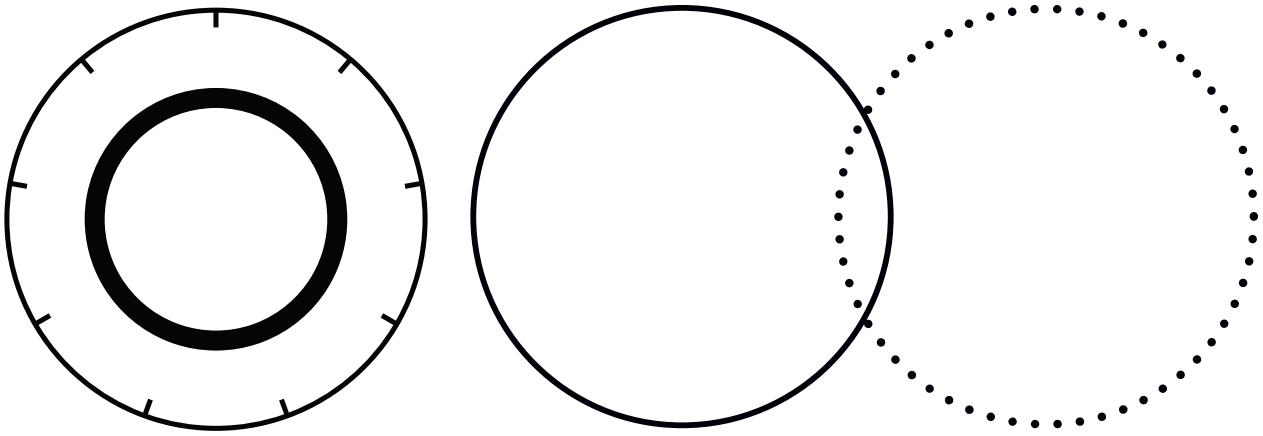
LaserCam-HR-InGaAs Beam Diagnostics Digital Camera USB 2.0

User Manual



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LaserCam™-HR-InGaAs Beam Diagnostics Digital InGaAs Camera USB 2.0

User Manual

Patents referenced in this User manual were active as of the printing date of the manual (see last page for date). The patents referenced herein may have expired. You are advised to check to see if the patents are still active: http://portal.uspto.gov/external/portal/pair.

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Technical Support

In the US:

Should you experience any difficulties with your laser or need any technical information, please visit our website: www.Coherent.com. Additional support can be obtained by contacting our Technical Support Hotline at 1.800.367.7890 (1.408.764.4557 outside the U.S.), or e-mail Product.Support@Coherent.com. Telephone coverage is available around the clock (except U.S. holidays and company shutdowns).

If you call outside our office hours, your call will be taken by our answering system and will be returned when the office reopens.

If there are technical difficulties with your laser that cannot be resolved by support mechanisms outlined above, e-mail or telephone Coherent Technical Support with a description of the problem and the corrective steps attempted. When communicating with our Technical Support Department via the web or telephone, the Support Engineer responding to your request will require the model and Laser Head serial number of your laser system.

Outside the US:

If you are located outside the U.S., visit our website for technical assistance or contact our local Service Representative. Representative phone numbers and addresses can be found on the Coherent website: www.Coherent.com.

Coherent provides telephone and web technical assistance as a service to its customers and assumes no liability thereby for any injury or damage that may occur contemporaneous with such services. These support services do not affect, under any circumstances, the terms of any warranty agreement between Coherent and the buyer. Operation of any Coherent laser with any of its interlocks defeated is always at the operator's own risk.

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1 Preface

This manual contains user information for the LaserCam™-HR-InGaAs Beam Diagnostics Digital Uncooled InGaAs camera.

1.1 Publication Updates

To view information that may have been added or changed since this publication went to print, connect to www.Coherent.com.

1.2 Signal Words and Symbols in this Manual

This documentation may contain sections in which particular hazards are defined or special attention is drawn to particular conditions. These sections are indicated with signal words in accordance with ANSI Z-535.6 and safety symbols (pictorial hazard alerts) in accordance with ANSI Z-535.3 and ISO 7010.

1.2.1 Signal Words

Four signal words are used in this documentation: **DANGER**, **WARNING**, **CAUTION** and ***NOTICE***.

The signal words **DANGER**, **WARNING** and **CAUTION** designate the degree or level of hazard when there is the risk of injury:

DANGER!
Indicates a hazardous situation that, if not avoided, will result in death or serious injury. This signal word is to be limited to the most extreme situations.

WARNING!
Indicates a hazardous situation that, if not avoided, could result in death or serious injury.

CAUTION!
Indicates a hazardous situation that, if not avoided, could result in minor or moderate injury.

The signal word "***NOTICE***" is used when there is the risk of property damage:

NOTICE!
Indicates information considered important, but not hazard-related.

Messages relating to hazards that could result in both personal injury and property damage are considered safety messages and not property damage messages.

1.2.2 Symbols

The signal words **DANGER**, **WARNING**, and **CAUTION** are always emphasized with a safety symbol that indicates a special hazard, regardless of the hazard level:

This symbol is intended to alert the operator to the presence of important operating and maintenance instructions.

This symbol is intended to alert the operator to the danger of exposure to hazardous visible and invisible laser radiation.

This symbol is intended to alert the operator to the presence of dangerous voltages within the product enclosure that may be of sufficient magnitude to constitute a risk of electric shock.

This symbol is intended to alert the operator to the danger of Electro-Static Discharge (ESD) susceptibility.

