

Daheng New Epoch Technology, Inc.

www.cdhoptics.com

#### PREFACE

Daheng Optics, based in Beijing, China, is a technical company specialized in optics. Its main business includes design and manufacture of optical components, modules, sub-systems assemblies and systems. Wealthy experiences in engineering and production, and service flexibility have been meeting our customer demands since 1987. Our company has grown steadily, up to now 150 people employed. Lead by an experienced technical team, most employees are skilled



technicians for professionally dealing on fine optics, fine mechanics and special tools. Qualified technical department inspects our products at 100% level for quality control.



### Research and Development

Daheng Optics possesses a strong professional design team for research and development with lens designers, mechanical design, control and integration engineers. Utilizing professional tools such as ZEMAX and ProE, the core design and engineering team offers solutions for OEM projects and products.



We serve and support our customers over the complete engineering cycle, from the conceptual design phase to the final delivery of the systems.

#### **Optical Manufacture**

#### Raw Materials

Lens blanks made of optical materials in the form of round disks or per-forms are received. We use approximately 200 different optical quality glass type, including fused silica, calcium fluoride, germanium, zinc sulfide and filter glasses.

#### **Pre-grinding**

Lens blanks (round disks or pre-forms) are pre-grinded with diamond fitted tools, each side separately to meet different curvature requirements.

#### Fine-grinding

Fine-grinding of the lens to the required radii is done with specialized tools, onto which pellets are glued. Diamond grains sized between 5 to 25 microns are sintered in these pellets.

#### **Polishing**

Tools lathed of aluminum and plated with a polyurethane foil for polishing the radii of the lens are used. The foils glued onto the tools are prepared by special counter tools to achieve the required precision. Cerium oxide is mainly used as the polishing medium. We use an in-process interferometer to conduct contact-free measurement for lens surface. The measurement results are used for adjusting the tools to achieve the requirements.



#### Centering

After the polishing of both radii, the lens has to be centered to its optical axis. For this purpose, a laser beam is launched to the lens, of which its optical axis is precisely aligned to a centering machine. A chuck is used to fit its position and its rim is ground centrically using one or two diamond grinding discs. During the same process, the chamfers are also centered.



#### Coating

Each lens surface in contact with air passes approximately 96% of the light due to reflection. Therefore, optical surfaces are commonly coated with a thin dielectric film to enhance the light transmission. Anti-reflection coating generally consists of 1 to 5 layers (in special cases up to 50 layers) and reduces reflection losses down to 0.2%. The coated films need to be specially adjusted to the required wavelengths and glass types. We offer anti-reflection coatings

for wavelength range from 350nm to 1800nm, as well as band pass filters, mirror-and beam splitter coatings and Dichroic filters.

#### Mechanical Mounts and Housings

We supply mounting plates or housings for optical components by precision CNC machining. Surfaces of the most mechanical components are commonly anodized black to reduce stray light in optical systems.)

#### **Quality Control**

In order to assure the high quality of our products, Daheng Optics is certified according to DIN and ISO9001:2008 for quality assurance. We conduct 100% quality inspection for our products. Sophisticated measurement instruments and tools are used to guarantee our promises. Continuous improvement is carried out in the company.





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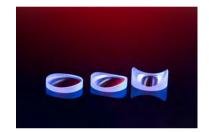




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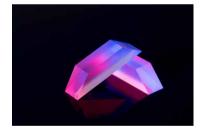




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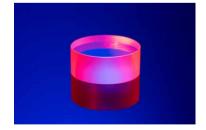




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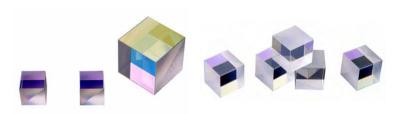


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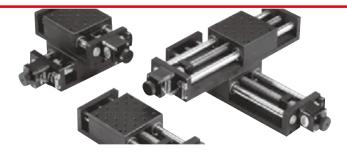
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#### General

Lens is an optical device with perfect or approximate axial symmetry which transmits and ref racts I ight, converging or diverging light. There are many forms of a lens or a lens system. A simple lens consists of a single optical element.

A compound lens or a lens system has a series of simple lenses (elements) with a common axis in order to correct optical aberrations to improve performances or image quality, of which a simple single lens cannot offer.

#### Classifications

Single lenses are classified by the curvatures of its two optical surfaces. A lens that has its both surfaces convex, is called biconvex (or double convex). When the radii of curvature of the surfaces are the same, the lens is equi-convex. If one of the surfaces is flat, i.e. the radius of curvature is infinitive, the lens is plano-convex. Similarly, there are lenses that are biconcave,

equi-concave and plano-concave if the lens surface is concave. A lens with one convex and concave side is convex-concave, or often called a meniscus lens.

A lens that converges light from infinitive and focuses a real spot has a positive focal length, and is called a positive lens; whereas a negative lens diverges light from infintitive with a virtual focus and has a negative focal length.

A doublet lens that often has a posi t ive and negative lens cemented together with a common surface is for chromatic aberration correction and called achromatic doublet. There are positive and negative doublets with positive and negative focal length, respectively.

Name	Legend
Plano-Convex Lens	
Bi-Convex lens	
Plano-Concave Lens	
Bi-Concave Lens	

Name	Legend
Meniscus Lens	
Positive Achromatic Doublet	
Negative Achromatic Doublet	

#### Materials

Most glass manufacturers can supply the same characteristics of materials under different trade names. They modify their material processes to achieve lead- and arseni c - f ree. Daheng Opt i c s utilizes many glass materials from main international manufacturers in our products. We source mainly in China with CDGM glasses which was founded in 1956 and is the largest production base of optical materials in China with its highest glass output in the world in recent years. With the constant efforts on development for new products and pursuing quality perfection, more than 200 types of optical glasses and optoelectronic glasses are in CDGM standard catalogue. Comparable glass materials and properties between CDGM and Schott are listed below.

CDGM         SCHOTT         Index of Refraction (Nd)         Abbe Number (vd)           H-K9L         Bk7         1.51680         64.20           H-K50         K5         1.52249         59.48           H-BaK6         NSK11         1.56388         60.76           H-BaK7         BaK4         1.56883         56.04           H-F4         F2         1.62005         36.35           H-LaK10         LaKN22         1.65113         55.89           H-ZBaF16         BaF11         1.66672         48.42           H-ZBaF52         BaF10         1.67003         47.20           H-ZF2         SF5         1.67270         32.17           H-ZF10         SF8         1.68893         31.16           H-ZF4         FD10         1.72825         28.32           H-ZF12         N-SF14         1.76182         26.61           H-ZF7LA         N-SF6         1.80518         25.46           ZF52         SF57         1.84666         27.76				
H-K50       K5       1.52249       59.48         H-BaK6       NSK11       1.56388       60.76         H-BaK7       BaK4       1.56883       56.04         H-F4       F2       1.62005       36.35         H-LaK10       LaKN22       1.65113       55.89         H-ZBaF16       BaF11       1.66672       48.42         H-ZBaF52       BaF10       1.67003       47.20         H-ZF2       SF5       1.67270       32.17         H-ZF10       SF8       1.68893       31.16         H-ZF4       FD10       1.72825       28.32         H-ZF12       N-SF14       1.76182       26.61         H-ZF7LA       N-SF6       1.80518       25.46	CDGM	SCHOTT	Index of Refraction (Nd)	Abbe Number (vd)
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H-ZBaF16       BaF11       1.66672       48.42         H-ZBaF52       BaF10       1.67003       47.20         H-ZF2       SF5       1.67270       32.17         H-ZF10       SF8       1.68893       31.16         H-ZF4       FD10       1.72825       28.32         H-ZF12       N-SF14       1.76182       26.61         H-ZF7LA       N-SF6       1.80518       25.46	H-F4	F2	1.62005	36.35
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ZF52 SF57 1.84666 27.76	H-ZF7LA	N-SF6	1.80518	25.46
	ZF52	SF57	1.84666	27.76

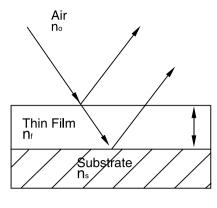
### **Antireflection Coating**

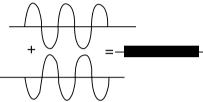
Antireflection (AR) coating improves vastly the transmission of a lens system. The most common type is 1/4 wave MgF<sub>2</sub> coating. Normally, most of lenses in our catalogue are

coated by this type of AR coating, of which the wavelength is centered at 550nm with 0° angle of incidence. We also offer specialized AR coatings such as 1/4 wave MgF<sub>2</sub> for visible range at different incidence angle, and broadband AR coatings for visible and near infrared ranges. The following table lists our capability on AR coatings.

AR coatings					
Coating Description	Specifications				
Blackened Edges	Eliminate stray light and improve signal-to-noise				
1/4 wave MgF <sub>2</sub> at 550nm	Rave≤1.75% 400-700nm(BK7)				
VIS 0° @425-675nm	Rave≤0.4%				
VIS 45° @425-675nm	Rave≤0.75%				
NIR I @ 800-1100nm	Rave≤0.5%				
NIR II @ 1200-1600nm	Rave≤0.25% @1295-1325nm Rave≤0.25% @1535-1565nm Rave≤0.25% @1200-1600nm				





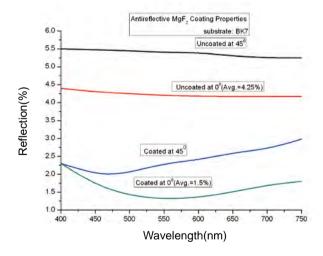


 $n_f = (n_o \ x \ n_s)^{1/2}$ 

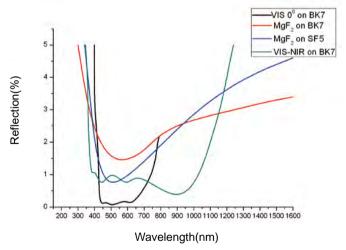
# Principle of Anti-reflection Coating

The transmission properties of an optical coating are dependent upon the wavelength of light being used, index of refraction of the substrate, index of refraction of the coating, the thickness of the coating, and the angle of the incident light. AR coating is designed to reduce back reflection at, say, air and glass interface caused by the difference of refractive index of the two media.

The AR coating design is such that the relative phase shift between the beam reflected at the upper and lower boundary of the thin film is 180. Destructive interference between the two reflected beams occurs, canceling both beams before they exit the surface. The optical thickness of the coating must be an odd number of quarter wavelengths.

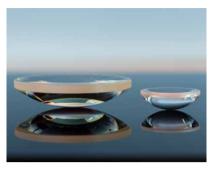


1/4 Wave MgF<sub>2</sub> Coating
The coatings of VIS 0° for 0° angle of incidence and VIS 45° for 45° angle of incidence provide optimized transmission for wavelength 425-675nm, achieving average reflection to 0.4% and 0.75%, respectively.



### Multiple Layers of AR Coating

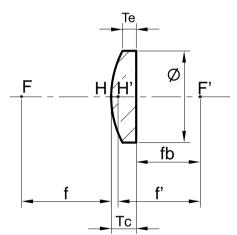
In order to increase transmission further, comparing with a single layer of AR coating, a triple-layer design is generally used with coating materials of  $MgF_2$ ,  $Ta_2O_5$  and  $Al_2O_3$ .



GCL-0101

#### GCL-0101 BK7 Plano-Convex Lenses

Plano-convex lenses are mostly used for focusing parallel rays of light to a spot. The asymmetry of these lenses between the front and back surface minimizes spherical aberration effectively, particularly in the situations where the object and image are not at equal distance from the lens. The optimum case is where the object is placed at infinity (regarded as parallel rays entering lens) and the image is on the focus, which has infinite conjugate ratio, i.e. object distance/image distance. The curved surface of the lens should face the object direction. The ZEMAX file of all products is available.



f: focal length (object side)

- f': focal length (image side)
- fb: back focal length Ø: lens diameter
- Tc: center thickness
- Te: edge thickness
- F,F': focal points
- H,H': principal points

GCL-0101

Material: BK7 grade A, fine annealed

• Focal Length (f'): ±2%@587.6nm Diameter(Ø) Tolerance: +0.0/-0.20 Center Thickness (Tc): ±0.1

3' Centration:

Form Error: 1 ~ 5 fringes 0.2 ~ 0.5 fringes Irregularity of Fringes: Surface Quality: 60-40 scratch-dig

Coating: GCL-0101xx: 1/4 wave MgF<sub>2</sub> coating at 550nm for 0°angle of incidence

GCL-0101xxA: VIS Multiple Layers AR coating, Rave≤0.5%@450-800nm

GCL-0101xxB: NIR Multiple Layers AR coating, Rave≤0.5%@800-1100nm

90% diameter Clear Aperture:



### GCL-0101 BK7 Plano-Convex Lenses (1/4 wave $MgF_2$ coating)

Part No.	Ø	f'	fb	Tc	Te	Weight(g)
GCL-010101	6.0	9.8	8.5	2.0	1.0	1
GCL-010102	6.0	19.0	17.7	2.0	1.5	1
GCL-010103	6.0	38.1	36.8	2.0	1.8	1
GCL-010131	10.0	10.0	6.8	4.8	1.1	1
GCL-010132	10.0	15.0	13.1	2.9	1.1	1
GCL-010133	10.0	20.0	18.4	2.4	1.1	1
GCL-010134	10.0	30.0	28.8	1.9	1.1	1
GCL-010168	10.0	40.0	38.02	3.0	2.39	0.5
GCL-010169	10.0	75.0	73.02	3.0	2.68	0.6
GCL-010170	10.0	100.0	98.02	3.0	2.76	0.6
GCL-010104	12.7	12.7	8.7	6.0	1.1	2
GCL-010105	12.7	25.4	22.8	4.0	2.4	2
GCL-010106	12.7	38.1	36.1	3.0	2.0	2
GCL-010107	12.7	50.8	48.8	3.0	2.2	2
GCL-010171	20.0	25.0	21.04	6.0	1.26	3
GCL-010135	20.0	30.0	26.2	5.7	2.0	4
GCL-010136	20.0	40.0	37.0	4.6	2.0	3
GCL-010137	20.0	50.0	47.4	4.0	2.0	3
GCL-010138	20.0	60.0	57.6	3.7	2.0	3
GCL-010139	20.0	80.0	77.9	3.2	2.0	3
GCL-010140	20.0	100.0	98.0	3.0	2.0	3
GCL-010158	25.4	30.0	24.66	8.1	1.49	6.5
GCL-010159	25.4	35.0	30.39	7.0	1.79	5.8
GCL-010108	25.4	38.1	33.5	7.0	2.4	6
GCL-010160	25.4	40.0	36.31	5.6	1.24	4.5
GCL-010161	25.4	45.0	41.57	5.2	1.43	4.3
GCL-010109	25.4	50.8	46.8	6.0	2.7	6
GCL-010162	25.4	60.0	56.9	4.7	1.98	4.3
GCL-010110	25.4	75.0	71.7	5.0	2.9	6
GCL-010163	25.4	85.0	82.17	4.3	2.42	4.3
GCL-010111	25.4	100.0	96.7	5.0	3.4	6
GCL-010164	25.4	125	122.69	3.5	2.24	3.7
GCL-010112	25.4	150.0	147.4	4.0	3.0	5
GCL-010113	25.4	175.0	172.4	4.0	3.1	5
GCL-010154	25.4	200.0	197.7	3.5	2.7	5
GCL-010165	25.4	225.0	222.69	3.5	2.8	3.4

Part No.	Ø	f'	fb	Tc	Те	Weight(g)
GCL-010166	25.4	250.0	247.69	3.5	2.87	3.4
GCL-010155	25.4	300.0	297.7	3.5	3	5
GCL-010167	25.4	400.0	397.69	3.5	3.11	3.6
GCL-010156	25.4	500.0	497.7	3.5	3.2	5
GCL-010157	25.4	1000.0	997.7	3.5	3.3	5
GCL-010141	30.0	60.0	55.8	6.4	2.5	9
GCL-010142	30.0	100.0	96.9	4.7	2.5	6
GCL-010143	30.0	120.0	117.1	4.3	2.5	6
GCL-010144	30.0	150.0	147.4	4.0	2.5	6
GCL-010114	38.1	75.0	69.7	8.0	3.0	14
GCL-010116	38.1	200.0	196.7	5.0	3.2	12
GCL-010145	40.0	80.0	74.3	8.7	3.5	20
GCL-010146	40.0	150.0	146.0	6.1	3.5	15
GCL-010147	40.0	200.0	196.4	5.5	3.5	15
GCL-010148	40.0	350.0	347.0	4.6	3.5	14
GCL-010173	50.8	75.0	67.42	11.5	2.02	35.6
GCL-010118	50.8	100.0	92.7	11.0	4.3	39
GCL-010174	50.8	125.0	120.06	7.5	2.3	25.2
GCL-010119	50.8	150.0	144.1	9.0	4.7	36
GCL-010175	50.8	175.0	171.04	6.0	2.36	21.4
GCL-010176	50.8	200.0	196.57	5.2	2.03	18.5
GCL-010120	50.8	250.0	245.4	7.0	4.5	30
GCL-010177	50.8	300.0	296.7	5.0	2.91	20.2
GCL-010121	50.8	400.0	396.0	6.0	4.4	26
GCL-010178	50.8	500.0	496.7	5.0	3.75	22.3
GCL-010179	50.8	600.0	596.7	5.0	3.96	22.9
GCL-010180	50.8	800.0	796.7	5.0	4.22	23.5
GCL-010122	76.2	175.0	165.8	14.0	5.6	115
GCL-010123	76.2	300.0	293.4	10.0	5.2	90
GCL-010124	76.2	500.0	494.7	8.0	5.2	76
GCL-010125	76.2	700.0	695.4	7.0	5.0	70
GCL-010126	76.2	1000.0	995.4	7.0	5.6	73
GCL-010127	100.0	500.0	493.5	9.9	5.0	79
GCL-010128	100.0	800.0	794.7	8.0	5.0	129
GCL-010129	100.0	1000.0	995.1	7.4	5.0	124



#### GCL-0101 BK7 Plano-Convex Lenses (Rave≤0.5%@450-800nm)

Part No.	Ø	f'	fb	Tc	Te	Weight(g)
GCL-010158A	25.4	30.0	24.66	8.1	1.49	6.5
GCL-010159A	25.4	35.0	30.39	7.0	1.79	5.8
GCL-010108A	25.4	38.1	33.5	7.0	2.4	6
GCL-010160A	25.4	40.0	36.31	5.6	1.24	4.5
GCL-010161A	25.4	45.0	41.57	5.2	1.43	4.3
GCL-010109A	25.4	50.8	46.8	6.0	2.7	6
GCL-010162A	25.4	60.0	56.9	4.7	1.98	4.3
GCL-010110A	25.4	75.0	71.7	5.0	2.9	6
GCL-010163A	25.4	85.0	82.17	4.3	2.42	4.3
GCL-010111A	25.4	100.0	96.7	5.0	3.4	6
GCL-010164A	25.4	125	122.69	3.5	2.24	3.7
GCL-010112A	25.4	150.0	147.4	4.0	3.0	5
GCL-010113A	25.4	175.0	172.4	4.0	3.1	5
GCL-010154A	25.4	200	197.7	3.5	2.72	5
GCL-010165A	25.4	225	222.69	3.5	2.8	3.4
GCL-010166A	25.4	250	247.69	3.5	2.87	3.4
GCL-010155A	25.4	300	297.7	3.5	2.98	5
GCL-010167A	25.4	400	397.69	3.5	3.11	3.6
GCL-010156A	25.4	500	497.7	3.5	3.19	5
GCL-010157A	25.4	1000	997.7	3.5	3.34	5

#### GCL-0101 BK7 Plano-Convex Lenses (Rave≤0.5%@800-1100nm)

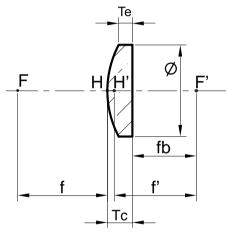
		`	<u> </u>	,		
Part No.	Ø	f'	fb	Tc	Te	Weight(g)
GCL-010158B	25.4	30.0	24.66	8.1	1.49	6.5
GCL-010159B	25.4	35.0	30.39	7.0	1.79	5.8
GCL-010108B	25.4	38.1	33.5	7.0	2.4	6
GCL-010160B	25.4	40.0	36.31	5.6	1.24	4.5
GCL-010161B	25.4	45.0	41.57	5.2	1.43	4.3
GCL-010109B	25.4	50.8	46.8	6.0	2.7	6
GCL-010162B	25.4	60.0	56.9	4.7	1.98	4.3
GCL-010110B	25.4	75.0	71.7	5.0	2.9	6
GCL-010163B	25.4	85.0	82.17	4.3	2.42	4.3
GCL-010111B	25.4	100.0	96.7	5.0	3.4	6
GCL-010164B	25.4	125	122.69	3.5	2.24	3.7
GCL-010112B	25.4	150.0	147.4	4.0	3.0	5
GCL-010113B	25.4	175.0	172.4	4.0	3.1	5
GCL-010154B	25.4	200	197.7	3.5	2.72	5
GCL-010165B	25.4	225	222.69	3.5	2.8	3.4
GCL-010166B	25.4	250	247.69	3.5	2.87	3.4
GCL-010155B	25.4	300	297.7	3.5	2.98	5
GCL-010167B	25.4	400	397.69	3.5	3.11	3.6
GCL-010156B	25.4	500	497.7	3.5	3.19	5
GCL-010157B	25.4	1000	997.7	3.5	3.34	5



GCL-0108

#### GCL-0108 Fused Silica Plano-Convex Lenses

Fused Silica is the material used in UV region and imaging applications. It has high transmission from 200nm to 2.5µm. In addition, it also can be used in higher operating temperatures. Fused silica positive lenses are most commonly used for focusing parallel rays of light to a spot.



f: focal length (object side)

H,H': principal points

GCL-0108

Material: UV grade fused silica

• Focal Length (f'): ±2%@587.6nm

• Diameter( Ø ) Tolerance: +0.0/-0.20

±0.1' • Center Thickness(Tc):

• Centration: 3′

• Form Error: 1 ~ 5 fringes

• Irregularity of Fringes:  $0.2 \sim 0.5 \text{ fringes}$ 

 Surface Quality: 60-40 scratch-dig

• Clear Aperture: 90% diameter

Uncoated

f': focal length (image side)

fb: back focal length Ø: lens diameter

Tc: center thickness

Te: edge thickness F,F': focal points



#### GCL-0108 Fused Silica Plano-Convex Lenses

#### GCL-0108 Fused Silica Plano-Convex Lenses

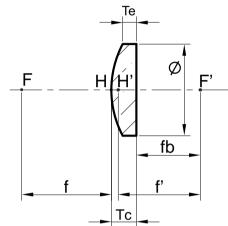
Part No.	Ø	f'	fb	Tc	Te	Weight(g)
GCL-010801	10.0	15.0	12.9	3.3	1.2	1
GCL-010802	10.0	30.0	28.5	2.3	1.4	1
GCL-010803	10.0	40.0	38.7	2.3	1.6	1
GCL-010804	12.7	25.4	22.5	4.0	2.1	1
GCL-010805	12.7	38.1	36.0	3.0	1.8	1
GCL-010806	12.7	50.8	48.3	3.0	2.1	1
GCL-010818	20.0	30.0	25.8	6	1.69	2.75
GCL-010807	20.0	40.0	36.7	5.0	2.1	4
GCL-010808	20.0	60.0	56.6	5.0	3.1	4
GCL-010809	20.0	80.0	76.7	4.5	3.1	4
GCL-010819	25.4	30.0	23.14	10	1.53	7.1
GCL-010810	25.4	38.1	33.3	7.0	1.5	5
GCL-010820	25.4	40.0	35.48	6.6	1.49	4.7
GCL-010811	25.4	50.8	46.3	6.0	2.2	5
GCL-010821	25.4	60.0	56.85	4.6	1.49	3.4
GCL-010812	25.4	75.0	71.6	5.0	2.6	5
GCL-010814	25.4	100.0	97.3	4.0	2.2	5
GCL-010822	25.4	125.0	122.94	3	1.58	4
GCL-010815	25.4	150.0	147.3	4.0	2.8	4
GCL-010816	25.4	175.0	172.3	4.0	3.0	4
GCL-010817	25.4	200.0	197.3	4.0	3.1	4
GCL-010813	25.4	250.0	246.6	5.0	4.3	2.6
GCL-010824	50.8	75.0	65.42	14	2.85	39.16
GCL-010825	50.8	100.0	93.15	10	2.35	28.05
GCL-010826	50.8	125.0	119.5	8	2.09	22.73
GCL-010827	50.8	150.0	145.2	7	2.16	20.54
GCL-010828	50.8	175.0	170.2	7	2.89	22.13
GCL-010829	50.8	200.0	195.2	7	3.42	23.29
GCL-010830	50.8	250.0	245.2	7	4.16	24.86
GCL-010831	50.8	300.0	295.9	6	3.64	21.51
GCL-010832	50.8	400.0	395.9	6	4.24	22.84
GCL-010833	50.8	500.0	496.6	5	3.59	21.34
GCL-010834	50.8	600.0	596.6	5	3.83	19.69
GCL-010835	50.8	800.0	796.6	5	4.12	20.34



GCL-0111

#### GCL-0111 Calcium Fluoride Plano-Convex Lenses

Calcium Fluoride has good thermal property due to its high transmission from 250nm to 7µm. It is commonly used in cooled thermal imaging systems or laser focusing. Plano-convex lenses are mostly used for focusing parallel rays of light to a spot.



- f: focal length (object side)
- f': focal length (image side)
- fb: back focal length
- Ø: lens diameter
- Tc: center thickness
- Te: edge thickness
- F,F': focal points H,H': principal points

- GCL-0111
- Focal Length (f'):
- Diameter(∅) Tolerance:
- Center Thickness(Tc):
- Centration:
- Form Error:
- · Irregularity of Fringes:
- Surface Quality:
- Clear Aperture:

- +/-2% at 5µm
- +0.0/-0.20
- ±0.1
- - 3 fringes
  - 0.5 fringes
  - 60-40 scratch-dig
- 90% diameter

Uncoated

#### GCL-0111 Calcium Fluoride Plano-Convex Lenses

Part No.	Ø	f' (5um)	fb	Tc	Te	Weight(g)
GCL-011101	25.4	50	45.43	6.4	1.83	6.8
GCL-011102	25.4	75	71.57	4.8	1.97	5.5
GCL-011103	25.4	100	97.07	4.1	2.02	5
GCL-011104	25.4	150	147.57	3.4	2.04	4.4
GCL-011105	25.4	200	197.86	3	1.98	4

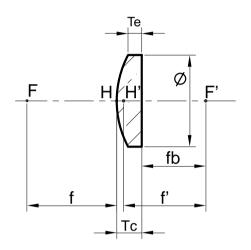




GCL-0121

#### GCL-0121 Zinc Selenide Plano-Convex Lenses

Zinc Selenide has good thermal property due to its high transmission from 600nm to 16µm. It is commonly used in cooled thermal imaging systems or laser focusing. Plano-convex lenses are mostly used for focusing parallel rays of light to a real spot. As it is a relatively soft material, it is not recommended for use in harsh environments; handling, mounting and cleaning this lenses are with particular care.



f: focal length (object side)

f': focal length (image side)

fb: back focal length Ø: lens diameter

Tc: center thickness

Te: edge thickness F,F': focal points

H,H': principal points

#### GCL-0121

• Focal Length (f'): +/-2% at 10.6µm

 Diameter(∅) Tolerance: +0/-0.2 • Center Thickness(Tc): ±0.1

3′ • Centration:

• Form Error: 3 fringes • Irregularity of Fringes: 0.5 fringes

 Surface Quality: 60-40 scratch-dig

· Clear Aperture: 90% diameter

Uncoated

#### GCL-0121 Zinc Selenide Plano-Convex Lenses

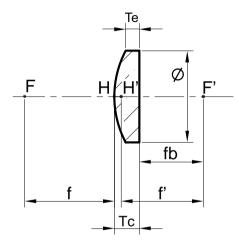
Part No.	Ø	f' (10.6um)	fb	Tc	Te	Weight(g)
GCL-012101	25.4	50.8	49.51	3.1	1.96	6.8
GCL-012102	25.4	75	73.84	2.8	2.03	6.4
GCL-012103	25.4	100	98.92	2.6	2.02	6.2
GCL-012104	25.4	150	149	2.4	2.02	5.9
GCL-012105	25.4	200	199.04	2.3	2.01	5.8



GCL-0131

#### GCL-0131 Germanium Plano-Convex Lenses

Germanium is ideal for mid-infrared applications. It stands up well to harsh environments. It is subject to thermal runaway, which means that the transmission decreases as temperature increases. Plano-convex lenses are mostly used for focusing parallel rays of light to a real spot.



- f: focal length (object side)
- f': focal length (image side)
- fb: back focal length
- Ø: lens diameter
- Tc: center thickness
- Te: edge thickness F,F': focal points
- H,H': principal points

GCL-0131

• Focal Length (f'):

+/-2% at 10.6µm

Diameter(∅) Tolerance:

+0/-0.2

• Center Thickness(Tc):

 $\pm\,0.1$ 

Centration:

3′

• Form Error:

3 fringes

• Irregularity of Fringes:

0.5 fringes

Surface Quality:

60-40 scratch-dig

• Clear Aperture:

90% diameter

Uncoated

#### GCL-0131 Germanium Plano-Convex Lenses

Part No.	Ø	f' (10.6µm)	fb	Tc	Te	Weight (g)
GCL-013101	25.4	50.8	50.18	2.5	1.97	6
GCL-013102	25.4	75	74.4	2.4	2.04	6
GCL-013103	25.4	100	99.43	2.3	2.03	5.8
GCL-013104	25.4	150	149.45	2.2	2.02	5.7
GCL-013105	25.4	200	199.45	2.2	2.07	5.8

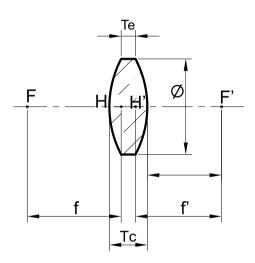




GCL-0102

#### GCL-0102 BK7 Bi-Convex Lenses

Similar to plano-convex lenses, a bi-convex lens has a positive focal length and focuses parallel rays of light to a spot. Because the front and back surface of the lens are spherically convex and have the same radius of curvature, in situations where the object and image are at equal of near equal distances from the lens, it particularly minimizes spherical aberration, at the same time, aberration coma and distortion are also identically canceled. As a guideline, bi-convex lenses offer minimum aberrations at the conjugate ratio between 5:1 and 1:5.



- f: focal length (object side)
- f': focal length (image side)
- fb: back focal length
- Ø: lens diameter
- Tc: center thickness Te: edge thickness
- F,F': focal points
- H,H': principal points

GCL-0102

Material: BK7 grade A, fine annealed

• Focal Length (f'): ±2% at 587.6nm

+0.0/-0.20 • Diameter( Ø ) Tolerance:

• Center Thickness(Tc): ±0.1

3' Centration:

• Form Error: 1~5 fringes

0.2~0.5 fringes · Irregularity of Fringes:

 Surface Quality: 60-40 scratch-dig

· Coating: 1/4 wave MgF2 coating at 550nm for 0°

angle of incidence

90% diameter Clear Aperture:

#### GCL-0102 BK7 Bi-Convex Lenses

Part No.	Ø	f'	fb	Tc	Te	Weight(g)
GCL-010201	6.0	19.0	18.1	3.0	2.5	1
GCL-010215	10.0	15.0	13.7	4.2	2.5	1
GCL-010216	10.0	30.0	28.7	3.9	3.0	1
GCL-010202	12.7	25.4	23.7	5.0	3.4	2
GCL-010203	12.7	38.1	36.7	4.0	3.0	2
GCL-010217	20.0	30.0	28.0	5.9	2.5	4
GCL-010218	20.0	40.0	37.9	5.0	2.5	3
GCL-010219	20.0	60.0	59.0	4.7	3.0	3
GCL-010220	20.0	75.0	73.7	4.4	3.0	3
GCL-010204	25.4	50.8	49.1	6.0	2.8	6
GCL-010205	25.4	100.0	98.5	5.0	3.4	6
GCL-010206	25.4	150.0	148.6	5.0	4.0	6
GCL-010207	25.4	175.0	172.7	5.0	4.1	6
GCL-010221	30.0	60.0	57.6	7.0	3.3	7
GCL-010222	30.0	120.0	118.7	5.0	3.2	7
GCL-010223	30.0	180.0	178.5	5.0	3.8	8
GCL-010224	30.0	250.0	248.0	5.0	4.1	9
GCL-010225	30.0	300.0	298.1	5.0	4.3	9
GCL-010226	40.0	100.0	97.0	8.0	4.0	20
GCL-010227	40.0	150.0	148.5	6.0	4.0	16
GCL-010228	40.0	250.0	247.9	5.6	4.0	16
GCL-010212	50.8	150.0	148.1	8.0	3.8	30
GCL-010213	50.8	250.0	248.8	6.0	3.5	25
GCL-010214	50.8	400.0	398.2	6.0	4.4	28

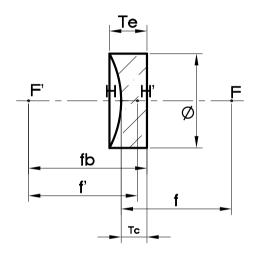




GCL-0103

#### GCL-0103 BK7 Plano-Concave Lenses

A plano-concave lens diverges parallel input rays. It has a negative focal length. While the output rays do not actually meet to form a point, they do appear to be diverging from a virtual image located on the object side of the lens. At absolute conjugate ratio greater than 5:1 and less than 1:5, planoconcave lenses are nearly the best form lens to reduce spherical aberration, coma, and distortion. The curved surface of the lens should face the object in distance or infinite conjugate, except in a high energy laser system, this should be reversed to eliminate the possibility of a virtual focus.



f: focal length (object side)

f': focal length (image side)

fb: back focal length

Ø: lens diameter

Tc: center thickness Te: edge thickness

F,F': focal points

H,H': principal points

GCL-0103

Material: BK7 grade A, fine annealed

• Focal Length (f'): ±2% at 587.6nm

+0.0/-0.20 • Diameter( Ø ) Tolerance:

• Center Thickness(Tc): ±0.1

3′ Centration:

• Form Error: 1~5 fringes

0.2~0.5 fringes · Irregularity of Fringes:

 Surface Quality: 60-40 scratch-dig

Coating: 1/4 wave MgF2 coating at 550nm for 0°

angle of incidence

90% diameter Clear Aperture:

#### GCL-0103 BK7 Plano-Concave Lenses

Part No.	Ø	f'	fb	Тс	Te	Weight(g)
GCL-010301	6.0	-9.8	-10.5	1.0	1.98	1
GCL-010327	10.0	-15.0	-16.0	1.5	3.3	1
GCL-010326	10.0	-20.0	-21.2	1.5	2.8	1
GCL-010325	10.0	-30.0	-31.0	1.5	2.3	1
GCL-010302	12.7	-19.0	-20.3	2.0	4.3	1
GCL-010303	12.7	-25.4	-26.7	2.0	3.6	1
GCL-010304	12.7	-38.1	-39.4	2.0	3.1	1
GCL-010324	20.0	-30.0	-31.6	2.5	6.2	3
GCL-010323	20.0	-50.0	-51.6	2.5	4.5	3
GCL-010322	20.0	-60.0	-61.6	2.5	4.2	2
GCL-010321	20.0	-80.0	-81.6	2.5	3.7	3
GCL-010328	25.4	-30.0	-31.98	3.0	9.61	7.7
GCL-010329	25.4	-40.0	-41.98	3.0	7.36	6.5
GCL-010305	25.4	-50.8	-52.8	3.0	6.3	5
GCL-010306	25.4	-75.0	-77.0	3.0	5.1	5
GCL-010307	25.4	-100.0	-102.0	3.0	4.6	5
GCL-010308	25.4	-150.0	-152.0	3.0	4.1	4
GCL-010330	25.4	-200.0	-201.98	3.0	3.78	4.33
GCL-010320	30.0	-60.0	-62.0	3.0	6.9	9
GCL-010319	30.0	-120.0	-121.9	3.0	4.8	9
GCL-010318	30.0	-150.0	-152.1	3.0	4.5	9
GCL-010317	40.0	-100.0	-102.3	3.5	7.5	14
GCL-010316	40.0	-200.0	-202.2	3.5	5.5	14
GCL-010315	40.0	-400.0	-402.4	3.5	4.5	13
GCL-010312	50.8	-250.0	-252.6	4.0	6.5	25
GCL-010313	50.8	-400.0	-402.6	4.0	5.6	25
GCL-010314	50.8	-500.0	-502.5	4.0	5.3	25

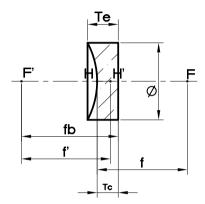




GCL-0109

#### GCL-0109 Fused Silica Plano-Concave Lenses

Fused Silica is the material used in UV region and imaging applications. It has high transmission from 200nm to 2.5µm. In addition, it also can be used in higher operating temperatures. A plano-concave lens diverges parallel input rays and has a negative focal length. The output rays do not actually meet to form a real focus and appear to be diverging from a virtual spot located on the object side of the lens.



f: focal length (object side)

GCL-0109

Material:

• Focal Length (f'):

Diameter(∅) Tolerance:

Center Thickness(Tc):

Centration:

• Form Error:

Irregularity of Fringes:

Surface Quality:

Clear Aperture:

Uncoated

UV grade fused silica

±2% at 587.6nm

+0.0/-0.20

±0.1

3'

1~5 fringes

0.2~0.5 fringes

60-40 scratch-dig

90% diameter

#### GCL-0109 Fused Silica Plano-Concave Lenses

Part No.	Ø	f'	fb	Tc	Te	Weight(g)
GCL-010901	10.0	-15.0	-16.9	2.3	4.5	1
GCL-010902	10.0	-30.0	-31.6	2.3	3.2	1
GCL-010903	10.0	-40.0	-41.8	2.3	3.0	1
GCL-010904	12.7	-25.4	-27.2	3.0	4.9	1
GCL-010905	12.7	-38.1	-40.1	3.0	4.2	1
GCL-010906	12.7	-50.8	-52.4	3.0	3.9	1
GCL-010907	20.0	-40.0	-42.3	3.2	6.1	3
GCL-010908	20.0	-60.0	-61.9	3.2	5.1	3
GCL-010909	20.0	-80.0	-81.9	3.2	4.6	3
GCL-010910	25.4	-38.1	-40.5	3.5	9.0	7
GCL-010911	25.4	-50.8	-52.8	3.5	7.3	6
GCL-010912	25.4	-75.0	-77.4	3.5	5.9	6

f': focal length (image side)

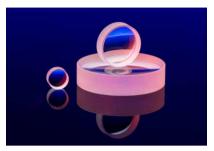
fb: back focal length

Ø: lens diameter

Tc: center thickness

Te: edge thickness

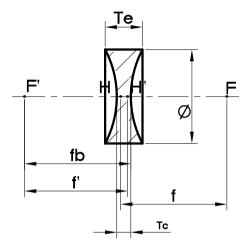
F,F': focal points H,H': principal points



GCL-0104

#### GCL-0104 BK7 Bi-Concave Lenses

Similar to plano-concave lenses, a bi-concave lens diverges parallel input rays and has a negative focal length. It has a virtual focus at the object side of the lens. Bi-concave lenses are usually suitable for absolute conjugate ratios closer to 1:1.



f: focal length (object side)

f': focal length (image side)

fb: back focal length Ø: lens diameter

Tc: center thickness Te: edge thickness

F,F': focal points

H,H': principal points

GCL-0104

• Form Error:

BK7 grade A, fine annealed Material:

· Focal Length (f'): ±2% at 587.6nm

Diameter(Ø) Tolerance: +0.0/-0.20

• Center Thickness(Tc): ±0.1

3′ Centration:

· Irregularity of Fringes: 0.2~0.5 fringes

 Surface Quality: 60-40 scratch-dig

Coating: 1/4 wave MgF2 coating at 550nm for 0°

angle of incidence

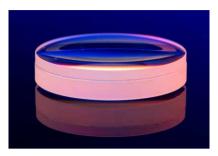
1~5 fringes

 Clear Aperture: 90% diameter



#### GCL-0104 BK7 Bi-Concave Lenses

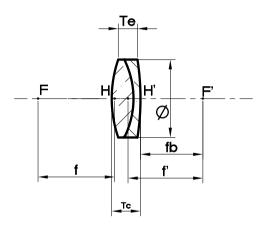
Part No.	Ø	f'	fb	Tc	Te	Weight(g)
GCL-010401	6.0	-9.8	-10.4	2.0	2.9	1
GCL-010424	10.0	-15.1	-15.8	2.0	3.6	1
GCL-010423	10.0	-30.0	-30.7	2.0	2.8	1
GCL-010402	12.7	-19.0	-19.7	2.0	4.2	1
GCL-010403	12.7	-25.4	-26.0	2.0	3.6	1
GCL-010404	12.7	-38.1	-38.8	2.0	3.0	1
GCL-010422	20.0	-30.0	-30.8	2.7	6.0	3
GCL-010421	20.0	-40.0	-40.9	2.7	5.1	3
GCL-010420	20.0	-60.0	-61.2	2.7	4.3	3
GCL-010405	25.4	-50.8	-51.8	3.0	6.2	6
GCL-010406	25.4	-75.0	-76.3	3.0	5.1	6
GCL-010407	25.4	-100.0	-101.7	3.0	4.6	6
GCL-010408	25.4	-150.0	-150.9	3.0	4.1	6
GCL-010419	30.0	-60.0	-61.3	3.5	7.1	7
GCL-010418	30.0	-180.0	-181.1	3.5	4.7	7
GCL-010417	30.0	-250.0	-251.3	3.5	4.4	7
GCL-010416	40.0	-100.0	-101.4	4.0	7.9	19
GCL-010415	40.0	-150.0	-151.4	4.0	6.6	18
GCL-010412	50.8	-250.0	-251.5	5.0	7.5	29
GCL-010413	50.8	-400.0	-401.6	5.0	6.6	29
GCL-010414	50.8	-500.0	-501.7	5.0	6.3	29



GCL-0106

#### GCL-0106 Positive Achromatic Doublets

An achromatic-doublet consists of a positive low-index (crown glass) cemented with a negative high-index (flint glass) lens. These lenses are computer-optimized for infinite conjugate ratio. They also exhibit excellent paraxial performance, with minimal spherical aberration, coma and chromatic aberration. When used for focusing or collimating, the convex part of the lens or the lens surface with smaller radius should face the collimated light. When used for imaging, the convex lens should face the object or the image that is furthest away.



f: focal length (object side)

f': focal length (image side) fb: back focal length

Ø: lens diameter

Tc: center thickness

Te: edge thickness

F.F': focal points H,H': principal points

GCL-0106

• Material: Optical glass(crown and flint)

• Focal Length (f'): ±2% at 587.6nm

• Diameter( Ø ) Tolerance: +0.0/-0.20

• Center Thickness(Tc): ±0.1

Centration:

• Form Error: 1~5 fringes

• Irregularity of Fringes: 0.2~0.5 fringes

 Surface Quality: 60-40 scratch-dig

· Coating: 1/4 wave MgF2 coating at 550nm for 0°

angle of incidence

• Clear Aperture: 90% diameter



#### GCL-0106 Positive Achromatic Doublets

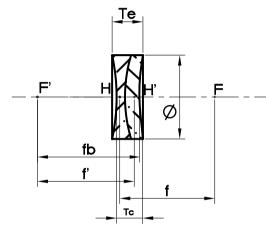
Part No.	Ø	f'	fb	Tc	Te	Weight(g)
GCL-010661	6.0	10.0	7.8	4.2	3.0	1
GCL-010662	6.0	20.0	18.6	3.1	2.5	1
GCL-010601	6.0	30.0	28.8	2.8	2.4	1
GCL-010612	10.0	20.0	17.0	5.0	3.4	1
GCL-010613	10.0	30.0	28.2	3.7	2.7	1
GCL-010618	12.7	15.0	10.43	8.5	5.74	3.2
GCL-010619	12.7	25.0	21.83	5.8	4.4	2.6
GCL-010602	12.7	50.0	48.1	4.3	3.3	2
GCL-010603	12.7	75.0	73.3	3.8	3.1	2
GCL-010620	20.0	40.0	35.5	8.5	5.4	7
GCL-010621	20.0	50.0	46.4	7.4	4.9	6
GCL-010622	20.0	60.0	56.8	6.7	4.7	6
GCL-010650	25.4	30.0	21.94	14.8	9.88	25.1
GCL-010651	25.4	40.0	33.26	12.0	8.42	20.8
GCL-010652	25.4	50.0	43.57	11.5	8.7	20.3
GCL-010653	25.4	60.0	52.56	9.4	7.13	21.0
GCL-010654	25.4	75.0	70.41	9.5	6.89	11.1
GCL-010604	25.4	100.0	96.4	7.7	5.7	11
GCL-010655	25.4	125.0	120.96	8.4	6.85	10.3
GCL-010605	25.4	150.0	147.1	6.5	5.2	10
GCL-010656	25.4	175.0	170.81	9.0	7.89	11.4
GCL-010606	25.4	200.0	197.3	6.1	5.1	9
GCL-010630	30.0	50.0	42.3	13.5	7.7	24
GCL-010631	30.0	75.0	69.7	9.9	6.2	18
GCL-010632	30.0	90.0	85.7	8.8	5.8	17
GCL-010640	40.0	120.0	114.2	12.1	8.1	40
GCL-010641	40.0	250.0	246.1	8.6	6.7	32
GCL-010642	40.0	300.0	296.349	8.0	6.4	29.7
GCL-010614	50.8	75.0	61.29	24.5	16.89	167.3
GCL-010615	50.8	100.0	90.15	18.0	12.44	124.3
GCL-010616	50.8	150.0	143.44	13.5	8.94	80.5
GCL-010617	50.8	200.0	193.8	12.5	8.99	77.5
GCL-010610	50.8	400.0	395.5	9.7	7.8	58
GCL-010611	50.8	500.0	495.9	9.0	7.5	48



GCL-0107

#### GCL-0107 Negative Achromatic Doublets

An achromatic-doublet consists of a negative low-index (crown glass) cemented with a positive high-index (flint glass) lens. These lenses are computer-optimized for infinite conjugate ratio. While the output rays do not actually meet to form a real point, they appear to be diverging from a virtual point located on the object side of the lens.



- f: focal length (object side)
  - f': focal length (image side)
- fb: back focal length
- Ø: lens diameter
- Tc: center thickness
- Te: edge thickness F,F': focal points
- H,H': principal points

GCL-0107

- Optical glass (crown and filnt) Material:
- Focal Length (f'): ±2% at 587.6nm
- Diameter(∅) Tolerance: +0.0/-0.10
- Center Thickness(Tc): ±0.1
- Centration: 3'
- 1~5 fringes • Form Error:
- Irregularity of Fringes: 0.2~0.5 fringes
- Surface Quality: 60-40 scratch-dig
- Coating: 1/4 wave MgF2 coating at 550nm for 0°
  - angle of incidence
- Clear Aperture: 90% diameter

#### GCL-0107 Negative Achromatic Doublets

Part No.	Ø	f'	fb	Tc	Te	Weight(g)
GCL-010711	25.4	-30	-36.15	12.0	16.71	28.5
GCL-010712	25.4	-40	-44.4	8.5	11.97	20.1
GCL-010713	25.4	-50	-53.37	6.6	9.32	15.6
GCL-010714	25.4	-75	-77.65	6.6	9.13	10.7
GCL-010715	25.4	-100	-102.37	4.6	5.95	10.4
GCL-010716	25.4	-150	-152.6	6.6	7.87	10

GCL-1101 Cylinder Plano-Convex Lenses	.027
GCL-1103 Cylinder Plano-Concave Lenses	.029
GCL-1105 Rod Lenses	.029

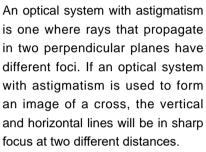


## Cylindrical Lenses CYLINDRICAL LENSES

#### Cylindrical Lenses

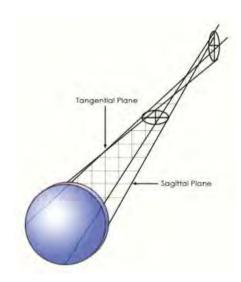
Cylindrical lenses focus or expand light in one axis only. They can be used to focus light into a thin line in optical metrology, laser scanning, spectroscopic, laser diode, acoustooptic, and optical processor applications. They can also be used to expand the output of a laser diode into a symmetrical beam.

#### **Astigmatism**



There are two distinct forms of astigmatism. The first is a thirdorder aberration, which occurs for objects (or parts of objects) away from the optical axis. This form of aberration occurs even when the optical system is perfectly symmetrical. This is often referred to as a "monochromatic aberration". because it occurs even for light of a single wavelength. This terminology may be misleading, however, as the amount of aberration can vary strongly with wavelength in an optical system.

The second form of astigmatism occurs when the optical system is not symmetric about the optical axis. This may be by design (as in the case of a cylindrical lens), or due to manufacturing error in the surfaces of the components or misalignment of the components. In this case, astigmatism is observed even for rays from on-axis object points. This form of astigmatism is extremely important in vision science and eye care, since the human eye often exhibits this aberration due to imperfections in the shape of the cornea or the lens.



### **Applications**

A. Generating a Line of Light from a Collimated Laser

Figure A

A common application of cylindrical lenses is shown in Figure A. A collimated laser beam of radius r0 is incident upon a cylindrical planoconcave lens of focal length, f. In this figure, the radius of the laser beam is exaggerated for clarity. The laser beam will expand with a halfangle  $\theta$  of  $r_0/f$ . The laser beam will appear to be expanding from a virtual source placed a distance f behind the lens. At a distance z after the lens, there will be a line with thickness  $2r_0$  (ignoring expansion of the Gaussian beam) and length

 $L = 2 (r_0/f)(z+f)$ 

If z is large compared to f, then we



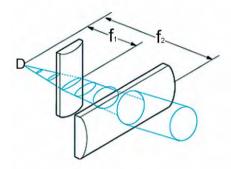


Figure B

have an expansion ratio that is very close to z/f. This is not an imaging problem; we are projecting the laser beam into a line at a particular distance. The length of the line is simply proportional to z.

If the thinnest possible line is required, a second lens, this one

a cylindrical plano-convex lens of focal length ~ z, can be inserted into the system just before or after the plano-concave lens. When oriented on the orthogonal axis, it will focus the laser at the screen onto which the line is projected.

#### B. Circularizing the Beam from a Laser Diode

The output of a laser diode diverges in an asymmetrical pattern, making collimating the beam a challenge. Cylindrical lenses can be used to circularize the beam. Consider a laser diode with beam divergence of  $\theta$  1 &  $\theta$  2 = 10° & 40°. Any attempt to collimate this beam with spherical optics would result in collimation in one direction only, with a diverging or converging beam in the other direction. With cylindrical optics the problem can be approached as two one-dimensional problems. The simplest solution would be to collimate the beam in one dimension with a single cylindrical lens, then collimate the orthogonal dimension with a second cylindrical lens (see Figure B).

A few observations will guide the selection and placement of the lenses:

1) To achieve a symmetrical beam shape, the ratio of the focal length of the two lenses should be approximately equivalent to the ratio of the beam divergences:

- $\theta 1/\theta 2 = 10^{\circ}/40^{\circ} = f_1/f_2$ .
- 2) First, to order, the laser diode is approximated by a point source, so the lenses should be placed at a distance equal to their respective focal lengths from the source to create a collimated output.
- 3) The principal planes of the two lenses should be spaced at a distance apart equal to the difference of their focal lengths  $f_2$   $f_1$ . The actual spacing between plano surfaces of the lenses is BFL<sub>2</sub> -BFL<sub>1</sub>. As with spherical lenses the convex surfaces should face the collimated rays to minimize aberrations.
- 4) Because of the rapid divergence of the laser diode beam, care must be taken to make sure the beam width at each lens does not exceed the lens clear aperture. Since each lens is placed one focal distance from the laser diode, the maximum beam width at each lens ( $d_1$  and  $d_2$ ) can be determined from the following equations:  $d_1 = 2f_1(\tan(\theta_2/2))$ , and  $d_2 = 2f_2(\tan(\theta_1/2))$

#### GCL-1101 Cylinder Plano-Convex Lenses

Similar to a Plano-Convex lens in profile, but only as a cylinder instead of a sphere, this cylindrical lens focuses light only in one dimension. It can also transform a point image into a line image or changing the height of an image without affecting its width. There are two circumference shapes, rectangular and circular.

