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PHOTONICS spectra

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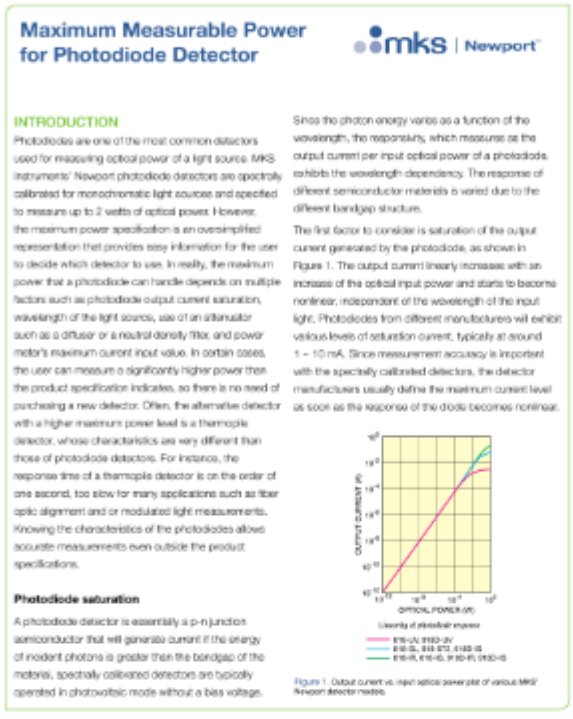
Maximum Measurable Power for Photodiode Detector

mks | Newport

INTRODUCTION

Photodiodes are one of the most common detectors used for measuring optical power of a light source. MKS Instruments' Newport photodiode detectors are spectrally calibrated for monochromatic light sources and specified to measure up to 2 watts of optical power. However, the maximum power specification is an oversimplified representation that provides easy information for the user to decide which detector to use. In reality, the maximum power that a photodiode can handle depends on multiple factors such as photodiode output current saturation, wavelength of the light source, use of an attenuator such as a diffuser or a neutral density filter, and power meter's maximum current input value. In certain cases, the user can measure a significantly higher power than the product specification indicates, so there is no need of purchasing a new detector. Often, the alternative detector with a higher maximum power level is a thermopile detector, whose characteristics are very different than those of photodiode detectors. For instance, the response time of a thermopile detector is on the order of one second, too slow for many applications such as fiber optic alignment and or modulated light measurements. Knowing the characteristics of the photodiodes allows accurate measurements even outside the product specifications.

Photodiode saturation

A photodiode detector is essentially a p-n junction semiconductor that will generate current if the energy of incident photons is greater than the bandgap of the material; spectrally calibrated detectors are typically operated in photovoltaic mode without a bias voltage. Since the photon energy varies as a function of the wavelength, the responsivity, which measures as the output current per input optical power of a photodiode, exhibits the wavelength dependency. The response of different semiconductor materials is varied due to the different bandgap structure.

The first factor to consider is saturation of the output current generated by the photodiode, as shown in Figure 1. The output current linearly increases with an increase of the optical input power and starts to become nonlinear, independent of the wavelength of the input light. Photodiodes from different manufacturers will exhibit various levels of saturation current, typically at around 1 – 10 mA. Since measurement accuracy is important with the spectrally calibrated detectors, the detector manufacturers usually define the maximum current level as soon as the response of the diode becomes nonlinear.

Figure 1. Output current vs. input optical power plot of various MKS Newport detector models.

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