

# VIDEOLOGY

IMAGING SOLUTIONS INC.  
Original Equipment Manufacturer

## Application Note Blue Sky Family Cameras

20D20x/ 21D20x  
20D35x/ 21D35x



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

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## 1. Document History

Revision	Issue Date	Reason	CN#
Rev A	09-17-10	Initial release	10-0151
Rev B	06-09-11	Entire App Note updated	11-0076
Rev C	07-05-11	Section 4.6 Command Registers updated	11-0085

## 2. Introduction

Our Blue Sky Series of camera boards use state of the art components which provide superb image quality, multiple functionality and excellent near infrared sensitivity.

The compact (32 x 32 mm) single board design permits easy integration of the camera into existing and future designs.

### 2.1. List of Models

*See a sales representative for complete model selections.*

#### 2.1.1. Color Cameras

##### *High Resolution 32mm Board*

20/ 21D20X	Composite 1Vp-p CVBS (75 ohms) output
20/ 21D20XB	Balanced video output
20/ 21D20XS	Sony Super HAD <sup>®</sup> , composite 1Vp-p CVBS (75 ohms) output

#### 2.1.2. B&W Cameras

##### *High Resolution 32mm Board*

20/ 21D35X	Composite 1Vp-p CVBS (75 ohms) output
20/ 21D35XB	Balanced video output
20/ 21D35XO	Aerospace grade, composite 1Vp-p (75 ohms) output
20/ 21D35XOB	Aerospace grade, balanced video output @ 10 ohms

#### *\* Audio Option:*

Equipment with audio recording capabilities is intended to be used only for legal and proper purposes. The customer assumes all liability related to legal and proper use per VIS waiver FOR-03-021.

### 3. Features

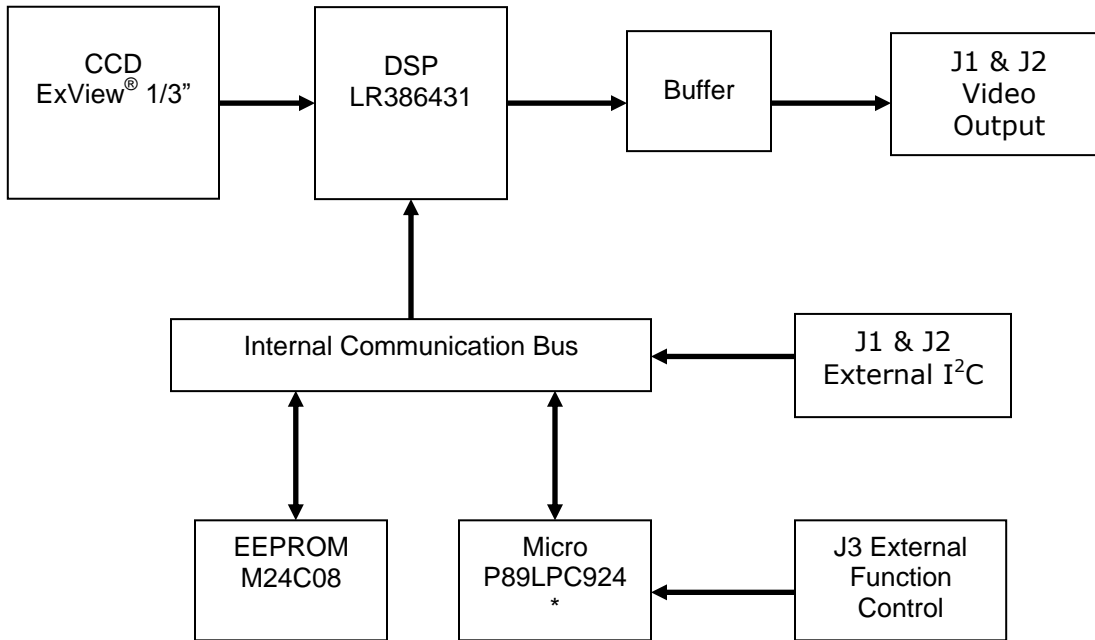
#### 3.1. 20/ 21D20X

- 1/3" Color Sharp CCD (480 TVL)
- 0.5 Lux Sensitivity
- Miniature 32mm x 32mm Single Board Camera
- Options Available With A 8-pin Connector
  - (All Features Available On A Single Board)
    - Sony Super HAD<sup>®</sup> Color High Resolution CCD (Sensitivity To 0.05 Lux)
    - Balanced Video Output For CAT5/CAT6 Transmission (Via 8-pin Connector)
- Computer Controllable Via I<sup>2</sup>C (8-pin Connector Version)
  - Gamma & Gain Control
  - Scan Mode for non-interlaced setting
  - Mirror Mode Preset
  - Backlight Compensation can be turned off (Via Connector Interface)
  - White Balance has 3 fixed modes
  - Shutter Speed Control
  - I<sup>2</sup>C Communication

#### 3.2. 20/ 21D35X

- Sony HR ExView<sup>®</sup> CCD
  - ICX258AL (1/3" B&W HR CCD EIA)
  - ICX259AL (1/3" B&W HR CCD CCIR)
- CVBS or 100-OHM differential video outputs
- Horizontal resolution of greater than 560 TVL
- Miniature 32mm x 32mm Single Board Camera
- Back light compensation selection pin on connector
- Factory customizable microprocessor with 6 I/O's
- I<sup>2</sup>C camera control with the following adjustments:
  - Automatic or manual gain control
  - Interlaced or non-interlaced output
  - Gamma 1 or 0.45
  - Contour (edge) enhancement
  - Electronic iris or 10 fixed shutter speeds
- Mirror and non-mirror modes

### 3.3. Block Diagram



\*The micro programmer is factory re-programmable for up to 6 I/O controls accessible at J3.

