

LLTF CONTRAST™

THE ULTIMATE SUPERCONTINUUM FILTER UP TO 20W INPUT POWER



The Laser Line Tunable Filter (LLTF CONTRAST) is a non-dispersive patented (US patent 7557990) tunable bandpass filter based on volume Bragg gratings. It combines very high optical density (> OD6), an outstanding out-of-band rejection, and wide tunability. The LLTF can be customized to cover the entire 400 nm to 2500 nm spectral range with a high spectral resolution. It can be coupled with a wide variety of broadband sources to create a tunable laser source. It can also be used as a cleanup filter for spectroscopy applications. There are numerous possible LLTF configurations whose spectral range and bandwidth can be finely tuned to fit specific needs. The specifications below of several tried-and-tested standard models may serve as a starting point.

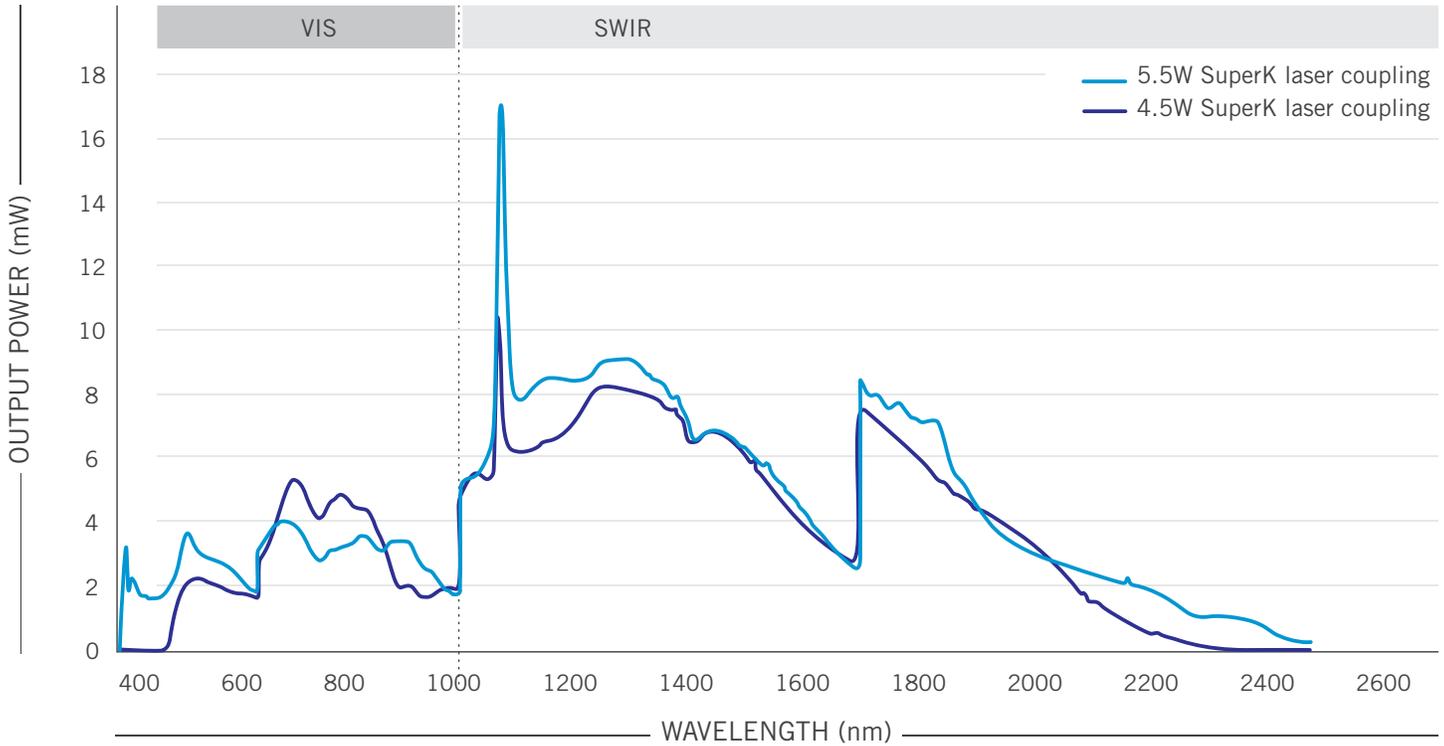
TECHNICAL SPECIFICATIONS

	CONTRAST VIS	CONTRAST SWIR	CONTRAST EXT-III		CONTRAST EXT-IV		CONTRAST X
Spectral range (custom spectral ranges also available ¹)	400-1000 nm	1000-2300 nm (2500 nm optional)	400-1700 nm		400-2300 nm (2500 nm optional)		Up to 5 gratings. See graph on page three for available gratings.
Bandwidth (FWHM) ²	1.5 - 2.5 nm	2.0 - 5.0 nm	400-1000 nm 1.5 - 2.5 nm	1000-1700 nm 2.0 - 5.0 nm	400-1000 nm 1.5 - 2.5 nm	1000-2300 nm 2.0 - 5.0 nm	0.15 - 0.9 nm See graph on page three for available gratings.
Out of band rejection ³	<-60 dB@±40 nm Typically -30 dB@±10 nm	<-60 dB@±80 nm ⁴ Typically -40 dB@±20 nm	<-60 dB@±40 nm Typically -30 dB@±10 nm	<-60 dB@±80 nm Typically -40 dB@±20 nm	<-60 dB@±40 nm Typically -30 dB@±10 nm	<-60 dB@±80 nm Typically -40 dB@±20 nm	Typically -55 dB @± -5 nm
Wavelength selection accuracy (relative)	<0.33 nm	<0.66 nm	<0.66 nm		<0.66 nm		<0.13 nm
Harmonic filters	Second harmonic suppression included over the 400-500 nm spectral range	Second harmonic suppression included over the 850-1250 nm spectral range. Additional filter for 500-850 nm harmonic suppression available upon request	Second harmonic suppression included over the 400-850 nm spectral range		Second harmonic suppression included over the 400-1250 nm spectral range		Upon request