#### GCL-11010 Rectangular Cylinder Plano-Convex Lenses



GCL-11010

Material: BK7, fine annealed Effective Focal Length(f): ±2% at 587.6nm

• Dimension Tolerance: +0.0/-0.2

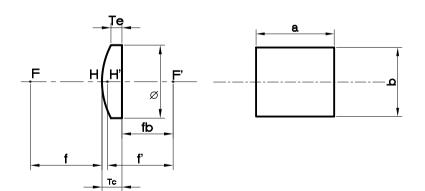
• Center Thickness Tolerance: ±0.2

 Surface Quality: 60-40 scratch-dig Clear Aperture: 90% surface area

Centration:

· Coatings: 1/4 wave MgF2 coating at 550nm for

0° angle of incidence



f: focal length (object side)

f': focal length (image side)

fb: back focal length

Ø: lens diameter Tc: center thickness

Te: edge thickness

F,F': focal points

H,H': principal points

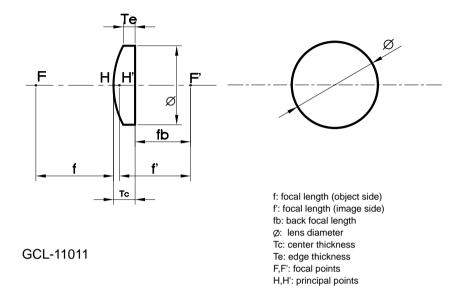
GCL-11010

#### GCL-11010 Rectangular Cylinder Plano-Convex Lenses

Part No.	axb	f'	fb	Tc
GCL-110101	15.0x15.0	40.0	36.7	5.0
GCL-110102	25.4x25.4	200.0	196.7	5.0
GCL-110103	40.0x40.0	400.0	400.0	5.0



### GCL-11011 Circular Cylinder Plano-Convex Lenses



#### GCL-11011 Circular Cylinder Plano-Convex Lenses

Part No.	Ø	f <sup>′</sup>	f <sub>b</sub>	Tc
GCL-110114	25.4	25	17.09	12
GCL-110115	25.4	50	47.03	4.5
GCL-110116	25.4	75	72.89	3.2
GCL-110117	25.4	100	97.89	3.2
GCL-110118	25.4	150	147.89	3.2

# Cylindrical Lenses



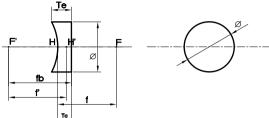
GCL-1103

f: focal length (object side) f': focal length (image side) fb: back focal length Ø: lens diameter Tc: center thickness Te: edge thickness F,F': focal points

H,H': principal points

# GCL-1103 Cylinder Plano-Concave Lenses

Similar to a Plano-Concave lens in profile, but only as a cylinder instead of a sphere, this cylindrical lens focuses light only in one dimension. It can be used with cylindrical plano-convex lens together in beam expander applications.



#### GCL-1103

Material: BK7, fine annealed Effective Focal Length(f): ±2% at 587.6nm • Dimension Tolerance: +0/-0.2

• Center Thickness Tolerance: ±0.2

60-40 scratch-dig Surface Quality: Clear Aperture: 90% surface area

Centration:

Coatings: 1/4 wave MgF<sub>2</sub> coating at 550nm for

0° angle of incidence

#### GCL-1103 Cylinder Plano-Concave Lenses

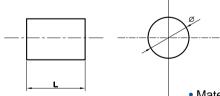
Part No.	Ø	f′	$f_b$	Tc
GCL-110311	25.4	-25	-26.98	3
GCL-110312	25.4	-50	-51.98	3
GCL-110313	25.4	-75	-77.31	3.5
GCL-110314	25.4	-100	-102.31	3.5

#### GCL-1105 Rod Lenses

Rod Lenses are polished on the circumference and ground on both ends. It is similar to a Plano-Convex cylinder lens. Collimated light passing through the diameter of the rod will be focused into a line.



GCL-1105



BK7, fine annealed Material:

• Dimension Tolerance: +0/-0.2

 Surface Quality: 60-40 scratch-dig

· Length: +0/-0.1

Uncoated

# GCL-1105 Rod Lenses

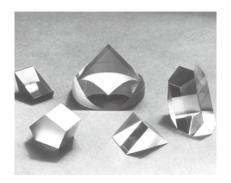
GCL-1105

Part No.	Ø	L
GCL-110501	5	20
GCL-110502	10	20

GCL-03010 BK7 Right Angle Prisms	032
GCL-03012 Fused Silica Right Angle Prisms	032
GCL-03013 Equilateral Prisms	033
GCL-0302 Penta Prisms	033
GCL-0303 45°Reflection Prisms	034
GCL-0304 Right Angle Roof Prisms	035
GCL-0305 Corner Cube Prisms	036
GCL-03051 Hollow Retroreflectors	037
GCM-0706 Hollow Retroreflector Adapter Rings	038
GCL-0306 Dove Prisms	039
GCL-04 Wedge Prisms	040



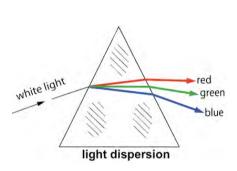
# Prisms PRISMS



#### General

Prisms are used in an optical system when the exit beam may be reflected or deviated from the entrance direction. The images produced by prisms can be made reversed, inverted or rotated. Prisms are typically made of glass materials, and can be made from any material that is transparent to the wavelengths.

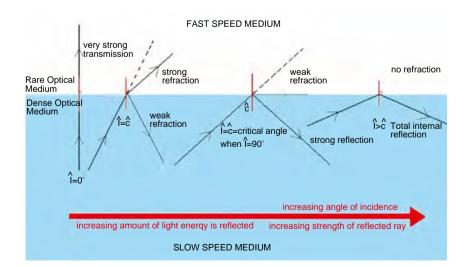
# Dispersion



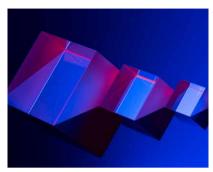
Light changes its speed as it moves from one medium to another, for example, from air into glass and from water to air. This causes the light to be refracted at the boundary and to enter the new medium at a different speed with a different angle (Huygens principle). The bending angle of the light path depends on the angle that the incident beam strikes at the interface and the ratio between the refractive indices of the two media (Snell's law). The refractive index of many materials such as glass varies with the wavelength or color of light, a phenomenon known as dispersion. This means that light of different colors is refracted differently and leaves the medium such as a prism at different angles, creating an effect similar to a rainbow. With this principle, a prism is used to separate a beam of white light into its constituent spectrum of colors, and so does a diffraction grating. However, prisms generally disperse light over a much larger frequency bandwidth than diffraction gratings, making them useful for broadspectrum spectroscopy.

# Total Internal Reflection (TIR) Prism

Prisms are sometimes used for the internal reflection at the surfaces rather than for dispersion. If light inside the prism hits one of the surfaces at a sufficiently steep angle, total internal reflection (TIR) occurs and all of the light is reflected. This makes a prism a useful substitute for a mirror in some situations. TIR Prism can be used to reflect light, or to split light into components with different polarizations.



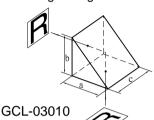




GCL-03010

# GCL-03010 BK7 Right Angle Prisms

Right angle prisms are ideal for beam bending and retro reflection applications. They are often used, instead of mirrors, in applications where deformation of the reflective surface may cause a problem. The fine balance between performance and cost has been optimized making these prisms ideal for OEM applications in the visible and near infrared wavelength range.



• Angles: 45°, 90°±3' or 30"

Material: BK7 grade A, fine annealed

• Flatness: λ/4

Surface Quality: 60-40 scratch-digClear Aperture: 90% surface area

Uncoated

# GCL-03010 BK7 Right Angle Prisms

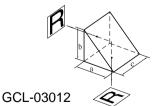
Dimension	Pa	rt No.
a=b=c	± 3 ′	± 30"
5.0	GCL-030104	GCL-030104A
10.0	GCL-030105	GCL-030105A
12.7	GCL-030101	GCL-030101A
20.0	GCL-030106	GCL-030106A
25.4	GCL-030102	GCL-030102A
30.0	GCL-030107	GCL-030107A
40.0	GCL-030108	GCL-030108A
50.8	GCL-030103	GCL-030103A



GCL-03012

# GCL-03012 Fused Silica Right Angle Prisms

Fused Silica is regarded as very good material to be used in UV laser and imaging applications. It has high transmission from 200nm to 2.5um. In addition, it also can be used in higher operating temperatures. Right angle prisms are ideal for beam bending and retro reflection applications. They are often used, instead of mirrors, in applications where deformation of the reflective surface may cause a problem.



• Angles: 45°, 90°±3'

Material: UV grade fused silica

• Flatness: λ/4

Surface Quality: 60-40 scratch-digClear Aperture: 90% surface area

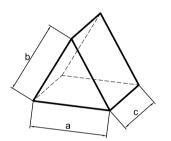
Uncoated

# GCL-03012 Fused Silica Right Angle Prisms

Part No.	a = b = c	
GCL-030121	10x10x10	
GCL-030122	25.4x25.4x25.4	



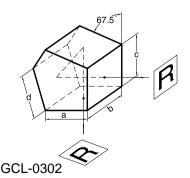
GCL-03013



GCL-03013



GCL-0302



# GCL-03013 Equilateral Prisms

An equilateral dispersing prism has an equilateral triangle in the crosssection with the three sides of equal length. They are used for wavelength separation. A light ray is refracted twice, passing through the prism with total deviation denoted by qd in the figure below. Deviation is a function of refractive index, and hence wavelength. Angular dispersion Dqd is the difference in deviation for light rays having different wavelengths and varies with prism orientation.

60°±2' Angles: SF11 Material: · Flatness: λ/4

 Surface Quality: 60-40 scratch-dig Clear Aperture: 90% surface area

Coatings: 1/4 wave MgF<sub>2</sub> coating at 550nm for all 3 surfaces

### GCL-03013 Equilateral prisms

Part No.	a = b = c
GCL-030131	10
GCL-030132	25.4
GCL-030133	40

## GCL-0302 Penta Prisms

A Penta prism is a five-side prism, featuring two important properties. Firstly, the image is neither inverted nor reversed while it is deviated by 90 degree. Secondly, it is a constant deflection device, i.e., all the transmitted rays are exactly deflected by 90 degree. Slight movement of the prisms does not affect the right deflected angle. This feature makes the prism useful in rangefinder. It is also used in viewfinders of single reflex cameras. The reflecting surfaces are enhanced aluminum-coated with black paint overcoat for protection.

Material: BK7, fine annealed

• Dimension Tolerance: ±0.1

Flatness: λ/4 at reflection surface

λ/2 at transmission surface

 Surface Quality: 60-40 scratch-dig

90% Clear Aperture:

Coatings: Reflecting surfaces are aluminized with black

paint.

Entrance and exit surfaces are 1/4 wave MgF<sub>2</sub> coating at 550nm for 0° angle of incidence.

#### GCL-0302 Penta Prisms

Part No.	a = b = c	d	<b>Total Deviation</b>
GCL-030201	20.0	21.6	90° ± 3′
GCL-030202	30.0	32.5	90° ± 3′
GCL-030203	40.0	43.3	90° ± 3′

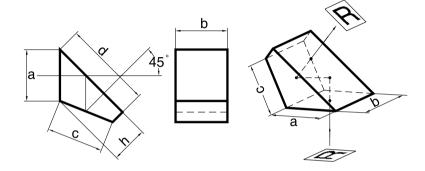




GCL-0303

# GCL-0303 45° Reflection Prisms

45° Reflection Prisms are used to deviate the line of sight by 45°. The reflecting surfaces are aluminized with black paint for protection.



### GCL-0303

• Beam Deviation: 45°±5'

• Material: BK7, fine annealed

±0.1 • Dimension Tolerance:

• Flatness: λ/4 at reflection surface

λ/2 at transmission surface

60-40 scratch-dig Surface Quality:

• Clear Aperture: 90%

· Coatings: Reflecting surfaces are aluminized with black

Entrance and Exit surfaces are 1/4 wave MgF<sub>2</sub> coating at 550nm for  $0^{\circ}$  angle of incidence.

### GCL-0303 45° Reflection Prisms

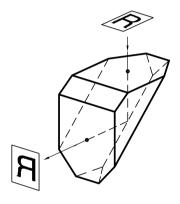
Part No.	(a=b)	С	d	h
GCL-030301	20.0	21.6	34.2	14.2
GCL-030302	30.0	32.4	51.3	21.3

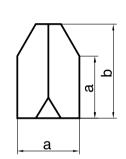


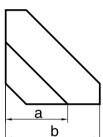
GCL-0304

# GCL-0304 Right Angle Roof Prisms

This type of prism consists of a roof edge produced upon the long reflecting face of a right-angle prism and is also called Amici roof prism. Like a right-angle prism, it reflects an image by 90°, but inverts the image simultaneously. It is commonly used as an erecting system in telescopes.







GCL-0304

90°±5' · Beam Deviation:

Material: BK7, fine annealed

• Dimension Tolerance: ±0.15

Flatness: λ/4 at reflection surface

λ/2 at transmission surface

• Roof Angle Tolerance: ±5", ±15"

• Surface Quality: 60-40 scratch-dig • Clear Aperture: 90% surface area

· Coatings: Entrance and exit surfaces are 1/4 wave MgF<sub>2</sub>

coating at 550nm for 0° angle of incidence.

Roof surfaces are uncoated.

### GCL-0304 Right Angle Roof Prisms

Part No.	а	b	Roof Angle	
GCL-030401	18.0	24.5	90 ±5"	
GCL-030401B	18.0	24.5	90 ±15"	
GCL-030403	32.0	41.0	90 ±5"	
GCL-030403B	32.0	41.0	90 ±15"	_



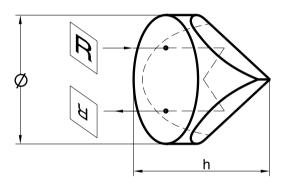


GCL-0305

### GCL-0305 Corner Cube Prisms

This prism has three mutually perpendicular intersected surfaces and a hypotenuse face. The three intersected surfaces are coated for high internal reflection. When light enters through the hypotenuse, it is reflected by each of the three surfaces in turn and emerges through the hypotenuse face parallel to the entering beam with a shift. The prism thus retro-reflects the beam to the source, regardless the orientation of the prism. It has a wider field of view. They are ideal in applications where orientation is difficult or impossible to control.

There is also an alternative form of the retro-reflector which consists of three perpendicular intersected mirrors in a holder. This is much lighter than the prism form but demands accurate assembly.



#### GCL-0305

· Beam Deviation: 180°±5"

BK7, optical glass fine annealed Material:

• Dimension Tolerance: 0.15 Wavefront Distortion: λ/4

 Surface Quality: 80-50 scratch-dig • Clear Aperture: 90% surface area

Reflecting surfaces are aluminized · Coatings:

with black paint.

Entrance surfaces is 1/4 wave MgF<sub>2</sub> coating at 550nm for 0° angle of

incidence

#### GCL-0305 Corner Cube Prisms

Part No.	Ø	h	Beam Deviation
GCL-030502	12.7	9.5	180 ± 5"
GCL-030503	25.4	19.1	180 ± 5"
GCL-030505	64	48.0	180 ± 5"



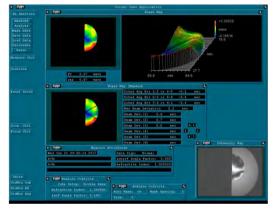
GCL-03051

# GCL-03051 Hollow Retroreflectors

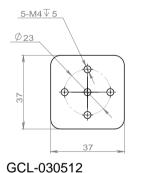
Hollow Retroreflectors are constructed of three front-surface mirrors assembled into an aluminum corner cube. It likes the solid glass prismtype retroreflectors, the parallel incident light is reflected back to the source with great accuracy, regardless of the angle of incidence. Reflected images are both inverted and reversed. Since the optical path is in air, this configuration eliminates material absorption and chromatic aberrations present in solid glass prism-type retroreflectors.

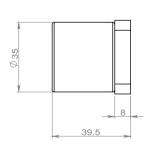
By adopting the elastic installation method, the stability is guaranteed and the effect of stress is reduced. It is convenient for users to use the GCM-0706 series or GCM-03 series to easily place the Hollow Retroreflectors in the light path, or use the M4 threaded hole on the back plate of the Hollow Retroreflectors for custom connection.

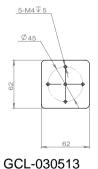
- 180° reflection independent of the angle of incidence
- Beam deviation: 5 arc sec
- Protected silver coating: R>95% throughout VIS
- Image inverted and reversed
- No material absorption or chromatic aberration

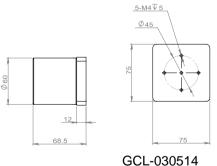


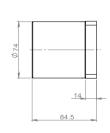
Angle test data











GCL-03051 Hollow Retroreflectors

Part No.	Aperture	Beam Deviation	Exiting Wavefront	Dimension	Surface Quality	Coating
GCL-030512	Ф25.4	5″	λ/3	37x37x39.5	80-50	Protected Silver
GCL-030513	Ф50.8	5″	λ/3	62x62x68.5	80-50	Protected Silver
GCL-030514	Ф63.5	5″	λ/3	75x75x84.5	80-50	Protected Silver



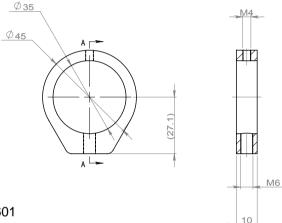


# GCM-0706

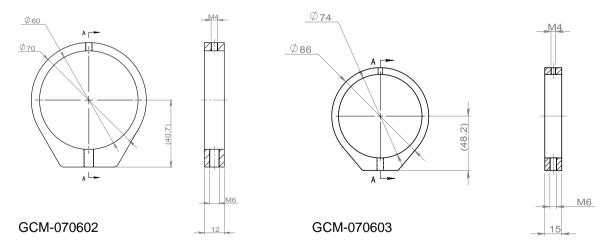
# GCM-0706 Hollow Retroreflector Adapter Rings

GCM-0706 series adapter rings consist of three products which matching GCL-03051 hollow retroreflectors. They are mainly used for holding hollow retroreflectors, which is convenient for users to place the retroreflectors into the optical system.

The adapter ring has a fastening screw with nylon head, which can protect the surface of the retroreflectors from being damaged when fastening them. And the switching ring of the structure can allow the retroreflectors to rotate in it, which is convenient for the user to adjust the direction of the beam.



# GCM-070601



### GCM-0706 Hollow Retroreflector Adapter Rings

Part No.	Inner Diameter	Outer Diameter	Center Height	Thickness	Weight(g)	Part No. of matching Hollow Retroreflectors
GCM-070601	Ф35	Φ45	27.1	10	21.2g	GCL-030512
GCM-070602	Ф60	Φ70	40.7	12	46.3g	GCL-030513
GCM-070603	Φ74	Ф86	48.2	15	77.1g	GCL-030514

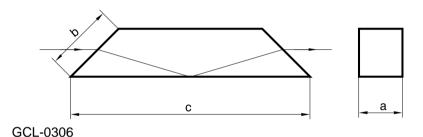


GCL-0306

# GCL-0306 Dove Prisms

This type of prism is a half of a common right-angle prism with the right angle corner truncated parallel to the hypotenuse face. Light, parallel to the hypotenuse face, enters one of slope faces, has total internal reflection on that face, and emerges from the other slope face parallel to its incident direction. Because of one reflection on the hypotenuse face, the image is flipped and inverted, but not laterally transposed. The emerging light is continued in the incident direction.

The most interested property of the Dove prism is that, if the prism is rotated about the incident axis through an angle, the image rotates twice of that angle. This makes it as a beam rotator which is widely used in optical instruments. A Dove prism must be used in parallel light or a collimated beam.



• Angle Tolerance:  $\pm 3'$ 

Material: BK7, fine annealed

• Dimension Tolerance:  $\pm 0.15$ Flatness:  $\lambda /4$ 

 Surface Quality: 60-40 scratch-dig · Clear Aperture: 90% surface area

Uncoated

# GCL-0306 Dove Prisms

Part No.	а	b	С
GCL-030601	10.0	14.14	42.28
GCL-030602	20.0	28.18	84.56

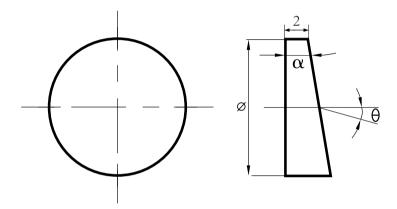




GCL-04

# GCL-04 Wedge Prisms

An optical element has plane-inclined surface. Wedge prisms are used as small beam steering elements in optical systems. By combining two wedges of equal power (equal wedge angle) in near contact and independently rotating them, a ray passing through the combination can be steered in anydirection, within a narrow cone.



GCL-04

Material: BK7, fine annealed

• Dimension Tolerance: +0.0/-0.15

• Flatness: λ/4~λ

 Surface Quality: 60-40 scratch-dig Clear Aperture: 90% surface area

· Coatings: 1/4 wave MgF<sub>2</sub> coating at 550nm for

0° angle of incidence

• Beam Deviation(e°): ≈(n\*-1)·α°

n\*: Index of the material

# GCL-04 Wedge Prisms

Part No.	Ø	Wedge Angle(α°)
GCL-040101	25.4	2.0
GCL-040102	25.4	4.0
GCL-040201	38.1	2.0
GCL-040202	38.1	4.0

# Windows

GCL-1201 Sapphire Windows	042
GCL-1202 Fused Silica Windows	042
GCL-1203 Calcium Fluoride Windows	043

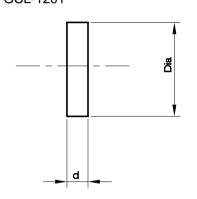




# Windows



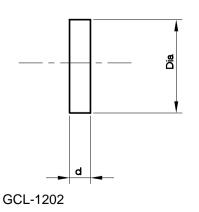
GCL-1201



GCL-1201



GCL-1202



# GCL-1201 Sapphire Windows

Sapphire is transparent from 170nm to 5.3 µm. Possessing high strength, hardness and chemical stability, it is an exellent material for severe environments. Being five times stronger than glass and heat resistant up to 2000°C, sapphire is often employed as pressure windows.

+0.0/- 0.1 • Diameter Tolerance: Wedge Angle: 3'

 Surface Quality: 80-50 scratch-dig · flatness: Without demand

Uncoated

#### GCL-1201 Sapphire Windows

Part No.	Dia	d
GCL-120101	12.7	1.0
GCL-120102	25.4	1.0

# GCL-1202 Fused Silica Windows

Fused silica is an ideal material for UV applications and is transparent from 220nm to 4.0 m. It is characterized by excellent chemical and radiation resistance, low coefficient of thermal expansion, low fluorescence, and resistance to scratch.

> +0.0/- 0.1 • Diameter Tolerance: Wedge Angle: 3'

flatness: λ/4 at 633nm per inch diameter 40-20 scratch-dig

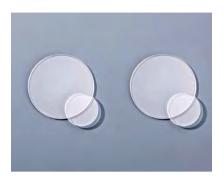
Surface Quality:

Uncoated

#### GCL-1202 Fused Silica Windows

Part No.	Dia	d
GCL-120201	12.7	2.0
GCL-120202	25.4	5.0
GCL-120203	38.1	5.0
GCL-120204	40	2.0
GCL-120205	50	3.0

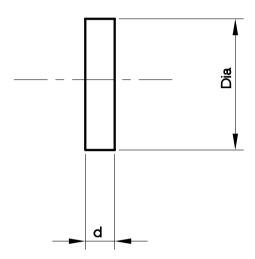
# Windows



GCL-1203

### GCL-1203 Calcium Fluoride Windows

Calcium Fluoride is extremely transparent over a wide spectrum from deep UV (135nm) to far IR (9.4 m), which makes it idealfor windows in very short wavelength excimer lasers. The crystal has very low refractive index (about 1.40), which eliminatesthe need of antireflection coatings. It is slightly soluble in water.



# GCL-1203

• Diameter Tolerance: +0.0/- 0.1

• Wedge Angle:

• flatness: λ/2 at 633nm Surface Quality: 80-50 scratch-dig

Uncoated

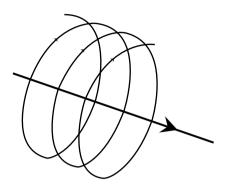
### GCL-1203 Calcium Fluoride Windows

Part No.	Dia	d
GCL-120301	12.7	3.0
GCL-120302	25.4	3.0
GCL-120303	38.1	4.0

GCL-0604 Quartz Zero-Order Waveplates	.048
GCL-0606 Quartz Multi-Order Waveplates	.049
GCL-0607 Air Space Quartz Zero-Order Waveplates	.050
GCL-0608 Achromatic Waveplates	.051
GCL-0702 Glan-Taylor Prims	.052
GCL-0711 Wollaston Prisms	.053



# **Crystal Components**



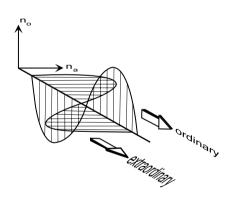
# Polarized light

Polarized light has the optical radiation with its electric field vibrating in a specific regular mode. Any generally polarized electric field can be resolved into two orthogonally polarized components. If the light is plane polarized, the electric field vibrates in a single plane - the plane of polarization, and the two components are in phase. If it is elliptically polarized, the two components have a constant phase difference, and the tip of the electric field vector follows a three dimensional ellipse as the

beam propagates.

Circularly polarized light is a special case of elliptically polarized light in which the two components have a 90 degree phase difference and the electric field vector describes a circular cross section spiral. When viewed looking towards the source, a right circularly polarized beam had a light vector that describes a clockwise circle, while left circularly polarized light describes an anticlockwise circle.

# Linear Birefringence

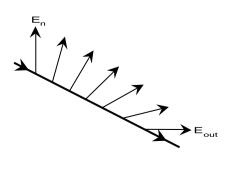


Linearly birefringent uniaxial crystalline materials are characterized by having a unique axis of symmetry, called the optic axis, which imposes constraints upon the propagation of light beams within the crystal. Two modes are permitted, either as an ordinary beam polarized in a plane normal to the optic axis, or as an extraordinary beam polarized in a

plane containing the optic axis.

Each of the beams has an associated refractive index, such that both the electric field (wave normal) velocities and the beam (ray) angles of the refraction are different. It is this latter property that enables suitably cut and oriented prisms of birefringent materials to act as polarizers and polarizing beam splitters.

# Circular Birefringence



If a plane polarized beam propagates down the optic axis of a material exhibiting circular birefringence (see crystal quartz), it is resolved into two collinear circularly polarized beams, each propagating with a slightly different velocity. When these two components emerge from the material, they recombine into a plane polarized beam whose plane of polarization is rotated from that of the incident beam. This effect of producing a progressive rotation of the plane of polarization with path length is called optical activity.



# **Birefringent Materials**

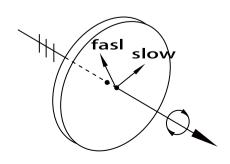
We use two principal materials out of a fairly wide range of birefringent crystals for the production of our polarizing components, calcite and crystal quartz.

Calcite is a widely preferred choice of material owing to its very high birefringence, wide spectral transmission and the availability of reasonably sized rhombs. It has the advantage of being non-hygroscopic, so that protection from the atmosphere is not necessary, though it is a fairly soft crystal and is easily scratched.

Quartz is another extremely useful birefringent material and is available as either natural crystals or as synthetic boules. Natural crystals occur as rough lumps that require orientation to determine the optic axis before processing, while synthetic crystals have reference surfaces aligned to crystallographic axes. When deciding which sort of quartz should be used for a component, two parameters that differ significantly between the two types should be considered: size and spectral transmission.

In general, components from synthetic quartz are limited to a maximum size in the direction of the optic axis of around 50mm, while natural quartz boules are available large enough to yield working apertures up to 100mm. The other significant discrimination between natural and synthetic quartz is the low wavelength cut-off. Natural quartz has a useful transmission (80%) from 220nm, while synthetic transmits similarly from 180nm. Both transmit to wavelength of about 1-6 microns.

Quartz is very hard (Moh's scale 7) and very strong. It thus lends itself to the fabrication of very thin low order retardation plate. Unlike calcite, quartz exhibits circular birefringence, and there is no unique direction (optic axis) down which ordinary and extraordinary beams propagate under one refractive index with the same velocity, instead, the optic axis is the direction for which the two indices are closest. This produces progressive optical rotation of an incident plane polarized beam, which is used as rotator.

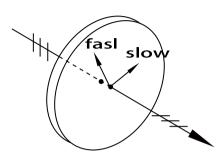


# **Retardation Plates**

Retardation plates are optical elements that introduce a fractional wavelength phase difference between the ordinary and extraordinary polarization components of an input beam. The plate, made from a birefringent

material, commonly crystal quartz, is oriented with its optic axis lying in the surface at 45 degree to the input polarization. The beam is then resolved into two equal amplitude components propagating with different velocities (fast and slow)

# **Crystal Components**



under the two refractive indices.

On exiting the plate, the two components recombine with a different phase relationship to the input beam, dependent on the plate thickness. The most useful retardations are a quarter and half wavelength for polarization analysis and separation purposes.

A quarter waveplate introduces a 90 degree phase shift between the two components, producing circularly polarized light. The sign of the phase shift determines whether the beam is left or right circularly polarized.

A half wave plate introduces a 180 degree phase shift, which has the effect of rotating the input plane of polarization through 90 degree. Notations in the diagrams in this section

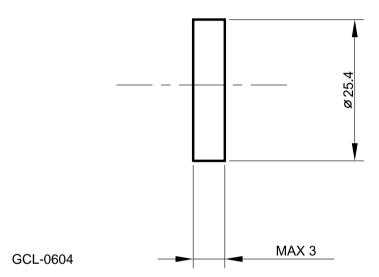




GCL-0604

# GCL-0604 Quartz Zero-Order Waveplates

Crystalline quartz is frequently used for the stringest quality retardation applications. Zero-order waveplate is made by cementing two quartz plates with their fast axes orthogonal to each other. The difference in thickness is equal to either /4 or  $\lambda$  /2 for a specified wavelength, Compared with multiple-order quartz retarders, they are much more insensitive to wavelength, temperature and angle of incidence. Waveplates of other wavelength and sizes are avalible for custom made.



 Material Crystalline quartz Diameter:: Ø25.4+0.0/-0.15 • Thickness:: 0.5~3±0.1 λ/300

GCL-0604 Quartz Zero-Order Waveplates

Uncoated

• Retardation Accuracy:

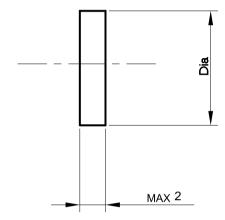
Part No.λ/4 plate	Part No.λ/2 plate	Wavelength (nm)
GCL-060401	GCL-060411	532
GCL-060402	GCL-060412	632.8
GCL-060403	GCL-060413	488
GCL-060404	GCL-060414	473
GCL-060406	GCL-060416	514.5



GCL-0606

# GCL-0606 Quartz Multi-Order Waveplates

Multi-order waveplates are made of high quality quartz crystals, providing delays of half and quarter wavelengths at various commonly used wavelengths.  $\lambda$  /2 waveplates are usually used to rotate the polarization of light, while  $\lambda$  /4 waveplates are used to convert linearly polarized light to circularly polarized light. Mult-order waveplates are more sensitive to wavelength and temperature changes than zero-order waveplates.



GCL-0606

•Material: Crystalline quartz

•Diameter tolerance : +0.0/-0.15
•Thickness : 0.5~2.0±0.1
•Retardation Accuracy : \( \lambda / 100 \)

Uncaoted

# GCL-0606 Quartz Multi-Order Waveplates

Part No. ( λ /4 plate)	Part No. (λ/2 plate)	Wavelength(nm)	Diameter
GCL-060601	GCL-060611	488	12.7
GCL-060602	GCL-060612	514.5	12.7
GCL-060603	GCL-060613	532	12.7
GCL-060604	GCL-060614	632.8	12.7
GCL-060605	GCL-060615	780	12.7
GCL-060606	GCL-060616	1064	12.7
GCL-060641	GCL-060651	441.6	25.4
GCL-060621	GCL-060631	488	25.4
GCL-060622	GCL-060632	514.5	25.4
GCL-060623	GCL-060633	532	25.4
GCL-060624	GCL-060634	632.8	25.4
GCL-060642	GCL-060652	650	25.4
GCL-060643	GCL-060653	670	25.4
GCL-060625	GCL-060635	780	25.4
GCL-060627	GCL-060637	800	25.4
GCL-060644	GCL-060654	808	25.4
GCL-060645	GCL-060655	830	25.4
GCL-060626	GCL-060636	1064	25.4
GCL-060646	GCL-060656	1310	25.4
GCL-060647	GCL-060657	1550	25.4





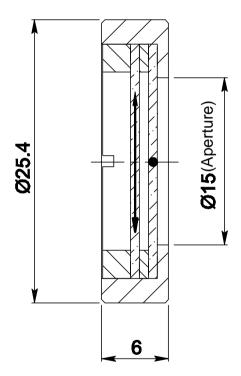
GCL-0607

# GCL-0607 Air Space Quartz Zero-Order Waveplates

Air space zero-order waveplates are air gap design, which has high damage threshold and are available in  $\lambda/2$  and  $\lambda/4$  options for commonly used wavelengths. These waveplate are composed of two multi-order quartz waveplates, which can produce corresponding optical path difference. A composite delay plate is formed by aligning the fast axis of one wave plate with the slow axis of another wave plate. The net delay is the difference between the two waveplates. Air space zero-order waveplates are less affected by temperature and wavelength than multi-level wave plate.

•Material : Crystalline quartz •Diameter : Ø 25.4+0.0/-0.15

•Retardation Accuracy: λ /500



GCL-0607

### GCL-0607 Air Space Quartz Zero-Order Waveplates

Part No. (λ/4 plate)	Part No. (λ/2 plate)	Wavelength(nm)	Damage Threshold
GCL-060701	GCL-060711	355	3J/cm <sup>2</sup> (10ns 10Hz 355nm)
GCL-060702	GCL-060712	532	5J/cm <sup>2</sup> (10ns 10Hz 532nm)
GCL-060703	GCL-060713	632.8	5J/cm <sup>2</sup> (10ns 10Hz 532nm)
GCL-060704	GCL-060714	800	8J/cm <sup>2</sup> (10ns 10Hz 1064nm)
GCL-060705	GCL-060715	808	8J/cm <sup>2</sup> (10ns 10Hz 1064nm)
GCL-060706	GCL-060716	1064	8J/cm <sup>2</sup> (10ns 10Hz 1064nm)



GCL-0608

# GCL-0608 Achromatic Waveplates

Achromatic Waveplates provide a constant phase shift independent of the wavelength of light that is used. Achromatic Waveplates are formed by using two different birefringent crystalline material quartz and magnesium fluoride. The relative phase difference between the two axes is either  $\lambda$  /4 or  $\lambda$  /2. The combination of quartz crystal and magnesium fluoride can minimize the effect of wavelength on phase delay, and a nearly flat spectral response can be obtained in the whole wavelength range of Achromatic Waveplates. The flat response of an Achromatic Waveplate is ideal for use with tunable lasers, multiple laser-line systems, and other broad spectrum sources. The fast axis direction of the waveplate is engraved on the outer shell.

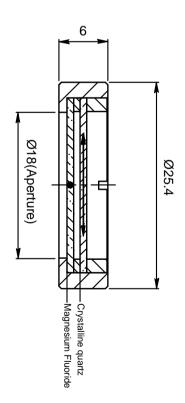
•Material: Crystalline quartz and Magnesium Fluoride

•Diameter:  $25.4 \pm 0.1$ 

•Thickness:

•Retardation Accuracy:  $\lambda /100 \sim \lambda /150$ 

Coatings: Multiple Layers AR coating



#### GCL-0608

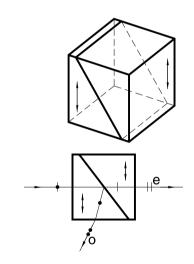
### GCL-0608 Achromatic Waveplates

Part No.( λ /4 plate)	Part No. ( λ /2 plate)	Wavelength(nm)	Damage Threshold
GCL-060801	GCL-060811	450-650	5J/cm <sup>2</sup> (10ns 10Hz 532nm)
GCL-060802	GCL-060812	650-1000	8J/cm <sup>2</sup> (10ns 10Hz 1064nm)
GCL-060803	GCL-060813	900-2100	8J/cm <sup>2</sup> (10ns 10Hz 1064nm)





GCL-0702



GCL-0702

# GCL-0702 Glan-Taylor Prisms

A Glan-Taylor prism is an air-spaced prism, which is used as a polarizer or polarizing beam splitter. It is one of the most common types of modern polarizing prism. It was first described by Archard and Taylor in 1948.

The prism is made of two right-angled prisms of calcite (or sometimes other birefringent materials) which are separated on their long faces with an air gap. The optical axes of the calcite crystals are aligned parallel to the plane of reflection. Total internal reflection of s-polarized light at the air-gap ensures that only p-polarized light is transmitted by the device. Because the angle of incidence at the gap can be reasonably close to Brewster's angle, unwanted reflection of p-polarized light is reduced. Noted that the transmitted beam is 100% polarized, but the reflected beam is not. The sides of the crystal can be polished to allow the reflected beam to exit, or can be blackened to absorb it. The latter reduces unwanted Fresnel reflection of the rejected beam. However, the Glan-Taylor type prisms have a smaller field angle, which is not symmetric about the longitudinal axis of the prism. The total filed angle is 8 degrees, but the symmetric field angle is only 5.5 degrees.

 $\begin{array}{lll} \bullet \text{Wavelength Range}: & 220 \text{nm} \sim 2500 \text{nm} \\ \bullet \text{Transmission}: & >85\%, \lambda_0 = 632.8 \text{nm} \\ \bullet \text{Optical Damage Threshold}: & \text{CW:} 100 \text{W/cm}^2 \\ \text{Pulsed:} 200 \text{MW/cm}^2 \\ \end{array}$ 

•Extinction Ratio :  $>1x10^5$ :1 •Wavefront Distortion :  $\lambda/8$ •Deviation Angle : 3'

# GCL-0702 Glan-Taylor Prisms

Part No.	Clear Aperture	Diameter x Length
GCL-070210	5	15 × 21.0
GCL-070211	8	25.4 × 24.5
GCL-070212	10	25.4 × 26.2
GCL-070213	12.7	25.4 × 27.5
GCL-070214	15	30 × 33.3
GCL-070215	18	38 × 42.3

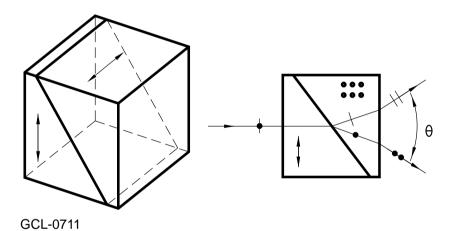


GCL-0711

### GCL-0711 Wollaston Prisms

A Wollaston prism, invented by William Hyde Wollaston, is an optical device that manipulates polarized light. It separates randomly polarized or nonpolarized light into two orthogonal linearly polarized outgoing beams.

The Wollaston prism consists of two orthogonal calcite prisms, cemented together on their base to form two right triangle prisms with perpendicular optic axes. The Wollaston prism is commonly used as a polarizing beamsplitter. The deviations of the two transmitted beams are nearly symmetric about the incident beam direction. The polarizations of the output beams are parallel and perpendicular to the plane where the entrance and exit beam lie. The beam splitting angle varies with the wavelength, therefore the data in the table below are approximate.



·Wavelength Range: 300nm~2500nm

•Transmission:  $>85\%, \lambda_0 = 632.8$ nm •Optical Damage Threshold: CW:50W/cm<sup>2</sup>

Pulsed:100MW/cm<sup>2</sup>

>1x10<sup>5</sup>:1 Extinction Ratio: •Beamsplitting Angle(θ): 15°

#### GCL-0711 Wollaston Prisms

Part No.	Clear Aperture	Diameter x Length
GCL-071110	8	25.4x17.0
GCL-071111	10	25.4x19.0
GCL-071113	15	30.0x23.0
GCL-071115	20	38.0x29.0

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# General

High reflectivity (HR) coating is generally required for mirrors and reflectors, though some are partial reflection or wavelength dependent. They work the opposite way to antireflection coatings. For high reflectivity, there are two main types of optical coating: metallic and dielectric coating. Aluminum, silver and gold are used for metallic coated mirrors. The performance of the coatings varies with reflectivity and wavelength range specified. An example of hybrid coating with metallic and dielectric materials is the protected or enhanced metallic coatings because most of metalliconly coatings often suffer oxidization or poor adhesiveness to substrates which affect their durability. Daheng Optics offers a wide range of HR coating products off-the-shelf, those are coated on substrates with variety and commonly used shapes and dimensions.

# Metallic Mirror Coating

This is the simplest and most common mirror coating. A layer of aluminum or silver makes an excellent reflector for the visible spectrum. Aluminum reflects about 90 percent of the light across the visible spectrum, while silver

reflects about 95%. The figure below shows the reflectivity of aluminum and silver against wavelength. The reflectance of a metal mirror can be calculated from the index of refraction n and the extinction coefficient K of the metal.

The reflectance of a metal surface in air is given by:

$$R(\%) = \frac{(n+1)^2 + K^2}{(n+1)^2 + K^2} \times 100$$

n AND K FOR SELECTED METALS

Wavelen	gth(µm)	0.2	0.3	0.4	0.5	0.6	0.7	1.0	2.0	4.0
Aluminur	m* <i>n</i> :	0.12	0.28	0.49	0.77	1.20	1.83	1.35	2.15	6.43
	<i>K</i> :	2.30	3.61	4.86	6.08	7.26	8.31	9.58	20.7	39.8
Silver	<i>n</i> :	1.07	1.51	0.17	0.13	0.12	0.14	0.21	0.65	2.30
	<i>K</i> :	1.24	0.96	1.95	2.92	3.73	4.52	6.76	12.2	24.3
Gold	n:	1.43	1.80	1.66	0.85	0.22	0.16	0.26	0.85	2.60
	<i>K</i> :	1.22	1.92	1.96	1.90	2.97	3.95	6.82	12.6	24.6

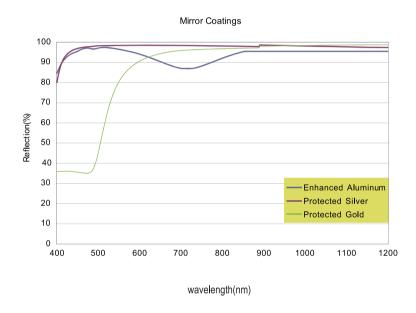
Aluminum has a reflectance dip at 0.8 $\mu$ m: for  $\lambda$ =0.8 $\mu$ m, n=2.80 and K=8.45



Across the visible spectrum, silver is the most reflective. The reflectivity of aluminum dips below 90% in the region from 0.8 to 1.0 m. In an optical system with several mirrors, this can be detrimental to performance. For example, a system with five mirrors that each has the reflectance of 85%

would have a throughput of only 44 percent. Gold is useful only in the red and IR spectral regions. Aluminum is fairly stable as a mirror but silver tarnishes quickly unless kept in a dry and contamination-free environment. In addition, an unprotected aluminum or gold mirror cannot withstand cleaning

with anything but the most gentle cotton ball or camel hair brush. To solve this problem, normally, a dielectric material such as silicon monoxide SiO for visible mirrors is coated over the mirror to strengthen the metal surface.



# **Dielectric Coatings**

This type of optical coating is deposited onto a substrate and constructed from multiple thin layers of transparent dielectric materials with high and low refractive index alternated. It is also called interference coating. The multiple layers of the dielectric materials modify the reflective properties

of the surface by exploiting the interference of the reflection from multiple optical interfaces. By careful choice of the exact composition, thickness, and number of these layers, it is possible to tailor the reflectivity and transmissivity of the coating to produce almost any desired characteristic. The

reflectivity can be increased to greater than 99.99%.

The periodic dielectric mirror coating significantly enhances the reflectivity of the surface but is limited only in the certain wavelength range. The band width is determined by the ratio of the two used indices only for quarter-

wave coating systems, which the thicknesses of the layers are generally quarter-wave. Comparing to the non-quarter-wave systems, the quarter-wave systems offer the broadest high reflection band, tens of nanometers in the visible spectrum range.

High reflective coatings are affected

by the incidence angle of the light. When used away from normal incidence, the reflective range shifts to shorter wavelengths, and becomes polarization dependent. This effect can be exploited to produce coatings that polarize a light beam.

By manipulating the exact thickness

and composition of the layers in the reflective stack, the reflection characteristics can be tuned to a particular application. The coating can be designed as a long- or shortpass filter, a bandpass filter, or a mirror with a specific reflectivity, which is useful in lasers.

# Selection

To select a suitable mirror for your application requires considering many aspects, including reflectivity, laser damage threshold, coating

durability, and thermal expansion of the substrate. Mirrors with reflective coatings cover the UV, visible, near infrared, and infrared regions. Metallic coatings are more broadband, while dielectric coatings give better reflectivity.



GCC-1010

## GCC-1010 Laser Line Dielectric Mirrors

These laser line mirrors are designed for high reflectance with high laser damage threshold at specific laser wavelengths, suitable for laser cavities or other laser applications. Dielectric multilayer coatings are deposited on the laser grade substrates using physical vapour deposition (PVD) technologies, these coatings are extremely durable, making them resistant also to damage from repeated cleaning.

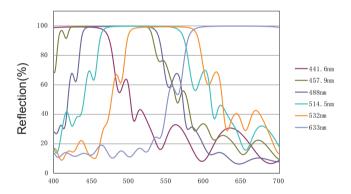
•Material: BK7, fine annealed.

•Diameter Tolerance: +0.0/-0.1
•Thickness: 4±0.1
•Parallelism: <3

Flatness: λ /8 at 633nm
 Surface Quality: 20-10 scratch-dig
 Back Surface: commercial polish
 Clear Aperture: 90% Diameter

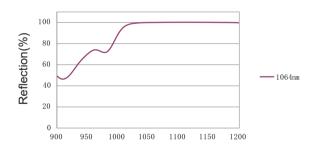
•Average Reflectance: Rave>99.5% for 45° angle of incidence

#### GCC-1010 Laser Line Dielectric Mirrors



Wavelength(nm)

#### GCC-10106x Laser Line Dielectric Mirrors



Wavelength(nm)

### GCC-1010 Laser Line Dielectric Mirrors

Part No.	Wavelength (nm)	Dia
GCC-101002	441.6	25.4
GCC-101041	532	20
GCC-101042	532	25.4
GCC-101044	532	40
GCC-101051	633	20
GCC-101052	633	25.4
GCC-101054	633	40
GCC-101061	1064	20
GCC-101062	1064	25.4
GCC-101064	1064	40



GCC-1011

# GCC-1011 Broadband Dielectric Mirrors

These mirrors provide high reflectance over a broad bandwidth, and are ideal for tunable laser and white light applications. They are intended for use at 45 incidence. Normal incidence is available on special request.

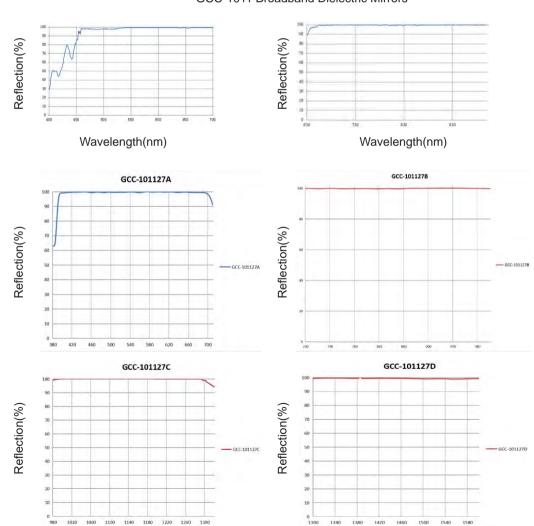
BK7, fine annealed. ·Material:

+0.0/-0.1 Diameter Tolerance: •Thickness:  $4\pm0.1$ •Parallelism: <3

•Flatness:  $\lambda$  /8 at 633nm Surface Quality: 20-10 scratch-dig Back Surface: commercial polish ·Clear Aperture: 90% Diameter

•Average Reflectance: Rave>99.5% for 45° angle of incidence

#### GCC-1011 Broadband Dielectric Mirrors





# GCC-1011 Broadband Dielectric Mirrors

Part No.	Wavelength (nm)	Dia
GCC-101127A	400-700	12.7
GCC-101127B	700-1000	12.7
GCC-101127C	1000-1300	12.7
GCC-101127D	1300-1600	12.7
GCC-101101	450-700	20
GCC-101102	450-700	25.4
GCC-101104	450-700	40
GCC-101111	650-1000	20
GCC-101112	650-1000	25.4
GCC-101114	650-1000	40
GCC-101121	1000-1400	20
GCC-101122	1000-1400	25.4
GCC-101124	1000-1400	40

# GCCH-1010 Nd:YAG Laser Mirrors

he Nd:YAG laser mirrors are designed for the fundamental, 2 harmonic, 3 harmonic and 4 harmonic of Nd:YAG lasers. They are intended for use at either 45° or normal incidence. We also offer dual wavelength mirrors for use at the fundamental and second harmonic wavelengths.

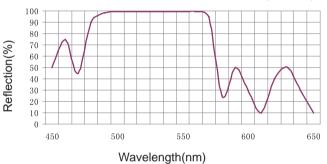
•Material: UV grade Fused Silica

+0/-0.2 •Diameter Tolerance: •Thickness:  $6 \pm 0.2$ •Parallelism: <3

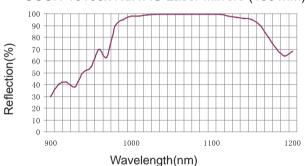
 $\lambda$  /10 at 633nm ·Flatness: ·Surface Quality: 20-10 scratch-dig ·Clear Aperture: 90% Diameter

GCCH-1010

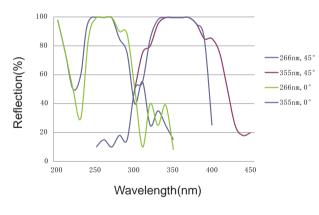
GCCH-10104x Nd:YAG Laser Mirrors (532nm)



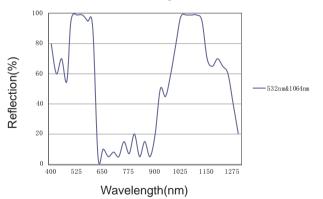
#### GCCH-10106x Nd:YAG Laser Mirrors (1064nm)



#### GCCH-1013xx Nd:YAG Laser UV Mirrors



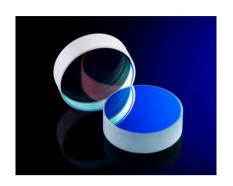
#### GCCH-101203 Dual Wavelength Nd:YAG Laser Mirrors



#### GCCH-1010 Nd:YAG Laser Mirrors

Part No.	Wavelength (nm)	Reflection (%)	Incident Angle	Dia	Damage Threshold
GCCH-101312	266	>99.8%@266nm >98%@255 ~ 275nm	45°	25.4	>1.0J/cm²(10ns 10Hz 355nm)
GCCH-101314	266	>99.8%@266nm >98%@255 ~ 275nm	0°	25.4	>1.0J/cm²(10ns 10Hz 355nm)
GCCH-101342	355	>99.8%@355 nm >98%@340 ~ 370nm	45°	25.4	>4J/cm <sup>2</sup> (10ns 10Hz 355nm)
GCCH-101344	355	>99.8%@355nm >98%@340 ~ 370nm	0°	25.4	>4J/cm²(10ns 10Hz 355nm)
GCCH-101042	532	>99.5%	45°	25.4	>5J/cm <sup>2</sup> (10ns 10Hz 532nm)
GCCH-101046	532	>99.5%	0°	25.4	>5J/cm <sup>2</sup> (10ns 10Hz 532nm)
GCCH-101062	1064	>99.5%	45°	25.4	>8J/cm²(10ns 10Hz 1064nm)
GCCH-101066	1064	>99.5%	0°	25.4	>8J/cm²(10ns 10Hz 1064nm)
GCCH-101203	532&1064	>99.5%	45°	25.4	>8J/cm²(10ns 10Hz 1064nm)



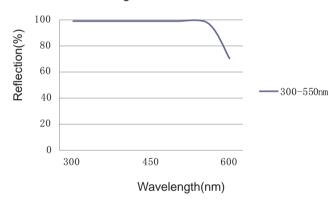


# GCCH-1011 High Power Broadband Mirrors

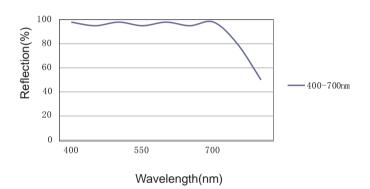
The high power broadband mirrors cover ultraviolet, visible and near-infrared wavelengths with excellent optical performance, stable reflectivity and high damage threshold.

