

## LB5284-E - May 23, 2024

Item # LB5284-E was discontinued on May 23, 2024. For informational purposes, this is a copy of the website content at that time and is valid only for the stated product.

### CALCIUM FLUORIDE BI-CONVEX LENSES, AR COATED: 2 - 5 mm

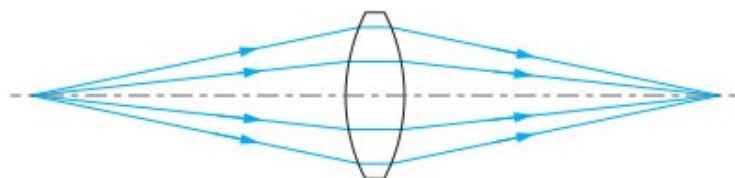
- ▶ AR Coating Optimized for the 2 - 5  $\mu\text{m}$  Range
- ▶ Choose from  $\text{\O}1/2''$  or  $\text{\O}1''$



LB5774-E



LB5766-E



## OVERVIEW

### Features

- Vacuum-Grade Calcium Fluoride Substrate
- $\text{\O}1/2''$  and  $\text{\O}1''$  Versions Available
- Broadband AR Coating for the 2 - 5  $\mu\text{m}$  Range
- Focal Lengths from 15.0 mm to 200.0 mm

Thorlabs'  $\text{\O}1/2''$  and  $\text{\O}1''$  Calcium Fluoride ( $\text{CaF}_2$ ) Bi-Convex Lenses are available uncoated or with a broadband AR coating optimized for the 2  $\mu\text{m}$  to 5  $\mu\text{m}$  spectral range deposited on both surfaces. This coating greatly reduces the surface reflectivity of the substrate, yielding an average transmission in excess of 95% over the entire AR coating range. See the *Graphs* tab for detailed information.

$\text{CaF}_2$  is commonly used for applications requiring high transmission in the infrared and ultraviolet spectral ranges. The material exhibits a low refractive index, varying from 1.35 to 1.51 within its usage range of 180 nm to 8.0  $\mu\text{m}$ . Calcium fluoride is also fairly chemically inert and offers superior hardness compared to its barium fluoride, magnesium fluoride, and lithium fluoride cousins.

Bi-convex lenses are popular for many finite imaging applications. Both surfaces are spherical and have the same radius of curvature, minimizing aberrations in situations where the object and image distances are equal or nearly equal. As a

### Common Specifications

Common Specifications	
Substrate Material	Vacuum-Grade Calcium Fluoride <sup>a</sup>
AR Coating Range	2 - 5 $\mu\text{m}$
Reflectance over Coating Range (Avg.)	<1.25%
Diameter Tolerance	+0.00/-0.10 mm
Thickness Tolerance	$\pm 0.1$ mm
Focal Length Tolerance	$\pm 1\%$
Surface Quality	40-20 (Scratch-Dig)
Spherical Surface Power <sup>b</sup>	$3\lambda/2$
Spherical Surface Irregularity (Peak to Valley)	$\lambda/2$
Centration	<3 arcmin
Clear Aperture	>90% of Diameter
Design Wavelength	588 nm

- a. Click Link for Detailed Specifications on the Substrate
- b. Much like surface flatness for flat optics, spherical surface power is a measure of the deviation between the surface of the curved optic and a calibrated reference gauge, typically for a 633 nm source, unless otherwise stated. This specification is also commonly referred to as surface fit.

guideline, bi-convex lenses are the best choice for minimizing aberrations if the conjugate ratio (object distance : image distance) is between 5:1 and 1:5. Outside this range, plano-convex lenses are usually preferred.

**Zemax Files**

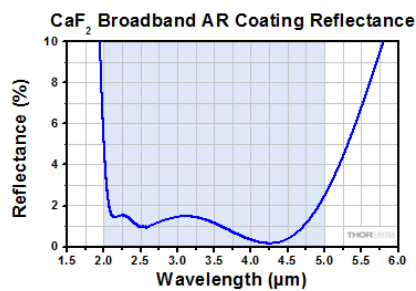
Click on the red Document icon next to the item numbers below to access the Zemax file download. Our entire Zemax Catalog is also available.



