WinCamD-IR-BB: 2–16 µm Beam Profiling Camera

Introduction

The WinCamD-IR-BB is an imaging solution for lasers in the MWIR and FIR range. With 17 µm pixels, a wavelength range of 2-16 µm, and an integrated shutter, the WinCamD-IR-BB offers unparalleled beam profiling capabilities. With a signal-to-noise ratio that exceeds 1000:1, the WinCamD-IR-BB can make ISO11146 compliant beam measurements. The microbolometer-based camera features very high sensitivity, and the integrated shutter allows for fully automated non-uniformity correction.

Features

- 17 micron pixel pitch
- Integrated shutter
- SNR 1000:1
- ISO11146 compliant beam measurements
- 10.8 x 8.16 mm active area
- 30 fps (7.5 fps for export)
- Port powered USB 3.0
- No chopper/TEC

- Automated NUC
- 14-bit ADC
- 14 ms thermal time constant
  - Pulsed lasers with PRR≥1 kHz appear as CW
- Parallel capture on multiple cameras
- M^2 measurements
- Divergence
- Focus finding

Applications

- MIR/FIR laser profiling
- Field servicing of MIR/FIR lasers and laser-based systems
- Optical assembly & instrument alignment
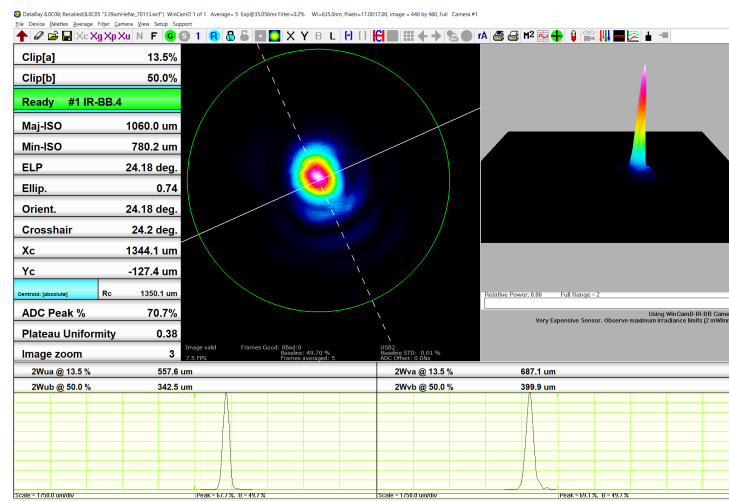- Beam wander & logging

Figure 1: 3.39 micron HeNe laser captured with WinCamD-IR-BB

Warnings and Precautions – *PLEASE READ*

- Protect your investment by handling the WinCamD-IR-BB with care, especially when the sensor is exposed

- *Always observe maximum irradiance limits*

  – Stay below the saturation irradiance to ensure safe power levels

- The WinCamD-IR-BB sensor package is particularly *expensive to replace* if damaged.

- Always follow proper laser safety protocol when working with lasers of any power. Refer to ANSI Z136.1.

- Be sure to understand the light's path, including every reflection/transmission through glass surfaces.