This symbol is intended to alert the operator to the danger of crushing injury.

This symbol is intended to alert the operator to the danger of a lifting hazard.

2 Safety and Compliance

This section describes requirements for safety and for compliance for persons setting up or operating the LaserCam-HR InGaAs camera.

2.1 General Safety Warnings and Cautions

Carefully review the following safety information to avoid personal injury and to prevent damage to this instrument or any sensor connected to it. This equipment contains no user-serviceable parts. For service information, refer to 'Obtain Service' (p. 31).

WARNING!
Do not operate the camera if its panels are removed or any of the interior circuitry is exposed.

WARNING!
Do not operate the camera in wet or damp conditions, or in an explosive atmosphere.

NOTICE
Operate the camera only within the specified voltage range.

CAUTION!
Do not operate the camera if there are suspected failures. Refer damaged equipment to qualified Coherent service personnel.

2.1.1 Laser and Optical Safety

DANGER!
The use and measuring of lasers is potentially dangerous. This instrument operates over wavelengths that include non-visible laser emissions.

Laser light, because of its optical qualities, poses safety hazards not associated with light from conventional light sources. The safe use of lasers requires all operators, and everyone near the laser system, to be aware of the dangers involved. Users must be familiar with the instrument and the properties of coherent, intense beams of light.

At all times, make sure that all personnel who operate, maintain or service the laser are protected from accidental or unnecessary exposure to laser radiation exceeding the accessible emission limits defined in the laser safety standards.

WARNING!
AVOID EYE OR SKIN EXPOSURE TO DIRECT OR SCATTERED RADIATION CLASS 4 LASER PRODUCT!

The greatest concern when using a laser is eye safety. In addition to the main beam, there are often many smaller beams present at various angles near the laser system. Always wear appropriate laser safety eyewear for protection against the specific wavelengths and laser energy being generated.

CAUTION!
Laser safety eyewear protects the user from accidental exposure to laser radiation by blocking light at the laser wavelengths.

However, laser safety eyewear may also prevent the operator from seeing the beam or the beam spot. Exercise extreme caution even while wearing safety glasses.

2.2 Electrical Safety

The LaserCam-HR InGaAscamera does not have dangerous voltages.

NOTICE

The LaserCam-HR InGaAs camera is designed to be operated as assembled; there are no user-serviceable components in the device. DO NOT disassemble the enclosure. *The Warranty is void if the enclosure is disassembled!*

2.2.1 Electrostatic Discharge (ESD)

The most common ESD damage occurs when handling a device during installation or use. Take the necessary measures to protect the system from ESD.

Dry air and carpet also create a higher potential for ESD. Remember to take precautions or shielding not only for operations, but for demonstrations or trade show exhibitions.

CAUTION!

Electrostatic charges as high as 4000 volts easily collect on the human body and equipment and can discharge without detection.

Although the electronics features have input protection, permanent damage can occur on devices subjected to high-energy electrostatic discharges. You must take correct ESD precautions to prevent damage or performance degradation.

2.2.2 Electrical Safety Precautions

Everyone must observe the electrical safety precautions when working with potentially hazardous electrical circuitry.

DANGER!

When working with electrical power systems, the rules for electrical safety must be strictly followed. Failure to do so could result in the exposure to lethal levels of electricity.

WARNING!
Normal operation of the camera should not require access to the power supply circuitry. Removing the power supply cover exposes the user to potential electrical hazards. Contact an authorized service representative before attempting to correct any problem with the power supply.

2.2.3 International Standards and Sources of Additional Information

Following are sources for information about electrical safety standards, as well as safety equipment and training.

Safety Requirements For Electrical Equipment For Measurement, Control and Laboratory Use
IEC 61010-1 / EN 61010-1

International Electrotechnical Commission (IEC)
www.iec.ch

2.3 Compliance

This section describes compliance with various government requirements for safety, environmental regulations, and control law.

2.3.1 Environmental Compliance

2.3.1.1 Electromagnetic Compatibility

Compliance of this laser with the Electromagnetic Compatibility (EMC) requirements is certified by the CE mark and the UKCA mark.

Each application and installation is unique, and in some cases, the user may experience Electromagnetic Interference (EMI) noise being emitted from various electronic components. This laser may use high-frequency RF. While adequate countermeasures have been taken to suppress this emission to meet the requirements stated on the Declaration of Conformity, the user may wish to employ additional measures to suppress the EMI to reduce the emissions further. Standard methods of reducing the EMI are:

1. Use of shielded control cables grounded on both ends
2. Addition of appropriate ferrite beads to cables connected to the beam source.

2.3.1.2 RoHS Compliance

This Coherent product was released as RoHS-compliant. If you purchased your product prior to 11/2006, contact Coherent Technical Support to determine the appropriate part numbers for your product. You can locate the date of manufacturing for your product on the serial number label.

2.3.1.3 European Union RoHS Compliance

The European Union RoHS Directive EN 50581:2012 restricts the use of certain hazardous substances in electrical and electronic equipment. Coherent is in compliance with this Directive and can provide RoHS certification upon request. Compliance of this laser with the EMC requirements is certified by the CE mark.

Coherent product(s) conform to all applicable requirements of the EU-REACH Regulation, (1907/2006). Compliance Declarations are available upon request.

2.3.1.4 China RoHS Compliance

Coherent product(s) conform to all applicable requirements of Restriction of Hazardous Substances Regulation SJ/T 11364-2014 commonly referred to as China RoHS.

