Integrating Spheres

Integrating spheres are unique tools used in many laser & photonics applications. Gigahertz-Optik offers a wide range of integrating spheres for both detection purposes and for uniform light sources . To meet the many varied application demands, spheres with different diameters are offered as well as different coatings and measurement geometries. Besides the modular UM series for light measurements and uniform light source set-ups Gigahertz-Optik offers the UP series with precisely aligned port geometries for reflectance and transmittance measurements. Complete systems can be assembled using accessory components and an instrument from Gigahertz-Optik's photometer, radiometer and colorimeter program. To satisfy specific application demands, custom design and private labeling solutions are offered.

Gigahertz-Optik

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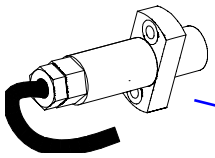
Individual Sphere Design

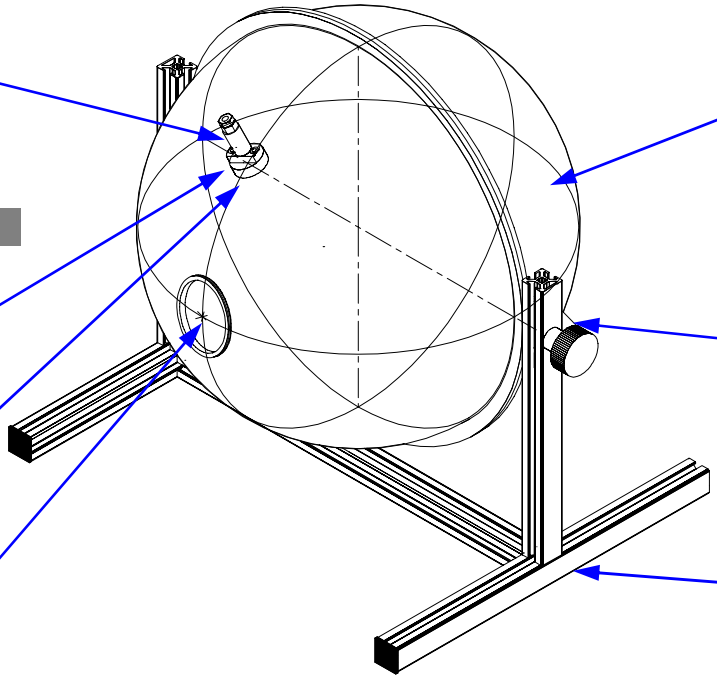
Years of experience in manufacturing integrating spheres has taught us that a line of standard spheres will not fulfill all possible customer needs. Most often either the end-user accepts a standard sphere as a compromise solution or must have the stock item custom modified adding extra cost and lead time.
The new **UM** integrating sphere series allows individual integrating sphere set-up in the specific configuration required with only those components needed. An added benefit to this design freedom is that you don't pay for something you don't need.
With standardized stock components and an innovative assembly process the UM series offers economical prices and short delivery times for integrating spheres that others can only claim as custom products.
Port frames with free apertures in different diameters as well as detector and light source ports can be added and positioned on the basic spheres according to end-user design. **UMB Basic Spheres** are available in different diameters and with different coatings.
Sphere Accessory Components such as port plugs, reducers, adapters, baffles, sphere mounts and stands are available.
Application Accessory Components & Instruments like fiber optic adapters, light sources & detectors, photometers, radiometers, colorimeters & calibration standards allow complete systems to be assembled.
The following pages describe typical application set-ups as well as individual component specifications. Light measurement instrumentation and calibration equipment technical specifications and descriptions are shown in other chapters of this catalog.

Light Detector

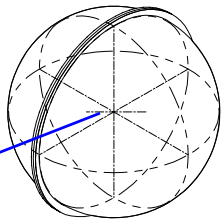


PD-11
Light Detector

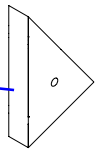
UM Sphere Configuration



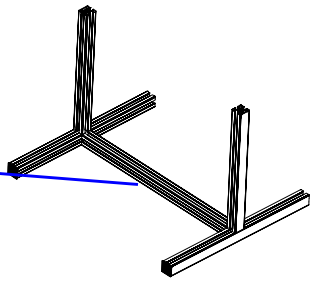
Sphere Components



UMB-300
300 mm diameter basic sphere

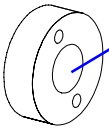


UMSS-SMT
Sphere Mount

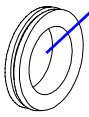


UMSS-BT300 Sphere Bench Top Stand

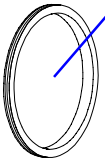
UM Frame Components



UMPA-0.5/11
Port Adapter for PD-11 detectors

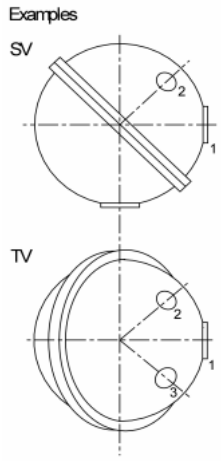


UMPF-0.5
Port Frame with 0.5 inch free aperture



UMPF-2.0
Port Frame with 2 inch free aperture

Assembly Orientation



Side View

Flange	135°
Port Ø 1	0°
Port Ø 2/3	45°
Stand	270°

Side View

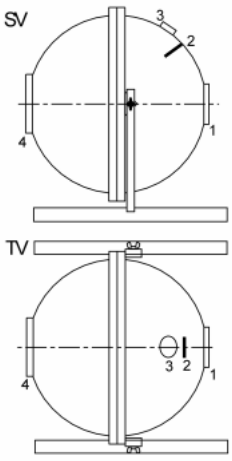
Flange	90°
Port Ø 1	0°
Port Ø 2	60°
Port Ø 4	180°
UMPB /2	45°
Stand	90°

Top View

Port Ø 1	0°
Port Ø 3	0°
Port Ø 4	180°
UMPB /2	0°

Top View

Port Ø 1	0°
Port Ø 2	45°
Port Ø 3	315°



UMB Basic Spheres are assembled using two hollow hemispheres made from aluminum sheet stock.
The **Orbit Flange** located on open side of each hemisphere is used to mechanically mate the sphere halves. The standard position for the orbit flange is vertical as shown in the above drawing. But its actual position can be specified at any angle from vertical. Note that port frames, sphere stands or other accessory may limit the choice of angle. 5 deg. angle steps with a tolerance of +/- 5 deg. are recommended.