Selection Guide		
Calcium Fluoride Lenses	Other MIR Lenses	Other Spherical Singlets

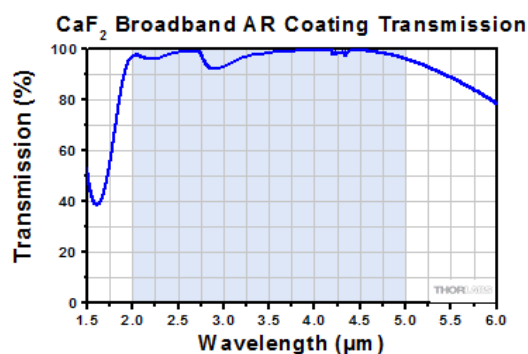
## GRAPHS

### 2 - 5 $\mu\text{m}$ AR Coating Graphs



Click Here for an Excel File with Plot Data

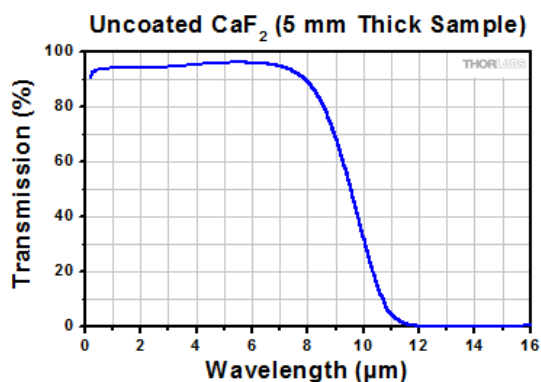
Shown above is a graph of the measured percent reflectance of the enhanced AR coating as a function of wavelength. The average reflectance in the 2 - 5  $\mu\text{m}$  range is  $<1.25\%$ . The blue shading indicates the region for which the AR coating is optimized. Performance outside of the specified range is not guaranteed and varies from lot to lot. The excel file above provides the coating curve data over an extended wavelength range.



Click Here for an Excel File with Plot Data

Shown above is a graph of the measured percent transmission of the enhanced AR coating as a function of wavelength. The blue shading indicates the region for which the AR coating is optimized. Performance outside of the specified range is not guaranteed and varies from lot to lot. The excel file above provides the coating curve data over an extended wavelength range.

### CaF<sub>2</sub> Transmission



Click Here for an Excel File with Plot Data

Shown above is a graph of the measured transmission of an uncoated, 5 mm thick sample of CaF<sub>2</sub>.




## FOCAL LENGTH SHIFT

## Wavelength-Dependent Focal Length Shift






The paraxial focal length of a lens is wavelength dependent. The focal length listed below for a given lens corresponds to the value at the design wavelength (i.e., the focal length at 588 nm). Since  $\text{CaF}_2$  offers high transmission from 0.18 - 8.0  $\mu\text{m}$ , users may wish to use these lenses at other popular wavelengths. Click on the icons below to view theoretically-calculated focal length shifts for wavelengths within the 0.18 - 8.0  $\mu\text{m}$  range.

The blue shading indicates the region for which the AR coating is optimized. Please see the *Graphs* tab for more information.

### Ø1/2" Bi-Convex Lenses

Item #	LB5766-E	LB5922-E	LB5864-E
<b>Focal Length @ 588 nm</b>	15.0 mm	20.0 mm	40.0 mm
<b>Focal Length Shift</b> (Click for Details)			
<b>Raw Data</b> (Click to Download)	Data	Data	Data

### Ø1" Bi-Convex Lenses

Item #	LB5774-E	LB5284-E	LB5247-E	LB5552-E	LB5454-E
<b>Focal Length @ 588 nm</b>	25.4 mm	50.0 mm	75.0 mm	100.0 mm	200.0 mm
<b>Focal Length Shift</b> (Click for Details)					
<b>Raw Data</b> (Click to Download)	Data	Data	Data	Data	Data

## MOUNTING OPTIONS



Click to Enlarge  
LMR1 Fixed Mount with  
Ø1" Lens



Click to Enlarge  
CXY1A Translation Mount  
and  
SM1 Lens Tube Mounted  
in a  
30 mm Cage System



