LASER COMPONENTS

Filters for Laser Applications

OMEGA® OPTICAL

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Laser Line Filters

At the laser source, while output is typically thought of as monochromatic and is described by a prominent line and a single output wavelength, there are often lower level transitions, plasma, and "glows" all of which create background errors. In addition, laser sources can shift in wavelength depending on power, temperature, and even manufacturing tolerances. Transmitting pure excitation energy requires a laser "clean-up" filter to control the unwanted energy.

Laser line filters are narrow bandpass filters centered on the resonance of the laser, which attenuate the background plasma and secondary emissions that often result in erroneous signals. In the case of diode lasers and LEDs, these filters can be used to make the light output more monochromatic. In the case of gas lasers, these filters can eliminate plasma in the deep blue wavelength region. Laser line filters provide 60 - 90% throughput (expect UV) with spectral control from 0.85 to 1.15 of the CWL. An accessory blocker can be ordered to control a much wider spectral range from the deep UV to the IR. This additional blocker results in a minor loss of throughput (<20%).

Part #	Laser Line	Application	Description	Typical T%	Blocking Range	Part #	Blocking Range
XL01	266	4th Nd Yag	266BP15	>/= 20	UV - FIR	N/A	
N/A	325	HeCd	325NB2			XLK02	UV - 2500nm
XL30	337.1	N2	337NB3	>/= 40	0.85 - 1.15 x CWL	XLK30	UV - 2500nm
XL31	351	Argon-Ion	351NB3	>/= 60	0.85 - 1.15 x CWL	XLK31	UV - 2500nm
N/A	355	3rd Nd Yag	355NB3			XLK03	UV - 2500nm
XL32	363.8	Argon	364NB4	>/= 60	0.85 - 1.15 x CWL	XLK32	UV - 2500nm
XL33	405 / 407	Blue Diode / DPSS	405NB5	>/= 60	0.85 - 1.15 x CWL	XLK33	UV - 1150nm
XL34	430	Blue Diode / DPSS	430NB2	>/= 60	0.85 - 1.15 x CWL	XLK34	UV - 1150nm
XL04	441.6	HeCd	442NB2	>/= 60	0.85 - 1.15 x CWL	XLK04	UV - 1150nm
XL05	457	Argon	457NB2	>/= 60	0.85 - 1.15 x CWL	XLK05	UV - 1150nm
XL35	473 / 476.6	Argon	473NB8	>/= 70	0.85 - 1.15 x CWL	XLK35	UV - 1150nm
XL06	488	Argon	488NB3	>/= 80	0.85 - 1.15 x CWL	XLK06	UV - 1150nm
XL07	514.4	Argon	515NB3	>/= 80	0.85 - 1.15 x CWL	XLK07	UV - 1150nm
XL08	532	2nd Nd Yag	532NB3	>/= 80	0.85 - 1.15 x CWL	XLK08	UV - 1150nm
XL09	543	HeNe Green	543NB3	>/= 80	0.85 - 1.15 x CWL	XLK09	UV - 1150nm
XL36	568	Argon / Argon Krypton	568NB3	>/= 80	0.85 - 1.15 x CWL	XLK36	UV - 1150nm
XL10	594	HeNe Yellow	594NB3	>/= 80	0.85 - 1.15 x CWL	XLK10	UV - 1150nm
XL11	612	HeNe Yellow	612NB3	>/= 80	0.85 - 1.15 x CWL	XLK11	UV - 1150nm
XL12	632.8	HeNe Red	633NB4	>/= 80	0.85 - 1.15 x CWL	XLK12	UV - 1150nm
XL37	635	Red Diode	635NB4	>/= 80	0.85 - 1.15 x CWL	XLK37	UV - 1150nm
XL13	647.1	Krypton	647NB4	>/= 80	0.85 - 1.15 x CWL	XLK13	UV - 1150nm
XL38	650	Red Diode	650NB5	>/= 80	0.85 - 1.15 x CWL	XLK38	UV - 1150nm
XL15	655	AlGaAs	655WB25	>/= 80	0.85 - 1.15 x CWL	XLK15	UV - 1150nm
XL14	676	Krypton	676NB4	>/= 80	0.85 - 1.15 x CWL	XLK14	UV - 1150nm
XL16	694	Ruby	694NB4	>/= 80	0.85 - 1.15 x CWL	XLK16	UV - 1150nm
XL17	775	AlGaAs	775WB25	>/= 85	0.85 - 1.15 x CWL	XLK17	UV - 1800nm
XL29	785	Sapphire	785NB4	>/= 80	0.85 - 1.15 x CWL	XLK29	UV - 1800nm
XL39	808 / 810	Diode	808WB25	>/= 85	0.85 - 1.15 x CWL	XLK39	UV - 1800nm
XL18	825	AlGaAs	825WB25	>/= 85	0.85 - 1.15 x CWL	XLK18	UV - 1800nm
XL40	830	GaAlAs	830WB25	>/= 85	0.85 - 1.15 x CWL	XLK40	UV - 1800nm
XL19	859	AlGaAs	850WB25	>/= 85	0.85 - 1.15 x CWL	XLK19	UV - 1800nm
XL20	875	AlGaAs	875WB25	>/= 85	0.85 - 1.15 x CWL	XLK20	UV - 1800nm
XL41	980	InGaAs	980WB25	>/= 85	0.85 - 1.15 x CWL	XLK41	UV - 1800nm
XL21	1060	1st Nd Yag	1060NB8	>/= 85	0.85 - 1.15 x CWL	XLK21	UV - 1500nm
XL22	1064	1st Nd Yag	1064NB8	>/= 80	0.85 - 1.15 x CWL	XLK22	UV - 1500nm
XL23	1152	HeNe IR	1152WB40	>/= 80	0.85 - 1.15 x CWL	XLK23	UV - 1350nm
XL24	1310	InGaAsP	1310WB40	>/= 80	0.85 - 1.15 x CWL	XLK24	UV - 1800nm
XL25	1320	Nd Yag	1320NB10	>/= 80	0.85 - 1.15 x CWL	XLK25	UV - 1800nm
XL42	1350	Diode	1350WB40	>/= 80	0.85 - 1.15 x CWL	XLK42	UV - 1800nm
XL26	1523	HeNe IR	1523NB10	>/= 80	0.85 - 1.15 x CWL	XLK26	UV - 1800nm
XL27	1550	InGaAsP / Diode	1550WB50	>/= 80	0.85 - 1.15 x CWL	XLK27	UV - 1800nm
XL28	1550	InGaAsP / Diode	1550NB10	>/= 80	0.85 - 1.15 x CWL	XLK28	UV - 1800nm

