

Laser Systems for Geometric Alignment L-730/740 Series

Single-Axis/Multi-Axis Lasers for
Precision Alignment and Analysis



Properly Aligned Machinery And Process Lines Run Better, Last Longer

Why Laser Alignment?

Sooner or later everything goes out of alignment. Machinery and process lines, when properly aligned, run better, last longer, require less maintenance, lower production costs and improve productivity.

Hamar Laser systems offer significant advantages over traditional alignment devices:

- Up to 70% faster
- Simultaneous multi-axis alignment
- Ultra high accuracy and reduced setups
- Data displays automatically update with each adjustment

As the leader in laser alignment technology, we introduced the world's first flat laser plane in 1974, and the first automatically sweeping laser plane in 1985. Today, no one can match our innovative systems for accuracy, versatility, fast setup, ease of use and the immediate, real-time generation of alignment data.

Hamar's Geometric Alignment Capabilities

Flatness (Level)

- Tables and Separated Surfaces
- Machine Beds and Lines of Motion
- Machine Bed and Vertical Axis Twist
- Surface Plates
- Pitch and Roll Angular Measurements

Squareness

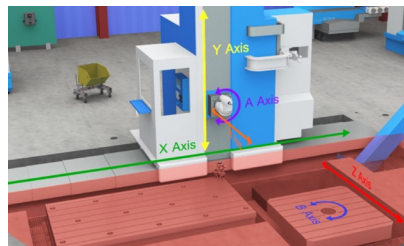
- Columns to Tables or Rails
- X to Y Axis, Z to X Axis and Z to Y Axis
- Rotary Axes to Main Machine Axes

Straightness

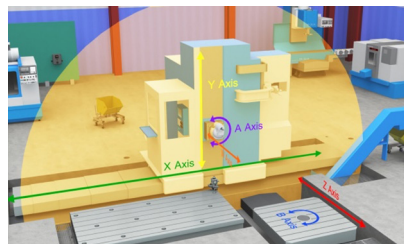
- Machine Beds and Lines of Motion
- Column Travel
- Yaw Angular Measurement
- Beams or Other Structures

Parallelism

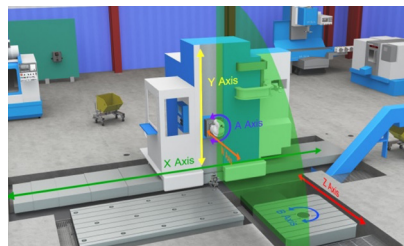
- Master Rail to Slave Rails on Gantries
- A, B, C & W Axes to Main Machine Axes
- Roll-to-Roll
- Platen to Platen, Ram to Ram



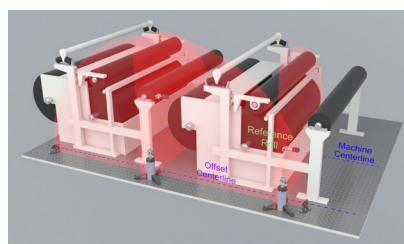
X, W, Z Flatness; W-Z Parallelism; B Rotation Parallelism



X Straightness; Y Flatness; Y-W Squareness; A Rotation Parallelism; Spindle Trimming



W, Y, Z Straightness; Y-X Squareness; W-X Squareness; Z-X Squareness; Z-W Squareness



Roll Parallelism

Case Histories

Machine Tool Service

"I want to give you some feedback on our first alignment with our new Hamar system [L-743 Ultra-Precision Triple Scan laser]. We used it to install and align a new bridge mill. It worked better than we expected and was so much easier than the levels [and granite squares] we've been using in the past. We leveled and squared the bridge mill with the L-743 in 1.5 days instead of the 4-5 days it would have taken using our old equipment! Based on this time savings, we think we will get a payback in 9-12 months!"

Saw Mill Operations

"Our new L-733 Precision Triple Scan® Laser has been working great in the saw mill. Our main application is to align machine centers. Our alignment consists of making sure our machine line is level, straight (in-line) and square to itself within .005".

"I like that the L-733 lets us shoot straight, elevation and square measurements in just one or two steps, and that it gives us real-time numbers. This is extremely helpful when having to move something back in line. I also like your R-1308 plug-in digital readout that attaches to the target for taking measurements, especially when we are moving something, because there is no delay. I can see the data right away. Overall the laser is a really great tool."