### 3.4. Differential (Balanced) Video Output

One option for this camera is to have differential (balanced) video output. The model then becomes 2XD35XB (B&W) or 2XD20XB (Color). This means that instead of a conventional CVBS output (where there is the video signal and ground), there are positive and negative video signal outputs.

The advantage of this form of transmission is that the signal can be transmitted over longer lengths with less expensive wire. On the receiver side of the video transmission, there is a video device called a balun. A balun converts the differential video signals back to the standard CVBS signal to be displayed or recorded in a standard monitor or video recorder. The balun should be active for all wire runs greater than 250 feet.

Many applications can accept a passive balance for shorter runs.

### 3.5. Electronic Iris and Fixed Shutter Speeds

The default operation of this camera is the electronic iris mode. The output of the CCD, which is dependent on the light intensity, is controlled by the electronics of the camera and not the mechanics of the lens. The amount of signal out of the CCD is dependent on the light intensity and the time that the charge can build up (the period during which no OFD pulse is present). 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.

Sometimes it is preferred that the shutter is fixed. One example would be 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 CCIR/PAL and max 1/60 sec for EIA/NTSC) the less sharp the image will be due to movement of the object during the integration period. To prevent this, the camera has 10 fixed shutter speeds that can be selected for the application. They are 1/60 (1/50 CCIR/PAL), 1/100 (1/120 CCIR/PAL), 1/250, 1/500, 1/1000, 1/2000, 1/10000, 1/20000, 1/50000 and 1/100000. Use the I2C camera control software to select electronic Iris or any of the 10 fixed shutter speeds.

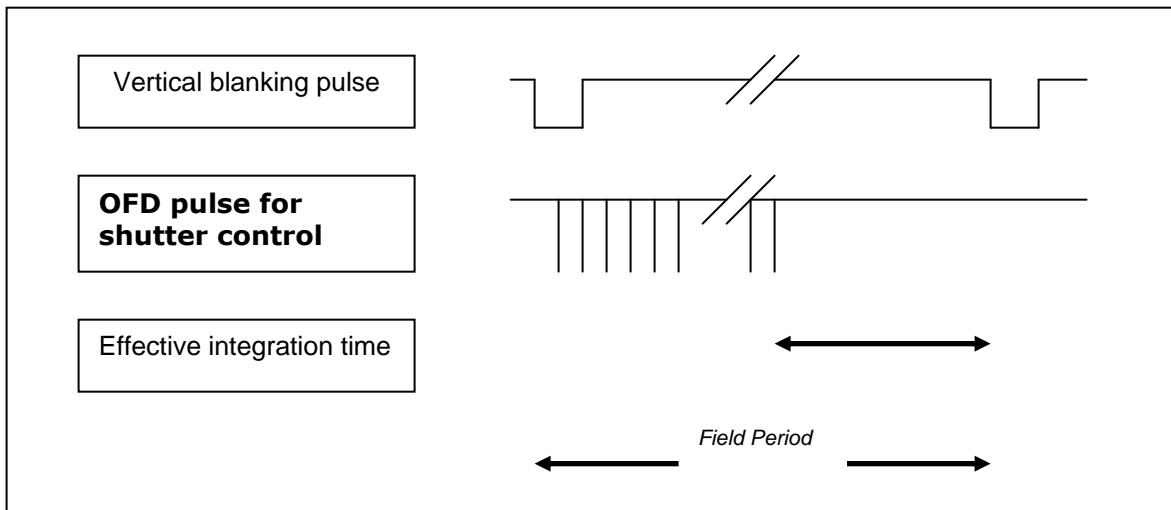


Figure 1. Shutter control

### 3.6. Automatic Gain Control (AGC)

This function is responsible for the output signal remaining constant at a certain level. If the camera is pointed to a gamma reflection chart 0.45 the output should be 1 Vp-p. This control circuit works with an integrator, which is generated from the video, and corresponds with the average value of the video signal. This average is then compared with an internal reference and depending on the outcome will increase or decrease the gain. This camera is in the automatic gain control as a default.

### 3.7. Manual gain control

The manual gain control is an option where the AGC is turned off and the user selects the amount of gain for the image or to turn the gain off all together. This would be used when the lighting for the scene is constant or controlled. To turn the AGC off, un-check the AGC box in the I<sup>2</sup>C camera control software and the slider bar will become active. Adjust the slider up or down to select a fixed gain.

### 3.8. Gamma

A camera has a gamma function to correct for the non-linear behavior of the monitor. The 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. However, if the camera video signal is processed for pattern recognition this gamma function may not be wanted. To make this possible the 20/21D35x has a gamma 1 option. The gamma settings are selected via the I<sup>2</sup>C camera control software.

Please note this function may be password protected.

### 3.9. Contour (edge) enhancement

Contour (edge) enhancement is an image-processing filter that improves the apparent sharpness of the video. It is accomplished by creating bright and dark highlights on the edges of lines in the image therefore enhancing the image and making it look sharper. The default setting for this camera is contour enhancement "on" but by un-checking the select box in the control software you can turn it off. There is also a slide bar that allows for the intensity or gain level of the enhancement to be selected. The default value is set to 15.

