



**Model LTD-10
3-Element Trap Detector**

S/N LTD-10-134

User Manual



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Warranty

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1 Overview of Trap Detector

L-1 Trap Detectors are high efficiency, standards grade detectors capable of measurements with 0.1% uncertainty when uncalibrated and 0.01% uncertainty when calibrated against an absolute standard such as the L-1 CryoRad III cryogenic radiometer. A low noise, high gain precision transimpedance amplifier such as the L-1 TIA enables such low uncertainty measurements.

The LTD-10 consists of 3 Hamamatsu 1337 windowless silicon photodiodes arranged in a retroreflecting, 'trap', configuration. This configuration greatly enhances the overall efficiency of the detector to well beyond that of a single silicon photodiode. An uncoated silicon photodiode has an index of refraction of approximately 3.5 and reflects approximately 30% of incident light. By increasing the number of detectors and adding their photocurrents, the number of reflections increases and the quantum efficiency of the device is enhanced. By increasing the number of reflections to five, the total light lost due to Fresnel reflections is decreased to 0.24% which, in turn, corresponds to an effective quantum efficiency of 99.76% for the entire detector. These detectors are also highly uniform and exhibit a nonuniformity of 0.02% peak to valley when scanned with a 250 micrometer spot size.

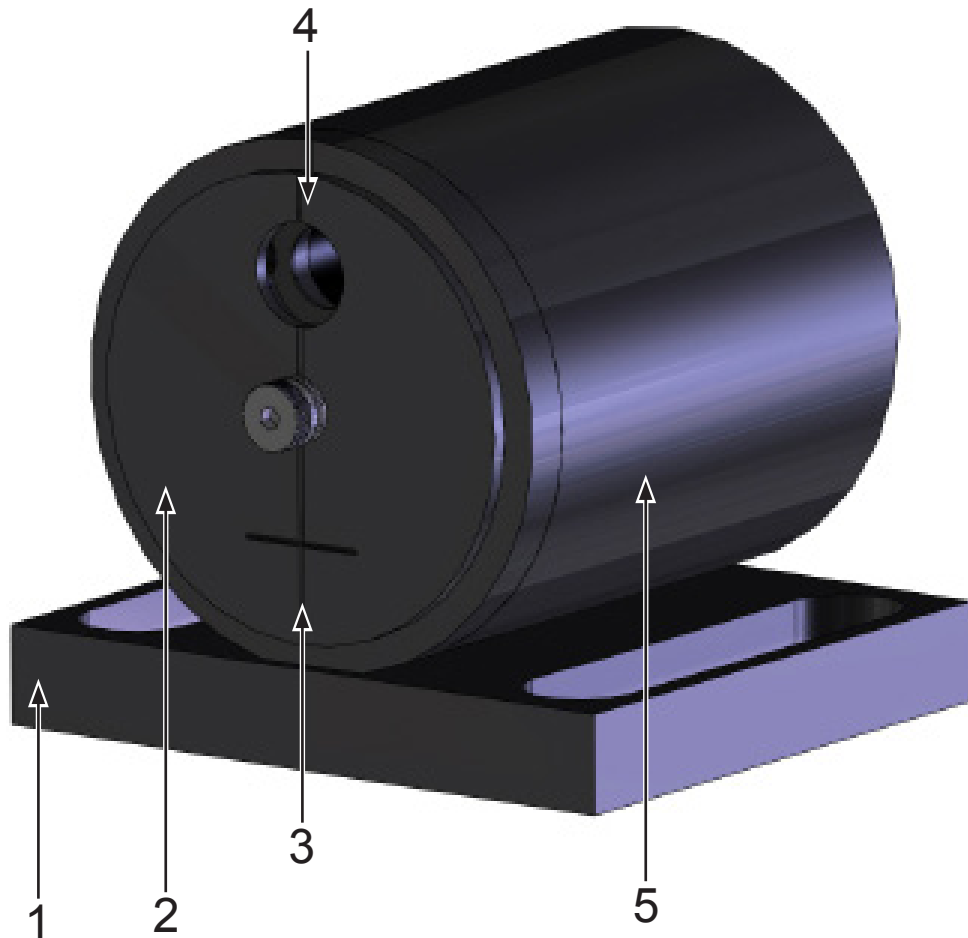
LTD-10 trap detectors have a 7mm diameter input opening for power level measurements. Radiance measurements are enabled by the installation of precision apertures over the front face of the detector. This operation is able to be performed by the user and is as simple as tightening two button head cap screws (2-56) to secure the aperture into place. Two tapped holes (1x 4-40 & 1x 8-32) populate the underside of the detectors for mounting to a post or baseplate, both of which are included your purchase of an LTD-10. To maintain a clean environment within the detector housing while the aperture is open and the detectors are exposed, a purge fitting is installed on the rear of the detector for purging the detector with pure, dry nitrogen at a flow rate of around 0.5 liters per minute.

