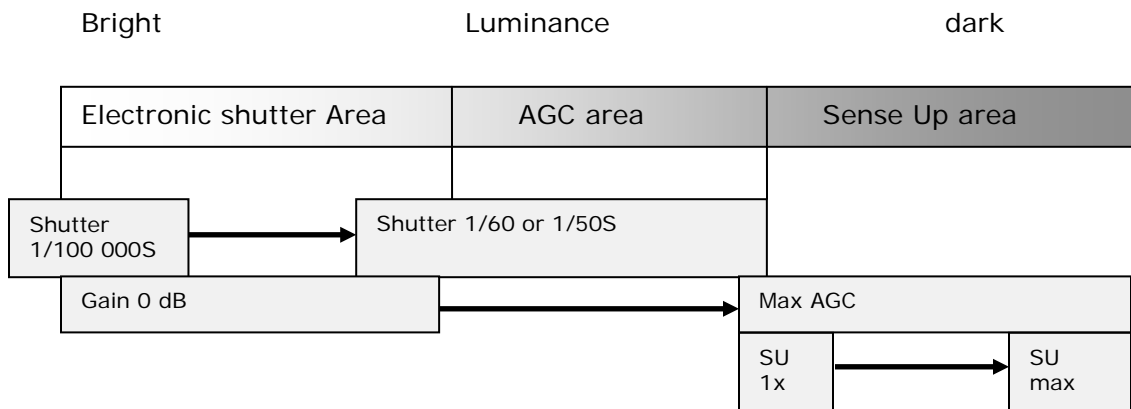
In default mode, the camera operates in the electronic iris mode. This means the CCD output, which is dependent on the light intensity, is controlled by the electronics of the camera and not the mechanics of the lens.

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 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

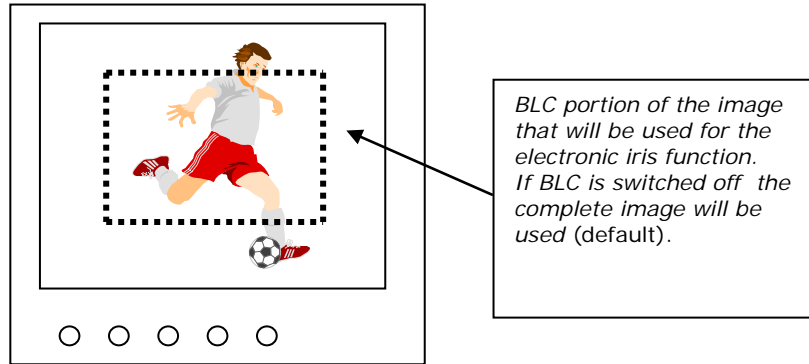
Edge enhancement will increase the sharpness impression of the camera. The level can be controlled via software and can even be switched off.

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

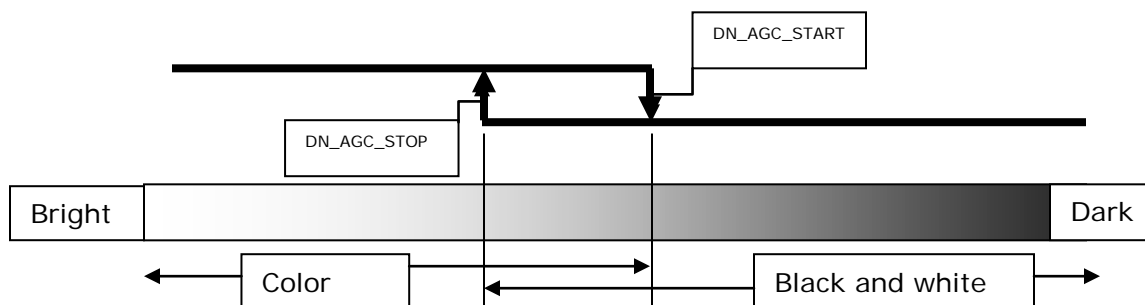
The camera has algorithms internally to reduce noise as much as possible. To do this the camera uses 2D and 3D noise cancellation algorithms.