### 3.10. Back Light compensation

BLC is when the electronic iris circuit only uses the main part of the scene to determine the level of the CCD output (see figure 2). When fixed shutter speeds are used, this function has no effect. The camera has a default setting of back light compensation (BLC) "on". To switch the BLC off, you ground pin 8 of connector J1 or pin 1 of the optional connector J2.

The Back Light Compensation is fully programmable through the I<sup>2</sup>C camera control software. The size and position of the window can be programmed along with the weighting factor (the relation between the BLC window and rest of the image).

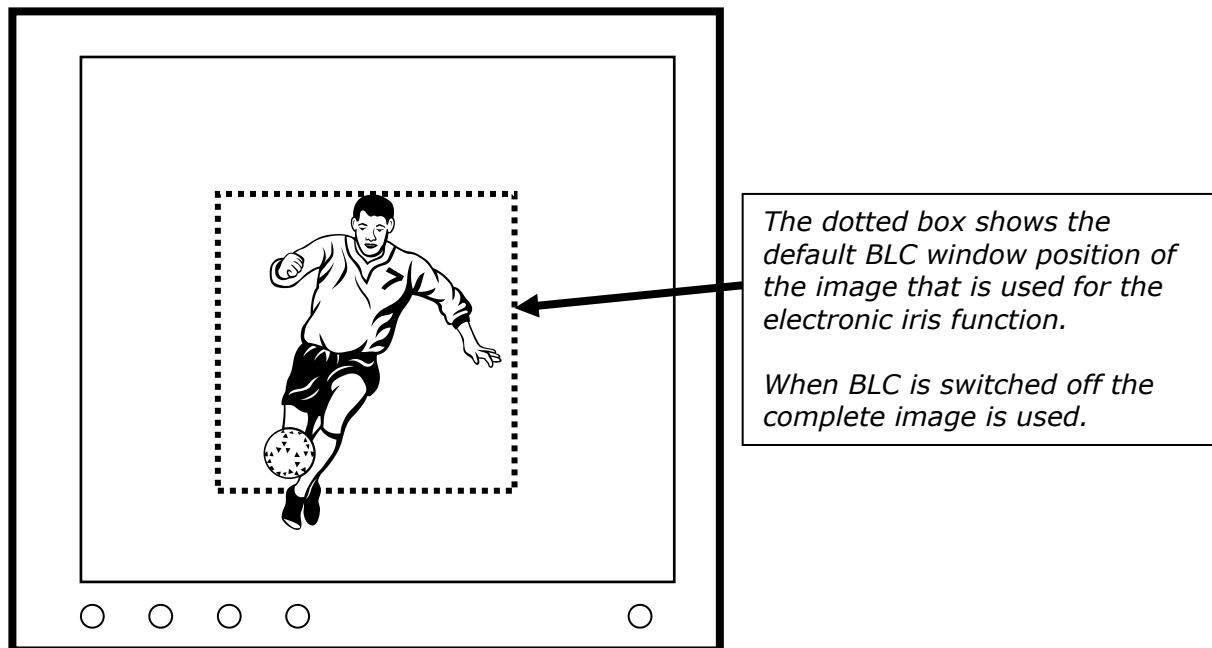


Figure 2. BLC

### 3.11. Spectral response (B&W models)

The CCD is the eye of the camera. It converts light into an electrical signal that will be turned into a video signal by the processing of the camera. However, the camera is not sensitive for all types of light and has a sensitivity peak at 550 nm.

The spectral curve of the 20/21D35x ranges from the visual part of the light to the near infrared area (1100 nm). Due to the use of Sony Exview<sup>®</sup> CCD the IR sensitivity is improved drastically. Only filters may change the response. The complete curve is shown in figure 3:

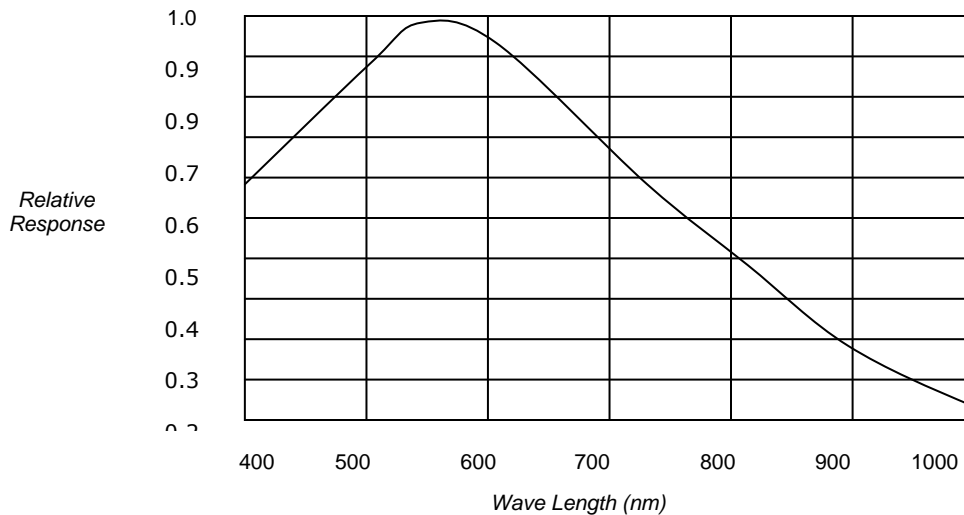


Figure 3. Spectral Response

### 3.12. Interlaced/Non-Interlaced

The camera runs normally in the interlaced mode according to the CCIR/PAL or EIA/NTSC standard. This means that a full picture (frame) is built up out of two half pictures (fields) that are shifted half a line compared to each other. (See figure 4.) Every 40 ms (CCIR/PAL) or 33.3ms (EIA/NTSC) the camera generates a complete picture.