GCCH-1011

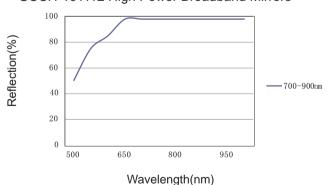
#### GCCH-101132 High Power Broadband Mirrors



## GCCH-101102 High Power Broadband Mirrors



#### GCCH-101112 High Power Broadband Mirrors



Material: Borofloat
 Diameter Tolerance: +0/-0.2
 Thickness: 8+/-0.2
 Incident Angle: 0°-45°
 Parallelism: <3′</li>

 $\begin{array}{ll} \bullet \text{Flatness:} & \lambda \, / 10 \text{ at 633nm} \\ \bullet \text{Surface Quality:} & 20\text{-}10 \text{ scratch-dig} \\ \bullet \text{Clear Aperture:} & 80\% \text{ Diameter} \\ \end{array}$ 

# GCCH-1011 High Power Broadband Mirrors

Part No.	Reflection Wavelength band	Reflection (%)	Damage Threshold	Diameter
GCCH-101132	UV	99%@300 ~ 550nm	1.5J/cm <sup>2</sup> (10ns 10Hz 355nm)	Ф25.4
GCCH-101102	VIS	99%@400 ~ 700nm	2.5J/cm <sup>2</sup> (10ns 10Hz 532nm)	Ф25.4
GCCH-101112	NIR	99%@700 ~ 900nm	4J/cm <sup>2</sup> (10ns 10Hz 1064nm)	Ф25.4

# GCCH-1013 UV Dielectric Mirrors



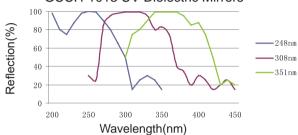
GCCH-1013

UV grade Fused Silica •Material:

+0/-0.2 Diameter Tolerance:  $6\pm0.2$ •Thickness: •Incident Angle: 45° •Parallelism: <3

•Flatness:  $\lambda$  /10 at 633nm Surface Quality: 20-10 scratch-dig ·Clear Aperture: 90% Diameter

#### GCCH-1013 UV Dielectric Mirrors



#### GCCH-1013 UV Dielectric Mirrors

Part No.	Wavelength (nm)	Reflection (%)	Dia	Damage Threshold
GCCH-101302	248	>99%	25.4	1.5J/cm²(10ns 10Hz 355nm)
GCCH-101322	308	>99.5%	25.4	1.5J/cm²(10ns 10Hz 355nm)
GCCH-101332	351	>99.5%	25.4	3J/cm²(10ns 10Hz 355nm)

# GCCH-1014 Argon-Ion Laser Mirrors



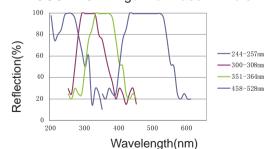
GCCH-1014

UV grade Fused Silica •Material:

•Diameter Tolerance: +0/-0.2 •Thickness:  $6\pm0.2$ 45° •Incident Angle: <3 ·Parallelism:

•Flatness:  $\lambda$  /10 at 633nm Surface Quality: 20-10 scratch-dig ·Clear Aperture: 90% Diameter

### GCCH-1014 Argon-Ion Laser Mirrors



# GCCH-1014 Argon-Ion Laser Mirrors

Part No.	Wavelength(nm)	Reflection(%)	Diameter	Damage Threshold
GCCH-101432	244 ~ 257	>98%	25.4	1.5J/cm²(10ns 10Hz 355nm)
GCCH-101402	300 ~ 308	>98%	25.4	1.5J/cm²(10ns 10Hz 355nm)
GCCH-101412	351 ~ 364	>98%	25.4	1.5J/cm²(10ns 10Hz 355nm)
GCCH-101422	458 ~ 528	>98%	25.4	3J/cm²(10ns 10Hz 532nm)



# GCCH-1015 Ultrafast Laser Mirrors



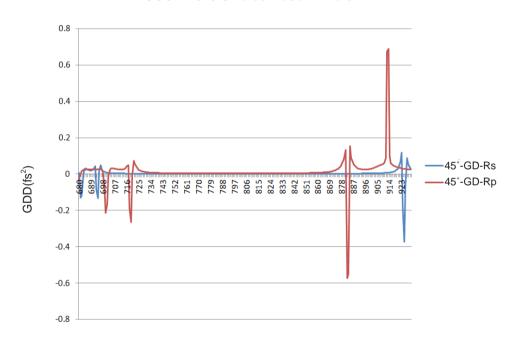
GCCH-101512

•Material: BK7, fine annealed

•Diameter Tolerance : +0/-0.1•Thickness :  $4\pm0.1$ •Incident Angle :  $45^{\circ}$ •Parallelism :  $<3^{'}$ 

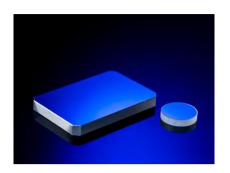
•Flatness:  $\lambda$  /8 at 633nm •Surface Quality: 20-10 scratch-dig •Clear Aperture: 90% Diameter

#### GCCH-1015 Ultrafast Laser Mirrors



# GCCH-1015 Ultrafast Laser Mirrors

Part No.	Wavelength(nm)	Reflection (%)	Diameter	Damage Threshold
GCCH-101512	770~830	>99%	25.4	>0.4J/cm <sup>2</sup> (800nm 52fsFWHM)

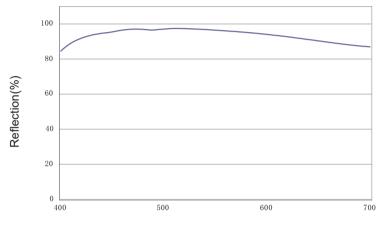


GCC-1021

#### GCC-1021 Enhanced Aluminum Mirrors

This design provides better performance than the protected aluminum coating with an average of about 92% reflection in the visible spectrum. The coating incorporates the use of a dielectric stack on the aluminum, which provides better resistance to abrasion than the raw metal.

GCC-1021 Enhanced Aluminum Mirrors



Wavelength(nm)

•Material: BK7, fine annealed.

•Diameter Tolerance: +0.0/-0.15 •Thickness:  $\pm\,0.1$ ·Parallelism: <3

•Flatness:  $\lambda$  /4 at 633nm Surface Quality: 60-40 scratch-dig ·Back Surface: fine ground ·Clear Aperture: 90% diameter

•Average Reflectance: R<sub>ave</sub>>99.5% for 45° angle of incidence

R<sub>ave</sub>>92% throughout VIS

#### GCC-1021 Enhanced Aluminum Mirrors

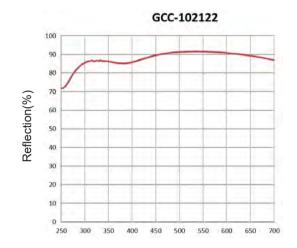
Part No.	Dimension	Thickness
GCC-102101	Ø 20	4
GCC-102102	Ø 25.4	4
GCC-102104	Ø 40	4
GCC-102105	Ø 50.8	4
GCC-102111	40 × 60	6
GCC-102112	70×100	10
GCC-102113	100×150	15



## GCC-10212 UV Enhanced Aluminum Mirrors



GCC-10212



BK7, fine annealed. •Material:

+0.0/-0.15 •Diameter Tolerance: •Thickness:  $4\pm0.1$ <3′ •Parallelism:

 $\lambda$  /4 at 633nm •Flatness: Surface Quality: 60-40 scratch-dig ·Back Surface: fine ground 90% Diameter ·Clear Aperture:

Rave>90%@250-450nm •Average Reflectance:

#### GCC-10212 UV Enhanced Aluminum Mirrors

Part No.	Diameter	Thickness
GCC-102122	Ф25.4	4
GCC-102125	Ф50.8	4

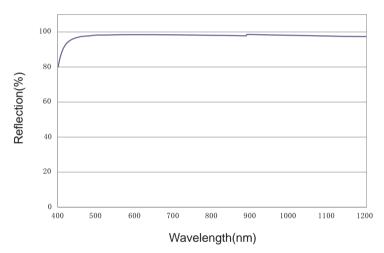


GCC-10220

#### GCC-10220 Protected Silver Mirrors

Protected silver coating offers a higher surface reflectivity than the enhance alumium coating. It provides an average feflection of apprximately 95% in the visible wavelength range. This coating is a hybrid design optimized to provide better environmental stability and maximum shelf life. The silver layer is protected both undemeath and above with dielectric layers which minimizes tarnishing and allows cleaning by normal laboratory methods. These mirrors have very high reflectivity from 0.45 m through to the infrared spectrum.

#### GCC-10220 Protected Silver Mirrors



•Material: BK7, fine annealed.

+0.0/-0.15 •Diameter Tolerance: •Thickness:  $4 \pm 0.1$ <3′ •Parallelism:

•Flatness:  $\lambda$  /4 at 633nm ·Surface Quality: 60-40 scratch-dig ·Back Surface: fine ground •Clear Aperture : 90% diameter

 Average Reflectance: R<sub>ave</sub>>95% throughout VIS

 $R_{ave}$ >98% at 2-12 $\mu$ m

#### GCC-10220 Protected Silver Mirrors

Part No.	Diameter	Center thickness
GCC-102201	20	4
GCC-102202	25.4	4
GCC-102204	40	4
GCC-102205	50.8	4



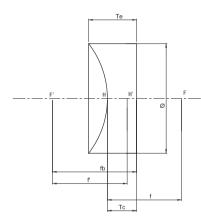
GCC-10222

#### GCC-10222 Protected Silver Plano-Concave Mirrors

•Material: BK7, fine annealed.

±2% ·Focal length (f') : •Diameter Tolerance: +0/-0.2 •Thickness Tolerance: +/-0.1

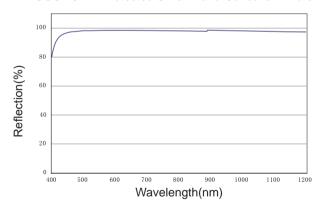
•Flatness: 1  $\lambda$  at 633nm Surface Quality: 40-20 scratch-dig •Clear Aperture : 90% Diameter



f: focal length (object side) f': focal length (image side) fb: back focal length Ø: lens diameter Tc: center thickness Te: edge thickness F,F': focal points H,H': principal points

GCC-10222

#### GCC-10222 Protected Silver Plano-Concave Mirrors



#### GCC-10222 Protected Silver Plano-Concave Mirrors

Part No.	Diameter	Focal Length	Edge Thickness
GCC-102221	25.4	25.4	6.35
GCC-102222	25.4	50.8	6.35
GCC-102223	25.4	76.2	6.35
GCC-102224	25.4	101.6	6.35
GCC-102225	25.4	152.4	6.35



GCC-1023

#### GCC-1023 Protected Gold Mirrors

These are precision flat mirrors with a metallic gold coating. The gold layer is protected both underneath and above with dielectric layers which ensures good adhesion to the substrate and allows cleaning by normal laboratory methods. These mirrors have very high reflectivity from 0.65 microns through to the infrared spectrum.

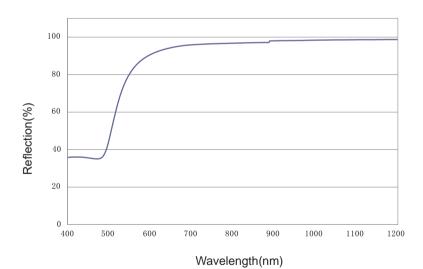
BK7. fine annealed. •Material:

•Diameter Tolerance: +0.0/-0.15 •Thickness:  $4\pm0.1$ ·Parallelism: <3

•Flatness:  $\lambda$  /4 at 633nm •Surface Quality: 60-40 scratch-dig ·Back Surface: fine ground ·Clear Aperture : 90% Diameter

•Average Reflectance: R<sub>ave</sub>>95% 0.65-2 microns  $R_{ave} > 98\%$  at 2-12µm

#### GCC-1023 Protected Gold Mirrors



#### GCC-1023 Protected Gold Mirrors

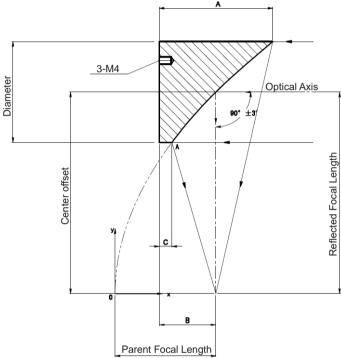
Part No.	Diameter	Center thickness
GCC-102301	20	4
GCC-102302	25.4	4
GCC-102304	40	4
GCC-102305	50.8	4



GCC-5011

#### GCC-5011 90°Off-Axis Parabolic Mirrors

The Off-Axis Parabolic Mirrors achromatically focus a collimated beam or collimate a divergent source, and their off-axis design separates the focal point from the rest of the beam path. The mirrors are fabricated using aluminum substrates. The parabolic surface has a protected gold coating which provides >95% average reflectance from 650nm to 20µm. The bottom of each mirror has three M4 mounting holes for easy installation and fixing.



GCC-5011

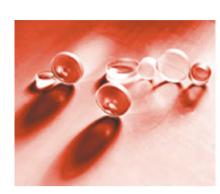
#### GCC-5011 90°Off-Axis Parabolic Mirrors

Part No.	Part Name	Parent Focal Length	Reflected Focal Length	Center offset	Diameter	А	В	С
GCC-501101	90° off-axis parabolic mirror	25.4	50.8	50.8	50.8	57.2	25.4	6.4
GCC-501102	90°off-axis parabolic mirror	50.8	101.6	101.6	50.8	57.2	28.5	6.4
GCC-501103	90°off-axis parabolic mirror	76.2	152.4	152.4	50.8	57.2	29.7	6.4
GCC-501111	90° off-axis parabolic mirror with through holes	25.4	50.8	50.8	50.8	57.2	25.4	6.4
GCC-501112	90° off-axis parabolic mirror with through holes	50.8	101.6	101.6	50.8	57.2	28.5	6.4
GCC-501113	90° off-axis parabolic mirror with through holes	76.2	152.4	152.4	50.8	57.2	29.7	6.4

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#### General

Optical filters transmit a certain portion of light spectrum and block the rest. They generally belong to two main categories, absorptive filters and interference or dichroic filters. They are commonly used in photography, in many optical instruments, and to colour stage lighting. Daheng Optics supplies standard and custom filter products

for research and instrumentation. They are designed to offer a rapid solution with high performance at an economic price. The off-the-shelf products are dichroic filters, longand short-pass filters, and neutral density filters. Optical filters are used in many optical applications such as fluorescence microscopy.

## Absorptive Filters

Absorptive filters are the simplest filters. They are usually made of absorptive materials of various inorganic or organic compounds doped into glass. The filters reply on the compounds that absorb some wavelengths of light while transmitting others. Absorptive filters are not sensitive to angle of incident. They generally maintain their performances for a wide angle of incident. The absorptive compounds can also be added to plastic to produce lighter and cheaper filters.

#### Dichroic Filter

Dichroic filters are interference filters coated with dielectric thin film on a glass substrate. They usually reflect the unwanted portion of the light and transmit the remainder, which are also called 'reflective' filters. As a type of dielectric optical coating, the dichroic filters use the principle of interference causing constructive and destructive interference of the light to achieve the required performance. Dichroic filters are very angle sensitive. By controlling the thickness and sequence of the coatings, dichroic filters can be designed to provide a specific wavelength range, the transmission level and the range of the incident angle. They are usually more expensive and delicate than absorption filters.

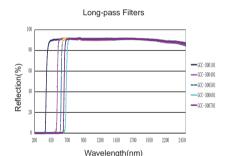
## **Neutral Density Filters**

Neutral density (ND) filters attenuate uniformly the intensity of light over a broad spectrum range. They can be absorptive or reflective type, or the combination of the two with thin metallic coating.

The level of the attenuation is specified by Optical Density (OD) of the filter. OD is defined as the negative of the common logarithm of the transmission coefficient, as

$$OD = -\log_{10}(\frac{T}{100})$$

where T is the transmission in percentage. For example, a filter with 1% transmission has an OD of



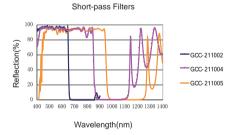
Filters

## Long-pass Filters

A long-pass (LP) filter blocks the wavelength range that is shorter than a specific cut-on wavelength and allows transmission of the longer wavelength range over the active spectrum. The cut-on wavelength is the wavelength at

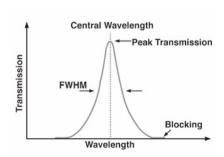
which its transmission increases to 50% of peak transmission. Longpass filters can have a sharp slope over transmission-wavelength chart and are also referred to as edge filters.

# Short-pass Filters



Similar to a long-pass filter but in reverse, a short-pass (SP) filter blocks longer wavelengths from the cut-off wavelength and transmits shorter wavelengths over the active

spectrum. The cut-off wavelength is the wavelength at which its transmission decreases to 50% of peak transmission. Short-pass filters are also as edge filters.



## **Band-pass Filters**

A band-pass filters only transmits a certain wavelength band or portion of the spectrum and blocks all other wavelengths. The band width of such a filter is, in wavelength, expressed as full width at half

maximum (FWHM), as shown in the figure below. The FWHM can be from a few Ångströms to a few hundred nanometers. The narrower the band width is, the more complex the coating s design is.



GCC-2010

#### GCC-2010 UV Interference Filters

Interference filters are fabricated by a series of thin layers of various dielectric materials sandwiched by glass substrates. When multi-wavelength light passes through the filter interference occurs due to the differences in refractive index, resulting in a very high transmittance for certain wavelengths, while other wavelengths are either reflected or absorbed. For a given wavelength a very narrow bandwidth (3nm-10nm) can be obtained. Optical interference filters are angle-sensitive and should be used with normal or near normal incident light. If the incident angle exceeds 20, it is essential to specify s-polarization, or p-polarization or random (the average of p and s polarization) when ordering. Filters for the major laser wavelengths are available from stock.

Those for other wavelengths and dimensions may be custom designed. The interference filters are extremely durable and withstand repeated cleaning.

Every filter comes in an anodized aluminum housing for protection against humidity and handling. The highly reflective side of the filter should generally face the source to minimize the thermal load on the absorptive glass and epoxies.

•Center Wavelengh Tolerance: ±2nm

•Transmission Spectrum width (FWHM): 10nm±2nm

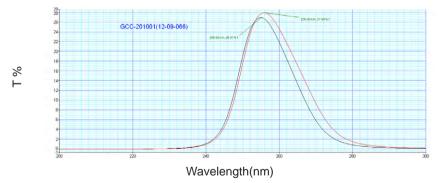
Out-of-Band Blocking: <0.1% (X-ray to 700nm)

•Housing Diameter: 25.0+0/-0.15

•Thickness: 6max

•Clear Aperture: >80% Diameter

#### GCC-2010 UV Interference Filters



#### GCC-2010 UV Interference Filters

Part No.	Center Wavelength (nm)	Peak Transmittance (%)
GCC-201001	254.0	≥8
GCC-201002	280.0	≥25
GCC-201003	340.0	≥30
GCC-201004	365.0	≥30



GCC-2020

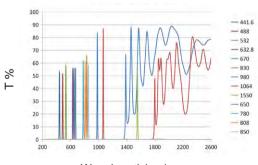
#### GCC-2020 VIS & IR Interference Filters

Interference filters are fabricated by a series of thin layers of various dielectric materials sandwiched by glass substrates. When multiwavelength light passes through the filter interference occurs due to the differences in refractive index, resulting in a very high transmittance for certain wavelengths, while other wavelengths are either reflected or absorbed. For a given wavelength a very narrow bandwidth (3nm-10nm) can be obtained. Optical interference filters are angle-sensitive and should be used with normal or near normal incident light. If the incident angle exceeds 20, it is essential to specify s-polarization, or p-polarization or random (the average of s and p polarization) when ordering. Filters for the major laser wavelengths are available from stock.

Those for other wavelengths and dimensions may be custom designed. The interference filters are extremely durable and withstand repeated cleaning.

Every filter comes in an anodized aluminum housing for protection against humidity and handling. The highly reflective side of the filter should generally face the source to minimize the thermal load on the absorptive glass and epoxies.

#### GCC-2020 VIS & IR Interference Filters



Wavelength(nm)

•Center Wavelengh Tolerance:

 $\pm 2nm$  Transmission Spectrum width (FWHM):  $10nm \pm 2nm$ 

•Minimum Peak Transmission: 410 to 515nm≥50%; 520 to 1550nm≥55%

Out-of-Band Blocking <0.01% (X-ray to far IR)

 Temperature Range: -50°C to+80°C

<0.02nm/ °C (linearly with Center Wavelength Shifts:

temperature) ·Housing Diameter: 25.4+0.0/-0.15

•Thickness: 6mm

•Clear Aperture : >80% Diameter

#### GCC-2020 VIS & IR Interference Filters

Part No.	Center Wavelength (nm)	Peak Transmittance (%)
GCC-202001	441.6	50%
GCC-202002	488	50%
GCC-202003	532	55%
GCC-202004	632.8	55%
GCC-202005	670	55%
GCC-202006	830	55%
GCC-202007	980	55%
GCC-202008	1064	55%
GCC-202009	1550	55%
GCC-202010	514.5	55%
GCC-202011	650	55%
GCC-202012	780	55%
GCC-202013	808	55%
GCC-202014	850	55%



GCC-2021

## GCC-2021 High Performance Interference Filters

•Center Wavelengh Tolerance: ±2nm •Transmission Spectrum width 10nm ± 2nm

(FWHM):

•Minimum Peak Transmission: ≥85%

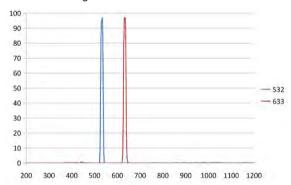
Out-of-Band Blocking: 0.01% (200-1100nm) from 442nm to 850nm

0.01% (200-1500nm) from 905nm to 1064nm 0.01% (200-1800nm) from 1310nm to 1550nm

Center Wavelength Shifts: <0.02nm/°C •Diameter Tolerance : 25.4+0/-0.2 •Thickness Tolerance: 5 + / - 0.1•Flatness: 5 Fringes

Surface Quality: 60-40 scratch-dig ·Clear Aperture: 85% Diameter

#### GCC-2021 High Performance Interference Filters



#### GCC-2021 High Performance Interference Filters

Part No.	Wavelength (nm)
GCC-202101	442
GCC-202102	470
GCC-202103	488
GCC-202104	515
GCC-202105	532
GCC-202106	542
GCC-202107	570
GCC-202108	633
GCC-202109	650
GCC-202110	670
GCC-202111	730
GCC-202112	766
GCC-202113	780
GCC-202114	808
GCC-202115	830
GCC-202116	850
GCC-202117	905
GCC-202118	940
GCC-202119	980
GCC-202120	1064
GCC-202121	1310
GCC-202122	1550

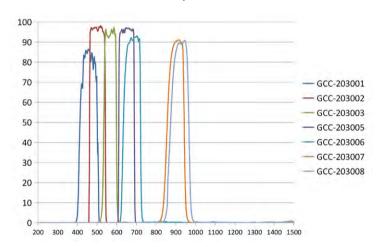
GCC-2030

## GCC-2030 Broadband Bandpass Interference Filters

•Minimum Peak Transmission: >85% Center Wavelength Shifts : <0.02nm/°C •Diameter Tolerance : 25.4+0/-0.2 Thickness Tolerance: 3+/-0.1 •Flatness: 5 Fringes

 Surface Quality: 60-40 scratch-dig •Clear Aperture: 85% Diameter

#### GCC-203€/Broadband Bandpass Interference Filters



#### GCC-2030Broadband Bandpass Interference Filters

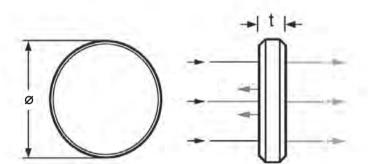
Part No.	Center Wavelength (nm)	FWHM (nm)	Blocking
GCC-203001	$450\pm4\text{nm}$	$80 \pm 4 \text{nm}$	OD4 @200-1100nm
GCC-203002	$500\pm4\text{nm}$	$80\pm4\text{nm}$	OD4 @200-1200nm
GCC-203003	$550\pm4\text{nm}$	$80\pm4\text{nm}$	OD4 @200-1200nm
GCC-203004	600 ± 6nm	$80\pm 6 nm$	OD4 @200-1200nm
GCC-203005	650 ± 6nm	$80\pm 6 nm$	OD4 @200-1200nm
GCC-203006	700 ± 6nm	$80\pm 6$ nm	OD4 @200-1500nm
GCC-203007	$880 \pm 6 \text{nm}$	$80\pm 6$ nm	OD4 @200-1500nm
GCC-203008	$950\pm 6 nm$	$80\pm 6$ nm	OD4 @200-1500nm



GCC-211

#### GCC-211 Short-Pass Filters

Optical Short-pass Filters are coated on a substrate of fused silica, which allows the transmission of any wavelength shorter than the cut-off wavelength and block any wavelength longer than the cut-off.



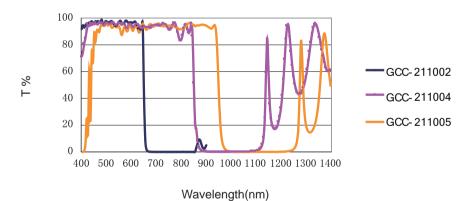
Substrate: Fused silica •Dimension Tolerance: +0/-0.2 4+/-0.2 •Thickness: <3′ •Parallelism: •Flatness:  $\lambda /4$ 

 Surface Quality: 40-20 scratch-dig ·Clear Aperture : 90% Diameter •Transmission: T≥85%

·Blocking: T≤1%

GCC-211

#### GCC-211 Short-Pass Filters



#### GCC-211 Short-Pass Filters

Part No.	Transmission Band	Blocking Band	Cut-off Wavelength	λ <sub>T=80%</sub> - λ <sub>T=10%</sub>	Diameter
GCC-211002	400 ~ 630nm	675 ~ 850nm	650nm	9nm	Ø 25.4
GCC-211004	400 ~ 820nm	910 ~ 1110nm	850nm	17nm	Ø 25.4
GCC-211005	450 ~ 910nm	1025 ~ 1235nm	950nm	20nm	Ø 25.4



GCC-300

## GCC-300 Long-Pass Filters

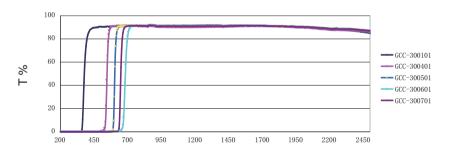
•Uniformity:

The substrate materials of the color filters inherently have different absorption and transmission properties across the spectrum. They are often used as long-pass and band-pass filters. It should be noted that the boundaries between passing and blocking wavelengths are less sharp than most coated filters, although peak transmission is often considerably higher.

•Material:	Color glass
•Dimension Tolerance:	+0/-0.2mm
•Thickness:	2+/-0.2mm
•Parallelism:	<3
•Flatness:	5 Fringes
•Surface Quality:	60-40 scratch-dig
•Clear Aperture:	>90% Diameter
•Transmission:	T>85%
•Blocking:	T<1%

#### GCC-300 Long-Pass Filters

95%



Wavelength(nm)

## GCC-300 Long-Pass Filters

Part No.	Transmission Band	Blocking Band	Cut-off Wavelength	λ <sub>T=80%</sub> - λ <sub>T=10%</sub>	Diameter
GCC-300101	500-2500nm	200-360nm	380nm	33nm	Ø 25.4
GCC-300201	560-2500nm	200-430nm	450nm	33nm	Ø 25.4
GCC-300301	600-2500nm	200-490nm	510nm	33nm	Ø 25.4
GCC-300401	650-2500nm	200-530nm	550nm	33nm	Ø 25.4
GCC-300501	680-2500nm	200-580nm	600nm	33nm	Ø 25.4
GCC-300601	720-2500nm	200-630nm	650nm	33nm	Ø 25.4
GCC-300701	800-2500nm	200-665nm	685nm	33nm	Ø 25.4

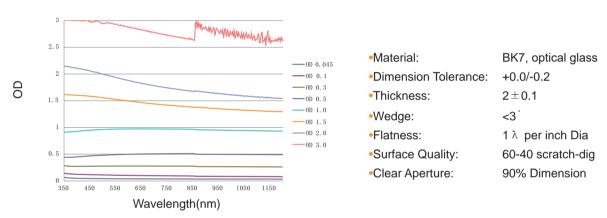


GCC-3010

#### GCC-3010 Neutral Density Filters

The metallic coatings on one side of the filter provide a nearly constant amount of transmitted energy over a wide visible and near infrared waveband. Daheng Optics's neutral density filters are spectrally neutral from about 400nm to 1200nm, On BK7 or quartz substrates, we produce a variety of standard neutral density films with optical densities (OD) including 0.1,0.3, 0.5, 1.0 2.0, and 3.0 etc. The coating can be specially designed to fit most transmission requirements. We do not recommend this type of coating to be used with high power lasers due to the absorptive properties of the metallic materials.

#### GCC-3010 Neutral Density Filters



#### GCC-3010 Neutral Density Filters

Part No.	Optical Density(550nm)	Transmittance	Dimension
GCC-301001	0.045	90%	Ø 25.4
GCC-301002	0.045	90%	50x50
GCC-301011	0.1	79%	Ø 25.4
GCC-301012	0.1	79%	50x50
GCC-301021	0.3	50%	Ø 25.4
GCC-301022	0.3	50%	50x50
GCC-301031	0.5	32%	Ø 25.4
GCC-301032	0.5	32%	50x50
GCC-301041	1.0	10%	Ø 25.4
GCC-301042	1.0	10%	50x50
GCC-301051	1.5	3.2%	Ø 25.4
GCC-301052	1.5	3.2%	50x50
GCC-301061	2.0	1.0%	Ø 25.4
GCC-301062	2.0	1.0%	50x50
GCC-301071	3.0	0.1%	Ø 25.4
GCC-301072	3.0	0.1%	50x50
GCC-301081	0.2	63%	Ø 25.4



GCC-3020

## GCC-3020 Rectangular Continuously Variable Metallic **Neutral Density Filters**

This ND filters provides linearly varying attenuation or beamsplitting in the visible and near infrared region. The optical density varies linearly across the length. Attenuation is achieved by a thin film of Ni-Cr-Fe protected with an overcoat of SiO. The rear surface is broadband AR coated for the visible region.

BK7 fine annealed · Material:

· Dimension Tolerance: +0.0/-0.2

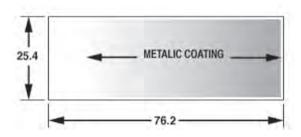
· Clear Aperture: 90% of length and 80% of width

 Optical Density (OD): 0.08-2.0±5%@632.8nm

• Linearity of Optical Density: ±5%

· Coatings: S1: Ni-Cr-Fe

> S2: Broadband AR coated, Rave<0.5% for 420-675nm at 0-15°incidence.



GCC-3020

## GCC-3020 Rectangular Continuously Variable Metallic Neutral **Density Filters**

Part No.	Length	Width	Thickness
GCC-302001	76.2	25.4	2.0





GCC-3030

# GCC-3030 Round Continuously Variable Metallic Neutral Density Filters

Circularly variable neutral density filters are designed to simplify attenuation and beamsplitting from VIS to near IR. The optical density gradually varies around a 270circle for convenient attenuation adjustment by simply rotating the filter. Attenuation is achieved by a thin Ni-Cr-Fe film, allowing these attenuators to withstand moderate laser energy as well as to act as variable beamsplitters.

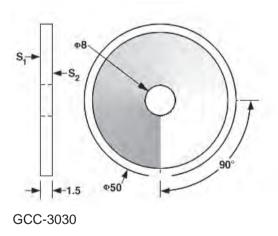
Circularly variable ND filters are available with BK7 substrates for general laboratory use, or with UV fused silica substrates for maximum thermal stability. Although the coatings are optimized for 450~700nm, they will operate from 400-1100nm with only minor losses.

Material: BK7 fine annealed

Outside Diameter: Ø 50±0.25
 Center hole Diameter: 8±0.25
 Thickness: 1.5±0.2

Clear Aperture: >80% diameter
 Linearity of Optical Density: ±5% at 632.8nm
 Coatings: S1: Ni-Cr-Fe

S2: Broadband AR coated,  $R_{ave}$ <0.5% for 420-675nm at 0-15° incidence.



GCC-3030 Round Continuously Variable Metallic Neutral Density Filters

Part No.	Relative Density Range	Tmin
GCC-303001	0.0-1.0	T=10%
GCC-303002	0.0-1.5	T=3.2%
GCC-303003	0.0-2.0	T=1.0%
GCC-303004	0.0-3.0	T=0.1%



GCO-07

## GCO-07 Mounted Circular Neutral Density Filter

The 50mm OD filters are available mounted. The durable anodized aluminum mount has an indicator arrow that accurately identifies the angular position of the filter for increased repeatability. A convenient M6 screw hole in the aluminum mount block permits a variety of mounting configurations.

•Material: BK7 fine annealed

•Dimension Tolerance: ± 0.1

•Wavelength: 400 ~ 700nm

•Parallelism: <30"

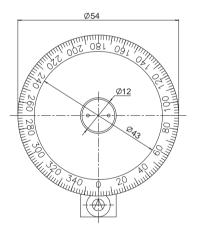
•Surface Quality: 40-20 scratch-dig

•Metallic Coating Area Angle: 270°

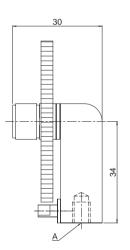
•Coating: S1: No-Cr-Fe

S2: Broadband AR coated, Rave<0.5%@430-

700nm



GCO-07



## GCO-07 Mounted Circular Neutral Density Filter

Part No.	ND Filter Part No.	Screw type (A)	Relative Density Range
GCO-0701M	GCC-303001	M6	0.0-1.0
GCO-0702M	GCC-303002	M6	0.0-1.5
GCO-0703M	GCC-303003	M6	0.0-2.0
GCO-0704M	GCC-303004	M6	0.0-3.0

GCC-4010 Laser Line Beamsplitter Cubes	087
GCC-4011 Broadband Beamsplitter Cubes	088
GCC-4020 Laser Line Polarization Beamsplitter Cubes	089
GCC-4021 Broadband Polarization Beamsplitter Cubes	090
GCC-4031 Broadband Non-polarization Beamsplitter Cubes.	091
GCC-4111 Broadband Conventional Beamsplitter Plates	092
GCC-4112/3 Beamsplitter Wedges	093
GCC-414 Dichroic Beamsplitter Plates	094





#### General

A beamsplitter is an optical device that divides or splits an incident beam in two or more output beams. There are different types of beamsplitters and used for different purposes. The optical power of the total output beams may or may not be added up to the input power due to the possible optical loss on the beam splitting coatings, which vary significantly between different types of devices. The splitting ratio of the output power is related to wavelength and polarization state of the input beam. In general, the reflectivity of a dielectric coated

surface depends on the polarization state of the input beam. A beam with a certain polarization can be totally reflected while the beam with different polarization is largely transmitted. It is also possible to have non-polarization beamsplitters.

Daheng Optics offers a variety of optical beamsplitters, off-the-shelf from its inventory, in the shapes of plate and cube, in terms of polarization and non-polarization, for different applications.

## Plate Beamsplitters

Being partial-reflective coated mirrors, but often used with the incident of angle at 45 °, plate beamsplitters consist of a thin plate of optical glass with a different type of coatings. The thin film coating determines, typically, to reflect half of the light incidence and to transmit the rest. The thin film coating can be half-metallic coating or dielectric coating. With dielectric coating, a

wide range of power splitting ratio can be designed. Depending on how they are used in applications, the splitting coating can be deposited on either surface of the glass plate and the other surface is coated with anti-reflective coating.

The dielectric coated beamsplitters can have a strongly wavelengthdependent reflectivity. They are

often called dichroic beam splitters which separate the different spectral components of the beam, depending on the difference in wavelength or polarization. Frequency doubler is an example of such a beam splitter to separate the harmonic beam from the residual pump light.

## **Cube Beamsplitters**

This is the most common form of beamsplitters, which is made from two triangular glass prisms glued together at their base, one base is coated optically for beam splitting.

They have several advantages over plate beamsplitters. They are easy to mount. The coating is resistant to degradation with time because it is sealed within the body of the cube.

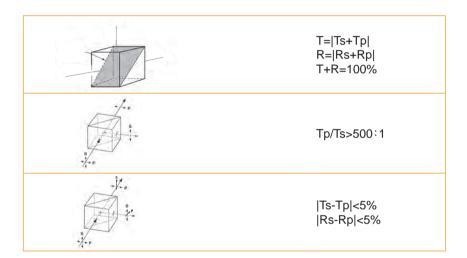
However, it cannot be used in high damage threshold laser systems because of the weakness of the cementing on sustaining optical power.

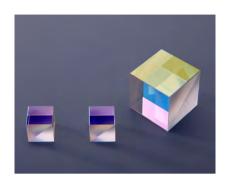


## Polarizing and Non-Polarizing Beamsplitters

Daheng Optics provides three kinds of beamsplitters, all with strictly guaranteed splitting ratio but are distinguished by the polarization of the input and output beams. For conventional beamsplitter, partially

polarized outgoing beams are obtained for randomly polarized incoming light. For polarizing beamsplitters, both s-polarized beam (reflecting) and p-polarized beam (transmitting) are the outputs from randomly polarized incoming light. For non-polarizing beamsplitter, the polarization of the outgoing beams remains the same when the incoming beam is varied polarized light.





GCC-4010

## GCC-4010 Laser Line Beamsplitter Cubes

This is a conventional beamsplitter independent of polarization. The incoming light should be one of the following: 45 linearly polarized, circularly polarized or natural light, i.e. the s-polarized and p-polarized components should be equal to within 5% of each other. The outgoing beams are two partially polarized beams of about equal intensities. It is advised not to use in polarization optical system.

Material: BK7 fine annealed optical glass.

• Dimension Tolerance: ±0.15

Flatness: λ/4 at 632.8nm · Surface Quality: 60-40 scratch-dig · Clear Aperture: >90% dimension

R/T ratio:  $50/50\pm3\% T=(Ts+Tp)/2, R=(Rs+Rp)/2$ 

· Beam Deviation:  $0^{\circ}\pm3'(T)$ ,  $90^{\circ}\pm5'(R)$ 

· Angle of Incidence: 0°±3′

· Coatings: Single wavelength partial reflectance

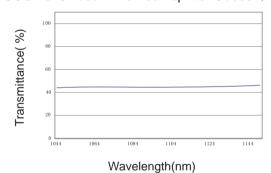
on hypotenuse face.

AR V-coatings on all input and output

surface, R<0.15%

# Multilayer Reflecting Coating

#### GCC-4010 Laser Line Beamsplitter Cubes (1064nm)

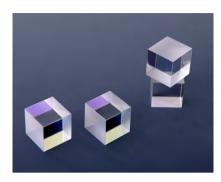


GCC-4010

#### GCC-4010 Laser Line Beamsplitter Cubes

Part No.	Wavelength (nm)	a=b=c(mm)
GCC-401001	488	12.7
GCC-401002	488	25.4
GCC-401011	532	12.7
GCC-401012	532	25.4
GCC-401021	632.8	12.7
GCC-401022	632.8	25.4
GCC-401031	670	12.7
GCC-401032	670	25.4
GCC-401041	780	12.7
GCC-401042	780	25.4
GCC-401051	1064	12.7
GCC-401052	1064	25.4
GCC-401061	1310	12.7
GCC-401062	1310	25.4





GCC-4011

#### GCC-4011 Broadband Beamsplitter Cubes

This is a conventional beamsplitter independent of polarization. The incoming light should be one of the following: 45 linearly polarized, circularly polarized or natural light, i.e. the s-polarized and p-polarized components should be equal to within 5% of each other. The outgoing beams are two partially polarized beams of about equal intensities. It is advised not to use in polarization optical system.

Material: BK7 fine annealed optical glass.

±0.15 Dimension Tolerance:

Flatness: λ/4 at 632.8nm Surface Quality: 60-40 scratch-dig · Clear Aperture: >90% dimension

R/T ratio:  $50/50 \pm 5\% T = (Ts + Tp)/2, R = (Rs + Rp)/2$ 

· Beam Devation: 0°±3′(T), 90°±5′(R)

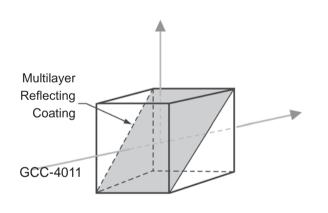
0°±3′ · Angle of Incidence:

Coatings: Single wavelength partial reflectance

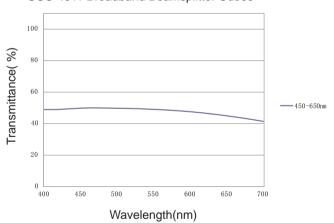
on hypotenuse face.

Broadband AR V-coatings on all input

and output faces, R<sub>ave</sub><0.5%.



#### GCC-4011 Broadband Beamsplitter Cubes



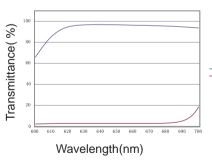
#### GCC-4011 Broadband Beamsplitter Cubes

Wavelength (nm)	a=b=c(mm)
450-650	12.7
450-650	25.4
650-900	12.7
650-900	25.4
900-1200	12.7
900-1200	25.4
1200-1600	12.7
1200-1600	25.4
	450-650 450-650 650-900 650-900 900-1200 900-1200 1200-1600

GCC-4020

GCC-4020

#### GCC-4020 Laser Line Polarization Beamsplitter Cubes (633nm)



## GCC-4020 Laser Line Polarization Beamsplitter Cubes

A polarizing cube beamsplitter consists of a pair of right angle prisms cemented together. The hypotenuse face of one prism is coated with a special multilayer dielectric coating. When nonpolarized light is normally incident upon the entrance face, it is separated into two polarized beams, emerging through two adjacent faces in perpendicular directions and polarized orthogonally to each other. The transmitted beam is p-polarized while the reflected beam is s-polarized. When the linearly polarized light is incident, it is similarly divided into two beams in a ratio depending upon the orientation of the electric field vector of the incident light beam. These polarizing beamsplitters are available for many common laser wavelengths and broadband ranges.

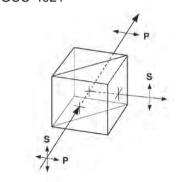
- Material: BK7 fine annealed optical glass.
- · Dimension Tolerance: ±0.15
- · Flatness: λ/4 at 632.8nm Surface Quality: 60-40 scratch-dig
- · Clear Aperture: >90% dimension Extinction Ratio: Tp/Ts>1000:1
- Beam Deviation: 0°±3′(Tp), 90°±5′(Rs)
- Angle of Incidence: 0°~2°
- Coatings: Single wavelength polarization partial reflectance on hypotenuse
  - face. Coatings of outside surfaces:multilayer AR V-coating, R <
- 0.15%. Temperature Range: -30°C to +70°C

#### GCC-4020 Laser Line Polarization Beamsplitter Cubes

GCC-402002 441.6 96% 99.9% 12.7 GCC-402003 441.6 96% 99.9% 25.4 GCC-402012 488.0 96% 99.9% 12.7 GCC-402013 488.0 96% 99.9% 25.4 GCC-402022 532.0 96% 99.9% 12.7 GCC-402023 532.0 96% 99.9% 25.4 GCC-402032 633 96% 99.9% 12.7 GCC-402033 633 96% 99.9% 12.7 GCC-402042 830 96% 99.9% 25.4 GCC-402042 830 96% 99.9% 25.4 GCC-402042 830 96% 99.9% 25.4 GCC-402052 1064 96% 99.9% 25.4 GCC-402052 1064 96% 99.9% 25.4		Part No.	Wavelength (nm)	Тр	Rs	a=b=c
GCC-402012 488.0 96% 99.9% 12.7 GCC-402013 488.0 96% 99.9% 25.4 GCC-402022 532.0 96% 99.9% 12.7 GCC-402023 532.0 96% 99.9% 25.4 GCC-402032 633 96% 99.9% 12.7 GCC-402033 633 96% 99.9% 25.4 GCC-402042 830 96% 99.9% 25.4 GCC-402042 830 96% 99.9% 12.7 GCC-402043 830 96% 99.9% 25.4 GCC-402052 1064 96% 99.9% 25.4 GCC-402053 1064 96% 99.9% 25.4		GCC-402002	441.6	96%	99.9%	12.7
GCC-402013         488.0         96%         99.9%         25.4           GCC-402022         532.0         96%         99.9%         12.7           GCC-402023         532.0         96%         99.9%         25.4           GCC-402032         633         96%         99.9%         12.7           GCC-402033         633         96%         99.9%         25.4           GCC-402042         830         96%         99.9%         12.7           GCC-402043         830         96%         99.9%         25.4           GCC-402052         1064         96%         99.9%         12.7           GCC-402053         1064         96%         99.9%         25.4		GCC-402003	441.6	96%	99.9%	25.4
GCC-402022         532.0         96%         99.9%         12.7           GCC-402023         532.0         96%         99.9%         25.4           GCC-402032         633         96%         99.9%         12.7           GCC-402033         633         96%         99.9%         25.4           GCC-402042         830         96%         99.9%         12.7           GCC-402043         830         96%         99.9%         25.4           GCC-402052         1064         96%         99.9%         12.7           GCC-402053         1064         96%         99.9%         25.4	—Tp —Ts	GCC-402012	488.0	96%	99.9%	12.7
GCC-402023         532.0         96%         99.9%         25.4           GCC-402032         633         96%         99.9%         12.7           GCC-402033         633         96%         99.9%         25.4           GCC-402042         830         96%         99.9%         12.7           GCC-402043         830         96%         99.9%         25.4           GCC-402052         1064         96%         99.9%         12.7           GCC-402053         1064         96%         99.9%         25.4		GCC-402013	488.0	96%	99.9%	25.4
GCC-402032       633       96%       99.9%       12.7         GCC-402033       633       96%       99.9%       25.4         GCC-402042       830       96%       99.9%       12.7         GCC-402043       830       96%       99.9%       25.4         GCC-402052       1064       96%       99.9%       12.7         GCC-402053       1064       96%       99.9%       25.4		GCC-402022	532.0	96%	99.9%	12.7
GCC-402033       633       96%       99.9%       25.4         GCC-402042       830       96%       99.9%       12.7         GCC-402043       830       96%       99.9%       25.4         GCC-402052       1064       96%       99.9%       12.7         GCC-402053       1064       96%       99.9%       25.4		GCC-402023	532.0	96%	99.9%	25.4
GCC-402042       830       96%       99.9%       12.7         GCC-402043       830       96%       99.9%       25.4         GCC-402052       1064       96%       99.9%       12.7         GCC-402053       1064       96%       99.9%       25.4		GCC-402032	633	96%	99.9%	12.7
GCC-402043     830     96%     99.9%     25.4       GCC-402052     1064     96%     99.9%     12.7       GCC-402053     1064     96%     99.9%     25.4		GCC-402033	633	96%	99.9%	25.4
GCC-402052         1064         96%         99.9%         12.7           GCC-402053         1064         96%         99.9%         25.4		GCC-402042	830	96%	99.9%	12.7
GCC-402053 1064 96% 99.9% 25.4		GCC-402043	830	96%	99.9%	25.4
		GCC-402052	1064	96%	99.9%	12.7
		GCC-402053	1064	96%	99.9%	25.4
GCC-402061 1310 96% 99.9% 5.0		GCC-402061	1310	96%	99.9%	5.0



GCC-4021



GCC-4021

## GCC-4021 Broadband Polarization Beamsplitter Cubes

A polarizing cube beamsplitter consists of a pair of right angle prisms cemented together. The hypotenuse face of one prism is coated with a special multilayer dielectric coating. When nonpolarized light is normally incident upon the entrance face, it is separated into two polarized beams, emerging through two adjacent faces in perpendicular directions and polarized orthogonally to each other. The transmitted beam is p-polarized while the reflected beam is s-polarized. When the linearly polarized light is incident, it is similarly divided into two beams in a ratio depending upon the orientation of the electric field vector of the incident light beam. These polarizing beamsplitters are available for many common laser wavelengths and broadband ranges.

Material: SF2Dimension Tolerance: ±0.15

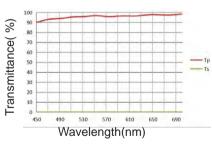
Angle of Incidence: 0°±2°

• Coatings: Single wavelength polarization partial reflectance on hypotenuse face.

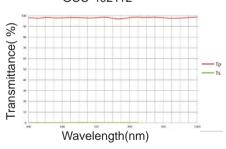
Coatings of outside surfaces: broadband multilayer AR V-coating, R<sub>ave</sub><0.5%.

Temperature Range: -30°C to +70°C

#### GCC-402103



GCC-402112

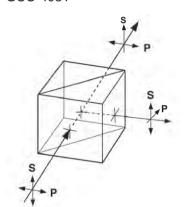


#### GCC-4021 Broadband Polarization Beamsplitter Cubes

Part No.	Wavelength (nm)	Тр	Rs	a=b=c
GCC-402102	420-680	>90%	>99.5%	12.7
GCC-402103	420-680	>90%	>99.5%	25.4
GCC-402111	620-1000	>90%	>99.5%	12.7
GCC-402112	620-1000	>90%	>99.5%	25.4
GCC-402121	900-1300	>90%	>99.5%	12.7
GCC-402122	900-1300	>90%	>99.5%	25.4
GCC-402131	1200-1600	>90%	>99.5%	12.7
GCC-402132	1200-1600	>90%	>99.5%	25.4

# GCC-4031 Broadband Non-polarizing Beamsplitter Cubes

GCC-4031



Broadband non-polarizing hybrid cube beamsplitters have moderate absorption but minimal polarization sensitivity. The broad spectral flatness of these beamsplitters make them ideal for use with multiple lasers or tunable lasers. Hybrid beamsplitters are less sensitive to changes in angle of incidence. Due to the metallic nature of the hybrid coating, these beamsplitters are not intended for use with high power lasers.

• Material: BK7 fine annealed optical glass.

• Dimension Tolerance: ±0.15

· Flatness: λ/4 at 632.8nm · Surface Quality: 60-40 scratch-dig · Clear Aperture: >90% dimension

Tp,s=43%±10%, Rp.s=43%±10% • R/T: |Ts-Tp|≤10%, |Rs-Rp|≤10%

 Beam Deviation: 0°±3′(T), 90°±5′((R)

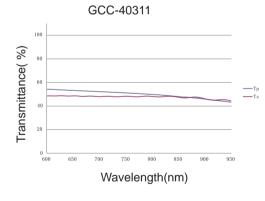
· Angle of Incidence: 0°±2°

Coatings: Broadband non-polarization partial reflectance on hypotenuse face. Coatings of outside surfaces:

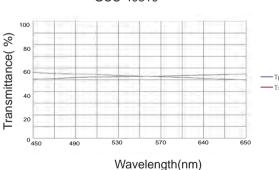
multilayer AR V-coatings, Rave < 0.5%

 Temperature Range: -30°C to +70°C





#### GCC-40310



GCC-4031 Broadband Non-polarizing Beamsplitter Cubes

Part No.	Wavelength (nm)	a=b=c(mm)
GCC-403101	450-650	12.7
GCC-403102	450-650	25.4
GCC-403111	650-900	12.7
GCC-403112	650-900	25.4
GCC-403121	900-1200	12.7
GCC-403122	900-1200	25.4
GCC-403131	1200-1600	12.7
GCC-403132	1200-1600	25.4



GCC-4111

## GCC-4111Broadband Conventional Beamsplitter Plates

This is a conventional beamsplitter independent of polarization. The incoming light should be one of the following: 45 linearly polarized, circularly polarized or natural light, i.e. the s-polarized and p-polarized components should be equal to within 5% of each other. The outgoing beams are two partially polarized beams of about equal intensities.

BK7 fine annealed optical glass · Material:

· Dimension Tolerance: +0.0/-0.15mm Thickness: 3±0.15mm

• Parallelism: ≤1'

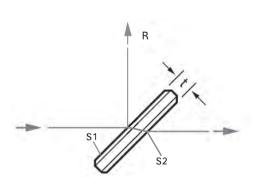
• Flatness: λ/8 at 632.8nm · Surface Quality: 40-20 scratch-dig · Clear Aperture: >90% diameter

· Incidence angle:

Coatings: S1: broadband beamsplitter coatings.

S2: broadband AR coatings,

R<sub>ave</sub><0.5%.



GCC-4111

# GCC-4111 100 Transmittance (%) 80 60 1150 1200 1250 1300 1350 1400 1450 1500 1550 1600 1650

Wavelength(nm)

GCC-4111Broadband Conventional Beamsplitter Plates

Part No.	Wavelength (nm)	T/R	Diameter
GCC-411102	450-650	5: 5	25.4
GCC-411104	450-650	1: 9	25.4
GCC-411106	450-650	3: 7	25.4
GCC-411112	650-900	5: 5	25.4
GCC-411113	650-900	5: 5	50
GCC-411114	650-900	1: 9	25.4
GCC-411116	650-900	3: 7	25.4
GCC-411122	900-1200	5: 5	25.4
GCC-411124	900-1200	1: 9	25.4
GCC-411126	900-1200	3: 7	25.4
GCC-411132	1200-1600	5: 5	25.4



GCC-4112/3

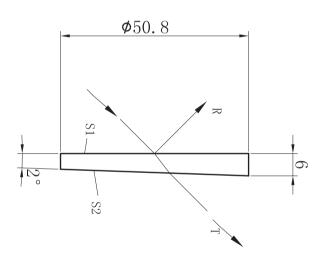
## GCC-4112/3 Beamsplitter Wedges

In order to eliminate the interference of the reflected light from the back surface, the large-sized beamsplitter plates will generally be made into a wedge form with a small angle. The reflected light from the rear surface deviates from the normal optical path at an angle.

•Material: BK7 fine annealed

•Diameter Tolerance: +0/-0.2 •Incident Angle: 45° •Flatness: 5 fringes

Surface Quality: 60-40 scratch-dig



#### GCC-4112/3 Beamsplitter Wedges

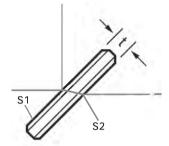
Part No.	Diameter	T:R	Wedge angle	Wavelength
GCC-411201	50.8	T:R=5:5	2°	450-650nm
GCC-411203	50.8	T:R=7:3	2°	450-650nm
GCC-411205	50.8	T:R=9:1	2°	450-650nm
GCC-411213	50.8	T:R=3:7	2°	450-650nm
GCC-411215	50.8	T:R=1:9	2°	450-650nm
GCC-411311	100	T:R=5:5	4°	450-650nm
GCC-411313	100	T:R=7:3	4°	450-650nm
GCC-411315	100	T:R=9:1	4°	450-650nm
GCC-411323	100	T:R=3:7	4°	450-650nm
GCC-411325	100	T:R=1:9	4°	450-650nm



GCC-414

## GCC-414Dichroic Beamsplitter Plates

Dichroic Beamsplitter Plates allow NIR light to pass through and reflect visible light at 45°incident angle. They have a very steep transition between the region of transmission and reflection. They have a hard and dielectric coating using interference ranther than absorption to isolate the spectral bands. Unlike colored glass filters the cut-off wavelength will shift to shorter wavelengths with an increase in angle of incidence.