A calibrated LTD-10 trap detector enables simple and highly accurate irradiance, radiance, and power level measurements. Owning an LTD-10 means your lab has the capability to make calibrated transfer standard optical measurements with a detector having a compact form factor and fast response time.

2 Parts List

•	Trap Detector	1 ea
•	Front Cover	1 ea
•	Base	1 ea
•	Base Screw Kit	1 ea
	- #4-40 X 7/16" SHCS	1 ea
	- #8-32 X 5/16" SHCS	1 ea
•	Mounting Post	1 ea
	- #8-32 X 1/2" Set Screw (installed)	1 ea
•	Hex Key Set	1 ea
	- 9/64"	1 ea
	- 3/32"	1 ea
	- 5/64"	1 ea
	- 1/16"	1 ea
•	Pelican 1120 Storage Case	1 ea
•	Spare Parts Kit:	1 ea
	- #8-32 X 5/16" SHCS	1 ea
	- #4-40 X 7/16" SHCS	1 ea
	- #2-56 X 1/8" Button Head Socket Screw	2 ea

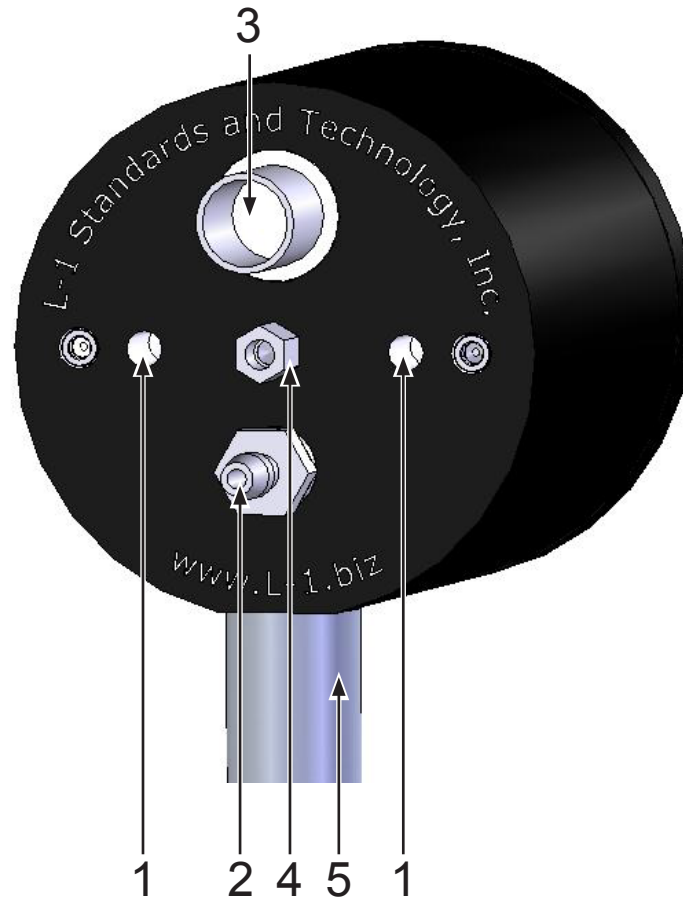
3 Identification - Front (shown with base)



- 1 Base
- 2 Aperture Wheel
- 3 Alignment Cross/Shutter

- 4 10 mm Opening
- 5 Housing

3 Identification - Rear (shown with mounting post)



- | | | | |
|---|-------------------------------|---|----------------------------------|
| 1 | Optional #8-32 Mounting Holes | 4 | Grounding Post |
| 2 | Purge Fitting | 5 | Optical Mounting Post (0.5" dia) |
| 3 | Detector Signal BNC | | |

4 Making Electrical Connection

NOTE

Turn off the transimpedance amplifier before starting the below steps.

- 1 Connect a BNC cable between Model LTD-10 trap detector and a standards grade current to voltage transimpedance amplifier. L-1's Model AMP-02 transimpedance amplifier is suggested and has gain uncertainties of 0.01 % and temperature coefficients of 1 to 10 ppm/C. A standards grade transimpedance amplifier minimizes drift and maintains the highest accuracy.
- 2 Connect the transimpedance amplifier output to a 6.5 digit voltmeter to easily monitor and maintain electrical calibration.
- 3 In some applications, it is advantageous to ground the trap detector to reduce noise. If desired, connect the grounding post to either the optical table, optical supports, or chassis of the transimpedance amplifier.

