COHERENT

User Manual

LaserCam-HR II™

Beam Diagnostics Digital CCD Camera

USB 2.0

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User Manual
LaserCam-HR II
Beam Diagnostics Digital CCD Camera
USB 2.0

COHERENT
27650 SW 95th Ave.
Wilsonville, OR 97070

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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.

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TABLE OF CONTENTS

Signal Words and Symbols in this Manual v
Signal Words v
Symbols vi
Preface vii
RoHS Compliance vii
Export Control Laws Compliance vii
Publication Updates vii

Section One: Safety 1-1
Waste Electrical and Electronic Equipment (WEEE, 2002) 1-2
Declaration of Conformity 1-2

Section Two: Description 2-1
Parts and Accessories List 2-2

Section Three: Setup 3-1
Software Installation 3-1
Cabling 3-1
USB Cable 3-2
Trigger Input and Pass/Fail Output Cable 3-2
Mounting the Camera 3-3

Section Four: Operation 4-1
Pixel Spacing 4-1
Power On 4-1
Warm-Up Time 4-2
Maximum Power Levels 4-2
Saturation 4-2
Trigger 4-3
Trigger In 4-3
Trigger Out 4-3
Low Distortion Face Plate (LDFP) 4-3
Dust/Dirt 4-3
Cleaning the Sensor 4-4
Fringes 4-5
How to Get the Most from your LaserCam-HR II System 4-5

Appendix A: Warranty A-1
Limited Warranty A-1
Warranty Limitations A-1
Obtaining Service A-2
Product Shipping Instructions A-3

Appendix B: Specifications B-1

LIST OF FIGURES

1-1. Waste Electrical and Electronic Equipment Label 1-2

3-1. USB Cable 3-2
3-2. Trigger Input and Pass/Fail Output Cable 3-2

4-1. Dust on Filter Glass 4-4
4-2. Filter Glass after Cleaning 4-4
4-3. Fringes 4-5

B-1. LaserCam-HR II Dimensions B-2

LIST OF TABLES

2-1. Parts and Accessories List 2-2

4-1. Pixel Spacing for LaserCam-HR II 4-1
4-2. Saturation 4-2
4-3. LaserCam-HR II Saturation Levels 4-2

A-1. Coherent Service Centers A-2

B-1. LaserCam-HR II Specifications B-1

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.

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.

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.

Preface

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

RoHS Compliance

This Coherent product was released as RoHS-compliant.

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.

Publication Updates

To view information that was added or changed since this publication went to print:

1. Connect to www.Coherent.com.
2. Type **LaserCam-HR II** in the Site Search box (top right of the screen).
3. Click the **LaserCam-HR II** link in the search results.
4. Click the **Literature** tab.
5. Click the **LaserCam-HR II User Manual** link to view the latest version of this document.

Note: If the Download Request form appears (which only occurs the first time you go to our website and request literature), fill in the information and then click the **Submit** button at the bottom of the form.

SECTION ONE: SAFETY

Carefully review the following safety information to prevent personal injury or damage to this instrument or any sensor connected to it. This equipment has no user-serviceable parts. For service information, refer to “Obtaining Service” (p. A-2).

The use and measuring of lasers can be dangerous. This instrument operates on wavelengths that include non-visible laser emissions.

Correct laser operating practice according to manufacturer recommendations is important.

Eyewear and other personal protective equipment must be used according to applicable laws and regulations.

If in doubt of correct operating procedures, contact the laser manufacturer and your laser safety officer.

The equipment is not for use in critical medical environments.

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

Do not operate the camera in wet or damp conditions, or in an explosive environment.

Operate the camera only within the specified voltage range.

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

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. The purpose of this directive is to minimize the disposal of WEEE as unsorted municipal waste and to facilitate its separate collection.

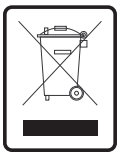

Figure 1-1. Waste Electrical and Electronic Equipment Label

Declaration of Conformity

Declaration of Conformity certificates are available upon request.