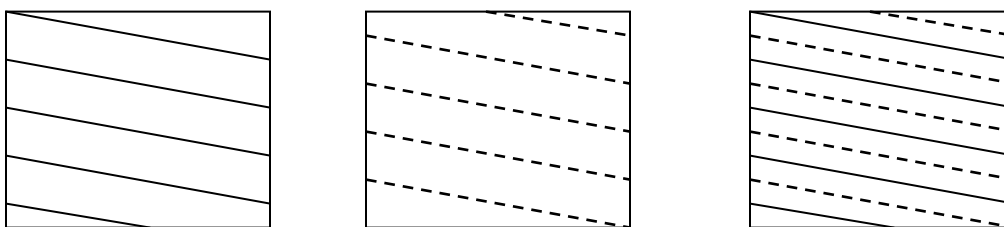


Figure 4. Interlaced Picture

However sometimes the application does not require the high vertical resolution, but requires having the same information in each field (without the half line shift between the fields). In this case the two fields are identical or non-interlaced. (See figure 5.)

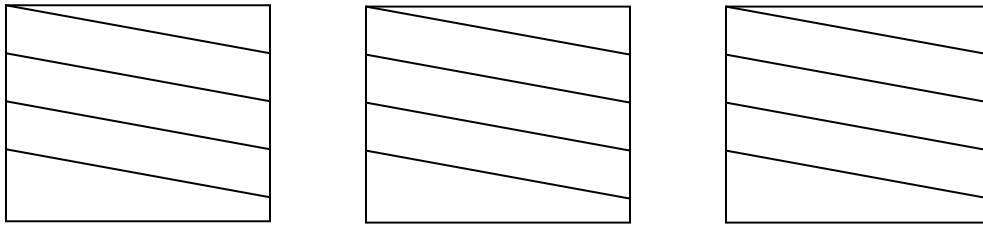


Figure 5. Non-Interlaced Picture

It can be seen that the vertical resolution is less (figure 5) compared with the interlaced mode (figure 4.). However, because the fields are identical the frame rate is increased (doubled).

To put the camera in the non-interlaced mode, connect the I2C control software to the camera and select non-interlaced in the drop down menu.

### 3.13. Software Control (CVBS Only)

The camera has an I<sup>2</sup>C serial control interface via three wires; clock, data and ground found on connectors J1 & J2. By connecting these wires to the I<sup>2</sup>C interface and using the Camera Control Software (SFT-03001) you can access the functions described in this application note.

Please order 60D2 or 60D2-U to obtain the I<sup>2</sup>C cables and software.

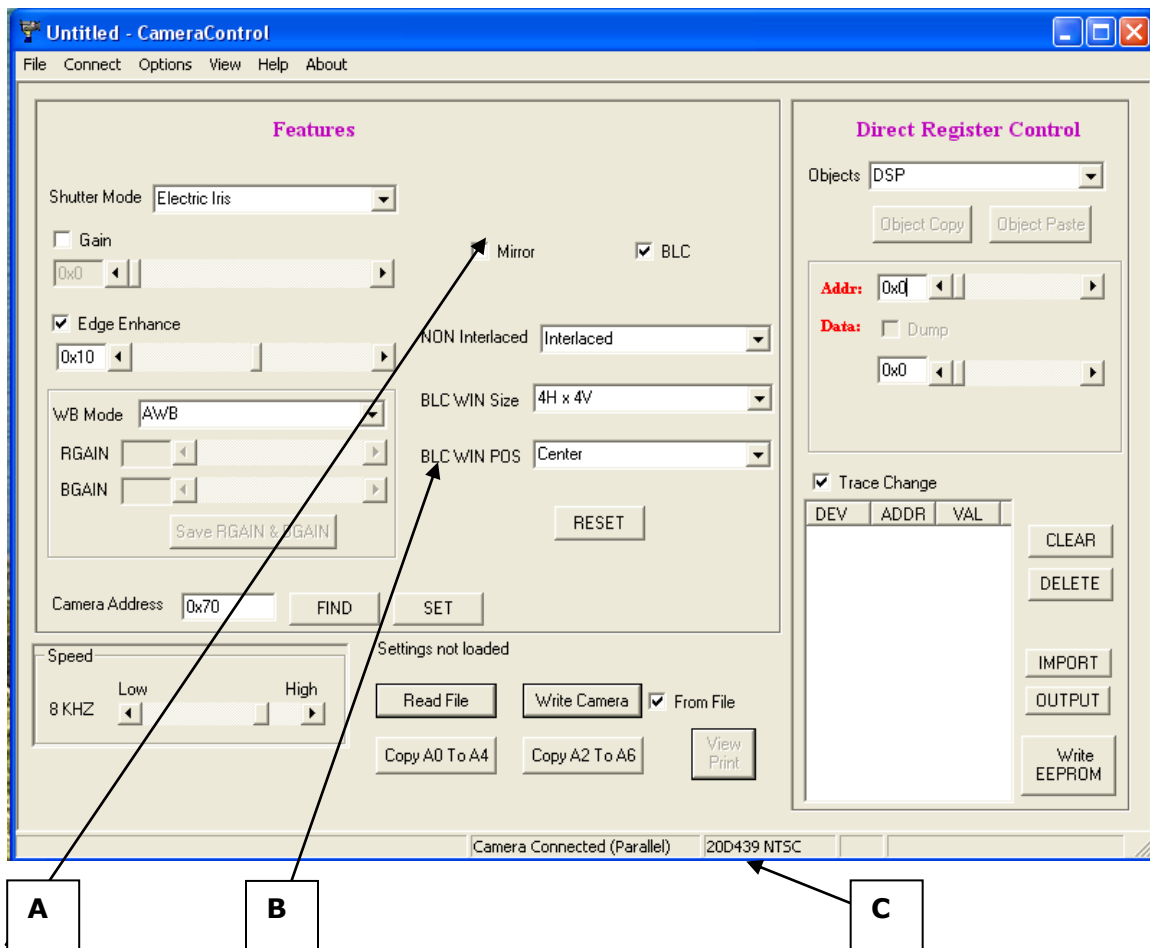
NOTE - a parallel port is needed on the computer for 60D2 or a USB port for 60D2-U. Only the top entry J1 is can be used with this kit.