How Lasers Work: Principles of Operation

LASER is an acronym for Light Amplification by Stimulated Emission of Radiation. Lasers radiate in a single wavelength, in one direction and in a straight line, and are detected by position sensing detectors (PSDs) to convert the center of energy of the laser spot into a calibrated digital reading for output to a hand-held readout or computer interface.

Continuously sweeping laser planes are produced by bending a laser beam precisely 90° using an optical pentaprism. Hamar Laser applies a patented correction process to the pentaprisms to produce ultra-flat, continuously sweeping laser planes.

To measure flatness, straightness or squareness, laser planes are used as references and need to be aligned or “bucked in” to reference points, either on a surface or along a machine’s axis. Three necessary reference points make the laser plane parallel to a surface. Only two points are needed to measure the straightness of an axis or a machine way. The laser plane is bucked in to a surface or line of motion by

adjusting the pitch, roll or yaw of the laser base, tilting the laser plane until the target displays the same reading at each reference point.

The targets are then used to measure the deviation from the reference points up to 100 feet (30.5 meters) away from the laser. Data provided by the targets is automatically and instantly updated so the machine can be adjusted and the readout will show the movement. When it shows zero, it’s aligned!

Hamar’s multi-plane lasers all feature laser planes that are orthogonal to each other and thus can be used to measure the squareness between surfaces or machine axes. In most cases with one setup, the laser can measure the squareness between all the axes of the machine tool.

Hamar Laser’s laser alignment systems feature auto-rotating laser planes, unique 3-plane design reducing setups and ultra precision that is 4x more reliable than the competition.

Feature	Hamar Laser	European Geo. Laser Manufacturers	Interferometers (Linear Distance Laser)	Laser Trackers	Traditional Methods (Straight edge, levels, squares, etc.)
Automatically rotating laser planes?	Yes, 7 models	Yes for 2 mfgs. Others use “Point & Shoot technology”	No, laser line only	No laser line only	No
Can be used for alignment?	Yes	Yes	No, measurement only	No, measurement only	Yes, for some
Number of setups for machine tools	Usually 1-2	3-4	8+	1-3+	5+
Number of auto-rotating laser planes	3 with L-733/L-743	1	N/A – laser line only	N/A	N/A
Estimated Slower Alignment Time vs. L-733/L-743	1	40-50% slower	70-80% slower	40-50% slower	60-70% slower
Real-time target data?	Yes	Yes	No	No	Some, yes
Number of machine axes measurable with 1 setup	Up to 6	Up to 2	No	Up to 6 but at lower accuracy	Up to 2
Measure multiple machine axes simultaneously?	Yes, up to 6	Yes, up to 2	No	No	Yes, up to 2
Sensors used simultaneously	Up to 15 in PC software	1	1	N/A	N/A
Wireless data delivery?	Yes	1 - yes; the rest, no	No	N/A	N/A
Number of setups for flatness of a surface	1	1	8 setups	1	8 setups
Measurement resolution	0.00025 mm	0.001 mm	0.0001 mm	0.0001 mm	Varies up to 0.001 mm
Measure entire length of machine axis?	Yes	Yes, but very slowly and not to machine tool specs	Yes	Yes, but not to machine tool specs	Yes, but only for leveling
Measure parallelism of gantry mill rails?	Yes	Yes, but difficult setup and not to machine tool specs	No	Yes, but not to machine tool specs	Yes, if rails are <1 M apart but at low accuracy
Measure bed twist?	Yes	Yes, but very slowly and not to machine tool specs	No	Yes, but not to machine tool specs	Yes with difficulty and low accuracy
Accuracy of laser plane	0.0013 mm/m ±0.0025 mm	0.02-0.03 mm/m ±0.05 mm	n/a	0.02 mm + 0.005 mm/m	n/a
Squareness measurement capability	Up to 0.005 mm/m	Approx. 0.02 mm/m laser to beam	Not published	0.02 mm + 0.005 mm/m	Approx. 0.005 mm/m
Range of laser	30.5 m in radius	20-60 m in radius	40 m	40 m in radius	1 m
Display equipment for target data	Wireless PDA or PC interface – up to 15 targets simultaneously	Wired/wireless proprietary display box. Must transfer data to PC for analysis	Laptop only. No handheld device	Desktop computer only-no handheld device	n/a
Machine tool alignment software?	Yes. 3D Plot runs on Windows PC	Yes but limited	Yes, for linear compensation	No	No
Surface flatness software?	Yes. Plane5 runs on Windows PC	Yes. Runs on display box	Yes, but for lines only	Yes, 3D measurement	Yes
Measure roll angular error for each machine axis?	Yes, very easily	Possible, but difficult and time consuming	No	Possible, but difficult and time consuming	
Measure roll angular error of vertical axes?	Yes, very easily	Possible, but difficult and time consuming	No	No	
Cost factor index	1.0	0.75	1.8	3.0	0.1-0.25

