

OPTICS FOR FIGHTING COVID-19



▶ **Optical components**
for your medical diagnostic application

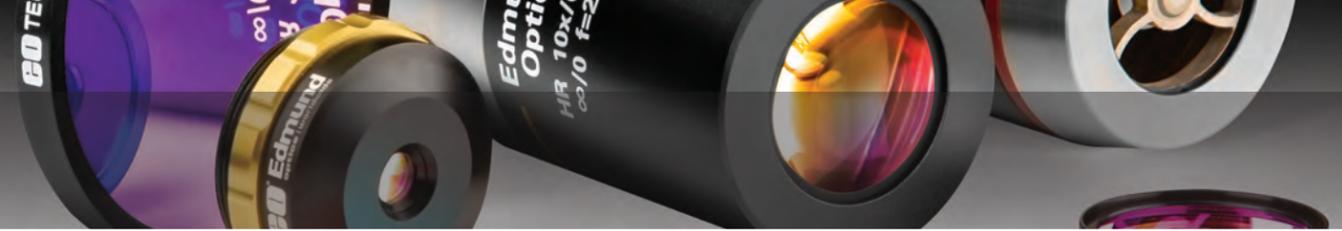
FILTERS | OBJECTIVES | LENSES | OPTICS

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optics | worldwide

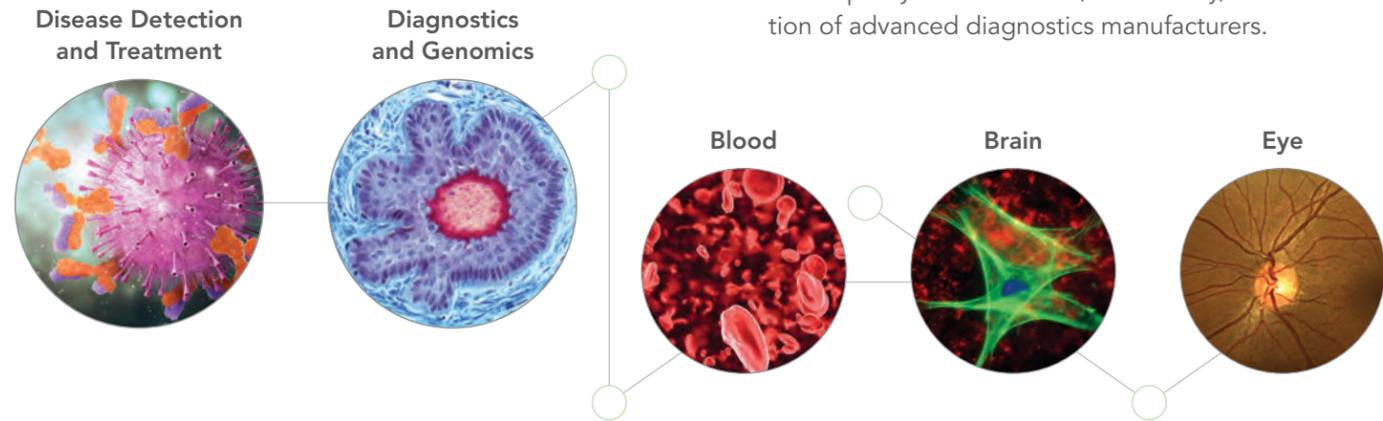
www.edmundoptics.com/advanced-diagnostics



Enabling Life-Saving Applications

Optical components from Edmund Optics® (EO) support life-saving advanced medical diagnostics ranging from fighting COVID-19, to ophthalmology, to brain diagnostics. Our engineers specialize in creating cost-effective solutions that meet your application needs, whether you are prototyping or taking a system to volume production.

Edmund Optics® is proud to support technologies as diverse as confocal and multi-photon microscopy, flow cytometry, cell sorting, optical coherence tomography (OCT), and many more.



Why Partner with Edmund Optics®?

- Extensive experience with lot control, change control, serialization, and other critical FDA requirements.
- Single-source stock and custom component provider of EO designed and manufactured optical components, imaging lenses, and advanced coatings.
- Over 200 engineers ready to assist with product selection, application support, and custom component design and manufacturing.
- Key products available from the most trusted brands, including Mitutoyo, Olympus, Nikon, Coherent®, SCHOTT, and Hamamatsu.
- ISO 9001:2015 and compliance programs designed to meet quality control needs, traceability, and serialization of advanced diagnostics manufacturers.

To learn more about our **INDUSTRY EXPERTISE**, visit www.edmundoptics.com/advanced-diagnostics

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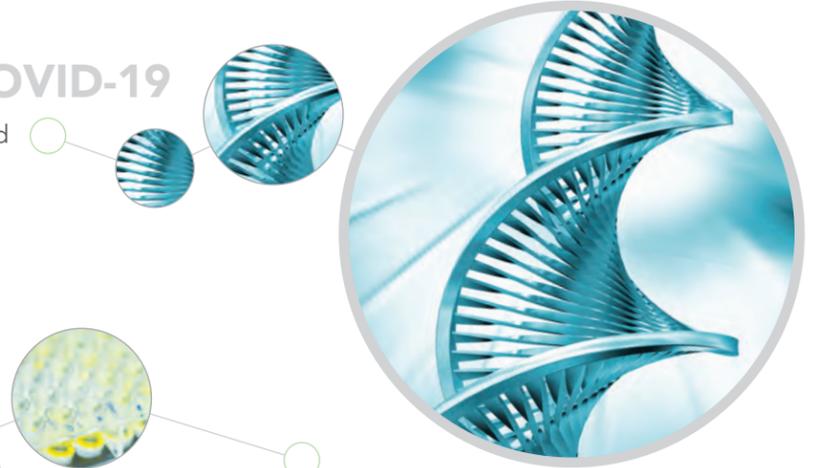
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Optics for Fighting COVID-19

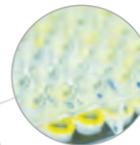
PCR TESTS FOR DIAGNOSING COVID-19

Detecting both symptomatic and asymptomatic cases



OPTICS FOR ANTIBODY DETECTION

Identifying immune responses to COVID-19



INFRARED FEVER DETECTION

Identify individuals who should proceed with further testing



VISION-GUIDED UV CLEANING ROBOTS

Safely sanitize hospitals and high-traffic locations

PCR TESTS for Diagnosing COVID-19

Quick, Reliable, and Accurate COVID-19 Testing



- Genetic material from nasal or throat swabs is added to a unique test solution.
- Sample DNA is replicated during a polymerase chain reaction (PCR).
- This exponentially replicates DNA samples to allow for accurate analysis.
- Fluorescence-based PCR systems feature higher sensitivity than other techniques.
- PCR systems utilize optical filters, lenses, and mirrors.

To learn more about this **CASE STUDY**, visit www.edmundoptics.com/covid-pcr

South Korean healthcare diagnostics company, MiCo BioMed, has developed a rapid, highly-sensitive molecular diagnostic device called the VERI-Q PCR 316 which uses bandpass filters, dichroic filters, spherical lenses, and aspherical lenses from Edmund Optics®.

The US Centers for Disease Control (CDC) has approved RT-PCR tests for combatting the spread of COVID-19.

