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THORLABS

BE20M-C - March 20, 2015

Item # BE20M-C was discontinued on March 20, 2015. For informational purposes, this is a copy of the website content at that time and is valid only for the stated product.

OPTICAL BEAM EXPANDERS: BEAM EXPANSION OR REDUCTION

► **Ideal for Reducing Beam Divergence**
► **Compatible with Many of our Standard Optics for Focusing**
► **Easy to Mount and Align Using Our Standard Posts and Mounts**

BE02M-A

BE10M-C

BE15M-C

BE03M-B

[Hide Overview](#)

OVERVIEW

Features

- Ideal for Reducing Beam Divergence
- Diffraction-Limited Performance with <λ/4 Wavefront Error Introduced
- Input Aperture is Threaded to Work with our SM05- and SM1-Threaded Adapters
- Easy to Mount and Align using our Standard Posts and Mounts

📄 **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.

These Galilean Beam Expanders provide an ideal solution for expanding or reducing beam diameters. They are also commonly used to reduce divergence, which will decrease by the same factor that magnification is increased. Another common use is to expand the beam and then focus with another lens to take advantage of a reduction in spot size. These beam expanders have all been designed to minimize the telescope length, minimize the introduced wavefront error (<λ/4), and provide diffraction-limited performance (for <Ø1 mm input).

The design incorporates a plano-concave singlet to provide the desired divergence and a doublet, which has been computer optimized to balance aberrations and re-collimate the beam. The rotary barrel controls adjustment of the diverging lens with graduations in 50 µm increments. All of the designs are available with a broadband antireflection coating for the 400 - 650 nm (-A), 650 - 1050 nm (-B), or 1050 - 1620 nm (-C) wavelength range.

Thorlabs also offers many other types of beam expanders, including variable beam expanders whose expansion ratio is achieved via rotation and fixed beam expanders with a sliding collimation adjustment mechanism. For more information on our extensive line of beam expanders, please click on the *Selection Guide* tab.

Easy Mounting and Alignment

These beam expanders have a variety of options for mounting in fixed or kinematic mounts. The input

aperture is threaded to provide compatibility with our externally threaded SM05 (for BE02M, BE03M, and BE05M) or SM1 (BE10M, BE15M, and BE20M) products. As a result, these beam expanders can be used with many of our kinematic mounts, lens holders, iris diaphragms, and other optomechanics.

The image to the right shows the beam expander mounted in a KM100 kinematic mount. A mounting ring allows the beam expander to be secured into 1" or 2" mounts. The BE02M, BE03M, and BE05M can be used with our KS1, KM100, or FMP1 mounts. The BE10M, BE15M, and BE20M have a 2" mounting ring that is compatible with mounts such as the KS2 or FMP2.

The image to the left shows the fixed post-mounting configuration available with these beam expanders. 4-40 and M3 tapped holes are provided on the BE02M, BE03M, and BE05M, while the BE10M, BE15M, and BE20M models have 8-32 and M4 tapped holes.

[Hide Specs](#)

SPECS

	BE02M	BE03M	BE05M	BE10M	BE15M	BE20M
Expansion	2X	3X	5X	10X	15X	20X
Input Aperture	Ø8.0 mm	Ø8.0 mm	Ø4.6 mm	Ø4.6 mm	Ø4.6 mm	Ø4.6 mm
Max. Input Beam Diameter[a]	Ø4.0 mm	Ø4.5 mm	Ø2.5 mm	Ø2.0 mm	Ø1.6 mm	Ø1.2 mm
Input Thread	SM05	SM05	SM05	SM1	SM1	SM1
Output Thread	SM1	M36[b]	M36[b]	SM2	SM2	SM2
Recommended Mount	KS1 / MSP1	KS1 / MSP1	KS1 / MSP1	KS2 / TR2	KS2 /TR2	KS2 / TR2
AR Coating Options	-A: 400 - 650 nm -B: 650 - 1050 nm -C: 1050 - 1620 nm					
Scratch-Dig	20-10					
Wavefront Error	<λ/4					
AR Coating Reflectivity	<0.5% over AR Coating Range					
Lens Substrates	N-BK7, SF2	N-BK7, N-SK11	N-BK7, N-SK11	N-BK7, SF2	N-BK7, N-SF5	N-BK7, N-SF5
Housing Dimensions						
Input Housing Dimension	Ø23.5 mm			Ø32.0 mm		
Output Housing Dimension	Ø31 mm	Ø39.8 mm	Ø42 mm	Ø56 mm	Ø59 mm	Ø59 mm
Length of Housing	38 - 42 mm	64 - 69 mm	71 - 78 mm	116 - 136 mm	197 - 215 mm	267 - 287 mm