L-730 Series Systems

High-Accuracy, Economically-Priced Laser Alignment Systems

The L-730 Series of single, dual and triple-plane laser systems adapts Hamar's metrology innovations to applications with less stringent alignment requirements like fabrication alignment, textile roll alignment, woodworking, and the water-jet/laser-cutting machine tool industries. You get the benefits of our high-accuracy laser systems, at a price that is easier to justify.

In addition, the L-730 Series lasers feature two target options:
 a) the A-1519-2.4ZB Single-Axis Target with 2.4GHz wireless communication (to PDA or PC), 1.3 in. x .4 in. (33 x 13 mm) PSD sensor, .00002 in. (0.0005 mm) resolution; and
 b) the A-1520-2.4ZB Single-Axis Target with 2.4GHz wireless communication (to PDA or PC), .4 in. x .4 in. (10 x 10 mm) PSD sensor, .00001 in. (0.00025 mm) resolution, both of which automatically download the target data into our S-1387 Machine-Tool Geometry or S-1388 Plane5 Surface Analysis software.



L-730 Precision Leveling Laser System



L-732 Precision Dual Scan® Laser



L-733 Precision Triple Scan® Laser

L-730 Series Features:

LASER PLANES One, two or three auto-rotating laser planes

ACCURACY Laser plane accurate to .00012 in./ft. or 0.01 mm/M

LASER PLANE ORTHOGONALITY up to .00012 in./ft. or 0.01 mm/M

SETUP Built-in, backlit level vials with .00012 in./ft. or 0.01 mm/M accuracy, Dimension measuring capability with target height-gage feature, 3-axis adjustment base for fast setups

L-740 Series Systems

Laser Alignment Systems for Complex, Ultra-Precise Applications

Our ultra-precision L-740 Series Laser Alignment Systems represent the pinnacle of achievement in laser alignment technology. With the L-743 Triple Scan laser, measure flatness, straightness, and squareness simultaneously, with one setup! Powerful machine geometry analysis software automatically downloads alignment data, corrects laser-slope and poor-reference-point errors and produces comprehensive alignment reports.

The system comes with 2 wireless target options:

- a) A-1519-2.4ZB Single-Axis Target with 2.4GHz wireless (to PDA or PC), 33x13 mm PSD, .00002" (0.0005 mm) resolution; and
- b) A-1520-2.4ZB Single-Axis Target with 2.4GHz wireless (to PDA or PC), 10x10 mm PSD, .00001" (0.00025 mm) resolution, Both targets automatically download the target data into our S-1387 Machine- Tool Geometry, S-1388 Plane5 Surface Analysis software or R-1355-2.4ZB Rugged PDA wireless readout, which can display up to 8 targets, 4 simultaneously. The A-910-2.4ZB Wireless PC radio receiver can download data from up to 99 targets at the same time.



L-740 Ultra-Precision Leveling Laser



L-741 Ultra-Precision Leveling Laser (with Plumb Beam)



L-742 Ultra-Precision Dual Scan® Laser



L-743 Ultra-Precision Triple Scan® Laser

L-740 Series Features:

LASER PLANES One, two or three auto-rotating laser planes

FLATNESS Laser plane flatness to .00003 in./ft or 0.0025 mm/M

LASER PLANE ORTHOGONALITY up to .00006 in./ft. or 0.005 mm/M

SETUP Built-in, backlit level vials with .00006 in./ft. or 0.005 mm/M accuracy, Dimension measuring capability with target height-gage feature, 3-axis adjustment base for fast setups

Which Laser System Is Right For You?

Laser System Options

Different applications require different levels of accuracy which is why we developed two basic families of laser alignment systems:

L-730 Series

Ideal for precision-level work but where tolerances are not as critical
(e.g. simple fabrication alignment checks, etc.)

L-740 Series

Ultra-precise, used for more demanding “mission critical” tasks
(e.g. aligning complex machine tool geometry, etc.)