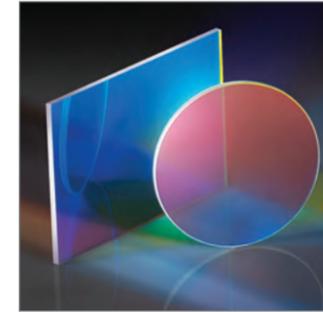
Related Products



TECHSPEC® Fluorescence Bandpass Filters

- Excitation and Emission Filters for Hundreds of Common Fluorophores
- High Transmission and Deep Blocking for Ultimate Signal to Noise Ratio
- Mounted Filter Sets Available for Standard Nikon and Olympus Microscope Configurations

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TECHSPEC® Fluorescence Dichroic Filters

- Dichroic Designs for Hundreds of Common Fluorophores
- Separate Excitation and Emission Channels
- Extended Transmission and Reflection Bands

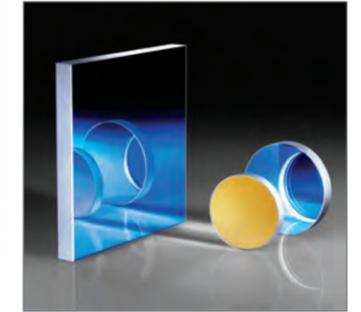
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- VIS and NIR Coating Options for Improved System Throughput
- Molded Designs for High Volume Production

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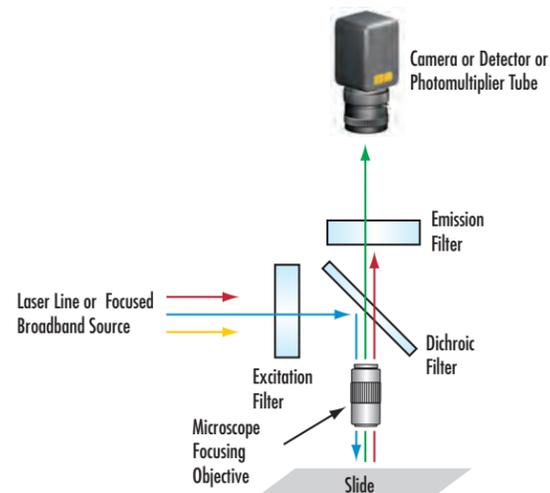


TECHSPEC® First Surface Mirrors

- Durable Coating Options for High Reflection or Harsh Environments
- Low Cost Designs Ideal for Illumination and Detection Channels
- High Performance Designs Ideal for Imaging Channels

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How are Optics Used in COVID-19 Detection?



- Many PCR screening systems rely on fluorescence.
- Targeted double-stranded DNA molecules are tagged with fluorescent dyes that emit light when exposed to a shorter wavelength input.
- These devices follow a similar schematic to fluorescence microscopes.

Microfluidics, where fluids are processed through channels on the order of microns, is the future of this diagnostic technology.

The optical design of fluorescence-based PCR screening systems like VERI-Q PCR 316 resembles this setup of a simple fluorescence microscope.

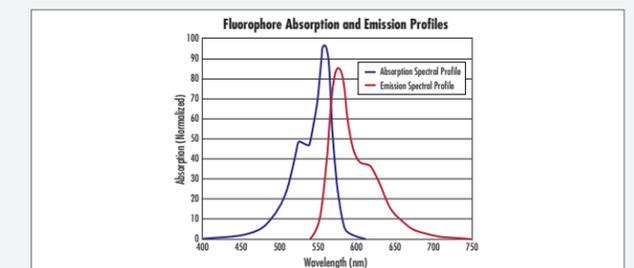
TECHNICAL NOTE

Increase Contrast & Signal Throughput

Fluorescence microscope systems can range from very simple, such as an epifluorescent microscope, to extremely complex, such as confocal or multi-photon systems. Whether simple or complex, fluorescence microscopes share the same basic concept: excitation energy is used to illuminate a sample which then produces emission energy, albeit weak, that is quantifiable. The excitation and emission wavelengths do not share the same center wavelength, and this allows specialized optical filters to increase overall contrast and signal.

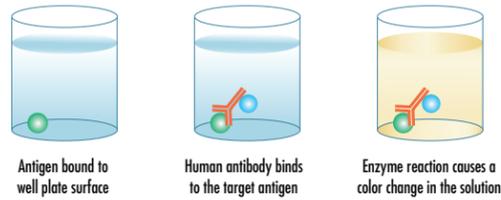
The most basic concept and schematic can be seen on page 4. A filter arrangement is constructed out of three very specific filters: an excitation filter, a dichroic filter, and an emission filter.

- **Excitation Filter:** Placed within the illumination path of a fluorescence microscope. It filters out all wavelengths of the light source except for the excitation range of the fluorophore or specimen.



- **Dichroic Filter:** Placed between the excitation filter and emission filter at a 45° angle. It reflects the excitation signal towards the fluorophore and transmits the emission signal towards the detector.
- **Emission Filter:** Placed within the imaging path of a fluorescence microscope. It filters out the excitation range of the fluorophore and transmits its emission range.

Identifying Immune Responses to COVID-19



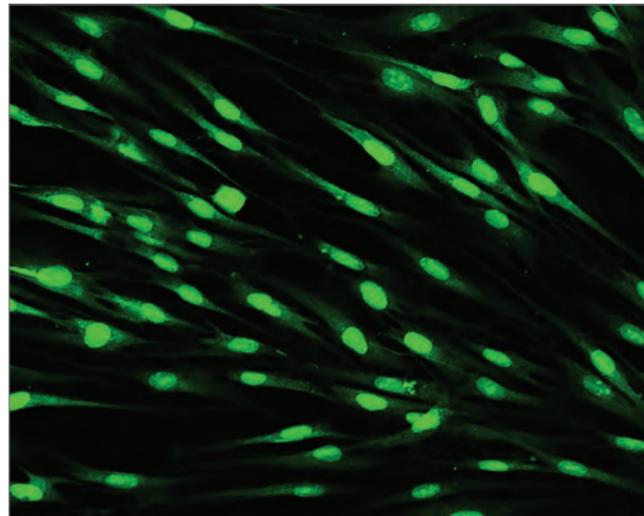
- One technique for identifying antibodies is direct enzyme-linked immunosorbent assay (ELISA).
- A patient's blood is drawn and processed into a serum.
- Any antibodies bond with an immobilized synthetic spike protein with a similar shape to COVID-19 in a well plate.
- A chemical is added which changes color if antibodies have bound to the target antigen.

To learn more about this **CASE STUDY**, visit www.edmundoptics.com/antibody

Antibodies are Y-shaped proteins produced by white blood cells to help stop a virus from intruding.

Color change indicates the presence of antibodies in the direct ELISA process.

Indirect Fluorescent Antibody (IFA) Tests

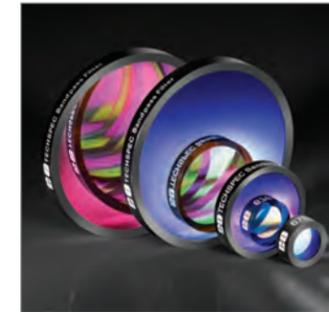


The fluorescence captured in this indirect immunofluorescence test indicates the presence of antibodies.