Specifications for Partially Blocked Filters:
Diameter: 25mm - Tolerance: +0.0, -0.5mm
Thickness: 3.5mm
Attenuation OD: 3 Min / 5 Avg

Specifications for Fully Blocked Filters:
Diameter: 25mm - Tolerance: +0.0, -0.5mm
Thickness: </= 8mm
Attenuation OD: 3 Min / 5 Avg or 5 Avg (see website)
Addition of blocking component will reduce T by 20%

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Edge Filters

At the detector, both desired signal and unwanted scatter will be present, with the signal orders of magnitude lower than the scatter. Scatter is the result of minor irregularities and characteristics of the system optics and application, including uncontrolled light from the sample and holder. To improve signal-to-noise, both Edge Filters and Laser Rejection filters can be used to attenuate, or block, the scattered energy from reaching the detector.

Longpass Edge filters are an excellent laser rejection solution when used in a collimated light path on the detector side of the system. They attenuate shorter wavelengths to ~ 0.7 wavelength edge or to the deep UV for wavelength < ~ 500nm, and exhibit steep slopes (< 3% 5-Decade slope factor), deep blocking of the laser line (OD > 5), and high throughput of the Raman signal. Edge filters will transmit ~ 85% of Stokes or anti-Stokes Raman or fluorescence signal and exhibit very high contrast between the Rayleigh and Raman transmission. They are manufactured with edges defined as 1.03 x laser wavelength. Angle tuning is required for optimal performance. Edge filter performance is superior to low throughput monochromators and Holographic Notch filters at far less cost.