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 where the algorithm will start and 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 I²C.

5.10. OSD Menu

For some basic camera functions the camera has an OSD menu. The menu can be activated via I²C. 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 I²C-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 I²C 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).

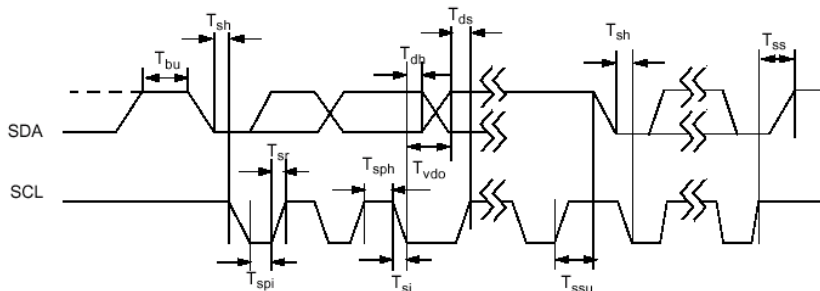


Figure 1. Communication Timing

I ² C 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 _{sph}	Clock high period			
T _{spi}	Clock low period		4.2	
T _{si}	Falling time clock			0.5
T _{ssu}				
F _{clk}	Clock frequency	KHz	1	110

I²C address camera: 0x70/71 (write read)

The communication-structure is the standard I²C 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 01=read to camera	0x30 = DSP commands 0xa0 = EEPROM Special: 0xE0: DSP bank 0 reg. 0xE2: DSP bank 1 reg 0x88: Erase EEpr comm. 0xF0: Status reg B0 0xF2: Status reg B1

Data block:

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

Cam_address	Data:
Access mode=00: 0x70	Write data to camera with ackn .
Access mode=01: 0x71	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. Connectors

The camera has a board to board connector (J100) to make interconnections as easy as possible.

8 pin connector JST- SMD-CONN-JST-VERT-8P-1MM

8	C or MD
7	IRIS or GND
6	I2C DAT
5	I2C CLK
4	GND
3	CVBS or Y
2	GND
1	Vin 5V

Camera is being supplied with 8 pin connector cable with flying leads (60C1041)