- For Diffraction-Limited Performance
- The SM2A19 adapter, shown below, makes these beam expanders compatible with our Ø2" Lens Tubes and 60 mm Cage Systems. It features external M36 threads and internal SM2 threads.

[Hide Selection Guide](#)

S E L E C T I O N   G U I D E

Thorlabs offers several different families of beam expanders to meet various experimental needs. The table below provides a direct comparison of the options we offer. Please contact Tech Support if you would like help choosing the best beam expander for your specific application.

Beam Expander Description	Fixed Magnification UV Fused Silica, Sliding Lens	Fixed Magnification Rotating Lens	Variable Ratio Rotating Lens	Variable Ratio Sliding Lens	Reflective Beam Expander Fixed Ratio
Expansions Available	2X, 3X, 5X, 10X	2X, 3X, 5X, 10X, 15X, 20X	2 - 5X 5 - 10X	0.5 - 2X	2X, 4X, 6X
AR Coating	240 - 360 nm (-UVB) 248 - 287 nm (-266) 960 - 10640 nm (-1064)	400 - 650 nm (-A)		400 - 650 nm (-A)	
Mirror Coating (Range)	N/A				Protected Silver (450 nm - 20 µm)
Reflectance (per Surface)	$R_{avg} < 0.2\%$ ($R_{Max} < 1.5\%$ for -UVB)	$R_{avg} < 0.5\%$		$R_{avg} < 0.5\%$	$R_{avg} > 96\%$
Max Input Beam Diameter $(1/e^2)$ [a]	2X: Ø8.5 mm 3X: Ø9.0 mm 5X: Ø4.3 mm 10X: Ø2.8 mm	2X, 3X: Ø4.0 mm 5X, 10X, 15X, 20X: Ø2.25 mm	Ø3.0 mm	0.5X: Ø6.0 mm to 2X: Ø3.0 mm	Ø3 mm
Input Aperture	2X: Ø9.7 mm 3X: Ø10.6 mm 5X: Ø7.0 mm 10X: Ø3.5 mm	2X, 3X: Ø8 mm 5X, 10X, 15X, 20X: Ø4.5 mm	Ø8.0 mm	Ø10.0 mm	Ø6 mm
Wavefront Error	<λ/4				<λ/10 [b]
Surface Quality	10-5 Scratch-Dig	20-10 Scratch-Dig			40-20 Scratch-Dig

- For Diffraction-Limited Performance
- For a Ø1.5 mm Input Beam at 2X magnification, Ø1.0 mm Input Beam at 4X magnification, or Ø0.5 mm Input Beam at 6X magnification.

WAVEFRONT DATA
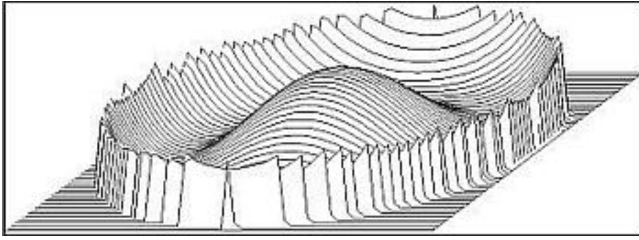
Left: Typical wire grid plot of the wavefront distortion of a Gaussian beam that has propagated through a BE series Gaussian beam expander. See the table below for the calculated peak-to-valley wavefront distortion value and the RMS wavefront distortion value for each BE series beam expander at its design wavelength.

Thorlabs' BE series of beam expanders are specified to provide diffraction-limited performance, which means that the introduced wavefront distortion in a Gaussian beam will be less than λ/4. However, the nominal performance of the BE series of beam expanders is typically much better than this specification. Below is a table that lists the calculated wavefront distortion for each BE series beam expander and the parameters of the beam used to make the calculation. The beam is normally incident on the beam expander and the propagation direction is such that the output beam is larger than the input beam. Click on the item number in the table to download the corresponding wire grid plot and the data file used to create that plot.

