

## ***Infrared viewer FAQs***

Answers to frequently asked questions regarding our infrared viewing devices

### **How does an infrared viewer work?**

Power Technology, Inc.'s infrared viewers work by focusing the infrared light reflected by or emitted from a chosen subject onto the image tube. An electron image is generated in accordance with the incident intensity and the S-1 spectral sensitivity of the photocathode material. The IR viewer is powered via push-button switch. When powered, an internal 3V battery-based power supply generates the 16 to 18kV required to accelerate the electron image into the output phosphor screen. The fluorescent green light output (550nm) is observed via an adjustable eyepiece lens.

### **What are common applications for an infrared viewer?**

<b>Laser alignment &amp; safety</b>	Near-IR viewers are ideal for applications involving the alignment of infrared laser beams or of optical components in near-IR systems.
<b>Forensics &amp; art restoration</b>	Substances have different transmission and reflection properties when viewed under near-infrared illumination as compared to visible illumination. These near-IR viewers can be used to examine documents, records, engravings, paintings, etc. for hidden differences. (Please note that IR filters and IR light sources are required for this application.)
<b>Ultraviolet applications</b>	Excimer/UV laser applications, UV spectral applications, UV lithography, fingerprint detection and analysis, liquid crystal display annealing
<b>Semiconductor inspection</b>	With the addition of a microscope adapter, an IR viewer can be used to view through the surface of silicon and gallium arsenide wafers.
<b>Photo processing</b>	Near-IR viewing devices have become invaluable tools for ensuring error-free processing of color sensitive photographic materials.
<b>Thermal imaging</b>	IR viewers can be used to image the radiation of objects above 600 degrees Centigrade (e.g., kilns, furnaces, and solder pots). Objects in this temperature range (and hotter) emit enough infrared radiation in the 0.8 to 1.7 micron wavelength range to be imaged by the viewer detector.
<b>Other applications</b>	Surveillance and investigation in botany, biophysics, medicine (with addition of IR filters and IR light sources). Infrared microscopy, infrared luminescence (by ultraviolet stimulation), fluorescence. Optical fiber alignment, telecommunications.

### **What can you tell me about photosensitivity?**

The minimum detectable signal for a near-infrared viewer depends on the following.

- Power density
- Wavelength of incident radiation (nm)
- Effective aperture of the objective lens
- Distance between the spot and the viewer
- Reflectivity of the diffusing surface
- Time duration of the signal (pulsed or continuous)
- Sensitivity of the human eye or device used in viewing the output of the IR viewer



The minimum power densities required to view an IR beam from a distance of one meter are approximately

- 20 $\mu$ W/cm<sup>2</sup> for a 1.06 $\mu$ m
- 500 $\mu$ W/cm<sup>2</sup> for a 1.3 $\mu$ m

One of our IRV1 or IRV2 infrared viewers with a sensitivity of 350 to 2000nm has the photocathode s-1+ type that contains an increased concentration of oxygen that, in turn, increases sensitivity of the photocathode and shifts it in the infrared area. The IR viewer can be used to view a 2.0 $\mu$ m laser beam at a minimum power density of 2W/cm<sup>2</sup>. When operated in the 1500 to 2000nm range, these viewers have a low spectral response. Therefore, observations can be performed when the following requirements are met.

1. Use an IR cut-off filter or interference filter, and darken the room to reduce the external background.
2. Use a metallic surface for viewing the laser infrared reflective radiation, as any paper for these purposes will absorb infrared radiation.

### **How do I determine the minimum power density required to yield a detectable signal?**

To determine the minimum power density in mW/cm<sup>2</sup> required to yield a detectable signal, use the following procedure. Divide the laser power in milliWatts by the area of the beam at the distance to be measured. For an elliptical beam, the area is equal to  $2/3 \times w \times h$ . For example, if  $h = 10\text{mm}$  and  $w = 40\text{mm}$ , then the area of the beam =  $2/3 \times 10\text{mm} \times 40\text{mm} = 2/3 \times 400\text{mm}^2 = 266.7\text{mm}^2$ . To convert to  $\text{cm}^2$ , divide by 100. Therefore, the area = approximately  $2.7\text{cm}^2$ . To determine the required power density, divide the laser power by the  $2.7\text{cm}^2$  figure. For example, if the laser output is 5mW, the required power density will be  $5\text{mW}/2.7\text{cm}^2$ , or  $1.85\text{mW}/\text{cm}^2$ .

For a circular beam, area is equal to  $\pi \times r^2$ , where  $r$  = the radius of the beam. For example, if both the height and width of a beam at the distance to be measured are 5mm, then the area of a beam at this distance =  $3.14 \times 2.5\text{mm}^2$  (half the diameter, squared) =  $3.14 \times 6.25\text{mm} = 19.6\text{mm}^2$ . Divide by 100 to convert to  $\text{cm}^2$ , so the area = approximately  $0.19\text{cm}^2$ . Now divide laser power by  $0.19\text{cm}^2$  to determine the required power density. For example, if the laser output is 5mW, the required power density will be  $5\text{mW}/0.19\text{cm}^2$ , or  $26.31\text{mW}/\text{cm}^2$ .

### **Can a CCD camera be used to view near-IR radiation as well?**

Certain models of CCD cameras can be used to observe near-infrared radiation at wavelengths up to about 1.1 $\mu$ m. However, because these cameras are designed specifically for optimum performance in the visible wavelength range, they do not perform as well in the near-infrared range. Image bleeding or blooming, low sensitivity, and low contrast can result when used to observe near-IR radiation.

### **Can an IR viewer be used to view mid-air infrared laser beams?**

No. IR viewers cannot be used to view infrared laser beams in mid-air. However, as is the case with a flashlight beam, a laser beam observed via IR viewer can become partially visible if dust particles are in the beam path. As a general rule, IR viewers can be used to see the projection of the infrared beam spot on a flat diffusing surface, such as a white card or metallic surface.

### **Why am I seeing small black spots on the image produced by my viewer?**

Small black spots can be found for several reasons. Because the image converter tube uses high voltage singles, the front and back faceplates often attract dust, which you can easily remove via cotton swab or lens cleaning cloth. In addition, because of the manufacturing process involved in producing all similar electro-optic devices, very small cosmetic blemishes can sometimes appear inside the image converter tube. These black spots do not affect the performance or reliability of the near-infrared viewer.