SECTION TWO: DESCRIPTION

The LaserCam-HR II beam diagnostics cameras use laser-grade 1/2-inch and 2/3-inch CCD sensors for detection and analysis of laser beam profiles from ~150 micron to 4 mm in diameter (1/2-inch camera) and ~150 micron to 6 mm in diameter (2/3-inch camera). The 1/2-inch model is a 12-bit camera with 4.6 micron pixel size. The 2/3-inch model is a 14-bit camera offering wider dynamic range with a 6.5 micron pixel size. LaserCam-HR II characteristics include excellent signal-to-noise ratio and linear response for accurate beam dimension and uniformity measurements, and 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
- Mountable in any orientation for maximum flexibility. Camera markings provide for X and Y alignments.
- Uses a single interface cable for data and power
- A Low Distortion Face Plate (LDFP) that minimizes room light, protects the CCD array, 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, attenuation, and UV conversion accessories
- High resolution: 1280 x 1024 active picture elements (pixels)
- Requires only USB 2.0 connections
- CE compliant when used with a CE-compliant computer and cables

Parts and Accessories List

Table 2-1 lists the orderable parts for the LaserCam-HR II system.

Table 2-1. Parts and Accessories List

Item	Part Number
LaserCam-HR II 1/2-inch USB Camera System (RoHS)	1282868
LaserCam-HR II 2/3-inch USB Camera System (RoHS)	1282870
Low Distortion Face Plate (LDFP)	1255961
Trigger In and Pass/Fail Output Cable (RoHS)	1120313
USB Cable, 3.0 meter (RoHS)	1114614
LaserCam-HR II Shipping Container	1073686
LaserCam-HR II CD (includes PDF User Manual)	1186807

SECTION THREE: SETUP

In this section:

- Software installation (this page)
- Cabling (this page)
- Mounting the camera (p. 3-3)

Software Installation

Refer to the *BeamView-USB Software Installation Guide* (1186747)—included on the CD that shipped with your product—for complete software installation instructions. To view that document online:

1. Connect to www.Coherent.com.
2. Type **LaserCam-HR II** in the Site Search box (top right of the screen).
3. Click the **LaserCam-HR II** link in the list of search results.
4. Click the **Literature** tab.
5. Click the **BeamView-USB Software Installation Guide** link to view the document.

Note: If the Download Request form appears (which only occurs the first time you go to our website and request literature), fill in the information and then click the **Submit** button at the bottom of the form.

Cabling

Position the LaserCam-HR II at the location where the beam will be measured. To protect the face plate from dust, keep the dust cap installed until ready to take measurements.

USB Cable

Connect the USB 2.0 cable to the USB 2.0 connector on the LaserCam-HR II camera (see Figure 3-1).

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

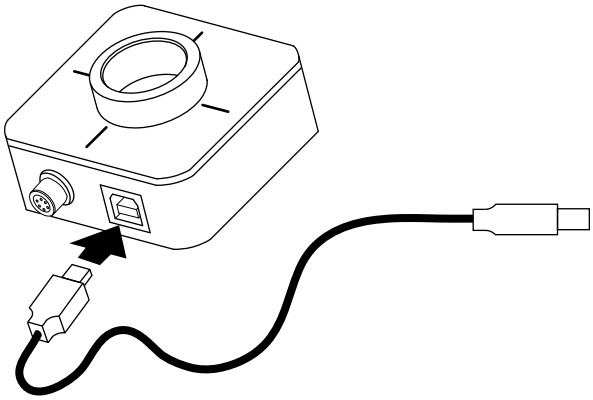

Figure 3-1. USB Cable

LaserCam-HR II will interface through the USB 2.0 connector of any compatible PC using Coherent BeamView Version 4.8.1 software.

Connecting the Trigger and Pass/Fail cable is described next.

Trigger Input and Pass/Fail Output Cable

For more information about the Trigger Input and Pass/Fail Output cable (1120313) shown in Figure 3-2, refer to the BeamView-USB software Help file.

