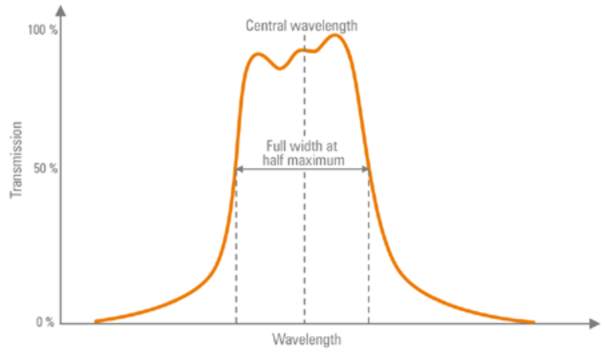
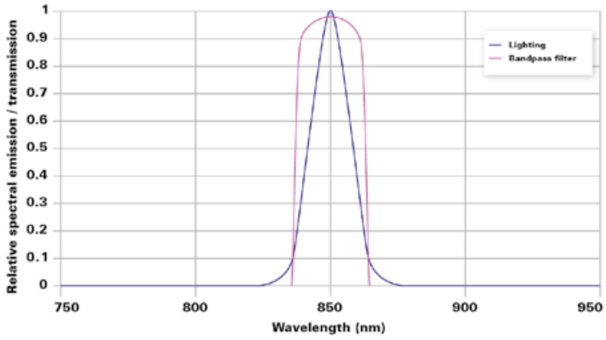
3.1 Bandpass filters



Parameters for a bandpass filter

A bandpass filter transmits a specific wavelength region. The remaining light is attenuated. The breadth of this transmission band is selected according to the intended purpose. There are filters with a bandwidth of less than 2 nm and filters with bandwidths of 80 nm or more. Narrow bandpass filters with widths between 2 and 5 nm are primarily used in highly demanding laser-based applications. On the other hand, filters with a bandwidth of 10 to 80 nm can be utilised for a range of applications of interest for Machine Vision. One of the most important areas in which they are used is eliminating extraneous light – especially in cases where flash lighting is not possible. When suppressing extraneous light, a daylight-cut filter is often used in conjunction with an infrared light source. These filters let infrared light pass, but attenuate ("cut") the entire visible and ultraviolet spectrum. This works to minimise the effects of daylight on the Machine Vision solution.



Bandpass filter for suppressing extraneous light

Since visible-light wavelengths are often required for a wide range of tasks, however, extraneous light cannot always be suppressed by using a daylight-cut filter. Instead, a narrow bandpass filter can be used. This involves mounting a bandpass filter precisely matched to the wavelength of the lighting system in front of the lens or the image capture device. The more accurately the filter's central wavelength matches the LED wavelength, the narrower the filter bandwidth that can be chosen. In consequence, as much light as possible is transmitted from the lighting system, while stray light is blocked entirely. Narrow-band filters are equally good at improving image stability for infrared lighting in comparison to standard daylight-cut filters. High-quality filters with specific compatibility are available for LUMIMAX® LED Lighting.

By permitting certain wavelengths to pass and attenuating other wavelengths, bandpass filters can also be used to increase the contrast in an image or separate out colours.

One special field of application for these types of filters is fluorescence. We will be looking at this more closely in chapter 5, and offering you a number of interesting examples.

Central wavelength (CWL)	The central wavelength specifies the midpoint of the two wavelengths at which 50% of the maximum transmission is achieved.
Full width at half maximum (FWHM)	The full width at half maximum describes the width at which 50% of maximum transmission is achieved.
Bandwidth	The bandwidth refers to the wavelength region that is transmitted (passed) by the filter.
Blocking range	The blocking range describes the wavelength region that is rejected (stopped) by the filter.
Optical density	The optical density describes the filter's power to reject wavelengths. Filters with a high optical density have a lower rate of transmission than those with a lower optical density.

Parameters for a bandpass filter