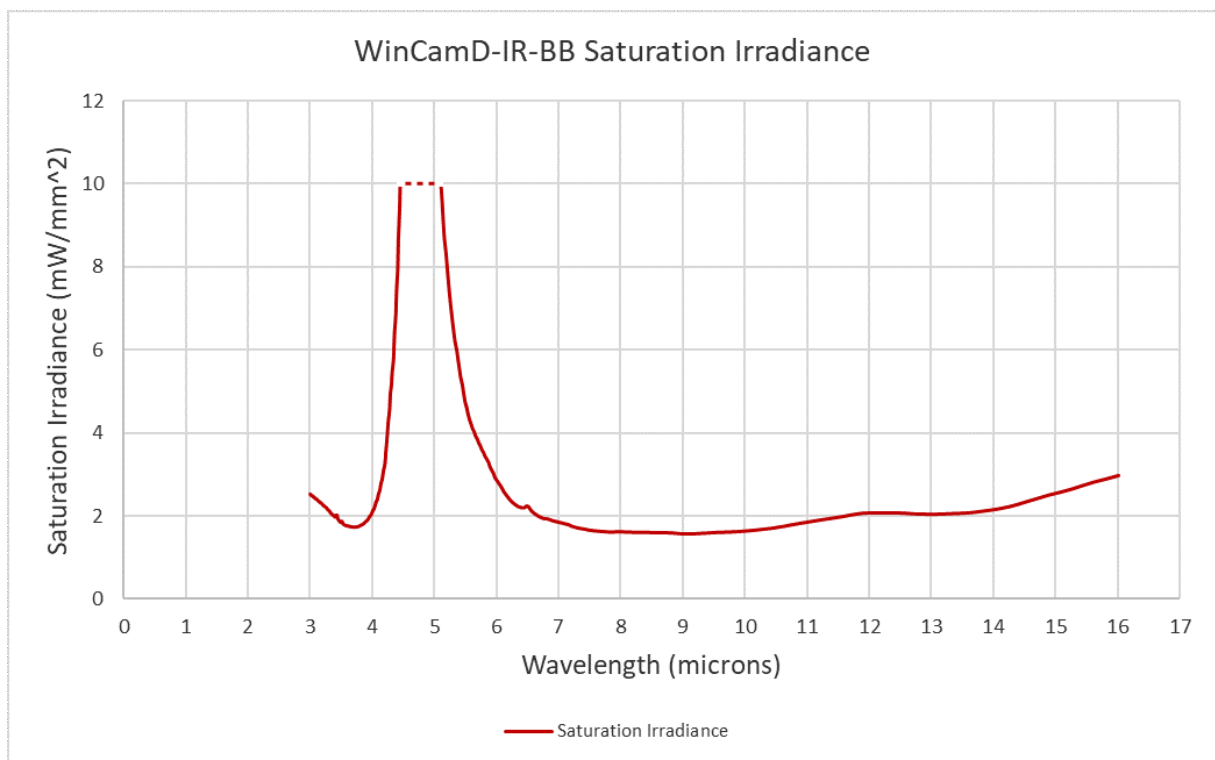 – The included ND-IR filters will reflect >99% of the input energy

Figure 2: WinCamD-IR-BB Saturation Irradiance. *Always operate below the saturation irradiance*.

Software

Minimum Computer Requirements

- Windows 7, 8, 8.1, 10; 64-bit versions.
- A 2 GHz Processor
- A processor or graphics card which supports OpenGL 3.3
- Minimum screen resolution 1366x768
- USB 3.0 port with 500 mA capability (the standard except on unpowered hubs).
- ≥1 GB of RAM

Installation

Important: Install the software before attaching the camera.

1. Attach the included installation USB drive to your computer, or download and extract the latest DataRay software for the IR-BB from the DataRay website.

2. Run the installation wizard and follow the prompts to install the software.

3. Attach the WinCamD-IR-BB to the computer using the included USB 3.0 cable. Allow Windows to find and install the necessary drivers.

Hardware

Parts List

- **WinCamD-IR-BB** – Broadband MWIR (2-16 μm) beam profiling camera

- **NDL-1-Ge** – 1" reflective germanium neutral density filter for IR OD: 1

- **NDL-2-Ge** – 1" reflective germanium neutral density filter for IR OD: 2

- **CBL-USB3-L** – 3 m USB 3.0 cable with thumbscrew hardware

- USB drive with software and user manual

Figure 8 provides the outline and mounting drawing for the WinCamD-IR-BB.

System Operation

1. Be sure that you have installed the latest DataRay software for the WinCamD-IR-BB.

2. Check the output power of the beam and prepare the necessary attenuation. The WinCamD-IR-BB comes with two ND-IR reflective filters, and you may also require additional samplers such as DataRay's Polarization Preserving Beam Sampler (PPBS). Remove the lens cap from the WinCamD-IR-BB and carefully attach the necessary filter(s), or prepare other attenuation/sampling.