Hazardous substances (if applicable) in the LaserCam-HR-InGaAs User Manual are shown in the material declaration table included with the equipment, REACH Compliance.

The LaserCam-HR InGaAs camera is a green and environmentally friendly product with electronic and electrical components that can be recycled appropriately. This is identified by the Green logo shown in Figure 2-1. This label is attached on the underside of the camera.

Figure 2-1. China RoHS Green Label

Hazardous substances in the LaserCam-HR II are shown on the China RoHS Compliant Components table in Figure 2-1.

Figure 2-2. China-RoHS Compliant Components

部件名称 Part Name	有害物质 Hazardous Substances					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
电缆装配 Cable Assembly	X	O	O	O	O	O
本表格依据SJ/T 11364的规定编制						
O: 表示该有害物质在该部件所有均质材料中的含量均在GB/T 26572规定的限量要求以下。 X: 表示该有害物质至少在该部件的某一均质材料中的含量超出GB/T 26572规定的限量要求。						

2.3.1.5 Waste Electrical and Electronic Equipment (WEEE, 2002)

The European Waste Electrical and Electronic Equipment (WEEE) Directive (2002/96/EC) is represented by a crossed-out garbage container label (see Figure 2-3, below). The purpose of this directive is to minimize the disposal of WEEE as unsorted municipal waste and to facilitate its separate collection.

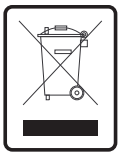


Figure 2-3. Waste Electrical and Electronic Equipment Label

2.3.2 Export Control Laws Compliance

It is the policy of Coherent to comply strictly with U.S. export control laws.

Export and re-export of lasers manufactured by Coherent are subject to U.S. Export Administration Regulations, which are administered by the Commerce Department. In addition, shipments of certain components are regulated by the State Department under the International Traffic in Arms Regulations.

The applicable restrictions vary depending on the specific product involved and its destination. In some cases, U.S. law requires that U.S. Government approval be obtained prior to resale, export or re-export of certain articles. When there is uncertainty about the obligations imposed by U.S. law, clarification must be obtained from Coherent or an appropriate U.S. Government agency.

Products manufactured in the European Union, Singapore, Malaysia, Thailand: These commodities, technology, or software are subject to local export regulations and local laws. Diversion contrary to local law is prohibited. The use, sale, re-export, or re-transfer directly or indirectly in any prohibited activities are strictly prohibited.

2.3.3 Declaration of Conformity

Declaration of Conformity certificates are available upon request.

3 Description

The LaserCam™-HR-InGaAs Beam Diagnostics camera uses a large area progressive scan sensor for detection and analysis of laser beam profiles. These profiles range from 500 µm to 6.0 mm in diameter with 30 µm by 30 µm spatial resolution over the spectral range of 900 to 1700 nm.

LaserCam-HR-InGaAs characteristics include excellent signal-to-noise ratio and linear response for accurate beam dimension and uniformity measurements. There is also high overexposure protection for distortion-less measurements of saturated beam profiles.Other features include:

- USB 2.0 digital interface
- Compact design minimizes space required in optical train
- Uses a single USB high-speed interface cable for data and power
- A Low Distortion Faceplate (LDFP) that minimizes room light and provides laser grade quality attenuation of 2500:1
- High sensitivity and dynamic range
- No lag, geometric distortion, or image burn-in
- Accepts C-mount optics, including all Coherent optical sampling and attenuation accessories.
- Large area 320 x 256 active picture elements (pixels)

- Requires only USB 2.0 connections
- CE compliant when used with a CE-compliant computer and cables

3.1 Parts and Accessories List

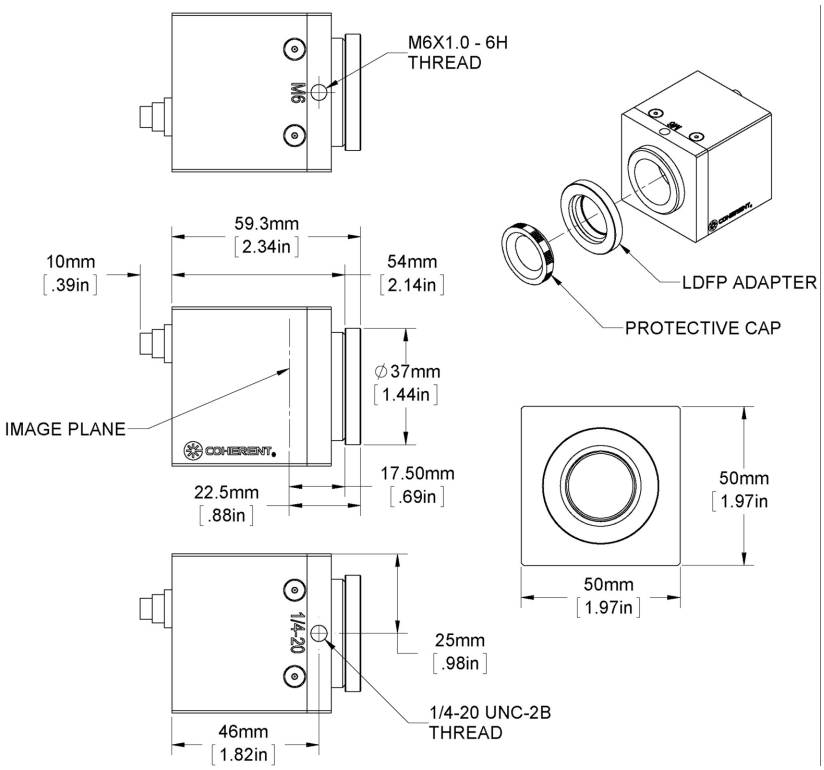
Table 3-1, below, shows the orderable parts for the LaserCam-HR-InGaAs system.