- IFA is similar to ELISA, but fluorescent dye-conjugated anti-immunoglobulin are added to reveal the presence of antibodies.
- Fluorescence microscopes are used to identify reactions indicating an immune response.
- An advantage of IFA over ELISA is the ability to use the morphology and location of fluorescence to better differentiate antibodies specifically tailored for COVID-19 from more general immune responses.
- These fluorescence systems use many of the same components used in PCR diagnostics.

Antibody tests provide valuable data required to properly track and combat the spread of COVID-19.

Related Products



TECHSPEC® Hard Coated OD4 Bandpass Filter

- Hundreds of Wavelengths Available for Common Lasers, Light Sources, and Protein Signals
- High Performance, Low Cost Design
- Narrow and Broad Bandwidths Available for Improved Signal Discrimination

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TECHSPEC® Precision Aspheric Lenses

- High Numerical Apertures for Compact Systems
- Ultraviolet, Visible, and NIR Optimized Designs
- High Precision for Demanding Applications

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Infinity Corrected Objectives

- Olympus, Zeiss, Mitutoyo, Nikon, and Edmund Optics Brands
- Long Working Distance
- Excellent Color and Field Flatness

www.edmundoptics.com/objectives



TECHSPEC® Cube Beamsplitters

- Polarization-Sensitive or Polarization-Neutral Designs Available
- Simplify System Integration
- Visible and NIR Designs Available

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TECHNICAL NOTE

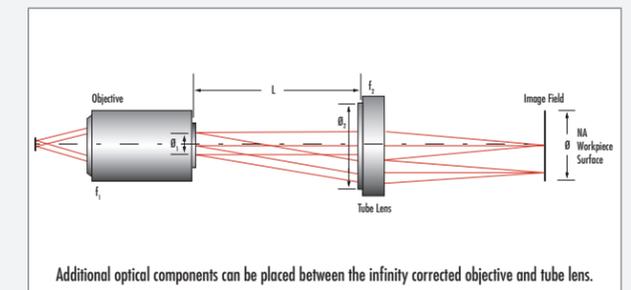
Using Tube Lenses with Infinity Corrected Objectives

Selecting the Proper Tube Lens

In order to create an image with an infinity corrected objective, a tube lens must be used to focus the image. One advantage to using an infinity corrected objective with a tube lens is that there can be a space between the objective and tube lens. The space allows additional optical components to be inserted into the system, such as optical filters or beamsplitters. The distance between the objective and the tube lens (L) can be varied, but this will affect the image field diameter (\varnothing). Equations 1 and 2 are approximation formulas to determine the relation between \varnothing and L .

$$\varnothing_1 = 2f_1 \text{NA} \quad (1) \quad L = \left(\frac{\varnothing_2 - \varnothing_1}{\varnothing} \right) f_2^2 \quad (2)$$

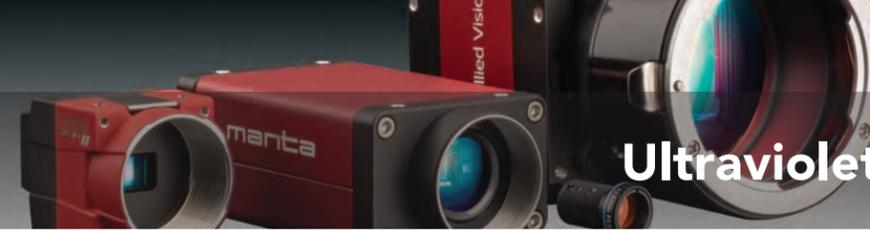
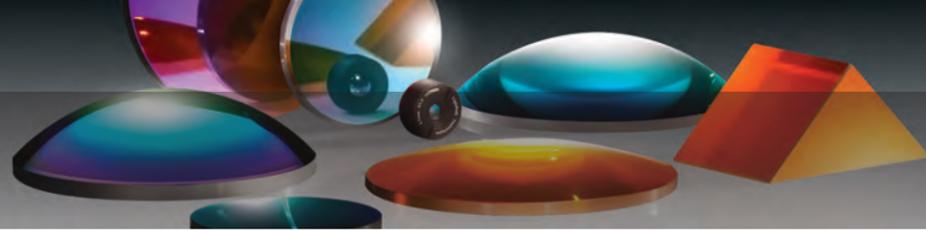
\varnothing_1 (mm) is the exit pupil diameter of the objective, \varnothing_2 (mm) is the entrance pupil of the tube lens, f_1 (mm) is the focal length of the objective, f_2 (mm) is the focal length of the tube lens, and NA is the numerical aperture of the objective.



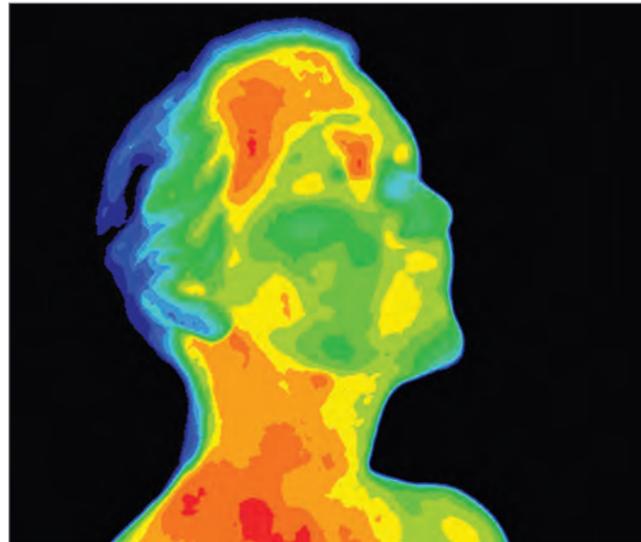
Additional optical components can be placed between the infinity corrected objective and tube lens.

Using a tube length less than this maximum value will prevent vignetting.

Visit www.edmundoptics.com/tube-length to use our Infinite Conjugate Tube Length Calculator and calculate the optimal tube length distance (L) for your application based on the parameters of your objective, tube lens, and imaging sensor.



Elevated Body Temperatures Could Indicate COVID-19



Thermal imaging systems, like non-contact thermometers, can measure infrared radiation to determine a subject's body temperature.

- Infrared optics are utilized to safely measure temperature at a distance.
- Inexpensive handheld devices are accessible and useful for measuring one person at a time.
- Large-area scanners can analyze groups of people at a longer range.
- These systems require optics made from germanium, zinc selenide, and other substrates that can transmit wavelengths around 9µm.

To learn more about this **CASE STUDY**, visit www.edmundoptics.com/fever-detection

Large-area temperature scanners typically require high-precision infrared components.

Safely Sanitizing Hospitals and High-Traffic Locations

- Cleaning robots destroy the DNA or RNA of viruses through UV-C irradiation.
- They use lidar or machine vision to navigate, dodge obstacles, and ensure all surfaces have been cleaned.
- Compact lenses and cameras give robots 3D stereoscopic vision.
- These systems do not require human operators.