3. Ensure that any reflections/transmissions from your sampling method are handled appropriately.

4. Attach the WinCamD-IR-BB to the computer's USB 3.0/2.0 port. Allow Windows to install the necessary drivers if it has not already.

5. Open the DataRay software and allow the software to recognize the WinCamD-IR-BB. This may take a few moments.

6. Press the Green bar or **G**o button to start the camera. Enable **HyperCal** to start a non-uniformity correction (NUC), and leave it enabled to allow the software to automatically perform additional NUCs as the camera temperature changes. The integrated shutter will close during a NUC.

7. Set a full capture block in the **Capture Setup** dialog.

8. Slowly walk the beam onto the edge of the sensor and be prepared to move the beam back away from the sensor if it becomes saturated.

9. The shutter will close if the impinging power saturates the sensor. To re-open the shutter, use the icon in the icon bar as shown in Figure 3.
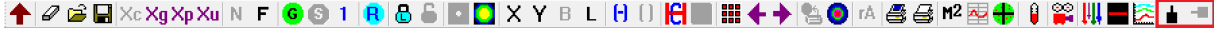
Figure 3: Icons for closing (left) and opening shutter (right) highlighted by red box.

- We recommend this step to avoid damaging the sensor if the chosen attenuation is not sufficient.

10. Adjust the beam power if necessary by changing the amount of attenuation.

11. Perform the desired measurements with the DataRay software using the same features available to all DataRay cameras. Please refer to the WinCamD User Manual.

Exposure Control

The WinCamD-IR-BB operates at a fixed frame rate of 30 Hz or 7.5 Hz (export model). There is no traditional exposure time option available for this type of camera, and the imager gain is not variable. The only way to change the sensor response is to change the irradiance of the beam by adjusting the attenuation or beam size.

Calibration

The WinCamD-IR-BB requires a non-uniformity correction (NUC) in order to provide optimum results. A default NUC is saved to the camera's memory. The camera makes use of its integrated shutter to block the beam and automatically perform a NUC. Enabling HyperCal by pressing the HC button in the DataRay software's toolbar will perform a NUC, and if left enabled will allow the camera to perform additional non-uniformity corrections every 10 minutes without additional user interaction. The NUC is particularly important as the camera warms up. Please note that during each non-uniformity calibration, the integrated black anodized aluminum shutter will shut and block the beam.

Attenuation

As emphasized previously, careful attention must be given to choosing proper attenuation for your light source when using the WinCamD-IR-BB. DataRay cannot be responsible for damaged sensors, but we are happy to assist customers in choosing the necessary attenuation/sampling for their specific beam. This will depend on the wavelength, power, and diameter of the beam. There is an attenuation spreadsheet available that can be opened in Excel 2007 or later to help estimate the irradiance for given input beam parameters and attenuation options.

ND-IR Filters

The standard WinCamD-IR-BB purchase includes two reflective ND-IR filters: ND-IR-1 and ND-IR-2. These filters can be attached directly to the WinCamD-IR-BB to attenuate the beam. The filters work by reflecting the majority of the incoming light, and allowing only a small percentage of light to reach the camera sensor. Always be aware of the location and power of the light reflected from the reflective IR filters–they do not absorb the power like our visible wavelength absorptive ND filters. Figure 4 shows the transmission of each ND-IR filter option.
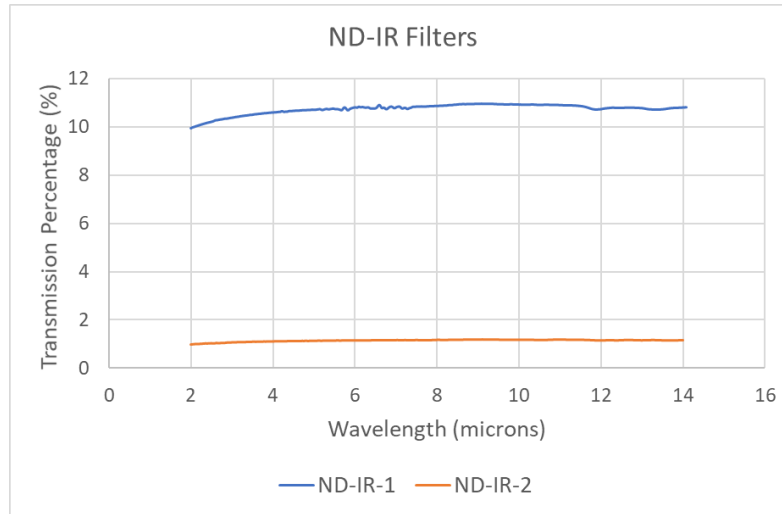
Figure 4: Transmission percentage of each ND-IR filter included with the standard WinCamD-IR-BB purchase

