



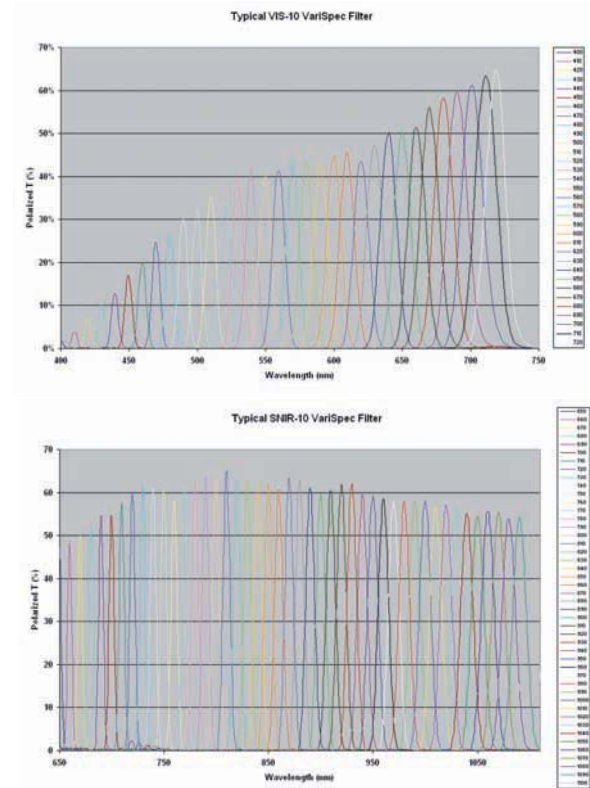
**Effortlessly tune** to any wavelength in the VIS or NIR range—without moving parts.

VariSpec™ Liquid Crystal Tunable Filters (LCTFs) from CRI are like high-quality interference filters, but the wavelengths of light they transmit are electronically controllable, providing rapid, vibrationless selection of any wavelength in the visible and near-infrared spectrum. VariSpec filters' wavelength selection, large apertures, and excellent imaging quality are valuable in a wide variety of applications such as remote sensing for agriculture and defense, chemical imaging, semiconductor process control, machine vision, and biomedical imaging.

CRI has manufactured and shipped thousands of LCTFs over the past decade as the leader in tunable imaging filter technology. VariSpec filters feature a fast, plug-and-play USB interface with a free Software Developer's Kit (SDK) that includes Windows® DLL support, LabVIEW™ and Matlab® drivers, as well as a full serial command set for use with other operating systems.

### Features & Benefits

- Solid-state design for rapid, vibrationless tuning
- Large apertures (up to 35 mm) with excellent imaging quality
- Wavelength ranges in the visible and near-infrared
- USB interface for efficient low-power operation and easy software integration

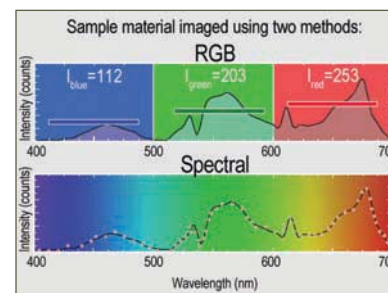


### Multispectral Imaging

Visible light is made up of a mixture of wavelengths that our eyes interpret as "color". Remarkably, although we can distinguish millions of different colors or color combinations, we cannot perceive all the wavelength (or "spectral") information in our visual environment. This is because our eyes (as well as conventional color films and color digital cameras) separate visible light, no matter how spectrally complex, into only three color bins: Red, Green, and Blue (RGB).

Light with completely different spectral content can have precisely the same RGB coordinates. For example, when we see a yellow color, we cannot tell if it comes from a "pure" yellow color or from a mixture of red color and green color. Multispectral imaging can.

Multispectral imaging is a technique that provides images of a scene at multiple wavelengths and can generate precise optical spectra at every pixel. CRI's VariSpec filters represent an ideal technology for precise, robust, and affordable multispectral imaging.



## VariSpec Terminology

### Bandwidth

The Full-Width at Half-Maximum (FWHM), measured as the spectral separation between the two points where the filter's transmission attains 50% of the peak value. The passband center wavelength is the wavelength midway between these two points. VariSpec filters come in a variety of bandwidths, which are set during the design and manufacturing process and are not adjustable by the end-user.

### Center Wavelength

Not necessarily the highest point in the transmission curve, this is defined as midway between the half-maxima points.

### Off-Axis Performance at limit of Field-of-View (FOV)

Off-axis rays at the limit of the field-of-view (FOV) are permitted to be spectrally shifted by up to Bandwidth/8 from the on-axis ray value. So, in the worst case, the center ray could have a center wavelength which exceeds the ideal by +Bandwidth/8, and an off-axis ray could be shifted by +Bandwidth/8 red of that, or +Bandwidth/4 away from the ideal value.

### Out-of-Band Transmittance or Contrast

The average ratio of transmission without the VariSpec filter in place to the transmission of unselected wavelengths with the filter in place. Typical performance is 0.01%.

### Passband

The spectral region from [Center Wavelength - 1.2 \* FWHM] to [Center Wavelength + 1.2 \* FWHM].

### Response Time

The time it takes to switch from one wavelength to another. Several factors affect this number, including the liquid crystal (LC) relaxation time from "charge" to "no charge" states under various ambient temperatures. Typically, this time is 50 ms for VIS models and 150 ms for others.