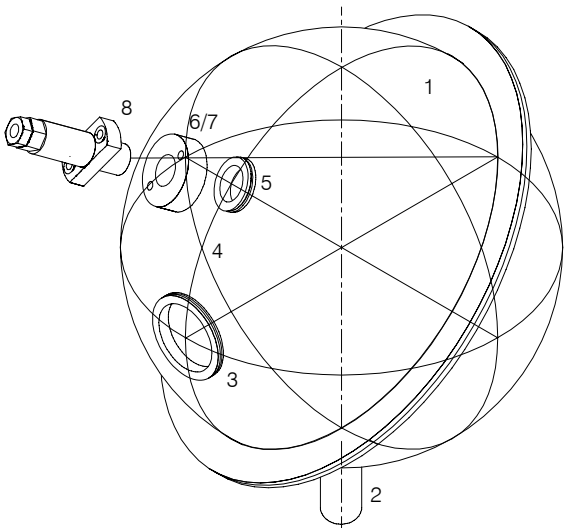
To specify position coordinates for **Accessory Components,** the same 5 deg. +/-5 deg. resolution is recommended. Position can be mapped using the side-view 'SV' and top-view "TV' angle charts as shown above.
The sphere Al sheet forming process only allows a typical position tolerance of +/- 5 degrees.
For more precise alignment **UP series spheres** are recommended.

UM Series "Set-up Examples"

Luminous Flux & Radiant Power Measurement of Spot Sources

The integrating sphere is the preferred tool for the measurement of radiant power or luminous flux of spot sources with a diverging light beam. Typical examples of spot sources are LEDs, LED panels, laser diodes, fiber bundle light sources, reflector spot lamps, flat panel displays, endoscopes and others.
The reason why the integrating sphere is preferable to a planar detector is that typical photodiode detectors are limited in active area, size and acceptance angle. Integrating spheres offer large area measurement apertures and large acceptance angles in observance to the rule that the 'measurement aperture area should not exceed 5% of the total sphere area'. Temperature is another reason for using integrating spheres in applications involving high power tungsten or xenon spot lamps. Large diameter spheres are required to maintain temperature within operating limits, prohibit heat damage and for stability/accuracy of the measurement.
In this set-up a measurement port and a detector port is needed. Photometric, radiometric or colorimetric detectors can be mounted onto the integrating sphere with an accompanying read-out instrument. In applications where wide variations in sphere housing temperature may occur, detectors with temperature stabilization are recommended to avoid drift of the measured signal. A spectrometer can also be used with or as an alternative to the integral light detector. Baffles are placed between the lamp and detector to prohibit direct illumination of the detector by the incoming signal.
The complete sphere system can be calibrated in absolute quantities such as luminous flux (lm), radiant power (W) or spectral radiant power (W/nm). Lamp standards are normally used for calibrations in illuminance (lx) or spectral irradiance (W/(m² nm)) . See *Calibration Standards* sec-

Directional LED Measurement



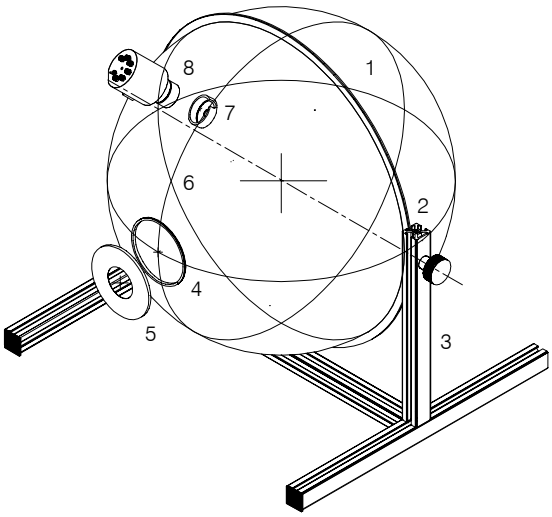
150 mm (6 in) dia sphere with photometric detector for luminous flux measurements.

1. *UMBB-150: 150 mm (6") dia integrating sphere*
2. *UMSS-SM14: sphere socket*
3. *UMPF-1.0: 1.0" dia port frame*
4. *UMPB-SM: port baffle*
5. *UMPF-0.5: 0.5" dia port frame*
6. *UMPA-0.5/11: port adapter for 11-type light detector*
7. *UMPA-0.5/RADIN: diffuser for UMPA-0.5/11 port adapter*
8. *VL-1101-2: photometric detector with calibration data connector for P-9710-1*
9. *P-9710-1: single channel optometer with RS232 Interface*
10. *KDW: Calibration of luminous flux sensitivity*

Options:

- *TD-11VL01-2: temp. stabilized photometric detector*
- *P-2000: two channel optometer with RS232 and IEEE488 interface.*
- *UMPF-2.0: 2.0" dia port frame*
- *UMPR-2.0/xx: port reducer plug, xx = aperture dia*
- *PM-B + PM-P: post stand*
- *UMSS-BT150: bench-top stand alternative to UMSS-*

Spot Lamp Measurement



500 mm (20 in) dia sphere with colorimetric detector for luminous flux and color temperature measurements.

1. *UMBB-500: 500 mm (20") dia integrating sphere*
2. *UMSS-SMT*
3. *UMSS-BT500: bench-top stand*
4. *UMPF-4.0: 4.0" dia port frame*
5. *UMPR-4.0/xx: 1 or more port reducer, xx = aperture dia*
6. *UMPB-SM: port baffle*
7. *UMDP-37: detector port for 37type detectors*
8. *CT-3701: luminous flux, color temperature and xy chromaticity value detector. Temperature stabilized*
9. *P-9801: 8-channel optometer with RS232 and IEEE488 interface*
10. *OS-P9801: remote control software*
11. *KDW: calibration of luminous flux sensitivity and color temperature*

Options:

- *UMSS-HF500: hinge Frame bench top stand for full opening of the front hemisphere*
- *Additional radiometric detectors*

Luminous Flux & Radiant Power Lamp Measurement

Measuring total radiant power or luminous flux emitted by lamps is one of the most common applications for integrating spheres. Other than spot sources, lamps emit light in all directions. The integrating sphere collects all of the emitted light entering it and supplies an integrated signal to its mounted light detector .