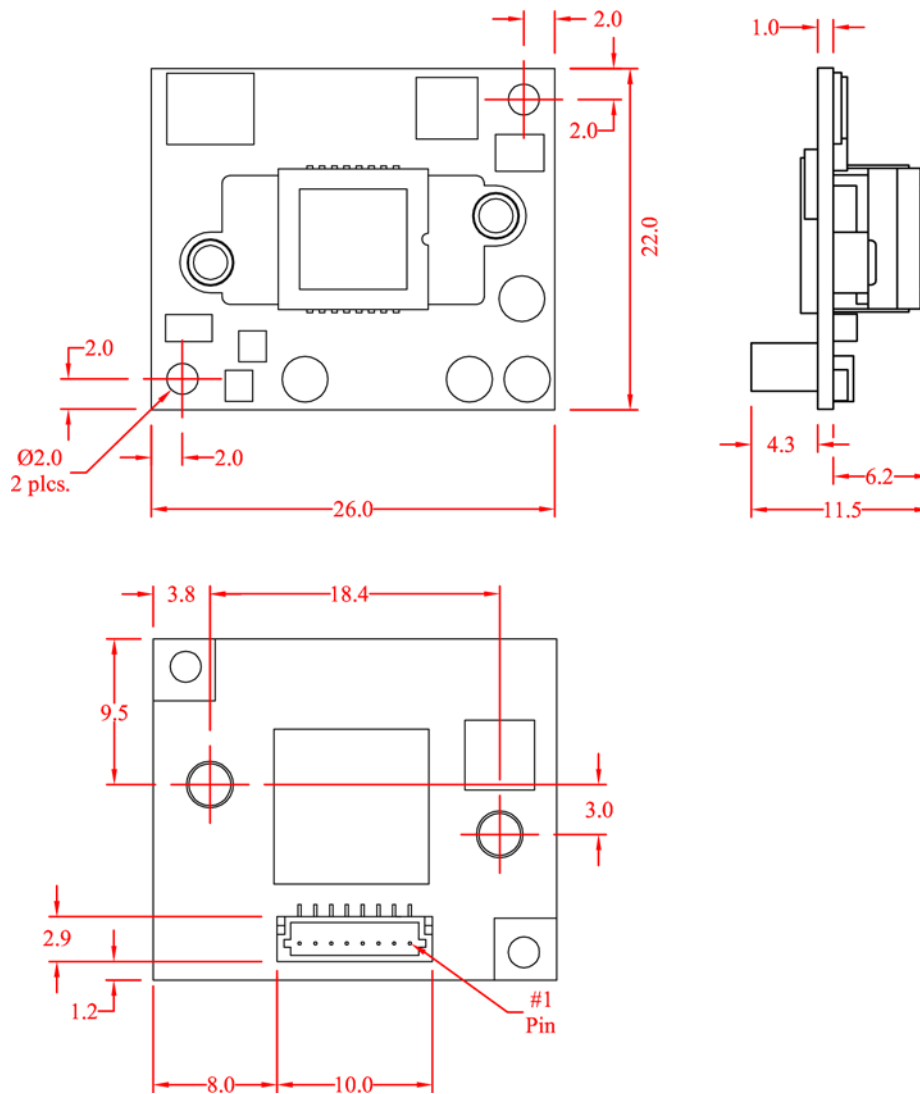


Figure 2. Camera Dimensions

8. I²C registers

The I²C registers are listed below. In paragraph one a table is placed with the registers in a numeric order. In section 8.2 Detailed Register Information a more detailed description can be found.

8.1. Registers Overview

Device address	Register address	Function
0x30	0x00	Shutter Selection
0x30	0x01	Sense Up mode
0x30	0x04	Offset (Brightness)
0x30	0x05	Mirror/flip mode
0x30	0x06	Sharpness Level
0x30	0x07	Analogue gain control (CVBS)
0x30	0x08	White Balance mode
0x30	0x09	Manual White Balance Blue gain
0x30	0x0a	Manual White Balance Red gain
0x30	0x10	BLC mode Selection
0x30	0x11	BLC gain
0x30	0x12	HSBLC level
0x30	0x13	BLC top/bottom; BLC left/right
0x30	0x14	BLC height; BLC width
0x30	0x15	HSBLC top/bottom ; HSBLC left/right
0x30	0x16	HSBLC height; HSBLC width
0x30	0x18	3DNR Mode
0x30	0x19	3DNR Level
0x30	0x1a	3DNR Start Level
0x30	0x1b	3DNR Stop Level
0x30	0x1c	3DNR Weight Factor
0x30	0x1d	3DNR Motion Level
0x30	0x20	DN Selection
0x30	0x21	DN Burst On
0x30	0x22	DN Delay
0x30	0x23	DN auto start level
0x30	0x24	DN auto stop level
0x30	0x25	Special shutter mode: min level
0x30	0x26	Special shutter mod: max level
0x30	0x27	AEX reference level
0x30	0x28	Low luminance colour suppression
0x30	0x29	Digital zoom on/off
0x30	0x2a	Digital zoom factor
0x30	0x2b	Pan position (zoom mode)
0x30	0x2c	Tilt position (zoom mode)
0x30	0x40	OSD menu
0x30	0x41	Auto blemish correction: Start & Clear
0x30	0x42	Auto blemish correction: Sense-up Level
0x30	0x43	Auto blemish correction: Difference Level
0x30	0x44	Auto blemish correction: Defect Pixel Viewing
0x30	0x45	Auto blemish correction: Field Selection
0x30	0x48	Manual blemish correction: Odd/Even Field
0x30	0x49	Manual blemish correction: Select Address
0x30	0x4a	Manual blemish correction: Horizontal Pixel Position low
0x30	0x4b	Manual blemish correction: Horizontal Pixel Position high
0x30	0x4c	Manual blemish correction: Vertical Pixel Position low