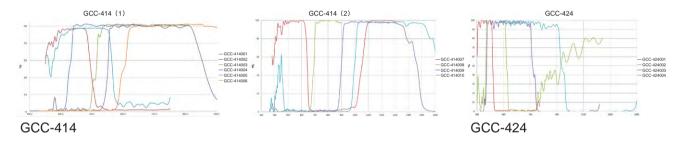
• Material: BK7 fine annealed

25.4+0/-0.2 Diameter Tolerance: • Thickness Tolerance: 3.5+/-0.1 • Incident Angle: 45°

Flatness: 5 Fringes

60-40 scratch-dig Surface Quality:

 Parallelism: <3'



#### GCC-414 Dichroic Beamsplitter Plates

GCC-414

Part No.	Specification	Cut-off Wavelength
GCC-414001	R>98%@380-410nm,T>90%@440-800nm	425nm
GCC-414002	R>98%@380-475nm,T>90%@505-800nm	490nm
GCC-414003	R>98%@380-490nm,T>90%@520-800nm	505nm
GCC-414004	R>98%@380-535nm,T>90%@565-800nm	550nm
GCC-414005	R>98%@380-550nm,T>90%@584-800nm	567nm
GCC-414006	R>98%@470-590nm,T>90%@620-700nm	605nm
GCC-414007	R>98%@580-621nm,T>90%@655-700nm	638nm
GCC-414008	R>98%@400-633nm,T>90%@685-1600nm	650nm
GCC-414009	R>98%@400-872nm,T>90%@932-1300nm	900nm
GCC-414010	R>98%@520-985nm,T>90%@1020-1550nm	1000nm

#### GCC-424 Dichroic Beamsplitter Plates

Part No.	Specification	Cut-off Wavelength
GCC-424001	T>90%@400-490nm,T < 2%@520-800nm	505nm
GCC-424002	T>90%@470-590nm,T < 2%@625-800nm	605nm
GCC-424003	T>90%@480-788nm,T < 2%@845-1300nm	805nm
GCC-424004	T>90%@560-985nm,T < 2%@1060-1550nm	1000nm

GCO-14 Beam Expanders	096
GCO-25 Zoom Beam Expanders	098
GCD-14 Motorized Zoom Beam Expanders	099
GCO-15 Laser Focusing Lenses	100
GCO-29 Fiber Focusing Lenses	102
GCO-31 F-theta Lenses	103
GCO-400101 Beam Shaping Lenses	105







GCO-14

#### GCO-14 Beam Expanders

A beam expander is an optical system for changing the diameters of input and output beams. The product of the diameter and divergence for a laser beam remains constant between input and output. This means that, if the beam diameter increases from input, the divergence of the output will decrease. Beam expanders use this inverse-proportional relationship between the diameter and divergence to expand a laser beam, or to reduce the beam divergence. Low divergence allows for a smaller focus spot of a Gaussian beam.

In summary, beam expanders are used for fine focusing, reducing beam divergence and minimizing diffraction effect. Daheng Beam Expanders (GCO-14) are professionally designed for complicated systems and ideally used in combination with Daheng F-Theta lenses (GCO-31).

#### **TECHNICAL NOTES**

#### • Type of beam expander

Beam expanders are generally of a focal system; in which two groups of lenses have their focal points coincided. The front and the rear lens group are input and output lens, respectively. There are two types of beam expanders, Galilean and Keplerian, based on the input lens.

Galilean beam expander is the most common type of beam expander, which is derived from Galilean telescope. It usually has one negative lens and one positive lens. The front focal point of the negative lens and the front focal point of the positive lens are coincided in front of the input lens. For lens expansion ratios <20x, the Galilean beam expander is most often used because of its simplicity, small package size and low cost. However, the Galilean beam expander is unable to accommodate spatial filters and limited to low expansion ratios.

In cases where larger expansion ratio or spatial filtering is required, the Keplerian beam expanders are employed. The Keplerian beam expander has two positive lenses, which the rear focal point of the first lens is positioned at the front focal point of the second lens. In addition, spatial filtering can be instituted by placing a pinhole at the coincided focus point.

#### • Expansion ratio, M

The expansion ratio M is the ratio of the output beam diameter  $\Phi_{\text{out}}$  to the input beam diameter  $\Phi_{\text{in}}$ . It can be calculated using the focal length of the input lens  $f'_n$  and the output lens  $f'_{\text{out}}$  as follows:

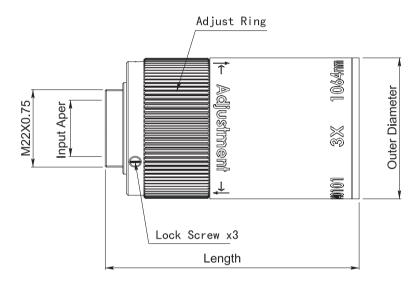
 $M = \frac{\phi_{out}}{\phi_{in}} = -\frac{f'_{out}}{f'_{in}}$ 

## GCO-14 Beam Expanders

As mentioned above, increasing the beam diameter means decreasing the divergence of the beam by inverse proportion. So,

 $M = -\frac{\tan(\theta_{in})}{\tan(\theta_{out})}$ 

where  $\theta_{\it in}$  is the divergence of the input beam and  $\theta_{\it out}$  is the divergence of the output beam.



GCO-14

#### GCO-14 Beam Expanders

Part No.	Expansion Ratio	Wavelength	Max. Input Beam Diameter(1/e²)	Input Aperture	Outer Diamter	Length	Transmitted Wavefront	Transmission	Damage Threshold
GCO-140101	3X	355nm	6	8	40	75	< λ /4(RMS)	>98.5%	
GCO-140102	5X	355nm	4	5.5	40	95	< λ /4(RMS)	>98.5%	
GCO-140103	8X	355nm	3	5	40	115	< λ /4(RMS)	>98.5%	
GCO-140111	3X	532nm	8	10.5	40	75	< λ /4(RMS)	>98.5%	10J/cm <sup>2</sup>
GCO-140112	5X	532nm	6	8	48	95	< λ /4(RMS)	>98.5%	@10ns 10Hz
GCO-140113	8X	532nm	4	8	48	105	< λ /4(RMS)	>98.5%	1064nm
GCO-140121	3X	1064nm	8	10.5	40	75	< λ /4(RMS)	>98.5%	
GCO-140122	5X	1064nm	6	8	48	95	< λ /4(RMS)	>98.5%	
GCO-140123	8X	1064nm	4	5.5	48	105	< λ /4(RMS)	>98.5%	

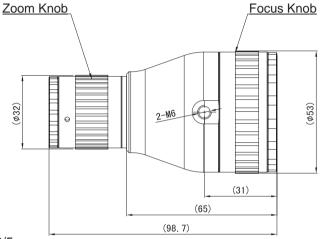




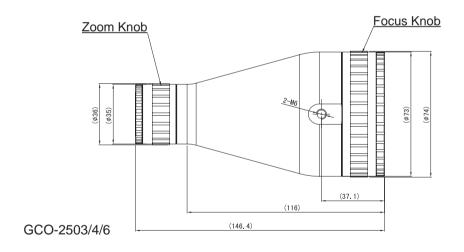
GCO-25

## GCO-25 Zoom Beam Expanders

GCO-25 Series Zoom Beam Expanders are designed for changing a collimated laser beam, there are two zoom ranges available: 2x~6x and 5x~10x. Adjusting the knob at the input and achieves expanding variation and restoration of collimation. With the design of using air-spaced lenses only, this series is suitable for high energy laser.



GCO-2501/2/5



#### GCO-25 Zoom Beam Expanders

Part No.	Waveband	Expansion Ratio	Input Aperture max.	Output Aperture max.	Diameter	Length	Wavefront Distortion
GCO-2501	450 ~ 680nm	2× ~ 6×	Ø 4	Ø 24	Ø 53	98.7	1/5 λ
GCO-2505	650 ~ 900nm	2× ~ 6×	Ø4	Ø 24	Ø 53	98.7	1/5 λ
GCO-2502	900 ~ 1100nm	2× ~ 6×	Ø4	Ø 24	Ø 53	98.7	1/5 λ
GCO-2503	450 ~ 680nm	5× ~ 10×	Ø4	Ø 40	Ø 74	146.4	1/2 λ
GCO-2506	650 ~ 900nm	5× ~ 10×	Ø4	Ø 40	Ø 74	146.4	1/5 λ
GCO-2504	900 ~ 1100nm	5× ~ 10×	Ø 4	Ø 40	Ø 74	146.4	1/2 λ

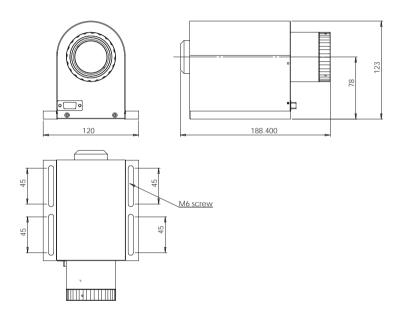


GCD-14

#### GCD-14 Motorized Zoom Beam Expanders

For automated applications, Daheng Optics developed motorized zoom beam expanders --GCD-14 series. GCD-14 series employ the 4 lens-element optical designs and the build-in adjustment motors for controlling lens groups. With the motorized systems, both magnification and focus can be controlled independently.

With Daheng Optics motorized zoom beam expanders, variable expansion ratio can automatically be set ranging from 1.5X~6X. This variability helps to reduce machine set up times and provides flexibility to equipment for a wide range of jobs.



GCD-14

#### GCD-1401

•Expansion Ratio: 1.5x-6x

•Waveband: 450-650nm

•Input Aperture: Ø 10mm

•Max Input Beam Diameter (1/e²): Ø 4mm

•Max Onput Beam Diameter (1/e²): Ø 40mm

•Damage Threshold: >10J/cm<sup>2</sup> (10ns 20Hz 1064nm)

>100W/ cm<sup>2</sup>

•Wavefront:  $\lambda/4$ •Transmission: >96%

•Diamension: 120x123x188mm





GCO-15

#### GCO-15 Laser Focusing Lenses

Air-spaced focusing lenses are designed to focus the high-power radiation emitted by lasers. The lenses are optimized for high precision applications such as used in laser machining systems for welding, cutting, drilling and strutting. They can also be used for collimating the laser beam delivered by fiber.

The Daheng's air-spaced focusing lens product utilizes high quality triple lens elements which are optimized to obtain a diffraction-limited focus spot. With the design-specific optical coating, the lens system achieves transmission throughout at a designed wavelength up to 98%.

## Spot size $D_{spot}(1/e^2)$

The minimal possible focus spot size from an air-spaced focusing lens is calculated by the wavelength of the laser multiplied with the focal length of the lens, f', the FAP factor and the diffraction value M<sup>2</sup> of the laser beam, and divided by the beam diameter D<sub>beam</sub>(1/e<sup>2</sup>).

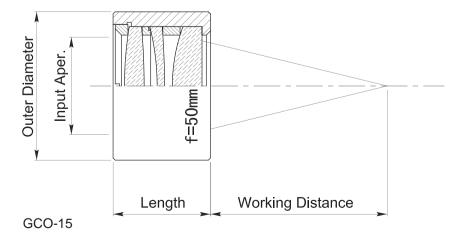
$$D_{spot} = \lambda \cdot f' \cdot FAP \cdot M^2 / D_{beam}$$

### Depth of focus

The depth of focus of an air-spaced focusing lens is defined by a doubled Rayleigh length. The Rayleigh length describes as a distance, along the optical axis, between the positions where the beam area is doubled in front of or behind the focal position.

The Rayleigh length ZR is calculated by the beam area in the focal plane multiplied with a factor (depending on the FAP-factor) divided by the wavelength and the diffraction value M<sup>2</sup> of the laser.

$$Z_R = \pi \cdot (d_0/2)^2 \cdot (FAP/1.2)^2 / (\lambda \cdot M^2)$$



# GCO-15 Laser Focusing Lenses

Part No.	EFL	Wavelength	Outer Diameter	Input Aperture	Length	Working Distance	Transmission	Damage Threshold
GCO-150101	25	355nm	25	12	17	17.2	>98.5%	
GCO-150102	48	355nm	30	23	20	40	>98.5%	
GCO-150103	60	355nm	40	34	27.6	47.5	>98.5%	
GCO-150111	25	532nm	25	12.5	13.5	19.7	>98.5%	10J/cm <sup>2</sup>
GCO-150112	50	532nm	35	23.5	23	42.2	>98.5%	@10ns 10Hz
GCO-150113	77	532nm	41	35	24	66.6	>98.5%	1064nm
GCO-150121	25	1064nm	25	12.5	13.5	20.1	>98.5%	
GCO-150122	50	1064nm	35	23.5	20	41.7	>98.5%	
GCO-150123	77	1064nm	41	35	24	67	>98.5%	



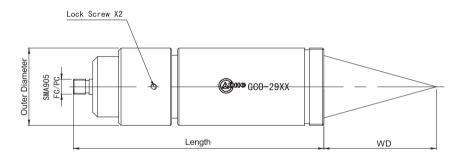


GCO-29

#### GCO-29 Fiber Focusing Lenses

Fiber focusing lenses are designed to use for the laser output of a fiber with common standard fiber connection attachment. They are widely used in laser machining systems for welding, cutting, drilling and structing applications. They are also used in the end-pump DPSS laser systems to focus the pump radiation output into the laser crystal.

Daheng fiber focusing lens (GCO-29) employs an optimized design with multi-elements system. The focus spot has a fix magnification with the fiber core diameter. The lenses also characterized with designated working distance ideal for the laser machining applications. A range of magnifications for spot sizes are available off-the-shelf.



GCO-29

#### GCO-29 Fiber Focusing Lenses

Part No.	Magnification	Transmission	nsmission WD		Length	core Diameter	N.A.	Interference
GCO-2901-FCPC	1:1	> 92%	46.6	32	97.6-102.6	0.4	0.22	FC/PC
GCO-2901-SMA	1:1	> 92%	46.6	32	101.2-106.2	0.4	0.22	SMA905
GCO-2902-FCPC	1:0.8	> 95%	49.2	37.5	92.3-97.3	0.4	0.22	FC/PC
GCO-2902-SMA	1:0.8	> 95%	49.2	37.5	925-100.9	0.4	0.22	SMA905
GCO-2904-FCPC	1:0.5	> 95%	30	44	120.5-125.5	0.4	0.22	FC/PC
GCO-2904-SMA	1:0.5	> 95%	30	44	124-129	0.4	0.22	SMA905
GCO-2912-FCPC	1:2	> 95%	75	32	93.6-96.1	0.4	0.22	FC/PC
GCO-2912-SMA	1:2	> 95%	75	32	97.2-99.7	0.4	0.22	SMA905
GCO-2914-FCPC	1:4	> 95%	300	44	102.4-104.9	0.8	0.22	FC/PC
GCO-2914-SMA	1:4	> 95%	300	44	106-108.5	0.8	0.22	SMA905



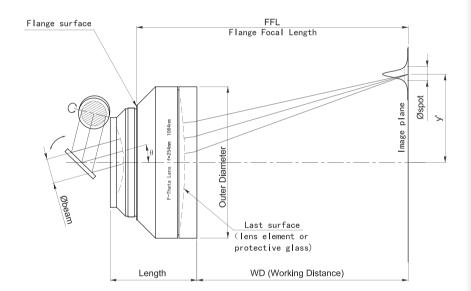
GCO-31

#### GCO-31 F-theta Lenses

F-theta Lenses are plane field objectives, which are commonly used in combination with XY galvanometer scanner. Contrary to a normal lens which focuses a input collimated beam on a spherical image plane, a F-theta lens focuses on a flat image surface. At the same time, it maintains almost constant spot size over the entire field when the input beam scans with input angle  $\theta$ . The position of the spot on the image plane is directly proportional to the scan angle, i.e. F-theta condition:

$$y' = f' \cdot \theta$$

Daheng F-theta lens series (Model number) fulfils the F-theta condition better than 0.1%.



#### **APPLICATION**

For laser material processing, F-theta lenses guarantee the best processing result over the entire scan field. These lenses contribute to production lines, especially for sophisticated applications. The wide range of applications includes:

- Drilling and fine cutting of metals and ceramics
- Plastic welding
- Marking
- Cleaning for treatment or restoration



#### **KEY PARAMETERS**

- The overall scan angle,  $\theta$  max, refers to the maximum diagonal scan angle.
- where the optical intensity is 13.5% of the peak intensity of the laser beam.
- Factor of apodisation (FAP) is the ratio of the beam diameter,  $\phi$  beam, and the entrance pupil,  $\phi$  aper, of the F-theta lens. FAP is used for calculation of the minimal possible focus spot size.

Ø aper/ Ø beam	FAP
2	1.27
1.5	1.41
1.25	1.56
1	1.83
0.9	1.99
0.75	2.32
0.5	2.44

- Diffraction value M<sup>2</sup> refers to the ability of focusing laser light, defined by ISO11146 standards. It is the ratio of the divergence angle of a laser beam to the divergence angle of an ideal Gaussian beam. A Gaussian beam would provide the smallest possible focus spot size, which M2 value is 1. This value is also used for calculation of the minimal possible focus spot
- Spot size Ø<sub>spot</sub> (1/e²) is the minimal possible focused spot size calculated as the wavelength of the laser multiplied with the focal length of F-theta lens, the FAP and the diffraction value M<sup>2</sup>, divided by the beam diameter Ø beam.

$$D_{spot} = \lambda \cdot f' \cdot FAP \cdot M^2 / \phi_{beam}$$

#### GCO-31 F-theta Lenses

					May Input						
Part No.	EFL	Wavelength	Scan Angle θ	Scan Area (mm*mm)	Max. Input Beam Diameter	EFL (mm)	WD (mm)	Spot Size Ø <sub>spot</sub> (µm)		Length (mm)	Screw
GCO-310101	100	355nm	±25°	61.5*61.5	6	127.1	115.7	11	90	51	M85X1
GCO-310102	160	355nm	±25°	98.7*98.7	6	205	186.3	18	90	51	M85X1
GCO-310103	254	355nm	±25°	156.7*156.7	10	346.4	298.8	17	120	65.9	M85X1
GCO-310201	100	532nm	±25°	61.5*61.5	12	109.7	100.2	8	90	52.0	M85X1
GCO-310202	160	532nm	±25°	98.7*98.7	12	188.3	178.8	13	90	50.2	M85X1
GCO-310203	254	532nm	±25°	156.7*156.7	16	324.2	293.2	16	120	69.5	M85X1
GCO-310301	100	1064nm	$\pm 25^{\circ}$	61.5*61.5	12	108.6	99.1	16	90	52.0	M85X1
GCO-310302	160	1064nm	±25°	98.7*98.7	12	188.2	178.7	26	90	50.2	M85X1
GCO-310303	254	1064nm	±25°	156.7*156.7	16	342.2	293.2	31	120	69.5	M85X1

GCO-400101

## GCO-400101 Beam Shaping Lens

#### Design features:

GCO - 400101 is an advanced beam shaping lens, light beam go through a special shaping components to make a gaussian speckle transform into a flat spot. GCO-400101 is of a great importance to some special applications

#### Characteristics:

- An incidence of gaussian spot can be converted into a square flat spot.
- Different spot size can be obtained when operated at different working distance.
- The beam energy distribution is uniformity;
- Low power loss, high efficiency;

#### Applications:

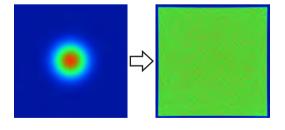
The beam intensity of traditional lighting is higher in the center, the lower at the edge, only the beam energy of the E3 area are effectively utilized, the excess light energy of E1 region E2 region of the light energy is lost, that the light energy utilization ratio is very low, unreasonable use, difficult to achieve a large area of uniform illumination.

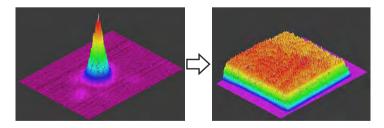




GCO-400101

After beam shaping, gaussian beam transform into the flat spot with uniform distribution of energy, which can realize larger effective uniform illumination.





#### GCO-400101 Beam Shaping Lens

Working wavelength/nm		532, 632.8									
Incident spot size /mm		Ф2-4									
Transmittance		>86%									
Working distance/mm	100	150	200	250							
Output spot size/mm	12*12	19.6*19.6	27.2*27.2	34.8*34.8							
Dimensions /mm	Ф30*197										

GCO-232 Bi-Telecentric Lenses (Iris adjustment)	112
GCO-23 Bi-Telecentric Lenses (Iris fixed)	114
GCO-2606/2607 Object-Telecentric Lenses	117
GCO-2616 Telecentric Microlens Adapter	118
GCO-260502 Zoom Object-Telecentric Micro-vision Lenses .	119
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GCX Fixed Focus Fiber Optic Collimators	122
GCX-C Fiber Couplers	123



For most lenses, an object closer to the lens produces a larger image. Consequently, the image of the object or parts of the object which does not lie in a plane parallel to the image plane will exhibit perspective

distortions. In many measurement applications, however, perspective distortions are undesirable. It is required that an imaging system performs parallel projection that eliminates the perspective distortions and removes occlusions of objects occurred. Such imaging system is the telecentric lens. They are frequently used in the machine vision industry for measurement and alignment applications.

#### **Principle**

Telecentric lenses in which the chief rays are parallel to the optical axis, providing a constant magnification regardless of the object distance, the system pupil is at infinity and this results in minimum perspective

errors when changing the object position. Therefore the size of the viewed object appears to be the same when changing the distance of the object (within the range of depth of field). These lenses are

ideal for precision measurements application.

There are three classifications of telecentric lens depending upon the optical spaces in which the chief rays exhibit this behavior.

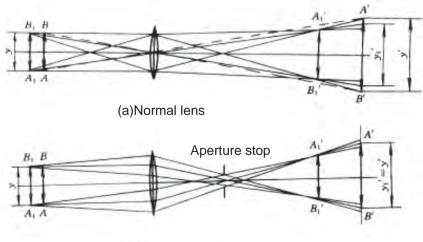
# Object-Space Telecentric Lens

The aperture stop is on the back focal plane of objective lens, and the entrance pupil located at infinity. A shift in the object plane does not affect image magnification. The incident chief rays are always

parallel to the axis, and the emergent chief rays will not change, so the intersection of rays on the image plane will also not change.

Object-space telecentric lenses are often used in machine vision

because they produce images with simple, constant perspective, like the flattened perspective that one see through binoculars or a telescope.



(b)Object-space Telecentric Lens

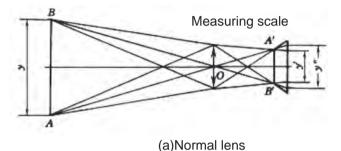


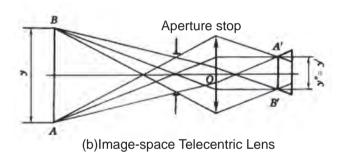
# Image-Space Telecentric Lens

The aperture stop is on the front focal plane of objective lens, and the exit pupil located at infinity. A shift in the image plane does not affect image magnification. The chief ray of the emergent rays will

be always parallel to the axis, and the intersection of it on the image plane will also not change.

Image-space telecentric lenses are in demand for digital cameras which make the light rays hit the sensor straight-on. The rays from a conventional lens are straighton only in the center; at the edge, however, they hit the sensor obliquely, causing color fringing.

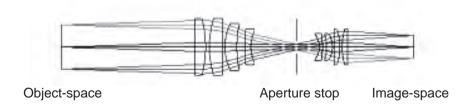




#### Bilateral

#### Telecentric Lens

An image-spaced and an objectspaced telecentric lens are combined together with the common focal plane. The aperture stop is on the common focal plane, resulting in both the entrance and exit pupils being located at infinity. Shifting either the image or object planes does not affect magnification given that double telecentric systems are afocal.



## **Telecentricity**

No Perspective Error. Telecentricity describes the angular deviation of the chief ray from a ray parallel to the optical axis. A lower angular value means a lens will reproduce an image more accurately.

Our telecentric target allows keystoning in an image to be visualized and accurately measured. The amount of keystoning is related

to the telecentricity of the lens that is imaging the target. The target is placed at a 45° angle to the optical axis so that the bottom of the target is further away from the lens than the top of the target. When imaging the target through a non-telecentric lens, the distance between the vertical lines will appear to decrease at the bottom of the image; this

effect is known as keystoning. A perfectly telecentric lens will have no keystoning and the telecentricity will be 0°

$$\alpha = arctg \frac{\Delta X}{\Delta Y} = arctg \frac{|X_1 - X_2|}{|Y_1 - Y_2|}$$







 $(Y_1X_1)$ 

**Target** 

How to test?

How to calculate?

#### Distortion

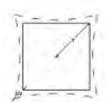
It is a deviation from a theoretical perfect point. It is a function of image height. Distortion is simply defined as the percentage difference between the distance of an image point from the image center and the same distance as it would be measured in a distortionfree image. There are a few typical distortion shapes commonly seen in imaging lenses, such as pincushion

and barrel, shown below.

Common machine vision lenses typically exhibit more than 1-2% distortion. This could severely limit accuracy in a dimensional measurement application, e.g. a 50mm object could look 51mm on the image plane. For instance, if a point of an image is 198 pixels distant from the center, while a distance of 200 pixels would be

expected in absence of distortion, the radial distortion, at that point, would be distortion = (198-200)/200 = -2/200 = -1%.

Daheng Optics telecentric lenses exhibit radial distortion less than 0.2%, e.g. a 50mm object will look no larger than 50.1 mm in the image plane, 10 times less distortion than the requirement for common machine vision applications.



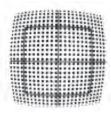
"pincushion"type distortion



"barrel"type distrotion



distrotion with telecentric lens



radial distortion



trapezoidal distortion

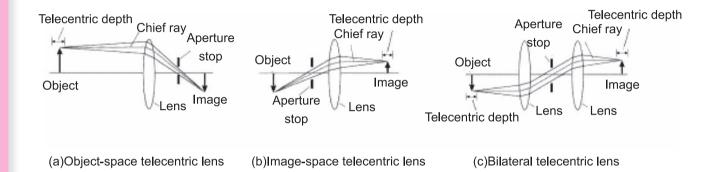


#### Telecentric Depth

Telecentric Depth or telecentric range is the total distance in the front of and behind an object that remains in focus and with constant magnification. Objects can be placed within the telecentric range for measurement without introducing perspective error.

Generally, larger apertures (lower F#) reduce field depth. Also,

although smaller apertures (higher F#) increase field depth, they reduce resolution and require much brighter illumination.



# Magnification

It is the ratio of the size of the image to the size of the object. A magnification specification of

 $0.5\,\times\,$  means that the lens reduces the object by a factor of 2 when it

projects the image onto a camera's sensor.

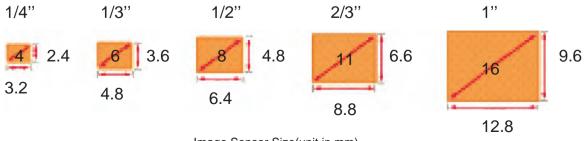
# Object size

Object size or field of view gives the maximum object size that the lens can image. Due to the way a telecentric lens works, the field of

view cannot exceed the diameter of the lens' front surface.

# Image size

Image size or sensor format specifies the maximum image size a lens can form.



#### **Working Distance**

It specifies the distance from the object to the front of the lens housing. A telecentric lens operates properly at only one working distance.

# **Applications**

#### Example 1:

Measurement of Mechanical Parts When standard optics are used to image 3D objects, closer objects appear relatively larger than those further away. As a consequence, when an object such as a cylindrical cavity is imaged, the top and bottom circular edges appear to be concentric and the inner walls are

imaged, as well (left). However, by using telecentric optics, the bottom edge disappears and the inner walls are not imaged (right).

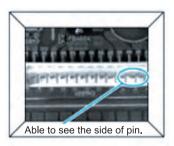


Non-telecentric Lens



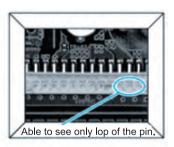
Telecrtric Lens

#### Example 2: **PCB** Inspection



Non-telecentric Lens

You can see the side of connector pins on the image of non-telecentric



Telecentric Lens

lens, whereas telecentric image has only top view of connector pins.

# Other applications

Plastic part measurement: to measure rubber seals, o-rings and plastic caps which definitely need non-contact optical measurement

techniques as they are difficult to handle without changing their shape thus altering the inspected dimensions.

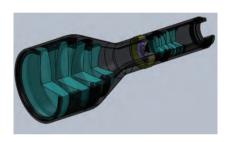
Electronics component measurement, Glass and pharmaceutical part measurement,

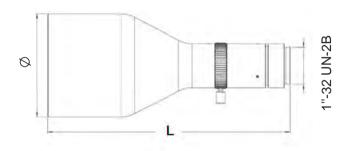
Surface defect inspection, and etc.



# GCO-232 Bi-Telecentic lenses (Intigrate, Iris adjustment)







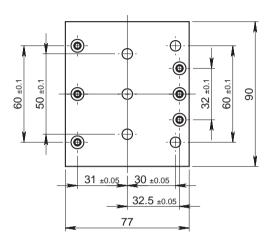
#### GCO-232 Bi-Telecentic lenses(Intigrate, Iris adjustment)

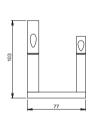
Part No.	Magnification	Working Distance	Field of View	Resolution	Field Depth	NA	Aperture (f/#)	Distortion	Sensor Format	Camera Thread	Dimension ØxL
GCO-232005	0.08x	494	80x60	13.8-26.85um	28.3-42.4	0.0018-0.005	8-21.7	0.018%	1/2"	С	Ø 116x233
GCO-232006	0.06x	494	80x60	36.5-85.0um	57.5-68	0.0018-0.0037	8-16.2	0.1%	1/3″	С	Ø 116X223
GCO-232103	0.32x	142	40x30	7.05-30.2um	10.0-12.0	0.003-0.02	8-43.6	0.038%	1″	С	Ø 70x191
GCO-232104	0.22x	142	40x30	12.6-36.2um	12.3-16.9	0.003-0.014	8-30.1	0.088%	2/3"	С	Ø 70x165
GCO-232105	0.16x	142	40x30	15.9-35.3um	18.1-21.4	0.004-0.01	8-21.7	0.028%	1/2″	С	Ø 70x149
GCO-232106	0.12x	142	40x30	18.4-43.4um	30.6-37.0	0.004-0.008	8-16.2	0.15%	1/3″	С	Ø 70x138
GCO-232107	0.12X	450	40X30	45.6-49.7um	33-61	0.003-0.0075	8-18.77	0.1%	1/3″	С	Ø 70x196
GCO-232203	0.64x	62	20x15	4.4-18.8um	3.9-4.7	0.007-0.04	8-43.6	0.005%	1″	С	Ø 44x140
GCO-232204	0.44x	62	20x15	7.3-21.7um	4.5-5.8	0.007-0.027	8-30.1	0.12%	2/3"	С	Ø 44x114
GCO-232205	0.32x	62	20x15	7.9-21.7um	4.3-6.2	0.007-0.027	8-21.7	0.05%	1/2″	С	Ø 44x98
GCO-232206	0.24x	62	20x15	7.5-18.6um	5.6-11.2	0.0073-0.062	8-16.2	0.1%	1/3″	С	Ø 44x87

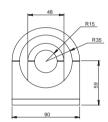
#### GCO-232 Lens Holder

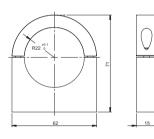


GCO-23







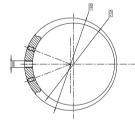


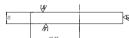
GCO-2321-FJ

GCO-2322-FJ



GCO-2301-FJ





GCO-2301-FJ

#### GCO-232 Lens Holder

Part No.	Application
GCO-2321-FJ	GCO-2321 Series
GCO-2322-FJ	GCO-2322 Series
GCO-2301-FJ	GCO-2301 Series

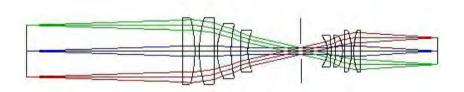


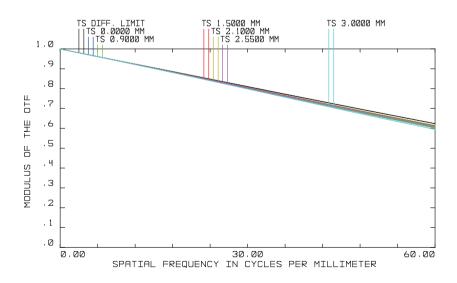
# The same of the sa

GCO-23 Telecentric Lens

#### GCO-23 Bi-Telecentic lenses (Match, Iris fixed)

The series of telecentric system is developed by using a pair of base lenses to achieve telecentricity required on object and image plane. The combined telecentric lens systems is afocal lens system with an aperture stop located at the common focus of the front and back lens, resulting in the chief ray being parallel to the optical axis in both object and image space. Both the entrance and exit pupil are at infinity. A constant perspective or viewing angle and a constant magification can therefore be achieved in the cases when the object and image surface are tilted with respect to the optical axis or the lens is defocused on either object surface or image surface. Another feature is the large depth of focus, up to several millimeters, which is extremely useful in inspection applications. C/T-mount adapters (GCO-230101~231206) are offered for coupling to CCD cameras.





#### GCO-23

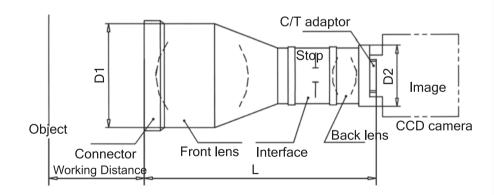
# GCO-23 Telecentric Lenses (The combinations of the base lenses)

Any two of the base lenses can be combined via an interface (GCO-230101~231206) to build a telecentric lens system, for specific magnifications. Every base lens can act as either the front lens or the back lens, according to the object size or image size.



#### Interfaces and CCD adapters

The interface settings between the base lenses are listed in the table below. A stop is built in the interface and aligned to achieve the telecentric effect. The CCD adapters are provided along with the interfaces. Custom CCD adapters are also available on special request.



GCO-23 Telecentric Lens



Part No.	Interface Part No.	Magnification	Working Distance	Field of View	Resolution	Field Depth	NA	Aperture (f/#)	Distortion	Sensor Format	Camera Thread	Dimension ØxL
GCO-2312+GCO-2303	GCO-231203	0.16X	494.5	80x60	43.0um	24.0	0.01	8	0.2%	1″	С	Ø 117x278
GCO-2312+GCO-2304	GCO-231204	0.11X	494.5	80x60	50.0um	44.7	0.007	8	0.02%	2/3"	С	Ø 117x251
GCO-2312+GCO-2305	GCO-231205	0.08X	494.5	80x60	26.85um	28.3	0.005	8	0.018%	1/2″	С	Ø 117x233
GCO-2312+GCO-2306	GCO-231206	0.06X	494.5	80x60	85.0um	68	0.0037	8	0.1%	1/3″	С	Ø 117x222
GCO-2301+GCO-2301	GCO-230101	1X	146.3	40x30	24.8um	4.0	0.062	8	0.012%	40x30		Ø 72x233
GCO-2301+GCO-2302	GCO-230102	0.5X	146.3	40x30	32.1um	8.0	0.031	8	0.077%	20x15		Ø 72x176
GCO-2301+GCO-2303	GCO-230103	0.32X	146.3	40x30	30.2um	10.0	0.02	8	0.038%	1″	С	Ø 72x190
GCO-2301+GCO-2304	GCO-230104	0.22X	146.3	40x30	36.2um	12.3	0.014	8	0.088%	2/3″	С	Ø 72x157
GCO-2301+GCO-2305	GCO-230105	0.16X	146.3	40x30	35.3um	18.1	0.01	8	0.028%	1/2″	С	Ø 72x146
GCO-2301+GCO-2306	GCO-230106	0.12X	146.3	40x30	43.4um	37.0	0.008	8	0.15%	1/3″	С	Ø 72x135
GCO-2302+GCO-2302	GCO-230202	1X	72.2	20x15	22.3um	3.7	0.062	8	0.038%	20x15		Ø 45x118
GCO-2302+GCO-2303	GCO-230203	0.64X	72.2	20x15	18.8um	3.9	0.04	8	0.005%	1″	С	Ø 45x134
GCO-2302+GCO-2304	GCO-230204	0.44X	72.2	20x15	21.7um	4.5	0.027	8	0.12%	2/3″	С	Ø 45x103
GCO-2302+GCO-2305	GCO-230205	0.32X	72.2	20x15	17.7um	5.3	0.02	8	0.054%	1/2″	С	Ø 45x101
GCO-2302+GCO-2306	GCO-230206	0.24X	72.2	20x15	18.6um	11.2	0.062	8	0.1%	1/3″	С	Ø 45x77
GCO-2303+GCO-2303	GCO-230303	1X	45.9	12.8x9.6	15.6um	2.4	0.062	8	0.022%	1″	С	Ø 42x111
GCO-2303+GCO-2304	GCO-230304	0.69X	45.9	12.8x9.6	15.9um	2.5	0.043	8	0.1%	2/3"	С	Ø31x74
GCO-2303+GCO-2305	GCO-230305	0.5X	45.9	12.8x9.6	12.9um	2.8	0.031	8	0.036%	1/2"	С	Ø 33x67
GCO-2303+GCO-2306	GCO-230306	0.375X	45.9	12.8x9.6	12.8um	4.3	0.031	8	0.1%	1/3″	С	Ø 37x56
GCO-2304+GCO-2304	GCO-230404	1X	30.9	8.8x6.6	13.9um	1.5	0.062	8	0.008%	2/3"	С	Ø 33x72
GCO-2304+GCO-2305	GCO-230405	0.73X	30.9	8.8x6.6	11.3um	1.7	0.045	8	0.06%	1/2"	С	Ø 30x56
GCO-2304+GCO-2306	GCO-230406	0.55X	30.9	8.8x6.6	11.8um	2.9	0.033	8	0.2%	1/3″	С	Ø 29x45
GCO-2305+GCO-2305	GCO-230505	1X	23	6.4x4.8	12.4um	1.6	0.062	8	0.4%	1/2"	С	Ø 35x38
GCO-2305+GCO-2306	GCO-230506	0.75X	23	6.4x4.8	10.9um	2.1	0.046	8	0.45%	1/3″	С	Ø 35x38
GCO-2306+GCO-2306	GCO-230606	1X	15.9	4.8x3.6	7.6um	1.4	0.062	8	0.25%	1/3″	С	Ø 33x33

#### Example



A 1/2 inch CCD camera is used to inspest a circular object of 45mm in diameter. One can choose a combination as follows. For the object of 45mm, the base lens GCO-2301 can be used, which offers 50mm object size. For 1/2 inch CCD camera, the base lens GCO-2305 can be chosen for 1/2 inch CCD camera to give an image size of 8mm (or 6.4x4.8mm). The combined system gives the magnification of 0.16. The total length of the combined system is 146mm. The conjugate distance from object to image is 304.7mm. A CCD adaptor is included.

Front Lens GCO-2301 (Object size 50)



Interface GCO-230105



**Back Lens** GCO-2305 (Image size Ø8)



1/2 inch CCD

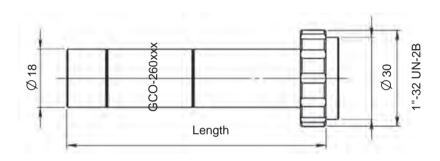


#### GCO-2606/2607 Object-Telecentic Micro-vision Lenses

GCO-2606/2607 Series are applied for various types of cameras including 1,300,000 or more pixels (4.65µm/ pixel). Higher resolution and contrast design achieve perfect image performance. This series provide accurate image for high-end detection and alignment applications.

- Support million pixels, more than 1,300,000 pixels
- High resolution for the full field
- Using internal reflection scattering design to reduce hot point.
- Large NA and contrast
- Compatible 2/3 " CCD or less

GCO-2606



GCO-2606

#### GCO-2606/2607 Object-Telecentic Micro-vision Lenses

Part No.	Magnification	Working Distance	Field of View	Resolution	Field Depth	NA	Aperture(f/#)	Distortion	Sensor Format	Camera Thread	Dimension(ΦxL)
GCO-260611	1x	65	8.8x6.6	7.6um	2.99	0.027	18.4	0.066%	2/3"	С	76.1
GCO-260612	2x	65	4.4x3.3	9.7um	2.85	0.029	17.3	0.189%	2/3"	С	77.4
GCO-260616	0.5x	63	17.6x13.2	17.5um	4.74	0.061	8	0.004%	2/3"	С	92.8
GCO-260617	0.8x	61	11x8.25	11.7um	3.55	0.046	10	0.066%	2/3"	С	94.9
GCO-260711	1x	65	8.8x6.6	7.0um	2.72	0.027	18.4	0.1%	2/3"	С	78.45
GCO-260712	2x	65	4.4x3.3	10.5um	3.40	0.03	16	0.2%	2/3"	С	76.6
GCO-260716	0.5x	63	17.6x13.2	14.3um	4.04	0.06	8	0.004%	2/3"	С	92.8
GCO-260717	0.8x	61	11x8.25	9.2um	2.94	0.046	10.8	0.1%	2/3"	С	94.9
GCO-260621	0.5x	110	17.6x13.2	13.7um	3.03	0.054	9.2	0.013%	2/3"	С	166.6
GCO-260622	0.75x	110	11.7x8.8	9.8um	1.63	0.038	13.3	0.2%	2/3"	С	156.2
GCO-260623	1x	110	8.8x6.6	9.9um	1.57	0.025	20.9	0.027%	2/3"	С	106.6
GCO-260624	2x	110	4.4x3.3	7.8um	0.77	0.015	33	0.008%	2/3"	С	126.6
GCO-260721	0.5x	110	17.6x13.2	14.8um	3.3	0.054	9.33	0.034%	2/3"	С	167.5
GCO-260722	0.75x	110	11.7x8.8	10.6um	1.76	0.037	13.4	0.008%	2/3"	С	158.6
GCO-260723	1x	110	8.8x6.6	9.7um	1.54	0.025	19.9	0.032%	2/3"	С	107.3
GCO-260724	2x	110	4.4x3.3	9.0um	0.89	0.015	33	0.008%	2/3"	С	129.0

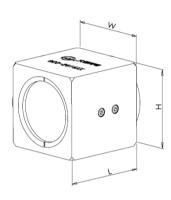


# GCO-2616 Object-Telecentric Lens Adapter

An object-telecentric lens adapter is used to give 90 degree side view. The reflection type only turns the image back by 90 degrees; Beam split type can also give a conventional imaging for observation in addition to fold like 90 degrees.



GCO-2616

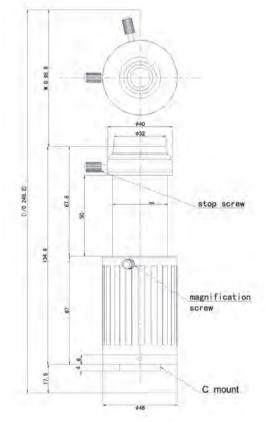


Product Part No.	Suitable for
GCO-261601	GCO-260611 Sleeve
GCO-261602	GCO-260612 Sleeve
GCO-261603	GCO-260616 Sleeve
GCO-261604	GCO-260617 Sleeve
GCO-261605	GCO-260621 Sleeve
GCO-261606	GCO-260622 Sleeve
GCO-261607	GCO-260623 Sleeve
GCO-261608	GCO-260624 Sleeve
GCO-261609	Large caliber reflecting connecter
GCO-2616010	Small caliber reflecting connecter
GCO-2616013	Large aperture beam split connecter
GCO-2616014	Small aperture beam split connecter
GCO-2616011	beam split connecter
GCO-2616012	beam split connecter



GCO-260502

# GCO-260502 Zoom Object-Telecentric Micro-vision Lenses



GCO-2605

#### GCO-260502 Zoom Object-Telecentric Micro-vision Lenses

Part No.	Magnification (X)	Working Distance (mm)	Field of View (mm)	Resolution (µm)	Field Depth (mm)	NA	Aperture (F/#)	Distortion (%)	Sensor Format	Lens Mount
	0.5x	171.7mm	17.6x13.2mm	23.8um	1.72mm	0.048	5.2	0.011%		
	0.8x   1   1.0x   1	136.7mm	12.6x9.4mm	29.4um	2.88mm	0.054	6.5	0.003%		
GCO-260502		125.6mm	11x8.25mm	30.3um	3.21mm	0.056	7.1	0.002%	2/3"	С
GCO-200302		110.3mm	8.8x6.6mm	26.3um	3.00mm	0.060	8.3	0.00007%	2/3	
		100mm	7.3x5.5mm	20.8um	2.45mm	0.06	9.6	0.00007%		
	1.3x	95.9mm	6.8x5.1mm	18.2um	2.18mm	0.06	10.2	0.0008%		

<sup>\*</sup>The resolution is the theoretical data at 550nm.

<sup>\*</sup>The field of view is specified at dispersive spot of  $40\mu m$  at imaging plane with 1/2" format sensor.



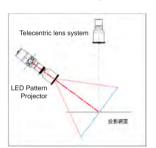


#### GCO - 2390 LED Pattern Projectors

GCO - 2390 series products are LED-based lighting pattern projection lens, for high-precision 3D measurement. It improved the light source of the triangulation test with the imaging lens not coaxial error brought by the test, can effectively improve the test precision.

- Its tilt adjustable lighting model can guarantee the projected target surface area is uniform lighting even if the target surface is not parallel with the lens face, this characteristic plays a vital role in calibration and testing;
- Configured with different reticle meet different resolutions and different projection pattern requirements, and can achieve projected reticle quickly replaced;
- Different high power LED light source are optional, suitable for the needs of the different color of light source, has a large luminous flux and lighting contrast
- C mount interface can be matched with telecentric lens to guarantee the projection pattern without distortion;

#### The core design





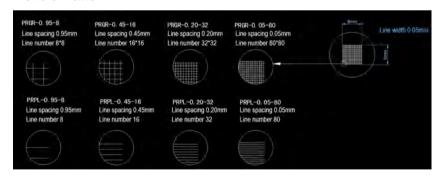
The projection pattern without tilt adjustment, pattern captured by the imaging system can only realize the good focus in center area.





The projection pattern after adjusting, pattern captured by the imaging system can realize good focus throughout the entire projection area.

#### Reticle Pattern



#### The projection principle and model choice:

In order to obtain undistorted projection target surface, C - mount interface of GCO - 2390 is suggested to be used with CDHC  $^{'}$  s double telecentric lens. According to the imaging system and the angle  $\,\theta\,$  of projection system, refer to recommended value in " reference table" to adjust the reticle knob on GCO-2390 series lens (Loosen the locking screw on the handwheel, then rotate the specified scale  $\,\varphi\,$ , after that lock the screw), you can get a clear undistorted projection target surface.

Table 1 Product series parameter

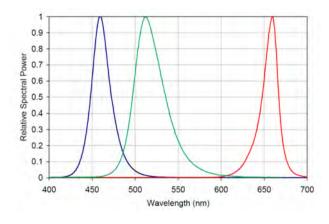
Name	Model	LED Wavelength	Aperture	Rated LED	LED Direct current	Reticle	Telecentric lens
ILPL	GCO-239001	660nm	120 lm	5W	2.8V		See
ILPL	GCO-239002	523nm	165 lm	5W	4.5V	All types of adaptation	reference
ILPL	GCO-239003	460nm	45 lm	5W	3.6V	5.5.5.p. 10.1.0.1	table

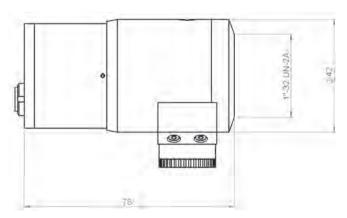
Table 2 Parameter of Annex

Reticle Model	Line gap (mm)	Line Qty	Line width (mm)	Reticle Size (mm)
PRPL-0.95-8	0.95	8	0.05	8x8
PRPL-0.45-16	0.45	16	0.05	8x8
PRPL-0.20-32	0.20	32	0.05	8x8
PRPL-0.05-80	0.05	80	0.05	8x8
PRGR-0.95-8	0.95	8	0.05	8x8
PRGR-0.45-16	0.45	16	0.05	8x8
PRGR-0.20-32	0.20	32	0.05	8x8
PRGR-0.05-80	0.05	80	0.05	8x8

Table 3 Projection telecentric lens reference table

	Projection		θ <b>=0</b> °		θ =15	0	θ =30	ō	θ =45	0
	length (mm)	Magnificant	H: LxW (mm)	Ø	H: LxW (mm)	Ø	H: LxW (mm)	Ø	H: LxW (mm)	Ø
GCO-232104	142.5	0.22X	36.4x36.4	0°	36.4x37.7	3.3°	36.4x42.0	6.6°	36.4x51.5	9.9°
GCO-232103	142.5	0.32X	25.0x25.0	0°	25.0x25.9	4.8°	25.0x28.9	9.6°	25.0x35.4	14.4°
GCO-232204	62.5	0.44X	18.2x18.2	0°	18.2x18.8	6.6°	18.2x21.0	13.2°	18.2x25.7	19.8°
GCO-232203	62.5	0.64X	12.5x12.5	0°	12.5x12.9	9.6°	12.5x14.4	19.2°	12.5x17.7	28.8°









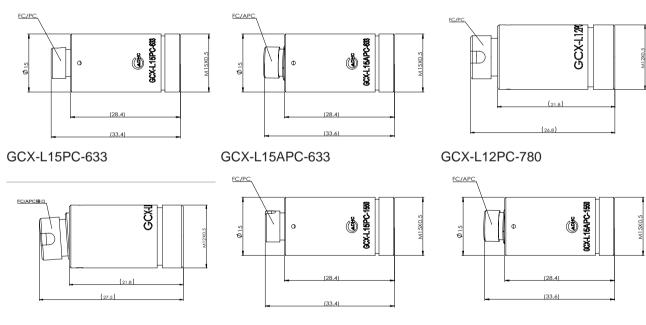
**GCX** 

#### **GCX Fixed Focus Fiber Optic Collimators**

Triple fiber optic collimators provide the better collimation, smaller spherical aberration, smaller wavefront and smaller angle divergence than double lenses and aspheric lenses. Its wavefront is less than 1/8 lambda. Its benefit is the M2 factor is close to 1 (Gauss beam).

- Broadband antireflective coating at 630nm, 660nm, 780nm & 1550nm
- Available focal length: 6mm, 12mm & 15mm
- Full-angle divergence <=0.12°</li>
- Fiber interface type FC/PC or FC/APC
- Exquisite stainless steel case
- Damage Threshold: 10J/cm2 (10ns 10Hz 1064nm)

We will calibrate the optical collimation for each one, and test the quality of the collimating beam by M2-200S-FW@spiriconM2. The M2 factor should be less than 1.3.



GCX-L12APC-780

GCX-L15PC-1550

GCX-L15APC-1550

#### GCX Fixed Focus Fiber Optic Collimators

	GCX-	GCX-	GCX-	GCX-	GCX-	GCX-
	L15PC-633	L15APC-633	L12PC-780	L12APC-780	L15PC-1550	L15APC-1550
Alignment Wavelength(nm)	633	633	780	780	1550	1550
Coating Wavelength(nm)	350-650	350-650	650-1050	650-1050	1050-1550	1050-1550
Waist Diameter (1/e²) mm	3	3	2.66	2.66	3.75	3.75
Fiber interface type	FC/PC	FC/APC	FC/PC	FC/APC	FC/PC	FC/APC
Full-angle Divergence	0.016	0.016	0.021	0.021	0.038	0.038
Focal Length (mm)	15	15	12.32	12.32	15	15
NA	0.14	0.14	0.14	0.14	0.14	0.14
Length (mm)	33.4	33.6	26.8	27.5	33.6	33.6
Diameter (mm)	15	15	12	12	15	15





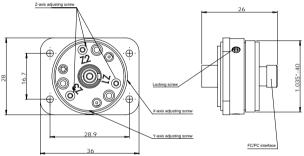
GCX-M010FC

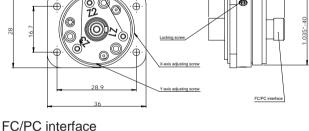
#### **GCX-C Fiber Couplers**

The series of fiber couplers are compact, cleverly designed and capable of precise five-dimensional adjustment in very small Spaces. It can be aligned with five degrees of freedom: linear alignment of the lens in X and Y, angular alignment for tip and tilt, and Z adjustment using the tip and tilt controls simultaneously. the travel range of the aspheric lens in the X and Y direction is  $\pm 0.5$  mm, the angular alignment range is  $\pm 4^{\circ}$ , the travel range in the Z direction is more than 2 mm. The couplers also have high coupling efficiency (70%) and good stability (<5%@72h).

- Broadband AR coating at 405nm, 532nm, 780nm & 1550nm
- Available focal length: 6mm, 15mm, 18mm
- Fiber interface type: FC/PC, FC/APC, SMA
- Exquisite stainless steel case

We will adjust the fiber couplers separately for each storage part, but due to the user's diverse beam conditions, the user needs to adjust again when using it to obtain the best coupling effect. The coupling efficiency and stability of the fiber couplers are closely related to the final state.