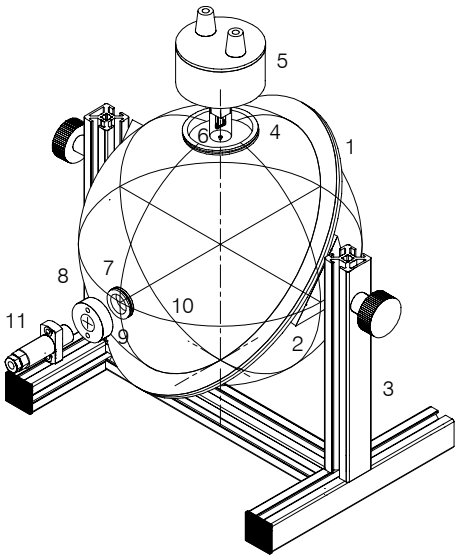
Lamps come in many different form, size and output power today. Examples include tungsten filament lamps, fluorescent tube & bulb shape lamps, high power xenon sources and many more. Selecting the size of the integrating sphere is typically based on the maximum dimension of the lamp to be measured. The sphere diameter should be at least ten times the maximum dimension of the lamp. For tube lamps it should be twice the largest dimension of the source.

For flux measurements a multi-directional lamp is placed in the center of the sphere. Different forms and sizes of sockets and individual lamp holders are required for each different lamp type. For smaller size lamps a top-load port can be used for insertion and removal. For large size lamps integrating spheres with a hinged frame allowing one half of the sphere to fully open are recommended .

Photometric, radiometric or colorimetric detectors can be mounted onto the integrating sphere with an accompanying read-out instrument. In applications where wide variations in sphere housing temperature may occur, detectors with temperature stabilization are recommended to avoid drift of the measured signal. A spectrometer can also be used with or as an alternative to the integral light detector. Baffles are placed between the lamp and detector to prohibit direct illumination of the detector by the incoming signal.

The complete integrating sphere light detection system can be calibrated in absolute optical measurement quantities such us luminous flux (lm), radiant power (W) or spectral radiant power (W/nm). Please refer to the *Calibration Standards* section for further

Miniature Lamp Measurement



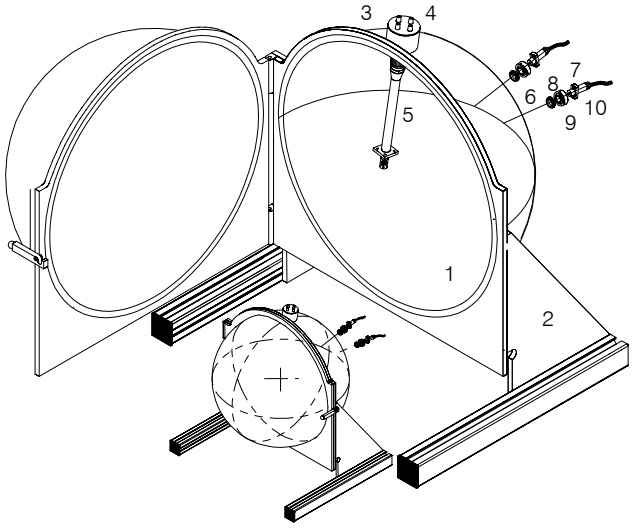
150 mm (6") dia top-load sphere with photometric detector for luminous flux measurement:

1. *UMBB-150: 150 mm (6") dia Sphere*
2. *UMSS-SMT: sphere mount*
3. *UMSS-BT150: bench-top stand*
4. *UMPF-1.5: 1.5" dia port frame*
5. *UMLA-1.5/B: lamp adapter base*
6. *UMLA-150: lamp holder. Without socket*
7. *UMPF-0.5: 0.5" dia port frame*
8. *UMPA-0.5/11: port adapter for 11 type detector head*
9. *UMPA-0.5/RADIN: RADIN Diffuser for UMPA-0.5/11 port adapter*
10. *UMPB-PM: port baffle*
11. *TD-11VL01-2: temp. stabilized photometric detector*
12. *P-9710: single channel optometer with RS232 Interface*
13. *BN-0104: luminous flux transfer standard with UMLA-150 lamp holder*
14. *LPS-250: lamp power supply*

Option:

- *P-2000: two channel bench-top optometer with RS232 and IEEE488 interface.*

Large-size Lamp Measurement



500 mm (20") dia sphere with photometric and UV-A detector for luminous flux and UV-A radiant power measurements.

1. *UMBB-500: 500 mm (20") dia sphere*
2. *UMSS-HF500: hinge frame bench-top stand*
3. *UMPF-1.5: 1.5" dia port frame*
4. *UMLA-1.5/B: lamp adapter base*
5. *UMLA-500: lamp holder. Without socket*
6. *2 x UMPF-0.5/11: 0.5" port frame*
7. *2 x UMPA-0.5/11: port adapter for MD-11 detector head*
8. *2 x UMPA-0.5/RADIN: diffuser for UMPA-0.5/11 port adapter*
9. *UMPB-PM: port baffle*
10. *TD-11VL01-2: temp. stabilized photometric detector*
11. *TD-11UV01-2: temp. stabilized UV-A detector*
12. *P-2000: two channel bench-top optometer with RS232 and IEEE488 interface.*
13. *BN-0104: spectral radiant power transfer standard lamp*
14. *LPS-250: lamp power supply*

Options:

- *UMLA-500: Additional lamp holder*
- *UMPA-2.0/AXL: Auxiliary lamp adapter*

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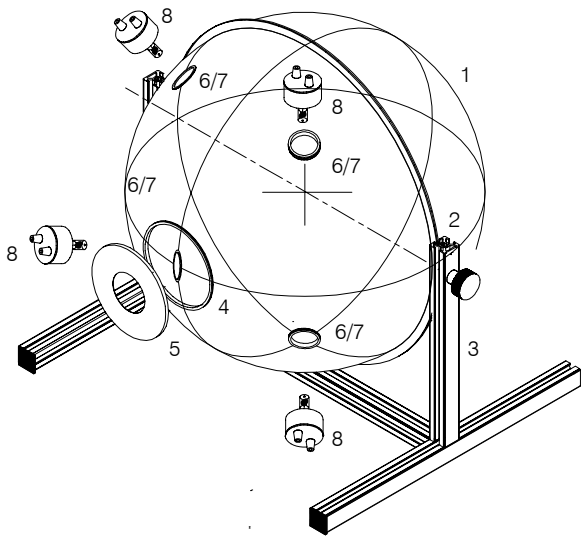
UM Series "Set-up Examples"

