BUMBLEBEE®2 SPECIFICATIONS

SPECIFICATION	BB2-03S2	BB2-08S2
Imaging Sensor	Sony® 1/3" progressive scan CCD	
	ICX424 (648x488 max pixels)	ICX204 (1032x776 max pixels)
	7.4µm square pixels	4.65µm square pixels
Baseline	12cm	
Lens Focal Length	2.5mm with 97° HFOV or 3.8mm with 66° HFOV or 6mm with 43° HFOV	
A/D Converter	12-bit analog-to-digital converter	
Video Data Output	8, 16 and 24-bit digital data (see Supported Data Formats below)	
Frame Rates	48, 30, 15, 7.5, 3.75, 1.875 FPS	18, 15, 7.5, 3.75, 1.875 FPS
Interfaces	6-pin IEEE-1394a for camera control and video data transmission 2 x 9-pin IEEE-1394b for camera control and video data transmit	
Voltage Requirements	8-30V via IEEE-1394 interface or GPIO connector	
Power Consumption	2.5W at 12V	
Gain	Automatic/Manual	
Shutter	Automatic/Manual, 0.01ms to 66.63ms at 15 FPS	
Gamma	0.50 to 4.00	
Trigger Modes	DCAM v1.31 Trigger Modes 0, 1, 3, and 14	
Signal To Noise Ratio	Greater than 60dB at 0dB gain	
Dimensions	157mm x 36mm x 47.4mm	
Mass	342 grams	
Camera Specification	IIDC 1394-based Digital Camera Specification v1.31	
Emissions Compliance	Complies with CE rules and Part 15 Class A of FCC Rules	
Operating Temperature	Commercial grade electronics rated from 0° to 45°C	
Storage Temperature	-30° to 60°C	

IMAGE ACQUISITION

Automatic Synchronization	Multiple Bumblebee2's on the same 1394 bus automatically sync
Fast Frame Rates	Faster standard frame rates
Multiple Trigger Modes	Bulb-trigger mode, overlapped trigger/transfer
Color Conversion	On-camera conversion to YUV411, YUV422 and RGB formats
Image Processing	On-camera control of sharpness, hue, saturation, gamma, LUT
Embedded Image Info	Pixels contain frame-specific info (e.g. shutter, 1394 cycle time)

CAMERA AND DEVICE CONTROL

Frame Rate Control	Fine-tune frame rates for video conversion (e.g. PAL @ 24 FPS)
Strobe Output	Increased drive strength, configurable strobe pattern output
RS-232 Serial Port	Provides serial communication via GPIO TTL digital logic levels
Memory Channels	Non-volatile storage of camera default power-up settings
Temperature Sensor	Reports the temperature near the imaging sensor
Camera Upgrades	Firmware upgradeable in field via IEEE-1394 interface.

CALIBRATION AND MECHANICS

Lens System	High quality microlenses protected by removeable glass system
Accurate Pre-Calibration	For lens distortions and camera misalignments
Stereo Pair Alignment	Left and right images aligned to within 0.1[1] pixel RMS error
Calibration Retention	Minimizes loss of calibration due to shock and vibration

[1]Based on a stereo resolution of 640x480 and is valid for all camera models. Calibration accuracy will vary from camera to camera.

STATUS LED

Steady on	Receiving power and successful camera initialization
Steady on and very bright	Acquiring / transmitting images
Flashing bright, then brighter	Camera registers being accessed (no image acquisition)
Steady or slow flashing on and off	Camera firmware updated (requires power cycle), or possible camera problem

Getting Started

Bumblebee®2 IEEE-1394a Stereo Vision Digital Camera System

The following items are included with your Bubblebee2 Development Accessory Kit

All Development Kits
- 4.5 meter, 6-pin to 6-pin IEEE-1394 cable
- IEEE-1394 OHCI PCI Host Adapter 3-port 400Mb/s card
- Hirose HR10 12-pin male GPIO connector pre-wired for easy triggering
- FlyCapture® SDK and Triclops SDK (C/C++ API and device drivers)

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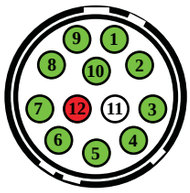
CAMERA INTERFACE

IEEE-1394 Connector
The Bumblebee®2 has a standard 6-pin IEEE-1394 connector that is used for data transmission, camera control and powering the camera. The maximum 1394 cable length between any 1394 node (e.g. camera to PCI card, card to hub, etc.) is 4.5m, as specified by the IEEE-1394 standard. Use standard, shielded twisted pair copper cables.

General Purpose Input/Output (GPIO)
The Bumblebee2 has a 12-pin Hirose HR10 (Mfg P/N: HR10A-10R-12SB) female circular connector on the back of the case. Camera KIT contents include a pre-wired male connector; refer to the diagram below for wire color-coding. Additional male counterparts (Mfg P/N: HR10A-10P-12P) can be purchased from Digi-Key (P/N: HR112-ND).



