Transitioning from Ladybug5 to Ladybug5+

Revised 1/2/2018

Applicable Products

- Ladybug®5
- Ladybug®5+

Application Note Description

The purpose of this application note is to:

1. Answer some frequently-asked questions about transitioning from Ladybug5 to Ladybug5+.

2. Outline the primary similarities and differences between the two cameras.

3. Offer suggestions and pointers to users for migrating their custom applications from Ladybug5 to Ladybug5+.

> **Note:** The Ladybug5+ was designed to replace the Ladybug5 with minimum disruption to existing systems.

Preparing for use

Before you use your camera, we recommend that you are aware of the following resources available from our downloads page:

- *Getting Started Manual* **for the camera**—provides information on installing components and software needed to run the camera.

- *Technical Reference* **for the camera**—provides information on the camera's specifications, features and operations, as well as imaging and acquisition controls.

- **Firmware updates**—ensure you are using the most up-to-date firmware for the camera to take advantage of improvements and fixes.

- **Tech Insights**–Subscribe to our monthly email updates containing information on new knowledge base articles, new firmware and software releases, and Product Change Notices (PCN).

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Questions about Upgrading from Ladybug5 to Ladybug5+

Is Ladybug5 being discontinued?

Yes, but not immediately. The Ladybug5+ is intended to replace the Ladybug5.

What other hardware is needed to use Ladybug5+?

Ladybug5+ uses the same hardware as Ladybug5.

- Interface Card—The Ladybug5+ requires a USB 3.1 PCIe host controller card compliant with the SuperSpeed USB Specification and the xHCI Specification. A host controller card is available as an accessory. For VR-360 applications, we recommend the latest on-board Intel host controller and driver to handle the high data rates associated with operating the camera at 30 FPS.

- Cable—The Ladybug5+ requires a USB 3.1 Type-A to Micro-B cable with locking screws. A 5 m cable is provided with the camera.

- Power supply—Power must be provided through the 12-pin GPIO interface. The required input voltage is 12-24 V. A power supply and wiring harness is provided with the camera.

- Mounting—Both a desktop and a tripod mount are provided with the camera.

Can I run Ladybug5+ with my existing application?

The Ladybug SDK version 1.15 (or newer) is required to run Ladybug5+. This version of the SDK contains the following new features and enhancements:

- Added ladybugSetGpsTimeSync() call to API

- Added ladybugGetGpsTimeSync() call to API

Additionally, the Ladybug SDK contains several new example programs to support new the features of Ladybug5+, including:

- ladybugGPSTimeSync

> **Note:** Using an earlier version of the Ladybug SDK with Ladybug5+ is not supported.