Item#	Input Beam Diameter	Wavelength	Peak-to-Valley Wavefront Distortion	RMS Wavefront Distortion	Output Beam Diameter
BE02M-A	4 mm	543.8 nm	0.0196λ	0.0056λ	8.12 mm
BE02M-B	4 mm	840 nm	0.0113λ	0.0032λ	8.04 mm
BE02M-C	4 mm	1315 nm	0.0100λ	0.0029λ	8.02 mm
BE03M-A	4 mm	543.8 nm	0.0255λ	0.0075λ	11.68 mm
BE03M-B	4 mm	840 nm	0.0117λ	0.0034λ	11.67 mm
BE03M-C	4 mm	1315 nm	0.0050λ	0.0015λ	11.67 mm
BE05M-A	2.25 mm	543.8 nm	0.0068λ	0.0019λ	10.91 mm
BE05M-B	2.25 mm	840 nm	0.0025λ	0.0007λ	10.90 mm
BE05M-C	2.25 mm	1315 nm	0.0009λ	0.0002λ	10.91 mm
BE10M-A	2.25 mm	543.8 nm	0.0185λ	0.0040λ	21.77 mm
BE10M-B	2.25 mm	840 nm	0.0685λ	0.0197λ	21.41 mm
BE10M-C	2.25 mm	1315 nm	0.0547λ	0.0159λ	21.33 mm
BE15M-A	2.25 mm	543.8 nm	0.0163λ	0.0034λ	32.73 mm
BE15M-B	2.25 mm	840 nm	0.0576λ	0.0163λ	32.18 mm
BE15M-C	2.25 mm	1315 nm	0.0430λ	0.0124λ	32.04 mm
BE20M-A	2.25 mm	543.8 nm	0.1022λ	0.0276λ	44.59 mm
BE20M-B	2.25 mm	840 nm	0.0288λ	0.0074λ	43.75 mm
BE20M-C	2.25 mm	1315 nm	0.0309λ	0.0085λ	43.51 mm

2X Optical Beam Expanders

BE02M-A

Item #	Expansion	Input Aperture	Max Input[a] (1/e^2)	AR Coating Range
BE02M-A	2X	Ø8 mm	4.0 mm	400 - 650 nm
BE02M-B	2X	Ø8 mm	4.0 mm	650 - 1050 nm
BE02M-C	2X	Ø8 mm	4.0 mm	1050 - 1620 nm

- For Diffraction-Limited Performance
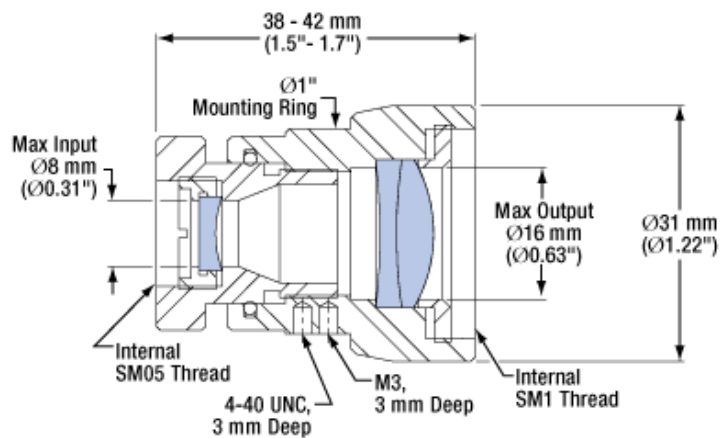
Click to Enlarge