0x30	0x4d	Manual blemish correction: Vertical Pixel Position high
0x30	0x4e	Manual blemish correction: Select as Active
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	UVgain 1 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 colour suppression low light
0xE0	0xa5	Set AGC level for start colour suppression low light
0xE0	0xa6	Set Y level HLC suppression dark range
0xE0	0xa7	Set gain high light colour/edge suppression
0xE0	0xa8	Set ratio edge suppression
0xE2	0x49	Set Y level HLC suppression dark range
0xF0	0x01	AGC mode (bit 2 & 3)
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 (bit 0 ~4)
0xF0	0xF0	Monitor mode

8.2. Detailed Register Information

Shutter Selection			
Device addr	Register addr	Bits:	Default value
0x30	0x00	[4:0]	0x0F
00000 = 1/50 - 1/60 00001 = Flickerless (1/100 - 1/120) 00010 = 1/250 00011 = 1/500 00100 = 1/1000 00101 = 1/2000 00110 = 1/5000 00111 = 1/10000 01010 = 1/100000 01111 = AUTO Mode 11111 = Limited AUTO Mode (see reg 0x25 and 0x26 for the shutter range)			

Sense Up Mode			
Device addr	Register addr	Bits:	Default value
0x30	0x01	[3:0]	0x0
0 = OFF; 1 = X2; 2 = X4; 3 = X8, 4 = X16; 5 = X32; 6 = X64; 7 = X128; 8 = X256			

Offset (brightness)			
Device addr	Register addr	Bits:	Default value
0x30	0x04	[7:0]	0x09
Value 0x00-0xff (-128 ~ +127 (2's complement))			

Mirror Mode			
Device addr	Register addr	Bits:	Default value
0x30	0x05	[1:0]	0x00
0 = OFF; 1 = MIRROR; 2 = V_FLIP; 3 = ROTATE (=both mirror and flip)			

Sharpness Level			
Device addr	Register addr	Bits:	Default value
0x30	0x06	[4:0]	0x06
Value 0x00-0x1f			

Analogue Y Gain Control (CVBS)			
Device addr	Register addr	Bits:	Default value
0x30	0x07	[7:0]	0x7C
Value 0x00-0xff			

White Balance Mode			
Device addr	Register addr	Bits:	Default value
0x30	0x08	[2:0]	0x01
AWB-mode 0 = ATW 1 = AWB 2 = MANUAL 3 = INDOOR 4 = OUTDOOR 5 = ONE PUSH White Balance Function ¹ 6 = AWC_SET (select the ONE PUSH white balance setting)			

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).

Manual Blue gain			
Device addr	Register addr	Bits:	Default value
0x30	0x09	[6:0]	0x32
Gain value: 0x00~0x64 Value is active if camera is in manual white balance mode (dev0x30 reg 0x04)			

Manual Red gain			
Device addr	Register addr	Bits:	Default value
0x30	0x0a	[6:0]	0x32
Gain value: 0x00~0x64 Value is active if camera is in manual white balance mode (dev0x30 reg 0x08)			

BLC Mode Selection			
Device addr	Register addr	Bits:	Default value
0x30	0x10	[1:0]	0x00
0 = OFF; 1 = BLC; 2 = HSBLC (High Sensitivity) Remark: HSBLC is used to block highlight spot. It should be "black" if that spot is high enough.			