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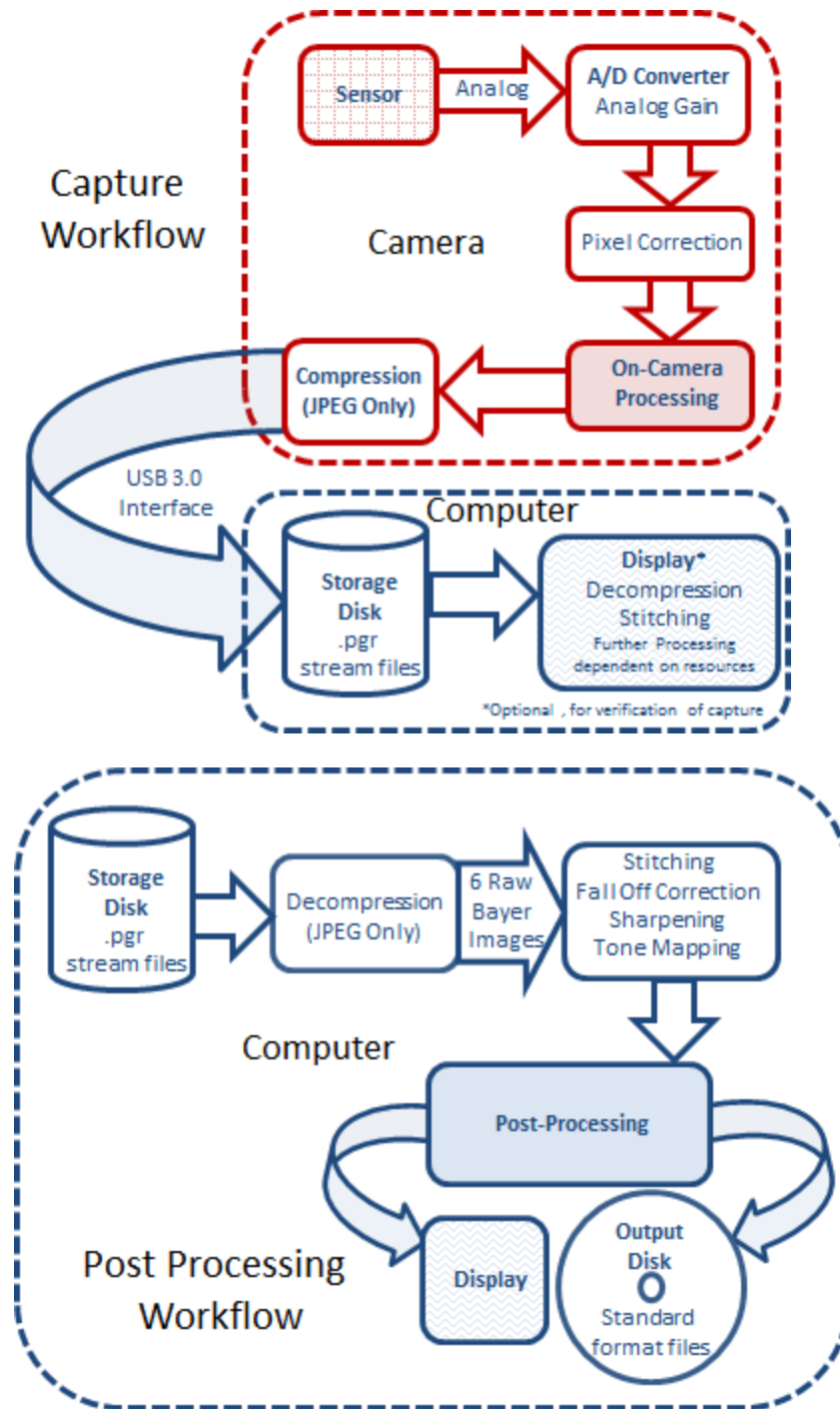
Image Processing Pipeline

Image Processing

For both Ladybug5 and Ladybug5+, when using Raw8 or JPEG8 pixel formats, some image processing is done on the camera during capture before being output to the PC. Additional post processing is then performed on the PC.

When using Raw12, RAW16, or JPEG12 pixel formats, most of the image processing is done on the PC. This processing is done as part of ladybugConvertImage(). This allows users to fine tune the output settings independently from image capture.

User access to adjusting the parameters for image processing is available in LadybugCapPro or via CSRs.

Description		Ladybug5/Ladybug5+
8-bit Pixel Formats	On Camera Processing	Gain Black level Pixel correction White balance Gamma
	Post Processing on PC	Stitching Fall off correction Sharpening Tone mapping
12- or 16-bit Pixel Formats	On Camera Processing	Pixel correction
	Post Processing on PC	Stitching Falloff correction Sharpening Tone mapping Bayer decoding Gain Black level White balance Gamma EV compensation

Data Format

Description	Ladybug5	Ladybug5+
Image Data Formats	Raw8, Raw12, Raw16, JPEG8, JPEG12	
Video Data Output	8-, 12-, or 16-bit Raw or JPEG compressed	
Resolution Full	2448 x 2048	2464 x 2048
Resolution Half	2448 x 1024	2464 x 1024

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Formats, Frame Rates, Image Sizes

	Ladybug5				Ladybug5+			
	Frame Rate		Image Size		Frame Rate		Image Size	
Pixel Format	Full 2448 x 2048	Half 2448 x 1024	Full 2448 x 2048	Half 2448 x 1024	Full 2464 x 2048	Half 2464 x 1024	Full 2464 x 2048	Half 2464 x 1024
Raw8	8	16	30 MB	15 MB	13	26	30 MB	15 MB
JPEG8 Compressed	10	16	Variable	Variable	30	60	Variable (13 MB maximum)	Variable (6 MB maximum)
Raw12	5	10.5	45 MB	22.5 MB	8	16	45 MB	22.5 MB
JPEG12 Compressed	10	16	Variable	Variable	30	60	Variable (13 MB maximum)	Variable 6 MB maximum)
Raw16	4	8	60 MB	30 MB	6	12	60 MB	30 MB

Values are calculated with a theoretical maximum of 400 MB/s on the USB3 host controller. The Ladybug5+ has automatic buffer JPEG usage enabled to adjust the JPEG quality to fit. The maximum variable values are the worst case scenarios.