Each family of lasers is available in single, dual and triple-plane versions. Many of the features and accessories within the two families are the same. The key difference is the degree of accuracy. For example, with the L-730 Series, laser plane flatness is accurate to 2 arc seconds (.00012 in./ft. or 0.01 mm/M). With the L-740 Series it's a more stringent 0.5 arcsec (.00003 in./ft. or 0.0025 mm/M).

As would be expected, the tighter the tolerances and greater the accuracy level, the higher the price. Accordingly, the L-730 Series is an economical choice perfectly suitable for a wide range of alignment applications that do not require the ultra precision attainable in our L-740 Series lasers.

L-730 & L-740 Series Features

- Live data output to measure, then fix misalignment in real time.
- Continuously sweeping laser planes with a range of 100 ft. (30.5 m) in radius.
- Built-in squareness measuring capability of up to .00006 in./ft. or 0.005 mm/M (multi-plane lasers only).
- Multiple targets displayed simultaneously for faster alignment and setup.
- Collect flatness and straightness data simultaneously.
- Work up to 70% faster than interferometers, theodolites, transits and other conventional methods.
- Easy to learn how to use, simple to operate.
- Able to collect complete geometry data on most machines in under 90 minutes.

	Precision Series			Ultra Precision Series			
	L-730	L-732	L-733	L-740	L-741	L-742	L-743
# of Laser Planes	1	2	3	1	1	2	3
Measurement Tasks							
Flatness/Leveling	•	•	•	•	•	•	•
Machine Bed Flatness	•	•	•	•	•	•	•
Squareness		•	•		•	•	•
Straightness	•	•	•	•	•	•	•
Parallelism	•	•	•	•	•	•	•
Rail Parallelism		•	•			•	•
Typical Applications							
Machine Tool Geometry					•	•	•
Roll Alignment		•	•			•	•
Injection Mold Machine		•	•			•	•
Aerospace Assembly	•	•	•	•	•	•	•
Surface Plates				•	•	•	•
Large-Part Alignment	•	•	•	•	•	•	•
Fabrication Alignment/Equip.	•	•	•				
Alignment Capabilities							
Laser Plane Flatness	.00012 in./ft. or 0.01 mm/M			.00003 in./ft. or 0.0025 mm/M			
Beam Plane Squareness	n/a	.00012 in./ft. or 0.01 mm/M		n/a	up to .00006 in./ft. or 0.005 mm/M		
Adjustment Parameters							
Coarse Adjustment Range	± 3.0°			± 3.0°			
Fine Adjustment Range	n/a			± .03°			
Course Adjustment Resolution	.010 in. (0.25 mm) in 100 ft. (30.5 m)			.010 in. (0.25 mm) in 100 ft. (30.5 m)			
Fine Adjustment Resolution	n/a			.001 in. (0.025 mm) in 100 ft. (30.5 m)			
Target/Readout Options							
Target:							
A-1519 & A-1520 Wireless	std.	std.	std.	std.	std.	std.	std.
Recommended Qty	1	2-3	3-5	1	1	2-3	3-5
Readout:							
Single-Axis Display	std.	std.	std.	std.	std.	std.	std.
Wireless	opt.	std.	std.	std.	std.	std.	std.
Price Range	\$	\$\$	\$\$\$	\$\$	\$\$	\$\$\$	\$\$\$\$

Powerful Data Analysis Software

Hamar's alignment software, combined with newly-designed wireless interfaces, makes collecting and analyzing alignment data fast and easy. Software is Windows based, and provides large, readable color graphics. Shown below is just a sampling of typical data screens.

Machine Tool Geometry Software

Machine Catalog

Choose from 6 typical machine configurations.

Axis Setup Screen

Set up each line of motion for number of points to be measured.

Data Taking Screen

Records up to 10 bi-directional runs for each axis with an auto-plotting graph.

Graph Screen

Shows axis straightness TIRs, parallelism & squareness and straightness graphs for each axis.

Plane5 Flatness Software

Projects Setup Screen

Configure shape and number of points for up to 9 surfaces.

Plane5 — Data Taking Screen

Data grid where the data points are recorded with up to 5 real-time target displays

Plane5 — Plot View Screen

3-D plot of surface flatness of 3 or more surfaces.

Plane5 — Report Screen

Complete report showing flatness, squareness and parallelism of all surfaces measured.

Accessories



A-1519/A-1520 Wireless Targets
2.4GHz Wireless data transmission with 2 resolution options and large measuring range.