Uniform Light Source, Luminance and Spectral Radiance Standard

Uniform light sources are required to perform uniformity calibration of imaging systems and to calibrate luminance and spectral radiance measurement instruments.
Because of the integrating sphere's ability to produce multiple diffuse internal reflections and a uniform illumination of the inner sphere wall, it is the right tool to form the basis for uniform light sources.
Integrating spheres are available in different diameters offering the possibility for larger diameter emitting windows.
A number of optional accessory components can be added to the integrating sphere to expand its basic capabilities.
- Multiple lamps can be mounted onto one sphere offering high flexibility in intensity level.
If each lamps is operated with its own power supply, intensity can be varied in steps by simply switching light sources on and off.
- External spot lamps can be combined with variable attenuators to control the light output intensity in small steps. Attenuators with different resolutions are available.
- External spot lamps can also be combined with manually exchangeable filters used for both neutral density attenuation and for forming the emission spectrum purposes.
- Remote control filter wheels and attenuators are another option to build a completely automated system.
- A large dynamic intensity range can be realized by combining neutral density filters with a variable attenuator.
- Extra band pass filtering allows uniformity calibration across different wavelength ranges.
- High speed shutters as fast as 40 ms enable calibration of the lamp's on/off characteristic.
- Luminance and spectral radiance calibration is available through GO's calibration lab (ISO EN 17025 accredited for spectral irradiance & sensitivity).

Large Aperture Uniform Light Source

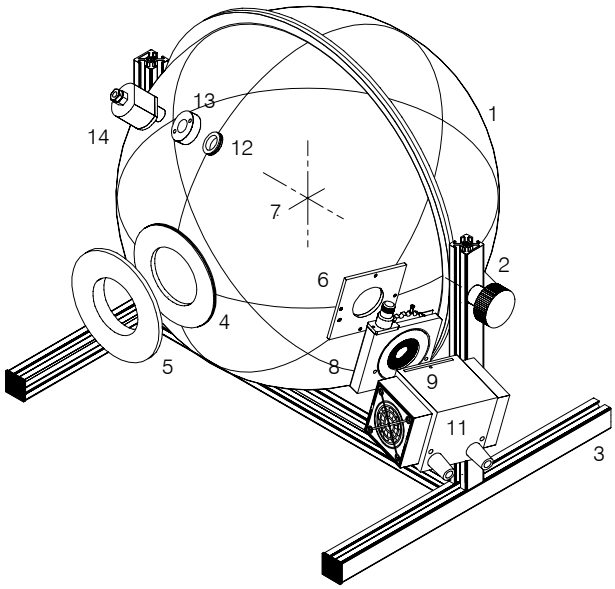


Uniform light source 500 mm (20 in) dia sphere and (4) light sources for high uniformity and high luminance intensity. Color temperature controlled light sources.

1. *UMBB-500: 500 mm (20") dia. integrating sphere*
2. *UMSS-SMT: sphere mount*
3. *UMSS-BT500: Bench top sphere stand*
4. *UMPF-5.0: 5" dia port frame*
5. *UMPR-5.0/xx: port reducer. xx = 100 mm dia*
6. *4 x UMPB-SM: port baffle*
7. *4 x UMPF-1.5: 1.5" dia port frame*
8. *4 x LS-IS1.5: light source with 50 W QH lamp*
9. *4 x LPS-250: lamp power supply*
10. *4 x BTH-19/2: 1/2 19" bench to housing for LPS-250*
11. *UMDP-37: detector port*
12. *UMPB-SM: port baffle*
13. *CT-3701: temperature stabilized color detector*
14. *P-9801: 8-channel meter*
15. *KLW: calibration of color temperature und luminance*

Options:
Software for remote control of intensity and color temperature control of each lamp

Adjustable Uniform Light Source



Adjustable uniform light source 300 mm (12 in) dia sphere and light source with manually controlled attenuator. Calibrated luminance detector for luminance intensity control.

1. *UMBB-300: 300 mm (12") dia integrating sphere*
2. *UMSS-SMT: sphere mount*
3. *UMSS-300: bench top sphere stand*
4. *UMPF-2.0/3.5: port frame*
5. *UMPR-2.0/3.5/xx: port reducer, xx = 50 mm dia*
6. *UMPF-LSOK30: port frame*
7. *UMPB-PM: port baffle*
8. *LS-OK30-MIR: micrometer drive variable attenuator*
9. *LS-OK30-H100: spot lamp with 100 W QH lamp*
10. *LPS-250: lamp power supply*
11. *BTH-19/2: 1/2 19" bench top housing for LPS-250*
12. *UMPF-0.5: port frame*
13. *UMPA-0,5/11: port adapter*
14. *TD-11VL01-2: temperature stabilized photometric detector head*
15. *P-9710-1: optometer*
16. *KLW: calibration of luminance intensity*

Multi-port Configurations for Reflectance, Transmittance, Absorbance

Integrating spheres offer unique functions which makes them very useful in reflectance, transmittance and absorbance applications.

The **Lambertian emittance characteristic** of uniform light sources incorporating integrating spheres provides a hemispherical diffuse and uniform illumination of test samples e.g. such as light panels used for backlighting of displays.

In this case the luminance contrast of the light panels can be measured using an additional luminance meter viewing through an additional port.

The large acceptance angle of integrating sphere based light detection systems is the main reason for using spheres in reflectance and transmittance applications.

Any light that is reflected by a diffuse material or passing through a diffuse material must be completely detected. This should be independent of the angle of reflected or transmitted light and also from any increase in spot size. Flat field detectors do not meet this requirement.

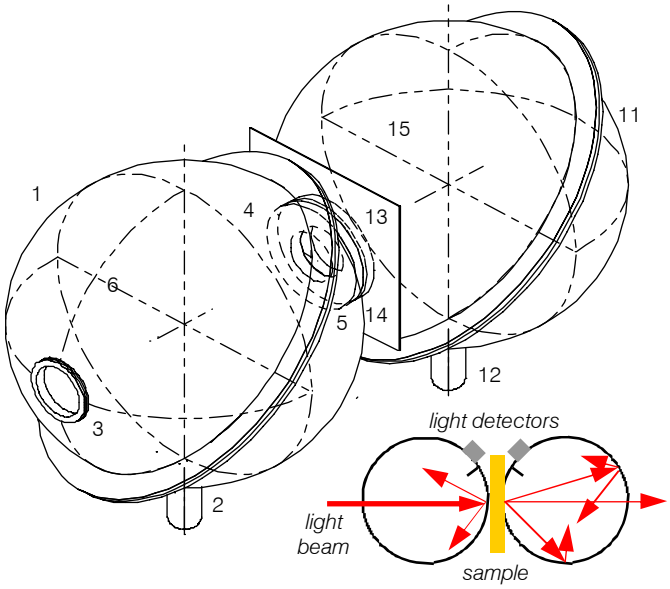
The port frame will not interfere with the acceptance angle if it is designed with a **knife-edge**.

