Glossary of Terms Used in This Catalog

Dark Resistance (Rd)
This is the resistance of a photoconductive device (PbS, PbSe, MCT etc.) in the dark state.

Dark Current (I_D)
The dark current is the small current which flows when a reverse voltage is applied to a photovoltaic detector (Ge, InAs, InSb etc.) under dark conditions. This is a factor determining the lower limit of light detection.

Position Detection Error
This is a characteristic measure for the PSD (position sensitive detector). It is a detection error in a range of 75% of that from the center of a PSD to the edge, and is defined as follows.

$$\text{Error}\ (\mu m) = \frac{L}{2} \times \frac{I_1 - I_2}{I_1 - I_2} - \text{incident position}\ (\mu m)$$

where L is the active area length and I_1 and I_2 are output currents.

NEP (Noise Equivalent Power)
This is the radiant power that produces a signal-to-noise ratio of 1 at the detector output. In this catalog, the NEP value at the peak wavelength and a bandwidth of 1Hz is listed. The NEP is given by

$$NEP = \frac{\text{Noise Current}\ (A/Hz^{1/2})}{\text{Radiant Responsivity at}\ \lambda p\ (A/W)} \quad [W/Hz^{1/2}]$$

In actual detector operation, the detection limit must be taken into account along with other factors such as the supply voltage, noise frequency bandwidth and signal processing. This means that the lower detection limit will be larger than the NEP obtained from the noise current under dark conditions.

FOV (Field of View)
The field of view is the angular measure of the volume of space within which the systems can respond to the presence of a target. It is related to the background radiation noise and greatly influences the value of D*.

Offset Voltage
This is a DC output voltage of an amplifier when the input is zero.

Excess Noise Figure
One of the parameters that determine the excess noise factor, F, in the multiplication process of an avalanche photodiode is given by

$$F=M^x$$

where M is the multiplication factor or gain and x is the excess noise figure. The shot noise current, i_n, of an avalanche photodiode is also dependent on the gain and the excess noise figure given as follows:

$$i_n^2 = 2q\ Ip\ M^{2+x}B$$

where q is the elementary charge, Ip is the photocurrent and B is the bandwidth.

Responsivity
1) Photo Sensitivity (S)
This is the detector output divided by the incident radiant power at a given wavelength. Usually expressed in A/V for photoconductive or pyroelectric detectors and in A/W for photovoltaic detectors. For photon drag detectors, this is represented as the output voltage with respect to incident pulsed energy of 1kW radiated from a CO_2 laser.
2) Responsivity
This term also expresses the output voltage from a photoconductive or pyroelectric detector when operated under certain conditions using a 500K blackbody light source. Photovoltaic Detector (Photodiode) A semiconductor detector that converts radiant energy into current or voltage when radiant flux enters its PN junction. Photovoltaic detectors include Ge, InGaAs, InAs and InSb detectors.

Photoconductive Detector
A semiconductor detector whose resistance decreases with increase in light intensity. Photoconductive detectors include PbS, PbSe and MCT detectors.

Photovoltaic Detector (Photodiode)
A semiconductor detector that convers radiant energy into current or voltage when radiant flux enters its PN junction. Photovoltaic detectors include Ge, InGaAs, InAs and InSb detectors.

Breakdown Voltage (V_{BR})
Increasing a reverse voltage applied to an avalanche photodiode triggers the internal multiplication process; however, breakdown occurs at a certain voltage level. Therefore, it must be operated with a reverse voltage that is somewhat lower than this breakdown voltage.

Peak wavelength (λ p)
This is the wavelength at which the responsivity of the detector is at maximum.

Maximum Reverse Voltage (V_R Max), Maximum Supply Voltage
Applying a reverse voltage to Ge and Si photodiodes (or applying a voltage to photoconductive cells) at a certain level can cause breakdown and severe deterioration of detector performance. The maximum reverse voltage (or maximum supply voltage) is the limit that can be applied to the detector.

Maximum Allowable Current
An MCT (HgCdTe) photoconductive detector is operated using a constant-current power supply. When the supply current is higher than the maximum allowable current, the detector performance may deteriorate, therefore, excessive current must be avoided.

Cutoff Frequency (fc)
This is the measure of a detector response to sine-wave incident light. It is defined as the frequency at which the output current decreases by 3dB from the low frequency response.

Rise Time (tr)
This is the measure of a detector time response to a stepped light input, and defined as the time required for transition from 10% to 90% (or 0 to 63%) of the output level. The light sources used are GaAs LED (0.92 μ m), laser diode (1.3 μ m), etc.

Terminal Capacitance (Ct)
In a photovoltaic detector, an effective capacitor is formed at the P-N junction. This capacitance is termed the junction capacitance and is a major factor in determining the response speed of the detector. In this catalog, this capacitance is measured between the lead terminals of the package including the package stray capacitance.

Short Circuit Current (Isc)
This is an indication of the responsivity of a photovoltaic detector. It refers to a current which flows when a detector with zero load resistance is illuminated by a tungsten lamp (2856K, 100 lux). The Isc value is proportional to the active area.

Cutoff Wavelength (λ c)
This represents the long wavelength limit of spectral response and in this catalog is listed as the wavelength at which the responsivity becomes 10% of the value at the peak wavelength.

Chopping Frequency
In the measurement of infrared detector responsivity, an optical chopper is often used to perform on-off operation of incident light. The chopping frequency is the frequency of this chopper.

D* (D-Star)
The D* is the detectivity of a detector that indicates the S/N ratio when radiant energy of 1W is incident on the detector. Since the D* is normalized by an active area of $1cm^2$ and a noise bandwidth of 1Hz, it is independent of the size and shape of the active element. The D* is defined with respect to the following three parameters: A) infrared source temperature (K) or wavelength (μ m), B) chopping frequency, and C) noise bandwidth, as represented in D*(A,B,C). The unit is $cm \cdot Hz^{1/2}/W$, and the higher the D* value, the better the detector. The D* is given by

$$D^* = \frac{S/N \cdot \Delta f^{1/2}}{P \cdot A^{1/2}}$$

where S is the signal, N is the noise, P is the incident energy in W/cm^2, A is the active area in cm^2 and Δ f is the noise bandwidth in Hz. The following relation is established between D* and NEP.

$$D^* = \frac{A^{1/2}}{NEP}$$

Noise (N)
The noise is the output voltage from a photoconductive cell operated under specified conditions and 300K background radiations.

Shunt Resistance (Rsh)
This indicates the dark current characteristics of a photovoltaic detector (Ge, InGaAs, InAs, InSb etc.). It is the voltage/current ratio of a detector operated in the 0V region (10mV in this catalog) in a dark state.

Quantum Efficiency (η)
This is the ratio of the number of incident photons to resulting photoelectrons in the output current. Quantum efficiency, and photo sensitivity have the following relation at a given wavelength λ .

$$\eta = 1.24\ S/\lambda$$