***The balanced video version will not work with this kit (only CVBS).***

## 4. Software Control

### 4.1. BLC and Reset

The GUI that is currently shipping has some issues when used with the 2xD20x series camera. Please see the diagram and list below.



- A. BLC is not controllable through software on 2xD20x Series cameras. The 2xD20x Series cameras default to BLC on. To turn it off, either pin 8 of J1 or J2 must be grounded.
- B. **DO NOT USE THE RESET BUTTON IN THE GUI. This can cause a permanent programming error that will necessitate returning the camera to be re-programmed.**
- C. Camera connection display will show 20D439NTSC or 21D439PAL when connected to 2xD20x series cameras.

### 4.2. Camera Software Protocols

Data, address and registers are all 8 bit words. Graphical the interface is shown in Figure 6. The maximum speed limitation is 10 kHz. The minimum speed should be higher than 100Hz. The write action to the EEPROM needs to be done with a waiting time between the write actions of at least 10msec.

Further wait time is required between the commands, so that the internal communication has the time to do the required internal communication. The delay time between the commands should be at least 2msec.

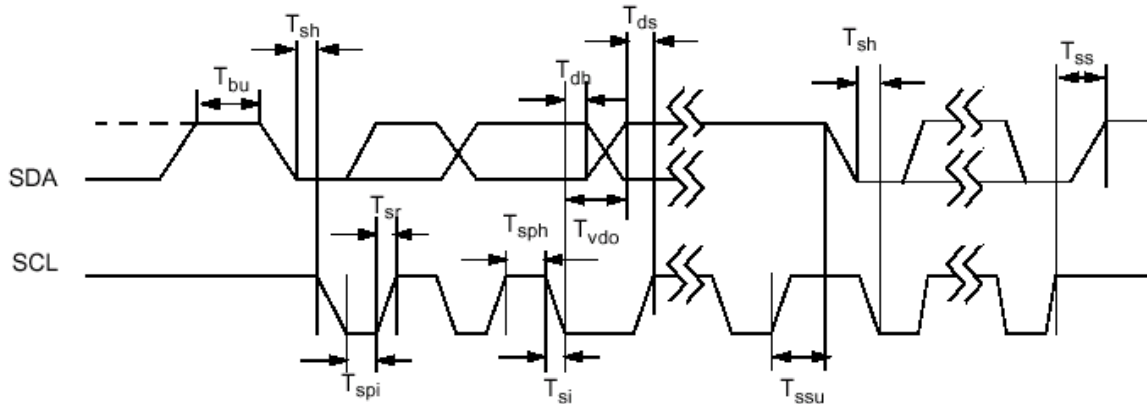


Figure 6. Communication timing

Standard I<sup>2</sup>C address camera: 0x70

The communication-structure contains a Command block and a Data block.

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 09=dump (write) EEPROM**	00=encoder 30=DSP 40=commands a0,a2,a4,a6= EEPROM

Data block (if acces\_mode !=09, accesmode is not configured as dump-mode) :

<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 NOT ackn.

\*The address can be changed. In address 0xa0 of the EEPROM: 0xa2 is the address of camera stored. Camera can get new address if customer wants/needs!

\*\*Special mode to access EEPROM faster for production. Block writing is not possible every time the camera address is required. First, both passwords have to be given before access is allowed!

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

**Example 1 write action:**

Set white balance mode to Push to White, this means:

Command 40; register 00 and data 03:

Write action:

Command-block:

<start> 70 ackn 00 ackn 40 ackn 00 ackn <stop>

datablock:

<start> 70 ackn 03 ackn

Description: camera-address 70, access mode write, device 40 (command), register 00,

datablock: write address 70 , data 03.

### Example 2 read action:

Command 40; register 00 and read data:

Read action:

Command-block:

<start> 70 ackn 01 ackn 40 ackn 00 ackn <stop>

datablock:

<start> 71 ackn data (returned) Nackn

Description: camera-address 70, access mode read, device 40 (command), register 00, datablock: read address 71 , camera will sent data.

