

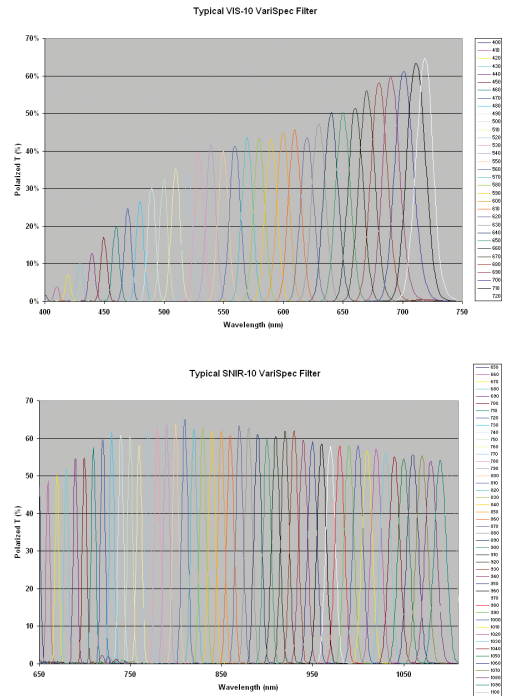
Effortlessly tune to any wavelength in the VIS or NIR range—without moving parts.

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

- Revolutionary new design eliminates the need for a separate controller box (except for XNIR-09-20 model)
- Solid-state design for rapid, vibrationless tuning
- Large apertures (up to 35 mm) with excellent imaging quality
- Variety of models offering tunability over hundreds of nanometers
- USB interface for efficient low-power operation and easy software integration

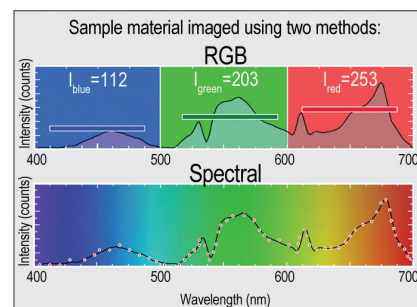


Multispectral Imaging

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 affordable, precise, and robust multispectral imaging.



VariSpec terminology and principles of operation

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.

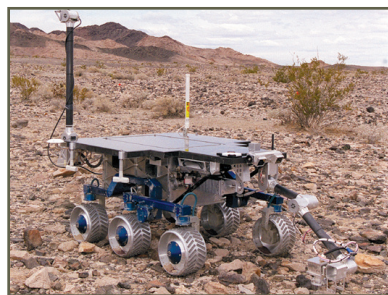
Tuning accuracy

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 variable retarders 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 or 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.



Your local CRI sales representative or distributor is:

Specifications

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

Nuance™, TRIO™, and Vectra™ Multispectral Imaging Systems

Rely on our powerful and easy to use Nuance, TRIO, and Vectra systems for turnkey, integrated multispectral imaging solutions.

Nuance and TRIO 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. Vectra offers award-winning automation for extracting proteomic and morphometric information in both brightfield immunohistochemical (IHC) and immunofluorescent tissue (IF) sections. Measure single or multiple proteins on a per-tissue, per-cell, or per-compartment basis.

About CRI

Cambridge Research & Instrumentation, Inc. (CRI), now part of Caliper Life Sciences (NASDAQ: CALP), designs, manufactures, and sells innovative optical imaging solutions. Our multidisciplinary team has been providing high-value solutions to academic, commercial, and government customers since 1985. With over 80 patents pending and issued, our innovations are being utilized around the world to enable breakthroughs in research, industry, health and medicine.

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

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

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