Pin	Function	Description
1	IO0	Input / Output (default Trigger_Src)
2	IO1	Input / Output
3	IO2	Input / Output / RS232 Transmit (TX)
4	IO3	Input / Output / RS232 Receive (RX)
5	RTS	RS-232 Request to Send
6	CTS	RS-232 Clear to Send
7	TX	RS-232 Transmit (Output)
8	RX	RS-232 Receive (Input)
9, 10	GND	
11	V_{EXT}	Voltage limit: 8-30V; Current limit: 1A
12	+3.3V	Power external circuitry up to a total of 150mA

To configure the GPIO pins, consult the "General Purpose Input / Output" section of the *PGR IEEE-1394 Digital Camera Register Reference*.

The Bumblebee2 GPIO pins are TTL 3.3V pins. **Inputs** can be configured to accept external trigger signals. When configured as inputs, the pins are internally pulled high using weak pull-up resistors to allow easy triggering of the camera by simply shorting the pin to ground (GND). The inputs are protected from both over and under voltage. It is recommended, however, that they only be connected to 5V or 3.3V digital logic signals. **Outputs** can be configured to send an output signal or strobe pulse. When configured as outputs, each line can sink 10mA of current.

STEREO IMAGE FORMATS

The Bumblebee2 can be configured to output images from both sensors at the same time as pixel (byte) interleaved stereo pairs using Format_7. Pixel interleaved images use a raw 16bit/pixel format, where the first byte is from the left camera and the second from the right.

BB2-HIxxx

Mode	Pixel Format	Max Size	FPS	Description
3	Raw16 (16bpp)	1024x768	20	Pixel interleaved stereo image

BB2-xxx

Mode	Pixel Format	Max Size	FPS	Description
3	Raw16 (16bpp)	640x480	48	Pixel interleaved stereo image

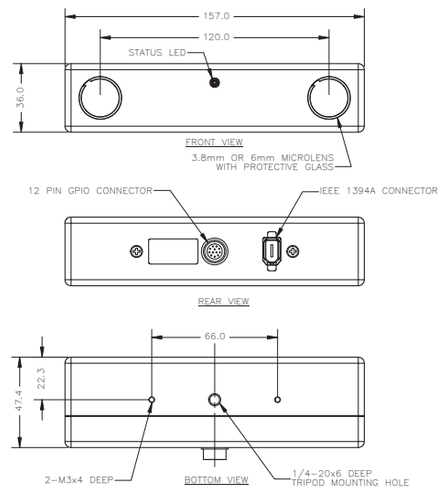
STANDARD IMAGE FORMATS

[1] Use the PAN control to select the camera that is outputting images

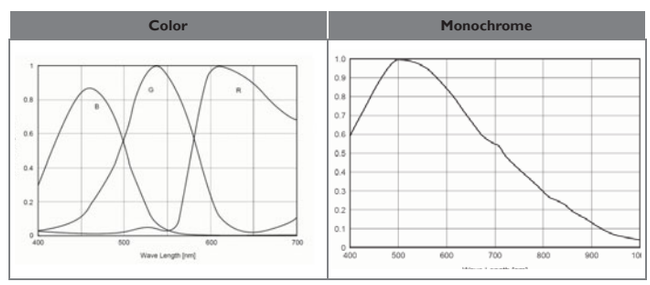
BB2-COL BB2-BW BB2-HICOL BB5-HIBW

Mode Description	Frames Per Second 1.875	3.75	7.5	15	30	60
640x480 YUV411	●	●	●	●	●	●
640x480 YUV422	●	●	●	●	●	
640x480 RGB	●	●	●	●	●	
640x480 Y8	●●	●●	●●	●●	●●	●●
640x480 Y16	●●	●●	●●	●●	●●	
1024x768 YUV422	●	●	●	●		
1024x768 RGB	●	●	●			
1024x768 Y8	●●	●●	●●	●●	●●	
1024x768 Y16	●●	●●	●●	●●	●	

TECHNICAL DRAWINGS



SPECTRAL RESPONSE (QE)



For full sensor datasheets, visit www.ptgrey.com/support/kb/index.asp?a=4&q=23

1 Installation

1. Recommended System Configuration

OS	CPU	RAM	VIDEO	PORTS
Windows XP SP1	2.0GHz or equivalent	512mb	AGP 64mb	IEEE-1394a