To learn more about this **CASE STUDY**, visit www.edmundoptics.com/uv-cleaning-robots

Mobile vision-guided cleaning robots reportedly disinfect rooms more thoroughly than humans.



Research published through the American Chemical Society found that 99.9% of aerosolized coronaviruses similar to COVID-19 were killed when directly exposed to a UV-C lamp.

Related Products



TECHSPEC® Infrared Windows

- More than 20 Glass and Crystalline Materials in Stock
- Wide Variety of Sizes and Coatings
- Extensive Custom Manufacturing Capabilities
- Visit www.edmundoptics.com/ir-windows for Complete Selection

Popular Off-The-Shelf Infrared Windows			
Material	Wavelength Range (µm)	Sizes (mm)	Anti-Reflective Coatings (µm)
Sapphire	0.3 - 5.5	2.5 - 75	1.65 - 3.0; 2.0 - 5.0
Zinc Sulfide	0.4 - 12	12.5 - 50	3.0 - 12.0
Zinc Selenide	0.6 - 18	10.0 - 75.0	3.0 - 12.0; 8.0 - 12.0
KRS-5	0.7 - 40	25.4 - 50.8	Uncoated
AMTIR-1	0.75 - 14	25.4	Uncoated
Gallium Arsenide	1.0 - 16	25.4 - 50.8	Uncoated
Cadmium Telluride	1.0 - 25	12.7 - 25.4	Uncoated
Silicon	1.2 - 7	10.0 - 76.2	3.0 - 5.0; DLC
Germanium	2.0 - 14	10.0 - 76.2	3.0 - 5.0; 8.0 - 12.0; 3.0 - 12.0; DLC

Related Products



TECHSPEC® Compact, M12 (S-Mount) Lenses

- Small Form Factor
- MegaPixel High Resolution Finite Conjugate Designs
- Ruggedized and Electronic Autofocus Versions Available

www.edmundoptics.com/microvideo



TECHSPEC® Mechanically-Streamlined Machine Vision Lenses

- Compact Instrumentation (Ci) Versions of our C Series Lenses
- Streamlined Designs for Instrumentation Integration
- Wide Range of Fixed Aperture Options

www.edmundoptics.com/3437



Compact Machine Vision Cameras

- Compact, Low Cost, High Performance Design for Machine Vision and Embedded Applications
- ALVIUM® System on Chip (SoC) Technology with Onboard Imaging Preprocessing
- Up to 20.2 MegaPixels, 1.1" Sensor Format

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Power Over Ethernet Cameras

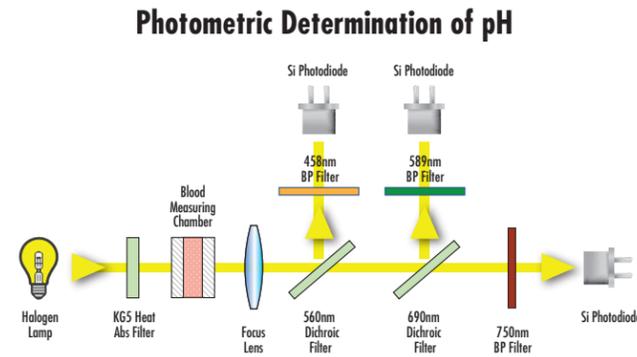
- Up to 1.1" Maximum Sensors
- Up to 128MB of Onboard Memory
- Power over Ethernet for Increased Flexibility

www.edmundoptics.com/3886

Patient Name John Doe
Date 05/07/15

Parameter	Patient Value	Normal Range
FiO ₂	0.8	0.21
pH	7.2	7.35 - 7.45
pO ₂	79.0 mmHg	35 - 45 (4.6 - 6.0)
pCO ₂		35 - 45
HCO ₃ ⁻		22 - 27

Monitoring Patients Using Ventilators to Prevent Complications



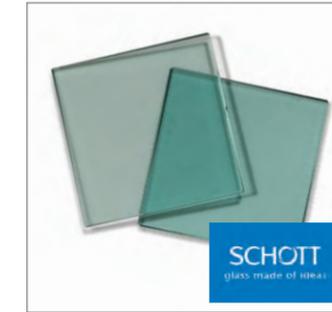
This schematic shows how optics are used to determine the pH level of a patient's blood. Different setups are used to measure O₂, CO₂, and other parameters.

- Ventilators are critical for COVID-19 patients experiencing inflammation in their lungs or respiratory failure.
- Optics are used to closely monitor the blood of ventilator users.
- Parameters including blood gas levels and acidity must be measured to avoid complications.
- These systems use a wide variety of optical components.

To learn more about this **CASE STUDY**, visit www.edmundoptics.com/ventilator-monitoring

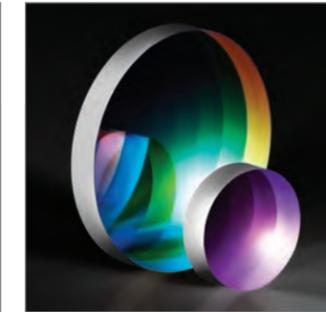
Carbon dioxide, oxygen, pH, and hemoglobin levels are key parameters in arterial blood gas monitoring.

Related Products



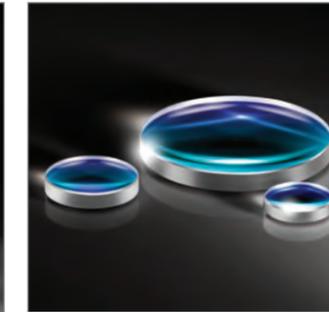
- SCHOTT**
Colored Glass Filters
- Over 60 Glass Types Available
 - Longpass, Bandpass, Heat Absorbing, and Neutral Density Options
 - Many Standard Sizes and Thicknesses Available in Stock

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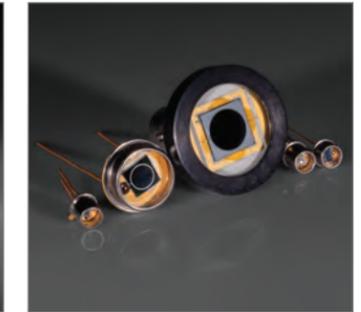
- TECHSPEC**
Hard Coated Filters
- Highest Transmission Filters Available
 - Deepest Blocking Filters Available
 - Ultimate Signal-to-Noise Ratio

www.edmundoptics.com/filters



- TECHSPEC**
UV Fused Silica Lenses
- Ideal for UV Applications
 - PCX, DCX, PCV, and DCV Options Available
 - 4 Broadband and 5 Laser Line AR Coatings In Stock

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- Silicon Photodiodes**
- UV Enhanced, Blue Enhanced, and Normal Response Options
 - Active Areas from <1 to 100mm²
 - C-Mount and S-Mount Mounting Solutions Available

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TECHNICAL NOTE

Three Filter Precision Levels for Different Needs

Edmund Optics® offers a wide variety of optical filters, but they can be generally characterized into 3 distinct precision categories. Each category has its own advantages and challenges, as summarized below. Our team of experienced applications engineers are available to help you choose from the over 3,000 filters available from stock, or to help custom design a filter for your specific needs.