### Transmission

The percentage of linearly polarized light, oriented so that maximum transmission is attained, passing through the filter relative to the amount which entered. Since the entrance element of the filter is a linear polarizer, transmission of randomly polarized light is half that of linearly polarized light in the correct orientation. VariSpec transmission is wavelength-dependent.

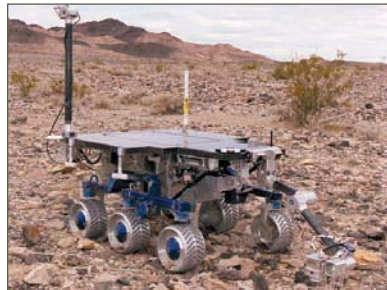
### Tuning accuracy

The tuning accuracy specification is that the center wavelength be correct within the actual Bandwidth/8 +/- 0.5 nm. Tuning accuracy is specified for on-axis rays.

### How do VariSpec filters work?

CRi's patented VariSpec technology adds liquid crystal elements to a Lyot filter design, enabling spectral tuning without moving parts. A series of optical elements are bonded together in series with index-matching epoxy. Each element transmits light with transparency that varies sinusoidally as a function of wavelength. The transmitted light adds constructively in the desired bandwidth region and destructively everywhere else within the wavelength range of the filter. Typical transmission outside the passband is 0.01% or less. See the separate technical note: "VariSpec Filter FAQs & Principles of Operation" for more detail.

VariSpec filters are very robust. Tunable filter modules have been flight-qualified for NASA space missions and have been used in airborne remote-sensing platforms for many years. Patented feedback circuitry provides accurate and stable tuning, independent of the ambient temperature and throughout a wide operating range.



Contact us at +1-781-935-9099 or at [www.cri-inc.com/varispec](http://www.cri-inc.com/varispec) to learn more about VariSpec filters or to obtain a sales quotation.

Your local CRi sales representative or distributor is:



Telephone: 1-204-753-5190

Toll Free: 1-866-300-9799

Email: [sales@channelsystems.ca](mailto:sales@channelsystems.ca)

Website: [www.spectralcameras.com](http://www.spectralcameras.com)

## Specifications

	VariSpec VIS / VISR	VariSpec SNIR / NIRr	VariSpec LNIR	VariSpec XNIR
<b>Spectral range</b>	400—720 nm (VIS) 480—720 nm (VISR)	650—1100 nm	850—1800 nm	1200—2450 nm
<b>Bandwidth</b>	7, 10, or 20 nm (VIS) 0.25 nm (VISR)	7 or 10 nm (SNIR) 0.75 nm (NIRr)	6 or 20 nm	9 nm
<b>Aperture</b>	20 or 35 mm	20 mm	20 mm	20 mm
<b>Angle-of-acceptance</b>	7.5° half-angle (VIS) 3.5° half-angle (VISR)	7.5° half-angle (SNIR) 3.5° half-angle (NIRr)	3.5° half-angle	3.5° half-angle
<b>Response time (room temp)</b>	50 ms (VIS) 150 ms (VISR)	150 ms	150 ms	150 ms
<b>Wavelength accuracy</b>	Bandwidth/8 +/- 0.5 nm	Bandwidth/8 +/- 0.5 nm	Bandwidth/8 +/- 0.5 nm	Bandwidth/8 +/- 0.5 nm
<b>Maximum optical throughput</b>	500 mW/cm <sup>2</sup>	500 mW/cm <sup>2</sup>	500 mW/cm <sup>2</sup>	500 mW/cm <sup>2</sup>
<b>Operating temp</b>	10 to 40 °C	10 to 40 °C	10 to 40 °C	10 to 40 °C
<b>Storage temp</b>	-15 to 55 °C	-15 to 55 °C	-15 to 55 °C	-15 to 55 °C
<b>Computer interface</b>	USB 1.1	USB 1.1	USB 1.1	USB 1.1
<b>Power supply</b>	USB bus-powered	USB bus-powered	USB bus-powered	USB bus-powered
<b>Software</b>	Free SDK, demo program	Free SDK, demo program	Free SDK, demo program	Free SDK, demo program

## Nuance™ & Maestro™ Multispectral Imaging Systems

Rely on CRi's powerful and easy to use Nuance and Maestro systems for an integrated multispectral imaging solution.

Nuance systems for your microscope enable you to clearly visualize multiplexed brightfield and fluorescent markers. Nuance systems can also be used in the field for remote sensing or industrial applications. Maestro *in vivo* imaging systems outperform all other imaging systems in being able to detect and separate even weak overlapping fluorescent signals in live animals, such as nude mice.

Contact CRi for information on our time-saving and intuitive systems solutions.

## About CRi

Cambridge Research & Instrumentation, Inc. (CRi) is a Boston-based company providing innovative optical imaging solutions to our customers for more than 20 years. Our multidisciplinary team is dedicated to working with our academic and commercial customers to provide high-value solutions. With over 80 patents pending and issued, our innovations are being utilized around the world to enable new breakthroughs in research, health and medicine.

We offer a broad array of tunable, solid-state optical components and modules for use in wavelength selection, polarization optics, telecommunications, and light modulation in optical processing applications.

CRi services a global network of distributors and partners through direct sales of systems and through strategic alliances as an OEM supplier.

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