R-1357-2.4ZB Rugged PDA
Readout with Read15 Software and 2.4GHz Wireless communication displays up to 5 targets.



A-910-2.4ZB USB 2.4GHz Radio
Receiver for tablets and laptops.



L-106 Instrument Stand
Lightweight, variable-height stands for flexible setup.

A Hamar Laser System For Every Alignment Need



Machine Tool

- Floor and Spar Mills
- Gantries
- Horizontal and Vertical Boring Mills
- Horizontal and Vertical Machining
- Centers
- Large-Lathe Beds
- Machine Tool Assembly and Calibration
- Roll-Forming Machines
- Transfer-Line Wing Bases
- Vertical and Horizontal Presses
- Vertical-Turning Lathes



Plastics

- Blown-Film Lines
- Film Lines
- Injection Molding Machines



Leveling

- Machine Bed Leveling
- Split Joints On Steam Turbines

Roll Alignment

- Aluminum Mills
- Continuous Casting Machines
- Paper Mills
- Printing Presses
- Steel Mills
- Textile Mills



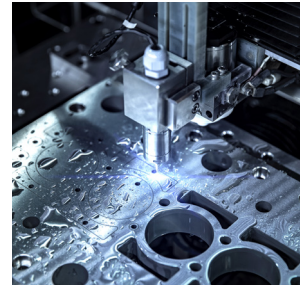
Quality Control

- Calibration of Large Fixtures
- Checking Flatness when
- Large-Part Flatness, Straightness
- Surface Plate Calibration and Jigs and Squareness Checks
- Scraping Machine Rails



Fabricating Machinery

- Laser-Cutting Machines
- Routers
- Saw Mills
- Tube-Bending Machines
- Water-Jet Machines
- Woodworking Machines



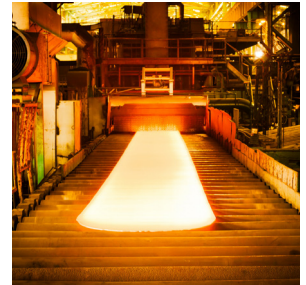
Fabrication Alignment

- Agricultural Machinery Assembly
- Large Construction Machinery Assembly
- Locomotive Assembly
- Truck Bed Assembly
- Wind Turbine Flange Parallelism



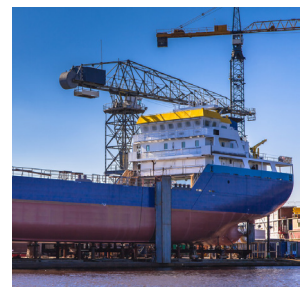
Aerospace

- Aircraft Interior Alignment (Storage Bins, Gallies, etc.)
- Body-to-Body Join Assembly
- Floor Beam Alignment
- Jig/Tooling Calibration and Leveling
- Seat-Track Alignment
- Wing-to-Body Joining Alignment



Ship Building

- Elevator Shaft Alignment
- Gun-Bearing Alignment
- LNG Tanker Hull Construction
- Section Alignment and Layout