Click to Enlarge  
LM2XY Translating Mount  
with Ø2" Lens



Click to Enlarge  
Ø1" Optic Mounted in a  
ST1XY-S XY Translator

### Recommended Mounting Options for Thorlabs Lenses

Item #
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		<b>Mounts for <math>\varnothing 2</math> mm to <math>\varnothing 10</math> mm Optics</b>
<b>Imperial</b>	<b>Metric</b>	
(Various)		Fixed Lens Mounts and Mini-Series Fixed Lens Mounts for Small Optics, $\varnothing 5$ mm to $\varnothing 10$ mm
(Various)		Small Optic Adapters for Use with Standard Fixed Lens Mounts, $\varnothing 2$ mm to $\varnothing 10$ mm
<b>Item #</b>		<b>Mounts for <math>\varnothing 1/2</math>" (<math>\varnothing 12.7</math> mm) Optics</b>
<b>Imperial</b>	<b>Metric</b>	
LMR05	LMR05/M	Fixed Lens Mount for $\varnothing 1/2$ " Optics
MLH05	MLH05/M	Mini-Series Fixed Lens Mount for $\varnothing 1/2$ " Optics
LM05XY	LM05XY/M	Translating Lens Mount for $\varnothing 1/2$ " Optics
SCP05		16 mm Cage System, XY Translation Mount for $\varnothing 1/2$ " Optics
(Various)		$\varnothing 1/2$ " Lens Tubes, Optional SM05RRC Retaining Ring for High-Curvature Lenses (See Below)
<b>Item #</b>		<b>Mounts for <math>\varnothing 1</math>" (<math>\varnothing 25.4</math> mm) Optics</b>
<b>Imperial</b>	<b>Metric</b>	
LMR1	LMR1/M	Fixed Lens Mount for $\varnothing 1$ " Optics
LM1XY	LM1XY/M	Translating Lens Mount for $\varnothing 1$ " Optics
ST1XY-S	ST1XY-S/M	Translating Lens Mount with Micrometer Drives (Other Drives Available)
CXY1A		30 mm Cage System, XY Translation Mount for $\varnothing 1$ " Optics
(Various)		$\varnothing 1$ " Lens Tubes, Optional SM1RRC Retaining Ring for High-Curvature Lenses (See Below)
<b>Item #</b>		<b>Mount for <math>\varnothing 1.5</math>" Optics</b>
<b>Imperial</b>	<b>Metric</b>	
LMR1.5	LMR1.5/M	Fixed Lens Mount for $\varnothing 1.5$ " Optics
(Various)		$\varnothing 1.5$ " Lens Tubes, Optional SM1.5RR Retaining Ring for $\varnothing 1.5$ " Lens Tubes and Mounts
<b>Item #</b>		<b>Mounts for <math>\varnothing 2</math>" (<math>\varnothing 50.8</math> mm) Optics</b>
<b>Imperial</b>	<b>Metric</b>	
LMR2	LMR2/M	Fixed Lens Mount for $\varnothing 2$ " Optics
LM2XY	LM2XY/M	Translating Lens Mount for $\varnothing 2$ " Optics
CXY2		60 mm Cage System, XY Translation Mount for $\varnothing 2$ " Optics
(Various)		$\varnothing 2$ " Lens Tubes, Optional SM2RRC Retaining Ring for High-Curvature Lenses (See Below)
<b>Item #</b>		<b>Adjustable Optic Mounts</b>
<b>Imperial</b>	<b>Metric</b>	
LH1	LH1/M	Adjustable Mount for $\varnothing 0.28$ " ( $\varnothing 7.1$ mm) to $\varnothing 1.80$ " ( $\varnothing 45.7$ mm) Optics
LH2	LH2/M	Adjustable Mount for $\varnothing 0.77$ " ( $\varnothing 19.6$ mm) to $\varnothing 2.28$ " ( $\varnothing 57.9$ mm) Optics
VG100	VG100/M	Adjustable Clamp for $\varnothing 0.5$ " ( $\varnothing 13$ mm) to $\varnothing 3.5$ " ( $\varnothing 89$ mm) Optics
SCL03	SCL03/M	Self-Centering Mount for $\varnothing 0.15$ " ( $\varnothing 3.8$ mm) to $\varnothing 1.77$ " ( $\varnothing 45.0$ mm) Optics
SCL04	SCL04/M	Self-Centering Mount for $\varnothing 0.15$ " ( $\varnothing 3.8$ mm) to $\varnothing 3.00$ " ( $\varnothing 76.2$ mm) Optics
LH160C	LH160C/M	Adjustable Mount for 60 mm Cage Systems, $\varnothing 0.50$ " ( $\varnothing 13$ mm) to $\varnothing 2.00$ " ( $\varnothing 50.8$ mm) Optics
SCL60C	SCL60C/M	Self-Centering Mount for 60 mm Cage Systems, $\varnothing 0.15$ " ( $\varnothing 3.8$ mm) to $\varnothing 1.77$ " ( $\varnothing 45.0$ mm) Optics

### Mounting High-Curvature Optics

Thorlabs' retaining rings are used to secure unmounted optics within lens tubes or optic mounts. These rings are secured in position using a compatible spanner wrench. For flat or low-curvature optics, standard retaining rings manufactured from anodized aluminum are available from  $\varnothing 5$  mm to  $\varnothing 4$ ". For high-curvature optics, extra-thick retaining rings are available in  $\varnothing 1/2$ ",  $\varnothing 1$ ", and  $\varnothing 2$ " sizes.