### 4.3. Camera Configuration:

The device addresses have two values, one for read the other one for write. The difference is that the last bit (LSB) is set to one. For the communication the next device addresses are available:

Device	Device write	Device read
DSP	0x30	Not possible
Commands	0x40	0x41
EEPROM page 1	0xa0	0xa1
EEPROM page 2	0xa2	0xa3
EEPROM page 3	0xa4	0xa5
EEPROM page 4	0xa6	0xa7

Table 1. Device addresses

It is not possible to read from the DSP. The DSP is a write only device.

Don't write to the DSP because it can make the camera non-functional.

EEPROM pages 3 and 4 are protected by a password! The normal user may not have access to these two pages since the backup settings and production date is saved in here.

The DSP settings are directly mapped on EEPROM page 1.

The camera will recognize several commands. Often these will be a combination of several internal commands to fulfill a certain task. To send commands to the camera, first the device number 0x40 has to be sent. After that, the command self (at the normal place, the address will be found) must be send, and the data third.

### 4.4. I<sup>2</sup>C Address

The camera has an I<sup>2</sup>C address so that more than one camera can be connected to I<sup>2</sup>C bus.

**The camera default address is 0x70.** In case user might have forgotten the new address, he can reset it back to the factory default by connecting pin 16 of the microprocessor (port 0.5, test-point available on board) to ground:

Connect to ground for at least 4 seconds.

The I<sup>2</sup>C address is stored in the EEPROM page 2 address 0x90 (hex).

To change this address one should write: device 0xa2; address 0x90; value 0xXX.

XX is free to choose. With this method you can have 256 different I<sup>2</sup>C addresses for the camera.

With device 0xa3 one can read the value.

#### 4.5. Communication Reset

Sometimes it can happen that communication is halted. The u-processor then will reset the communication lines.

#### 4.6. Command Registers

To address the command 40h has to be sent. Next the command number and value.

The following commands can be executed.

For more detail please see the readme.doc which is with the SW-package.

Command	Command number	Data range
White balance mode	0x00	0x00: auto white balance 0x01: fixed white balance mode 1 0x02: fixed white balance mode 2
Mirror mode	0x05	0x00=normal, 0xff=mirror
Shutter mode	0x06	0x00: electronic iris 0x01: 1/50 or 1/60 sec 0x02: flickerless 0x03: 1/250 0x04: 1/500 0x05: 1/1000 0x06: 1/2000 0x07: 1/10000 0x08: 1/20000 0x09: 1/50000 0x0a: 1/100000 0x0b: 1/25 or 1/30 sec (intermittent frame readout) 0x0c: 1/12.5 or 1/15 sec (intermittent frame readout) 0x0d: 1/6.5 or 1/7.5 sec (intermittent frame readout) 0xff: hardware control 8 values, via PROG-MODE pins connector J710.
Gain control	0x07	0x00: auto mode 0x80: fixed gain minimal 7 LSB's are fixed gain: The MSB indicates fixed gain 0xff: fixed gain maximal gain
Non-interlaced	0x0a	0x00: interlaced 0x0f: non-interlaced
Edge enhancement	0x0b	0xc0 edge enhancement off gain range 0x00 upto 0x1F

BLC window can be programmed for special light situations:

Size BLC window	0x08	64 windows can be defined over the whole active pixels. This means that for PAL: H = 94 pixels and V = 72 pixels; For NTSC: H= 96 pixels and V = 62 pixels. Size H x V 0x00 1H x 1V 0x01 1H x 2V 0x02 1H x 4V 0x03 1H x 8V 0x04 2H x 1V 0x05 2H x 2V 0x06 2H x 4V 0x07 2H x 8V 0x08 4H x 1V 0x09 4H x 2V 0x0A 4H x 4V 0x0B 4H x 8V 0x0C 8H x 1V 0x0D 8H x 2V 0x0E 8H x 4V
Position BLC window ( 9 window positions possible)	0x09 (See also figure below)	0x00 center 0x01 Top left 0x02 Top center 0x03 Top right 0x04 Center left 0x05 Center right 0x06 Bottom left 0x07 Bottom center 0x08 Bottom right

1	2	3
4	0	5
6	7	8

Figure 7. BLC position

The BLC weighting factor can also be programmed. In address 0x13 with a data range of 0x01 to 0x40 and should be stored in page 1 address 13.

The command setting is stored inside the memory of the camera. After a power down the camera will come up with the last used settings again (except standby).

## 5. Connectors

20D35X(B) / 20D20X(B) or (S)

Table 1:

J1 (**bottom mount**) pin out configuration  
(JST-BM08B-SRSS-TB)

Pin	Standard CVBS output	Differential output
1	+12VDC in	+12VDC in
2	Ground	Ground
3	Video output	Differential (+) output
4	*Ground	Differential (-) output
5	I <sup>2</sup> C Clock	I <sup>2</sup> C Clock
6	I <sup>2</sup> C Data	I <sup>2</sup> C Data
7	Ground	Ground
8	BLC Off	BLC Off

Table 2:

J2 (**side mount**) pin out configuration  
(JST-SM08B-SRSS-TB)

Pin	Standard CVBS output	Differential output
8	+12VDC in	+12VDC in
7	Ground	Ground
6	Video output	Differential (+) output
5	*Ground	Differential (-) output
4	I <sup>2</sup> C Clock	I <sup>2</sup> C Clock
3	I <sup>2</sup> C Data	I <sup>2</sup> C Data
2	Ground	Ground
1	BLC Off	BLC Off

\* Iris output is possible with optional configuration

\* Iris output is possible with optional configuration

Table 3:

Optional connector J4 pin out configuration

Pin	
1	CVBS
2	Ground
3	+12VDC in

Table 4:

Optional connector J5 pin out configuration (for pass thru LEDs etc.)