Shutter Range

Both Ladybug5 and Ladybug5+ offer four preset shutter range modes to set the maximum shutter value:

- Drive Highway—maximum shutter is set to as short as possible to prevent motion blur. Best used outdoors at high speeds or images may be too dark. This is the default.

- Drive City—maximum shutter is slightly longer than highway mode, suitable for slower speeds (~45 km/hour or 25 mph).

- Indoor—maximum shutter is slightly longer than the drive modes, for use in indoor applications.

- Low Noise—maximum shutter is not restricted.

Auto Exposure Modes

Both Ladybug5 and Ladybug5+ offer three preset modes for the auto exposure algorithm:

- Bottom 50%—uses only the bottom 50% of the five side cameras and excludes the top camera from its calculations.

- Top 50%—uses only top 50% of the five side cameras and includes the top camera in its calculations. This is the upside down version of the first mode, used when the camera is mounted upside down (for example, on a helicopter).

- Full Image—uses the entire image of all six cameras for its calculations. This is the default.

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For 8-bit pixel formats, the auto exposure modes are set for image capture. For 12- and 16-bit pixel formats, the auto exposure modes are set both for image capture and post processing on the PC.

Software Workflow

Image Acquisition

The Ladybug5+ can be started and controlled in the same way as Ladybug5. However, there are some changes to your source code that should be made.

- Auto buffer usage should be enabled in JPEG data formats, instead of using a fixed JPEG quality value. This allows the camera to adjust the JPEG compression quality in order to fit the image into the available buffer size. The camera clamps the maximum quality value used to 80%. You can control the feature using ladybugSetAutoJPEGQualityControlFlag(), and control the buffer usage using ladybugSetAutoJPEGBufferUsage(). A buffer usage value between 90% to 95% is suggested.

- The default SDK settings when starting the camera are designed to allocate the appropriate frame buffer sizes in order to support 30 FPS or 60 FPS acquisition via an Intel host controller. If the desired frame rate or bandwidth is lower, the default SDK settings may be inadequate. Please see TAN2017010 - Using Packet and Buffer Size to Adjust Frame Rate on Ladybug5+ for further information on how to optimally tune your settings.

Stream Recording

The Ladybug5+ has the same maximum bandwidth and the amount of data written to disk per second is the same as Ladybug5. It is possible to greatly reduce the amount of data sent in JPEG modes by reducing the compression quality.

Image Processing and Stitching

The workflow for data formats with on-camera image processing remains the same. See the LadybugPanoStitch example for an example.

For data formats that do not perform image processing on-camera, see ladybugImageAdjustment.h in the \include directory for image processing parameters as well as usage instructions. In addition, the LadybugCapPro application provides a graphical interface to these parameters.

In both cases, ladybugConvertImage() prepares the image for output purposes, including JPEG decompression, Bayer demosaicing as well as image post processing.

Image Output

The image output functionality remains the same as previous LadybugCapPro versions. If a full resolution panoramic image is desired, it is recommended that an output size of 10000 x 5000 is used.

Image output formats:
- JPG
- BMP
- PNG

Video output formats:
- AVI
- FLV
- WMV

- TIFF8, TIFF16

- HDR

- H.264

- H.265

- VP9

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Image Size

For Ladybug5, the size of a single camera image after image conversion is 2448 x 2048. For Ladybug5+, the size of a single camera image after image conversion is 2464 x 2048.

If your software allocates its own memory for image conversion and texture updating, the amount of memory to be allocated should be 6 x W x H x (bytes per channel), where bytes per channel is 1 for 8-bit modes, 1.5 for 12-bit modes, and 2 for 16-bit modes.

For example, the memory size required to contain a JPEG8 image after conversion is:

Ladybug5: 6 x 2448 x 2048 x 1 = 30081024 bytes

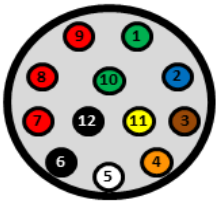Ladybug5+: 6 x 2464 x 2048 x 1 = 30277632 bytes