Standard input module	Free-space and compatible with 12 mm diameter supercontinuum collimator						
Standard output module	Free-space and output cap compatible with NKTP SuperK Connect						
Maximum input average power	HP8 (up to 8 W laser) HP20 (up to 20W laser) on demand						
Peak efficiency ⁵	Typically around 65%						
Optical density (OD)	> OD6 (measured at 1064 nm)						
Damage threshold	< 5 GW/cm ² peak power @ 1064 nm, 8 ns						
Input beam diameter	< 5 mm						
Input beam divergence requirement (full angle)	< 1.5 mrad						
Pointing stability across spectral range	<0.5 mm displacement @1 m from filter		<1.0 mm displacement @ 1 m from filter				

TECHNICAL SPECIFICATIONS					
	CONTRAST VIS	CONTRAST SWIR	CONTRAST EXT-III	CONTRAST EXT-IV	CONTRAST X
Typical scanning speed			20 ms stabilization time for 0.2 nm step or less 25 ms stabilization time for 1 nm step 28 ms stabilization time for 2 nm step 35 ms stabilization time for 5 nm step 50 ms stabilization time for 10 nm step		
Software	PC (Windows10 - 64-bits) with PHySpec™ control and analysis software (computer not included), connection via USB 2.0 (1.1 compatible)				
Dimensions (L x W x H)		9 x 6.3 x 6.7 (inches) 23 x 16 x 17 (cm)		11.8 x 9.1 x 6.7 (inches) 30 x 23 x 17.4 (cm)	9 x 6.3 x 6.7 (inches) 23 x 16 x 17 (cm)
Operating temperature	10 to 40 °C				
Storage temperature	0 to 50 °C				
Power requirement	120 VAC / 60 Hz 230 VAC / 50 Hz				
	¹ Eg: 500-2000 nm, 500-900 nm, 400-650 nm, 650-1000 nm, 1000-1700 nm, 1700-2300 nm, etc.				
	² Valid if the divergence of the input beam does not exceed 1.5 mrad (full angle)				
	³ Measured in output fibered configuration with an OSA				
	⁴ Some third harmonics wavelengths < 850 nm can be present in the output. We recommend an external clean-up long-pass filter if the detector is sensitive to visible wavelengths.				
	⁵ For input beam divergence under 1.5 mrad (full angle) and M ² < 1.2.				