Pin	
1	+ 12VDC output
2	Ground

Table 5:

Optional connector J3 pin out configuration (JST-SM07-SRSS)

Pin	
1	I/O 1
2	I/O 2
3	I/O 3
4	I/O 4
5	I/O 5
6	I/O 6
7	Ground

## 6. Specifications

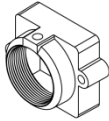
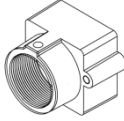
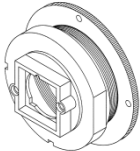
### 6.1. 20D20X

<b>Electrical</b>	20D20X (NTSC)	21D20X (PAL)
Image Sensor	1/3" IL CCD	
Picture Elements	768 x 492	752 x 582
Resolution	480 TVL	
Sensitivity	< 0.5 Lux (50 IRE) f1.2, 3200 <sup>0</sup> K	
Signal To Noise Ratio	>48 dB (AGC off)	
Gamma	0.45	
Gain Control	AGC 36dB	
Synchronization	Internal (crystal controlled)	
Scan Mode	Interlaced	
White Balance	AWB	
Backlight Compensation	On (off via jumper)	
Contour Enhancement	On	
Iris Controls	Electronic	
Video Output	Composite 1Vp-p CVBS @75 ohms Balanced video output option @ 100 ohms (20D20XB)	
Power Supply	+12VDC (+10% / -20%)	
Power Consumption	< 1.0W	

### Environmental

Operating Temperature	-15° C ~ 55° C (5° F ~ 131° F)
Storage Temperature	-30° C ~ 80° C (-22° F ~ 176° F)
Operating Humidity	20 to 93% RH
Storage Humidity	Up to 98% RH
Lifetime	MTBF >150000 hours
Packaging	Metallized, conductive bags
Warning: Avoid aiming the camera at the sun or other extremely bright lights. The CCD image sensor may be damaged if exposed to very bright objects.	

### Mechanical

Dimensions W x H x D	32mm x 32mm x 26.8mm (1.26" x 1.26" x 1.05")		
Weight	8.9g (0.020 lbs)		
Lens mount	Replace "X" in model number with desired lens mount option:		
Example: Change 20D20X to 20D205 to select an M-12 Board Mount	<b>2</b> = Metal M-12 Pinhole	<b>5</b> = Metal M-12 Board	<b>8</b> = Metal CS
			

### Accessories

Included	70V0213	Cable (J4)	3-pin AMP unterminated
Optional	60C0002-F	Cable (J4)	3-pin AMP with power & BNC (video)

### Models (Minimum 100 Piece Lot Size Required)

20/21D20XB	Balanced video output via 8-pin connector
20/21D20XS	Sony Super HAD®, color high resolution CCD (sensitivity to <b>0.05</b> lux), composite output, I <sup>2</sup> C OEM control via 8-pin connector

**X = lens mount option (refer to Mechanical)**

Please contact your Videology sales representative for details.

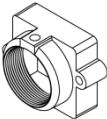
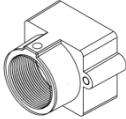
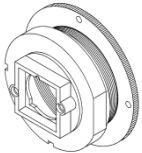
## 6.2. 20D35X

<b>Electrical</b>	20D35X (NTSC)	21D35X (PAL)
Image Sensor	1/3" Sony Ex-View® CCD	
Picture Elements	768 x 492	752 x 582
Resolution	570 TVL	
Sensitivity	< 0.005 Lux (50 IRE) f1.2, 3200°K	
Signal To Noise Ratio	>54 dB (AGC off)	
Gamma	0.45	
Gain Control	AGC 36dB	
Synchronization	Internal (crystal controlled)	
Scan Mode	Interlaced	
Backlight Compensation	Default On	
Contour Enhancement	On	
Iris Controls	Electronic	
Video Output	Composite 1Vp-p CVBS @75 ohms Balanced video output option (20/21D35XB)	
Power Supply	+12VDC (+10% / -20%)	
Power Consumption	< 1.5W	

### Environmental

Operating Temperature	-15° C ~ 55° C (5° F ~ 131° F)
Storage Temperature	-30° C ~ 80° C (-22° F ~ 176° F)
Operating Humidity	20 to 93% RH
Storage Humidity	Up to 98% RH
Lifetime	MTBF >150000 hours
Packaging	Metallized, conductive bags
Warning: Avoid aiming the camera at the sun or other extremely bright lights. The CCD image sensor may be damaged if exposed to very bright objects.	

