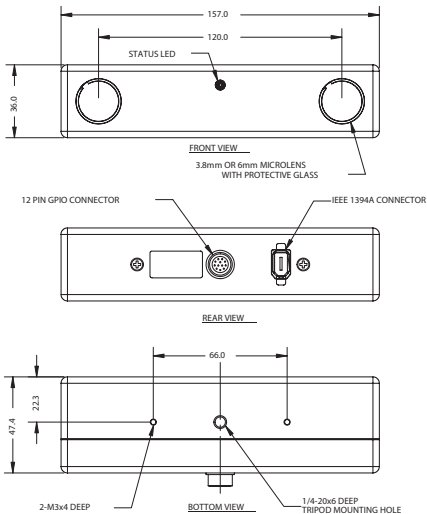


Development Kit Contents

- 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)

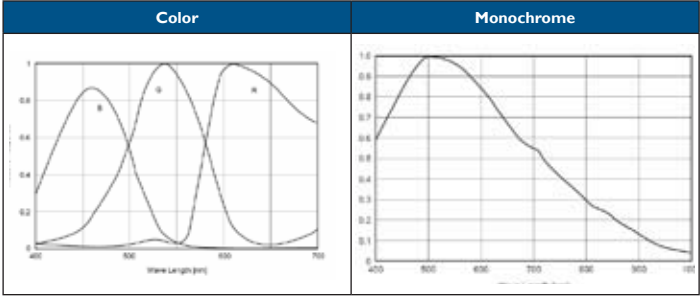
Physical Dimensions



Camera Specifications

Specification	Low-Res (640x480)		High-Res (1024x768)	
Imaging Sensor	Two Sony 1/3" progressive scan CCD			
	ICX424 (648x488 max pixels)		ICX204 (1024x768 max pixels)	
	7.4µm square pixels		4.65µm square pixels	
Baseline	12cm			
Lens Focal Length	2.5mm with 100° HFOV or 3.8mm with 70° HFOV or 6mm with 50° HFOV			
A/D Converter	Analog Devices 12-bit analog-to-digital converter			
Video Data Output	8, 16 and 24-bit digital data (see <i>Supported Data Formats</i> 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-1394 for camera control and video data transmission 4 general-purpose digital input/output (GPIO) pins.			
Voltage Requirements	8-32V			
Power Consumption	Less than 3W			
Gain	Automatic/Manual/One-Push Gain modes			
	0dB to 24dB		0dB to 24dB	
Shutter	Automatic/Manual/One-Push Shutter modes			
	0.01ms to 66.63ms @15 FPS		0.01ms to 66.63ms @15 FPS	
	Extended Shutter modes			
	0.01ms to 7900ms @ 15 FPS		0.01ms to 5200ms @ 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			

Spectral Response (QE)



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

Status LED

LED Status	Description
Steady on	Camera receiving power and initialized
Steady on and very bright	Camera acquiring and transmitting images
Flashing bright, then brighter	Camera registers being accessed
Steady or slow flashing on and off	Firmware updated, or possible camera problem (power cycle)

Camera Features

Image Acquisition

Feature	Description
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

Feature	Description
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

Feature	Description
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 0.05' pixel RMS error
Calibration Retention	Minimizes loss of calibration due to shock and vibration

¹ Based on epipolar accuracy at a stereo resolution of 320x240; valid for 1024x768 and 640x480 model.

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-HLxxx

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

BB2-xxx

3	Raw16 (16bpp)	640x480	48	Pixel interleaved stereo image
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Single Camera Image Formats

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

● BB2-COL ● BB2-BW ● BB2-HICOL ● BBS-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	●●	●●	●●	●●	●	

Camera Interface

IEEE-1394 Connector and Cables

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 I/O Connector

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).

Diagram	Pin	Function	Description
Model A	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)
Model B	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 <i>PGR IEEE-1394 Digital Camera Register Reference</i> .		

^{**}Due to stock fluctuation the GPIO cable you receive is either Model A or B

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.

1 Installation

1. Recommended System Configuration

- Windows XP Service Pack 1
- 512MB of RAM
- Intel Pentium 4 2.0GHz or compatible processor
- AGP video card with 128MB video memory
- PCI slot for the IEEE-1394 OHCI card
- Microsoft Visual C++ 6.0 (to compile and run example code)



2. Electrostatic Precautions and Camera Care

- To avoid static discharge that could damage a camera, users 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.
- 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



- 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 that 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 *setup.exe*.
- 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:
<http://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, click "Open", then "OK".
- Select the camera model and 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".

4 Installation

8. Test Camera Capabilities

- To test the camera's image acquisition capabilities, run FlyCap. From the Start menu, select All Programs > Point Grey Research > PGR FlyCapture > FlyCap.exe.
- To test stereo processing, run TriclopsDemo. From the Start menu, select All Programs > Point Grey Research > Triclops SDK > TriclopsDemo.exe.

5 Troubleshooting

The FlyCapture User Guide and other technical references can be found in the Programs > Point Grey Research directory. Our on-line [Knowledge Base](http://www.ptgrey.com/support/kb/) (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.

Contacting Point Grey Research

- Email:** For all general questions about Point Grey Research please contact us at info@ptgrey.com.
- For technical support (existing customers only) contact us at www.ptgrey.com/support/contact/.
- Main Office:** **Mailing Address:** Point Grey Research, Inc.
12051 Riverside Way
Richmond B.C. Canada V6W 1K7
- Tel:** +1 (604) 242-9937
Toll Free (N.America only): +1 (866) 765-0827
Fax: +1 (604) 242-9938
Email: sales@ptgrey.com
- Knowledge Base:** Find answers to commonly asked questions in our knowledge base at www.ptgrey.com/support/kb/.
- Downloads:** Users can download the latest manuals and software from www.ptgrey.com/support/downloads/.



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Bumblebee®2

IEEE-1394 Stereo Vision Digital Camera System



Getting Started
Manual

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