Table 3-1. Parts and Accessories List

Item	Part Number
LaserCam-HR-InGaAs System (RoHS)	1149002
Low Distortion Face Plate (LDFP)	1255961
Trigger In and Pass/Fail Output Cable (RoHS)	1148592
USB Cable, 3.0 meters (RoHS)	1114614
LaserCam-HR-InGaAs Shipping Container	1073686
LaserCam-HR-InGaAs User Manual (this document)	1148416

3.2 Dimensions

The figure below gives complete size and dimension information for the camera.



4 Installation

This section discusses the following topics:

- 'Install Software' (p. 17)
- 'Setup Cables' (p. 20)
- 'Mount Camera' (p. 22)

It's important to follow the set-up procedure in the order in which it is presented. Failure to do so may result in errors.

NOTICE

The correct order for system set-up is:
— Install the software first, but *wait* to launch the software.
— Unpack and inspect the camera and accessories.
— Set up and connect the camera to the workstation.
— Start the software on the workstation.

4.1 Install Software

This section explains how to install the software on the following operating systems.

If the USB cable is connected prematurely from the camera to the workstation before the software is installed, the Microsoft operating system detects the camera as a new device and attempts to install a standard Windows device driver. This results in an incorrect device driver installed, and the BeamView-USB software then cannot recognize the camera.

4.1.1 System Requirements

It is recommended that to use the most current and robust workstation possible. Support is provided on the following operating systems:

- Windows v10, v11 (32- and 64-bit)

In addition, the workstation must meet the following minimum requirements:

- CPU: 2.5 GHz or faster processor
- RAM: Minimum of 2 GB of RAM
- Available hard disk space: 10 GB
- USB 2.0 high-speed port
- Display: 1280 x 1024 screen resolution
- Microsoft .NET Framework 4.0 or higher. If no version (or an older version) is found on the workstation, then the installation program installs a version of Microsoft .NET Framework.

4.1.2 Installation Steps

NOTICE

Do *not* connect a LaserCam-HR-InGaAs camera to a USB 2.0 PC port at this time. The software must be installed *before* physically connecting a camera to the computer.

Install BeamView-USB software:

1. Start the Installation Wizard and follow instructions on-screen.
2. Review the License Agreement, and then accept the terms of the Agreement.

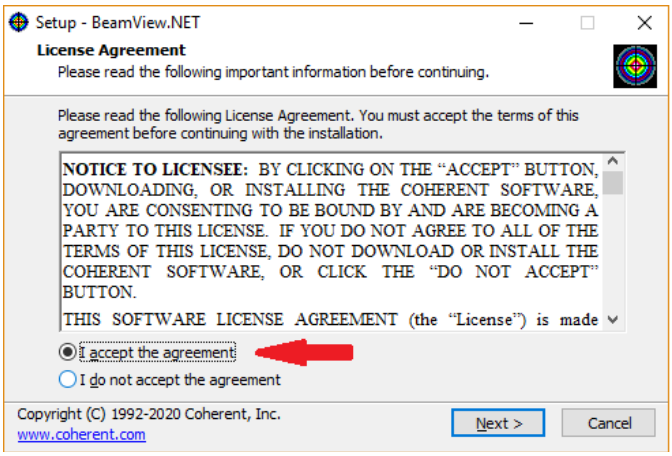


Figure 4-1. License Agreement

3. Select the desired directory on the workstation to install the files.

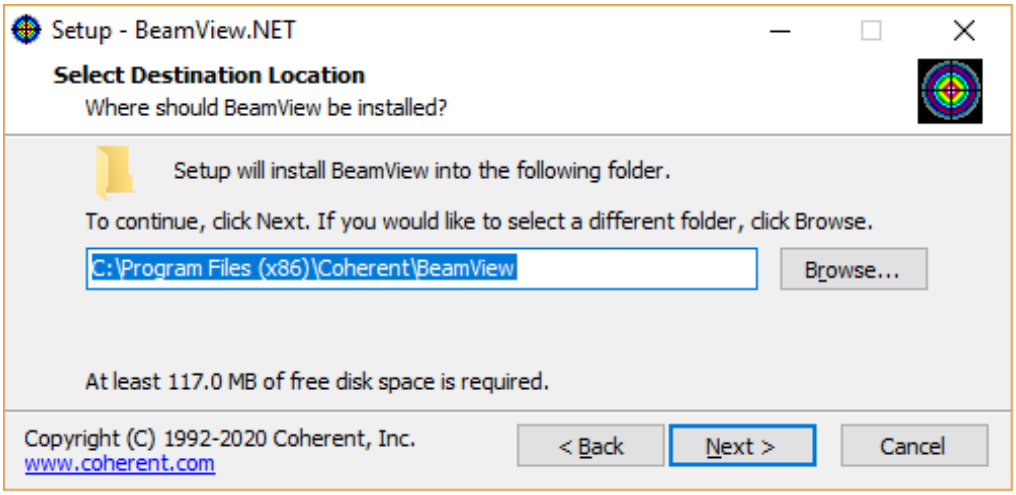


Figure 4-2. Select Install Location

4. Select a directory where you want to place a shortcut for the program.
5. Set up a shortcut (icon on the desktop).
6. Review settings and begin installation.
7. Install device drivers as desired, when prompted.
8. Finish the software installation and close the Installation Wizard.