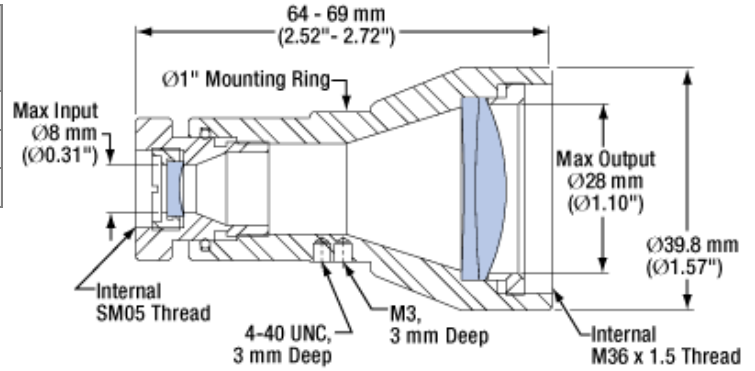| Part Number	Description	Price	Availability
BE02M-A	2X Optical Beam Expander, AR Coated: 400 - 650 nm	$394.00	Lead Time
BE02M-B	2X Optical Beam Expander, AR Coated: 650 - 1050 nm	$394.00	Lead Time
BE02M-C	2X Optical Beam Expander, AR Coated: 1050 - 1620 nm	$394.00	Lead Time

3X Optical Beam Expanders

BE03M-B

Item #	Expansion	Input Aperture	Max Input[a] (1/e^2)	AR Coating Range
BE03M-A	3X	Ø8 mm	4.5 mm	400 - 650 nm
BE03M-B	3X	Ø8 mm	4.5 mm	650 - 1050 nm
BE03M-C	3X	Ø8 mm	4.5 mm	1050 - 1620 nm

- For Diffraction-Limited Performance

The SM2A19 adapter featured at the bottom of this page allows the BE03M Series beam expanders to be used with our SM2-threaded (2.035"-40) components, such as Ø2" lens tubes and 60 mm cage systems.

64 - 69 mm (2.52"- 2.72")
Ø1" Mounting Ring
Max Input Ø8 mm (Ø0.31")
Internal SM05 Thread
4-40 UNC, 3 mm Deep
M3, 3 mm Deep
Max Output Ø28 mm (Ø1.10")
Ø39.8 mm (Ø1.57")
Internal M36 x 1.5 Thread

Click to Enlarge

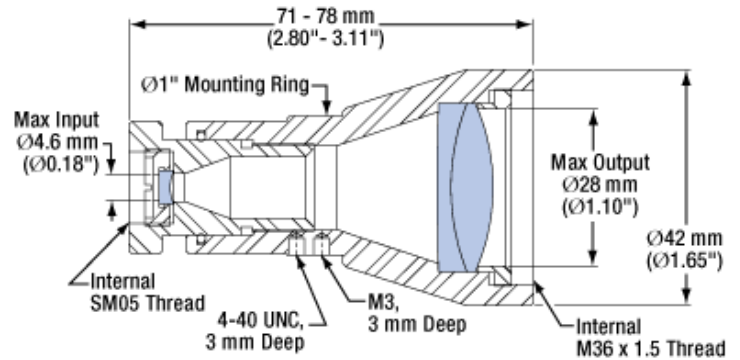| Part Number	Description	Price	Availability
BE03M-A	3X Optical Beam Expander, AR Coated: 400 - 650 nm	$483.00	Lead Time
BE03M-B	3X Optical Beam Expander, AR Coated: 650 - 1050 nm	$483.00	Lead Time
BE03M-C	3X Optical Beam Expander, AR Coated: 1050 - 1620 nm	$483.00	3-5 Days

5X Optical Beam Expanders

BE05M-C

Item #	Expansion	Input Aperture	Max Input[a] (1/e^2)	AR Coating Range
BE05M-A	5X	Ø4.6 mm	2.5 mm	400 - 650 nm
BE05M-B	5X	Ø4.6 mm	2.5 mm	650 - 1050 nm
BE05M-C	5X	Ø4.6 mm	2.5 mm	1050 - 1620 nm

- For Diffraction-Limited Performance

The SM2A19 adapter featured at the bottom of this page allows the BE05M Series beam expanders to be used with our SM2-threaded (2.035"-40) components, such as Ø2" lens tubes and 60 mm cage systems.