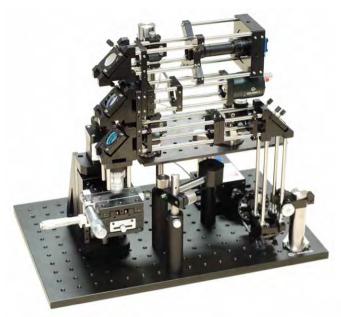
FC/APC interface

**GCX-C Fiber Couplers** 

Part No.	Focal Length	NA	Clear Aperture	Coating	Interface	Dimension
GCX-C6APC-A	6.7	0.5	5mm	AR400nm-650nm	FC/APC	36x28x22
GCX-C6PC-A	6.7	0.5	5mm	AR400nm-650nm	FC/PC	36x28x21.8
GCX-C6SMA-A	6.7	0.5	5mm	AR400nm-650nm	SMA	36x28x25.4
GCX-C18APC-A	18.4	0.15	5.5mm	AR400nm-650nm	FC/APC	36x28x26
GCX-C18PC-A	18.4	0.15	5.5mm	AR400nm-650nm	FC/PC	36x28x26
GCX-C18SMA-A	18.4	0.15	5.5mm	AR400nm-650nm	SMA	36x28x26
GCX-C18APC-B	18.4	0.15	5.5mm	AR600-1050nm	FC/APC	36x28x26
GCX-C18PC-B	18.4	0.15	5.5mm	AR600-1050nm	FC/PC	36x28x26
GCX-C18SMA-B	18.4	0.15	5.5mm	AR600-1050nm	SMA	36x28x26
GCX-C15APC-C	15.4	0.16	5.5mm	AR1050-1600nm	FC/APC	36x28x23
GCX-C15PC-C	15.4	0.16	5.5mm	AR1050-1600nm	FC/PC	36x28x23
GCX-C15SMA-C	15.4	0.16	5.5mm	AR1050-1600nm	SMA	36x28x23



# **GCT Cage System**



An optical cage system uses four rigid steel rods to mount optical components along a common optical axis. Cage systems are available with 30 mm and 60 mm standard systems. Daheng Optics provides an extensive selection of accessories for the optical cage system as well as adapters that allow the user to switch back and forth between the two different cage standards offered.





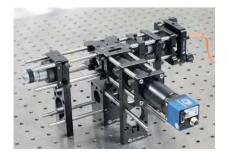












GCT-06010 Varia	able Neutral	Density I	Filter Wheel	 .126
GCT-L010 Moun	ted Lenses .			 .127





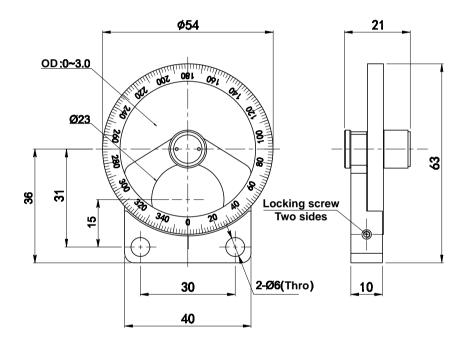
#### GCT-06010 Variable Neutral Density Filter Wheel

This series of variable neutral density filters are used in 30mm cage system and can be rotated with 360°. Because of the absorption characteristics of the coating, it can only be used for the laser system with lower power.





Application



GCT-060101

#### GCT-06010 Variable Neutral Density Filter Wheel

Part No.	OD	Application Wavelength
GCT-060101	OD: 0-3.0	400-1600nm

#### **GCT-L010 Mounted Lenses**



The centration of mounted lenses has been adjusted and fixed, less than 0.04mm. The diameter of mounted lenses is 30mm. They can be used together with GCT-030130, GCT-080315 and GCT-02011 series mounts.

GCT-L010

#### Mounted N-BK7 Plano-Convex Lenses

Part No.	Lens Shape	EFL(mm)	Thickness(mm)	Lens Part No.
GCT-L010158	Mounted N-BK7 Plano-Convex Lenses	30.0	15	GCL-010158
GCT-L010109	Mounted N-BK7 Plano-Convex Lenses	50.8	15	GCL-010109
GCT-L010110	Mounted N-BK7 Plano-Convex Lenses	75.0	10	GCL-010110
GCT-L010111	Mounted N-BK7 Plano-Convex Lenses	100.0	10	GCL-010111
GCT-L010164	Mounted N-BK7 Plano-Convex Lenses	125.0	10	GCL-010164
GCT-L010112	Mounted N-BK7 Plano-Convex Lenses	150.0	10	GCL-010112
GCT-L010154	Mounted N-BK7 Plano-Convex Lenses	200.0	10	GCL-010154

#### Mounted UV Fused Silica Plano-Convex Lenses

Part No.	Lens Shape	EFL(mm)	Thickness(mm)	Lens Part No.
GCT-L010819	Mounted UV Fused Silica Plano-Convex Lenses	30.0	15	GCL-010819
GCT-L010811	Mounted UV Fused Silica Plano-Convex Lenses	50.8	10	GCL-010811
GCT-L010812	Mounted UV Fused Silica Plano-Convex Lenses	75.0	10	GCL-010812
GCT-L010814	Mounted UV Fused Silica Plano-Convex Lenses	100.0	10	GCL-010814
GCT-L010815	Mounted UV Fused Silica Plano-Convex Lenses	150.0	10	GCL-010815
GCT-L010816	Mounted UV Fused Silica Plano-Convex Lenses	175.0	10	GCL-010816
GCT-L010817	Mounted UV Fused Silica Plano-Convex Lenses	200.0	10	GCL-010817
GCT-L010813	Mounted UV Fused Silica Plano-Convex Lenses	250.0	10	GCL-010813

#### Mounted Achromatic Lenses

Part No.	Lens Shape	EFL(mm)	Thickness(mm)	Lens Part No.
GCT-L010650	Mounted Achromatic Lenses	30.0	20	GCL-010650
GCT-L010652	Mounted Achromatic Lenses	50.0	20	GCL-010652
GCT-L010654	Mounted Achromatic Lenses	75.0	15	GCL-010654
GCT-L010604	Mounted Achromatic Lenses	100.0	15	GCL-010604
GCT-L010605	Mounted Achromatic Lenses	150.0	15	GCL-010605
GCT-L010606	Mounted Achromatic Lenses	200.0	15	GCL-010606

#### Mounted N-BK7 Plano-Concave Lenses

Part No.	Lens Shape	EFL(mm)	Thickness(mm)	Lens Part No.
GCT-L010328	Mounted N-BK7 Plano-Concave Lenses	-30	15	GCL-010328
GCT-L010329	Mounted N-BK7 Plano-Concave Lenses	-40	10	GCL-010329
GCT-L010305	Mounted N-BK7 Plano-Concave Lenses	-50.8	10	GCL-010305
GCT-L010306	Mounted N-BK7 Plano-Concave Lenses	-75	10	GCL-010306
GCT-L010307	Mounted N-BK7 Plano-Concave Lenses	-100	10	GCL-010307
GCT-L010308	Mounted N-BK7 Plano-Concave Lenses	-150	10	GCL-010308
GCT-L010330	Mounted N-BK7 Plano-Concave Lenses	-200	10	GCL-010330

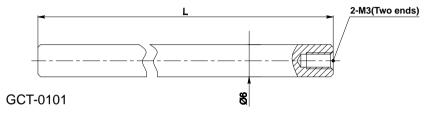
Cage System Construction Rods	129
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# GCT- 0101 Cage System Construction Rods



These cage rods are made from stainless steel. The two top ends of the rods are M3 threaded holes with a depth of 6 mm, which can be connected by GCT-540201 screw connector, and can be combined into the length required by the system.



GCT- 0101 Cage System Construction Rods

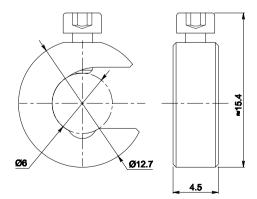
Specification
Ø6, L10mm
Ø6, L12mm
Ø6, L25mm
Ø6, L50mm
Ø6, L100mm
Ø6, L200mm
Ø6, L300mm
Ø6, L400mm



GCT-010201

## GCT-010201 Clamps

The semi-annular sliding clamp can be fastened to the 6mm rod, it is suitable for the system that need to be adjusted frequently. The semiannular design could be installed and removed quickly.



#### GCT-010201

#### GCT-010201 Clamps

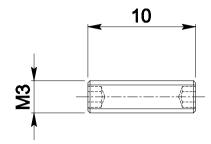
Part No.	Diameter of Mounting
GCT-010201	Ø6mm





#### GCT-540201 Screw Connector

GCT-540201 Screw Connector can be used to extend the length of cage rods or connect cage rod with other components of cage system.



GCT-540201

#### GCT-540201 Screw Connector

Part No.	Screw
GCT-540201	M3

GCT-540201



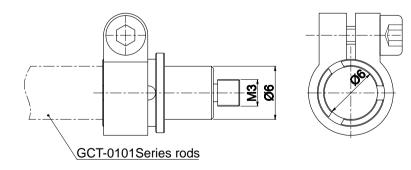
#### GCT-540101



Application

# GCT-540101 Rod Adapter

GCT-540101 Rod Adapter is a stud adapter that will allow any cage assembly to be easily separated when adding or removing components. The adapter has a M3 threaded head on one end that can be threaded into the end of other cage rods. There is a Ø6mm bore on the other side of adapter.



GCT-540101

#### GCT-540101 Rod Adapter

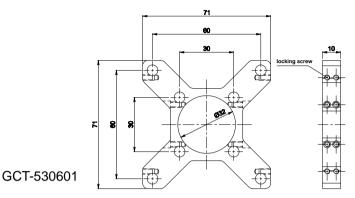
Part No.	Screwv
GCT-540101	M3



GCT-530601

## GCT-530601 30mm to 60mm Cage Plate Adapter

The GCT-530601 Cage Plate Adapter provides a convenient means for coupling 30mm and 60mm cage systems via our GCT-0101 rods.



#### GCT-530601 30mm to 60mm Cage Plate Adapter

Part No.	Dimension
GCT-530601	30mm to 60mm

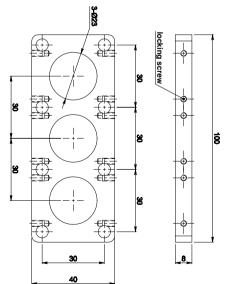
# GCT-530101 Cage Adapter Plate

GCT-530101 Cage Adapter Plate is the key component to connect two separate cage systems while maintain the parallelism of the optical axis



GCT-530101





GCT-530101

#### GCT-530101 Cage Adapter Plate

Part No.	Size
GCT-530101	100x40



# GCT-0201/0261 Post Mounts

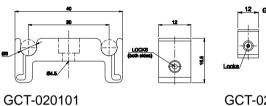
GCT-020101



GCT-026101

Post mounts are used to support the entire set of cage systems to the optical table. There are two kinds of mounts: GCT-020101/GCT-026101 bottom support mount and GCT-020102/GCT-026102 side support mount. Side support mount has the ability to hold the cage system both horizontally and vertically.

- Quick connect fixture for 30 mm and 60 mm cage systems
- Quickly insert and remove from cage systems
- GCT-020101 and GCT-026101 adopt flexible design
- Two support methods: bottom support and side support



GCT-026101



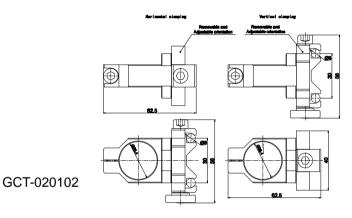
GCT-020102

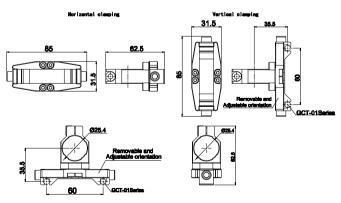


GCT-026102



GCT-0201/0261 Post Mounts





Part No.	Application System	Support Method
GCT-020101	30mm Cage System	Bottom
GCT-020102	30mm Cage System	Side
GCT-026101	60mm Cage System	Bottom
GCT-026102	60mm Cage System	Side

GCT-026102

Support Mounts	134
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GCT-020111



GCT-020115

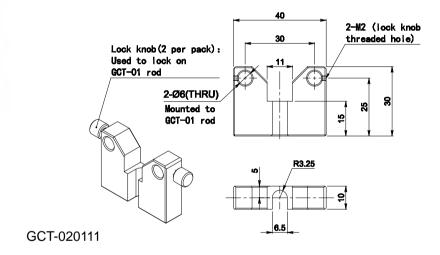
#### **GCT-02011 Support Mounts**

This series support mounts belongs to the bottom support device of the cage system structure. It uses for firmly connecting the standard support rods of 30mm pitch with a fixed center optical axis height and optical platform or other mounting planes.

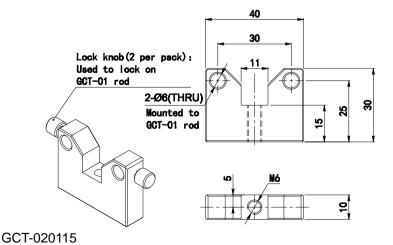
According to the height of each support mount, there will be different rows of Ø6mm holes for cage rods. The cage rods can be mounting on the optical installation plane with different center optical axis height. GCT-020112, GCT-020113 and GCT-020114 have Ø25mm or Ø30mm holes for mounting GCT-0310 series adapters, so that various components can be carried into the optical system.

The mounting holes of M6 screws are reserved at the support mount, which can be connected with the mounting surfaces of the platform.

#### GCT-020111 Foundation Support Mount

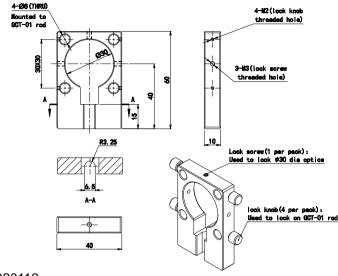


#### GCT-020115 Foundation Support Mount



# GCT-020112 Single-axis Support Mount

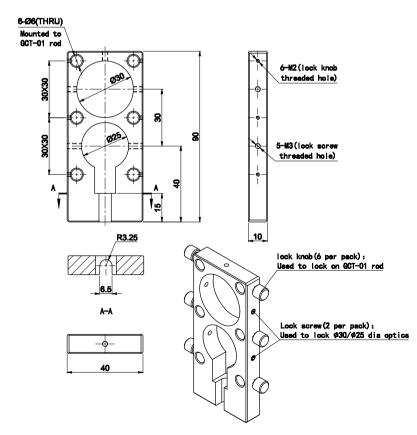




#### GCT-020112

# GCT-020113 Biaxial Support Mount





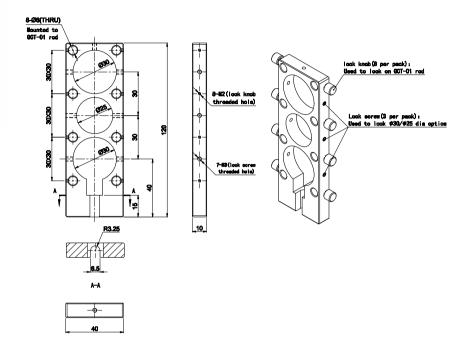
GCT-020113





GCT-020114

# GCT-020114 Three-axis Support Mount



GCT-020114

#### GCT-02011 Support Mounts

Dort No.	Description	Mounting Holes Dimension
Part No.	Description	Mounting Holes Dimension
GCT-020111	2 holes for cage rods	Ø6.5
GCT-020115	2 holes for cage rods	M6
GCT-020112	4 holes for cage rods	Ø6.5
GCT-020113	6 holes for cage rods	Ø6.5
GCT-020114	8 holes for cage rods	Ø6.5





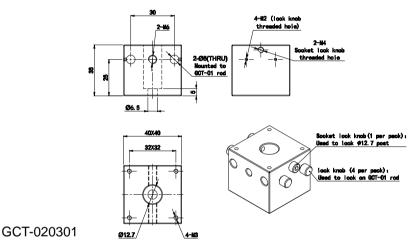
GCT-020301

# **GCT-0203 Support Mounts**

This series mounts belongs to the cross-border connecting device of the coaxial optical path system structure. It is used to install the special optical and optoelectronic components into the 30mm cage system.

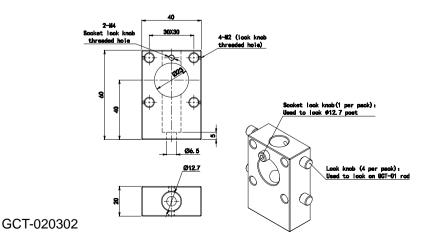
# GCT-020301 Turning Support Mount

Two Ø6mm holes are reserved for mounting cage rods. The upper surface has four M3 mounting threaded holes with spacing 32x32mm. There is a 30mm deep Ø12.7mm hole at the center of the upper surface. Small translation stages or conventional posts and their fixtures can be installed into the cage system.



# GCT-020302 Compatible Support Mount

There are four Ø6mm holes for mounting cage rods. One Ø12.7mm hole with a depth of 55mm is reserved at the center of the upper surface, so that the conventional post and its fixture can be installed into the cage system.





GCT-020302

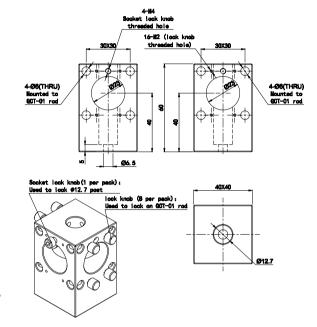




GCT-020303

# GCT-020303 Vertical Support Mount

There are eight Ø6mm holes for mounting cage rods. One Ø12.7mm hole with a depth of 55mm is reserved at the center of the upper surface, so that the conventional post and its fixture can be installed into the cage system.



# GCT-020303

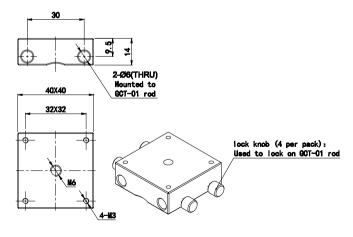
GCT-020304

# GCT-020304 Cage Rods Support Mount

There are two  $\Phi$ 6mm holes for mounting cage rods. The upper surface has four M3 mounting threaded holes with spacing 32x32mm. There is a M6 thread hole at the center of the upper surface. Small translation stages or conventional posts and their fixtures can be installed into the cage system.



GCT-020304



### **GCT-0203 Support Mounts**

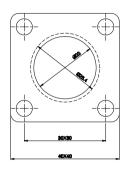
• •		
Part No.	Size	Center Hole Size
GCT-020301	40x40x35	Ø12.7x30
GCT-020302	40x20x60	Ø12.7x55
GCT-020303	40x40x60	Ø12.7x55
GCT-020304	40x40x14	M6

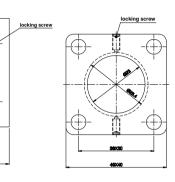
# GCT-0801/02 Optic Locking Mounts

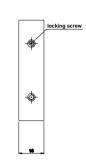
Daheng Optics offers optic locking mounts that designed for our 30mm cage system. They are ideal for holding Ø25.4mm optical components.











Application

GCT-080104 GCT-080204

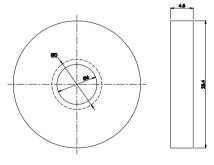
# GCT-0801/02 Optic Locking Mounts

Part No.	Holding Diameter ØD	Holding Thickness	Locking Type
GCT-080104	25.4mm	≤7mm	1.035"-40 Retaining Ring
GCT-080204	25.4mm	≥3mm	Locking Screw

# GCT-08021 Optic Retaining Rings



- Matching with any Ø25.4mm mounts
- Various holding diameter available
- Compatible with 30mm cage system
- Easy to exchange



GCT-080204

### GCT-08021

# GCT-08021 Optic Retaining Rings

Part No.	ØD	Ød	Edge Thickness of Clamping Lens
GCT-080210	6	5	≤2.2
GCT-080211	10	8	≤2.2
GCT-080212	12.7	10.5	≤2.2
GCT-080213	20	19	≤2.5

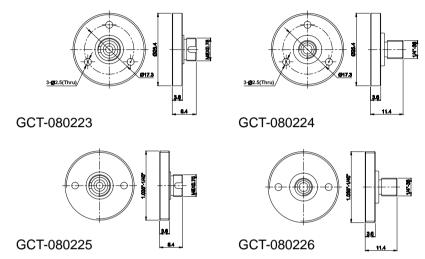




GCT-0802

# GCT-0802 Fiber Interface Adapter

- · Standard fiber interface adapter with precise alignment;
- Two external connection modes can be used with any Ø25.4 mounts;
- FC/PC and SMA905 interfaces available;



# GCT-0802 Fiber Interface Adapter

Part No.	D	Interface	L
GCT-080223	Ø25.4	FC/PC	8.4
GCT-080224	Ø25.4	SMA905	11.4
GCT-080225	1.035"-40	FC/PC	8.4
GCT-080226	1.035"-40	SMA905	11.4



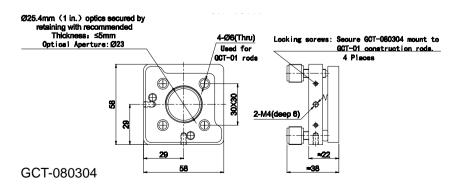
GCT-080304



Application

# **GCT-0803 Kinematic Mounts**

GCT-0803 kinematic mounts are designed for easy integration into the 30mm cage system. They are ideal for holding Ø25.4mm optical components. Both the front and rear plates have been machined with four clearance holes matched for GCT-01 cage rods. In addition to 30 mm cage compatibility, the GCT-0803 is post mountable via M4 tapped hole.



### GCT-0803 Kinematic Mounts

Part No.	Holding Diameter ØD	Tilt	Holding Thickness	Locking Type
GCT-080304	25.4mm	$\pm3^\circ$	≤5mm	1.035"-40 Retaining Ring

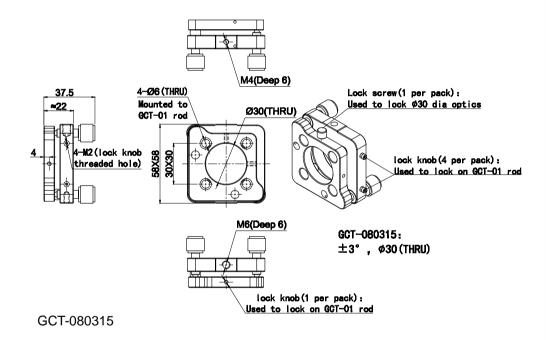


GCT-080315

### GCT-080315 Kinematic Mounts

Daheng Optics offers 30mm cage compatible kinematic mounts that are designed for easy integration into our cage assembly system. They are ideal for holding our GCT-L010 mounted lenses, GCT-031 and GCT-032 series accessories, enabling precise angular alignment of a beam along the axis of a 30 mm cage system. Four clearance holes matched for GCT-01 cage rods. In addition to 30 mm cage compatibility, the GCT-080315 is post mountable via M4 tapped hole.

- ±3° Tilt
- Accept Ø30mm Optics
- Compatible with 30 mm Cage System



### GCT-080315 Kinematic Mounts

Part No.	Holding Diameter	Tilt
GCT-080315	Ø30mm	±3°



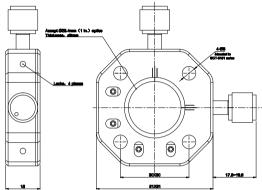


GCT-0804

### GCT-0804 XY Translation Mounts

The GCT-0804 XY Translator provides  $\pm 1$  mm of travel perpendicular to the optical axis of a 30 mm cage system. They accept Ø25.4mm optics up to 9mm thick.

The translation mount also features four Ø6mm through holes for use with our GCT-01 cage rods.



GCT-080404

### GCT-0804 XY Translation Mounts

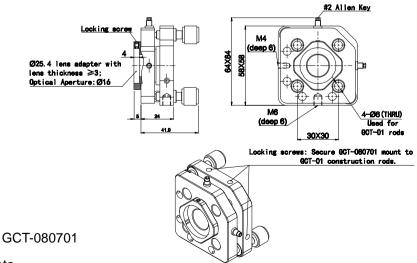
Part No.	Holding Diameter ØD	Travel	Holding Thickness	Locking Type
GCT-080404	25.4mm	$\pm1$ mm	≤9mm	1.035"-40 Retaining Ring

# GCT-0807 4-Axis Kinematic Mounts



GCT-0807

The GCT-0807 4-Axis kinematic mount offers an optic cell that can be adjusted along 4 axes (pitch, yaw and XY). The translating cell has threading for attaching Ø25.4mm optics. The mount also features four Ø6mm through holes for use with our GCT-01 cage rods. In addition to 30 mm cage compatibility, the GCT-0807 is post mountable via M6 tapped hole.



### GCT-0807 4-Axis Kinematic Mounts

P	art No. Hold	ling Diameter ØD	Pitch/Yaw	Travel	Locking Type
GC	Γ-080701	25.4mm	$\pm$ 4 $^{\circ}$	±1mm	Locking Screw

# GCT-0805 Quick Release Cage Mounts

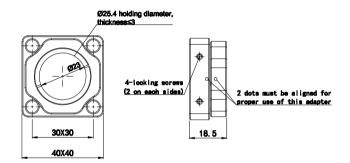


GCT-080501



The GCT-080501 consists of a back plate compatible with the 30 mm cage system and a mounting carriage that is magnetically coupled with pairs of magnets to the back plate. The mounting carriage can be easily inserted or removed from the cage system by separating it from the back plate, rotating it sideways, and then extracting it from the cage. The retaining ring allows optical components up to 3mm thick to be secured in the mounting carriage.

- \* 30mm cage system Compatible
- Magnetically Coupled Mounting Carriage
- Easy Placement and Removal of Ø25.4mm Optic up to 3mm Thick
- Retaining Ring Included



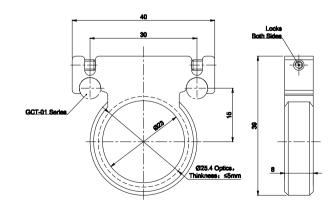


GCT-080504



Application

The GCT-080504 allows Ø25.4mm optics to be easily inserted into or removed from an assembled 30 mm cage structure.



### GCT-080504

GCT-080501

# GCT-0805 Quick Release Cage Mounts

Part No.	Holding Diameter ØD	Holding Thickness	Locking Type
GCT-080501	25.4mm	≤3mm	1.035"-40 Retaining Ring
GCT-080504	25.4mm	≤3mm	1.035"-40 Retaining Ring





GCT-080604

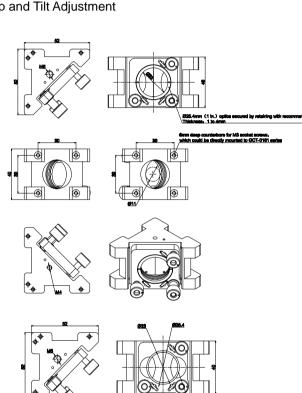
# GCT-0806 Right-Angle Kinematic Mirror Mounts

The GCT-0806 right-angle mount provides pitch and yaw adjustment for Ø25.4 mm optic held in a mounting plate whose nominal horizontal position is at a 45° angle. The ports are equipped with four M3 6.0mm deep smooth bore holes spaced to mate with our 30 mm cage system standard.

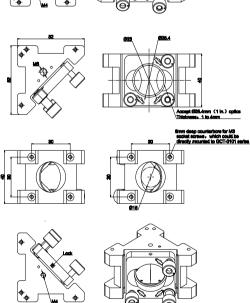
- Mounts Ø25.4mm Optics at a 45° Angle to the Optical Axis
- $\bullet \pm 3^{\circ}$  Kinematic Tip and Tilt Adjustment



Application



### GCT-080604



GCT-080614

# GCT-0806 Right-Angle Kinematic Mirror Mounts

Part No.	Holding Diameter ØD	Tilt	Holding Thickness	Locking Type
GCT-080604	25.4mm	$\pm3^{\circ}$	≤4mm	1.035"-40 Retaining Ring
GCT-080614	25.4mm	±3°	≥3mm	Locking Screw

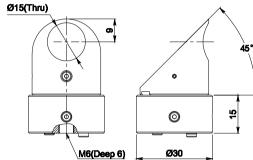


GCT-080605 Right-Angle Kinematic Mounts

GCT-080605

# GCT-080605 Right-Angle Kinematic Mounts

The GCT-080605 Right-Angle Kinematic Mount secures the optic within a 30 mm cage system at a  $45^{\circ}$  angle to the optical axis. The mount provides  $\pm\,3^{\circ}$  of kinematic pitch and yaw adjustment. The pitch and yaw axes are actuated using two adjustment screws are positioned on the bottom. The mount can be used together with GCT-0201 and GCT-030130. In addition to 30 mm cage compatibility, the GCT-080605 is post mountable via M6 tapped hole.



GCT-080605

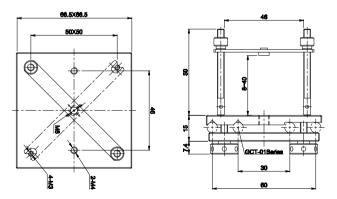
Part No.	Tilt	Locking Type
GCT-080605	$\pm 3^{\circ}$	Bonding

# GCT-066203 Prism Mounts



GCT-066203

The GCT-066203 Prism Mount is compatible with both 30mm and 60mm cage systems. The mount securely holds optics ranging in size from 8mm up to 40 mm thick. The top plate with anti-friction plastic block allows for quick height adjustment for varying sized optics. In addition, the GCT-066203 is post mountable via M4 and M6 tapped holes.



GCT-066203

### GCT-066203 Prism Mounts

Part No.	Holding Thickness
GCT-066203	8-40

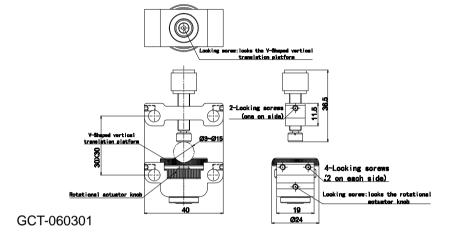




GCT-060301

# GCT-060301 V-Clamp

- \* 30mm Cage System Compatible
- Consists of Fasten knob and V-groove Lab Jack Rotation Stage
- Mounts Optics Ranging from Ø3mm to Ø15mm

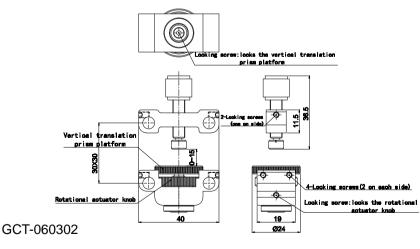


# GCT-060301 V-Clamp

Part No.	Holding Dimension
GCT-060301	Ø3-13

# GCT-060302: Prism Mounts

- \* 30mm Cage System Compatible
- Consists of Fasten knob and Lab Jack Rotation Stage
- Mounts Optics Ranging from 0 to 15mm



### GCT-060302: Prism Mounts

Part No.	Holding Dimension
GCT-060302	0-15



GCT-060302



Application

GCT-090101



Application



GCT-090111

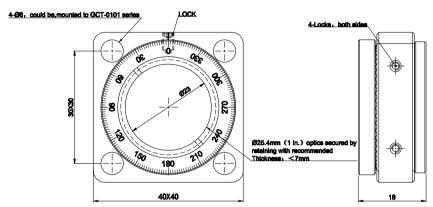


Application

### GCT-0901 Rotation Mounts

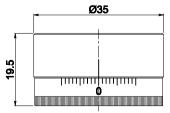
The GCT-090101 and GCT-090111 have a smooth rotation mechanism that allows for precise positioning of the rotation carriage and mounts are compatible with the 30 mm cage system. The GCT-090101 is designed to mount Ø25.4mm optics up to 7mm thick. For thicker optics, the GCT-090111 can be used instead. But unlike the GCT-090101, GCT-090111 can not be used alone in cage systems. They can be used with GCT-030135 cage fixing plate.

- Accepts Ø25.4 mm Optics
- 360° Coarse Rotation
- Precise Positioning of Wave Plates and Polarizers



GCT-090101





GCT-090111

### GCT-0901 Rotation Mounts

Part No	. Holding Diameter	Holding Thickness	Locking Type
GCT-090	101 25.4mm	≤7mm	1.035"-40 Retaining Ring
GCT-090	111 25.4mm	≤11mm	1.035"-40 Retaining Ring



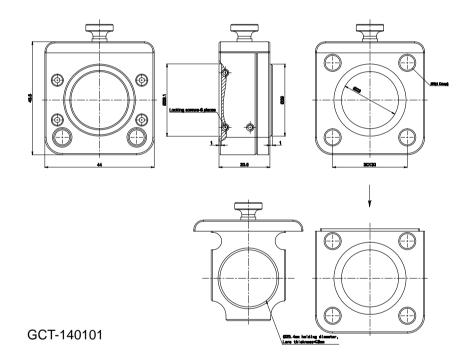


GCT-140101

### GCT-140101 Lens/Filter Mounts

The GCT-140101 lens/filter mount is suitable for 30mm cage system and is divided into two parts: the lens/filter holder and the base. The four \$\phi\$ 6mm through holes of the base can be fixed in the cage system with the GCT-01 series pots. The lenses and filters can be easily inserted or removed from the cage system. This lens/filter mount can hold two lenses or filters at the same time. The design of this embedded cooperation not only realizes overlapping use, but also reduces side stray light convergence.

NOTE: The upper two \$\phi\$ 6mm holes of the base are blind holes with a depth of 4mm and another two \$\phi\$ 6mm holes are through holes.



### GCT-140101 Lens/Filter Mounts

Part No.	Holding Diameter	Holding Thickness	Locking Type
GCT-140101	25.4mm	≤8mm	1.035-40 Retaining Ring

# GCT-570101 Iris Diaphragm

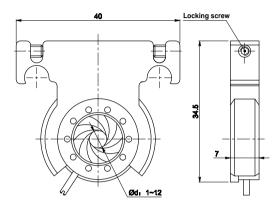


- \* 30mm Cage System Compatible
- Aperture Variation Ranging from Ø1mm to Ø12mm
- Easy Placement and Removal Within Cage System





Application



GCT-570101

### GCT-570101 Iris Diaphragm

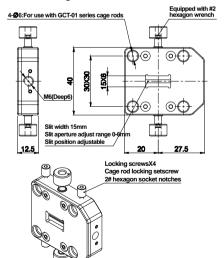
Part No.	Aperture Range	Installation Mode
GCT-570101	Ø1-12mm	Flexible snap in with fastening screw

# GCT-560201 Cage System Adjustable Slit



GCT-560201

The GCT-560201 has been machined with four clearance holes matched for GCT-01 cage rods. In addition to 30 mm cage compatibility, the GCT-560201 is post mountable via M6 tapped hole. Adjustment range of slit width is 0-6mm, and the slit length is 15mm.



GCT-560201

# GCT-560201 Cage System Adjustable Slit

Part No.	Slit Dimension
GCT-560201	15x0 ~ 15x6

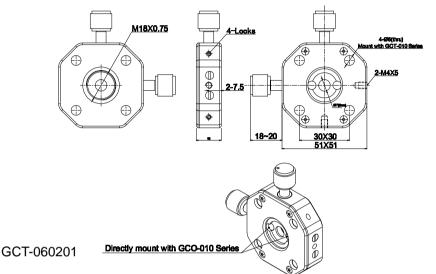




GCT-060201

# GCT-060201 Pinhole Mounts

Daheng Optics offers the GCT-060201 to mount the GCO-010 series pinhole in a 30mm cage system. The pinhole is magnetically coupled with pairs of magnets to the mounts and can be easily inserted or removed from the mounts. The GCT-060201 provides  $\pm 1$  mm of travel perpendicular to the optical axis of a 30 mm cage system.



Application

### GCT-060201 Pinhole Mounts

Part No.	Adjustment Direction	Travel
GCT-060201	X-Y	±1



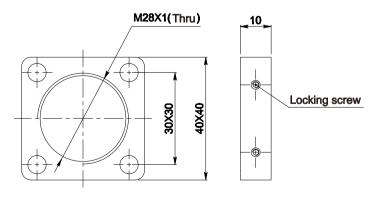
GCT-180101



Application

# GCT-180101 LED Mounts

Daheng Optics offers the GCT-180101 to mount the GCI-0604 series LED light sources in a 30mm cage system.



GCT-180101

### GCT-180101 LED Mounts

Part No.	Holding Dimension
GCT-180101	M28x1

Accept the diameter of optics less than Ø36mm

# 30mm Cage System



GCT-T13M

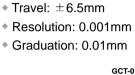
# GCT-T13M Translation Stage and Accessories

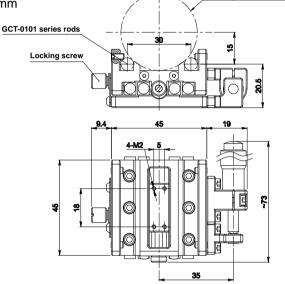
The GCT-T13M Translator is designed to be used in 30 mm cage systems that require translation along the optical axis of the cage. Precision crossed roller bearings are used to ensure smooth, high-resolution motion. The graduated micrometer provides 12.7mm of linear translation and has 0.01mm graduations.

The GCT-T13M Translator should be used together with GCT-T13M01 optic mount in 30 mm cage systems.



GCT-T13M01



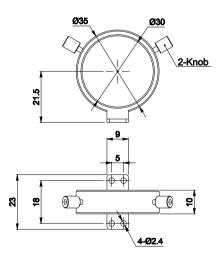


Application

GCT-T13M



Application



GCT-T13M01

### GCT-T13M Translation Stage and Accessories

Part No.	Part Name	Specification
GCT-T13M	Translator	Travel $\pm$ 6.5mm
GCT-T13M01	Optic Mount	Ø30mm



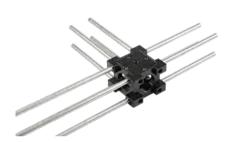
# GCT-070101 Cage Cube for Beamsplitter Cubes

Daheng Optics' GCT-070101 Cage Cube is designed to hold 25.4mm beamsplitter cube in the center. This cube consists of a kinematic base with four Ø23mm threaded ports surrounded by four M3 tapped holes for compatibility with 30 mm cage systems.

GCT-070111 Cage Cube Adapter is designed to hold 12.7mm beamsplitter cube in the center, so that it can be converted into a cube with size of 25.4mm. It is easy to be assembly in the 30 mm cage systems.



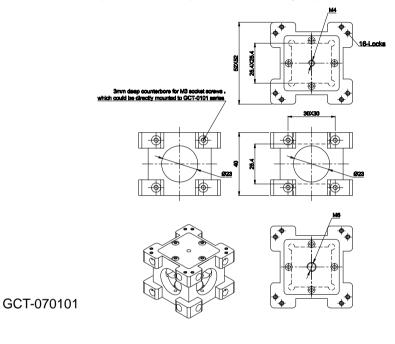
GCT-070101

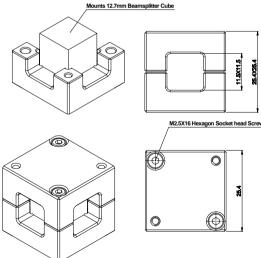


应用实例



GCT-070111





### GCT-070111

### GCT-070101 Cage Cube for Beamsplitter cubes

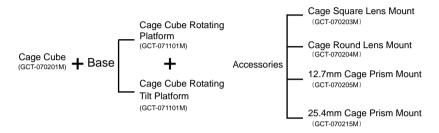
Part No.	Part Name	Holding Cube Size
GCT-070101	Cage Cube	25.4x25.4x25.4mm
GCT-070111	Cage Cube Adapter	12.7x12.7x12.7mm

# CAGE CUBE

# GCT-0702 Cage Cube Combination Unit

The GCT-0702 Cage Cube Combination Unit structure is mainly used for 30mm cage system when the optical path changes 90°. It is composed of three parts: cage cube, base and accessories.

This series of products can not be used alone. It needs three products to be combined into one unit and used in 30mm cage system.

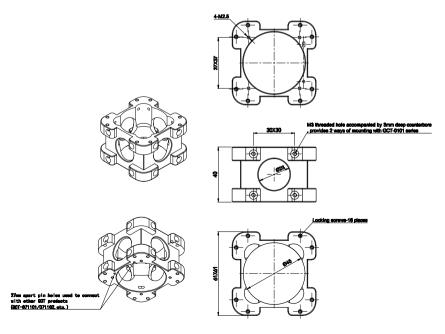




# GCT-070201 Cage Cube

GCT-070201 Cage Cube assembled with GCT-071101, a Cage Cube Rotating Platform or GCT-071102, a Cage Cube Rotating Tilt Platform, which can be used in 30mm cage system as a unit. Users can also choose more accessories according to their application.

Assembly: Aligning locating Pin holes of each items and tighten with screws.



GCT-070201



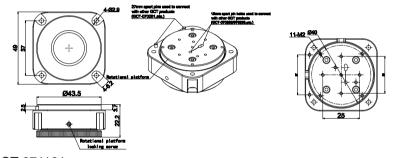


GCT-071101

# GCT-071101 Cage Cube Rotating Platform

GCT-071101 Cage Cube Rotating Platform is the base of the cage cube. Cage cubes (GCT-070201) and accessories (GCT-070202 to GCT-070205 and GCT-070215) can do 360° rotation through the base. The rotating platform is lockable. Eleven M2-threaded holes and two positioning holes provided on the stage platform, can match the positioning pins of the accessories.

Note: This series of products cannot be used alone. It should be used together with GCT-070201~070205 or GCT-070215.

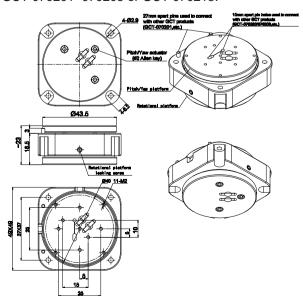


GCT-071101

# GCT-071102 Cage Cube Rotating Tilt Platform

GCT-071101 Cage Cube Rotating Tilt Platform is the base of the cage cube. Cage cubes (GCT-070201) and accessories (GCT-070202 to GCT-070205 and GCT-070215) can do  $360^{\circ}$  rotation and  $\pm 4^{\circ}$  tilt adjustment through the base. The rotation stage is lockable. Eleven M2-threaded holes and two positioning holes provided on the stage platform, can match the positioning pins of the accessories.

Note: This series of products cannot be used alone. It should be used together with GCT-070201~070205 or GCT-070215.





GCT-071102

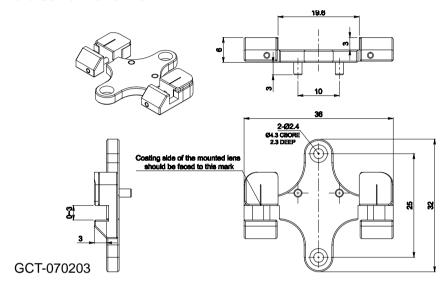
GCT-071102



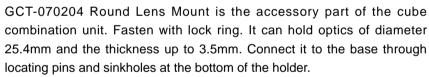
GCT-070203

# GCT-070203 Cage Square Lens Mount

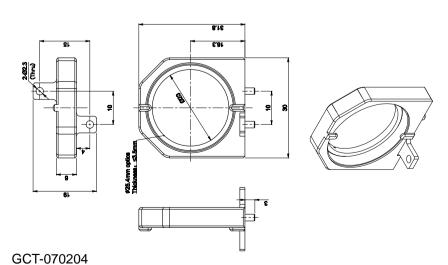
GCT-070203 Square Lens Mount is the accessory part of the cube combination unit, which is mainly used for clamping square lenses. The thickness of the lens that can be clamped needs to be less than 3mm. This product cannot be used alone. It should be used together with GCT-070201 and GCT-071101/071102.



# GCT-070204 Cage Round Lens Mount



Note: This product can't be used alone. It should be used together with GCT-070201, GCT-071101 and GCT-071102.





GCT-070204





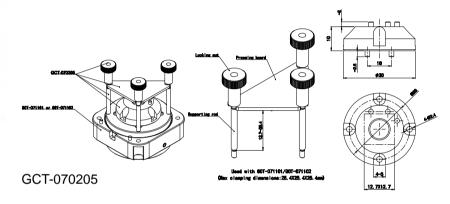


# GCT-070205 Cage Prism Mount

GCT-070205 is the accessory of cube combination unit. It can hold a prism with dimension of  $12.7mm \times 12.7mm \times 12.7mm$ .

Assembly: Screw the three posts into the base (GCT-071101/GCT-071102). Put and stick the prism onto the three 2mm locating pins to ensure it is in the center of the holder. Use the screw nuts that are on the upper end of the plate to compress the prism tightly. Connect it with the base/stage through location pins and sinkholes at the bottom of the holder.

Note: This product can't be used alone. It should be used together with GCT-070201, GCT-071101 and GCT-071102.



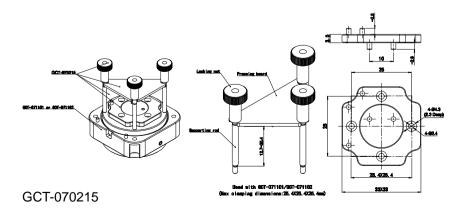
# GCT-070215 Cage Prism Mount

GCT-070215 is the accessory of cube combination unit. It can hold a prism with dimension of 25.4mm  $\times$  25.4mm.

Assembly: Screw the three posts into the base (GCT-071101/GCT-071102). Put and stick the prism onto the three 2mm locating pins to ensure it is in the center of the holder. Use the screw nuts that are on the upper end of the plate to compress the prism tightly. Connect it with the base/stage through location pins and sinkholes at the bottom of the holder.

Note: This product can to be used alone. It should be used together with GCT-070201, GCT-071101 and GCT-071102.





# GCT-0702 Cage Cube Combination Unit

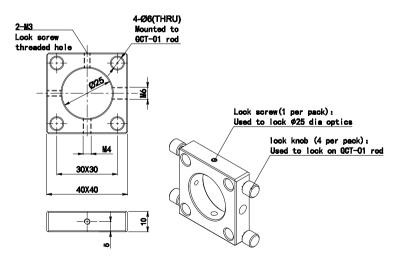
Part No.	Item Name	Application
GCT-070201	Cage Cube	Fix the cube combination unit into a 30mm cage system
GCT-071101	Cage Cube Rotating Platform	The base of the cage cube. Cage cube (GCT-070201) and accessories (GCT-070202 to GCT-070205 and GCT-070215) can do 360° rotation through the base
GCT-071102	Cage Cube Rotating Tilt Platform	The base of the cage cube. Cage cube (GCT-070201) and accessories (GCT-070202 to GCT-070205 and GCT-070215) can do $360^{\circ}$ rotation and $\pm 4^{\circ}$ tilt adjustment through the base.
GCT-070203	Cage Square Lens Mount	GCT-070203 should be used together with GCT-071101 or GCT-071102. They can hold square optics which thickness are less than 3 mm and wide are less than 4mm.
GCT-070204	Cage Round Lens Mount	GCT-070204 should be used together with GCT-071101 or GCT-071102. They can hold round optics with diameter 25.4mm. The thickness of mounting optics should be less than 3.5mm.
GCT-070205	Cage Prism Mount	GCT-070205 should be used together with GCT-071101 or GCT-071102. They can hold prisms with height 12.7mm
GCT-070215	Cage Prism Mount	GCT-070215 should be used together with GCT-071101 or GCT-071102. They can hold prisms with height 25.4mm



GCT-0301

# GCT-0301 Cage Plates

The GCT-0301 cage plate is compatible with our GCT-L010 mounted lens, GCT-031 and GCT-032 series accessories. Each cage rod through hole is accompanied by a side-located locking setscrew.



GCT-0301

# GCT-0301 Cage Plates

Part No.	ØD
GCT-030125	25mm
GCT-030130	30mm
GCT-030135	35mm





GCT-031001



T-03100

GCT-031001



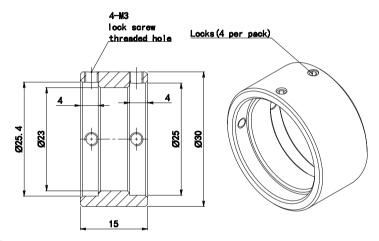
GCT-031002

### GCT-031 Accessories

This series of accessories cannot be used in cage system alone. It should be used together with GCT-080315 Kinematic Mount or GCT-0301 cage plate to achieve various functions.

# GCT-031001 Optic Mount

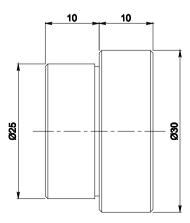
The GCT-031001 is a fixed Optics mount designed to be used with Ø25.4mm or Ø25.0mm lenses. The optic is held in place by four nylontipped set screws. The outer diameter of mount is Ø30mm and the clear aperture is Ø23mm.



GCT-031001

# GCT-031002 End Cap

GCT-031002 is black-anodized aluminum end cap used to block beam in the light path. It has two installation dimensions, one side outer diameter is 25mm and the other side outer diameter is 30mm.



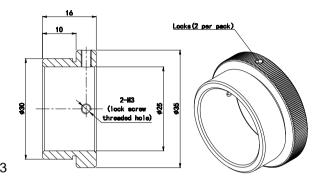
GCT-031002



GCT-031003

# GCT-031003 30/25 Adapter

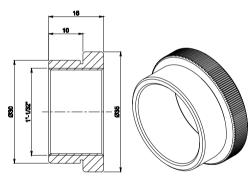
The GCT-031003 is fixed adapter that allow cylindrical components with diameter 25mm to be mounted to the 30mm cage system.



GCT-031003

# GCT-031004 C-Mount Adapter

The internal thread is a standard C-mount 1"-1/32", which can be used to screw the components of the standard C interface. The outer diameter is 30mm.



GCT-031004



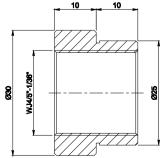
GCT-031004



GCT-031005

# GCT-031005 Threading Adapter

GCT-031005 is fixed adapter that allow threaded WJ4/5"-1/36" components to be mounted to our GCT-0201, GCT-030130 and GCT-080315 optic mounts.



GCT-031005

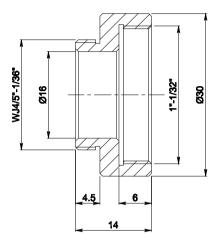




GCT-031006

# GCT-031006 Threading /C-Mount Adapter

The internal thread is the standard C-mount 1"-1/32", the outside thread is the standard objective thread WJ4/5"-1/36", which can connect the objective lens and C interface, the clear aperture is Ø16mm.



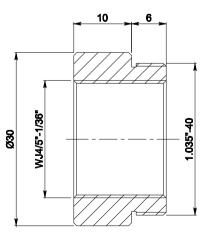
GCT-031006



GCT-031007

# GCT-031007 Threading Adapter

The internal thread is a standard objective thread WJ4/5"-1/36", which can be screwed directly into the objective lens. It has two mounting sizes, one end outer diameter 30mm, can be used with GCT-0201 series mount and GCT-030130 mount or GCT-080315 lens/mirror holder. The other end is with external thread 1.035"-40, can be screwed on any mount such as GCT -080404, GCT-080304, etc. with a 1.035"-40 threaded ring-type cage system.



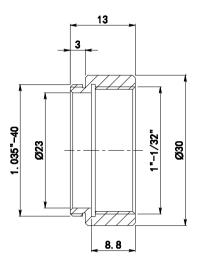
GCT-031007



GCT-031009

# GCT-031009 1.035"-40 External Adapter

The internal thread is standard 1"-1/32" C interface thread, the other end external thread is 1.035-40 can be connected with any mount or adapter with internal thread of 1.035"-40. Such as GCT-080404, GCT-080304, etc. The outer diameter is 30mm, which can be used with GCT-0201 series mount and GCT-030130 mount or GCT-080315 lens/mirror holder.



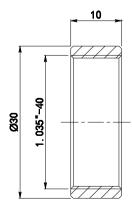
GCT-031009

# GCT-031010 1.035"-40 Internal Adapter



GCT-031010

The internal thread of GCT-031010 is 1.035"-40 and it is compatible with all external 1.035"-40 threaded components. The outer diameter is 30mm. It can be used with GCT-0201 series mount and GCT-030130 mount or GCT-080315 lens/mirror holder.



GCT-031010

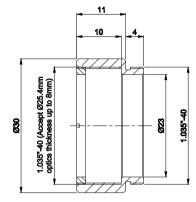




GCT-031011

# GCT-031011 1.035"-40 Adapter

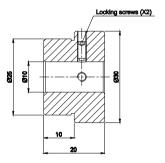
GCT-031011 is fixed adapter that allow Ø25.4mm optics to be mounted to our GCT-0201, GCT-030130 and GCT-080315 optic mounts. The internal thread is 1.035"-40 and it is compatible with all external 1.035"-40 threaded components. The outer diameter is 30mm.



GCT-031011

# GCT-031013 Adapter

GCT-031013 is fixed adapter that allow Ø10mm Cylindrical optics to be mounted to our optic mounts.



GCT-031013



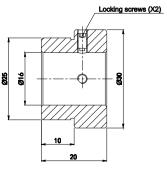
GCT-031013



GCT-031014

# GCT-031014 Adapter

GCT-031014 is fixed adapter that allow Ø16mm Cylindrical optics to be mounted to our optic mounts.



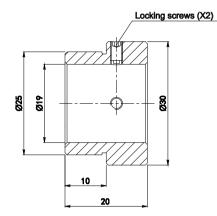
GCT-031014



GCT-031015

# GCT-031015 Adapter

GCT-031015 is fixed adapter that allow Ø19mm Cylindrical optics to be mounted to our optic mounts.



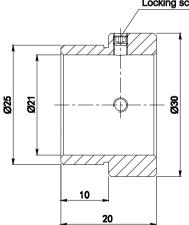
GCT-031015



GCT-031016

# GCT-031016 Adapter

GCT-031016 is fixed adapter that allow Ø21mm Cylindrical optics to be mounted to our optic mounts. Locking screws (X2)

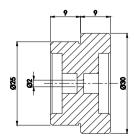


GCT-031016

# GCT-031019 Adapter



GCT-031019



GCT-031019

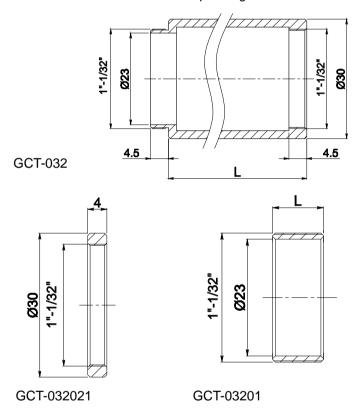




GCT-032

### GCT-0320 Lens Tube

This series of lens tube has a standard C-mount 1"-1/32" external thread with 4.5mm length at one end and a standard C-interface 1"-1/32" internal thread with 4.5mm depth at the other end. It can be combined into tubes of different lengths. It can be directly connected to the C-interface CCD camera or used as light-blocking tube in the cage system. The outer diameter is 30mm, which can be used with the GCT-0201 series mount and GCT-030130 mount. The tube connection ring, the outer ring is a standard C interface 1"-1/32" thread, the inner ring is a hole with diameter 23mm, which can be used as a tube adapter ring.