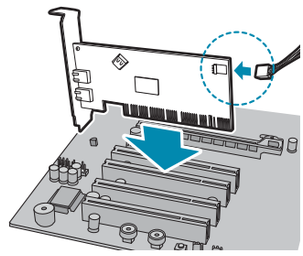
- Windows XP Service Pack 1
- 512MB of RAM
- Intel Pentium 4 2.0GHz or compatible processor
- AGP video card with 64MB video memory
- 32-bit standard PCI slot for the IEEE-1394 PCI card
- Microsoft Visual C++ 6.0 (to compile and run example code)

2. Electrostatic Precautions and Camera Care

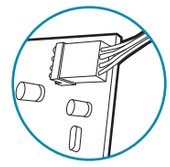
- Users who have purchased a bare board camera should:
  - Either handle bare handed or use non-chargeable gloves, clothes or material. Also use conductive shoes.
  - Install a conductive mat on the floor or working table to prevent the generation of static electricity.
  - When handling the camera unit, avoid touching the lenses. To clean the lenses, use a standard camera lens cleaning kit or a clean dry cotton cloth. Do not apply excessive force.
- To clean the imaging surface of your CCD, follow the steps outlined in www.ptgrey.com/support/kb/index.asp?a=4&q=66.
- Extended exposure to bright sunlight, rain, dusty environments, etc. may cause problems with the electronics and the optics of the system.
- Avoid excessive shaking, dropping or mishandling of the device.

2 Installation

3. Install the IEEE-1394 PCI card

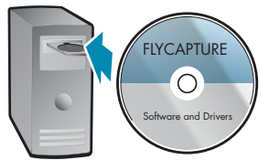


- Turn computer off and place the IEEE-1394 PCI card in an open PCI slot.
- Connect the 4-pin connector on the card to the PC power supply.



- Turn the computer back on and log into Windows.
- In most cases, the Windows IEEE-1394 drivers will be automatically installed for the card, with no user input required. However, in some cases the **Found New Hardware Wizard** will appear. Follow the prompts given by the Wizard to install the card.
- Open Windows Device Manager by going to the ***Control Panel > System > Hardware tab > Device Manager***. Ensure the PCI card is properly installed as an ***IEEE 1394 Bus host controller***.

4. Install the FlyCapture® and Triclops™ Software

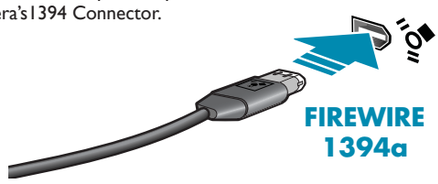


- Insert the software CD-ROM. If the Installation Wizard does not automatically run, browse to your CD-ROM directory and run the ***setup.exe*** file.
- Follow the installation instructions to install the software.
- A dialog will appear asking if you want to downgrade your Windows XP drivers. If you have installed Service Pack 2, we encourage users to do this. See this Knowledge Base article for further information: www.ptgrey.com/support/kb/index.asp?a=4&q=171

3 Installation

5. Connect the 1394 PCI Card and Cable to the Camera

- Plug the 4.5 meter, 6-pin to 6-pin, IEEE-1394 cable into the 1394 PCI card and the camera's 1394 Connector.



NOTE: The camera relies on the 6-pin 1394 cable to provide power. If using an interface card other than that provided, ensure that adequate power is provided.

- If the Microsoft Windows *"Found New Hardware Wizard"* appears, proceed to Step 7. Otherwise, proceed to Step 8.

6. Install the Camera Driver

- Click ***"Install from a list or specific location"*** and click ***"Next"***.
- Select ***"Don't search. I will choose the driver to install"*** and ***"Next"***.
- Click ***"Have Disk"*** and browse to ***C:\Program Files\Point Grey Research\PGR FlyCapture\driver\signed\<your platform>***, click ***"Open"***, then ***"OK"***.
- Select the camera model. Click ***"Next"***.
- You will be prompted to continue installation - click ***"Continue Anyway"*** then ***"Finish"*** to complete installation.

7. Confirm Successful Installation

- Check the Device Manager to confirm that installation was successful. Go to the **Start** menu, select **Run** and enter "**devmgmt.msc**". Verify the camera is listed under "Point Grey Research Devices".

4 Troubleshooting

The FlyCapture® User Guide and other technical references can be found in the **Programs > Point Grey Research > PGR FlyCapture > Documentation** directory. Our on-line Knowledge Base (www.ptgrey.com/support/kb/) also addresses the following problems:

- Article 21: Troublesome hardware configurations
- Article 91: PGR camera not recognized by system and not listed in Device Manager
- Article 93: My laptop's IEEE-1394 port or PCMCIA card doesn't supply power to my camera
- Article 145: Image discontinuities or horizontal tearing of images when displayed on monitor
- Article 171: Performance of 1394 devices may decrease after installing Windows XP SP2
- Article 188: Image data acquired by my camera is corrupt and displayed images are broken
- Article 189: Image capture freezes after a period of successful image capture.

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