BLC Gain			
Device addr	Register addr	Bits:	Default value
0x30	0x11	[1:0]	0x01
BLC gain: 0 = LOW; 1 = MEDIUM; 2 = HIGH			

HSBLC Level			
Device addr	Register addr	Bits:	Default value
0x30	0x12	[1:0]	0x04
Value: 0 ~ 8			

BLC top/bottom; BLC left/right			
Device addr	Register addr	Bits:	Default value
0x30	0x13	[7:0]	0x21
bit 7:4 = BLC top/bottom (0 ~ 7) bit 3:0 = BLC left/right (0 ~ 7)			

BLC height; BLC width			
Device addr	Register addr	Bits:	Default value
0x30	0x14	[7:0]	0x46
bit 7:4 = BLC height (0 ~ 8) bit 3:0 = BLC width (0 ~ 8)			

HSBLC top/bottom; HSBLC left/right			
Device addr	Register addr	Bits:	Default value
0x30	0x15	[7:0]	0x00
bit 7:4 = HSBLC top/bottom (0 ~ 7) bit 3:0 = HSBLC left/right (0 ~ 7)			

HSBLC height; HSBLC width			
Device addr	Register addr	Bits:	Default value
0x30	0x16	[7:0]	0x88
bit 7:4 = HSBLC height (0 ~ 8) bit 3:0 = HSBLC width (0 ~ 8)			

3D Dynamic Noise Reduction Mode			
Device addr	Register addr	Bits:	Default value
0x30	0x18	[1:0]	0x01
bit[0] = mode ON/OFF; 1 = ON bit[1] = auto ON/OFF; 1 = ON Remark: operates only when both bit[0] and bit[1] are 1			

3D Dynamic Noise Reduction Level			
Device addr	Register addr	Bits:	Default value
0x30	0x19	[6:0]	0x32
Value from 0x00 ~0x64			

3D Dynamic Noise Reduction AGC start level			
Device addr	Register addr	Bits:	Default value
0x30	0x1a	[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	0x1b	[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	0x1c	[7:0]	0x80
0x00~0xff			

3D Dynamic noise reduction motion level			
Device addr	Register addr	Bits:	Default value
0x30	0x1d	[7:0]	0xB5
0x00~0xff			

Day/Night Mode			
Device addr	Register addr	Bits:	Default value
0x30	0x20	[1:0]	0x01
Bit[1:0] : 00 = Black and white, 01= colour, 11=auto mode			

Day/Night burst on/off (CVBS analogue output)			
Device addr	Register addr	Bits:	Default value
0x30	0x21	[0]	0x00
0=Burst Off, 1 = Burst On			

Day/Night delay			
Device addr	Register addr	Bits:	Default value
0x30	0x22	[5:0]	0x05
Time in seconds before D&N becomes active after reaching required AGC level Range 0x00-0x3f			

Day/Night start level			
Device addr	Register addr	Bits:	Default value
0x30	0x23	[6:0]	0x4b
AGC Level where 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	0x24	[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. Range 0x00-0x64			

Minimum shutter value for special auto shutter mode			
Device addr	Register addr	Bits:	Default value
0x30	0x25	[2:0]	0x00
If Special Shutter Mode is selected in reg 0x00 this setting is used to determine the longest integration time. 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.			

Maximum shutter value for special auto shutter mode			
Device addr	Register addr	Bits:	Default value
0x30	0x26	[2:0]	0x07
If Electric Iris 1 mode is selected in reg 0x04 this setting is used to determine the shortest integration time. 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 level			
Device addr	Register addr	Bits:	Default value
0x30	0x27	[7:0]	0x2f
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 colour suppression			
Device addr	Register addr	Bits:	Default value
0x30	0x28	[7:0]	0x89
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 colour noise is rather noticeable. To reduce this effect the camera will reduce slowly the colour gain when the AGC reaches the LLCS level.			

Digital zoom mode			
Device addr	Register addr	Bits:	Default value
0x30	0x29	[0]	0x00
0= digital zoom off, 1= digital zoom on.			

Digital zoom factor			
Device addr	Register addr	Bits:	Default value
0x30	0x2a	[7:0]	0xff
Digital zoom factor. Zoom factor goes from 1x-32x. 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	0x2b	[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	0x2c	[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	0x40	[2:0]	0x0
Data=0: STOP (no change) Data=1: cursor LEFT or decrement value Data=2: cursor RIGHT or increment value Data=3: cursor UP Data=4: cursor DOWN Data=5: SET (return/enter) 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! 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-clipper			
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° to +45°. 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° to +45°. 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° to +45°. 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.			