### GCT-0320 Lens Tube

Part No.	Part Name	L (mm)
GCT-032001	Lens Tube	6
GCT-032002	Lens Tube	10
GCT-032003	Lens Tube	15
GCT-032004	Lens Tube	25
GCT-032005	Lens Tube	37.5
GCT-032006	Lens Tube	50
GCT-032007	Lens Tube	80
GCT-032021	Lens Tube Locking Ring	4
GCT-032011	Lens Tube Connection Ring	10
GCT-032012	Lens Tube Connection Ring	20
GCT-032013	Lens Tube Connection Ring	30

O	ptic Mounts	16	66	6
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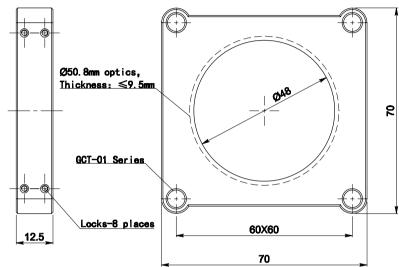




GCT-086104

# GCT-086104 Optic Locking Mounts

GCT-086104 mounts are designed for easy integration into the 60mm cage system. They are ideal for holding Ø50.8mm optical components. It has been machined with four Ø6mm clearance holes matched for GCT-01 cage rods.

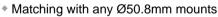


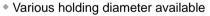
GCT-086104

# GCT-086104 Optic Locking Mounts

Part No.	Holding Diameter ØD	Holding Thickness	Locking Type
GCT-086104	50.8mm	≤9.5mm	2.035"-40 Retaining Ring
GCT-086204	50.8mm	≥3mm	Locking Screw

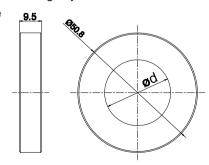
# GCT-0802 Optic Retaining Rings





Compatible with 60mm cage system

Easy to exchange



GCT-080214

### GCT-080214/15

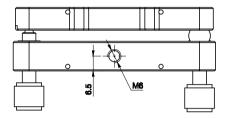
### GCT-0802 Optic Retaining Rings

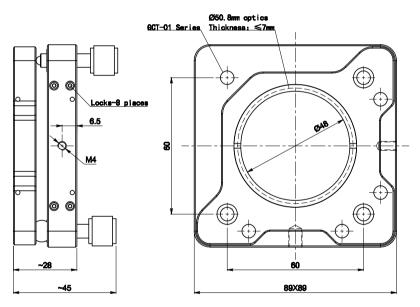
Part No.	ØA	Ød	В	С
GCT-080214	30	28	9.5	≤6.5
GCT-080215	40	38	9.5	≤6

GCT-086304

### GCT-0863 Kinematic Mounts

GCT-0863 kinematic mounts are designed for easy integration into the 60mm cage system. They are ideal for holding Ø50.8mm optical components. Both the front and rear plates have been machined with four Ø6mm clearance holes matched for GCT-01 cage rods. In addition to 60 mm cage compatibility, the GCT-0863 is post mountable via M6 tapped





GCT-086304

### GCT-0863 Kinematic Mounts

Part No.	Holding Diameter ØD	Tilt	Holding Thickness	Locking Type
GCT-086304	50.8mm	$\pm3^{\circ}$	≤7mm	2.035"-40 Retaining Ring



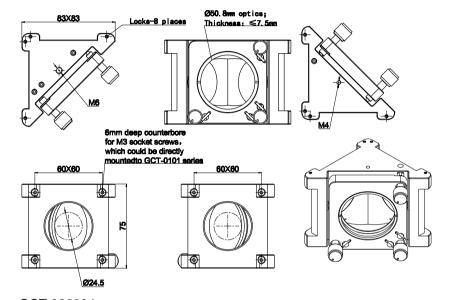


GCT-0866

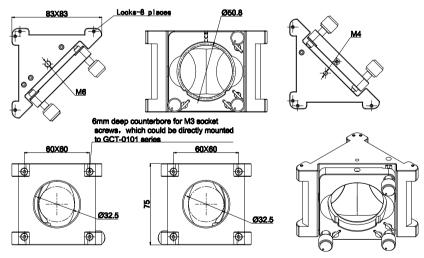
# GCT-0866 Right-Angle Kinematic Mirror Mounts

The GCT-0866 right-angle mount provides pitch and yaw adjustment for Ø50.8 mm optic held in a mounting plate whose nominal horizontal position is at a 45° angle. The ports are equipped with four M3 6.0mm deep smooth bore holes spaced to mate with our 60 mm cage system standard.

- Mounts Ø50.8mm Optics at a 45° Angle to the Optical Axis
- $\bullet~\pm\,4^\circ$  Kinematic Tip and Tilt Adjustment



### GCT-086604



GCT-086614

### GCT-0866 Right-Angle Kinematic Mirror Mounts

Part No.	Holding Diameter ØD	Tilt	Holding Thickness	Locking Type
GCT-086604	50.8mm	$\pm$ 4 $^{\circ}$	≤7.5mm	2.035"-40 Retaining Ring
GCT-086614	50.8mm	±4°	≥3mm	Locking Screw

GCM-T Translation Stages	173
GCM-TP High Precision Translation Stages	177
GCM-TPS Stainless Steel Translation Stages	179
GCM-12 Special Translation Stages	182
GCM-TD Rack and Pinion Translation Stages	186
GCM-83 Digital Display Translation Stages	187
GCM-VC Vertical Translation Stages	188
GCM-V Side-Driven Vertical Translation Stages	189
GCM-161 Mini Threaded Vertical Translation Stages	190
GCM-162 High Precision Vertical Translation Stages	190
GCM-17 Lab Jacks	191







# **Product Range**

Translation stages are for moving components linearly. An actuator pushes the platform relative to the base of the stage. A built-in guide in the stage maintains the translation movement. The form of the guide generally determines the characteristics of the translation stages. Daheng Optics offers a variety type of the translation stages off-the-shelf. There are of single axis or dual axis.

### **Guide Form**

The translation stage consists of a platform and a base, joined by some form of guide or linear bearing in such a way that the platform is restricted to linear motion with respect to the base. The performance of the translation stages is primarily determined by the type of the bearing used. Below is the comparison.

### ► Gothic Arch Ball Bearing

The bearing and the sliding plates are integrated. The bearing groove is directly machined between the upper and lower sliding plates of the translation stage. The high-precision grinding Gothic arch groove is adopted, which has high flatness and parallelism, and can obtain high moving accuracy. There are four contact points between the steel balls and nearing rail for higher load capacity and rigidity.

The GCM-TPS series Stainless Steel Translation Stage use the Gothic arch ball bearing.

### ► Crossed-roller Bearing:

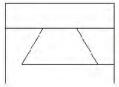
The crossed-roller bearing consists of two V-groove guides, rollers and roller holders. The rollers cross each other along the V-grooves so that they can be loaded in multiple directions. The crossed-roller bearing can realize the high precision, high speed and smoothly linear movement.

The GCM-T, GCM-TP and GCM-V series Translation Stages use the crossed-roller bearing.

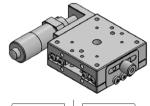
### ► Dovetail Bearing:

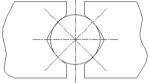
The dovetail bearing is composed of dovetail bearing and sliding block. The bearing rail is in face contact with each other, with large friction coefficient, simple structure and strong load capacity. However, it is not suitable for high-speed movement because of low positioning accuracy.

The GCM-TD and GCM-G series Translation Stages use the dovetail bearing.

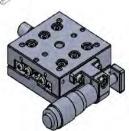








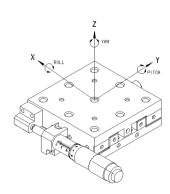












# **Driving Actuators**

In addition to the guide in a translation stage, a linear actuator pushes and controls the position of the moving platform relative to the fixed base. Daheng Optics provides a variety of different manual actuators.

### Precision screws

These products are supplied with a hardened steel ball tip and the brass bushing, which provide exceptionally smooth and repeatable movements. The pitch of the precision screws defines the adjustment resolution. Daheng Optics provides a wide range of high quality fine adjusters, including pitch of 0.35mm and 0.25mm.

### Metric micrometers heads

They can also be used as driving actuators for precise movement in demanding requirements. Daheng Optics offers metric micrometer heads with travel range from 6.5mm to 25mm and fine scale reading from 0.01mm to 0.001mm.

# Rack and pinion

This structure comprises a pair of gears which converts rotational motion into linear motion.

# Accuracy

### ► Run-out error:

It is the measure for how straight the line of movement is, which is the maximum distance off the ideal straight line in the perpendicular directions of the motion. For each axis travel, there are two associated orthogonal run-out measurements corresponding to the two remaining translational degrees of freedom. For instance, for an x-axis translation stage, there exists a y-axis run-out and a z-axis run-out. They are referred to as straightness of travel (in plane motion) and flatness of travel (out of plane motion, respectively). Run-out error is generally measured by a dial gauge.

### ► Tilt and wobble:

It is the angular error that refers to the offset between the ideal straight line motion and actual measured motion. It has three mutually perpendicular components reference to the x-, y- and z-axis, which generally is the roll, pitch and yaw. These three components are normally resulted from the geometrical shapes in the structure.

### ► Straightness:

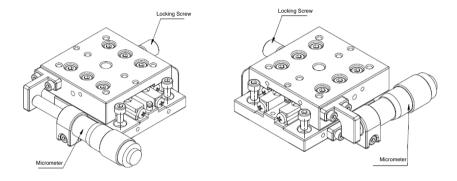
It is the ability of a machine to accurately travel in a straight line with respect to a known reference plane, and the specification refers to the maximum possible deviation from the desired straight line path.



# Installation

There are four counter-sank through hole on the fixing base of each translation stage. To access them, please follow the procedure below:

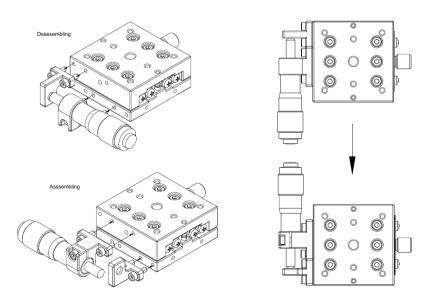
Rotate the micrometer head (or other built-in driving actuator) in one direction so that the table moves to the one end of its travel range. Make sure to release the locking knob before the operating. Two installment holes are then revealed for fixing. Next, turn the micrometer head (or other built-in driving actuator) in the opposition direction until the table moves to the other end of its travel range. The other two installment holes are then revealed for fixing.



# Vertical installation

When the translation stage is used vertically, the force of the spring in the translation stage will not be able to restore the displacement stage to its proper position due to the gravity in the vertical direction. This problem can be overcome by changing the position of the screw seat of the micrometer. The figure below shows GCM-T and GCM-TP series stages used in the vertical Z direction.

The customer can change the screw and make multi-dimensional combination according to the diagram. For GCM-TPS stainless steel series translation stages, if vertical use is required, we propose to change the direction of screw seat by our company's professionals at the time of purchase.



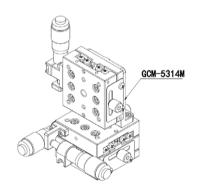


### **GCM-T Translation Stages**

GCM-T Series Translation Stages manufactured by Daheng Optics, which is made of aluminum alloy. These stages use crossed-roller bearings to support precision motion and high load capacities. The translation stage is divided into single-axis and dual-axis types. The thickness of single-axis is 20mm, and the thickness of dual-axis is 33mm. The size of the corresponding platform is 45x45mm and 65x65mm, with travel of  $\pm 6.5$ mm and  $\pm 12.5$ mm respectively. The customer can change the installation position of the micrometer according to the use demand, and the installation hole position is reserved for each translation stage.



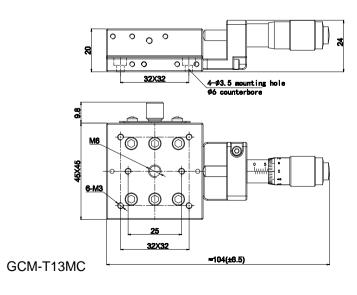
Accessories GCM-5314



# GCM-T13M 13mm Travel Translation Stage

Part No.	GCM-T13MC	GCM-T13ML	GCM-T13M2C	GCM-T13M2L	
Driving Direction	Center Drive	Side Drive(Left)	Center Drive	Side Drive(Left)	
Thickness(mm)	20	0	3	3	
Travel(mm)		₫	6.5		
Platform Size(mm)		45X45			
Bearing Type	Crossed-roller Bearings				
Resolution( µ m)	10				
Yaw(")	50				
Pitch(")	50				
Straightness(um)	5				
Horizontal Load Capacity(kg)	5				
Weight(kg)	0.16	0.16	0.29	0.29	
Material	Aluminum Alloy				



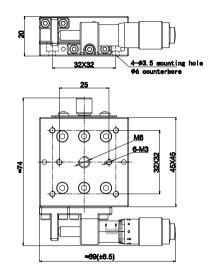




## GCM-T13M 13mm Travel Translation Stage



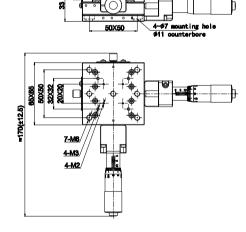
GCM-T13ML



GCM-T13ML



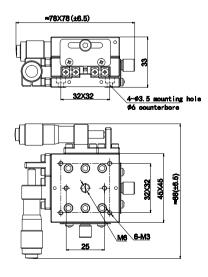
GCM-T13M2C



GCM-T13M2C



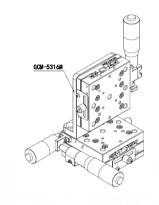
GCM-T13M2L



GCM-T13M2L



Accessories GCM-5316





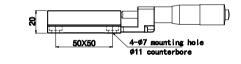
GCM-T25MC

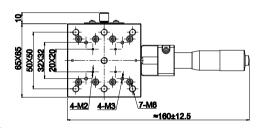


GCM-T25ML

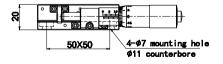
# GCM-T25M 25mm Travel Translation Stage

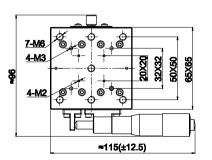
Part No.	GCM-T25MC	GCM-T25ML	GCM-T25M2C	GCM-T25M2L
Driving Direction	Center Drive	Side Drive(Left)	Center Drive	Side Drive(Left)
Thickness(mm)	2	20	3	3
Travel(mm)		± '	12.5	
Platform Size(mm)	65X65			
Bearing Type	Crossed-roller Bearings			
Resolution( µ m)	10			
Yaw(")	50			
Pitch(")	50			
Straightness(um)	5			
Horizontal Load Capacity(kg)	7			
Weight(kg)	0.35kg	0.35kg	0.45kg	0.45kg
Material	Aluminum Alloy			





GCM-T25MC



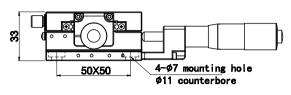


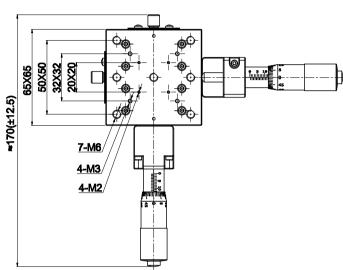
GCM-T25ML



### GCM-T25M 25mm Travel Translation Stage



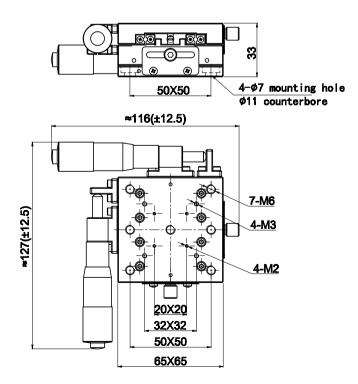




GCM-T25M2C



GCM-T25M2L

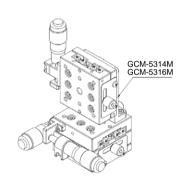


GCM-T25M2L





Accessories GCM-5314M/GCM-5316M



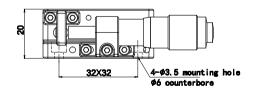


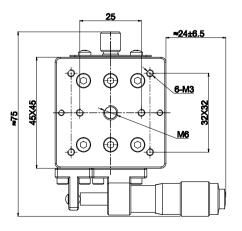
GCM-TP13ML

## **GCM-TP High Precision Translation Stage**

GCM-TP series products are high-precision translation stages of Daheng Optics. The stage is constructed with a full aluminum body and crossedroller steel bearings for precision motion and high-load capacity. The thickness of the stage is 20mm and the travel is 13mm and 25mm. The platform size is 45X45mm and 65X65mm.

Part No.	GCM-TP13ML	GCM-TP13MR	GCM-TP25ML	GCM-TP25MR	
Driving Direction	Side Drive(Left)	Side Drive(Right)	Side Drive(Left)	Side Drive(Right)	
Travel(mm)	±	6.5	±1	2.5	
Platform Size (mm)	45)	<b>&lt;</b> 45	65)	<b>&lt;</b> 65	
Thickness(mm)	2	0	2	0	
Bearing Type	Hig	High Precision Cros		ings	
Micrometer Head	Mitu	Mitutoyo		Mitutoyo	
Resolution( µ m)	10		10		
Yaw(")	20		20		
Pitch(")	20		20		
Straightness ( µ m)	;	3		3	
Parallelism( µ m)	10		1	0	
Horizontal Load Capacity (kg)	5		-	7	
Weight (kg)	0.16		0.16 0.35		
Material	Alumin		ım Alloy		





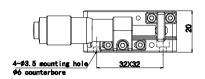
GCM-TP13ML

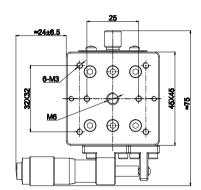


## **GCM-TP High Precision Translation Stage**

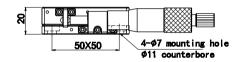


GCM-TP13MR



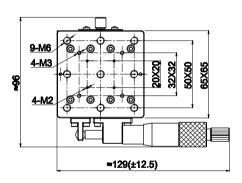


GCM-TP13MR





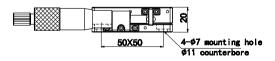
GCM-TP25ML

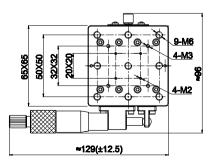


GCM-TP25ML



GCM-TP25MR





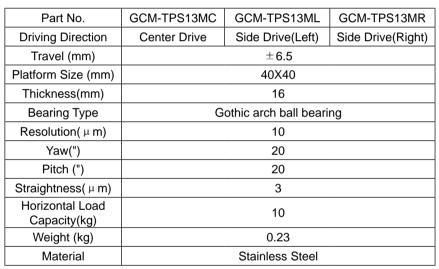
GCM-TP25MR

### **GCM-TPS Stainless Steel Translation Stages**

GCM-TPS series products are compact high-precision stainless steel translation stages of Daheng Optics. The thickness is 16mm and the travel is 13mm and 25mm. The platform size is 40X40mm and 65x65mm respectively. They all have the characteristics of high precision, compact size, good rigidity, strong loading capacity and long-term stability, and can be used in high precision adjustment products such as laser equipment.

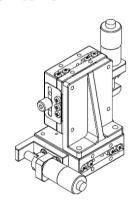
- Full stainless steel body for good rigidity and long-term stability
- Gothic arch ball bearing for high precision and strong load capacity
- · Compact design suitable for small space equipment

### GCM-TPS13M 13mm Travel Stainless Steel Translation Stages



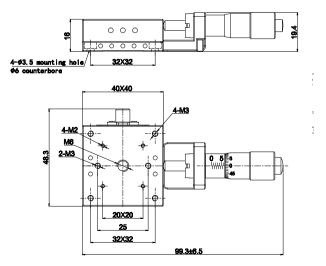


Accessories GCM-531401M





GCM-TPS13MC



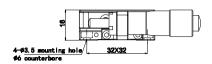
GCM-TPS13MC

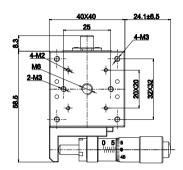


## GCM-TPS Stainless Steel Translation Stages



GCM-TPS13ML

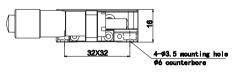


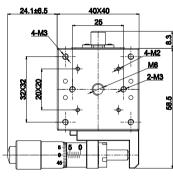


GCM-TPS13ML



GCM-TPS13MR

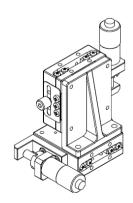




GCM-TPS13MR



Accessories GCM-531601M



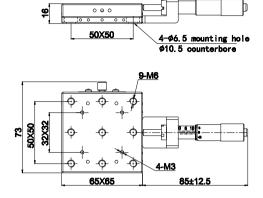
### GCM-TPS25M 25mm Travel Stainless Steel Translation Stages

			,	
Part No.	GCM-TPS25MC	GCM-TPS25ML	GCM-TPS25MR	
Driving Direction	Center Drive	Side Drive(Left)	Side Drive(Right)	
Travel (mm)		$\pm$ 12.5		
Platform Size (mm)		65X65		
Thickness(mm)		16		
Bearing Type	Gothic arch ball bearing			
Resolution( µ m)	10			
Yaw(")	20			
Pitch (")	20			
Straightness( µ m)	3			
Horizontal Load	20			
Capacity(kg)	20			
Weight (kg)	0.5			
Material		Stainless Steel		

# **GCM-TPS Stainless Steel Translation Stages**



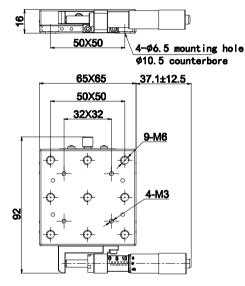
GCM-TPS25MC



GCM-TPS25MC



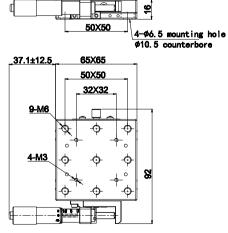
GCM-TPS25ML



GCM-TPS25ML



GCM-TPS25MR



GCM-TPS25MR



GCM-123

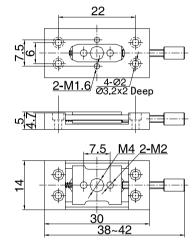
### **GCM-12 Special Translation Stages**

### GCM-123 Bar-guided Micro Translation Stages

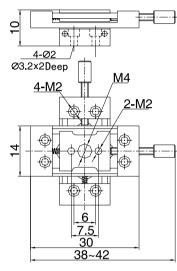
GCM-123 Bar-guided Micro Translation Stage is commonly used in positioning optical components of small size. There are types of 1-, 2- and 3-axis stages. The guide is a precision bar of Ø1.5mm with compact design. The stages are suitable in the situations of light weight and low accuracy.



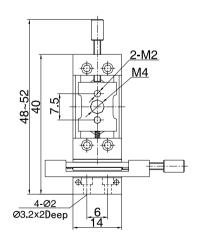
3-Axis



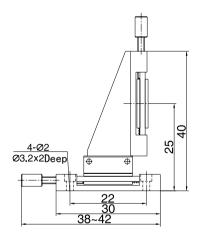
GCM-123101M



GCM-123102M



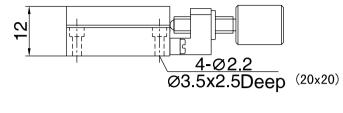
GCM-123103M



#### GCM-123 Bar-guided Micro Translation Stages

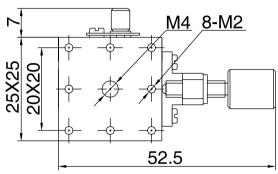
Part No.	Translation Axis	Platform Size	Travel	Weight(g)
GCM-123101M	Х	30x14	±2	4.5
GCM-123102M	x,y	30x14	±2	9.2
GCM-123103M	x,y,z	30x14	±2	17

### GCM-120 Dovetail Translation Stages





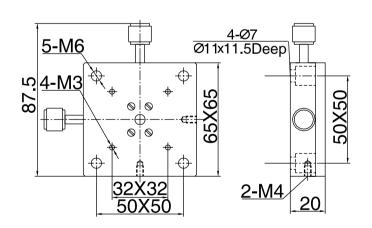
GCM-120101AM



GCM-120101AM



GCM-122101M



GCM-122101M

#### GCM-120 Dovetail Translation Stages

Part No.	Translation Axis	Platform Size	Travel	Weight(g)
GCM-120101AM	Х	25x25	$\pm3.25$	45
GCM-122101M	x-y	65x65	±3	225



### **GCM-125 Precision Translation Stages**

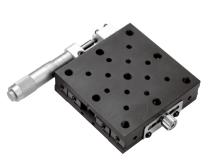
Ball and rod bearing combined with a micrometer (or precision lead screw) drive provide smooth and creep free linear translation with an accuracy of 0.001mm. If fitted with the precision GCM-4111 micrometer, an even higher accuracy can be accomplished. In the below table, "A" indicates that the micrometer is installed on the front of the translation platform; "B" indicates that the micrometer is installed on the side of the translation platform. GCM-53 series products produced by Daheng Optics can be used together when it needs to be combined into three-dimensional translation stages.



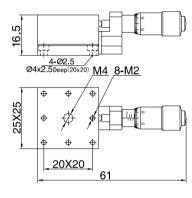
GCM-125001ASM

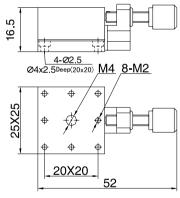


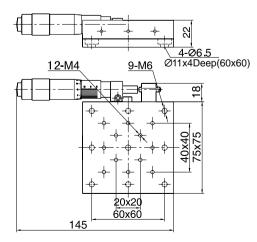
GCM-125001AM



GCM-125401BM



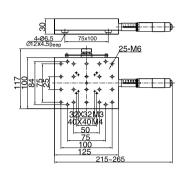




### **GCM-125 Precision Translation Stages**



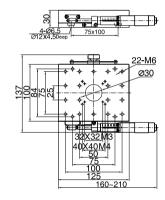
GCM-125501AM



GCM-125501AM



GCM-125501BM



GCM-125501BM



GCM-124501BM

4-Ø6.5 Ø1 1x4 deep (60x60) 2-Ø4.5 Ø8 deep10 6-M6 6-M4 130

GCM-124501BM

### GCM-125 Precision Translation Stages

Part No.	Translation Axis	Platform Size	Travel	Weight(g)
GCM-125001AM	Х	25X25	$\pm3.25$	30
GCM-125001ASM	Х	25X25	± 3.25	40
GCM-125401BM	Х	75X75	± 12.5	355
GCM-125501AM	Х	100X125	±25	465
GCM-125501BM	Х	100X125	±25	475
GCM-124501BM	Х	75X75	± 12.5	350



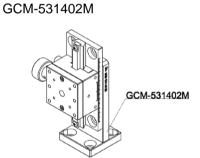
### **GCM-TD Rack and Pinion Translation Stages**

This series of stages are driven by rack and pinion to achieve translation. They have the characteristics of long travel, fast speed, smooth movement and convenient use. A ruled scale and vernier permit a readout accuracy of 0.1 mm. The stage has mounting holes that can be combined with each other, and the right angle bracket GCM-531402M can be combined with each other to form two-dimensional or three-dimensional with vertical direction.



Part No.	Travel (mm)	Horizontal Load Capacity (kg)	Vertical Load Capacity (Kg)	Parallelism (mm)	Weight (Kg)
GCM-TD50MX	$\pm 25$	10kg	2kg	0.1	0.2
GCM-TD70MX	±35	10kg	2kg	0.1	0.25
GCM-TD150MX	±75	10kg	2kg	0.1	0.35
GCM-150401M	90	10kg	2kg	0	0.36







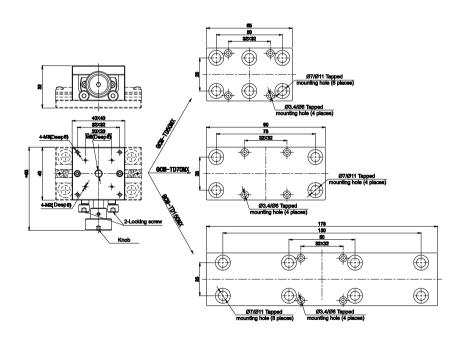
GCM-1D50MX

Accessories



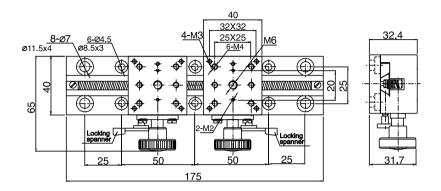
GCM-TD70MX





# **GCM-TD Rack and Pinion Translation Stages**





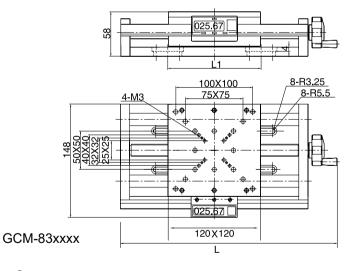
GCM-150401M

### GCM-83 Digital Display Translation Stages

The GCM-83 series Digital Display Translation Stages use bearing rails to accomplish a linear movement. They can provide a long distance smooth movement. The position can be digitally displayed by LED with a resolution of 0.01mm. These stages can be integrated to make a 2- or 3-axis stage upon the request.



GCM-83



#### GCM-83 Digital Display Translation Stages

Part No.	Travel	L	L1	weight(g)
GCM-830301M	50	234	125	3550
GCM-830302M	75	254	125	3850
GCM-830303M	100	284	175	4100
GCM-830304M	150	334	175	4540
GCM-830305M	200	384	225	4960





GCM-VC

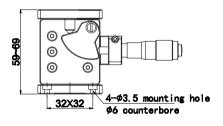
### **GCM-VC Vertical Translation Stages**

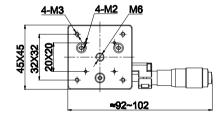
This series of products are provided by Daheng Optics for vertical translation stages moving along the center of the table. The material is aluminum alloy. The guide form is crossed-roller bearing, which improves the accuracy and load capacity of the stages. The travel is 10mm and 13mm, and the size of the platform is 45X45mm and 65x65mm.

Part No.	GCM-VC10M	GCM-VC13M
Driving Direction	Vertical	Vertical
Travel (mm)	10	13
Platform Size (mm)	45X45	65X65
Bearing Type	Crossed-roller bearing	Crossed-roller bearing
Resolution( µ m)	10	10
Straightness( µ m)	6	6
Load capacity(kg)	3	3
Weight (kg)	0.23	0.39
Material	Aluminum Alloy	Aluminum Alloy



GCM-VC10M

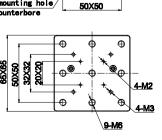




GCM-VC10M



GCM-VC13M





GCM-V

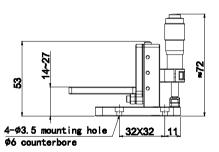
### GCM-V Side-Driven Vertical Translation Stages

GCM-V series products are new precise side-driven vertical stage launched by Daheng Optics. They are made of aluminum alloy. The type of guide is crossed-roller bearing, which improves the accuracy and load capacity of the stages. The travel is 13mm and 25mm.

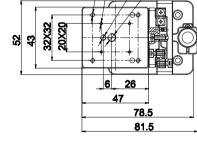
Part No.	GCM-V13M	GCM-V25M	
Driving Direction	Verti	cal	
Travel (mm)	13	25	
Platform Size (mm)	43X47	65X66	
Bearing Type	Crossed-roller bearing		
Resolution( µ m)	10	10	
Straightness( μ m)	6	6	
Load Capacity(kg)	2	4	
Weight (kg)	0.22	0.5	
Material	Aluminum Alloy		



GCM-V13M



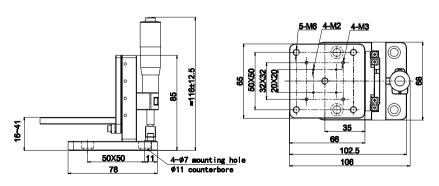
GCM-V13M



4-M2 M4 M6



GCM-V25M



GCM-V25M

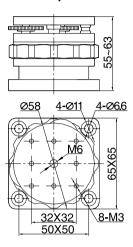


### GCM-161 Mini Threaded Vertical Translation Stages

Smooth, accurate and backlash free vertical translation is achieved by screws thread motion. GCM-1612M can also provide  $\pm 3^{\circ}$  tilt movement in X and Y directions, which is convenient to adjust the levelness.



GCM-1612M



GCM-1612M

#### GCM-161 Mini Threaded Vertical Translation Stages

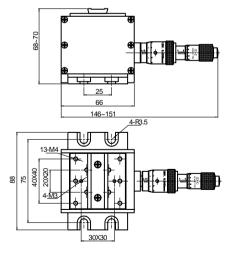
Part No.	Weight(g)
GCM-1612M	355

### GCM-162 High Precision Vertical Translation Stages

This device provides smooth and play-free vertical motion driven by a precision micrometer. The dovetail guide enables it to withstand higher loads.



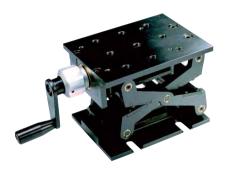
GCM-1622M



GCM-1622M

#### GCM-162 High Precision Vertical Translation Stages

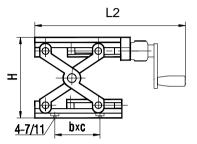
•	· ·	
Part No.	Resolution	Weight(g)
GCM-1622M	0.25µm	788

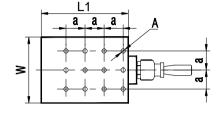


GCM-1701M/1702M/1703M

#### GCM-170 Lab Jacks

Lab jacks provide a rugged, height adjustable platform ideal for mounting optomechanical sub-assemblies that, as a functional group, require height adjustment. Daheng Optics offers three different models, each with unique design characteristics suited for different ranges of end applications.





GCM-1701M/1702M/1703M

#### GCM-170 Lab Jacks

Part No.	L1	L2	W	а	b	С	$H_{min}$	$H_{\text{max}}$	Load Capac	city A	Weight(g)
GCM-1701M	100	165	75	25	50	50	75	109	15kg	9-M6	1465
GCM-1702M	130	195	100	25	50	75	92	130	30kg	15- M6	3455
GCM-1703M	230	295	150	25	125	75x2	128	222	50kg	41- M6	10125

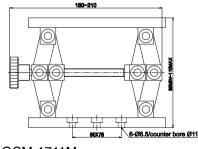
#### GCM-1711M Lab Jack

#### GCM-1711M Lab Jack

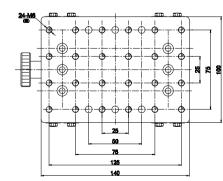
GCM-1711M Lab Jack utilizes a dual-pantograph design which offers excellent rigidity. The adjustment mechanism uses a lead screw to close the angle between the opposing pairs of supporting struts. The material of GCM-1711M is aluminum alloy.



GCM-1711M



GCM-1711M



#### GCM-1711M Lab Jack

Part No.	Platform Size	Travel	Load Capacity
GCM-1711M	100X140	48mm	20Kg

GCM-110 Rotation Stages	193
GCM-1112M Gimbal Base	196
GCM-113 Rotation Adapter	196



### **GCM-110 Rotation Stages**

These stages allow manual rotation through 360 ° and fine angular adjustments achieved through a precision worm gear drive or micrometer movement. The GCM-1104M and GCM-1105M models have a central hole to allow the passage of light or can be fitted with an optional adapter (GCM-110401M or GCM-110501M, respectively) for conversion to a solid rotation stage. The GCM-11 series can be mounted on the GCM-12 series translation stages or other optical platforms.



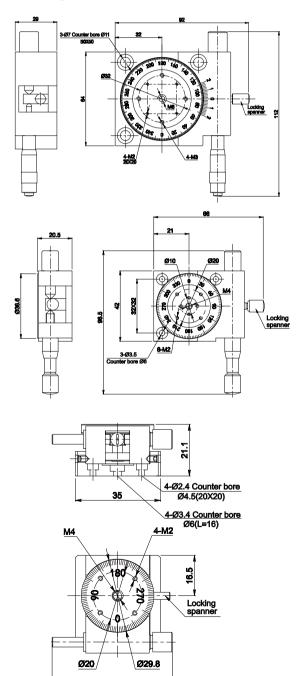
GCM-1101M



GCM-1102M



GCM-1103M

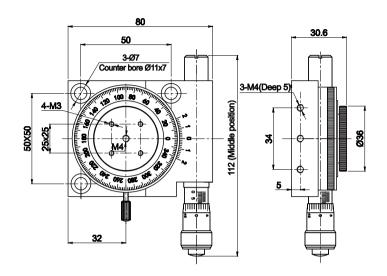




### **GCM-110 Rotation Stages**

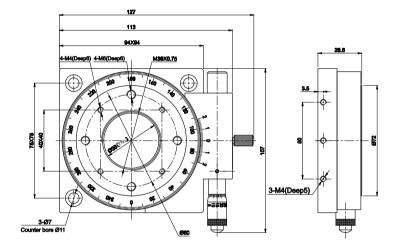


GCM-1104M



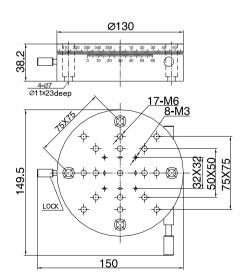


GCM-1105M





GCM-1106M



# **GCM-110 Rotation Stages**



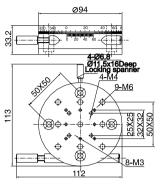
GCM-1107M

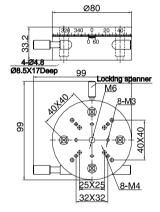


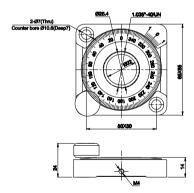
GCM-1108M



GCM-1109M







### GCM-110 Rotation Stages

Part No.	Fine Adjustment	Resolution	Weight(g)
GCM-1101M	±4°	± 10'	305
GCM-1102M	±5°	-	110
GCM-1103M	±4°	-	65
GCM-1104M	±5°	± 10'	285
GCM-1105M	±4°	±6'	565
GCM-1106M	±4°	± 1'	1190
GCM-1107M	±5°	± 2'	555
GCM-1108M	±3°	± 5'	420
GCM-1109M	-	-	210

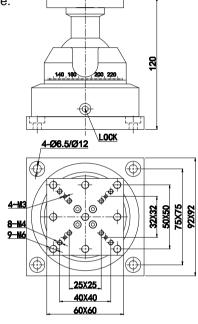




GCM-1112M

#### GCM-1112M Gimbal Base

The GCM-1112M base is a socket-mounted platform with a high precision ball that offers free spherical motion over a complete hemisphere. A single locking mechanism provides reliable and rapid angular positioning of any component mounted on the base.



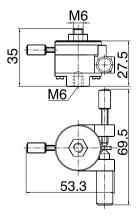
#### GCM-1112M Gimbal Base

Part No.	Weight(g)
GCM-1112M	930



### **GCM-113 Rotation Adapter**

The rotation adapter allows 360° rotation manually with  $\pm 15$ ° fine angle adjustment. A thread of M6 adapts other components or modules.



#### GCM-113 Rotation Adapter

Part No.	Fine Adjustment	Resolution	Weight(g)
GCM-1131M	±15°	± 10'	105

GCM-190 Single-Axis Tilt Platforms	198
GCM-191 Rotatable Tilt Platforms	199
GCM-112 Tip Tilt and Rotation Stages	200
GCM-G Goniometer Stages	201



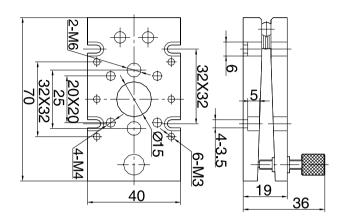


### GCM-190 Single-Axis Tilt Platforms

Single-axis tilt platform provide stable, high-resolution alignment and high load capacity. They offer precise and smooth adjustment with backlash-free motion.

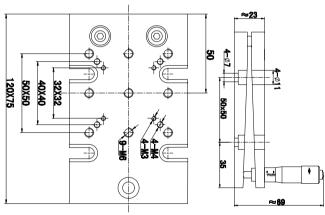


GCM-1901M



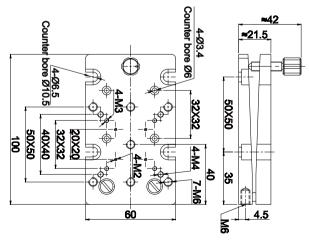


GCM-1902M





GCM-1903M



#### GCM-190 Single-Axis Tilt Platforms

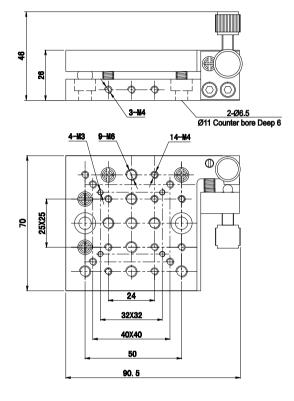
Part No.	Tilt Angle	Weight(g)
GCM-1901M	$\pm3.8^\circ$	100
GCM-1902M	±3.8°	490
GCM-1903M	±3.8°	100



GCM-1911M

#### GCM-191 Rotatable Tilt Platforms

After from being able to be tilted, this platform can also be rotated through a small angle in the horizontal plane.



GCM-1911M

#### GCM-191 Rotatable Tilt Platforms

Part No.	Tilt Angle	Rotation Angle	Weight(g)
GCM-1911M	± 1.8°	$\pm1.8^{ m o}$	350



# GCM-112 Tip Tilt and Rotation Stages

The GCM-112 Tip Tilt and Rotation Stages provide  $\pm 5^{\circ}$  uncoupled tilt adjustment in pitch and roll. The resolution of single-axis is 10'. These adjustments allow optical components and fixtures to be aligned with a plane and then rotated within that plane.

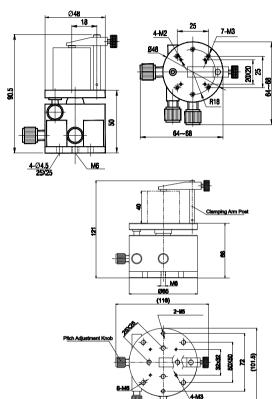


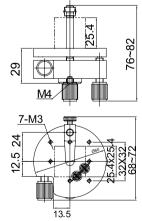






GCM-1123M





### GCM-112 Tip Tilt and Rotation Stages

Part No.	Tip/Tilt Adjustment Range	Micrometer Resolution	Weight(g)
GCM-1121M	±5°	± 10'	235
GCM-1122M	±5°	± 10'	770
GCM-1123M	±4°	± 2'	210

# **GCM-G Goniometer Stages**



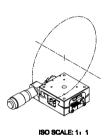
GCM-G

A goniometer stage is a device used to rotate an object precisely, within a small angular range, about a fixed point in space. Goniometers are similar to linear stages, but, rather than providing linear movement, the stage partially rotates about a fixed point above the mounting surface of the stage. In our product lines, the distance from the point of rotation to the mounting surface was designed so that two different goniometer models (GCM-G40M and GCM-65M) may be stacked in an XY configuration and both stages will rotate about the same point. The GCM-G Goniometer Stages employ precision micrometer as the actuation component, grinding dovetail bearing as the guide way. The precision dovetail design, accompanied by a backlash-free lead screw and a vernier scale, provides accurate and repeatable positioning.

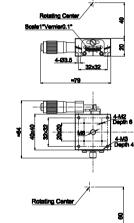


GCM-G40M40L

GCM-G40M60L

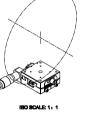


GCM-G40M40L

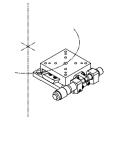




GCM-G40M60L





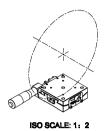


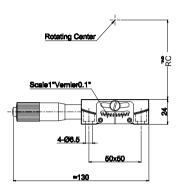


# **GCM-G Goniometer Stages**

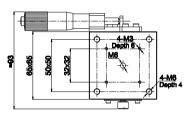


GCM-G65M76L





GCM-G65M76L

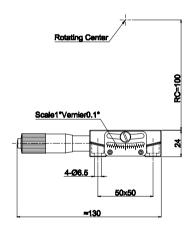


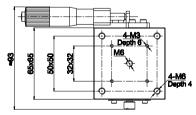


GCM-G65M100L



ISO SCALE: 1: 2





GCM-G65M100L

### **GCM-G Goniometer Stages**

	9					
Part No.	Platform Size (mmxmm)	Thickness (mm)	Height to Point of Rotation (mm)	Travel	Load Capacity (kg)	Weight (g)
GCM-G40M40L	40X40	20	40	$\pm 7$	2.5	100
GCM-G40M60L	40X40	20	60	±5	2.5	100
GCM-G65M76L	65X65	24	76	±8	2.5	300
GCM-G65M100L	65X65	24	100	±6	2.5	300
GCM-G50M75-H	50X50	22	75(Horizontal)	$\pm 3$	2.5	300

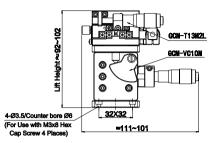
GCM-90 3-Axis Stages	204
GCM-91 4-Axis Stages	206
GCM-92 5-Axis Stages	207
GCM-93 6-Axis Stages	 208

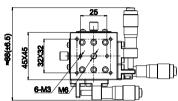




### GCM-90 3-Axis Stages







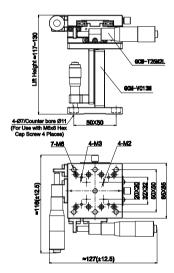
Part No.: GCM-901601M

• Height: 92mm

 Max Size: 85 × 71.5 × 92 Travel: X.Y: ± 6.5 Z: ± 5.5

Composed Part	Quantity
GCM-T13M2L	1
GCM-VC10M	1





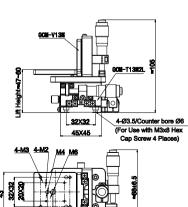
Part No.: GCM-901602M

Height: 126mm

 Max Size: 137 × 129 × 126 Travel: X.Y: ± 12.5 Z: ± 6.25

Composed Part	Quantity
GCM-T25M2L	1
GCM-VC13M	1





 Part No.: GCM-901603M Center Height: 50mm

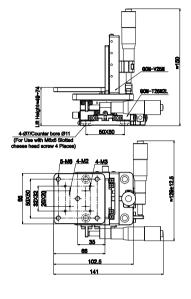
Max Size: 85 × 101.5 × 100

Travel: X.Y.Z: ± 6.5

Composed Part	Quantity
GCM-T13M2L	1
GCM-V13M	1

### GCM-90 3-Axis Stages





 Part No.: GCM-901604M Center Height: 60mm

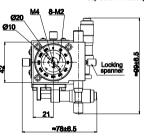
Max Size: 137 × 129 × 148.5

Travel: X.Y.Z: ± 12.5

Composed Part	Quantity
GCM-T25M2L	1
GCM-V25M	1







Part No.: GCM-901101M

Height: 52.8mm

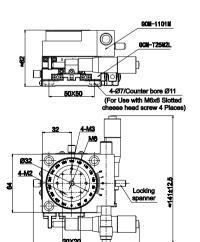
Max Size: 85 × 71.5 × 52.8

Travel: X.Y: ± 6.5

Horizontal Rotation: 360°

Composed Part	Quantity
GCM-T13M2L	1
GCM-1102M	1





Part No.: GCM-901102M

Height: 65mm

Max Size: 137 × 129 × 65

Travel: X.Y: ± 12.5

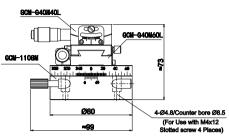
Horizontal Rotation: 360°

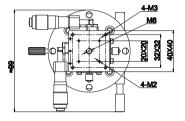
Composed Part	Quantity
GCM-T25M2L	1
GCM-1101M	1



### GCM-90 3-Axis Stages







Part No.: GCM-901103M

Height: 77.2mm

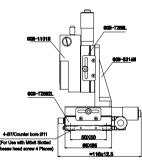
 Max Size: 110 × 110 × 77.2 Horizontal Rotation: 360°

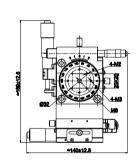
• Tilt: ± 5°

Composed Part	Quantity
GCM-G40M40L	1
GCM-G40M60L	1
GCM-1108M	1

### GCM-91 4-Axis Stages





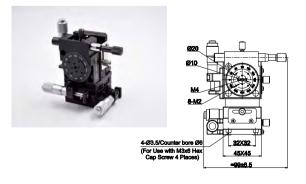


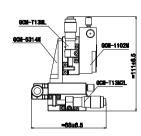
 Part No.: GCM-910401M Center Height: 114.5mm

Max Size: 134 × 112 × 174.5

 Travel: X.Y.Z: ± 12.5 Vertical Rotation: 360°

Composed Part	Quantity
GCM-T25MC	1
GCM-T25ML	1
GCM-1101M	1
GCM-5316M	1





Part No.: GCM-910402M

Center Height: 81.5mm

Max Size: 115 × 90 × 126.5

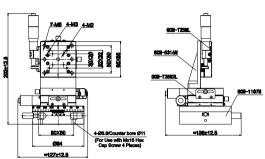
Travel: X.Y.Z: ± 6.5

Vertical Rotation: 360°

Composed Part	Quantity
GCM-T13M2L	1
GCM-T13ML	1
GCM-1102M	1
GCM-5314M	1

### GCM-91 4-Axis Stages



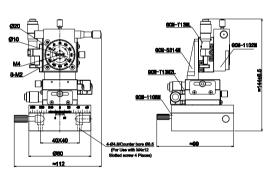


- Part No.: GCM-910403M
- Center Height: 121.7mm
- Max Size: 150 × 207.2
- Travel: X.Y.Z: ± 12.5
- Horizontal Rotation: 360°

Composed Part	Quantity
GCM-T25ML	1
GCM-T25M2L	1
GCM-1107M	1
GCM-5316M	1

### GCM-92 5-Axis Stages

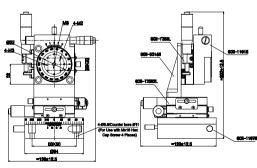




- Part No.: GCM-920501M
- Center Height: 94.2mm
- Max Size: 115 × 139.2
- Travel: X.Y.Z: ± 6.5
- Horizontal and Vertical Rotation: 360°

Composed Part	Quantity
GCM-T13ML	1
GCM-T13M2L	1
GCM-5314M	1
GCM-1102M	1
GCM-1108M	1





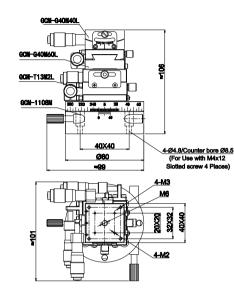
- Part No.: GCM-920502M
- Center Height: 121.7mm
- Max Size: 150 × 181.7
- Travel: X.Y.Z: ± 12.5
- Horizontal and Vertical Rotation: 360°

Composed Part	Quantity
GCM-T25ML	1
GCM-T25M2L	1
GCM-5316M	1
GCM-1101M	1
GCM-1107M	1



# GCM-92 5-Axis Stages



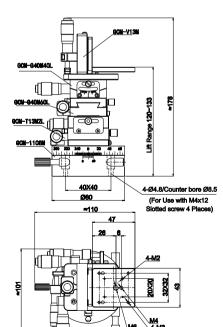


- Part No.: GCM-920504M
- Height: 109.5mm
- Max Size: 115 × 109.5
- Travel: X.Y: ± 6.5
- Horizontal Rotation: 360°
- Tilt: ± 5°

Composed Part	Quantity
GCM-T13M2L	1
GCM-G40M40L	1
GCM-G40M60L	1
GCM-1108M	1

### GCM-93 6-Axis Stages





- Part No.: GCM-930602M
- Height: 128.5mm
- Max Size: 115 × 109.5
- Travel: X.Y.Z: ± 6.5
- Horizontal Rotation: 360°
- Tilt: ± 5°

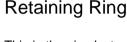
Composed Part	Quantity
GCM-V13M	1
GCM-T13M2L	1
GCM-G40M40L	1
GCM-G40M60L	1
GCM-1108M	1

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#### Mounts and Holders for Optic Components

Daheng Optics supplies several series of optical holders to mount a wide range of optical components. The two types of mounting style, post or base, enable simple construction and easy alignment in optical systems.



This is the simplest and commonlyused mount structure for holding optical components. A retainer ring holds the optics in the mount, which can be quickly dismounted by using a spanner wrench. The diameter of the retainer should have a clearance to the diameter of the optics in order for the optics to be put in easily. This may make the optics eccentric.

#### **Three-Point Mounting**

Instead of holding optical components in a ring with clearance in diameters, in this structure, the optics is held by three equally-spaced points in the circumference. One of the three contact points is a nylon tip, which can be loosed for easy replacement of the component.

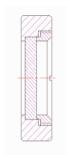
#### Self-Centering

As its name indicates, this type of mount overcomes the eccentric problem in the retainer ring structure. The self-centering structure has three spring - loaded jaws that move along the same circular track to ensure its concentricity. This type of holders is ideal for holding optic components that are round and cylindrical in shape and requiring reliable axial positioning. Another advantage is that it can maintain the position of the optical axis even when lenses with different diameters are put in. It has sufficient diameter space to load and unload lenses, particularly in the systems which lenses are changed frequently. However, the spring-loading strength of the jaws can be limited to hold a large and heavy optics.