### Mechanical

Dimensions W x H x D	32mm x 32mm x 26.8mm (1.26" x 1.26" x 1.05")		
Weight	8.9g (0.020 lbs)		
Lens mount	Replace "X" in model number with desired lens mount option:		
Example: Change 20D35X to 20D355 to select an M-12 Board Mount	<b>2</b> = Metal M-12 Pinhole	<b>5</b> = Metal M-12 Board	<b>8</b> = Metal CS
			

### Accessories

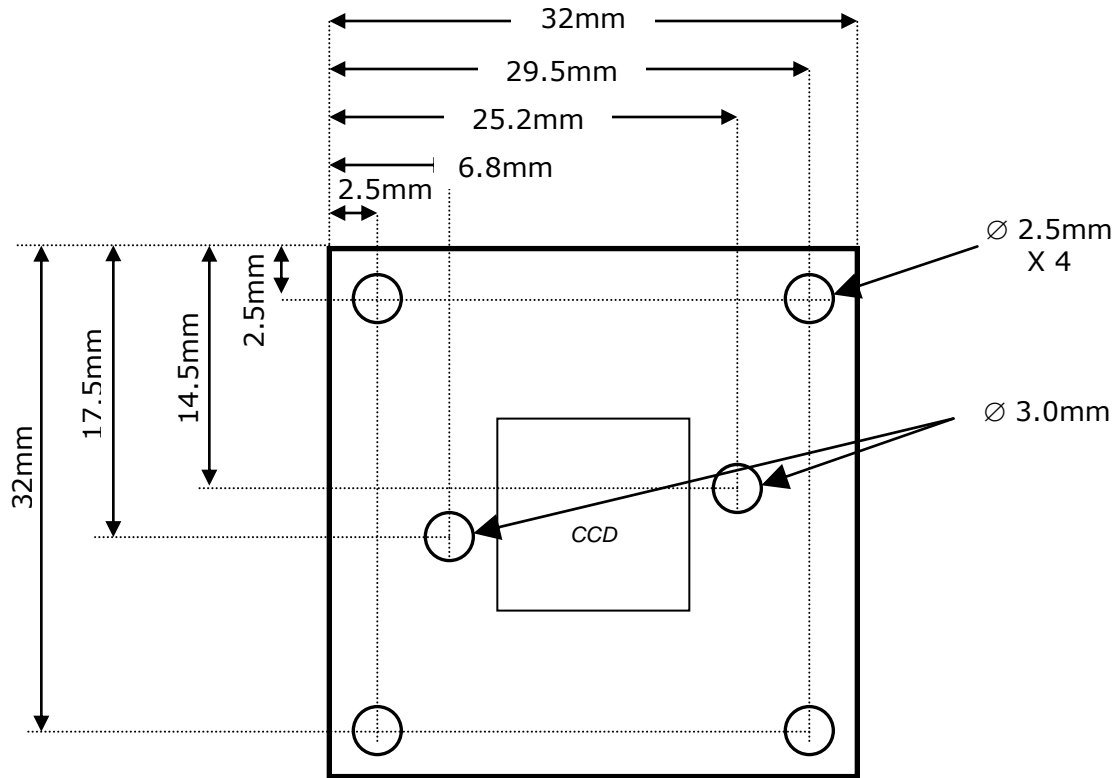
Included	70V0213	Cable (J4)	3-pin AMP unterminated
Optional	60C0002-F	Cable (J4)	3-pin AMP with power & BNC (video)

### Models (Minimum 100 Piece Lot Size Required)

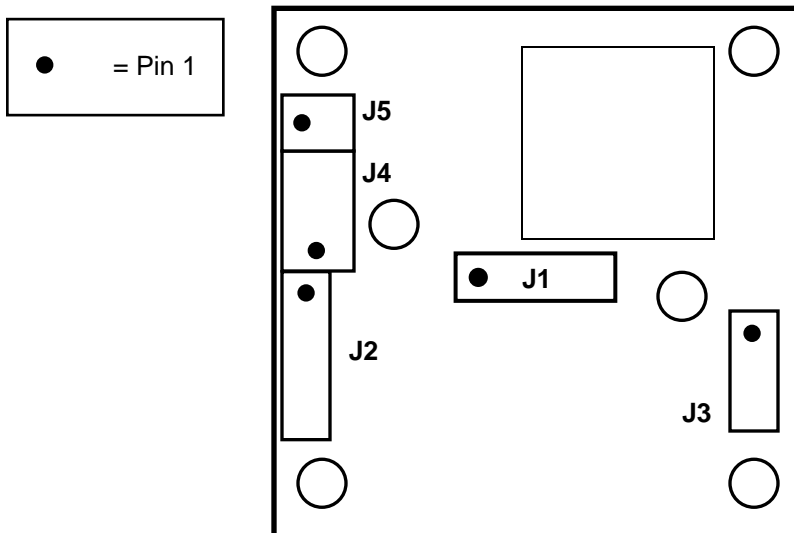
20/21D35XB	Balanced video output via 8-pin connector
20/21D35XS	OEM option, I <sub>2</sub> C controllable via 8-pin connector
<b>X = lens mount option (refer to Mechanical)</b>	
Please contact your Videology sales representative for details.	

## 7. Dimensions and Connector Placement

### 7.1. Front



### 7.2. Back



## 8. 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:

<b>North / South America:</b>	<b>Europe:</b>
Videology Imaging Solutions Inc. 37M Lark Industrial Parkway Greenville, RI 02828 USA Tel: (401) 949-5332 Fax: (401) 949-5276	Videology Imaging Solutions Europe Neutronenlaan 4 NL-5405 NH Uden, Netherlands Tel: +31 (0) 413 256 261 Fax: +31 (0) 413 251 712

Please visit our website at: <http://www.videologyinc.com>

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