Besides acceptance angle, larger measurement apertures can be made, an other argument for the integrating sphere.

A precisely collimated light beam is a prerequisite for accurate reflectance and transmittance measurements. The collimated beam must not only precisely target the sample area but also not contain any diffraction rings which can produce an offset light level inside the sphere limiting measurement resolution.

Consider the UP series integrating spheres for reflection, transmission, absorbance and other applications where more precise port positioning is critical.

Reflectance & Transmittance



Combined reflectance transmittance system built with two 150 mm (6 in) dia. spheres and two detectors.

Reflectance sphere:

1. *UMBB-150: 150 mm (6") dia integrating sphere*
2. *UMSS-14/M6: post stand*
3. *UMPF-1.0: 1.0" dia port frame*
4. *UMPF-1.5: 1.5" dia port frame*
5. *UMPR-1.5/xx: 1.5" port reducer with xx = 25 mm dia and knife edge*
6. *UMPB-SM: port baffle*
7. *UMPF-0.5: 0.5" dia port frame*
8. *UMPA-0.5/11: port adapter*
9. *UMPA-0.5/RADIN: diffuser*
10. *PD-1101-2: detector head*

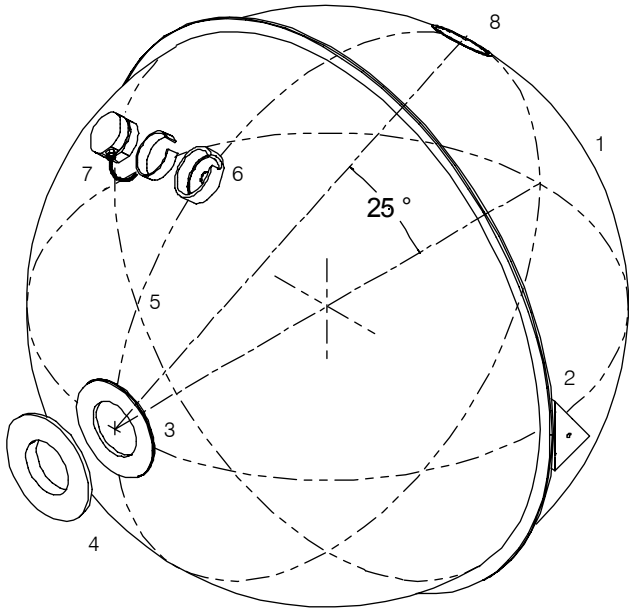
Transmittance sphere:

11. *UMBB-150: 150 mm (6") dia integrating sphere*
12. *UMSS-14/M6: post stand*
13. *UMPF-1.5: 1.5" dia port frame*
14. *UMPR-1.5/xx: 1.5" port reducer with xx = 50 mm dia and knife edge*
15. *UMPB-SM: port baffle*
16. *UMPF-0.5: 0.5" port frame*
17. *UMPA-0.5/11: port adapter*
18. *UMPA-0.5/RADIN: diffuser*
19. *PD-1102-2: detector head*

Option:

20. *P-2000: 2-channel optometer*

Transmittance of Diffuse Transmitting Samples



Reflectance sphere 500 mm (20") dia, 25 deg illumination port and photometric detector. Without bench top stand.

1. *UMBB-500: 500 mm (20") dia integrating sphere*
2. *UMSS-SMT: sphere mount*
3. *UMPF-2.5/3.5: 2.5/3.5" port frame*
4. *UMPR-2.5/3.5/xx: 2.5/3.5" port reducer with xx = 50 mm dia and knife edge*
5. *UMPB-SM: baffle*
6. *UMDP-37: 37mm dia detector port*
7. *VL-3701-2: photometric illuminance detector with 37type package*
8. *UMPF-2.0: 2.0" dia port frame*

Option:

9. *P-9710: Optometer*
10. *LS-CB50: collimated light source set-up for 25 mm beam diameter*
11. *LPS-250: lamp power supply*
12. *BTH-19/2: 1/2 19" bench top housing*

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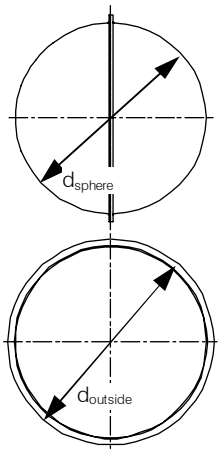
UM Series Components

UM Basic Spheres

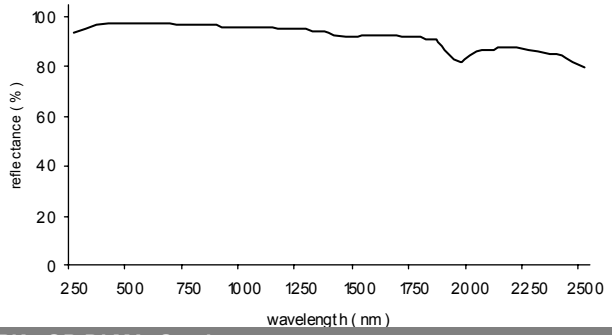
Hollow spheres with diameters from 100 mm (4 in.) to 1700 mm (68 in.) and three different coatings are offered to build integrating spheres to your need. Port frames, sphere stand and application accessory is assembled by your selection.
Please contact your local representation or the Gigahertz-Optik head office for personal assistance to discuss the set-up of the sphere and get your offer for the complete sphere set-up.

O.E.M. inquiries with different diameters, custom color painting of the sphere housing etc. are welcome.