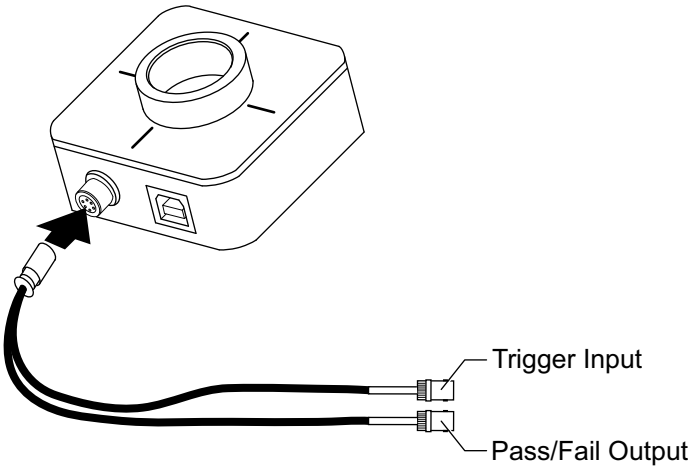

Figure 3-2. Trigger Input and Pass/Fail Output Cable

Mounting the Camera

LaserCam-HR II can be mounted in any rotational position with a $^{1}/_{4}$-20 or M6 threaded mounting post. Figure B-1 (p. B-2) shows the mounting post location. Alignment marks permit rotation of the camera and alignment with the vertical and horizontal orientation of the sensor. Note: The beam movement on the camera will not match the beam movement on the monitor for all positions between 0 and 90 degrees.

SECTION FOUR: OPERATION

In this section:

- Pixel spacing (this page)
- Power on (this page)
- Warm-up time (p. 4-2)
- Maximum power levels (p. 4-2)
- Saturation (p. 4-2)
- Trigger (p. 4-3)
- Low Distortion Face Plate (LDFP) (p. 4-3)
- Dust/dirt (p. 4-3)
- Cleaning the sensor (p. 4-4)
- Fringes (p. 4-5)
- How to get the most from your LaserCam-HR II II system (p. 4-5)

Pixel Spacing

The LaserCam-HR II pixel spacing values are shown in Table 4-1.

Table 4-1. Pixel Spacing for LaserCam-HR II

	Horizontal Spacing	Vertical Spacing
LaserCam-HR II 1/2-inch System	4.6 µm	4.6 µm
LaserCam-HR II 2/3-inch System	6.5 µm	6.5 µm

Power On

LaserCam-HR II has no ON/OFF switch. When power is applied to the camera via the USB 2.0 connection, it begins to operate.

Warm-Up Time

The LaserCam-HR II does not require warm-up. However, if the camera is used to make high-accuracy measurements, it must warm-up for at least 15 minutes to insure best baseline (background) stability.

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

Maximum Power Levels

Damage can occur at power levels more than 10,000 times saturation power density or 32 mJ/cm^2 at 1064 nm.

Saturation

Table 4-2. Saturation

Wavelength	On Array	On LDFP
633 nm (CW)	16.0 µW/cm^2	40.0 mW/cm^2
1064 nm (CW)	320.0 µW/cm^2	800.0 mW/cm^2
1064 nm (Pulse)	3.2 µJ/cm^2	8.0 mJ/cm^2

Table 4-3. LaserCam-HR II Saturation Levels

	LaserCam-HR II (1/2-inch)	LaserCam-HR II (2/3-inch)
CW Saturation	13 mW/cm^2 (with LDFP) at 633 nm	5 mW/cm^2 (with LDFP) at 633 nm
	5 µW/cm^2 (without LDFP) at 633 nm	2 µW/cm^2 (without LDFP) at 633 nm
	70 mW/cm^2 (with LDFP) at 1064 nm	25 mW/cm^2 (with LDFP) at 1064 nm
	340 µW/cm^2 (without LDFP) at 1064 nm	125 µW/cm^2 (without LDFP) at 1064 nm
Pulsed Saturation	0.4 mJ/cm^2 (with LDFP) at 1064 nm	0.15 mJ/cm^2 (with LDFP) at 1064 nm
	2 µJ/cm^2 (without LDFP) at 1064 nm	0.7 µJ/cm^2 (without LDFP) at 1064 nm

Trigger

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

Trigger In

Trigger In uses the BNC connector labeled “IN” on the LaserCam-HR II Trigger and Pass/Fail cable. This 5 VDC, TTL input—available on the rising or falling edge—causes the camera to immediately reset and begin integrating light. The Trigger In delay is 75 µs (1/2-inch camera) and 20 µs (2/3-inch camera). This is the time it takes for the camera to start integrating light once the trigger signal occurs. The LaserCam-HR II can sample laser pulse repetition rates to a maximum of 200 Hz without averaging adjacent pulses.