NOTICE
A shortcut to BeamView.NETis automatically put on the desktop. Do not click it at this time. Continue with the installation.

4.2 Unpack and Examine

The LaserCam-HR-InGaAs is a digital, uncooled camera, designed for use with a USB 2.0 interface. The camera, trigger cable, and CD-ROM are shipped in a high-density plastic carrying case. This specially-designed case protects all items during shipment.

Visually check all cartons for damage before unpacking. If there is no visible external damage, remove all items from the cartons and inspect them for damage. Immediately advise Coherent of any damage. A Returned Material Authorization (RMA) will be issued for any damaged instruments (refer to the last page of this guide for contact information).

NOTICE

When inspecting a LaserCam-HR-InGaAs camera, remove only the protective cover, not the LDFP (Low Distortion Faceplate). See Figure 4-4

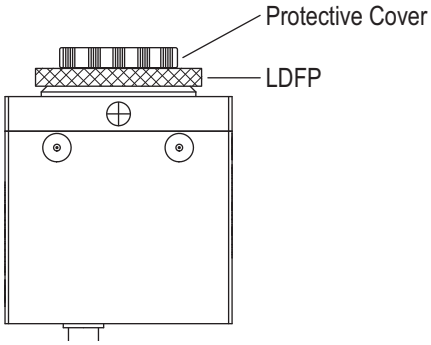


Figure 4-3. Camera with Protective Cover

4.3 Setup Cables

Two cables are provided with the LaserCam-HR-InGaAs camera: USB and Trigger Input and Pass/Fail Output:

- The USB cable must be connected between the camera and the computer for proper operation.

- The Trigger Input and Pass/Fail Output cable provides for asynchronous pulsed laser beam capture or a TTL level Pass/Fail output signal. This cable is not required for CW (continuous) laser analysis or pulsed laser beam capture using BeamView in the auto-trigger mode based on an intensity threshold.

These cables are explained in more detail, next.

4.3.1 USB Cable

Connect the USB 2.0 cable to the USB 2.0 connector on the LaserCam-HR-InGaAs camera—for more information, refer to Figure 4-4.

NOTICE

Do not connect the USB cable to the computer until instructed to do so.

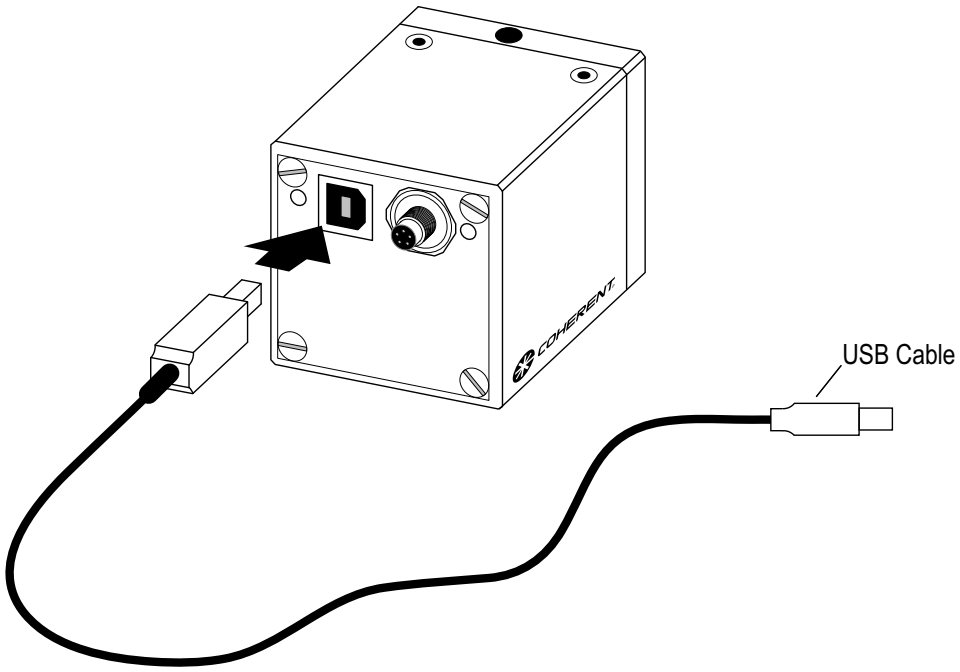


Figure 4-4. Connecting the USB Cable

LaserCam-HR-InGaAs produces a standard UB 2.0 digital signal. It will interface through the USB 2.0 connector of any compatible PC using Coherent BeamView-USB software.

Trigger Input and Pass/Fail Output cable connection is discussed, next.

4.3.2 Trigger Input and Pass/Fail Output Cable

The Trigger Input and Pass/Fail Output cable shown in Figure 4-5, below, provides for pulsed laser beam capture or a TTL level Pass/Fail output signal. This cable is not required for CW (continuous) laser analysis or pulsed laser beam capture using BeamView in the auto-trigger mode based on an intensity threshold.