Extra-thick retaining rings offer several features that aid in mounting high-curvature optics such as aspheric lenses, short-focal-length plano-convex lenses, and condenser lenses. As shown in the animation to the right, the guide flange of the spanner wrench will collide with the surface of high-curvature lenses when using a

standard retaining ring, potentially scratching the optic. This contact also creates a gap between the spanner wrench and retaining ring, preventing the ring from tightening correctly. Extra-thick retaining rings provide the necessary clearance for the spanner wrench to secure the lens without coming into contact with the optic surface.

### Ø1/2" CaF<sub>2</sub> Bi-Convex Lenses, AR Coated: 2 - 5 $\mu\text{m}$


Item #	Diameter	Focal Length	Diopter <sup>a</sup>	Radius of Curvature	Center Thickness	Edge Thickness <sup>b</sup>	Back Focal Length <sup>c</sup>	Reference Drawing
LB5766-E	1/2" (12.7 mm)	15.0 mm	+66.6	12.1 mm	5.6 mm	2.0 mm	12.9 mm	
LB5922-E	1/2" (12.7 mm)	20.0 mm	+50.0	16.6 mm	4.5 mm	2.0 mm	18.4 mm	
LB5864-E	1/2" (12.7 mm)	40.0 mm	+25.0	34.2 mm	3.2 mm	2.0 mm	38.9 mm	

Suggested Fixed Lens Mount: LMR05(/M)

- a. Reciprocal of the Focal Length in Meters
- b. Edge Thickness Given Before 0.2 mm at 45° Typical
- c. Chamfer Measured at Design Wavelength, 588 nm

Part Number	Description	Price	Availability
LB5766-E	Ø1/2" CaF <sub>2</sub> Bi-Convex Lens, f = 15.0 mm, AR-Coated: 2 - 5 $\mu\text{m}$	\$224.51	Today
LB5922-E	Ø1/2" CaF <sub>2</sub> Bi-Convex Lens, f = 20.0 mm, AR-Coated: 2 - 5 $\mu\text{m}$	\$224.51	Today
LB5864-E	Ø1/2" CaF <sub>2</sub> Bi-Convex Lens, f = 40.0 mm, AR-Coated: 2 - 5 $\mu\text{m}$	\$224.51	Today

### Ø1" CaF<sub>2</sub> Bi-Convex Lenses, AR Coated: 2 - 5 $\mu\text{m}$

Item #	Diameter	Focal Length	Diopter <sup>a</sup>	Radius of Curvature	Center Thickness	Edge Thickness <sup>b</sup>	Back Focal Length <sup>c</sup>	Reference Drawing
LB5774-E	1" (25.4 mm)	25.4 mm	+39.4	20.2 mm	11.0 mm	2.0 mm	21.2 mm	
LB5284-E	1" (25.4 mm)	50.0 mm	+20.0	42.5 mm	5.9 mm	2.0 mm	47.9 mm	
LB5247-E	1" (25.4 mm)	75.0 mm	+13.3	64.4 mm	4.5 mm	2.0 mm	73.4 mm	
LB5552-E	1" (25.4 mm)	100.0 mm	+10.0	86.2 mm	3.9 mm	2.0 mm	98.6 mm	
LB5454-E	1" (25.4 mm)	200.0 mm	+5.0	173.1 mm	2.9 mm	2.0 mm	199.0 mm	

Suggested Fixed Lens Mount: LMR1(/M)

- a. Reciprocal of the Focal Length in Meters
- b. Edge Thickness Given Before 0.2 mm at 45° Typical
- c. Chamfer Measured at Design Wavelength, 588 nm

Part Number	Description	Price	Availability
LB5774-E	Ø1" CaF <sub>2</sub> Bi-Convex Lens, f = 25.4 mm, AR-Coated: 2 - 5 $\mu\text{m}$	\$250.65	Today
LB5284-E	Ø1" CaF <sub>2</sub> Bi-Convex Lens, f = 50.0 mm, AR-Coated: 2 - 5 $\mu\text{m}$	\$250.65	Today
LB5247-E	Ø1" CaF <sub>2</sub> Bi-Convex Lens, f = 75.0 mm, AR-Coated: 2 - 5 $\mu\text{m}$	\$250.65	Today
LB5552-E	Ø1" CaF <sub>2</sub> Bi-Convex Lens, f = 100.0 mm, AR-Coated: 2 - 5 $\mu\text{m}$	\$250.65	Today
LB5454-E	Ø1" CaF <sub>2</sub> Bi-Convex Lens, f = 200.0 mm, AR-Coated: 2 - 5 $\mu\text{m}$	\$250.65	Today