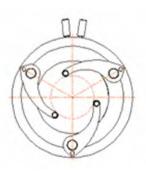
#### **Gimbal Mounts**

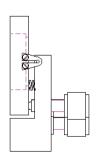
Gimbal mounts imply the center of rotation is located at the geometrical center and on the front surface of the optical component. They allow for non-coupled rotation adjustment of the optics with any translation. They are typically used when even small changes in optical path length are critical.











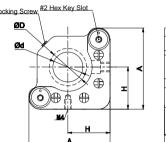


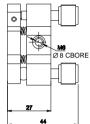
GCM-0858

#### GCM-0858 Precision Lens/Mirror Holders

The Series of Precision Lens/Mirror Holders, GCM-0858, is designed to mount a lens or mirror. By adjusting the two of fine threads, the lens or mirrors can be precisely adjusted in both pitch and rotation directions. The adjustment range for single axis is  $\pm 4^{\circ}$ . There is a M4 tapped hole on the holder for connecting to a post mount or other products.

Designed to Hold Thickness ≥2mm Lens/Mirror





GCM-0858

#### GCM-0858 Precision Lens/Mirror Holders

Part No.	ØD	Ød	Н	$A \times A$	Weight(g)
GCM-085820M	20	18.5	26	50 × 50	95
GCM-0858254M	25.4	23.9	26	50 × 50	95
GCM-085830M	30	28.5	28	52 × 52	95
GCM-0858381M	38.1	36.6	32	62 × 62	125
GCM-085840M	40	38.5	32	62 × 62	121
GCM-085850M	50.8	48.8	36	69 × 69	135

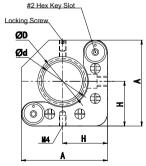
#### GCM-0868 Precision Lens/Mirror Holders

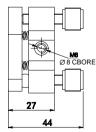


GCM-0868

The Series of Precision Lens/Mirror Holders, GCM-0868, is designed to mount a lens or mirror. By adjusting the two of fine threads, the lens or mirrors can be precisely adjusted in both pitch and rotation directions. The adjustment range for single axis is  $\pm 4^{\circ}$ . There is a M4 tapped hole on the holder for connecting to a post mount or other products.

Designed to Hold Thickness 1.5-5mm Lens/Mirror





#### GCM-0868

#### GCM-0868 Precision Lens/Mirror Holders

Part No.	ØD	Ød	Н	$A \times A$	Weight(g)
GCM-086820M	20	18	26	50 × 50	106
GCM-0868254M	25.4	23.5	26	50 × 50	106
GCM-086830M	30	28	28	52 × 52	106
GCM-0868381M	38.1	36.6	32	62 × 62	135
GCM-086840M	40	38	32	62 × 62	126
GCM-086850M	50.8	48	36	71 × 71	145

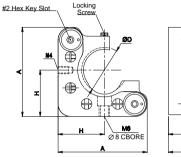


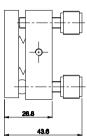


### GCM-08231 Kinematic Corner Lens/Mirror Holders

Several Kinematic Corner Lens/Mirror Holders are available for different applications. They provide smooth and precision tilt in two directions for adjustment. The total angle adjustment in any of the directions is  $\pm 4^{\circ}$  with a resolution of 10". Screw M4 makes it compatible with post mounting.

Designed to Hold Thickness ≥2mm Lens/Mirror





GCM-08231

GCM-08231

#### GCM-08231 Kinematic Corner Lens/Mirror Holders

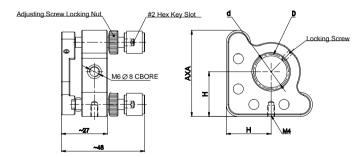
Part No.	ØD	Н	$A \times A$	Weight(g)
GCM-082313M	20	26	50 × 50	94
GCM-082314M	25.4	26	50 × 50	91
GCM-082315M	30	28	52×52	95
GCM-082316M	38.1	32	62 × 62	116
GCM-082317M	40	32	62×62	114
GCM-082318M	50.8	36	69 × 69	124

#### GCM-08081 Slim Kinematic Lens/Mirror Lockable Holders



The series of 2D Kinematic Lens/Mirror holders, which adjustment range for single direction is  $\pm 4^{\circ}$ . The thread pair is axially locked, and make the spot more stable during locking process. These holders are more suitable for thinner optics which thickness ≥2mm

Designed to Hold Thickness ≥2mm Lens/Mirror



GCM-08081

#### GCM-08081

#### GCM-08081 Slim Kinematic Lens/Mirror Lockable Holders

Part No.	ØD	Ød	Н	Α	Weight(g)
GCM-080813M	20	18.5	26	50	100
GCM-080814M	25.4	23.9	26	50	100
GCM-080815M	30	28.5	28	52	105
GCM-080817M	40	38.5	32	62	123
GCM-080818M	50.8	48.8	36	69	132

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## Optic Holders

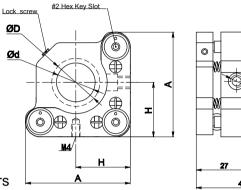


GCM-0878

#### GCM-0878 3D Kinematic Lens/Mirror Lockable Holders

The series of 3D Kinematic Lens/Mirror Lockable Holders, has many different sizes to meet different requirements. They provide high precision screws for adjustment. The adjustment range for single axis is  $\pm 4^{\circ}$ . Using for Lens/Mirror thickness ≥2mm

Designed to Hold Thickness ≥2mm Lens/Mirror



GCM-0878

#### GCM-0878 3D Kinematic Lens/Mirror Lockable Holders

Part No.	ØD	Ød	Н	Α	Weight(g)
GCM-087820M	20	18.5	26	50	107
GCM-0878254M	25.4	23.9	26	50	103.5
GCM-087830M	30	28.5	28	52	107.5
GCM-087840M	40	38.5	32	62	130
GCM-087850M	50.8	48.8	36	69	143

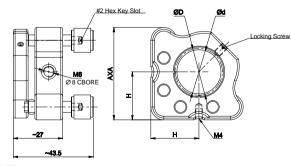


GCM-0888

#### GCM-0888 Stainless Steel Precision Lens/Mirror Holders

High quality stainless steel is used for the series of Precision Lens/ Mirror Holders, GCM-0888. These Precision Lens/Mirror Holders provide good stability, high corrosion resistance and can be used for vacuum applications.

Designed to Hold Thickness ≥2mm Lens/Mirror



GCM-0888

#### GCM-0888 Stainless Steel Precision Lens/Mirror Holders

Part No.	ØD	Ød	Н	Α	Weight(g)
GCM-088803M	20	18.5	26	50	223
GCM-088804M	25.4	23.9	26	50	223
GCM-088805M	30	28.5	28	52	223
GCM-088807M	40	38.5	32	62	223
GCM-088808M	50.8	48.8	36	69	332



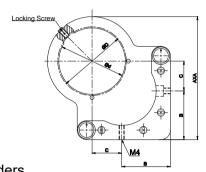


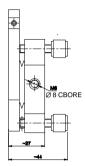
GCM-08310xM

#### GCM-0831 Kinematic Off-center Lens/Mirror Holders

Several Kinematic Off-Center Lens/Mirror Holders are available for different applications. They provide smooth and precision tilt in two directions for the mounted lens or mirror. The total angle adjustment in any of the directions is  $\pm 4^{\circ}$ . Screw A makes it compatible with post mounting.

Designed to Hold Thickness ≥2mm Lens/Mirror





GCM-0831x

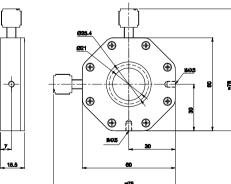
#### GCM-0831 Kinematic Off-center Lens/Mirror Holders

Part No.	ØD	Ød	В	С	Α	Weight(g)
GCM-083103M	20	18.5	26	11	52	80
GCM-083104M	25.4	24	26	11	55	95
GCM-083105M	30	28.5	28	11	59	120
GCM-083107M	40	38.5	32	12	70	145
GCM-083108M	50.8	49.3	36	22	91	150

#### GCM-083904M X-Y Lens/Mirror Holders



The series of X-Y Lens/Mirror Holder, GCM-083904M, can be used for  $\varphi$  25.4mm optics with maximum thickness 5mm. The adjustment range is  $\pm\,1\text{mm}$ . The holders can be connected to the post GCM-03011 through the bottom M4 thread hole.



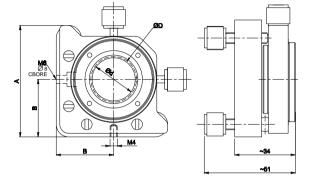
GCM-083904M

#### GCM-083904M X-Y Lens/Mirror Holders

Part No.	Lens/Mirror Size (mm)	Lens/Mirror Thickness (mm)	Adjustment Range (mm)	Weight(kg)
GCM-083904M	Ф25.4	≤5	±1	0.3

#### GCM-08041 4D Precision Lens/Mirror Holders

The series of 4D Precision Lens/Mirror Holders, GCM-08041, have many different size to meet different requirements. By adjusting four of fine threads, they offer horizontal adjustment along with both X and Y direction, and angular adjustment along with both Y and Z direction.



GCM-08041xM

GCM-08041x

#### GCM-08041 4D Precision Lens/Mirror Holders

Part No.	D	d	В	Α	Weight(g)
GCM-080413M	20	18.5	32	62	177
GCM-080414M	25.4	24	32	62	177

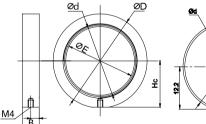
#### GCM-0811 Simple Lens/Mirror Holders



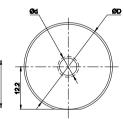
GCM-0811 Simple Lens/Mirror Holders

GCM-0811

The series of Simple Lens/Mirror Holders, GCM-0811 offer different size. They can be used with post GCM-0301 and other products.







GCM-081106-13M

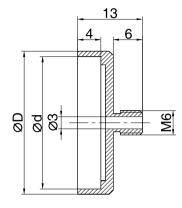
Part No.	Ød	ØD	В	Hc	ØE	Weight(g)
GCM-081106M	6	25.4	8	12.2	5	11
GCM-081110M	10	25.4	8	12.2	8.5	10
GCM-081113M	12.7	25.4	8	12.2	11	10
GCM-081120M	20	36	8	17.5	18	16
GCM-081125M	25.4	41.5	8	20.3	23.5	20
GCM-081130M	30	46	8	22.5	28	22
GCM-081140M	40	56	8	27.5	38	28
GCM-081150M	50.8	67	12	33	49	50





#### GCM-0801 Lens/Mirror Mounts

GCM-0801 mounts with different diameters, can be used on series of small lens/mirrors, GCM-0802.



GCM-0801

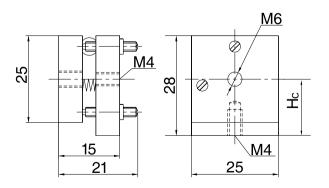
#### GCM-0801 Lens/Mirror Mounts

Part No.	Ød	ØD	Weight (g)
GCM-0801127M	12.7	13.5	2.2
GCM-080120M	20	20.8	2.8
GCM-0801254M	25.4	26.2	5
GCM-080130M	30	30.8	7

#### GCM-0802 Small Lens/Mirror Holders

The GCM-0802 series of small lens/mirror holders can be tilted about Y and Z axes through  $\pm 4^{\circ}$ , and can be fixed on other holders (GCM-0301) by means of the tapped hole A





GCM-080201M

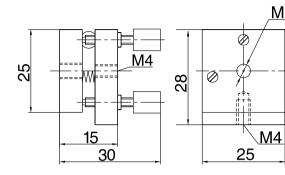
<u>M6</u>

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## Optic Holders

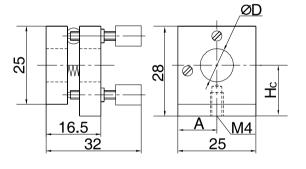
#### GCM-0802 Small Lens/Mirror Holders

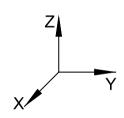




GCM-080202M



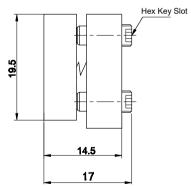


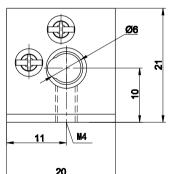


GCM-080203M GCM-080204M



GCM-080205M





#### GCM-0802 Small Lens/Mirror Holders

Part No.	D	Α	H <sub>c</sub>	Weight (g)
GCM-080201M			15.5	27
GCM-080202M			15.5	29
GCM-080203M	10	12.5	15.5	25
GCM-080204M	12.7	11	14	25
GCM-080205M	6	10.5	10	27





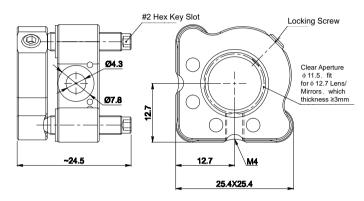
GCM-080213M



Adjustment Tooling: GCBS-010102 Hex Key

#### GCM-080213M Mini Stainless Steel Precision Lens/ Mirror Holders

The series of Mini Stainless Steel Precision Lens/Mirror Holders, GCM-080213M, can be used for \$\phi\$ 12.7mm optical elements. They offer angular adjustment along with both X and Y direction, with adjustment range  $\pm 4^{\circ}$ .



#### GCM-080213M Mini Stainless Steel Precision Lens/Mirror Holders

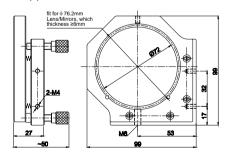
Part No.	Lens/Mirror Size	Weight(g)
GCM-080213M	Ø 12.7	38



GCM-0805/0806

#### GCM-0805/0806 Medium Lens/Mirror Holders

The series GCM-0805/0806 of Medium Lens/Mirror Holders hold lenses or mirrors of  $\phi$  76.2mm (or  $\phi$  100mm). They can be tilted about the Y and Z axes through  $\pm 4^{\circ}$ , and can be fixed on other types of holders by means of the tapped hole M6.



GCM-080501M

GCM-080601M

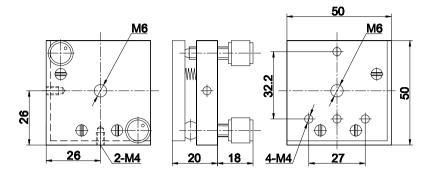
#### GCM-0805/0806 Medium Lens/Mirror Holders

Part No.	А	BxB	H <sub>c</sub>	Weight(g)	
GCM-080501M	53	99x99	76.2	53	200
GCM-080601M	71	134x134	100	71	514

#### GCM-080303M Mirror Holders

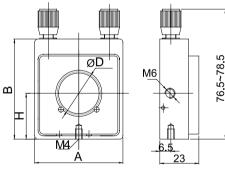


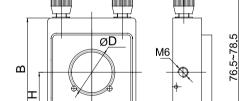
GCM-080303M



#### GCM-080904M Vertical Drive Kinematic Lens/Mirror Holders

GCM-080904M is a Vertical Drive Kinematic Lens/Mirror Holder, which provides two-axis tilting adjustment by means of two high precision screws on the top of the holder. It can be used in minimizes space along the optical axis, which can avoid obstructing the beam path during the adjustment. Each tilting adjustment has a range of  $\pm 2.5^{\circ}$  ( $\Theta$ x,  $\Theta$ y) rotations. There is also a tapped hole of M4 for adapting our other products.





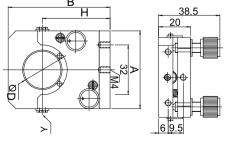
# GCM-080904M

#### GCM-081904M Gimbal Lens/Mirror Holders

GCM-081904M is a Gimbal Lens/Mirror Holder, which provides two high precision screws for orthogonal and coplanar adjustments independently. Each tilting adjustment has a range of  $\pm 5^{\circ}$  ( $\Theta x$ ,  $\Theta y$ ) rotations. There is also a tapped hole of M4 for adapting our other products.



GCM-081904M



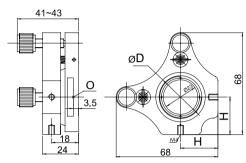




#### GCM-082904M Compact Gimbal Lens/Mirror Holders

GCM-082904M is a Compact Gimbal Lens/Mirror Holders, which provides two high precision screws for fine tilting adjustments in two separate axis without center translation. Each tilting range is  $\pm 4^{\circ}(\Theta x, \Theta y)$  rotations. There is also a tapped hole of M4 for adapting our other products.





#### GCM-082904M Compact Gimbal Lens/Mirror Holders

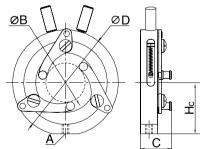
Part No.	AxB	ØD	Н
GCM-080303M	50x50		28
GCM-080904M	52x59	25.4	27
GCM-081904M	50x65.5	25.4	43.5
GCM-082904M	68x68	25.4	25

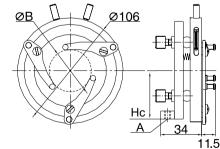
#### GCM-04/05 Self-Centering Lens Holders

GCM-04



The series GCM-04/05 of Self-Centering Lens Holders offer a reliable and self-centering mechanism for any round optical components. They are very useful when optics of variable diameters must be interchanged frequently and the height of the optical axis must be kept unchanged. Moreover, Adjustable Self-Centering Lens Holders GCM-05 can also be tilted relative to the X or Z axes through  $\pm 4^{\circ}$ .





GCM-04

GCM-05

#### GCM-04/05 Self-Centering Lens Holders

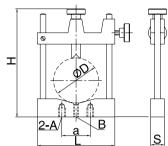
Part No.	Α	$\emptyset B_{\min}$	$\emptyset B_{max}$	H <sub>c</sub>	С	ØD	Weight (g)
GCM-0401M	M4	4	35	30	18	62	70
GCM-0402M	M4	7	64	52	23.5	106	190
GCM-0403M	M6	5	80	75	52	150	450
GCM-0501M	M6	7	64	45.5	45.5	106	285



GCM-0603

#### GCM-0603 V-Grooved Lens Chucks

The series GCM-0603 of V-grooved Lens Chucks can hold one or two optical elements in different shape, size and orientation. There is prism table for flat surface elements, like prisms, as well as a V-groove for positioning cylindrical or curved elements.



#### GCM-0603

#### GCM-0603 V-Grooved Lens Chucks

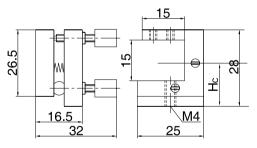
Part No.	H <sub>max</sub>	L	S	А	а	В	$ØD_{max}$	Weight(g)
GCM-060301M	73	48	10			M4	30	49
GCM-060302M	110	68	12	2-Ø6.5(Ø11x15)	25	M4	50	90
GCM-060303M	140	95	14	M6	50	M6	75	150
GCM-060304M	175	128	14	M6	50	M6	100	225

#### GCM-10 Kinematic Cylindrical Lens Holders

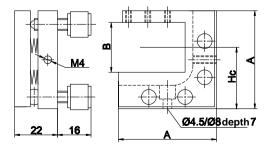
The series of Kinematic Cylindrical Lens Holders, GCM-10, provide smooth and precision tilt in two directions for the mounted cylindrical lens. The total angle adjustment in any of the direction is  $\pm 4^{\circ}$ . Screw M4 makes it compatible with post mounting.



GCM-1002



#### GCM-100201M



GCM-100202M

GCM-100203M

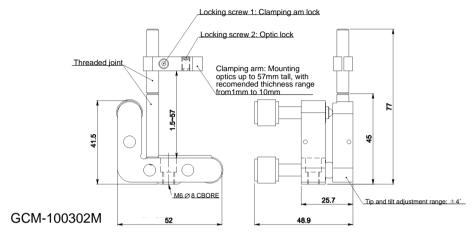




GCM-100302M

# GCM-100302M Cylindrical/Rectangular Lens Adjustable Holders

The series of adjustable holders for cylindrical lens, GCM-100302M, the height range is 5-50.8mm. The adjustment range for single axis is  $\pm 4^{\circ}$ . Fixed base has M6 threaded hole and  $\phi$  4mm hole.



#### GCM-10 Cylindrical/Rectangular Lens Adjustable Holders

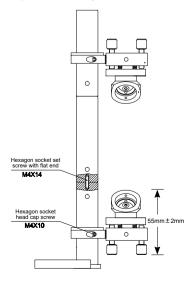
	,					
Part	No.	AxA	В	H <sub>c</sub>	Adjustment Range	Weight(g)
GCM-10	00201M	See Sketch	See Sketch	16.5	<del></del>	20
GCM-10	00202M	50x50	25.4	30	<del></del>	85
GCM-10	00203M	60x60	40	34		100
GCM-10	00302M	See Sketch	See Sketch	See Sketch	5-50.8	

#### **GCO-11 Beam Steerers**

GCO-11 is a Beam Steerer, which is used for setting or adjusting both the height and the direction of a laser beam. It can offer maximum 200mm height. Its lens holders can be assembled 25.4mm mirrors. It can be installed directly on the optical table by GCM-532 Clamping Fork.



GCO-11



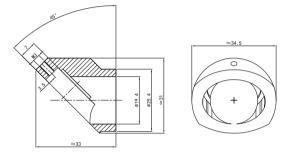
GCO-11



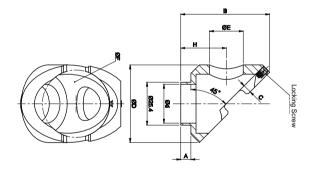
GCM-08110

#### GCM-081101/02/03M 45° Lens/Mirror Holders

The series of 45 ° Lens/Mirror Holders can make the light path turn 90 °. The minimum thickness of mounting optics should be thicker than 2mm. The locking method used is the top wire lock. In addition, the holders are equipped with bosses with diameter of 25.4mm. Users need to use these holders to fit with other opto-mechanical components with 25.4mm



GCM-081101M



GCM-081102M/03M

#### GCM-081101/02/03M 45º Lens/Mirror Holders

Part No.	Lens/Mirror Size F	Α	В	С	D	d	E	Н
GCM-081101M	25.4	6	32.7	7	30.7	19.4	/	/
GCM-081102M	40	6	53	5	46	23	20	27
GCM-081103M	50.8	6	65	5	57	23	28	39

GCM-06/07 Prism Tables	225
GCM-0602 V-groove Mounts	227
GCM-09 Polarizer/Waveplate Holders	227
GCM-09120 Glan Prism Adaptor Holders	228
GCM-092 Linear Polarization Attenuator	228
GCM-14 Filter Mounts	229
GCM-080305M CCD Adaptor Holders	230
GCM-080311M Objective Mounts	231
GCM-13 Plate Holders	231
GCM-18 Laser Holders	232

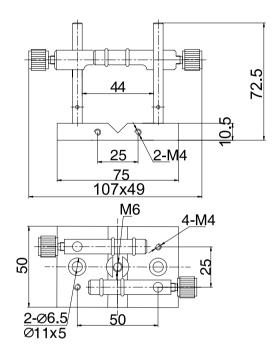


#### GCM-06/07 Prism Tables

The series of Prism Table, GCM-06/07, is designed to mount a square prism or crystal element. Various types of Prism Tables offer multiple adjustments, including pitch, tilt positioning and rotation.

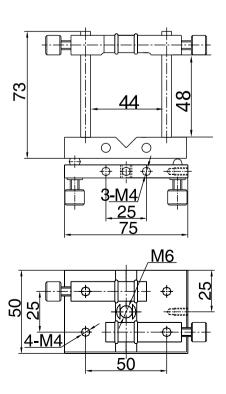


GCM-0601M





GCM-070101M

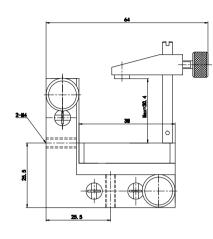


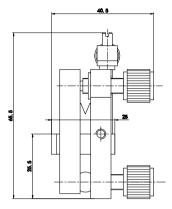


#### GCM-06/07 Prism Tables



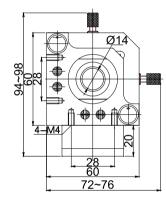
GCM-0702M

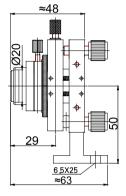






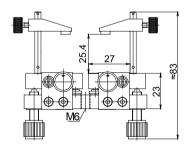
GCM-0704M 5D Prism Polarizer Holder

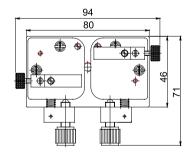






GCM-0705M





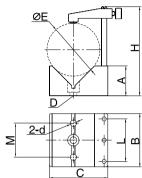
#### GCM-06/07 Prism Tables

Part No.	Max Mounting Size	Weight(g)
GCM-0601M	32 × 50 × 50	135
GCM-070101M	$32\times50\times50$	245
GCM-0702M	$30\times30\times30$	100
GCM-0704M	Ø 14	250
GCM-0705M	25.4 × 25.4 × 25.4	255

## GCM-0602 V-groove Mounts

GCM-0602

The Series of V-groove Mounts, GCM-0602, is designed to mount one or two optical elements in different sharp, size and orientation. There is a V-groove for positioning cylindrical or curved elements.



#### GCM-0602 GCM-0602 V-groove Mounts

Part No.	Α	В	С	Н	L	D	d	ØE	M	Weight(g)
GCM-060201M	20	20	34	50.5		M4		0~25		36.5
GCM-060202M	28	50	55	88	32	M6	Ø3.2/ Ø6x3.5	12~50	40	170
GCM-060203M	45	80	105	153	50	M6x14	Ø7/ Ø12x8	50~100	64	750
GCM-060204M	35	65	78	115	50	M6x10	Ø6.5/ Ø12x7	25~75	50	370

#### GCM-09 Polarizer/Waveplate Holders



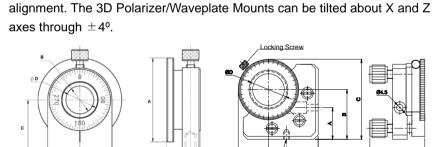




GCM-090



GCM-091



The series of Polarizer/Wave Plate Holders, GCM-09, is designed to mount the circular thin elements, such as polarizer (GCL-05) and waveplate (GCL-06). There is scale mark of 360° on the head face, for easy angular

#### GCM-09 Polarizer/Waveplate Holders

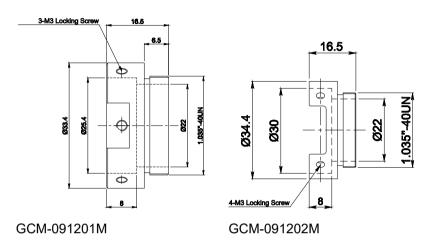
Part No.	А	В	С	ØD	W	Weight(g)
GCM-0901M	Ø30	Ø10	20	Ø12.7	12	15
GCM-0902M	Ø42	Ø22	26	Ø25.4	12.5	30
GCM-0903M	Ø43	Ø27	30	Ø30	12.5	45
GCM-0905M	Ø70	Ø46	40	Ø50.8	16	145
GCM-0911M	14.5	22.5	37	Ø12.7	31	40
GCM-0912M	22	34.5	55.5	Ø25.4	41.6	75





#### GCM-09120 Glan Prism Adaptor Holders

The series of Glan Prism Adaptor Holders, GCM-09120, is designed to mount Glan Prisms (GCL-0702). The Glan Prisms can be rotated by connecting to the 3D Waveplate Holders (GCM-09).

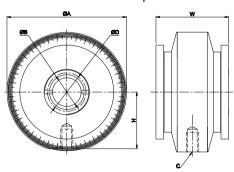


#### GCM-09120 Glan Prism Adaptor Holders

Part No.	Mounting Size
GCM-091201M	Ø25.4
GCM-091202M	Ø30.0

# GCM-092 Linear Polarization Attenuator

The Linear Polarization Attenuator has two linear polarizers, centered on the same axis, which can be rotated relatively to achieve different attenuation level. The rotating angle is marked. The mechanism of attenuation is based on the Malus Principle.





GCM-092

#### GCM-092 Linear Polarization Attenuator

Part No.	Α	В	С	D	W	Н	Weight(g)
GCM-0922M	Ø39.5	Ø9	M4	Ø12.7	24	18.7	75
GCM-0923M	Ø50	Ø22	M4	Ø25.4	24	24.5	130
GCM-0926M	Ø78	Ø47	M4/M6	Ø50.8	38	39	205

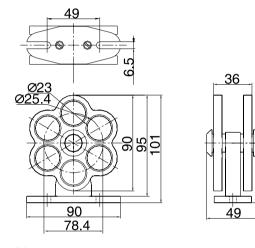
56

## Optic Mounts

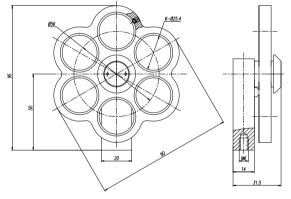


#### **GCM-14 Filter Mounts**

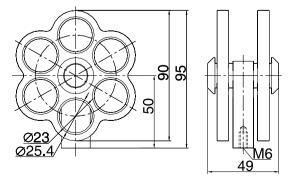
The series of Filter Mounts, GCM-14, is designed to mount up to 12 pieces of ND filters or any filters for 1-inch (or 25mm) diameter. Various Optical Densities can be obtained by rotating the filter wheels (GCM-140) or combination the five slot filter holders (GCM-141). There is locating slot on the filter mount, provides precision positioning.



#### GCM-1401M



#### GCM-1402M



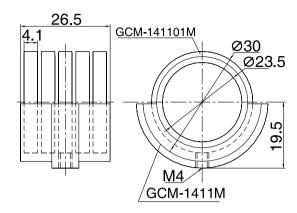
GCM-1403M





GCM-141M

#### **GCM-14 Filter Mounts**



**GCM-14 Filter Mounts** 

Part No.	Weight(g)
GCM-1401M	220
GCM-1402M	110
GCM-1403M	170
GCM-1411M	23
GCM-141101M	2

## GCM-080305M CCD Adaptor Holders

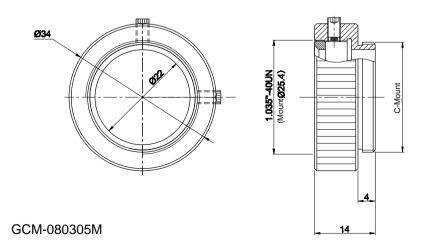
The series of CCD Adaptor Holders, GCM-080305M, is designed to mount the filters with minimum 2mm thickness to the CCD camera. There is 1" - 32 male thread to match C-mount CCD camera, and 1.035" -40 female thread on the other end which is available for other types of CCD camera. The locking mode includes locking ring and locking screw, to mount various thickness filters.



GCM-080305M

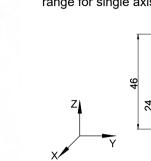


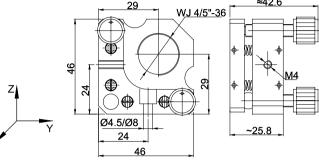
Example



#### GCM-080311M Objective Mounts

The series of Objective Mounts, GCM-080311M, is designed to mount the standard objective. By adjusting the two of fine threads, the lens can be precisely adjusted in both pitch and rotation directions. The adjustment range for single axis is  $\pm 4^{\circ}$ .





GCM-080311M Objective Mounts

Part No.	Weight(g)
GCM-080311M	188

#### GCM-13 Plate Holders

The series of Plate Holders, GCM-13, is designed to hold flat optics with thickness ≤5mm, and can be mounted to the post GCM-01.



GCM-130M

GCM-080311M



GCM-131M

36 1311M 40 4 35.5

GCM-1312M **GCM-13 Plate Holders** 

Part No.	А	L	Weight(g)
GCM-1301M	M6	100	155
GCM-1302M	M6	60	105
GCM-1311M	M6	52	105
GCM-1312M	M4	85	55





GCM-180201M



GCM-181101M



GCM-181102M



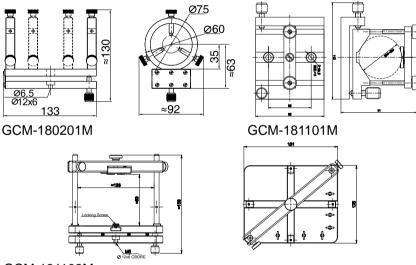
#### **GCM-18 Laser Holders**

GCM-180201M is designed to mount  $\,\phi$  25-60mm diameter lasers. The six nylon faced screws hold laser tubes gently and firmly, so that to make a fine and precise alignment of the laser beams. The base can be tilted over  $\pm\,3^{\circ}$ .

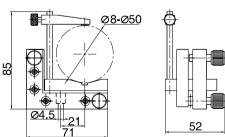
GCM-181101M is designed to mount  $\phi$  25-50mm diameter lasers. It features V-groove kinematic pivots to assure reliable holding and repeatable angular orientation. The base can be tilted over  $\pm 2^{\circ}$ .

GCM-181102M is designed to mount cuboid lasers with 123mm width, 100mm height and any length. The rubber blocks hold laser cuboids gently and firmly. The 4 sliding blocks on the table provide a initial stable location. The base can be tilted over  $\pm 2^{\circ}$ .

GCM-182101M is designed to mount  $\phi$  8-50mm diameter lasers. It can provide an angular range of  $\pm$ 4°. Its high-resolution adjustment screws act on hardened carbide inserts for smooth adjustment, minimal cross coupling and accurate beam placement.



GCM-181102M



GCM-182101M GCM-18 Laser Holder

Part No.	Weight (g)
GCM-180201M	135
GCM-181101M	555
GCM-182101M	186
GCM-181102M	1361

GCM-182101M

GCO-01 Spatial Filter	234
GCO-010 Pinholes	235
GCM-57 Iris Diaphragm	235
GCM-5721M CCD Diaphragm	237
GCM-5601 Slit	237
GCD-5702M Electric Diaphragm	238



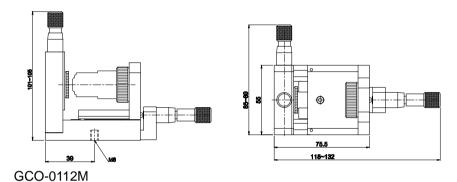




GCO-01

#### GCO-01 Spatial Filter

Spatial Filter features a standard 40x objective and a Pinhole. The laser through them is formed spherical light wave. The 40x objective (GCO-21) is used to focus the laser beam. Z direction is adjusted through the guide rail of high precision screw thread pair. Pinhole (GCO-010A) and objective(GCO-21) can be chosen according to requirements. We also offer a series of fiber connector (GCO-010xM) as its accessories.



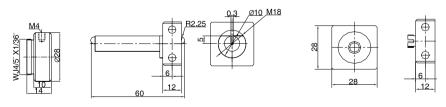
GCO-01 Spatial Filter

Part No.	Accessories	Weight (g)
GCO-0112M	1 piece of 40x Objective 3pieces of pinhole (10 μ m,15 μ m,25 μ m)	405



#### **Spatial Filter Accessories**

Fiber connectors (GCO-010xM) can replace the pinholes (GCO-010xM) in spatial filter. GCO-0120M is used in conjunction with 35mm standard objective lens.



GCO-0120M GCO-0101M

GCO-0102M/0103M

#### GCO-01Spatial Filter Accessories

•			
Part No.	Accessories	Specification	Weight (g)
GCO-0101M	Fiber Connector	Core Dia. <300 μ m	20
GCO-0102M	Fiber Connector	SMA905	20
GCO-0103M	Fiber Connector	FC/PC	20
GCO-0120M	Objective Lens ring	Ø28	10



GCO-010 Pinholes

#### GCO-010 Pinholes

A series of pinholes have different sizes. Their diameter are 10mm and their thickness are 0.1mm. The pinhole holder is easy to be placed on the spatial filter (GCO-01). GCO-010xxx is a pinhole without mount.

#### GCO-010 Pinholes

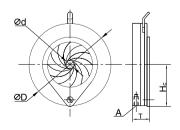
Part No.	Aperture(µm)
GCO-01005	5
GCO-01010	10
GCO-01015	15
GCO-01020	20
GCO-01025	25
GCO-01050	50
GCO-01100	100
GCO-01005A	5
GCO-01010A	10
GCO-01015A	15
GCO-01020A	20
GCO-01025A	25

## GCM-57 Iris Diaphragm

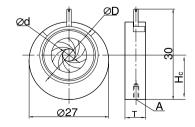
The iris diaphragm offers a continuously variable aperture for a variety of optical systems. Moving the shift lever can change diameter of the diaphragm. The threaded hole A (see fig.) is used for mounting the diaphragm on a post.



GCM-57



GCM-5701M



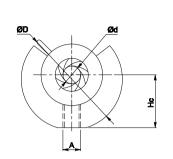
GCM-5702M

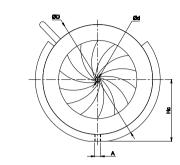


## GCM-57 Iris Diaphragm









GCM-5703M

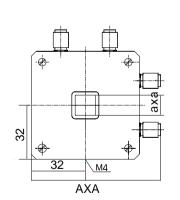
GCM-5704M

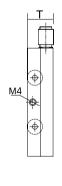
#### GCM-57 Iris Diaphragm

Part No.	А	ØD	Ød <sub>min</sub>	Ød <sub>max</sub>	Т	Hc	Weight(g)
GCM-5701M	M4	50	2.0	28	18	24.5	40
GCM-5702M	M4	27	1.0	12	7.8	14.5	10
GCM-5703M	M4	23	0.8	7.5	6.5.	12	8
GCM-5704M	M4	83	3	52	9.5	41	50









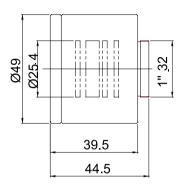
#### GCM-5711M

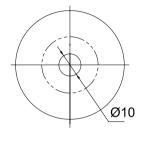
Part No.	AxA	axa <sub>min</sub>	axa <sub>max</sub>	Т	Weight(g)
GCD-5711M	77x77	0.1x0.1	12x12	16	153

## GCM-5721M CCD Diaphragm



GCM-5721M





GCM-5721M

#### GCM-5721M CCD Diaphragm

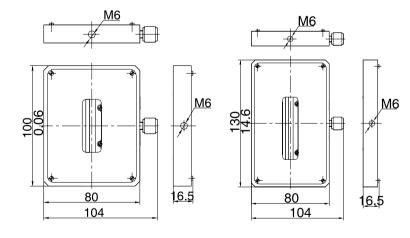
Part No.	Weight(g)
GCM-5721M	170

#### GCM-5601 Slit

A series of slits (GCM-56) provide different lengths with adjustable width. There are M6 holes on the two sides, which are used together with the post (GCM-030) or other products to obtain horizontal or vertical slits.



GCM-5601



GCM-560101M

GCM-560102M

#### GCM-5601 Slit

Part No.	Dimension	Weight(g)
GCM-560101M	40x0~40x10	220
GCM-560102M	80x0~80x6	270



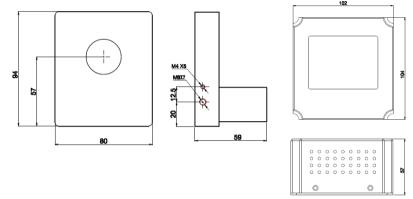


GCD-5702M

#### GCD-5702M Electric Diaphragm

GCD-5702M has a controller with a touch display controller, which can drive diaphragm's change in diameter, and its state can watched through its display directly.

The controller need to connect power supply (GCD-040201M). User also can control it with specified software. In addition, it support to control several apertures at same time.



GCD-5702M

#### GCD-5702M Electric Diaphragm

Part No	. Ødmin(mm)	Ødmax(mm)	Tolerance	Min. Opening and Closing Time	Weight(kg)
GCD-570	2M Φ2.5	Ф28	$\pm0.5$	8s	0.5

GCM-01 Threaded Adjustable Post	240
GCM-02 Coarse-Fine Adjustment Post Holders	240
GCM-030 Ø12.7 Series Standard Posts and Holders	241
GCM-03031 Pre-pressed Post	242
GCM-031 Ø6 Series Mini Posts and Holders	243
GCM-030 Ø25.4 Stainless Steel Post	244
GCM-550111M Right Angle Mount	248
GCM-22 Ø38.1 Series Posts and Accessories	249
GCM-51 Extension Posts Rods	252
GCM-55 Ø12.7 Rod Clamps	252
GCM-54 Screw Adapter	254

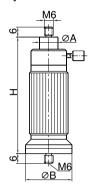




#### GCM-01 Threaded Adjustable Post

The height of the posts can be adjusted conveniently, quickly and accurately. One complete turn produces 12mm height change. The post can be reliably locked in place by a thumbscrew. The posts can be easily mounted on magnetic bases (GCM-42), magnetic plates (GCM-43), breadboards (GCM-30) and post bases (GCM-53), or directly mounted to an optical table.

GCM-01



#### GCM-01 Threaded Adjustable Post

G	C	M	-(	0	1

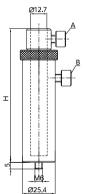
Part No.	ØA	ØB	$H_{min}$	H <sub>max</sub>	Weight(g)
GCM-0101M	12	32	50	65	109
GCM-0102M	12	32	60	85	129
GCM-0103M	12	32	75	115	160
GCM-0104M	12	32	110	180	237

#### GCM-02 Coarse-Fine Adjustment Post Holders



GCM-02

GCM-02 Coarse-Fine Adjustment Post Holders provide both coarse and fine height adjustments for the GCM-0301 posts. By lossening screw A; the post can rotate 360° and its height can be coarsely adjusted. After tightering screw A, the height can be finely adjusted by turning the large thumbscrew. Screw B locks the post in place. The holders can be mounted on magnetic bases (GCM-42), magnetic plates (GCM-43), breadboards (GCM-30), and post bases (GCM-53), or directly mounted to an optical table.



#### GCM-02 Coarse-Fine Adjustment Post Holders

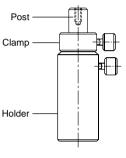
Part No.	$H_{min}$	H <sub>max</sub>	Weight(g)
GCM-0201M	77	90	80
GCM-0202M	103	116	95

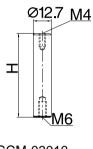
GCM-02

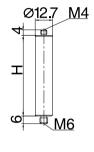
# GCM-030

#### GCM-030 Ø12.7 Series Standard Posts and Holders

This series consists of posts (GCM-0301), clamps (GCM-0302) and holders (GCM-0303), providing a quick way to set the height and angular orientation of mounted components. The posts can be rotated 360° without changing their height. All the posts are of stainless steel. The holders can be mounted on magnetic bases (GCM-42), magnetic plates (GCM-43), breadboards (GCM-30), and post bases (GCM-53), or directly mounted to an optical table.

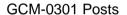






GCM-03010

GCM-03011

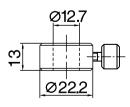


Part No. (Internal thread)	Part No. (External thread)	Н	Weight(g)
GCM-030107M	GCM-030117M	25	25
GCM-030108M	GCM-030118M	37.5	38
GCM-030101M	GCM-030111M	51	50
GCM-030102M	GCM-030112M	76	75
GCM-030103M	GCM-030113M	102	100
GCM-030104M	GCM-030114M	152	150
GCM-030105M	GCM-030115M	203	195
GCM-030106M	GCM-030116M	305	295

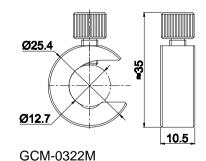




GCM-0302



GCM-0302M



#### GCM-0302 Clamps

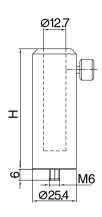
Part No.	Weight(g)
GCM-0302M	15
GCM-0322M	10



#### GCM-030 Ø12.7 Series Standard Posts and Holders



GCM-0303

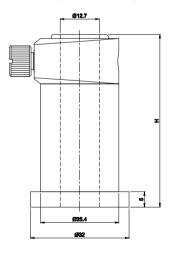


#### GCM-0303 Holders

Н	Weight(g)
51	50
76	80
102	105
152	150
25	26
37.5	38
	51 76 102 152 25

#### GCM-03031 Pre-pressed Post

A series of GCM-03031 are adjustment posts which can keep the rod (GCM-0301) from falling while in the process of adjustment and locking.



#### GCM-03031 Pre-pressed Post

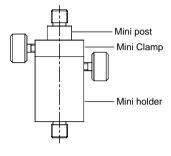
Part No.	Н
GCM-030311M	37.5
GCM-030312M	51
GCM-030313M	76
GCM-030314M	102

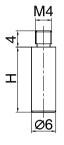




#### GCM-031 Ø6 Series Mini Posts and Holders

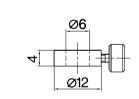
Where space is limited, the GCM-0311 Mini Posts, GCM-0312 Mini Clamps and GCM-0313 Mini Holders can be used. They can be quickly and conveniently assembled into a height and angle adjustable system. The posts can rotate 360° without changing height. The Mini Holders can be mounted on GCM-42 magnetic bases or onto an optical table.

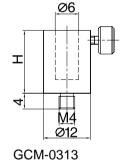




GCM-031

GCM-0311





GCM-0312

GCM-0311 Mini Posts

Part No.	Н	Weight(g)
GCM-031101M	16	4
GCM-031102M	21	5
GCM-031103M	26	6
GCM-031104M	31	7

#### GCM-0312 Mini Clamp

Part No.	Weight(g)
GCM-0312M	2

#### GCM-0313 Mini Holders

Part No.	Н	Weight(g)
GCM-031301M	16	4
GCM-031302M	21	6
GCM-031303M	26	7





GCM-0313



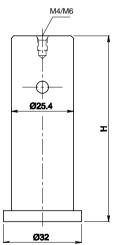
GCM-03012

#### GCM-030 Ø25.4 Stainless Steel Post

A series of Stainless steel posts include post, connecting rod, gasket and matching accessory. The main products are made of high quality stainless steel which provides good strength and rigidity. Their diameters are 25.4mm and their stability are high. This series of products are ideal support components for high-precision tests.

#### GCM-03012 Ø25.4 Stainless Steel Post

A series of posts (GCM-03012) are made of stainless steel with high strength and rigidity. Their upper ends are M4/M6 screw hole for easy connection of various optical frames, their lower ends have bases, which are convenient to be fixed by clamping fork (GCM-5328M) to improve its stability. The side face has a  $\Phi$ 5mm through-hole, which provides more prying force when tightening with the fastening tools.



GCM-03012

#### GCM-03012 Ø25.4 Stainless Steel Post

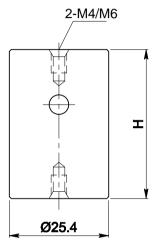
Α	Н	Weight(g)
M4	12.7	60
M4	25.4	105
M4	38.1	158
M4	50.8	213
M4	76.2	305
M4	101.6	415
M6	12.7	60
M6	25.4	107
M6	38.1	157
M6	50.8	212
M6	76.2	305
M6	101.6	415
	M4 M4 M4 M4 M4 M6 M6 M6 M6	M4     12.7       M4     25.4       M4     38.1       M4     50.8       M4     76.2       M4     101.6       M6     12.7       M6     25.4       M6     38.1       M6     50.8       M6     76.2



GCM-03013

#### GCM-03013 Ø25.4 Stainless Steel Rod

A series of stainless steel rods (GCM-03013) provide good strength and rigidity. The upper and lower ends are M4/M6 screw holes are easy to connect various mechanical component with thread adapter (GCM-541102). Its side face has a  $\Phi$ 5 mm through-hole, which provide more prying force when tightening with the fastening tools.



GCM-03013

#### GCM-03013 Ø25.4 Stainless Steel Rod

Part No.	Α	Н	Weight(g)
GCM-030130M	M4	12.7	50
GCM-030131M	M4	25.4	96
GCM-030132M	M4	38.1	147
GCM-030133M	M4	50.8	196
GCM-030134M	M4	76.2	295
GCM-030135M	M4	101.6	393
GCM-030630M	M6	12.7	50
GCM-030631M	M6	25.4	95
GCM-030632M	M6	38.1	145
GCM-030633M	M6	50.8	195
GCM-030634M	M6	76.2	295
GCM-030635M	M6	101.6	395
GCM-030636M	M6	200	785
GCM-030637M	M6	300	1178

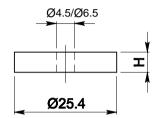




GCM-03014

#### GCM-03014 Ø25.4 Stainless Steel Plate

A series of Stainless steel plates are regarded as compensation for the height of post (GCM-03012 series) and the rod (GCM-03013 series). They does not reduce structural stiffness. Two sizes of  $\Phi4.5/\Phi$  6.5 through holes in the middle of plate.



GCM-03014

#### GCM-03014 Ø25.4 Stainless Steel Plate

Part No.	Through-hole	Н	Weight(g)
GCM-030141M	4.5	1	5
GCM-030142M	4.5	2	8
GCM-030143M	4.5	5	19
GCM-030144M	6.5	1	5
GCM-030145M	6.5	2	8
GCM-030146M	6.5	5	19

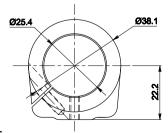
# GCM-0302 Ø25.4 Stainless Steel Accessory

GCM-030211M

Example

The post collar (GCM-030211M) is made of aluminum alloy. It is used on side of stainless steel post face, fixed mirror mount and other adjustment components.





GCM-030211M

#### GCM-030211M Post Collar

GCM-030211M Post Collar

Part No.	Ødmin(mm)	Ødmax(mm)	Thickness	Weight(g)
GCM-030211M	38.1	25.4	12.7	27

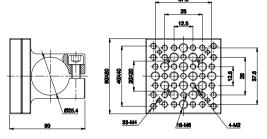


GCM-030212M



# GCM-030212M Post Mounting Plates

The post mounting plate GCM-030212M has enough mounting holes to hold various devices vertically on stainless steel post (GCM-03012 and GCM-03013).

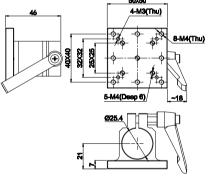


GCM-030212M

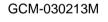
GCM-030212M Post Mounting Plates

Part No.	Size
GCM-030212M	50x50

# GCM-030213M Post Adapter



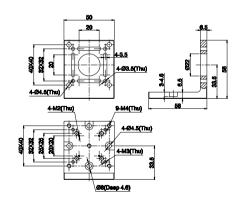




# GCM-030241 Right Angle Post Adapter







#### GCM-030241M

Part No.	Size	Weight(g)
GCM-030213M	50x50	113
GCM-030241M	50x58	





GCM-030221M



Example



GCM-030231M



Example

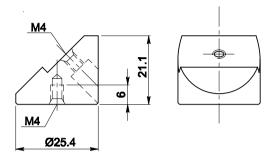


GCM-550111M



#### GCM-030221M 45° Rod

The 45° rod is made of high-quality stainless steel. It is used for turning adjustment rack angle into 45°, convenient for changing in light path. The upper and lower ends are M4 threaded holes for easy connection.



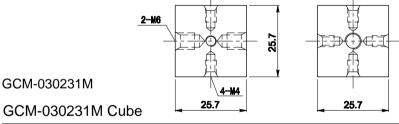
GCM-030221M

#### GCM-030221M 45° Rod

Part No.	ØD	Thickness
GCM-030221M	25.4	21.1

#### GCM-030231M Cube

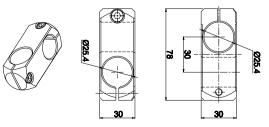
The cube is made of high quality stainless steel. It is used for 90° conversion between stainless steel post and other products. Upper and lower ends have M6 threaded-hole, and the other four surfaces are respectively provided with M4 threaded holes for easy connection.



Part No.	ØD
GCM-030231M	25.7

# GCM-550111M Right Angle Mount

Right angle mount GCM-550111M can be used to secure two stainless steel posts with Ø25.4mm.



GCM-550111M

#### GCM-22 Ø38.1 Series Posts and Accessories

This series include a post, sliding clamp and accessories, providing fast vertical alignment of mounted components with high stability, rigidity and lead capacity. The accessories may be purchased separately or as a system.



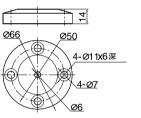


Part No.	Weight(g)
GCM-220401M	155

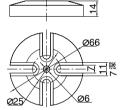


GCM-220401M

GCM-220501M GCM-220502M



GCM-220501M



GCM-220502M

#### GCM-2205 Post Bases

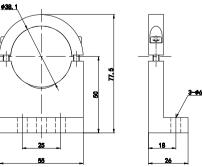
Part No.	Weight(g)
GCM-220501M	85
GCM-220502M	70

#### GCM-220503M Mount

The GCM-220503M mount is designed for horizontally holding a 38.1 mm diameter post.



GCM-220503M



GCM-220503M Mount

Part No.	Weight(g)
GCM-220503M	95

GCM-220503M

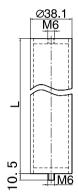




GCM-2211

#### GCM-2211 Ø38.1 Gear Rack Posts

The posts are made of stainless steel. Optical components mounted or a sliding platform attached to the post can be easily raised of lowered over a wide range.



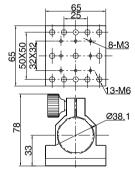
GCM-2211

GCM-2211 Posts

Part No.	L	Weight(g)
GCM-221101M	203	705
GCM-221102M	355	945

# GCM-2212 Sliding Bracket Clamp

This clamp is used together with the GCM-2211 posts and other accessories for adjusting the height of optical components. A reliable locking mechanism is incorporated.