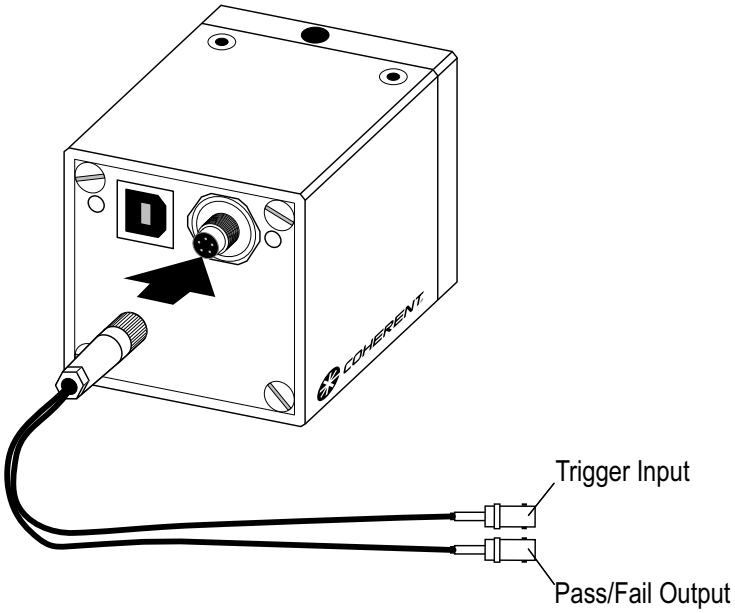


Figure 4-5. Connecting the Trigger Input and Pass/Fail Output Cable

4.4 Mount Camera

LaserCam-HR-InGaAs is designed to be mounted with a $^{1}/_{4}$-20 or M6 threaded mounting post. Mounting post attachment locations are shown in Figure 4-6.

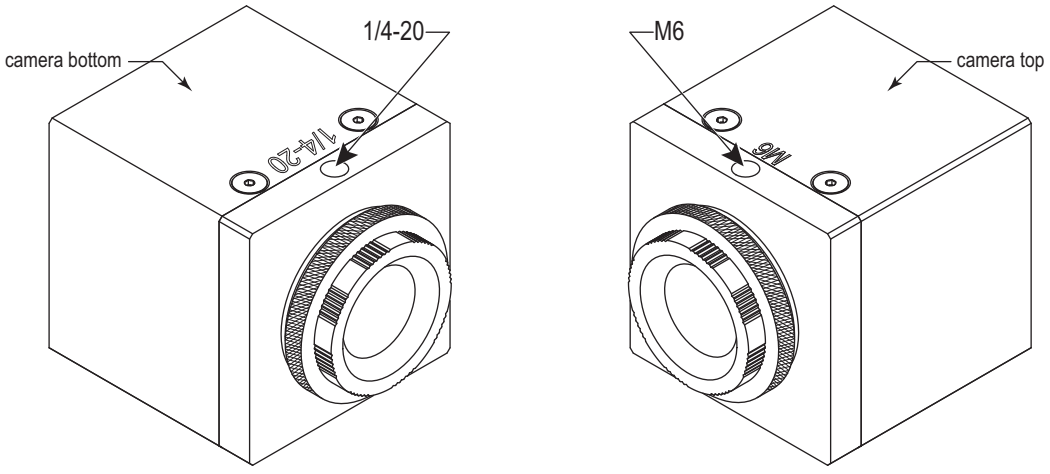


Figure 4-6. Mounting Post Attachment Locations

4.5 Attach to Workstation and Start Software

NOTICE

Connect a LaserCam-HR-InGaAs camera to the USB 2.0 PC port before continuing with the installation.

- Connect a LaserCam-HR-InGaAs camera to the USB 2.0 PC port on the workstation computer.
- Double-click the BeamView-USB shortcut on the desktop. This action will start the BeamView-USB program and automatically install the camera.

The installation process is now complete.

5 Operation

This section discusses the following topics:

- Pixel spacing; Power on (this page)
- Warm-up time (p. 26)
- Maximum power levels; Saturation, Trigger (p. 27)
- Low Distortion Faceplate (LDFP); Dust/dirt, Clean (p. 28)
- Fringes; Get the most from the system (p. 28)

5.1 Pixel Spacing

The LaserCam-HR-InGaAs pixel spacing values are shown in Table 5-1, below.

Table 5-1. Pixel Spacing for LaserCam-HR-InGaAs

	Large Area Format	
	Horizontal Spacing	Vertical Spacing
LaserCam-HR-InGaAs	30 µm	30 µm

5.2 Power On

LaserCam-HR-InGaAs has no ON/OFF switch. As soon as power is applied to the camera via the USB 2.0 connection, it begins operating.

5.3 Warm-Up Time

The LaserCam-HR-InGaAs does not require warm-up. However, for high-accuracy measurements, it should be allowed to warm-up at least 30 minutes. This gives the best baseline (background) stability.

NOTICE
For best results, the background map should be taken after the camera warm-up period.

5.4 Maximum Power Levels

The camera will saturate at approximately 50 µW/cm^2 at 1064 nm wavelength, 30 µW/cm^2 at 1523 nm wavelength, or 0.08 µJ/cm^2 pulsed 1064 nm wavelength.

CAUTION!
Damage can occur at power levels that exceed 10,000 times saturation power density.

5.5 Saturation

Table 5-2. Saturation

Wavelength	On Array	On LDFP
1064 nm (CW)	50 µW/cm^2	3.5 mW/cm^2
1064 nm (Pulse)	0.08 µJ/cm^2	5 µJ/cm^2
1523 nm (CW)	30 µW/cm^2	350 µW/cm^2

5.6 Trigger

The LaserCam-HR-InGaAs trigger permits the beam diagnostic system to interface with pulsed lasers and transient optical events, including single shot lasers.

5.6.1 Trigger In

Trigger In uses the BNC connector labeled “TRIG IN” on the LaserCam-HR-InGaAs Trigger and Pass/Fail cable. This 5 VDC, TTL input—which is available on the rising or falling edge—causes the camera to immediately reset and begin integrating light. The Trigger In delay is 19 µS. This is the time it takes for the camera to begin integrating light once the trigger signal occurs. The LaserCam-HR-InGaAs is capable of capturing laser pulse repetition rates of up to 500 Hz without averaging adjacent pulses.