Polarization Preserving Beam Sampler

The Polarization Preserving Beam Sampler (PPBS) is an available accessory that samples a small percentage of a beam's power for measurement applications where the original beam's power density would otherwise damage the measurement instrument or standard ND filters. The PPBS samples the reflections from two orthogonal wedge windows to safely reduce the power of high intensity light while preserving the original polarization of the input beam and eliminating the effects of multiple reflections from each air-glass interface. For more information, please refer to the PPBS App Note.
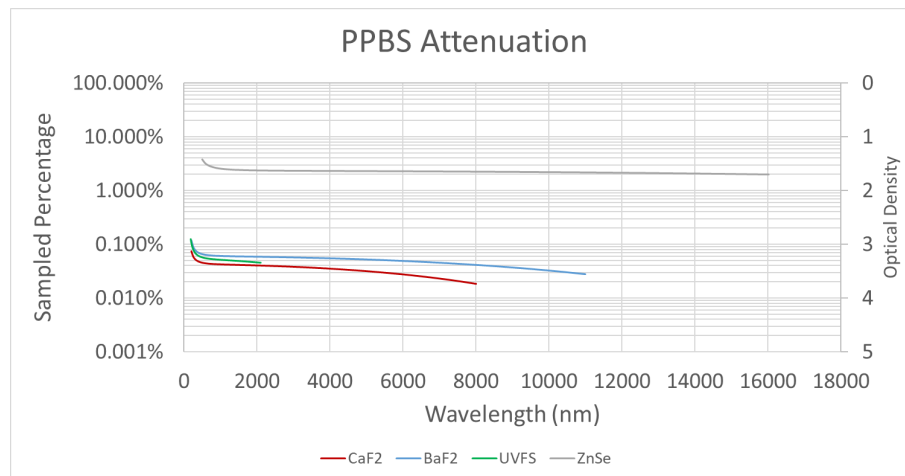