Detailed Comparison between the Ladybug5 and Ladybug5+

Mechanical Properties

Description	Ladybug5	Ladybug5+
Digital Interface	USB 3.1 for camera control and video data, with locking screws for secure connection	
General Purpose I/O Ports	12-pin GPIO connector for external trigger input, strobe output, and power	12-pin GPIO connector for external trigger input, strobe output, power, and PPS
IR Filter	The infrared cut-off filter used has the same transmittance properties	
Dimensions	197 mm x 160 mm	
Optics	Six high quality 4.4 mm focal length lenses	
Case	Machined aluminum housing, anodized red or black; single unit, water resistant	
Mass	~2.9 kg	3 kg
Mounting	The case is equipped with five M4 X 0.7 mounting holes on the bottom that can be used to attach the camera directly to the desktop mount, tripod adapter, or a custom mount	
Desiccant	Desiccant plug to minimize moisture in the enclosure and prevent lens fogging	
Transfer Rates	5 Gbit/s	

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GPIO Properties

Diagram	Color	Pin	Function	Ladybug5 Description	Ladybug5+ Description
	Green	1	OPTO_GND	Ground for opto-isolated IO pins	
	Blue	2	I0	Opto-isolated input (default Trigger in)	
	Brown	3	O1	Opto-isolated output	
	Orange	4	IO2	Input/Output	Input/Output / GPS data
	White	5	+3.3 V	Power external circuitry up to 150 mA	
	Black	6	GND	Ground for bi-directional IO, V_{EXT}, +3.3 V pins	
	Red	7	V_{EXT}	Allows the camera to be powered externally	
	Red	8	V_{EXT}	Allows the camera to be powered externally	
	Red	9	V_{EXT}	Allows the camera to be powered externally	
	Green	10	OPTO_GND	Ground for opto-isolated IO pins	
	Yellow	11	IO3	Input/Output	Input/Output / PPS signal
	Black	12	GND	Ground for bi-directional IO, V_{EXT}, +3.3 V pins	

Hardware/Electronics

Description	Ladybug5	Ladybug5+
Sensors	Sony ICX655 CCD x 6	Sony IMX264 CMOS x 6
Power Interface	via GPIO only, not via USB3 interface	
Power Consumption	12-24 V, 13 W	
A/D Converter	12-bit	
Environmental Sensors	Temperature, Barometer, Humidity, Accelerometer, Compass	Temperature, Humidity
LED	One general purpose status LED for monitoring camera power, initialization, and USB 3.1 activity	
Operating Temperature	0° to 45°C	-20° to 50°C
Storage Temperature	-30° to 60°C	
Relative humidity Operating	20 to 80% (no condensation)	
Relative humidity Storage	20 to 95% (no condensation)	
Field of view	~90% of full sphere	
Spherical Distance	Calibrated from 2 m to infinity	
Focus Distance	~200 cm. Objects have an acceptable sharpness from ~60 cm to infinity	

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Firmware

| Description	Ladybug5	Ladybug5+
Camera Specifications	IIDC v1.32	
High Dynamic Range	Cycle 4 gain and exposure presets	
External Trigger Modes	Trigger Modes 0, 1, 3, 14, 15	
Gain	0 dB to 18 dB	
Gamma	0.50 to 4.00	
Shutter Speed	0.02 ms to 2 seconds (extended shutter mode)	
Shutter Type	Global Shutter	
Memory Channels	2 memory channels for custom camera settings	
Flash Memory	1 MB	

Software, Driver, and System Support

Description	Ladybug5	Ladybug5+
Driver Options	FLIR PGRxHCI driver	FLIR PGRUSBCam driver
Bandwidth Management	USB 3.1 does not automatically manage bandwidth allocation[1]	
Camera Enumeration	Enumeration on the Universal Serial Bus is supported natively by the OS	
Ladybug SDK versions	1.7 Release X+	1.15 Release X+
Recommended Operating Systems	Windows 7 64-bit Ubuntu 12.04 64-bit, for capture and recording only	Windows 10, 64-bit Ubuntu 16.04 64-bit, for capture and recording only
Software Requirements for Ladybug SDK	Microsoft Visual Studio 2005	Microsoft Visual Studio 2010, or newer g++ 5.4.0, or newer
CPU (recommended)	3 GHz Dual/Quad Core	Intel Core i7 processor
RAM (recommended)	8 GB	

[1]For more information on setting up multiple USB 3.1 cameras, see TAN2012005.