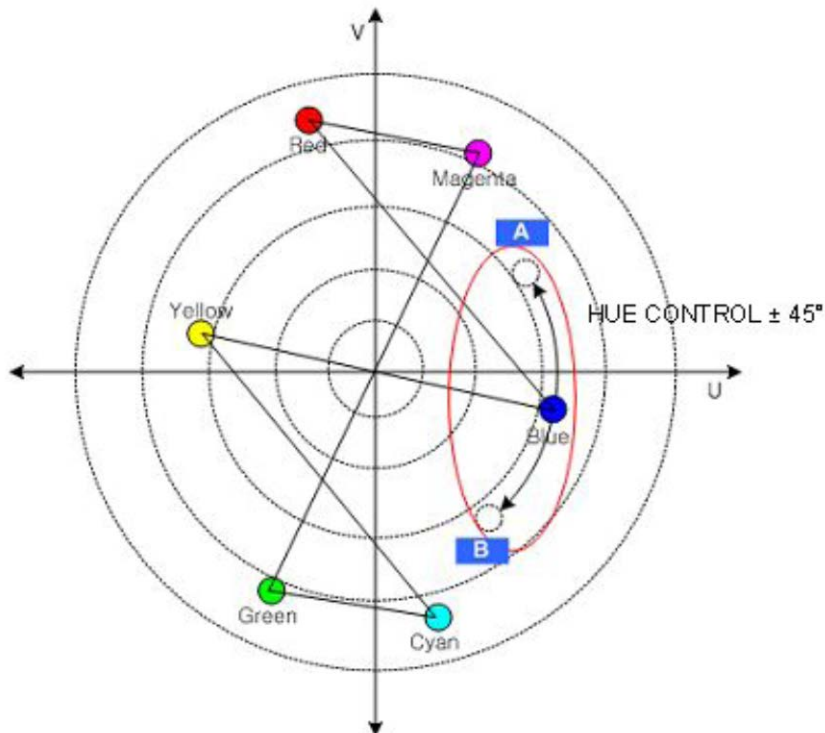


Figure 3. HUE control

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.			