OPTIONS AND ACCESSORIES					
	CONTRAST VIS	CONTRAST SWIR	CONTRAST EXT-III	CONTRAST EXT-IV	CONTRAST X
Enhance SWIR option	N/A	Increase throughput over 1700 nm and allow to reach 2500 nm	N/A	Increase throughput over 1700 nm and allow to reach 2500 nm	
Fibered input	An X-Y-Z translation refractive adjustment allows coupling optimization. FC/APC standard connector (SMA, FC/APC on demand). Compatible with fiber core of 25 µm or less and N.A. of 0.12 or less. Custom adjustments upon request.		A ThetaX-ThetaY reflective adjustment allows coupling optimization. FC/APC standard connector (SMA, FC/APC on demand). Compatible with fiber core of 25 µm or less and N.A. of 0.12 or less. Custom adjustments upon request.		An X-Y-Z translation refractive adjustment allows coupling optimization. FC/APC standard connector (SMA, FC/APC on demand). Compatible with fiber core of 25 µm or less and N.A. of 0.12 or less. Custom adjustments upon request.
Fibered output	An X-Y-Z translation adjustment allows coupling optimization. FC/APC standard connector (SMA, FC/APC on demand). Both lens and mirror based models available.				
SWIR manual corrective lens	N/A	Compensate the supercontinuum divergence in SWIR region. Must be used to achieve bandwidth specification over the whole spectral range in most cases.	Compensate the supercontinuum divergence in SWIR region. Must be used to achieve bandwidth specification over the whole spectral range in most cases.	Compensate the supercontinuum divergence in SWIR region. Must be used to achieve bandwidth specification over the whole spectral range in most cases.	Compensate the supercontinuum divergence in SWIR region. Must be used to achieve bandwidth specification over the whole spectral range in most cases.
SWIR automatic corrective lens		N/A			
Harmonic filter	Second harmonic suppression already included (400-500nm)	Blocks the harmonics coming from the region 850-1250 nm. Additional filter for 500-850nm harmonic suppression available upon request.	Second harmonic suppression already included (400-850nm)	Second harmonic suppression already included (400-1250nm)	Depends on the spectral range
Alignment kit (for free space)	In free space configuration (input/output), the alignment kit allows the user to rapidly find the correct alignment.				

LLTF VIS AND SWIR OUTPUT POWER (data taken with the Enhanced SWIR option)



Examples of available gratings/bandwidth for the LLTF CONTRAST X

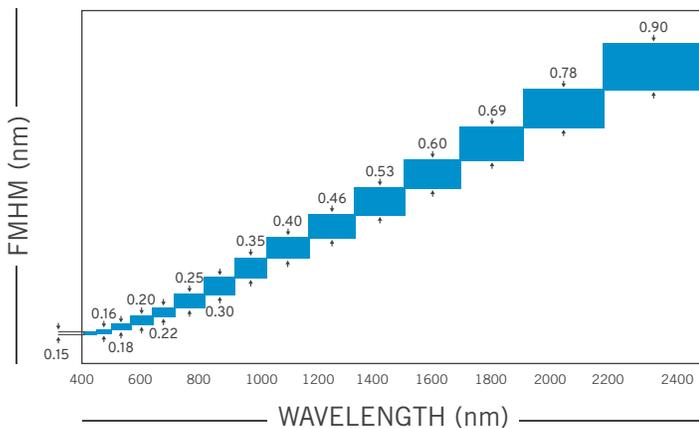
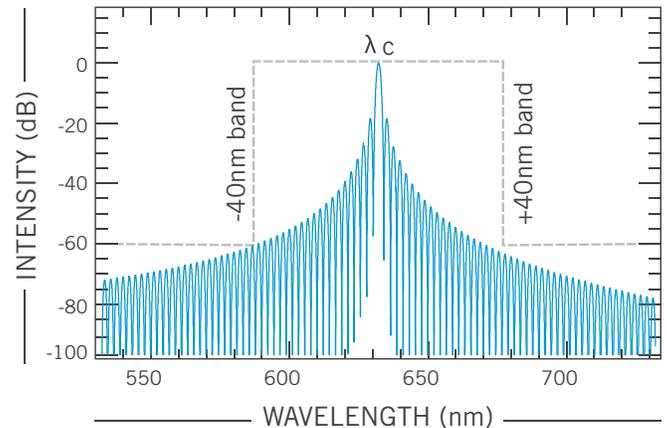
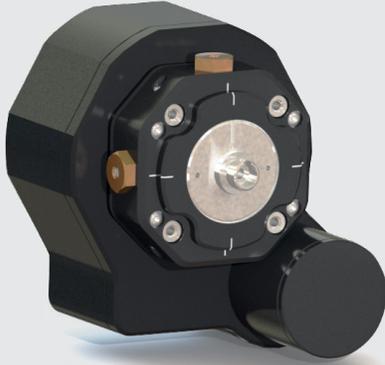