Dimensions

Note: The Ladybug5+ case has a dowel pin locator to ensure consistent orientation when mounting.
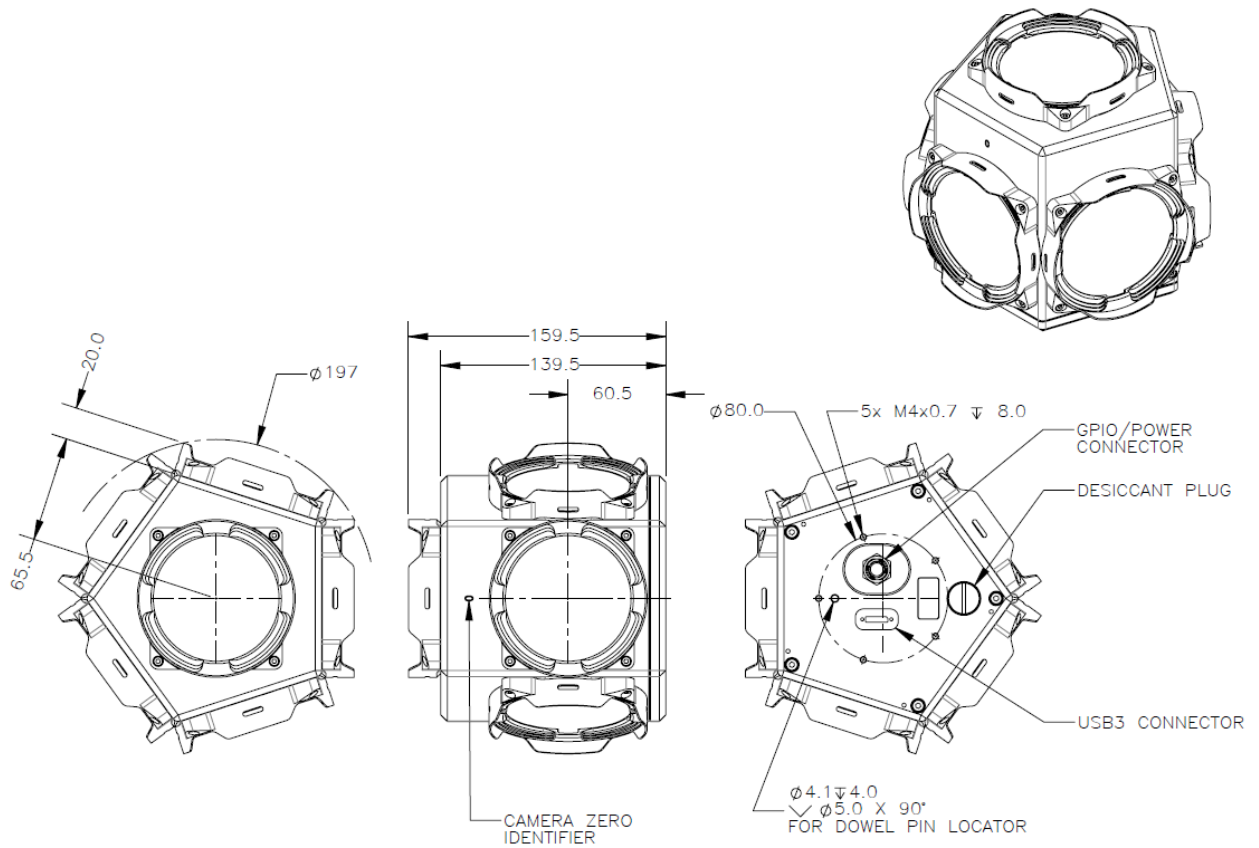
Ladybug5 and Ladybug5+ Dimensional Diagram

Downloads and support

FLIR endeavors to provide the highest level of technical support possible to our customers. Most support resources can be accessed through the Support section of our website.

The first step in accessing our technical support resources is to obtain a customer login account. This requires a valid name and email address. To apply for a customer login account go to our downloads page.

Customers with a customer login account can access the latest **software** and **firmware** for their cameras from our website. We encourage our customers to keep their software and firmware up-to-date by downloading and installing the latest versions.

Finding information

Ladybug® SDK—The Ladybug SDK provides API examples and the LadybugCapPro camera evaluation application. Available from our downloads page.

Product Documentation—The camera's *Getting Started Manual* provides information on installing components and software needed to run the camera. The *Technical Reference* provides information on the camera's specifications, features and operations, as well as imaging and acquisition controls. They are available from the downloads page.

Knowledge Base—A database of articles and application notes with answers to common questions as well as articles and tutorials about hardware and software systems. Available from our knowledge base.

Learning Center—Our Learning Center contains links to many resources including videos, case studies, popular topics, other application notes, and information on sensor technology.

Contacting technical support

Before contacting technical support, have you:

1. Read the product documentation?

2. Searched the knowledge base?

3. Downloaded and installed the latest version of software and/or firmware?

If you have done all the above and still can't find an answer to your question, contact our technical support team.

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