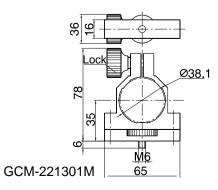
GCM-221201M

GCM-2212 Sliding Bracket Clamp

Part No.	Weight(g)
GCM-221201M	355

### GCM-2213 Narrow Sliding Clamp

The GCM-2213 Narrow Sliding Clamp is designed for horizontally holding a 38.1 mm diameter post.



GCM-2213 Narrow Sliding Clamp

Part No.	Weight(g)
GCM-221301M	105

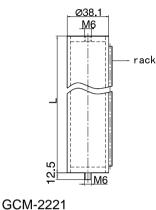


GCM-221201M



#### GCM-2221 Ø38.1 Gear Rack Posts

The post is made of high quality stainless steel, which can be equipped with gear plate and installed with other series of products. The height of optical element can be adjusted quickly and widely.



GCM-2221 Gear Rack Posts

Part No.	L	Weight (g)
GCM-222101M	203	570
GCM-222102M	355	1335



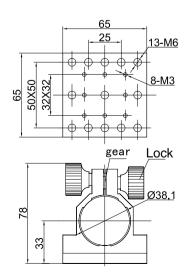
#### GCM-222201M



GCM-2221 Example

# GCM-2222 Pinion Titled Clamp

In connection with the GCM-2221 posts, this clamp is used for vertical adjustment of optical components through a reliable rack and pinion movement. The height may be locked in place.



GCM-222201M

# GCM-2222 Pinion Tilted Clamp

Part No.	Weight (g)
GCM-222201M	355

GCM-51

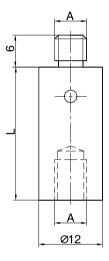


# **Mechanical Accessory**



#### **GCM-51 Extension Posts**

The extension posts are supplied in a variety of lengths, ranging from 25mm to 75mm. Threaded at both ends, they can be connected to each other, or mounted on top of other posts such as GCM-03.



**GCM-51 Extension Posts** 

Part No.	Α	L	Weight
GCM-510101M	M4	25	25
GCM-510102M	M4	38	38
GCM-510103M	M4	50	50
GCM-510104M	M4	63	63
GCM-510105M	M4	75	75
GCM-510201M	M6	25	25
GCM-510202M	M6	38	38
GCM-510203M	M6	50	50
GCM-510204M	M6	63	63
GCM-510205M	M6	75	75

GCM-51



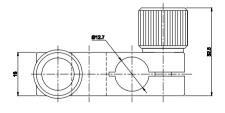
GCM-550101 Example

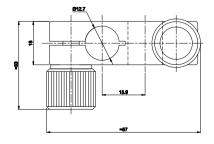


GCM-550101

# GCM-55 Ø12.7 Rod Clamps

The GCM-5501 Series of Rod Clamps are used for securing two rods or lens/mirror holders at 45°, 90° or 360° angle to each other.





GCM-55

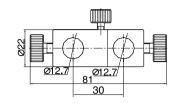
# **GCM-55 Rod Clamps**



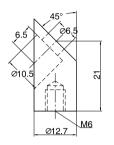
GCM-550102



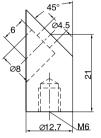
GCM-550103M GCM-550104M



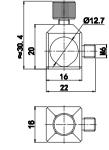
GCM-550102



GCM-550103M



GCM-550104M



GCM-550105M



Part No.	Specification	Weight (g)
GCM-550101	90°、Ø12.7	65
GCM-550102	360° 、Ø12.7	55
GCM-550103M	45°、M6	5
GCM-550104M	45° 、 M4	6
GCM-550105M	90°、M6、Ø12.7	15



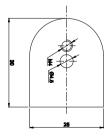
GCM-550105M

# GCM-550201M Flip Mount Adapter

Quick switching, stable reset, can be used with the company's various frames.



GCM-550201M



GCM-550201M

#### GCM-550201M Flip Mount Adapter

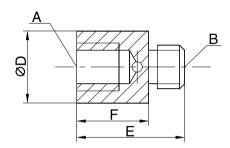
Part No.	Angle	Weight(g)
GCM-550201M	90°	65

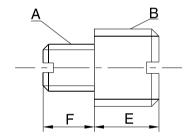


GCM-540

# GCM-54 Screw Adapter Rods

Thread adaptors have threads at both ends. They offer a convenient way to connect components with different threads such as metric and imperial or different diameters.







GCM-541

#### GCM-54 Screw Adapter Rods

Part No.	A—B	ØD	F	E	Weight (g)
GCM-540101	8-32 to 1/4"-20	10	9	15	2
GCM-540102	8-32 to M4	10	9	14	2
GCM-540103	8-32 to M6	10	9	15	2
GCM-540201	1/4"-20 to 8-32	10	10	15	2
GCM-540202	1/4"-20 to M4	10	10	15	2
GCM-540203	1/4"-20 to M6	10	10	16	4
GCM-540301	M4 to 8-32	10	9	14	2
GCM-540302	M4 to 1/4"-20	10	9	15	2
GCM-540303	M4 to M6	10	9	15	2
GCM-540401	M6 to 8-32	10	10	15	2
GCM-540402	M6 to 1/4"-20	10	10	16	2
GCM-540403	M6 to M4	10	10	15	5
GCM-540501	M10x1 to 8-32	13	15	20	6
GCM-540502	M10x1 to M4	13	15	20	6
GCM-540503	M10x1 to 1/4"-20	13	15	21	6
GCM-540504	M10x1 to M6	13	15	21	7

#### GCM-541 Screw Adapters

Part No.	А—В	F	Е	Weight (g)
GCM-541101	M4 to M4	5	5	0.2
GCM-541102	M4 to M6	5	6	0.8
GCM-541202	M6 to M6	6	6	1

GCM-42 Magnetic Bases2	56
GCM-43 Magnetic Plates2	57
GCM-53 Post Bases2	57
GCM-532 Table Clamps2	59
GCM-532 Clamping Fork2	60
GCBS-0611 Wire Clamp2	60
GCM-AB Right Angle Adapter2	61
GCM-5333M Right Angle Bracket2	62
GCM-531 Right Angle Bases2	62
GCD Right Angle Plateform2	64
GCM-AP Angle Adapter Bracket2	65
GCM-30 Breadboards2	66
GCM-301011M Breadboard Feet2	67
GCM-30102 Vetical Bracket2	67
GCM-30103M Breadboard Handle2	68
GCM-72 Optical Rails2	69





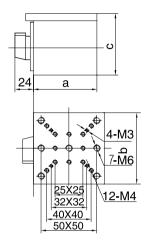
# **GCM-42 Magnetic Bases**

Magnetic bases provide a solid, stable support for optical components. A tapped hole can accommodate various posts such as the GCM-01, GCM-02 and GCM-03.



\$ 8

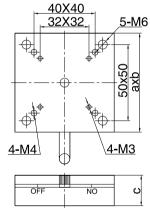




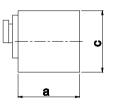
GCM-420101M

GCM-420102M









20X20

4-M2(Depth5)

M6(Depth5) GCM-420401M

GCM-420302M

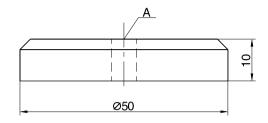
#### GCM-42 Magnetic Bases

Part No.	а	b	С	Attractive force (kg)	Weight (g)
GCM-420101M	61	51	55	45	450
GCM-420102M	65	65	63	45	520
GCM-420302M	65	65	20	30	550
GCM-420401M	35	30	35	10	250



# **GCM-43 Magnetic Plates**

These plates provide a stable and reliable base for optical components. They are small, stable and easy to re-position. A tapped hole accommodates the GCM-01,GCM-02,GCM-03 posts.



GCM-43 Magnetic Plates

Part No.	Α	Attractive Force (kg)	Weight (g)
GCM-4301M	M6	>6kgs	120

#### GCM-53 Post Bases

The post bases allow posts, translation stages and rotation stages to be mounted anywhere on an optical table or optical breadboard.



GCM-530101M



GCM-530201M



GCM-530101M



GCM-530201M



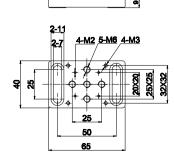
6



GCM-530301M



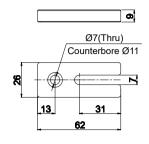
GCM-530301M





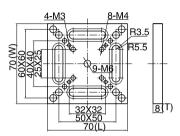
# **GCM-53 Post Bases**





GCM-530401M

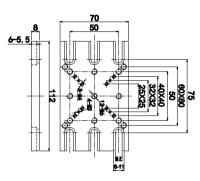
GCM-530401M



GCM-5305M



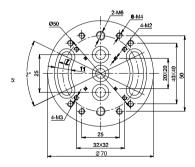
GCM-5305M



GCM-5306M



GCM-5306M



GCM-5308M

GCM-5308M

#### GCM-53 Post Bases

Part No.	Т	LxW	Weight (g)
GCM-530101M	9	62x26	39
GCM-530201M	9	62x26	59
GCM-530301M	9	65x40	40
GCM-530401M	9	62x26	37
GCM-5305M	8	70x70	75
GCM-5306M	8	112x70	150
GCM-5308M	8	Ø70	65

GCM-5321M



GCM-532102M



GCM-532103M



GCM-532104M



GCM-5322M



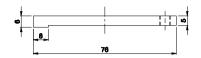
GCM-532202M



Example

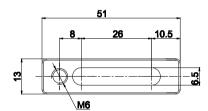
# GCM-532 Table Clamps

Table Clamps (GCM-532) are used to press the products which are not easy to be fixed on the platform.



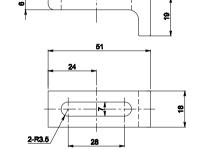


GCM-5321M

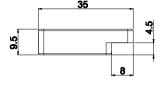


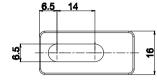


GCM-532103M



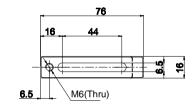
GCM-5322M



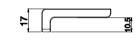


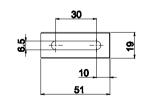
GCM-532102M





GCM-532104M





GCM-532202M

### GCM-532 Table Clamps

Part No.	LxW
GCM-5321M	76X18
GCM-532102M	35X16
GCM-532103M	51X13
GCM-532104M	76X16
GCM-5322M	51X18
GCM-532202M	51X19





GCM-5326M

GCM-5328M







GCM-5327M

GCM-5329M

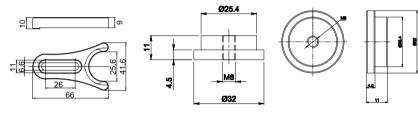




GCM-5325M

### GCM-532 Clamping Fork

GCM-5326M Clamping Fork and GCM-5327M Post Base are made of aluminum alloy.GCM-5328M Clamping Fork and GCM-5325M、GCM-5329M Post Base are made of stainless steel. GCM-5325M Post Base includes four pieces of magnetic disks which can be easy for its assembly.



GCM-5326M GCM-5328M

GCM-5327M GCM-5329M

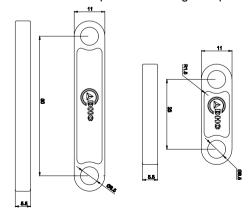
GCM-5325M

#### GCM-532 Clamping Fork

Part No.	Material	Weight (g)
GCM-5326M	Aluminum Alloy	60
GCM-5327M	Aluminum Alloy	30
GCM-5328M	Stainless Steel	75
GCM-5329M	Stainless Steel	50
GCM-5325M	Stainless Steel	55

### GCBS-0611 Wire Clamp

The wire clamp is used to fix various wires on the optical platform. A series of products include five short clamps and five long clamps.



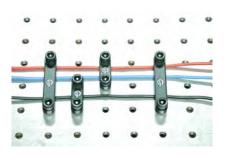
#### GCBS-0611

#### GCBS-0611 Wire Clamp

Part No.	Hole spacing
GCBS-0611	5pieces of 25mm + 5pieces of 50mm



GCBS-0611



Example



GCM-AB0101M



GCM-AB0102M



GCM-AB0103M



GCM-AB0104M

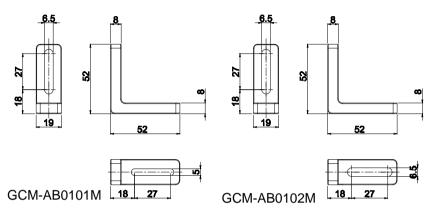


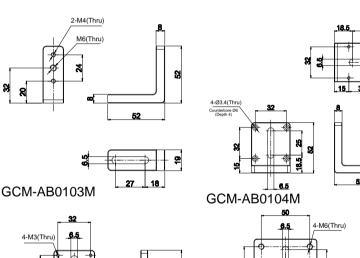
GCM-AB0105M

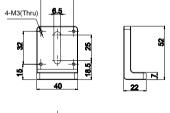


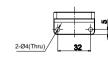
# GCM-AB Right angle Adapter

A series of right angle adapter (GCM-AB) have long through-hole, which are convenient for mounting various components.

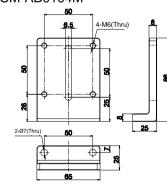








GCM-AB0105M



GCM-AB0106M

#### GCM-AB Right Angle Adapter

Part No.	Size	Diameter
GCM-AB0101M	52x52x19	Ø6.5~Ø5
GCM-AB0102M	52x52x19	Ø6.5~Ø6.5
GCM-AB0103M	52x52x19	Ø6.5
GCM-AB0104M	52x52x40	Ø6.5
GCM-AB0105M	52x22x40	Ø6.5
GCM-AB0106M	86x25x65	Ø6.5

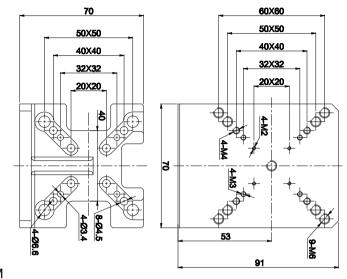




GCM-5333M

# GCM-5333M Right Angle Bracket

GCM-5333M right angle bracket is used to connect two components vertically. It has abundant holes for various devices.



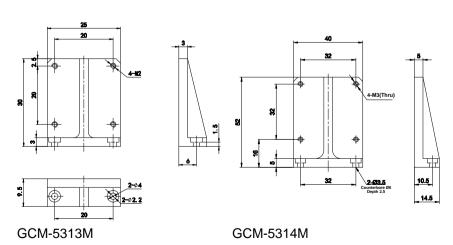
GCM-5333M

#### GCM-5333M Right angle Bracket

Part No.	Weight (g)
GCM-5333M	185

# GCM-531 Right Angle Bases

The GCM-531 Right Angle Bases are used for mounting 3-dimentional translation stages, or holding two components at right angle.

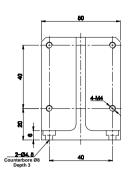


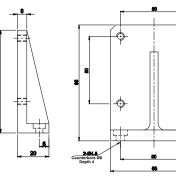


# GCM-531 Right Angle Bases



GCM-531



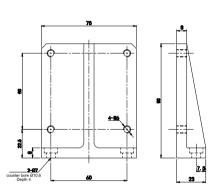


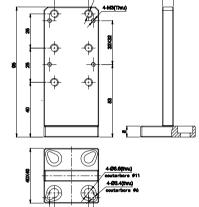
GCM-5315M

GCM-5316M





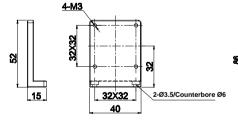


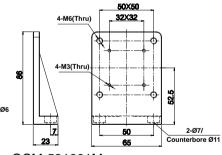


GCM-531601M/GCM-531404M stainless steel

GCM-5317M

GCM-531402M





GCM-531401M

GCM-531601M

#### GCM-531 Right Angle Bases

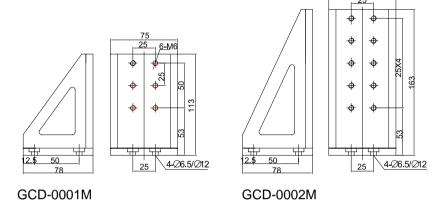
•	0			
Part No.	Hole spacing (mm)	Hc(mm)	Weight (g)	Material
GCM-5313M	20X20(M2)	17.5	10	Aluminum
GCM-5314M	32X32(M3)	32	35	Aluminum
GCM-5315M	40X40(M4)	40	70	Aluminum
GCM-5316M	50X50(M6)	52.5	125	Aluminum
GCM-5317M	60X60(M6)	52.5	165	Aluminum
GCM-531402M	25X25(M6)	65	90	Aluminum
GCM-531401M	32X32(M3)	32	210	Stainless steel
GCM-531601M	50X50(M6)	52.5	330	Stainless steel

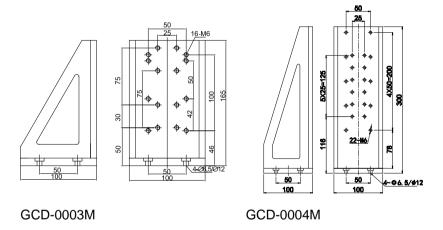




# GCD Right Angle Plateform

The right angle platform is used for the two-dimensional and threedimensional combination of the motorized stages.





### GCD Right Angle Plateform

•		
Part No.	Size	Weight (g)
GCD-0001M	113x75x78	450
GCD-0002M	163x75x78	590
GCD-0003M	165x100x100	870
GCD-0004M	300x100x100	1400



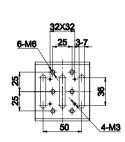
GCM-AP1030M

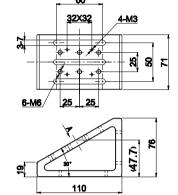


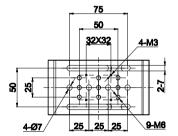
GCM-AP1045M

# **GCM-AP Angle Adapter Bracket**

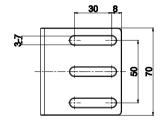
The Angle Adapter Bracket can be used to connect the breadboard or other mechanical components requiring angle of 45°, 30° and 60°. Its structure design is integrated to give high strength support performance.

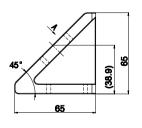


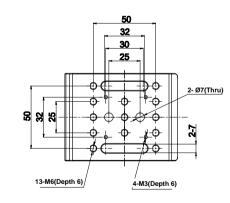




#### GCM-AP1030M







GCM-AP1045M

#### GCM-AP Angle Adapter Bracket

Part No.	Angle	Material	Weight (g)
GCM-AP1045M	45°	Aluminum	260
GCM-AP1030M	30° or 60°	Aluminum	430

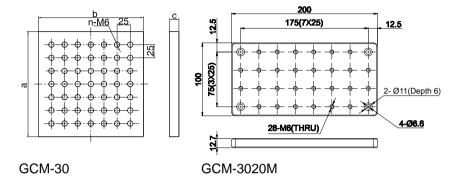


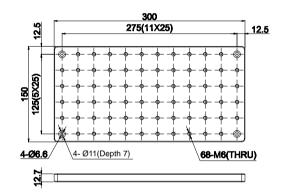


GCM-30

#### GCM-30 Breadboards

These breadboards are made of two kinds of materials, alloy steel (GCM-300) and aluminum alloy (GCM-301). The surface is arranged with M6 thread holes with 25mm offset.





GCM-3021M

#### GCM-30 Breadboards

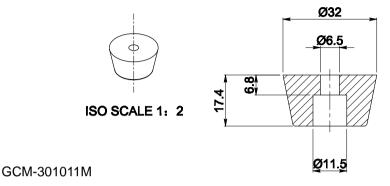
Part No.	axbxc	n	Material	Weight (g)
GCM-3001M	200x200x12.7	49	Alloy Steel	3725
GCM-3002M	200x250x12.7	63	Alloy Steel	4680
GCM-3003M	200x300x12.7	77	Alloy Steel	5270
GCM-3004M	250x300x12.7	99	Alloy Steel	6905
GCM-3005M	300x450x12.7	187	Alloy Steel	12555
GCM-3006M	450x600x12.7	391	Alloy Steel	25110
GCM-3007M	600x600x12.7	529	Alloy Steel	33480
GCM-3011M	200x200x12.7	49	Aluminum Alloy	1955
GCM-3013M	200x300x12.7	77	Aluminum Alloy	2000
GCM-3015M	300x450x12.7	187	Aluminum Alloy	4300
GCM-3016M	450x600x12.7	391	Aluminum Alloy	8600
GCM-3017M	600x600x12.7	529	Aluminum Alloy	11465
GCM-3018M	600x900x12.7	805	Aluminum Alloy	17200
GCM-3019M	300x600x12.7	253	Aluminum Alloy	5989
GCM-3020M	100x200x12.7	28	Aluminum Alloy	900
GCM-3021M	150x300x12.7	68	Aluminum Alloy	1230





#### GCM-301011M Breadboard Feet

GCM-301011M breadboard s feet are 4 pieces in a set, which can be installed on the bottom of any size breadboards with one M6 screw. The low friction resin material can effectively protect the bottom surface and make it easy to locate or move the breadboard.



#### GCM-30102 Vetical Bracket

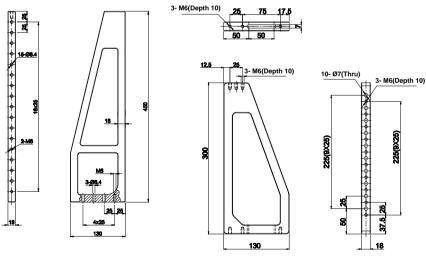
GCM-030102 vertical bracket has M6 threaded holes and through-holes, allows the breadboard of various sizes to be fixed vertically to the optical platform. In addition, there are various holes on the vertical bracket can be used to fix different products.



GCM-301021M



GCM-301021M

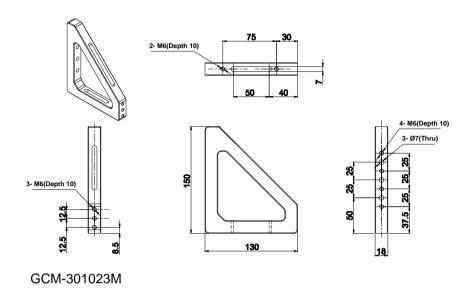


GCM-301021M

GCM-301022M



#### GCM-301021M Breadboard vertical bracket

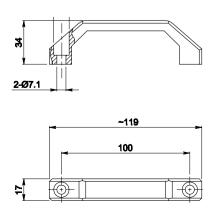


GCM-301021M Breadboard Vertical Bracket

Part No.	Size
GCM-301021M	450x130x18
GCM-301022M	300x130x18
GCM-301023M	150x130x18

# GCM-301031M Breadboard Handle

The GCM-301031M breadboard handle can be installed on all types of breadboards, making it easy to move large and heavy breadboards. The handle is made of aluminum alloy. The handle shape is small (the installation hole distance is 100mm) and compact.





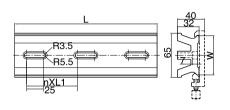


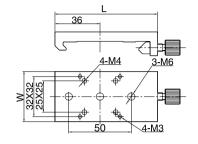


GCM-301031M

### **GCM-72 Optical Rails**

The GCM-72 Optical rails can be used to arrange a group of optical mechanical components, keep the position of the central axis when the carriers are moving on them.

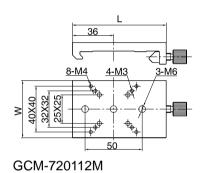


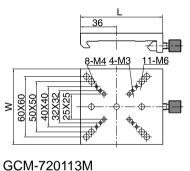


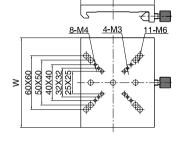
GCM-7201 Example

GCM-720101M/720102M

GCM-720111M







GCM-720114M

#### 58mm width Rail

Part No.	WxL	n x L1	Weight (g)
GCM-720101M	58x310	2x100	995
GCM-720102M	58x610	4x125	1950
GCM-720104M	58x1210	5x200	3965

### 58mm width Carriers

Part No.	LxW	Weight (g)
GCM-720111M	82x40	85
GCM-720112M	82x50	105
GCM-720113M	82x75	155
GCM-720114M	82x100	200



# **GCM-72 Optical Rails**



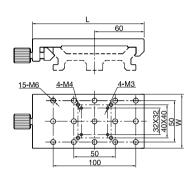
R3.5 R6 50 nXL1

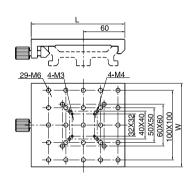
<u>5-M</u>6

GCM-7202 Example

GCM-7202

GCM-720211M





GCM-720212M

GCM-720213M

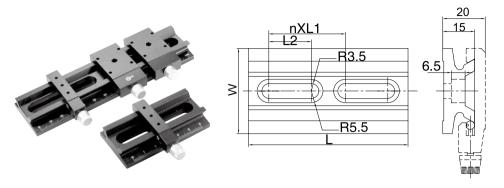
#### 100mm width Rail

Part No.	WxL	n x L1	Weight (g)
GCM-720202M	100x500	2x175	1860
GCM-720203M	100x800	4x175	2925
GCM-720205M	100x1200	6x175	4015

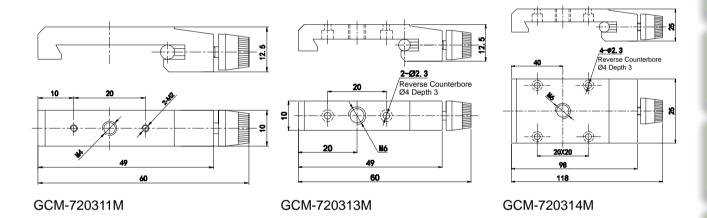
#### 100mm width Carriers

Part No.	LxW	Weight (g)
GCM-720211M	135x40	190
GCM-720212M	135x65	275
GCM-720213M	135x120	475

# **GCM-72 Optical Rails**



#### GCM-7203 Example



#### 40mm width Rail

Part No.	WxL	n x L1	L2	Weight (g)
GCM-720303M	40x100	1x50	25	80
GCM-720304M	40x150	1x80	50	115

#### 40mm width Carriers

Part No.	LxW	Weight (g)
GCM-720311M	60x10	10
GCM-720313M	60x10	10
GCM-720314M	60x25	25

# Precision Screws/Vernier Micrometers

GCM-39 Precision Screws	273
GCD-6101 Motorized Actuators	274



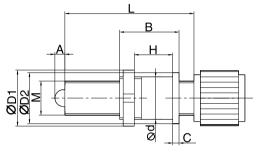
# Precision Screws/Vernier Micrometer

#### **GCM-39 Precision Screws**



These high precision screws have a threadpitch of 0.25~0.35mm, giving better accuracy than ordinary micrometers can achieve. They can be employed in various components.





GCM-39

#### **GCM-39 Precision Screws**

Part No.	М	D1	D2	Α	В	С	Н	L	Ød	Weight (g)
GCM-390101M	M6x0.25	14	12	2	12	1.5	6~8	20	9	20
GCM-390102M	M6x0.25	14	12	2	12	1.5	6~8	30	9	34
GCM-390103M	M6x0.25	14	12	2	12	1.5	6~8	40	9	41
GCM-390111M	M8x0.25	16	14	2.5	15	2	7~9.5	25	11	36
GCM-390112M	M8x0.25	16	14	2.5	15	2	7~9.5	45	11	48
GCM-390113M	M8x0.25	16	14	2.5	15	2	7~9.5	65	11	58
GCM-390201M	M4x0.35	-	8	1.25	8	1.5	6.5	13	6	10
GCM-390202M	M4x0.35	-	8	1.25	8	1.5	6.5	18	6	12
GCM-390203M	M4x0.35	-	8	1.25	8	1.5	6.5	23	6	15
GCM-390211M	M6x0.35	14	12	2	12	1.5	6~8	20	9	20
GCM-390212M	M6x0.35	14	12	2	12	1.5	6~8	30	9	34
GCM-390213M	M6x0.35	14	12	2	12	1.5	6~8	40	9	41
GCM-390221M	M8x0.35	16	14	2.5	15	2	7~9.5	25	11	36
GCM-390222M	M8x0.35	16	14	2.5	15	2	7~9.5	45	11	48
GCM-390223M	M8x0.35	16	14	2.5	15	2	7~9.5	65	11	58



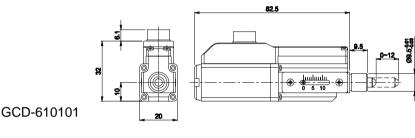
# Precision Screws/Vernier Micrometer

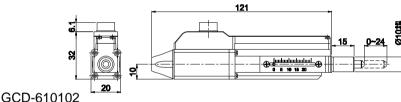
GCD-6101

#### GCD-6101 Motorized Actuators

Motorized Actuators (GCM-6101) are offered with varying travel by a stepping motor. They have compact structure and stable operation. They can provide precise positioning accuracy and be used with GCM-T series high-precision translation stages, GCM-G series angle swinger and precision mirrors which have 9.5mm thread. The maximum horizontal load is 3kg, the working temperature is -20 ~55 C; the maximum speed is 5mm/s; the speed can be adjusted by specified software. It shall be used together with controller and controller power supply.

Note: The motor of this product is exposed, the temperature of the motor increases during operation, please don't touch it.





#### GCD-6101 Motorized Actuators

Part No.	Travel distance	Positioning Accuracy	Double Direction Repeat Positioning Accuracy
GCD-610101	12mm	≤20µm	≤5µm
GCD-610102	24mm	≤20µm	≤5µm



Example



GCD-6101

## GCD-6101 Motorized Actuators Controller

Motorized Actuators controller (GCD-6101) is equipped with a touch screen and two DIN jacks, which can manually control the motorized actuators in one or two dimensions through the touch screen. If this controller is equipped with GCD-040201M or GCD-040202M power supply of steping motor control, it also supports to control several actuators at the same time. online can be realized.

#### GCD-6101 Motorized Actuators controller

Part No.	Name	Dimension (mm)	Operating Voltage (V)	Weight (g)	
GCD-6101	Motorized Actuators controller	100x102x54	24	480	

GCD-040 Servo Motor Controller and Power Supply	277
GCD-212100M Servo Motorized Linear Stages	277
GCD-0401M Stepper Motor Controllers	278
GCD-101050M Small Motorized Linear Stages	279
GCD-10 Conventional Motorized Linear Stages	279
GCD-20/40 Linear/Crossed Roller Bearing Motorized Linear Stages	280
GCD-501100M High Precision Motorized Linear Stages	282
GCD-302 Long Travel Motorized Linear Stages	283
GCD-730101M High-precision Motorized Goniometer Stages	284
GCD-01 Motorized Rotation Stages	285
GCD-301101M Motorized Linear Stage	287
GCD-301202M Motorized High-Load Vertical Translation Stage	288







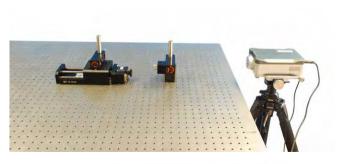
### **Motorized Stages**

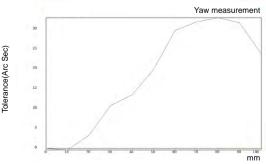
Daheng Optics provides a variety of electronic control products, including electronically controlled translation stage / electronically controlled rotary stage. This series of products are driven by stepper motors, which can realize the automatic adjustment of linear displacement and angular rotation. Among them, key components such as precision roller screws, linear guides, and elastic couplings are all imported high-quality products to ensure the high quality of the whole product. Users can choose different precision levels according to specific conditions to achieve different configurations. The mounting holes of the product are standardized to facilitate many different combinations. The stepper motor uses a standard interface to facilitate the transmission of control signals, and the rear is equipped with a manual adjustment knob for manual adjustment.

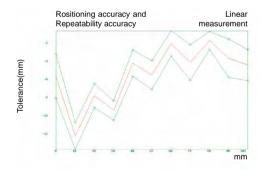
- \* X, Y, Z electronically controlled translation stage series
- Electric control rotary table series
- Compact structure and modular design
- High quality and precision
- Multiple products to choose from
- Customization

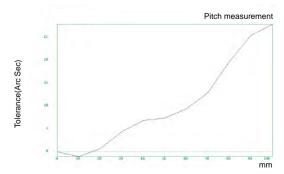
#### **Quality Control:**

For the key indicators of the electrical console, we use advanced testing methods to ensure that they meet the design requirements. The positioning accuracy, repeat positioning accuracy of each product, the tilting of the table and the pitching of the table has been tested. The test uses an advanced laser interferometer, and the corresponding test report can be provided at the factory.











GCD-040111M



GCD-040211M



GCD-212100M

### GCD-040 Servo Motor Controller and Power Supply

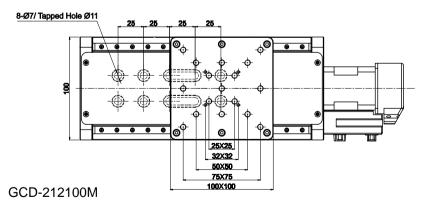
GCD-040111M is an electronically controlled translation stage controller designed using a DSP high-performance chip. Used with AC servo motor platform. With grating sposition feedback loop, make the position control more accurate. The use of new motor vector control technology makes the platform move more smoothly, lower noise and more stable performance.

Part No.	Function	Dimensions (WxHxL)
GCD-040111M	Servo motor controller	114x116x57.5
GCD-040211M	Servo/Linear motor controller (1-Axis)	163x130x52.5

### GCD-212100M Servo Motorized Linear Stages

GCD-212100M is a servo motor product developed by Daheng Optics. It uses high-precision ball bearing as the drive. The motor part adopts semiclosed loop control to achieve micron-level high precision. Compared to stepper motors, it runs faster. GCD-212100M has a closed design, which provides better protection against dust (debris). In addition, it also has a central reset function, which is convenient for users to quickly reset the platform and repeat different operations.





#### GCD-212100M Servo Motorized Linear Stages

Part No.	Platform size (mm×mm)	range	Maximum Velocity (mm/s)	Repetition accuracy	Positioning accuracy ( µ m)	Yaw (")	Pitch (")	Horizontal load (kg)	Vertical load (kg)	Weight (kg)	Material
GCD-212100M	100X100	100	80	±1	15	±10	±10	20	5	2.5	Aluminum Alloy





GCD-04

#### GCD-0401M Stepper Motor Controllers

GCD-0401M Stepper Motor Controller is a USB-to-CAN, using CAN bus network communication, internally uses a high-performance CPU chip to control and drive the electric translational stage and rotary stage compact controller. It has the functions of host computer automatic control, manual control, emergency stop and limit, multi-dimensional sequence, pulse signal output, and other functions. It can be used alone or networked, and it supports up to 15 multi-dimensional cascades. The supporting software can control the single travel command of the electric platform, and can also continuously execute the travel command list written by the user using this software. At the same time, the operating parameters of each controller can be set, including startup speed, startup coefficient, single-step accuracy, etc. Pulse signal output function, drive external equipment to run by the pulse signal. The communication protocol is open to users, and it is equipped with VC and LabView demo software, which is convenient for users' secondary development.

GCD-0401M uses a separate controller and power supply design. The power supply is divided into one-dimensional controller power and four-dimensional controller power. The modular design is convenient for combination use. GCD-0401M electric stage controller is suitable for various series of electronically controlled translation stage or electrically controlled rotary stage produced by our company such as GCD-10, GCD-20, GCD-40, GCD-50, GCD-01, GCD-30.

- Controller working voltage: Input: AC100V ~ 240V Output: DC24V 3A
- Maximum dimensions: 15
- Single step accuracy: Provide 8 levels of precision adjustment (adjusted by program)
- Stroke: straight (mm) or circle (°)
- Speed: Provides 20 speed options. After the user changes the single step accuracy, the moving speed will also change.
- Maximum frequency of 23.697 KHz
- Communication method: CAN
- Maximum communication distance: 1500 m







GCD-040101M

GCD-040201M

GCD-040202M

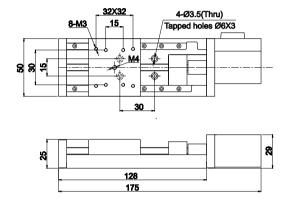
#### GCD-0401M Stepper Motor Controllers

Part No.	Description	Size
GCD-040101M	Controller	102x100x54
GCD-040201M	1-port power supplier	158x120x40
GCD-040202M	4-port power supplier	462x132x43

GCD-101050M

GCD-101050M Small Motorized Linear Stages

GCD-101050M is a compact small stage developed by Daheng Optics. With threaded screws as drive, it can be used for vertical use. This product has a center-to-zero reset function, which is convenient for users to quickly reset the platform and repeat different operations. Due to its small size, this product can be used in space-constrained equipment. At present, this product has been used in the terahertz time-domain spectrometer developed by Daheng Optics.



#### GCD-101050M Small Motorized Linear Stages

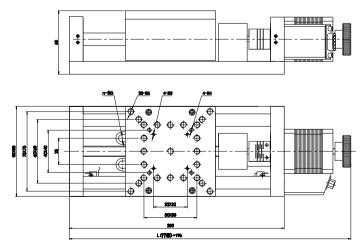
Part No.	Platform size(mm)	Travel I range	Resolution ( µ m)	Repeatability (μm)	Yaw (")	Pitch (")	Max Velocity mm/s	Horizontal Load capacity (kg)	Vertical Load Capacity (kg)	Weight (kg)
GCD-101050M	175X50X25	± 25	50	5	60	60	3	10	5	0.5

### GCD-10 Conventional Motorized Linear Stages

The Motorized Linear Stage GCD-10 Series uses a linear motor for load carrying and linear guide, which features with low cost and dust resistance, but low load capacity. This type of translation stage is not suitable for long travel and heavy load.



GCD-104



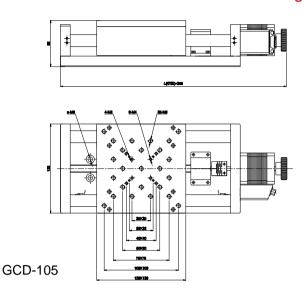
GCD-104



### GCD-10 Conventional Motorized Linear Stages



GCD-105



#### GCD-10 Conventional Motorized Linear Stages

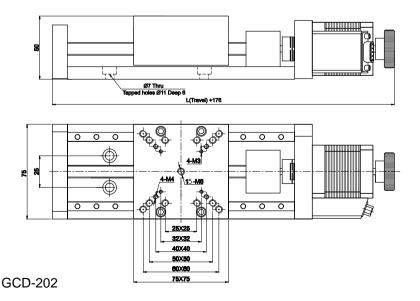
Part No.	Platform size(mm)	Travel Range(mm)	Pitch (mm)	Resolution (µm)	Repeatability (µm)	Max velocity (mm)	Horizontal load capacity(Kg)	Vertical load capacity(Kg)	Hole spacing (mm)
GCD-104150M	85X85	150	4	0.001	<0.005	40mm/s	5kg	3kg	25X(25~175)
GCD-105050M	120X120	50	4	0.001	<0.005	40mm/s	5kg	3kg	25X(25~50)
GCD-105200M	120X120	200	4	0.001	<0.005	40mm/s	5kg	3kg	25X(25~200)

### GCD-20/40 Linear/Crossed Roller Bearing Motorized Linear Stages

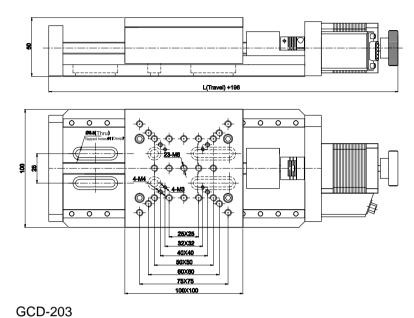


GCD-20

The Motorized Linear Stages GCD-20/40 series are implemented in the design with linear/cross roller guides that have high load capacity and suitable for long travel length and heavy loads.

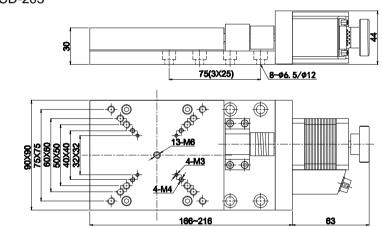


# GCD-20/40 Linear/Crossed Roller Bearing Motorized Linear Stages





GCD-402050M



GCD-402050M

### GCD-20/40 Linear/Crossed Roller Bearing Motorized Linear Stages

Part No.	Platform size (mm)	Travel Range (mm)	Pitch (mm)	Resolution (um)	Repeatability (um)	Max velocity (mm)	Horizontal load capacity (Kg)	Vertical load capacity (Kg)	Hole spacing (mm)	Weight (Kg)
GCD-202050M	75X75	50	4	0.001	<0.005	20mm/s	20kg	5kg	25x50	1550
GCD-202100M	75X75	100	4	0.001	<0.005	20mm/s	20kg	5kg	25x(25 ~ 75)	1730
GCD-202150M	75X75	150	4	0.001	<0.005	20mm/s	20kg	5kg	25x(25 ~ 125)	2000
GCD-203050M	100X100	50	4	0.001	<0.005	20mm/s	20kg	5kg	25x(25 ~ 125)	2500
GCD-203100M	100X100	100	4	0.001	<0.005	20mm/s	20kg	5kg	25x(25 ~ 125)	2800
GCD-203200M	100X100	200	4	0.001	<0.005	20mm/s	20kg	5kg	25x(25 ~ 150)	3400
GCD-203300M	100X100	300	4	0.001	<0.005	20mm/s	20kg	5kg	25x(25 ~ 250)	3900
GCD-402050M	90X110	50	1	0.00025	<0.005	10mm/s	5kg	1kg	75x(25 ~ 75)	1300



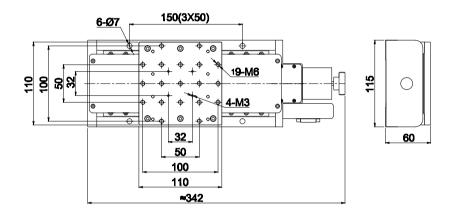


GCD-501100M

### GCD-501100M High Precision Motorized Linear Stages

GCD-501100M High precision motorized linear stage is newly developed by Daheng Optics. GCD-501100M consists of high precision ball screw and fine linear guide. The combination of GCD-501100M with GCD-0401(Motorized stage controller) is able to provide super high accurate linear motions (error in microns). The features of high precision and high stability are highly demanded by the applications of THz spectrometer and Femtosecond/ Picoscecond Lasers micromachining systems.

GCD-501100M employs integrated enclose design which improves the stability as well as the dustproof ability of the stage. Furthermore, GCD-501100M equipped with center reset function that allows the users to relocate the stage at the center of travel rapidly and conveniently, facilitates complex operations.



GCD-501100M

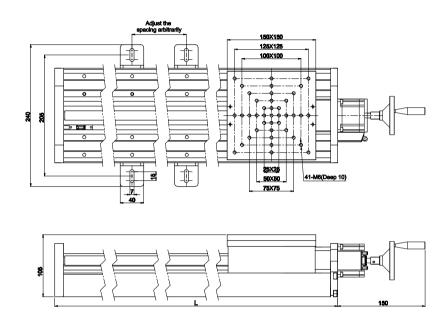
#### GCD-501100M High Precision Motorized Linear Stages

Part No.	Platform size (mmxmm)	Travel range	Resolution (µm)	Repeatability (µm)	Repeatability (µm)	Yaw (")	Pitch (")	Horizontal Load capacity (Kg)	Vertical Load Capacity (kg)	Weight (Kg)	Material
GCD-501100M	110×110	100	0.5	±1	10	±10	±10	20	5	2.8	Aluminum Alloy



### GCD-302 Long Travel Motorized Linear Stages

The Motorized Translation Stages GCD-302 series are implemented in the design with rod linear guides that have high load capacity and suitable for long travel range and heavy loads.



GCD-302

#### GCD-302 Long Travel Motorized Linear Stages

Part No.	Travel range(mm)	Platform size(mm)	L (mm)	Pitch (mm)	Resolution (µm)	Repeatability (µm)	Max velocity (mm/s)	Horizontal load capacity(Kg)	Vertical load capacity(Kg)
GCD-302001M	400	150x150	597	5	0.00125	0.05	10mm/s	50kg	15kg
GCD-302002M	600	150x150	797	5	0.00125	0.05	10mm/s	50kg	15kg
GCD-302003M	800	150x150	997	5	0.00125	0.05	10mm/s	50kg	15kg
GCD-302004M	1000	150x150	1197	5	0.00125	0.05	10mm/s	50kg	15kg
GCD-302005M	1500	150x150	1712	5	0.00125	0.05	10mm/s	50kg	15kg
GCD-302006M	2000	150x150	2247	5	0.00125	0.05	10mm/s	50kg	15kg



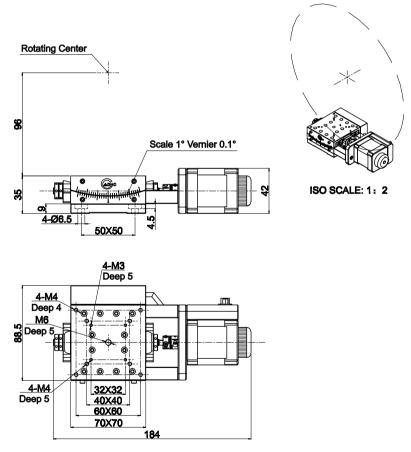


GCD-730101M

### GCD-730101M High-precision Motorized Goniometer Stage

GCD-730101M High precision motorized goniometer stage employs precision worm gear as the actuation component, crossed roller bearing as the guide way, rely on which Daheng Optics's goniometer stage features high accuracy and outstanding repeatability, as well as high loading capacity.

The 70mm70mm rotary platform rotates on a transverse axis that is 96mm above the horizontal position of the platform. GCD-730101M provides a travel range of ±10°. The reset function (GCD-0401 motorized stage controller) helps to return the platform to a horizontal position (0°) rapidly and conveniently, facilitates complex operations. Moreover, GCD-730101M equipped with an angle scale which has a main scale of 1° and a vernier scale of 0.1°. In other words, the users may obtain a decimal angle displacement manual operation (rotary knob and observing scale).



GCD-730101M

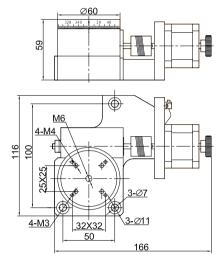
#### GCD-730101M High-precision Motorized Goniometer Stage

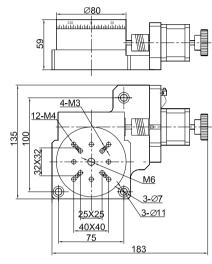
Part No.	$\begin{array}{c} \text{Size} \\ \text{(mm} \times \text{mm} \times \text{mm)} \end{array}$	Rotating Center (mm)	Platform Size (mm×mm)	Travel	Accuracy	Bi-directional Repeatability
GCD-730101M	$184\times88.5\times35$	96	70 × 70	$\pm10^\circ$	$0.05^{\circ}$	$\pm0.004^\circ$

### GCD-01 Motorized Rotation Stages

Motorized Rotation Stages GCD-01 provides 360° of rotation with high accuracy and stability. This is an excellent general-purpose rotator. A coarse angular position is indicated on a 360° engraved scale on the rotating platform, graduated in 1° increment.



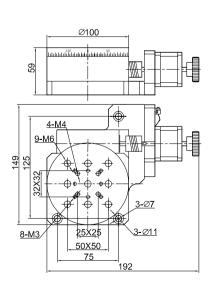


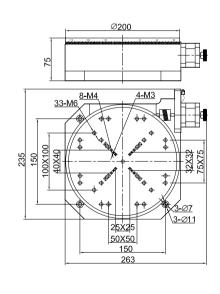


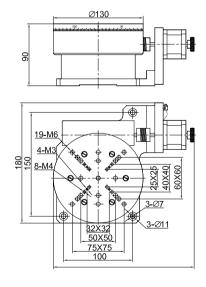
GCD-011

GCD-011060M

GCD-011080M







GCD-011100M

GCD-011200M

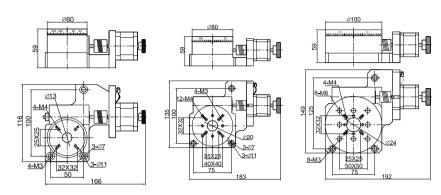
GCD-011130M



# **GCD-01 Motorized Rotation Stages**



GCD-012

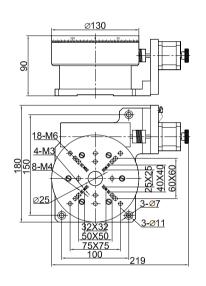


GCD-012060M

GCD-012080M

GCD-012100M

Ø200



32-M6 8-M4

GCD-012130M

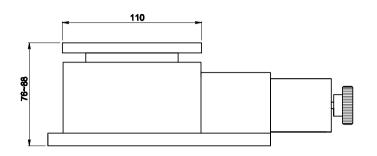
GCD-012200M

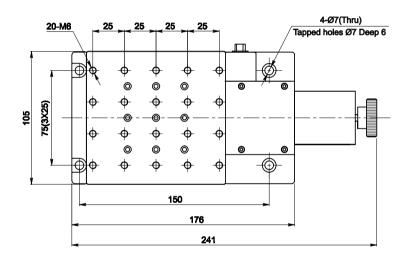
### GCD-01 Motorized Rotation Stages

Part No.	Platform size/ Central hole size	Worm gear ratio	Resolution(µm)	Max velocity (r.p.m)	Max Troque (N*m)	Load capacity (Kg)	Weight (Kg)
GCD-011060M	Ø60/M6	100:1	0.0009° /3.24″	3r.p.m	0.45N·m	20kg	1.2kg
GCD-011080M	Ø80/M6	135:1	0.00067° /2.4″	2r.p.m	0.45N·m	25kg	1.6kg
GCD-011100M	Ø100/M6	180:1	0.0005° /1.8″	1r.p.m	0.45N·m	30kg	2.1kg
GCD-011130M	Ø130/M6	225:1	0.0004° /1.44″	1r.p.m	0.45N·m	35kg	4.2kg
GCD-011200M	Ø200/M6	300:1	0.0003° /1.08″	1r.p.m	0.45N·m	45kg	7.5kg
GCD-012060M	Ø60/Ø13	100:1	0.0009° /3.24″	3r.p.m	0.45N·m	20kg	1.1kg
GCD-012080M	Ø80/Ø20	135:1	0.00067° /2.4″	2r.p.m	0.45N·m	25kg	1.6kg
GCD-012100M	Ø100/Ø24	180:1	0.0005° /1.8″	1r.p.m	0.45N·m	30kg	2.0kg
GCD-012130M	Ø130/Ø25	225:1	0.0004° /1.44″	1r.p.m	0.45N·m	35kg	4.0kg
GCD-012200M	Ø200/Ø42	300:1	0.0003° /1.08″	1r.p.m	0.45N·m	45kg	7.3kg

# GCD-301101M Motorized Linear Stages







GCD-301101M

#### GCD-301101M Motorized Linear Stages

Part No.	Platform size(mm)	Travel (mm)	Resolution (µm)	Gear ratio	Repeatability (µm)	Horizontal load capacity (Kg)	Weight (Kg)
GCD-301101M	110X110	12	2.5	0.5	5	20	2.9



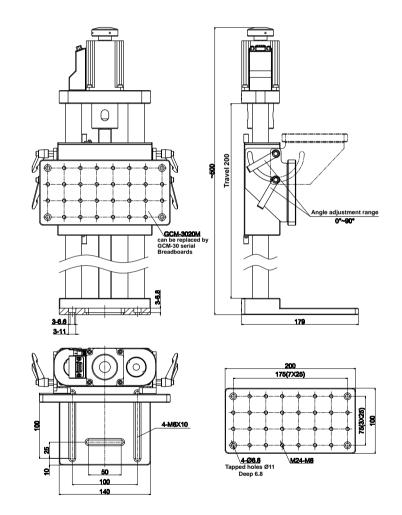


GCD-301202M

### GCD-301202M Motorized High-Load Vertical Translation Stage

GCD-301202M Motorized Vertical Translation Stage offers up to 200mm of smooth, stepper motor driven linear height adjustment.

- High Load Capacity of 20 Kg
- Motorized Stage with 200mm vertical Travel
- Velocity (Max): 10mm/s
- Need Control by GCD-0401M Stepper Motor Controllers



GCD-301202M

Part No.	Travel (mm)	Platform Size(mm)	Velocity (Max) (mm/s)	Vertical Load(Kg)	Weight(Kg)
GCD-301202M	200	200X100	10	20	8.1

Daheng Optics provides full-service optical design, engineering, manufacturing and assembly to a varied client-base worldwide for over 30 years. We use leading professional optical design software such as Zemax, Thin Film Calc, and Solid Works, to provide customers with lens manufacturing, optical coating and complete optical design consulting services.

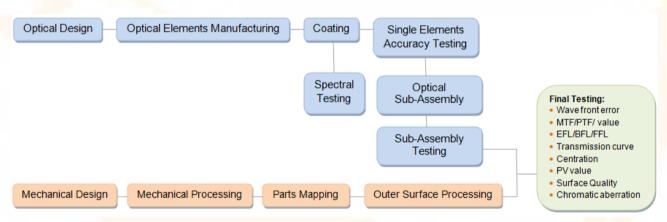
Our optical system solutions can be applied to many different fields such as Machine Vision, Laser Material Processing, Defense and Research.

We can provide DFM (design for manufacture) input on optical designs from the very beginning stages to volume production, in order to provide our customers with the ultimate market advantage.

### **Advantages**

- Competitive Cost and Top Quality Products
- Rapid prototyping & volume production
- Solid manufacturing experience and excellent process control

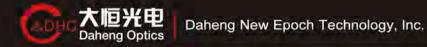
# **Prototyping Flow**



Effective Prototyping: We are comfortable with low volume prototyping before going into mass production. Our adjustment on prototyping is also very effective.

Process Control: Every single processing is accompanied with strict inspection & QA policies to ensure that each part will fully meet your expectations. All processing follows ISO: 9001 standards.

Full Inspection: A final inspection report on all specs per customer's demand will be provided along with part shipment.



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