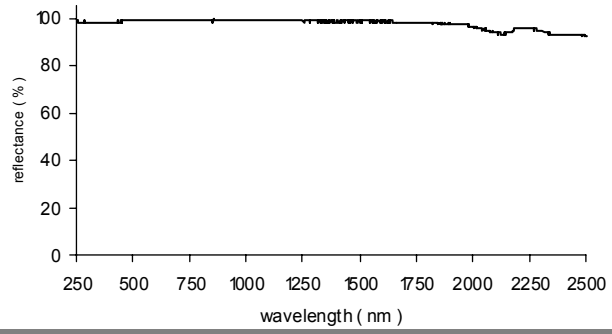
UMB: Basic Spheres



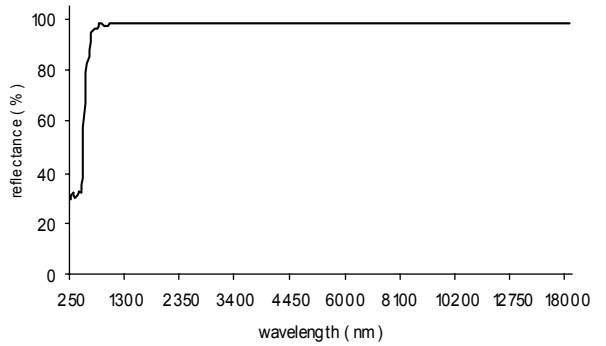
UMBB - Barium-Sulfate Coating



UMBK - OP.DI.MA. Coating



UMBG - Gold Coating



Barium sulfate is an economical coating offering a ~ 97 % (555nm) diffuse reflectance characteristic within the wavelength range from 300 nm to 2400 nm. For photometric applications the reflectance can be reduce to ~ 80 % to reduce substitution effects errors produced by high reflectance.
Besides the standard ODP97 coating with best reflectance characteristic a more durable coating is available with slightly less reflectance capability.

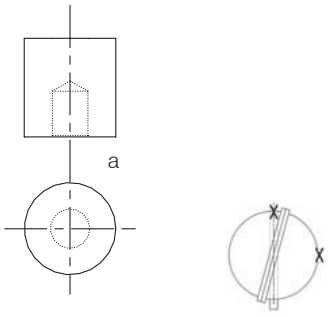
OP.DI.MA. is Gigahertz-Optik's own white plastic with an excellent diffuse reflectance characteristic and high durability.
Its diffuse reflectance is close to that of a perfect lambertian reflector ensuring a highly uniform light distribution across the inner walls of the integrating sphere.
The spectral reflectance covers a wide spectral range from ultraviolet to IR, 250 nm to 2500 nm with > 95 % reflectance and a peak reflectance of > 98 % in the VIS/NIR spectral range.

Uncoated gold outperforms all other uncoated metallic reflectors at infrared wavelengths. Gold's high reflectivity in the red portion of the visible spectrum is apparent by it's yellow hue. With a reflectance of ~ 95 % in the wavelength range from 800 nm to 20 μm, gold is the best choice for surface coating of integrating spheres used in IR applications. A proprietary interior surface preparation creates the diffuse reflectivity required for uniform light distribution inside the sphere .

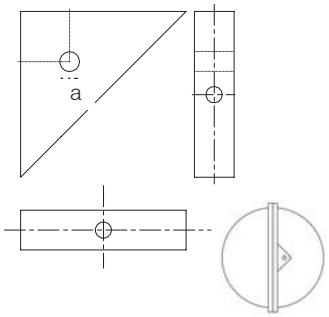
Ordering Information & typical Specifications

Model	Coating / Reflectance %	Hollow Sphere Diameter mm / in.	Sphere Frame Diameter mm / in.	Hollow Sphere Surface cm²	5% Area Port Size mm / in.
UMBB-100	ODP97 / 97%	100 / 4	124 / 4.9	314	43 / 1.7
UMBB-150	ODP97 / 97%	150 / 6	174 / 6.8	707	66 / 2.5
UMBB-210	ODP97 / 97%	210 / 8.3	234 / 9.2	1385	93 / 3.6
UMBB-300	ODP97 / 97%	300 /12	324 / 12.7	2827	130 / 5.1
UMBB-500	ODP97 / 97%	500 /20	524 / 20.6	7584	220 / 8.6
UMBB-1000	ODP97 / 97%	1000 / 39	tbc	31416	450 / 17.7
UMBB-1700	ODP97 / 97%	1700 / 68	tbc	90792	760 / 29.9
UMBK-190	ODM98 / 98%	190 / ~7.5	234 / 9.2	1134	84 / 3.3
UMBK-250	ODM98 / 98%	250 / 10	324 / 12.7	1964	112 / 4.4
UMBK-460	ODM98 / 98%	460 / 18	524 / 20.6	6648	205 / 8.0
UMBG-100	ODG95 / 95%	100 / 4	124 / 4.9	314	43 / 1.7
UMBG-150	ODG95 / 95%	150 / 6	174 / 6.8	707	66 / 2.5
UMBG-300	ODG95 / 95%	300 / 12	324 / 12.7	2827	130 / 5.1

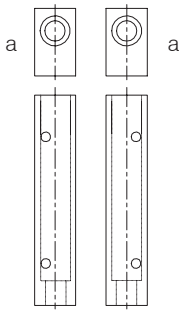
UMSS-SM14, UMSS-SMT & UMSS-SMV Sphere Mount Adapters



The UMSS-SM14 sphere mount is the right choice for small diameter spheres up to 150 mm (6 in). The 14 mm diameter socket with M6 tapped hole allows the spheres to be mounted to commercial optical bench posts. The UMSS-SM14 is specified for upright use or for hanging .



The UMSS-SMT sphere mount is required to assemble UMB series spheres to the UMSS-BT bench-top stands using the M6 horizontal side holes provided. The SMT is fixed to the orbit flange. Additional M6 holes offer additional sphere mounting options into end-user applications.



The UMSS-SMV sphere mount enables spheres with a vertical orbit orientation to be assembled onto post mounts. The SMV is fixed to the orbit flange. Vertical M6 holes are provided for this purpose.