Figure 5: Attenuation for each PPBS wedge material option

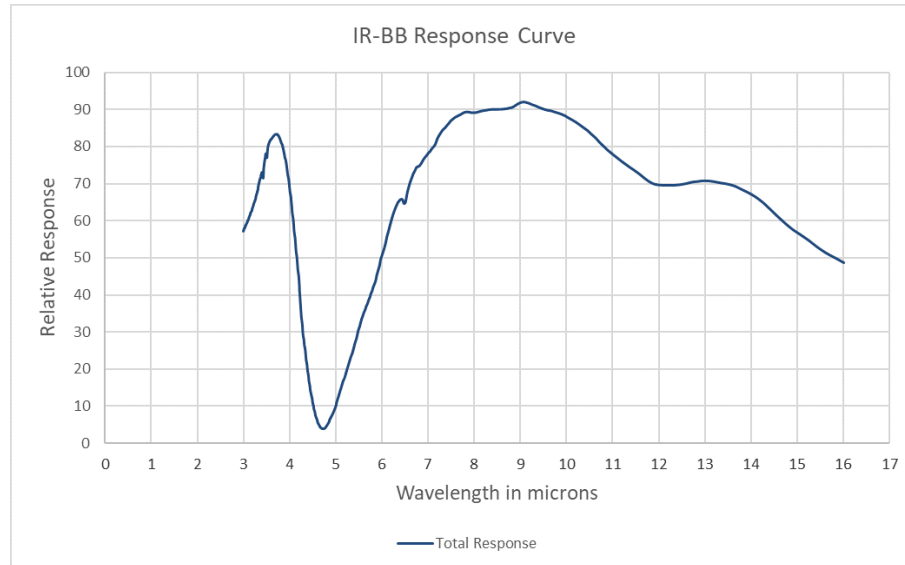## Relative Spectral Response

Figure 6: Typical WinCamD-IR-BB Response Curve

Additional Notes

Optical Interference Fringing with Coherent Beams

DataRay's beam profiling cameras are typically window-less in order to prevent fringing caused by window reflections. Since the WinCamD-IR-BB uses a microbolometer sensor package that must be kept in a vacuum, it is not possible to remove the window from the sensor package. While there is an anti-reflective coating on the outside of the window, there will still be reflections between the window surfaces and the WinCamD-IR-BB sensor. The impact of fringing due to the window is largely beam and wavelength dependent. Focused beams will have little impact from fringing, while collimated beams have the most potential for fringing to affect measurements.
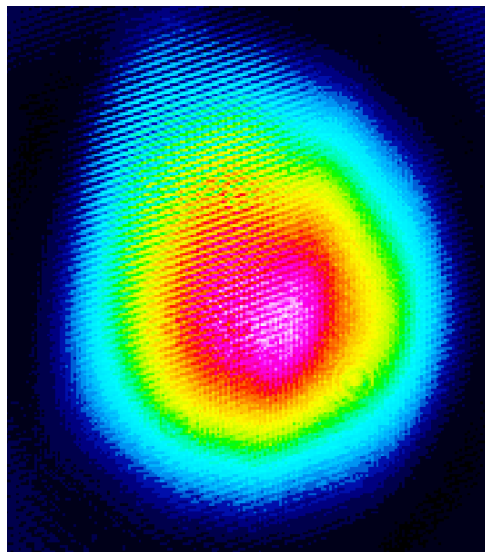
Figure 7: An example of straight line fringing from a 3.39 micron laser due to the WinCamD-IR-BB window

M^2 Measurements

The WinCamD-IR-BB is capable of performing ISO-11146 compliant beam diameter measurements and can be used with DataRay's M2DU stages to perform M^2 measurements. Please note that since the WinCamD-IR-BB does not have exposure control, the attenuation will have to be adjusted manually as the beam size changes during an M^2 measurement.
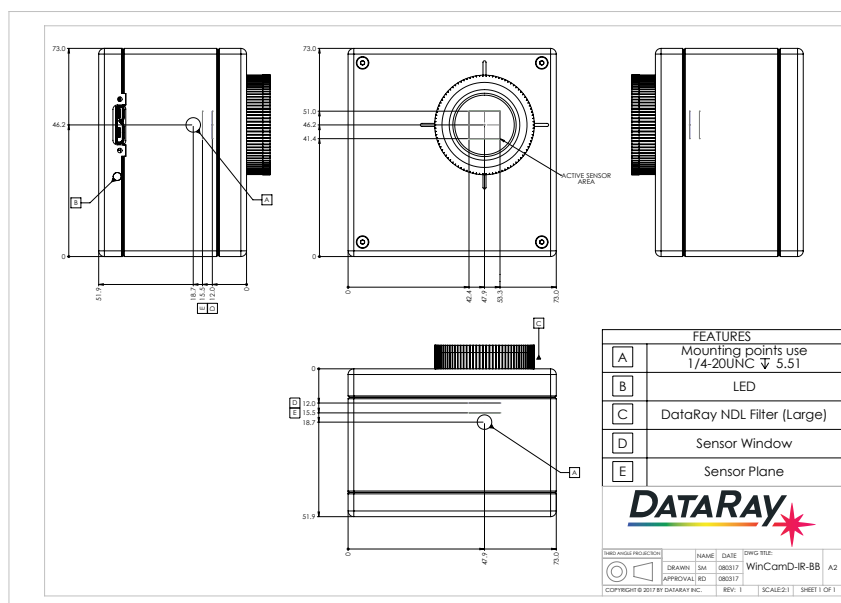
Outline and Mounting Drawing

Figure 8: Drawing of the IR-BB with mounting specifications.