Trigger Out

Coherent suggests that an external pulse generator be used if the laser under test does not supply a “sync-out” signal. Connect the pulse generator to the Trigger In connector. A delayed trigger should be applied to the Enable or Trigger input connector of the laser. Keep in mind that integration begins 75 µs (for the 1/2-inch camera) and 20 µs (for the 2/3-inch camera) after the rising edge of the camera trigger (Trigger In), so you must delay the laser enable pulse by 75 µs (for the 1/2-inch camera) or 20 µs (for the 2/3-inch camera), minus any delay in the laser firing circuit.

Tip: To avoid missed pulses due to jitter, add additional trigger delay beyond the listed trigger delay values. For low rep. rate lasers—such as 10 Hz lasers—delay the trigger enough to place the laser pulse in the middle of the integration window.

Low Distortion Face Plate (LDFP)

The Low Distortion Face Plate 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—refer to “Fringes” (p. 4-5)—and does not distort the beam image. 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.

Dust/Dirt

If low intensity spots or small circles are seen in the camera video then dust may be present on the CCD sensor or on the Low Distortion Face Plate—see Figure 4-1 (p. 4-4). 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 illumination 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 methanol and lens tissue to clean the LDFP filter glass. Take all necessary precautions to insure that nothing comes in contact with the sensor surface.

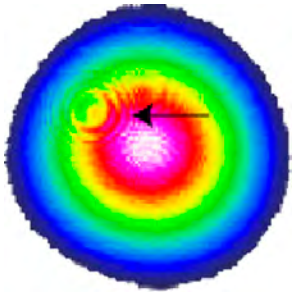

Figure 4-1. Dust on Filter Glass

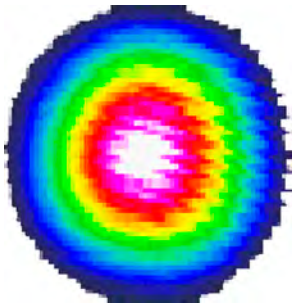

Figure 4-2. Filter Glass after Cleaning

Cleaning 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 “Coherent Service Centers” (p. A-2) for contact information.

NOTICE!
Touching the sensor will cause irreversible damage.

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

Fringes

If the LDFP filter glass is installed in the camera, fringes can appear in the video (see Figure 4-3). The fringe pattern is caused by a second reflection off the sensor and LDFP superimposing back on the original beam image. Correct this condition 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 decrease this effect.

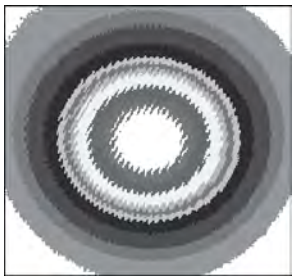

Figure 4-3. Fringes

How to Get the Most from your LaserCam-HR II System

The LaserCam-HR II 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 items will help you get the best performance from your LaserCam-HR II:

- System tray—Turn off everything that is non-essential to the running of the computer. This action will help assure the fastest frame update rate possible.
- Resolution—Select 640 x 512 x 8 resolution to get the highest update rates.
- RAM—A minimum of 512 MB is required. 1 GB is recommended. More RAM is typically better.
- Processor speed—A minimum of 3.3 GHz is recommended. Faster clock speeds give higher frame update rates. The faster the processor speed, 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, finger-

prints, 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.

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

NOTICE!
Cleaning the sensor surface will void the warranty and can possibly damage the camera.

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

- Read the user documentation—The LaserCam-HR II 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 II 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 can at first appear to require post-processing or exporting of the data to another application are included in the instrument. The user documentation is explains all of the functions in an easy-to-use format.