5 Alignment

NOTE

Do not exceed 10 mW total optical power or 500 mW/cm² incident upon the trap detector or damage to the detectors may result.

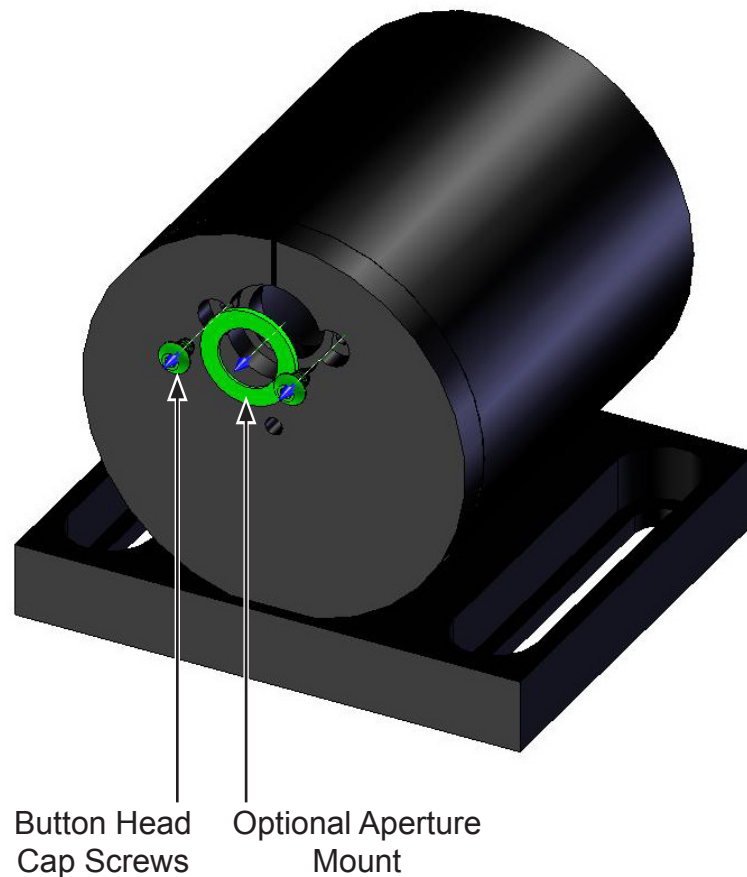
- 1 The maximum acceptance angle is:
 - Beam focused at the aperture wheel: 6.2 degrees (100 mrad) Full Angle
- 2 Start with the aperture wheel in the alignment cross/shutter position over the trap entrance with the top of the cross aligned with the mark on the front of the trap detector housing.
- 3 Align incident beam so that it is centered on alignment cross.
- 4 Align front face of trap detector so that it is normal to the incident beam. Verify proper alignment by placing a flat mirror (not provided) against the aperture wheel at the alignment cross position and adjust trap detector until the beam is retroreflected upon itself.
- 5 To adjust the aperture wheel position, gently move the outside edge of the wheel with your thumb until you reach the desired position. If necessary, slightly loosen the screw holding the wheel in place to move the aperture wheel and then retighten.
- 6 The 10 mm opening and the alignment cross both have a line extending to the edge of the aperture wheel that should be aligned with the mark on the front of the trap detector housing when in use.

6 Optional Aperture Mount

The trap detector has an area in front of the entrance where an aperture can be installed (see diagram below). To install an aperture in this area:

- 1 Remove the aperture wheel and the two button head socket cap screws holding the aperture mount in place.
- 2 Remove the aperture mount from the trap detector entrance and permanently install an aperture in the recess of the aperture mount.
- 3 Replace the aperture mount, the button head cap screws and the aperture wheel before use.

The aperture wheel is not shown in the below diagram.



7 Cleaning and Maintenance

NOTE

Do not clean the detectors located inside the housing. The detectors are windowless with exposed silicon surfaces and delicate gold wire bonds that are easily damaged.

- Every attempt should be made to limit exposure to dust and contaminants. Use the provided front cover at all times when not in use.
- A purge fitting is provided on the rear of the detector housing. Dry, filtered nitrogen gas can be attached to the purge fitting and allowed to flow at a rate no more than 0.5 liters/minute (1 SCFH) to prevent dust from entering the detector housing.
- The outside of the detector housing can be cleaned with a low particle producing cleanroom wipe (such as Texwipe® BlueWipe®) dampened with a small amount of ethanol. Do not apply any liquid directly onto the housing as it may seep inside and damage the detectors.