5.7 Low Distortion Faceplate (LDFP)

The Low Distortion Faceplate provides a protective window for the camera array that also acts as a background attenuator with 0.04% to 0.05% typical. The LDFP is made of laser grade filter glass that minimizes interference fringes and does not distort the beam image—refer to ’Fringes’ (p. 28). The LDFP limits room light, instrumentation lights, and flash lamp light from reaching the camera sensor. These lights cause a background level that may not be effectively subtracted by the Background Subtraction Wizard.

5.8 Dust/Dirt

If low intensity spots or small circles are noticed in the camera video. then dust is present on the InGaAs sensor or on the Low Distortion Faceplate. See Figure 5-1, below. Dust on the LDFP filter glass can cause distortion in the form of small circular diffraction rings, or can cause low-intensity spots if present on the sensor array.

Observe the defects with a flashlight or a small light illuminating the camera. If the defect moves when the light angle is changed, then the dust is on the LDFP. Otherwise it is dust on the sensor array. Use clean air at low pressure, or an approved optics cleaning fluid and lens tissue to clean the LDFP filter glass. Make sure that nothing comes in contact with the sensor surface.

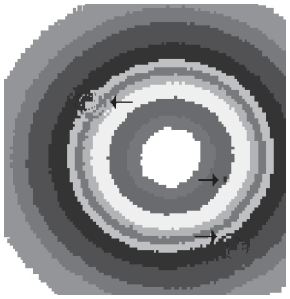


Figure 5-1. Dust on Filter Glass

5.9 Clean the Sensor

Avoid unnecessary exposure of the sensor to dust and dirt. If the surface of the sensor has to be cleaned, *never* use any kind of cloth, tissue, or brush, and strictly avoid the use of any kind of cleaning fluid. Only use clean, dry, micro-filtered low-pressure air to gently blow away particles from the surface of the sensor. Contact Coherent Customer Service if the sensor requires additional cleaning—refer to Table 6-1, 'Coherent Service Centers,' on page 31 for contact information.

CAUTION!
Touching the sensor will cause irreversible damage.

NOTICE
Always cover the sensor with a dust cap when not in use.

5.10 Fringes

If the LDFP filter glass is installed in the camera, fringes can appear in the video (see Figure 5-2, below). The fringe pattern is due to a second reflection off the sensor and LDFP superimposing back onto the original beam image. This can be corrected by loosening the C-mount setscrew and rotating the LDFP housing until the fringes are no longer present. Slightly turning the camera with respect to the laser beam can also reduce this effect.

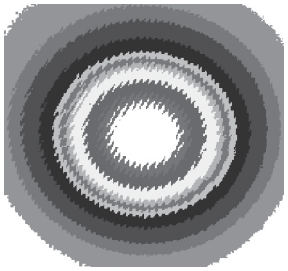


Figure 5-2. Fringes

5.11 Get the Most From Camera System

The LaserCam-HR-InGaAs camera has been carefully designed to provide accurate measurements of the spatial and intensity characteristics of laser beams. Significant attention has been paid to every aspect of the instrument that impacts data accuracy. The following will help to obtain the best performance from your LaserCam-HR-InGaAs:

- System tray—Set everything to OFF that is non-essential to the operation of the computer. This action will help assure the fastest frame update rate possible.

- RAM—A minimum of 512 MB is required. 1 GB is recommended. More is typically better.

- Processor speed—A minimum of 2.1 GHz is recommended. Faster clock speeds provide higher frame update rates. Again, “the faster the better.”

- Keep all optics clean—Dirty LDFP, beam sampling, and attenuation optics will distort the beam under test. It is important that you regularly check these optical surfaces for dust, fingerprints, and other contamination. Follow standard coated optical surfaces cleaning techniques. Use the Inclusion command to reduce the size and amount of data that is processed.

- Use the Inclusion command to give control of the sensor area where calculations are performed. Reducing this area can significantly increase frame update rates and is especially effective with small spot sizes.

CAUTION!

Cleaning the sensor surface with anything other than clean dry air will void the warranty and most likely will damage the camera.

It is strongly recommended that the LDFP always be left in place and that the dust cap be used to protect the LDFP when the instrument is not in use.

- Read the user documentation—The LaserCam-HR-InGaAs camera is a complex piece of optical test equipment. Many functions are included in the system that may not be obvious to a casual or first-time user. Review the *LaserCam-HR-InGaAs User Manual* (this manual) and the BeamView-USB Help (accessed by clicking the Help button in the BeamView software) to learn about these useful functions. Many calculations and functions that may at first appear to require post-processing or exporting of the data to another application are included in the instrument. The user documentation is designed to explain all of the functions in an easy-to-use format.

WARNING!

Observe standard Laser Safety procedures—laser beams can cause serious eye injury.

6 Service

This section includes information on the following topics:

- Obtain service (p. 31)
- Product shipment instructions (p. 32)

6.1 Obtain Service

In order to obtain service under this warranty, Customer must notify the Company of the defect before the expiration of the warranty period and make suitable arrangements for the performance of service. The Company shall, in its sole discretion, determine whether to perform warranty service at the Customer's facility, at the Company's facility or at an authorized repair station.