Color Filter Glass		Traditional (Evaporative) Coatings		Hard (Sputtered) Coatings	
Pros	Cons	Pros	Cons	Pros	Cons
Low cost, absorptive glass	Lower transmission than coated filters	Low cost, high volume coating technology	Transmission limited to ~75 - 85%	Transmissions >95% Available	Typically more expensive than evaporative coatings
Durable and resistant to scratches	Less steep transitions from high transmission to high blocking	Many designs from Deep UV to Far IR	Blocking limited to ~OD 4.0 (0.01%)	Blocking >OD6.0 (0.0001%) Available	Limited materials for UV or IR designs
Easy to handle and clean	More limited selection than coated filters	Highly customizable	Edge steepness limited to ~2%	Sharp slopes between transmission and blocking	Very angular sensitive
Insensitive to angle of incidence	Since light is absorbed, can be damaged by high heat or laser power	Many bandpass, edge, dichroic, and neutral density options to choose from	Coatings can be damaged by cleaning or handling	Many bandpass, edge, and dichroic designs to choose from	Coating costs scale considerably with size and complexity

TECHNICAL NOTE

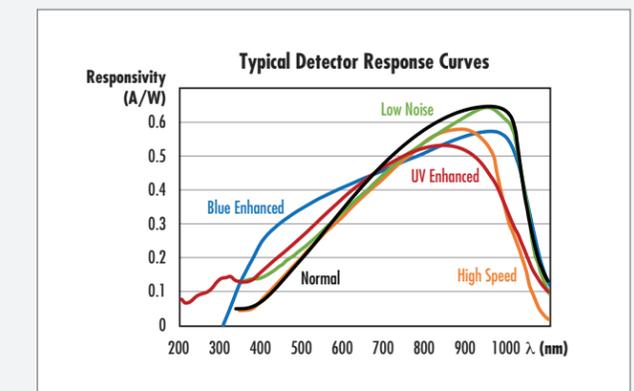
Basics of Silicon Detectors

Transforming Light into Electrical Current

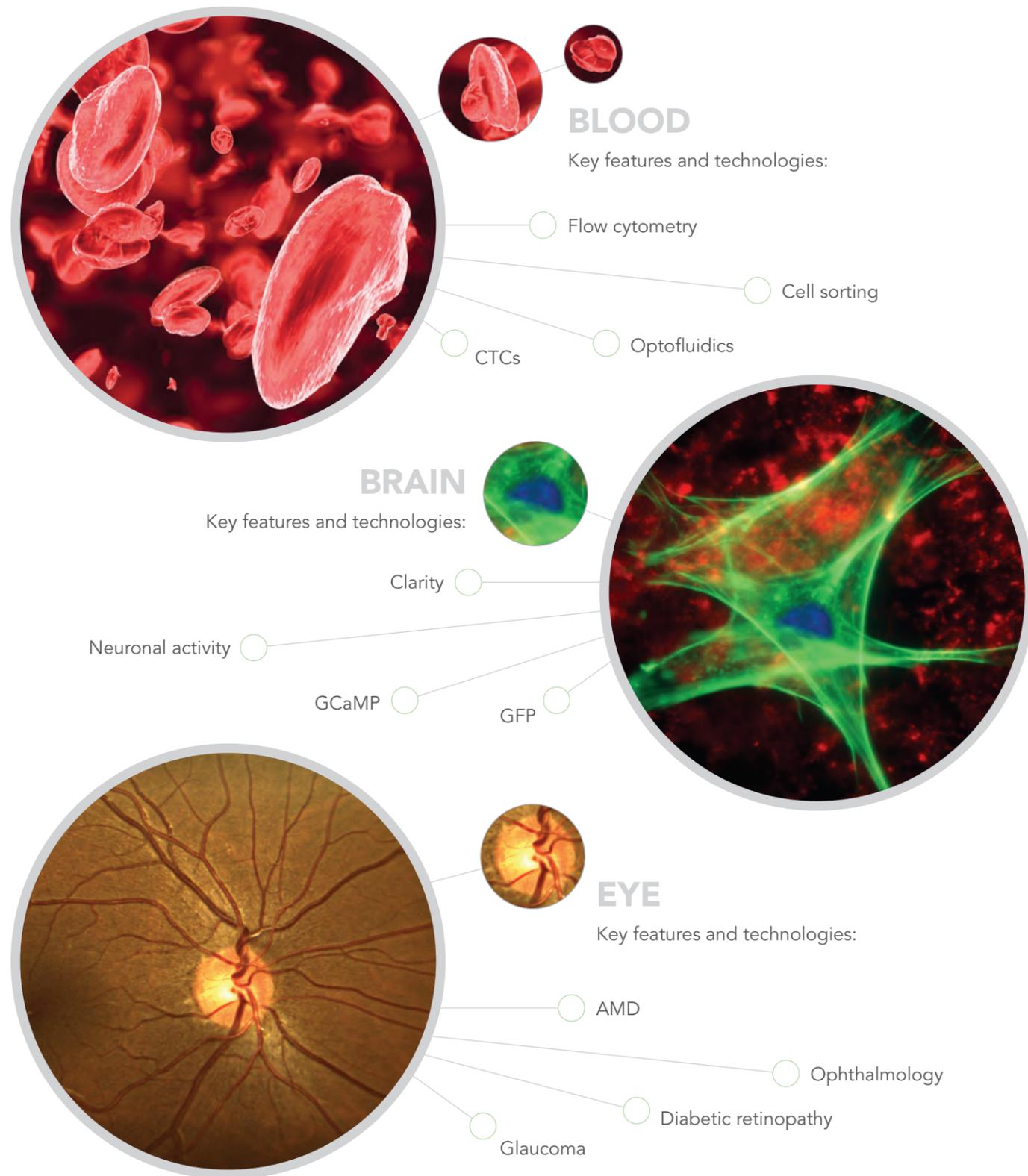
When light with enough energy to excite an electron from the valence to the conduction band is incident upon the detector, the resulting accumulation of charge leads to a flow of current in an attached circuit. Light is not the only source of energy that can excite an electron, and a variety of these "non-light" contributions make up the total noise within the detector. The ratio of the overall signal output to the noise level is known as the signal to noise ratio (S/N) and can be used to determine whether noise will be a concern for a particular application.

Different Operating Modes

- **Photovoltaic (unbiased):** No external bias is applied to the photodiode. Since dark current is a function of bias magnitude, dark current is eliminated as a source of noise. In this case, the noise equivalent power will be lower, allowing greater sensitivity at lower wavelengths. However, one disadvantage is the slightly lower responsivity at higher wavelengths.



- **Photoconductive (biased):** A reverse bias on the photodiode results in a number of response advantages, such as a faster rise time. This makes this type of operation more suitable for high frequency applications. One inconvenience is that the dark current increases with this applied biased current, so noise is introduced into the system.



FILTERS: From UV to IR, We Cover Your Wavelength

Filter Coatings and Color Glass

Edmund Optics® provides precision filters for even the most demanding applications requiring high optical density, high transmission, and steep slopes. From ultra-durable dielectric coatings deposited on precision substrates to custom color glass, we have a filter solution for your application with extensive experience in the documentation, controls, and processes required for FDA-approved devices.