71 - 78 mm (2.80"- 3.11")
Ø1" Mounting Ring
Max Input Ø4.6 mm (Ø0.18")
Internal SM05 Thread
4-40 UNC, 3 mm Deep
M3, 3 mm Deep
Max Output Ø28 mm (Ø1.10")
Ø42 mm (Ø1.65")
Internal M36 x 1.5 Thread

Click to Enlarge

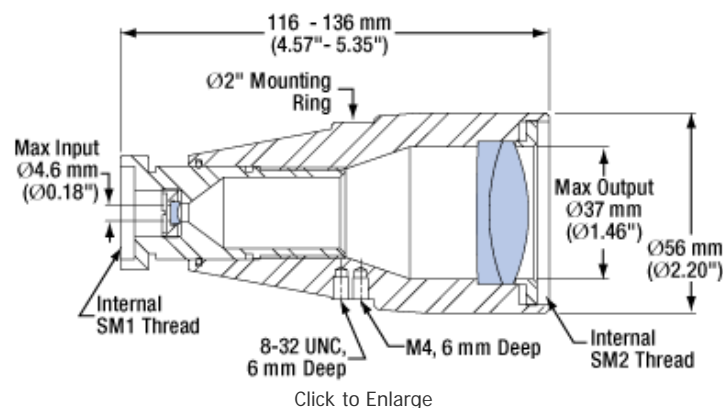| Part Number	Description	Price	Availability
BE05M-A	5X Optical Beam Expander, AR Coated: 400 - 650 nm	$462.00	Lead Time
BE05M-B	5X Optical Beam Expander, AR Coated: 650 - 1050 nm	$462.00	Lead Time
BE05M-C	5X Optical Beam Expander, AR Coated: 1050 - 1620 nm	$462.00	Lead Time

10X Optical Beam Expanders

BE10M-A

Item #	Expansion	Input Aperture	Max Input[a] (1/e²)	AR Coating Range
BE10M-A	10X	Ø4.6 mm	2.0 mm	400 - 650 nm
BE10M-B	10X	Ø4.6 mm	2.0 mm	650 - 1050 nm
BE10M-C	10X	Ø4.6 mm	2.0 mm	1050 - 1620 nm

- For Diffraction-Limited Performance

116 - 136 mm (4.57"- 5.35")
Ø2" Mounting Ring
Max Input Ø4.6 mm (Ø0.18")
Max Output Ø37 mm (Ø1.46")
Ø56 mm (Ø2.20")
Internal SM1 Thread
8-32 UNC, 6 mm Deep
M4, 6 mm Deep
Internal SM2 Thread

Click to Enlarge

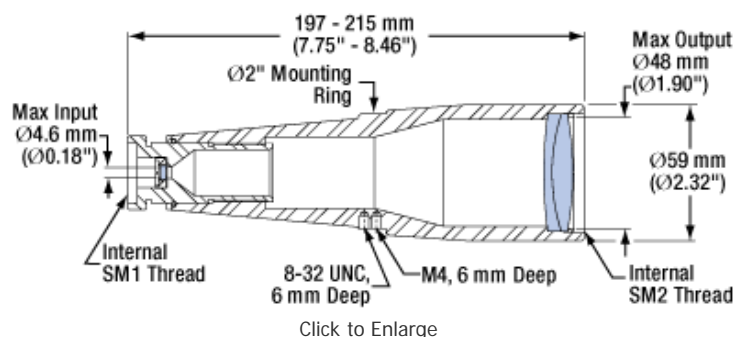| Part Number	Description	Price	Availability
BE10M-A	10X Optical Beam Expander, AR Coated: 400 - 650 nm	$536.00	Lead Time
BE10M-B	10X Optical Beam Expander, AR Coated: 650 - 1050 nm	$536.00	Lead Time
BE10M-C	10X Optical Beam Expander, AR Coated: 1050 - 1620 nm	$536.00	Today

15X Optical Beam Expanders

BE15M-B

Item #	Expansion	Input Aperture	Max Input[a] (1/e²)	AR Coating Range
BE15M-A	15X	Ø4.6 mm	1.6 mm	400 - 650 nm
BE15M-B	15X	Ø4.6 mm	1.6 mm	650 - 1050 nm
BE15M-C	15X	Ø4.6 mm	1.6 mm	1050 - 1620 nm

- For Diffraction-Limited Performance

197 - 215 mm (7.75" - 8.46")
Ø2" Mounting Ring
Max Input Ø4.6 mm (Ø0.18")
Max Output Ø48 mm (Ø1.90")
Ø59 mm (Ø2.32")
Internal SM1 Thread
8-32 UNC, 6 mm Deep
M4, 6 mm Deep
Internal SM2 Thread