If Customer is directed by the Company to ship the product to the Company or a repair station, Customer shall package the product (to protect from damage during shipping) and ship it to the address specified by the Company, shipping prepaid. The Company shall pay the cost of shipping the Product back to the Customer in conjunction with product failures within the first twelve months of time of sale.

A Returned Material Authorization number (RMA) assigned by the Company must be included on the outside of all shipping packages and containers. Items returned without an RMA number are subject to return to the sender.

For the latest Customer Service information, refer to our website: www.Coherent.com.

Detailed instructions on how to prepare a product for shipping are shown under 'Product Shipment Instructions' (p. 32).

Table 6-1. Coherent Service Centers

Location	Phone	E-Mail
USA	1.800.343.4912	LSM.service@coherent.com
Europe	+49-6071-968-0	customer_service@Coherent.com
International	503.454.5700	customer.service@Coherent.com

6.2 Product Shipment Instructions

To prepare the product for shipping to Coherent:

1. Contact Coherent Customer Service for a Return Material Authorization number—refer to Table 6-1, “Coherent Service Centers,” on page 31.
2. Attach a tag to the product that includes the name and address of the owner, the person to contact, the serial number, and the RMA number you received from Coherent Customer Service.
3. Wrap the product with polyethylene sheeting or equivalent material.
4. Using the original shipping and packaging materials, pack the product. If the original carton and packing materials are not available:
   - Get a corrugated cardboard shipping carton with inside dimensions that are at least 6 in. (15 cm) taller, wider, and deeper than the product.
   - The shipping carton must be made of cardboard with a minimum of 375 lb. (170 kg) test strength.
   - Make a cushion for the instrument in the shipping carton. Use packing material or urethane foam on all sides between the carton and the product. Allow at least 3 in. (7.5 cm) on all sides, as well as the top and bottom.
5. Make a seal on the shipping carton with shipping tape or an industrial stapler.
6. Ship the product to:

   Coherent, Inc.
   27650 SW 95th Ave.
   Wilsonville, OR 97070
   Attn: RMA # (*add the RMA number you received from Coherent Customer Service*)

7 Warranty

This section includes information on the Coherent Warranty and Limitations.

7.1 Limited Warranty

Coherent, Inc. (the “Company”) warrants its laser beam diagnostic products (“Products”) to the original purchaser (the “Customer”) that the product is free from defects in materials and workmanship and complies with all specifications, active at the time of purchase, for a period of twelve (12) months.

If the Product fails and is returned to the Company within one year following the date of purchase, the Company will, at its option, repair or replace the Product or any component found to be defective. This warranty applies only to the original purchaser and is not transferable.

Refer to the sales agreement for full warranty details and for warranty limitations.

7.2 Warranty Limitations

The foregoing warranties shall not apply, and Coherent reserves the right to refuse warranty service, should malfunction or failure result from:

- Damage caused by incorrect installation, handling, or use.
- Laser damage (including sensor elements damaged beyond repair).
- Failure to follow recommended maintenance procedures.
- Unauthorized product modification or repair.
- Operation outside the environmental specifications of the product.

Coherent assumes no liability for Customer-supplied material returned with Products for warranty service or recalibration.

A Specifications

The following table shows specifications for the LaserCam-HR-InGaAs camera.

Table A-1. Specifications (Sheet 1 of 2)

Parameter	Description
General	
Spectral Range	900 to 1700 nm
Camera Type	Uncooled InGaAs focal plane array
Video Format	14-bit digital USB 2.0 hi-speed
Sensor Active Area	9.6 mm (H) x 7.7 mm (V)
Sensor Elements	320 (H) x 256 (V)
Sensor Element Spacing	30 µm (H) x 30 µm (V)
Recommended Beam Diam.	0.5 mm min., 6.0 mm max. ($1/e^2$)
Optical Dynamic Range	> 1,000 to 1
Dimensional Accuracy	± 2% (typical), ± 5% (over entire spectral and dimensional range)
Pulse Trigger In	TTL, rising or falling edge
Pulse Integration Timing	Integration begins 19 µS after rising edge of Trigger In
Automatic Pulse Trigger	0 to 100% of camera peak response (user adjustable)
Max. Sample Rate	25 Hz (Live mode), 15 Hz (Run mode)
Noise, Peak	5 nW/cm^2 at room temperature
CW Saturation	3.5 mW/cm^2 at 1.06 µm (with LDFP)
Pulsed Saturation	0.08 $µJ/cm^2$ at 1.06 µm (with LDFP)
Damage Threshold	0.4 $µJ/cm^2$ at 1.06 µm (without LDFP)
Distance to Image Plane	17.5 ± 0.5 mm (from front of LDFP)
Dimensions	50 x 50 x 68 mm
Weight	232 g (345 g with USB and Trig In cables)

Table A-1. Specifications (Sheet 2 of 2)

Parameter	Description
Optical Mount	C-mount
Mounting	$^1/_4$-20 and M6
I/O Connector	USB 2.0 Type B
Electrical	
Signal-to-Noise Ratio	> 69dB
Power	Powered through USB 2.0 interface
Power Consumption	< 4W
Video Output	Digital: USB 2.0
Black Level	Self-adjusting
Integration Time	Adjusted to 1 ms (user adjustable: 20 µsec to 10 msec)
Synchronization	Internal free-running (crystal)
Gamma	1.0
Gain	No automatic gain control. Gain is factory set for optimum linear dynamic range.
Environmental	
Operating Temperature	10 to 35°C
Relative Humidity	To 95% non-condensing

LaserCam-HR-InGaAs User Manual

Part No. 1148416 Rev. AC

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