A vast selection of standard filters is in-stock and ready to ship. Custom filters are available for both large volume production and prototyping volumes. Our custom filter capabilities cover the entire range of filter designs including shortpass, longpass, laser-line bandpass, fluorescence bandpass, dichroic, notch, and color glass filters. Contact us for more information or to arrange a quote at www.edmundoptics.com/contact.

Filter Coating Capabilities	
Description	
Dimensions (Diameter or Square):	2 - 100mm
Substrates:	All Glass Types
Spectral Ranges:	193nm - 14µm
Edge Steepness (T _{50%} to OD >4):	<0.5%
Spectral Edge Tolerance:	<1% Deviation, <0.2% Special Cases
Blocking:	>OD 7, Measured
Neutral Density Tolerance:	OD ±5%
Center Wavelength (CWL):	±1nm
Bandwidth:	1nm - Broadband
Transmission:	>95%, Typical
Reflection:	0.1 - 99.95%
Polarization (S:P):	10,000:1
Laser Damage Threshold:	Up to 20 J/cm ² @ 20ns Pulses
Durability:	MIL-STD-810F, Section 507.4, MIL-C-48497A, Section 3.4.1
Parallelism:	1 arcsec
Surface Quality:	20-10

TECHNICAL NOTE

Filters for Advanced Diagnostics

Bandpass Filters – transmits light within a defined bandwidth, which can be as narrow as <5nm or as broad as >50nm. Available in various precision levels from colored glass to advanced hard-coated options.

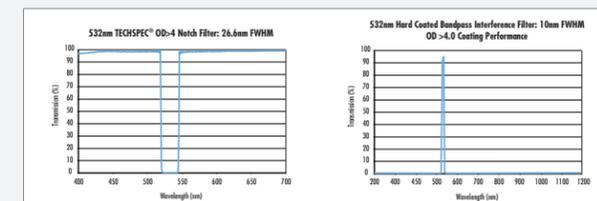


Figure 1: Transmission spectra of bandpass and notch filters

Notch Filters – blocks a pre-selected bandwidth while transmitting all other wavelengths within the design range. Used to remove a single laser wavelength or other narrow band of light.

Longpass Edge Filters – wavelengths shorter than the cut-on wavelength are reflected or absorbed, while longer wavelengths are transmitted.

Shortpass Edge Filters – wavelengths longer than the cut-off wavelength are reflected or absorbed, while shorter wavelengths are transmitted.

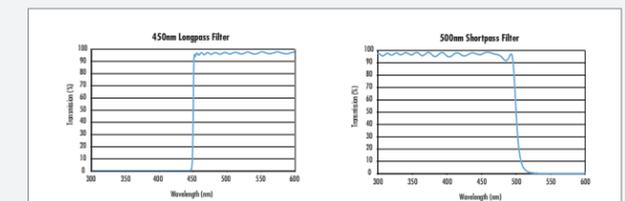
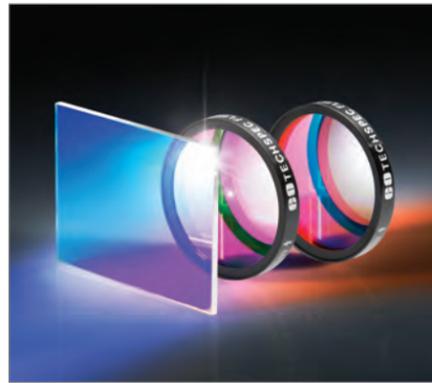


Figure 2: Transmission spectra of longpass and shortpass filters

Dichroic Filters – a specific wavelength range is transmitted while a different range is reflected. These designs can be longpass or shortpass and also allow for specific polarization control.

Neutral Density (ND) Filters – attenuates, or reduces transmission evenly, across a designed wavelength range. They either reflect or absorb light and are typically characterized by their optical density (OD).



TECHSPEC® Fluorescence Filters

- Excitation, Emission, and Dichroic Filters for Fluorescence Imaging
- Common Wavelengths for Popular Fluorophores
- High Transmission and OD 6 Blocking for Maximum Brightness and Contrast

TECHSPEC® Fluorescence Filters offer a complete excitation, emission, and dichroic filter solution for fluorescence microscopy applications. The excitation and emission filters feature high transmission, OD 6 blocking, and center wavelengths that perfectly match the wavelengths of common fluorophores between 340 and 832nm. The dichroic filters are sized to fit into most common Nikon, Zeiss, and Olympus fluorescence microscopes and feature a sharp transition between reflection and transmission wavelengths. TECHSPEC® Fluorescence Filters feature excitation and emission filters with blocking ranges from 250 to 1100nm, ensuring optimum signal-to-noise at the detector. For Fluorescence Filters centered around other fluorophores or in different sizes, please contact us.

TECHSPEC® Fluorescence Filters			
Fluorophore	Excitation Filter – 25mm Diameter Stock No.	Emission Filter – 25mm Diameter Stock No.	Dichroic Filter – 25.2 x 35.6mm Stock No.
DAPI	#84-093	#84-095	#86-330
CFP	#67-026	#67-028	#67-078
Lucifer Yellow	#67-026	#67-031	#86-331
GFP	#67-027	#67-030	#67-079
FITC	#67-028	#67-031	#67-080
SpectrumGreen™	#84-096	#84-098	#67-080
Qdot® 525	#86-349	#86-354	#86-332
Qdot® 605	#86-349	#86-356	#86-332
Qdot® 625	#86-349	#86-357	#86-332
Qdot® 655	#86-349	#86-358	#86-332
YFP	#67-029	#67-032	#67-081

TECHSPEC® Fluorescence Filters			
Fluorophore	Excitation Filter – 25mm Diameter Stock No.	Emission Filter – 25mm Diameter Stock No.	Dichroic Filter – 25.2 x 35.6mm Stock No.
SpectrumGold™	#84-099	#84-100	#86-334
SpectrumOrange™	#67-032	#84-101	#67-082
Cy3™	#67-031	#67-034	#67-082
TRITC	#67-032	#67-034	#67-082
Texas Red	#67-033	#67-035	#67-083
mCherry	#67-033	#67-036	#67-083
SpectrumRed™	#84-101	#84-103	#86-335
Cy5™	#67-035	#67-038	#67-084
Cy5.5™	#67-037	#67-039	#67-085
Indocyanine Green (ICG)	#84-105	#84-107	#86-336

TECHSPEC® Hard Coated OD 4 Bandpass Filters

- Ideal for Life Sciences or Chemical Analysis
- Deep Blocking and High Transmission
- Steep Transmission and Rejection Slopes

TECHSPEC® Hard Coated OD 4 Bandpass Filters are narrowband filters used extensively in life sciences for applications such as fluorescence, bio-imaging, and chemical analysis. These single substrate filters feature hard coatings that maximize transmission and blocking, while preventing long-term performance degradation. Each filter features steep slopes with deep, extended blocking to achieve high performance in demanding applications. TECHSPEC® Hard Coated OD 4 Bandpass Filters are mounted in a black anodized aluminum ring and are available with 5nm, 10nm, 25nm, or 50nm full width-half max and with center wavelengths from the UV to the IR.