Illustration of the out-of-band rejection of a volume holographic grating at $\lambda_c = 632$ nm. Bands of ± 40 nm are presented and an out-of-band rejection of -60 dB is obtained.

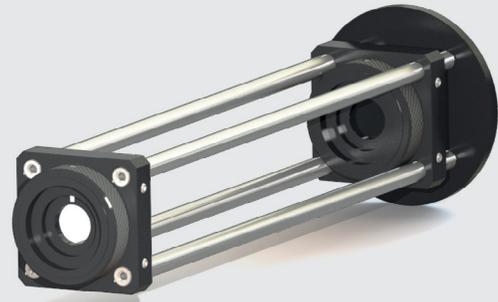


ACCESSORIES



FIBEROPTIC INPUT/OUTPUT

The LLTF Contrast, in its basic configuration, delivers a collimated free-space output beam. The fibered output option takes this beam and couples it into a fiber to fit the needs of various applications. An X-Y-Z translation adjustment allows coupling optimization. Compatible with most standard fiber connectors (ex. FC/PC, FC/APC, etc.)



ALIGNMENT KIT (FOR FREE-SPACE)

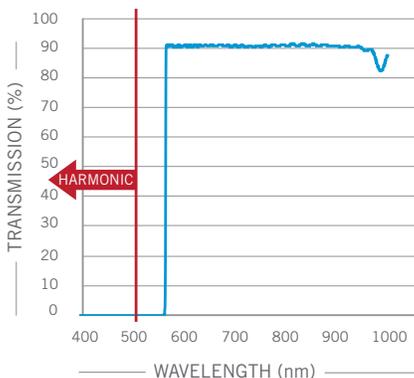
In free-space configuration, the alignment of the input laser into the LLTF is a challenging task without the proper tools. The alignment kit allows the user to rapidly find the correct alignment. Two irises, mounted on removable posts, are easily placed at the entrance of the filter. The laser beam then simply needs to follow the path created by the irises.

OPTIONS

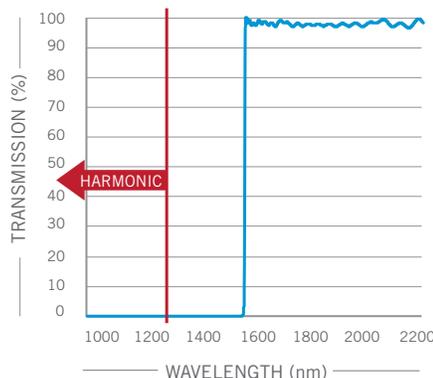
HARMONIC FILTER

Like in every diffraction grating, the 2nd harmonic of a given wavelength is present in the output light of the LLTF Contrast™. Fortunately, we have a set of harmonic longpass filters that blocks this 2nd harmonic to bring it down to OD6. We generally recommend using these filters in order to get the full advantage of the LLTF optical purity. The harmonic filter performances we offer for the Contrast VIS and SWIR are described with the following graphics.

HARMONIC FILTER - VIS-HF2



HARMONIC FILTER - SWIR-HF2



HARMONIC FILTER - SWIR-HF12