Part #	Laser Line	Application	Transmission %	Attenuation OD	Part #	Laser Line	Application	Transmission %	Attenuation OD
XE266	266	4th Nd: Yag	> 85 Avg	> 5	XE635	635	Red Diode	> 85 Avg	> 5
XE325	322 / 325	HeCad	> 85 Avg	> 5	XE647	647.1	Krypton / Krypton-Argon	> 85 Avg	> 5
XE337	337.1	N2	> 85 Avg	> 5	XE650	650	Red Diode	> 85 Avg	> 5
XE351	351	Argon-Ion	> 85 Avg	> 5	XE655	655	AlGaAs	> 85 Avg	> 5
XE355	355	3rd Nd: Yag	> 85 Avg	> 5	XE676	676	Krypton	> 85 Avg	> 5
XE364	363.8	Argon-Ion	> 85 Avg	> 5	XE694	694.3	Ruby	> 85 Avg	> 5
XE407	405 / 407	Blue Diode	> 85 Avg	> 5	XE785	785	Ti: Sapphire	> 85 Avg	> 5
XE430	430	Blue Diode / DPSS	> 85 Avg	> 5	XE810	808 / 810	Diode	> 85 Avg	> 5
XE442	441.6	HeCd	> 85 Avg	> 5	XE830	830	GaAlAs	> 85 Avg	> 5
XE458	457.9	Argon	> 85 Avg	> 5	XE859	859	AlGaAs	> 85 Avg	> 5
XE477	473 / 476.6	Argon	> 85 Avg	> 5	XE875	875	AlGaAs	> 85 Avg	> 5
XE488	488	Argon	> 85 Avg	> 5	XE980	980	InGaAs	> 85 Avg	> 5
XE514	514.4	Argon	> 85 Avg	> 5	XE1064	1064	1st Nd: Yag	> 85 Avg	> 5
XE532	532	Nd: Yag	> 85 Avg	> 5	XE1152	1152	HeNe IR	> 85 Avg	> 5
XE543	543	HeNe Green	> 85 Avg	> 5	XE1310	1310	InGaAsP	> 85 Avg	> 5
XE568	568	Argon / Argon-Krypton	> 85 Avg	> 5	XE1320	1320	Nd Yag	> 85 Avg	> 5
XE594	594	HeNe Yellow	> 85 Avg	> 5	XE1350	1350	Diode	> 85 Avg	> 5
XE612	612	HeNe Orange	> 85 Avg	> 5	XE1523	1523	HeNe IR	> 85 Avg	> 5
XE632	632.8	HeNe	> 85 Avg	> 5	XE1550	1550	Diode	> 85 Avg	> 5

Specifications:
Diameter: 25mm - Tolerance: +0.0, -0.5mm
Attenuation OD: see website
Thickness: </=7.6mm

Angle Tuning Edge Filters

All Edge filters can be angle-tuned to achieve optimal signal-to-noise. Angle-tuning the filter will blue-shift the transmission curve and allow Raman signals closer to the laser line to pass through the filter at some expense to blocking at the laser line. The filter can be oriented up to about 15% from normal incidence. A secondary feature of angle-tuning is that reflected energy is redirected from the optical axis. For Longpass Edge filters, select a filter with an edge that is to the red of the desired cut-off, and adjust the filter angle until optimal performance is achieved.

Another option for achieving higher transmission at small Raman shifts is to use two filters in series, each designed to block the laser line at OD=2-3 levels. Used in combination, the blocking at the laser line is additive (OD=4-6) and the 5-decade slope factor is effectively decreased from 3% to as low as 1.5 degress.

Edge Filters - Shortpass

Shortpass Edge filters, used as laser clean-up solutions on the laser source side of the system, attenuate wavelengths to ~ 1.3 wavelength edge. They serve as excellent clean-up filters when there are no laser lines or plasma at shorter wavelengths than the primary line being used. Compared to Laser Line filters, they provide higher transmission and fully block the laser "tail" on the long wavelength side of the laser line.

If you are interested in a Shortpass Edge filter, provide us with your specifications using our Rapid Custom Filter Program: Build-A-Filter link at www.omegafilters.com.