CAUTION!
Observe standard Laser Safety procedures—The eyes you save may be your own.

APPENDIX A: WARRANTY

In this section:

- Limited warranty (this page)
- Warranty limitations (this page)
- Obtaining service (p. A-2)
- Product shipping instructions (p. A-3)

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.

Coherent, Inc. will, at its option, repair or replace any product or component found to be defective during the warranty period. This warranty applies only to the original purchaser and is not transferable.

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 improper 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.

THIS WARRANTY IS EXCLUSIVE IN LIEU OF ALL OTHER WARRANTIES WHETHER WRITTEN, ORAL, OR IMPLIED. COHERENT SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT SHALL THE COMPANY BE LIABLE FOR ANY INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES IN CONNECTION WITH ITS PRODUCTS.

Obtaining 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, connect to www.Coherent.com.

Detailed instructions on how to prepare a product for shipping are shown under “Product Shipping Instructions” (p. A-3).

Table A-1. Coherent Service Centers

Location	Phone	Fax	E-mail
USA	1.800.343.4912	503.454.5777	info_service@Coherent.com
Europe	+49-6071-968-0	+49-6071-968-499	info_service@Coherent.com
International	503.454.5700	503.454.5777	info_service@Coherent.com

Product Shipping Instructions

To prepare the product for shipping to Coherent:

1. Contact Coherent Customer Service—refer to Table A-1 (p. A-2)—for a Return Material Authorization number.
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. If the original packing material and carton are not available, obtain 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 constructed of cardboard with a minimum of 375 lb. (170 kg) test strength. Cushion the instrument in the shipping carton with packing material or urethane foam on all sides between the carton and the product. Allow 3 in. (7.5 cm) on all sides, top, and bottom.
5. Seal 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*)

APPENDIX B: SPECIFICATIONS

Table B-1 lists specifications for the LaserCam-HR II.

Table B-1. LaserCam-HR II Specifications

	LaserCam-HR II (1/2-inch)	**LaserCam-HR II (2/3-inch)**
Sensor Elements (pixels)	1280 x 1024	
Pixel Size (µm)	4.6 x 4.6	6.5 x 6.5
Sensor Active Area (mm) (H x V)	5.9 x 4.8	8.3 x 6.6
Camera Bit Depth	12-bit	14-bit
Spectral Range (nm) without LDFP with LDFP included with BIP-12F accessory	 190 to 1100[a] 400 to 1100 190 to 355	
Recommended Beam Diameter (mm)	0.15 to 4.0[b]	0.2 to 6.0[b]
Glassless Sensor	Low Distortion Face Plate is removable	
Low Distortion Face Plate	Laser-grade ND filter	
(LDFP, LDFP-UV)	OD = 2.5 at 632.8 nm	
Electrical Interface	USB 2.0	
Capture Modes	Continuous (CW), pulsed	
Variable Exposure Time	1 to 500 msec, default at 5 msec	
Pulsed Mode Trigger Methods	Trigger In (TTL)	
Trigger Delay (µs)	75	20
Maximum Pulse Trigger In Rate (Hz)	200 (without averaging adjacent pulses)	
Maximum Frame Rate (FPS) Live video, no calculations Capture with calculations	 15 10	
Damage Threshold without LDFP	 32 mJ/cm^2 at 1064 nm	
CW Saturation with LDFP without LDFP with LDFP without LDFP	 13 mW/cm^2 at 633 nm 5 µW/cm^2 at 633 nm 70 mW/cm^2 at 1064 nm 340 µW/cm^2 at 1064 nm	 5 mW/cm^2 at 633 nm 2 µW/cm^2 at 633 nm 25 mW/cm^2 at 1064 nm 125 µW/cm^2 at 1064 nm
Pulsed Saturation with LDFP without LDFP	 0.4 mJ/cm^2 at 1064 nm 2 µJ/cm^2 at 1064 nm	 0.15 mJ/cm^2 at 1064 nm 0.7 µJ/cm^2 at 1064 nm
USB 2.0 Cable	10 ft. standard A/B cable (included)	
Trigger Connector	BNC receptacle (trigger cable included)	
Part Number	1282868	1282870

a. There is a risk of degradation in the 190 to 300 nm range due to DUV exposure. The optional BIP-12F UV-to- visible fluorescence converter can be used to prevent drift.

b. It is possible to measure smaller diameter beams, but resolution is reduced.