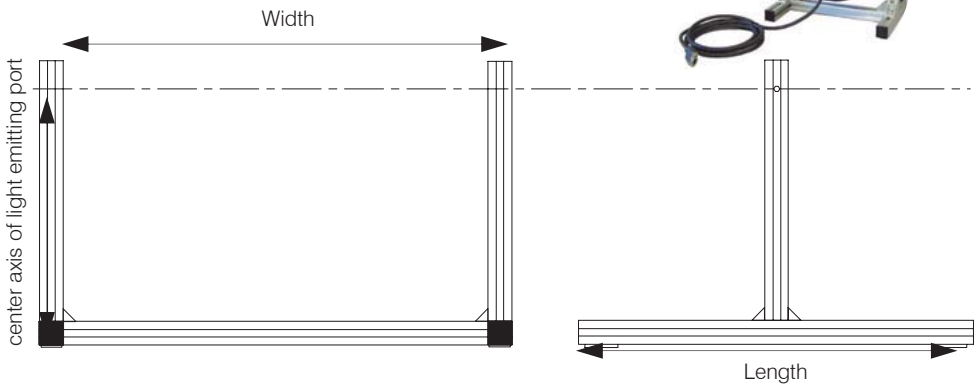
UMSS-SM14

UMSS-SMT

Ordering Information & typical Specifications		
Model	**Description**	**Mounting Holes a**
UMSS-SM14	Post mount socket fix mounted to sphere	M6
UMSS-SMT	Pair of flange mounted triangular sockets fix mounted to sphere	M6
UMSS-SMV	Pair of flange mounted sockets for fix mounted to sphere	for M6 screws
Only available with UMB basic sphere order		

UMSS-BT Bench-top Sphere Stands

UMBB-150 in UMSS-BT150 in the set-up for luminous flux measurement with top load port



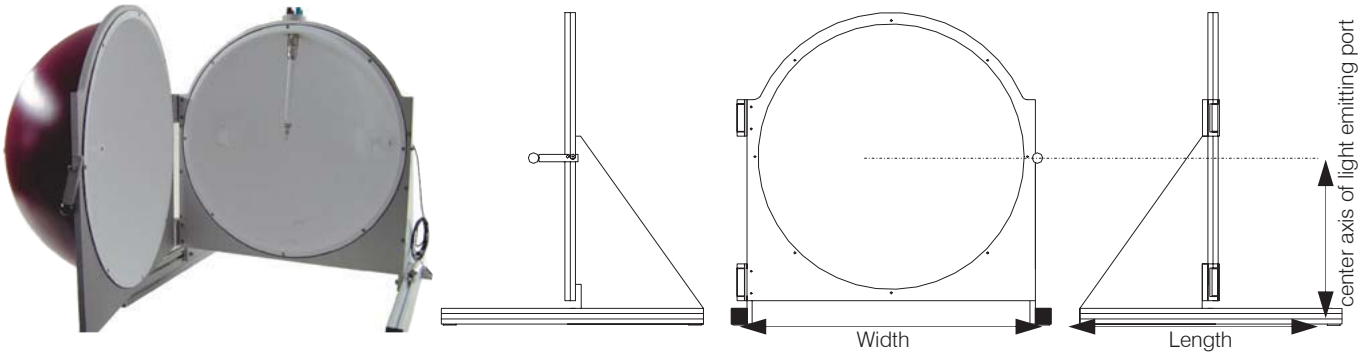
The UMSS-BT stands are available for UMB series spheres from 150 mm (6") to 1700 mm (68") diameters.
The stands are made out of aluminum for lightweight stability. A modular design allows freedom for custom design modification or complete application setups.

Ordering Information & typical Specifications					
Stand Model	**Sphere Model**	**Optical Axis (mm)**	**Width (mm)**	**Length**	**Al profile**
UMSS-BT150	UMBB&UMBK-150	118	220	150	20 x 20
UMSS-BT210	UMBB-210, UMBK-190	tbc	tbc	tbc	20 x 20
UMSS-BT300	UMBB-300, UMBK-250, UMBG-300	203	370	300	20 x 20
UMSS-BT500	UMBB-500, UMBK-460	315	593	500	30 x 30
UMSS-BT1000	UMBB-1000	tbc	tbc	tbc	tbc
UMSS-BT1700	UMBB-1700	tbc	tbc	tbc	tbc
Only available with UMB basic sphere order					

Gigahertz-Optik

UM Series Components

UMSS-HF Bench-top Hinged Frame Sphere Stands

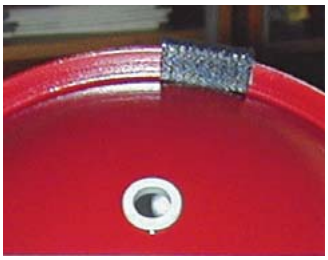


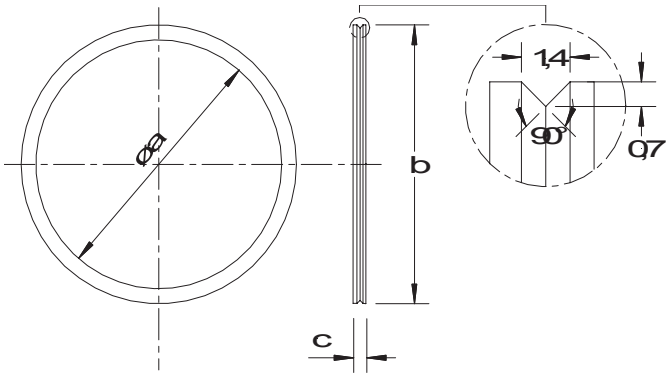
The UMSS-HF bench-top sphere stand is designed for those applications requiring open access to the center of the integrating sphere for insertion and removal of the test lamp or sample. This is a common requirement in luminous flux or radiant power measurements of large multi-directional lamps, absorbance and transmission measurements. The UMSS-HF stands are designed for rugged long-term use. Port frames and other components like detector ports, light guide adapters, auxiliary lamps & lamps holders can be assembled to both sphere halves.

Ordering Information & Specifications

Model	Sphere Model	Height of optical axis	Width	Length	Al profile
UMSS-HF300	UMBB-300	tbc	tbc	tbc	tbc
UMSS-HF500	UMBB-500	345	610	500	20 x 40
UMSS-HF1000	UMBB-1000	tbc	tbc	tbc	tbc
UMSS-HF1700	UMBB-1700	tbc	tbc	tbc	tbc
Only available with UMB basic sphere order					

UMPF Port Frames



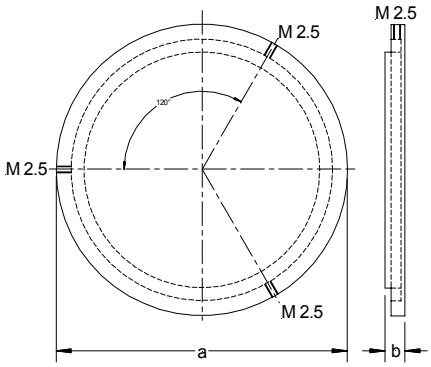


Port frames are permanently mounted to the sphere at specified positions. Frames are available with free apertures from 0.5 to 5 inch diameter. A machined V-groove around the frame's outer edge allows assembly of port plugs, reducers, adapters and other accessory components onto the port. Gold coated port frames are offered for use with UMBG series spheres.