Laser Rejection Filters

At the detector, both signal and scatter will be present, with the scatter orders of magnitude higher than the signal. To improve signal-to-noise, both Laser Rejection and Edge filters can be used to attenuate, or block, the scattered energy from reaching the detector.

Laser Rejection filters are designed to block more than 99.9% of light in a 15 to 40nm bandwidth. The average transmission outside the stopband is 75% except in those spectral regions where higher and lower harmonics cause relatively high reflection. Specially designed Rejection Band filters reflect more than one spectral band, or perform at off-normal angles of incidence. Rejection, or Notch, filters provide the ability to measure both Stokes and anti-Stokes signals simultaneously and have tunability for variable laser lines. Edge filters can also be used for laser rejection, providing deeper blocking of the laser line and steeper edges, for small Stokes shifted applications.

Part #	Laser Line	Description	Transmission %	Attenuation OD	Thickness (mm)
XB09	457, 488, 514	488-S3D	>/= 60 Avg	>/= 3 Avg	</= 3
XB11	532, 1064	532-D2C	>/= 80 Avg	>/= 4 Avg	</= 4
XB12	532, 694, 1064	532-S3A	>/= 70 Avg	5 Min	</= 5
XB23	632	633-S1E	>/= 75 Avg	3 Min	</= 3

Specifications:
Diameter: 25mm - Tolerance: +0.0, -0.5mm
Aperture: >/= 20mm

Raman Filter Sets

Omega® currently offers five stock filter sets for common Raman laser wavelengths. Each set is comprised of a Laser Line filter for removing spurious background from the probe laser, and a Longpass Edge filter, with an ALPHA-Epsilon edge (1% 5-Decade slope factor), to provide deep blocking of the Rayleigh scattering. Custom sets or individual parts can be made for other laser wavelengths.

Part #	Laser Line	Components				
		Type	Part #	Description	Transmission %	Attenuation OD
XR01	488 Argon	Edge Filter	XR3000	493AELP	> 85 Avg	> 5
		Laser Line w/Blocker	XLK06	488NB3	>/= 56	5 Avg
XR02	514 Argon	Edge Filter	XR3001	520AELP	> 85 Avg	> 5
		Laser Line w/Blocker	XLK07	515NB3	>/= 54	5 Avg
XR03	532 Nd: Yag	Edge Filter	XR3002	538AELP	> 85 Avg	> 5
		Laser Line w/Blocker	XLK08	532NB3	>/= 54	5 Avg
XR04	632.8 HeNe	Edge Filter	XR3003	640AELP	> 85 Avg	> 5
		Laser Line w/Blocker	XLK12	633NB4	>/= 54	5 Avg
XR05	785 Ti: Sapphire	Edge Filter	XR3004	793AELP	> 85 Avg	> 5
		Laser Line w/Blocker	XLK29	785NB3	>/=656	3 Min / 5 Avg

Specifications:
Diameter: 25mm - Tolerance: +0.0, -0.5mm

ALPHA-Epsilon Longpass Edge Filter
Cut-On Tolerance: +/- 2nm
Attenuation: OD 5 at Laser Line
Laser Attenuation: > OD 5
Spectral Edgewidth: Wavenumbers between OD 3 (50% T) & OD 5 points - < 200 wave numbers
Transmission in Passband: > 85% Average

Fully Blocked Laser Line Filters
Diameter Tolerance: +0.0, -0.5mm
Thickness w/Blocker: </= 8mm

UV Raman Edge Filter Capabilities

These filters, produced using Omega Optical's proprietary ALPHA™ technology, exhibit steep edge slopes, deep blocking of the laser line, and high throughput of the Raman signal. They are compact and exhibit very high contrast between the Rayleigh and Raman transmission. Constructed of an exposed, hard oxide coating on an optical quality substrate and manufactured using Ion Assist Deposition (IAD), these filters are extremely durable and exhibit no detectable wavelength shifting under variable moisture conditions. UV Edge filters have slopes as steep as 5-decade slope factors at 3%. For example, a filter designed to block the 248nm laser line at OD 5 will transmit 50% at 256nm. Currently we produce filters for laser wavelengths as low as 229nm and are continuously pushing this limit to shorter wavelengths.

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