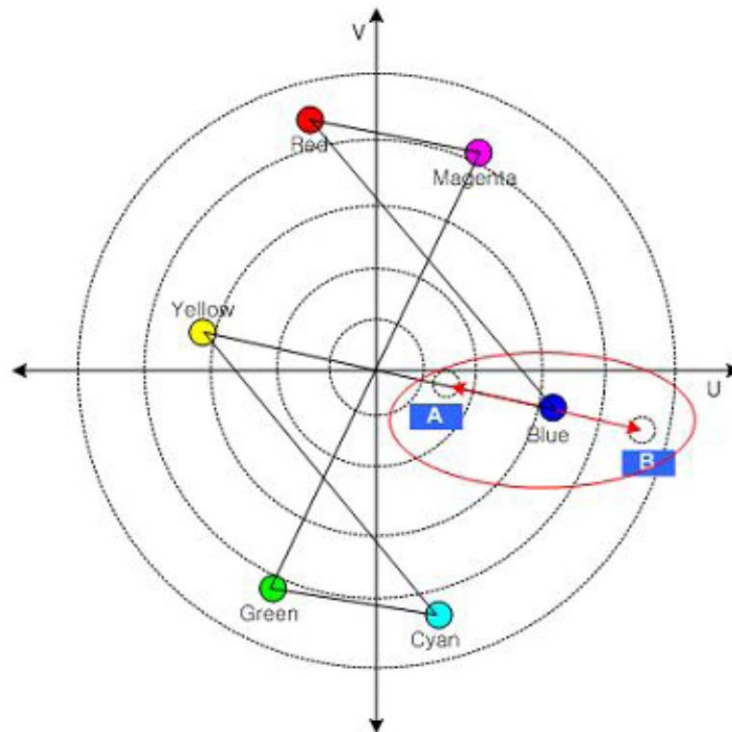
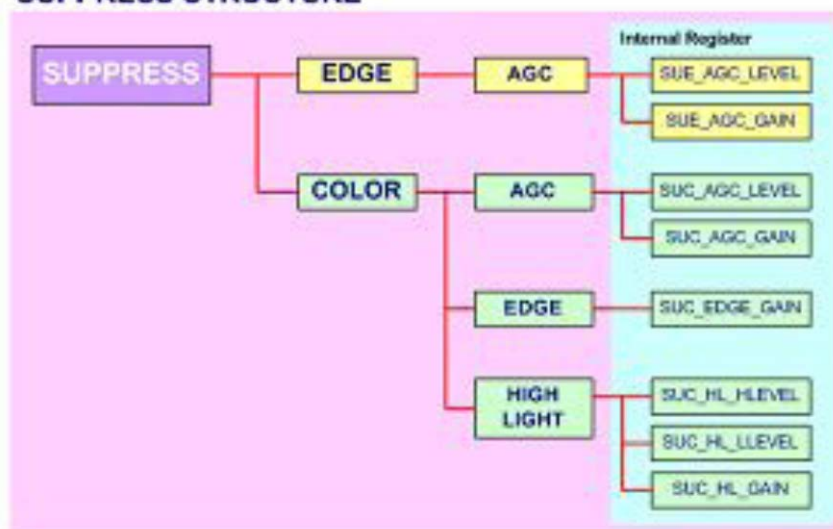


Figure 4. Color Gain (Saturation)

SUPPRESS STRUCTURE



Start Edge suppression at low light as function of AGC			
Device addr	Register addr	Bits:	Default value
0xE0	0xA3	[7:0]	
Set AGC level for the start of edge suppress in low illumination If AGC value is above the value set, edge suppress will be applied.			

Set ratio colour 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 colour/edge suppression			
Device addr	Register addr	Bits:	Default value
0xE0	0xA7	[7:0]	
Bits[7:0]: Set ratio for highlight color suppress. Bits[3:0]: Set ratio for the suppression of color component at edge.			

Set gain high light colour/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 0x01 = AGC low mode 0x02 = AGC middle mode 0x03 = AGC high mode			

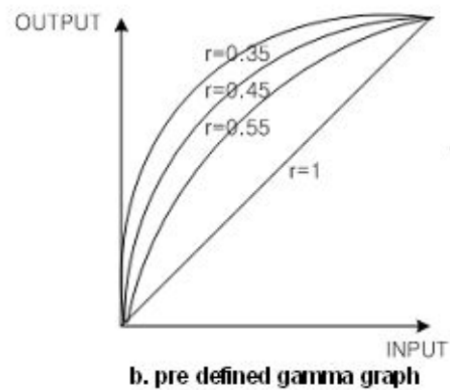
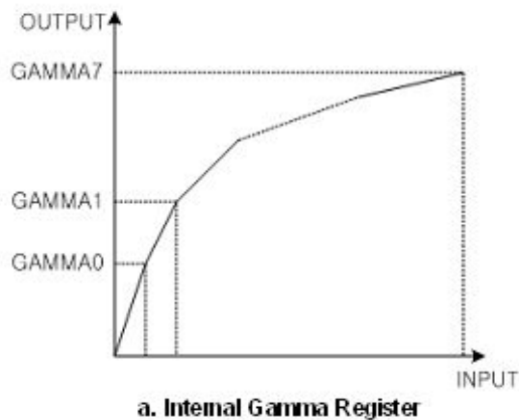
AGC max value low mode			
Device addr	Register addr	Bits:	Default value
0xF0	0x11	[7:0]	
Max AGC value. Valid range 0x00-0xff			

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). Gamma goes from 0.05 to 1 in steps of 0.05			



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

9. Contact Information

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

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