TECHSPEC® Hard Coated OD 4 Bandpass Filters - 25mm Diameter General Filters					
Center Wavelength CWL (nm)	Transmission Color	Blocking Range (nm)	10nm FWHM Stock No.	25nm FWHM Stock No.	50nm FWHM Stock No.
400	●	200 - 1200	#65-132	#86-652	#84-781
450	●	200 - 1200	#65-140	#86-653	#84-782
500	●	200 - 1200	#65-149	#86-654	#84-783
550	●	200 - 1200	#65-159	#86-655	#84-784
600	●	200 - 1200	#65-163	#86-656	#84-785
650	●	200 - 1200	#65-170	#86-657	#84-786
700	●	200 - 1200	#88-012	#86-658	#84-787
750	●	200 - 1200	#88-013	#86-659	#84-788
800	●	200 - 1200	#65-179	#86-660	#84-789
850	●	200 - 1200	#86-090	#86-661	#84-790
900	●	200 - 1200	N/A	#86-662	#84-791
950	●	200 - 1200	#88-572	#86-663	#84-792



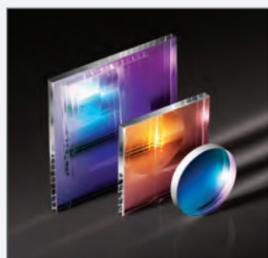
Microscope Filter Cubes

- Ensure Proper Alignment of Filter Sets
- Easily Adapt to Common Microscopes
- Available in Three Versions

Microscope Filter Cubes	
Description	Stock No.
Filter Cube for Nikon Ni, Ci, and LV-N Series Microscopes	#87-304
Filter Cube for Olympus BX2/IX2 Microscopes	#86-832
Filter Cube for Olympus BX3/IX3 Microscopes	#86-833

TECHSPEC® Hard Coated OD 4 Bandpass Filters - 25mm Diameter Laser Line Filters				
Center Wavelength CWL (nm)	Transmission Color	Blocking Range (nm)	5nm FWHM Stock No.	10nm FWHM Stock No.
355	●	200 - 1200	#39-344	#34-491
405	●	200 - 1200	#39-348	#86-653
515	●	200 - 1200	#39-349	#86-654
532	●	200 - 1200	#39-356	#86-655
633	●	200 - 1200	#39-359	#86-656
785	●	200 - 1200	#39-360	#86-657
808	●	200 - 1200	#39-363	#86-658
1064	●	200 - 1200	#39-364	#86-659
1550	●	400 - 1800	N/A	#86-660

CUSTOM COLOR GLASS FILTERS



- 60 SCHOTT Optical Filter Glass Types in Stock
- No Minimum Order Quantity for Both Standard and Custom Dimensions
- Build-to-Print Manufacturing and Full-Custom Design
- Rapid Turnaround for Prototypes

SCHOTT Optical Filter Glass Types Available for Customization					
BG3	BG60	VG9	GG395	GG495	RG695
BG7	BG61	VG20	GG400	OG515	RG715
BG18	BG62	UG1	GG420	OG530	RG9
BG25	BG63	UG5	GG435	OG550	RG780
BG38	BG64	UG11	GG455	OG570	RG830
BG39	BG67	BG36	GG475	OG590	RG850
BG40	RG1000	N-WG280	KG5	RG610	NG5
BG42	KG1	N-WG295	NG1	RG630	NG9
BG50	KG2	N-WG305	NG3	RG645	NG11
BG55	KG3	N-WG320	NG4	RG665	Contact Us for More!

Objectives: Top Brands in the Industry



Olympus Objectives

- Ideal For Brightfield, Darkfield, Fluorescence, Water Immersion, or Super Resolution Techniques
- Excellent Price-to-Performance Ratio
- Ideal for Biological and Industrial Applications

Olympus Objectives									
Objective Type	Wavelength Range (nm)	4X Stock No.	5X Stock No.	10X Stock No.	20X Stock No.	40X Stock No.	50X Stock No.	60X Stock No.	100X Stock No.
Plan Achromatic (PLN)	400 - 700	#86-812	N/A	#86-813	#86-814	#86-815	N/A	N/A	#86-816
Plan Fluorite (UPLFLN)	400 - 700	#86-817	N/A	#86-818	#86-819	#86-820 #86-821	N/A	#86-822	#86-823
Long Working Distance Plan Fluorite (LMPLFLN)	400 - 700	N/A	#88-202	#88-203	#88-204	N/A	#88-205	N/A	#88-206
Brightfield / Darkfield (LMPLFLN-BD)	400 - 700	N/A	#86-827	#86-828	#86-829	N/A	#86-830	N/A	N/A
X-Line Extended Apochromat	400 - 1000	#14-905	N/A	#14-906	#14-907	#14-908	N/A	#14-909	#14-910
Super Long Working Distance (SLMPLN)	400 - 700	N/A	N/A	N/A	#86-824	N/A	#86-825	N/A	#86-826
Water Immersion (UMPLFLN)	360 - 850	N/A	N/A	#34-555	#34-556	#34-557	N/A	N/A	N/A



Mitutoyo Objectives

- Long Working Distances
- High Quality Plan Apochromat Design
- Excellent Brightness
- Flat Image Surface Over Entire Field of View

Mitutoyo Objectives								
Objective Type	Wavelength Range (nm)	2X Stock No.	5X Stock No.	10X Stock No.	20X Stock No.	50X Stock No.	80X Stock No.	100X Stock No.
Standard (M PLAN APO)	435 - 655	#46-142	#46-143	#46-144	#46-145	#46-146	N/A	#46-147
High Resolution (M PLAN APO HR)	435 - 655	N/A	#34-247	#58-236	N/A	#58-237	N/A	#58-238
Long Working Distance (M PLAN APO SL)	435 - 655	N/A	N/A	N/A	#46-398	#46-399	N/A	#46-401
Near Infrared (M PLAN APO NIR)	480 - 1800	N/A	#46-402	#46-403	#46-404	#46-405	N/A	#46-406
High Resolution Near Infrared (M Plan NIR)	480 - 1800	N/A	N/A	N/A	#89-350	#56-982 #89-351	N/A	#56-983
Near Ultraviolet (M PLAN NUV)	355 - 620	N/A	N/A	#86-176	#46-407	#46-408	N/A	#46-409
Ultraviolet (M PLAN UV)	266 & 532	N/A	N/A	#86-175	#56-320	#56-321	#56-322	N/A



Zeiss Objectives

- Ideal For Brightfield, Darkfield, Fluorescence, Water Immersion, or Super Resolution Techniques
- Excellent Price-to-Performance Ratio
- Ideal for Biological and Industrial Applications

Zeiss Objectives									
Objective Type	Wavelength Range (nm)	1X Stock No.	2X Stock No.	5X Stock No.	7.5X Stock No.	10X Stock No.	20X Stock No.	50X Stock No.	100X Stock No.
EC Epiplan	400 - 700	N/A	#13-822	#13-823	#13-824	#13-825	#13-826	N/A	#13-827
A-Plan	400 - 700	#13-814	#13-815	#13-816	#13-817	#13-818	N/A	#13-819	#13-820 #13-821

Nikon Objectives

- Excellent Color Reproduction
- Long Working Distance and High Numerical Aperture
- Strain Free
- M25 x 0.75 Mounting Thread

Designed to meet the most advanced imaging requirements, the CFI60 objectives represent the culmination of Nikon's optical technology. Relying on a 60mm parfocal distance and a much larger barrel diameter allows these objectives to offer increased brightness and the highest possible combination of working distance and numerical aperture for light gathering ability. Designed to correct lateral and axial chromatic aberrations over the entire field of view, these objectives produce crisp, flat, and clear images with high contrast and high resolution.



