

Instructions LASNIX Infrared Attenuator  
Models 110, 111, 102, 204

1. **HANDLING.** LASNIX infrared attenuators operate on light diffraction. The active optical elements consist of very thin, structured metal membranes.

**WARNING:**

The metal membranes are mechanically fragile.

Do not touch or blow air. Do not use cleaning liquids.

2. **INSTALLATION.** Either end of the attenuator can serve for radiation input. The attenuator function does not depend on the angular alignment within the clear aperture.

3. **WATER COOLING.** Connect cooling water when you apply infrared power exceeding 30 W c.w. (or quasi-c.w.). The actual flow of water, at a rate of roughly 0.5 liter/min., is necessary only when one or more attenuator elements are exposed to the beam (of maximal power) for longer than 5 s.

4. **OPERATION.** Attenuation is instantly achieved by flipping in one or more attenuator elements. The attenuation of individual elements (in decibels) is additive.

5. **UNITS.** The following table may facilitate the interconversion of units. We have  $T = 10^{-A/10} = 1/F$ , where T is the power transmittance, A is the attenuation in decibels (db), and F is the attenuation factor:

A(db)	T(%)	F	A(db)	T(%)	F
0	100	1.00	6	25.1	3.98
0.01	99.97	1.0023	7	20.0	5.01
0.1	97.7	1.023	8	15.9	6.31
1	79.4	1.26	9	12.6	7.94
2	63.1	1.59	10	10	10
3	50.1	2.00	20	1.0	100
4	39.8	2.51	30	0.1	1000
5	31.6	3.16	40	0.01	10000

## 6. POWER HANDLING.

The maximum power (c.w. or quasi-c.w.) is 200 W, and the maximum pulse energy density is 20 J/cm<sup>2</sup>. Exceptions are 300 W and 20 J/cm<sup>2</sup> for model 204; 20 W and 1 J/cm<sup>2</sup> for models 110 and 111; and 70 W and 20 J/cm<sup>2</sup> for model 102-L.

**WARNING:** The specified power handling limits apply to relatively wide beams filling at least half the aperture area in a smooth manner. This is the case, for example, with a near fundamental mode having a  $1/e^2$  diameter of at least about 2/3 of the aperture diameter.

### USING NARROW BEAMS:

For narrow beams the power limits scale down *linearly* with the beam diameter.

This important point may be illustrated by an example: while model 102 accomodates a 200 W CO<sub>2</sub> laser beam with a mode diameter of 12 mm, this limit reduces to 100 W when the mode diameter is reduced to 6 mm.

### USING SINGLE PULSES:

The specified limit of pulse energy density applies to single short pulses provided the intensity does not exceed the plasma breakdown threshold. The latter is near 500 MW/cm<sup>2</sup>.

### USING REPETITIVE PULSES:

The specified quasi-c.w. power limit applies to repetitively pulsed beams, with the added requirement that each pulse is within the specified pulse energy density limit.

Thus for example, model 102 accomodates at a repetition rate of 200 pps pulse energies up to 1 J.

## 7. HAZARD FROM DAMAGED ELEMENT.

In a first stage of permanent damage the metal membrane becomes distorted. This change does not appreciably alter the attenuation properties of the element. However, it is possible that in this situation part of the input radiation is reflected out of the attenuator, in a near-backward direction towards the laser.