Figure B-1 lists the physical dimensions of the LaserCam-HR II camera.

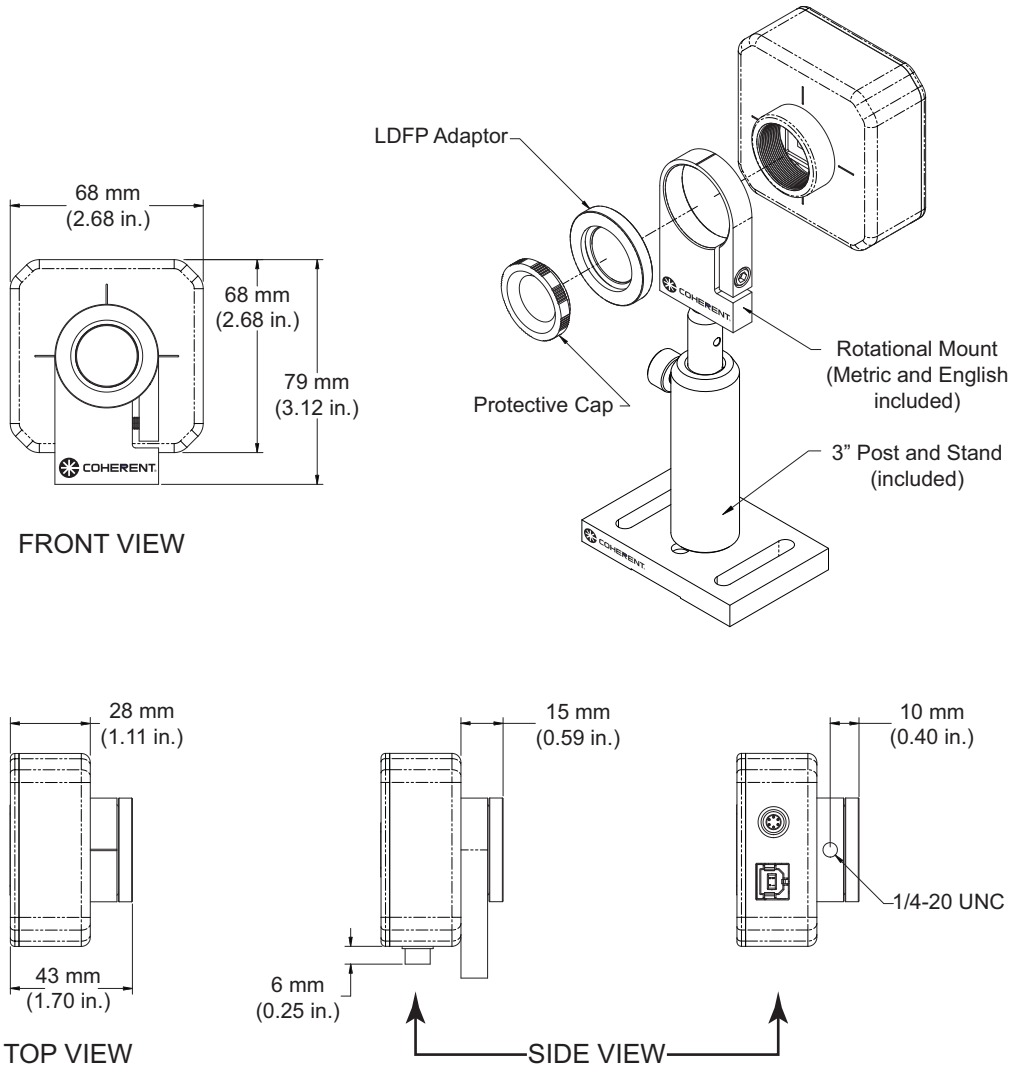

Figure B-1. LaserCam-HR II Dimensions

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