CFI60 Brightfield Objectives

Nikon Objectives										
Objective Type	Wavelength Range (nm)	2.5X Stock No.	4X Stock No.	5X Stock No.	10X Stock No.	20X Stock No.	40X Stock No.	50X Stock No.	60X Stock No.	100X Stock No.
CFI60 Brightfield (CFI TU Plan Epi)	435 - 850	N/A	N/A	#58-515	#58-516	#58-517	N/A	#58-518	N/A	#58-519
CFI Plan Fluor	435 - 850	N/A	#88-378	N/A	#88-379	#88-380	#88-381	N/A	#88-382	N/A
CFI Super Fluor	435 - 850	N/A	#88-374	N/A	#88-375	#88-376	#88-377	N/A	N/A	N/A
Interferometry	400 - 700	#59-310	N/A	#59-311	#59-312	#59-313	N/A	#59-314	N/A	#62-788

Tube Lenses

- Variety of Options Covering Wavelengths as Low as 266nm and up to 1064nm

In order to create an image with an infinity corrected objective, a tube lens must be used to focus the image. One advantage to using an infinity corrected objective with a tube lens is that there can be a space between the objective and tube lens. The space allows additional optical components to be inserted into the system, such as optical filters or beamsplitters.



Tube Lenses		
Tube Lenses	Wavelength Range (nm)	Stock No.
Mitutoyo MT-4	435 - 655	#54-428
Mitutoyo MT-40	435 - 655	#83-911
Mitutoyo MT-1	435 - 655	#54-774
Mitutoyo MT-2	435 - 655	#56-863
Mitutoyo MT-L	355 - 1064	#56-073
Mitutoyo MT-L4	266 - 620	#56-864

Tube Lenses		
Tube Lenses	Wavelength Range (nm)	Stock No.
Olympus Single Port, 180mm	400 - 700	#86-835
Olympus Wide Field, 180mm	400 - 700	#36-401
Nikon Single Port, 200mm	400 - 700	#58-520
InFocus™ Tube Lens	435 - 655	#33-137
InfiniTube™ Ultima	435 - 655	#34-482
Zeiss 1X	400 - 700	#13-828



TECHSPEC® Spherical Singlet Lenses

- Vast Selection of Materials, Focal Lengths, Sizes, and Coatings
- Used for Light Focusing or Collimation
- >50 Years of Manufacturing Experience
- Visit www.edmundoptics.com/pcx-lenses for Over 4,400 PCX Lenses



TECHSPEC® Achromatic Doublet Lenses

- Minimize Chromatic and Spherical Aberrations using Multiple Lens Elements
- Wide Selection of Wavelength Ranges
- Standard Mounted Options Available
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Molded Aspheric Lenses

- Small Diameter Lenses for Laser Collimation and Focusing
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- Lightweight Options for Weight-Sensitive Systems
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TECHSPEC® Machined Aspheric Lenses

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- Laser Line Coated Options Available
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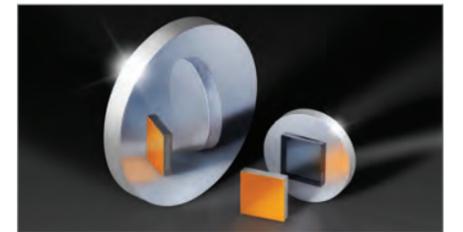
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- Vast Selection of Laser Line and Broadband Coatings
- Ultrafast Laser Mirrors Ideal for Multiphoton Microscopy
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TECHSPEC® Float Glass Mirrors

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- Easily Customizable for Your Specific Application
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- Metallic and Dielectric Coatings Available
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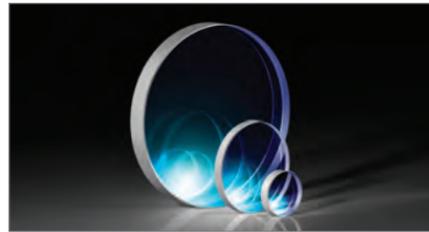
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- Flat Fields, High Resolution Images
- Low Lens-to-Lens Variation

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TECHSPEC® HEO® Series M12 Imaging Lenses

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- Optimized for Infinite Conjugate Systems
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- Waterproof (Cw) Versions of TECHSPEC® C Series Fixed Focal Length Lenses
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- Hydrophobic Coated Window Eliminates the Need for a Protective Lens Cover

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- Sensor Formats: 1/8", 3/8", 1" and 2"
- <0.1° Telecentricity

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- Ultra-Compact (UC) Form Factor
- 4K Resolution Designed for Small Pixels ($\leq 2.2\mu\text{m}$)
- Optimized for 1/2.5" Sensors and Supports up to 1/4.8"

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TECHSPEC® HP Series Fixed Focal Length Lenses

- High Performance (HP) Design
- Up to 9 MegaPixel Resolution Across the Field
- Optimized for 1/2.5" Sensors and Supports up to 1/4.8"

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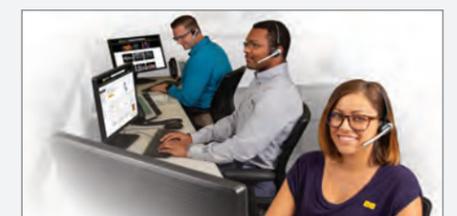
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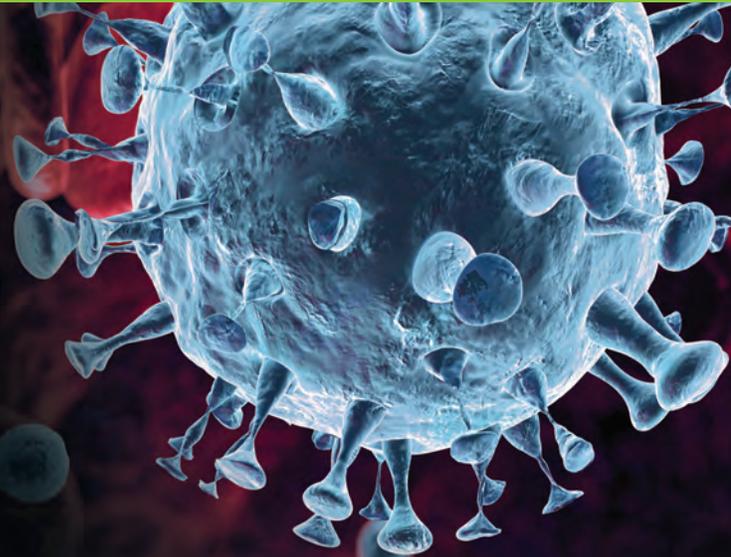
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