8 General Specifications

NOTE

Do not exceed 10 mW total optical power or 500 mW/cm² incident upon the trap detector or damage to the detectors may result.

Detectors:	Hamamatsu 1337 Windowless Silicon Photodiodes 10 mm square
Arrangement:	Three detectors arranged in a retroreflecting design providing a total of five reflections from the silicon diode detectors. Detectors are oriented so as to minimize polarization sensitivity.
Max Acceptance Angle (Full):	Beam focused at aperture wheel: 6.2° (100 mrad)
Linearity:	Detector responsivity guaranteed to be linear up to 500 µW over the spectral range of 450 nm to 950 nm.
Vacuum Compatibility:	Can be used in clean, high vacuum environments when none of the following are used (due to the non-vented screws): base, mounting post, or optional aperture mount.
Weight:	59.7 grams (without base or mounting post)
Storage Environment:	0° C to 50° C Up to 80 % relative humidity, non-condensing
Operating Environment:	15° C to 40° C Up to 80 % relative humidity, non-condensing
Wavelength Range:	450 nm – 950 nm
Warranty:	All goods manufactured by L-1 shall be free from defects in material and workmanship for a period of one (1) year from the date of delivery. The purchaser is responsible for all transportation costs to and from the factory for repair. Resale products shall carry only the warranty offered by the original manufacturer.

9 Characterization Equation

In general, the spectral responsivity **R** for a photon detector can be given by:

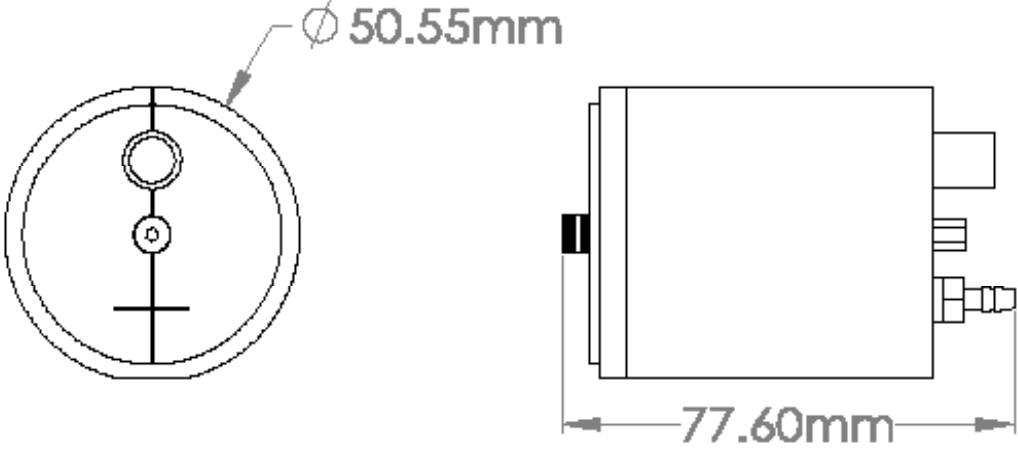
$$R = \frac{\eta q \lambda}{hc}$$

In energy units, where:

- η = quantum efficiency
- q = electron charge
- λ = vacuum wavelength
- h = Planck's constant
- c = velocity of light

See Appendix A for responsivity data.

10 Dimensions



A Appendix: Responsivity Data

The spectral responsivity R for LTD-10 trap detectors is:

$$R = \frac{0.9965 \lambda}{1239.84} \text{ A W}^{-1}$$

where λ is the vacuum wavelength in nm.

The following table lists the spectral power responsivity.

—	Power Responsivity	
A (nm)	(A W ⁻¹)	
—	—	Uncertainty (U=2)
450	0.3817	0.5%
475	0.3818	0.5%
500	0.4019	0.5%
525	0.4220	0.5%
550	0.4421	0.5%
575	0.4621	0.5%
600	0.4822	0.5%
625	0.5023	0.5%
650	0.5224	0.5%
675	0.5425	0.5%
700	0.5828	0.5%
725	0.5827	0.5%
750	0.6028	0.5%
775	0.6229	0.5%
800	0.6430	0.5%
825	0.6631	0.5%
850	0.6832	0.5%
875	0.7033	0.5%
900	0.7234	0.5%
925	0.7435	0.5%
950	0.7635	0.5%