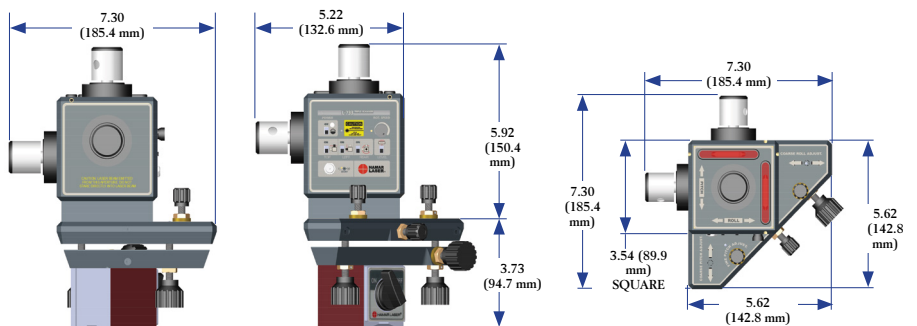


L-733/L-743 Triple Scan® Lasers

Laser Type	Class II visible diode, 635 nm wavelength (Class I in scanning mode); 0.160 in. (4.06 mm) beam diameter
Beam Power	<0.9 mW for each beam
Laser Plane Flatness	<p><u>L-733:</u></p> <ul style="list-style-type: none"> • 180/360° Sweep: 2.0 arc sec (0.00012 in/ft or 0.01 mm/m), plus translational error of ±.0003 in. (0.008 mm) • 90° Sweep: 1 arc sec (.00006 in/ft or 0.005 mm/m), plus translational error of ±.00015 in. (0.004 mm). <p><u>L-743:</u></p> <ul style="list-style-type: none"> • 180/360° Sweep: 0.5 arc sec (.00003 in/ft or 0.0025 mm/m), plus translational error of ±.0001 in. (0.0025 mm) • 90° Sweep: 0.25 arc sec (.000015 in/ft or 0.0013 mm/m) plus translational error of ±.0001 in (0.0025 mm).
Plane Squareness	<p><u>L-733:</u></p> <ul style="list-style-type: none"> • Top-to-Left and Top-to-Back plane: 2 arc secs (.00012 in/ft or 0.01 mm/m); • Left-to-Back Plane: 3 arc secs (.00018 in/ft or 0.015 mm/m) <p><u>L-743:</u></p> <ul style="list-style-type: none"> • Top-to-Left and Top-to-Back plane: 1 arc sec (.00006 in/ft or 0.005 mm/m); • Left to Back plane: 3 arc secs (.00018 in/ft or 0.015 mm/m);
Operating Range	100 feet (30.5 m) in radius
Operating Modes	3 beams or 1, 2 or 3 continuously rotating laser planes in any combination, individually switched
Operating Temperature	35° F to 95° F (2° C to 35° C)
Power Supply	<ul style="list-style-type: none"> • Lithium Polymer rechargeable battery pack with up to 16 hours battery life for all 3 planes • 115-240V AC adapter
Course Adjustment Range	± 3 degrees (±.62 in/ft or 51.6 mm/m)
Fine Adjustment Range	± 0.3 degrees (±.062 in/ft or 0.51 mm/m). L-743 only.
Coarse Adjustment Resolution	.010 in. per 100 feet (0.25 mm in 30.5 meters)
Fine Adjustment Resolution	.001 in. per 100 feet (0.025 mm in 30.5 m). L-743 only.
Weight	Laser: 5.0 lbs. (2.3 kg) Base: 4.8 lbs. (2.2 kg)
Material	Laser: Aluminum and stainless steel Base: Aluminum

A-1519/A-1520 Wireless Targets

Resolution	A-1519-2.4ZB: .00002 in. (0.0005 mm) A-1520-2.4ZB: .00001 in. (0.00025 mm)
Linearized Accuracy	<p>A-1519-2.4ZB: ±.00015 in. (±0.0038 mm) over ± .55 in. (±14 mm) of PSD</p> <p>A-1520-2.4ZB: ±.00006 in. (±0.0015 mm) over ± .1 in. (2.5 mm) of PSD</p>
Detector Size/Type	<p>A-1519-2.4ZB: 2-Axis PSD 1.3x.51 in. (33x13 mm)</p> <p>A-1520-2.4ZB: 2-Axis PSD .39x.39 in. (10x10 mm)</p>
Operating Range	100 feet (30.5 m) from laser to target
Angle Acceptance Range	±10 degrees from pointing directly at laser
Auto On/Off Power	Targets automatically turn on when the laser beam sweeps across the target and turn off when the laser stops sweeping.
Battery Life	11.5 hours continuous duty
Operating Temperature	5° F to 140° F (-15° C to 60° C)
Power Supply	7.5-12vDC, 500mA
Size	2.00 x 4.11x 1.75 in. (50.8x78.5x105.2 mm)
Weight	13.5 oz. (0.38 kg)
Wireless Range	133 feet (40 m)
Magnetic Base Size	2.00x 3.09x 4.14 in. (50.8 x78.5 x105.2 mm)
Magnetic Base Weight	2.78 lb. (1.26 kg)
Radio Frequency	2.4 GHz, DSSS (Direct Sequence Spread Spectrum)
Certification	Agency Certifications for the XBee® 802.15.4 Series 1 FCC (United States of America) Certification Contains FCC ID: OUR-XBEE IC (Industry Canada) Certification Contains Model XBee 802.14.4 IC:4214A-XBEE Complies with ETSI (Europe), C-TICK (Australia) and Telec (Japan)



Hamar Laser Instruments, Inc.
5 Ye Olde Road Danbury, CT 06810
Fax: 203.730.4611 Int'l: +1.203.730.4600
sales@hamarlaser.com www.hamarlaser.com