Click to Enlarge

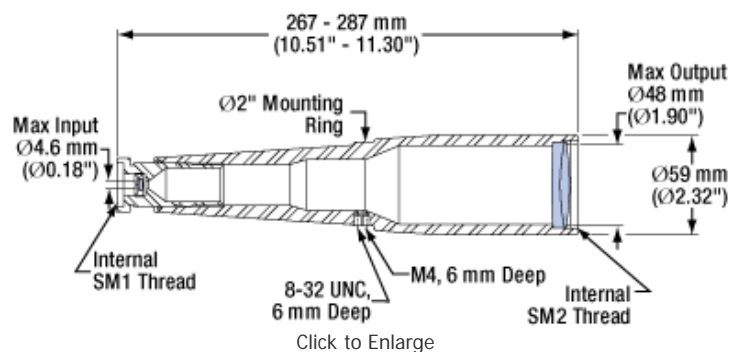| Part Number	Description	Price	Availability
BE15M-A	15X Optical Beam Expander, AR Coated: 400 - 650 nm	$588.00	Today
BE15M-B	15X Optical Beam Expander, AR Coated: 650 - 1050 nm	$588.00	Lead Time
BE15M-C	15X Optical Beam Expander, AR Coated: 1050 - 1620 nm	$588.00	Today

Hide 20X Optical Beam Expanders

20X Optical Beam Expanders

BE20M-C

Item #	Expansion	Input Aperture	Max Input[a] (1/e^2)	AR Coating Range
BE20M-A	20X	Ø4.6 mm	1.2 mm	400 - 650 nm
BE20M-B	20X	Ø4.6 mm	1.2 mm	650 - 1050 nm
BE20M-C	20X	Ø4.6 mm	1.2 mm	1050 - 1620 nm

- For Diffraction-Limited Performance

267 - 287 mm (10.51" - 11.30")
Max Output Ø48 mm (Ø1.90")
Max Input Ø4.6 mm (Ø0.18")
Ø2" Mounting Ring
Ø59 mm (Ø2.32")
Internal SM1 Thread
8-32 UNC, 6 mm Deep
M4, 6 mm Deep
Internal SM2 Thread

Click to Enlarge

Part Number	Description	Price	Availability
BE20M-A	20X Optical Beam Expander, AR Coated: 400 - 650 nm	$746.00	Lead Time
BE20M-B	20X Optical Beam Expander, AR Coated: 650 - 1050 nm	$746.00	3-5 Days
BE20M-C	20X Optical Beam Expander, AR Coated: 1050 - 1620 nm	$746.00	Lead Time

Hide SM2 Adapter for 3X and 5X Optical Beam Expanders

SM2 Adapter for 3X and 5X Optical Beam Expanders

SM2A19

Our SM2A19 adapter is ideal for making any of our BE03M or BE05M beam expanders compatible with the SM2 (2.035"-40) thread standard found on many of our products including our Ø2" lens tubes and 60 mm cage systems. The adapter features internal SM2 threads and external M36 x 1.5 threads.

SM2A19 Typical Application

External M36 x 1.5 to Internal SM2 Adapter
Beam Expander
SM2A19
SM2 Lens Tube

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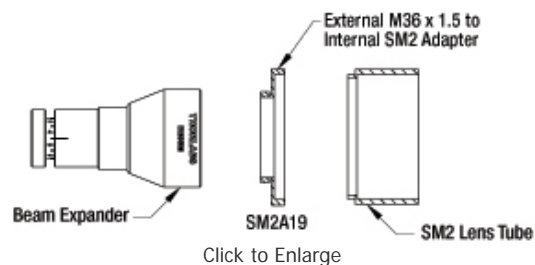
Part Number	Description	Price	Availability
SM2A19	Adapter with External M36x1.5 Threads and Internal SM2 Threads	$29.00	Today

Visit the *Optical Beam Expanders: Beam Expansion or Reduction* page for pricing and availability information:
http://www.thorlabs.com/newgrouppage9.cfm?objectgroup_id=1580