Ordering Information & Specifications

Model BaSO4	Model Gold	Free aperture diameter (a)	Outer diameter (b)	Frame Height (c)
UMPF-0.5	**UMPF-0.5-G**	0.5 in. / 12.7 mm	0.75 in. / 18.8 mm	0.1 in. / 2.7 mm
UMPF-1.0	**UMPF-1.0-G**	1.0 in. / 25.4 mm	1.25 in. / 31.5 mm	0.1 in. / 2.7 mm
UMPF-1.5	**UMPF-1.5-G**	1.5 in. / 38.1 mm	1.75 in. / 44.2 mm	0.1 in. / 2.7 mm
UMPF-2.0	**UMPF-2.0-G**	2.0 in. / 50.8 mm	2.25 in. / 56.9 mm	0.1 in. / 2.7 mm
UMPF-2.0/3.5	**UMPF-2.0/3.5-G**	2.0 in. / 50.8 mm	3.5 in. / 88.9 mm	0.1 in. / 2.7 mm
UMPF-2.5	**UMPF-2.5-G**	2.5 in. / 63.5 mm	2.75 in. / 69.6 mm	0.1 in. / 2.7 mm
UMPF-3.0	**UMPF-3.0-G**	3.0 in. / 76.2 mm	tbc	0.1 in. / 2.7 mm
UMPF-4.0	**UMPF-4.0-G**	4.0 in. / 101.6 mm	4.25 in. / 107.7 mm	0.1 in. / 2.7 mm
UMPF-5.0	**UMPF-5.0-G**	5.0 in. / 127 mm	5.25 in. / 133.1 mm	0.1 in. / 2.7 mm
Only available with UMB basic sphere order				

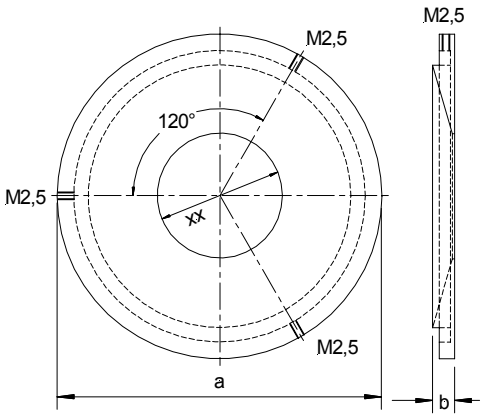
UMPP Port Plugs



Port plugs are used with UMPF port frames to close sphere port openings while maintaining it's uniformly coated interior surface. Plugs are fixed onto the side V-groove of the port frame with three M2.5 screws. The surface facing the sphere interior is coated with barium sulfate or gold as applicable. Port plugs for UMBK spheres are available by special request.

Ordering Information & Specifications				
Model BaSO4	**Model Gold** 1)	**Port Frame**	**Outer diameter a (mm / inch)**	**Height b (mm / inch)**
UMPP-0.5	**UMPP-0.5-G**	UMPF-0.5	27 / 1.06	5.3 / 0.2
UMPP-1.0	**UMPP-1.0-G**	UMPF-1.0	39.9 / 1.57	5.3 / 0.2
UMPP-1.5	**UMPP-1.5-G**	UMPF-1.5	52.6 / 2.07	5.3 / 0.2
UMPP-2.0	**UMPP-2.0-G**	UMPF-2.0	65.3 / 2.57	5.3 / 0.2
UMPP-2.0/3.5	**UMPP-2.0/3.5-G**	UMPF-2.0	97 / 3.81	5.3 / 0.2
UMPP-2.5	**UMPP-2.5-G**	UMPF-2.5	78 / 3.07	5.3 / 0.2
UMPP-3.0	**UMPP-3.0-G**	UMPF-3.0	tbc	5.85 / 0.23
UMPP-4.0	**UMPP-4.0-G**	UMPF-4.0	116.1 / 4.57	5.85 / 0.23
UMPP-5.0	**UMPP-5.0-G**	UMPF-5.0	141.5 / 5.57	5.85 / 0.23
1) Only available with sphere system order				

UMPR Port Reducer



Port reducers for the UMPF series spheres enable the free aperture diameter of port frames to be variably decreased according to the application. The aperture diameter can be end-user specified up to the maximum aperture on order. The edge of the aperture is machined in a knife-edge design. Port reducers are fixed onto the V-groove of the port frame with three M2.5 screws. The surface facing the sphere interior is coated with barium sulfate or gold as applicable. Port plugs for UMBK spheres are available by special request. Other optional forms of non-circular reducer such as slits can be custom ordered.

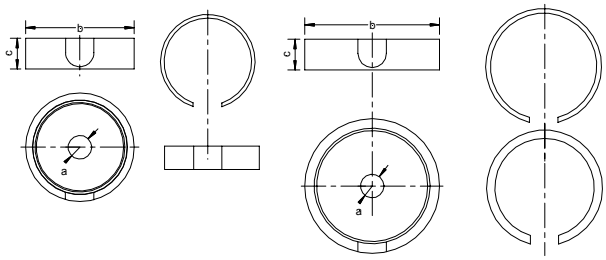
Ordering Information & Specifications					
Model BaSO4	**Model Gold**	**Port Frame**	**Outer diameter a (mm / inch)**	**Height b (mm / inch)**	**xx = 0 to max free aperture *)**
UMPR-0.5/xx	**UMPR-0.5/xx-G**	UMPF-0.5	27 / 1.06	5.3 / 0.2	12.5 / 0.5
UMPR-1.0/xx	**UMPR-1.0/xx-G**	UMPF-1.0	39.9 / 1.57	5.3 / 0.2	25.4 / 1.0
UMPR-1.5/xx	**UMPR-1.5/xx-G**	UMPF-1.5	52.6 / 2.07	5.3 / 0.2	38.1 / 1.5
UMPR-2.0/xx	**UMPR-2.0/xx-G**	UMPF-2.0	65.3 / 2.57	5.3 / 0.2	50.8 / 2.0
UMPR-2.0/3.5/xx	**UMPR-2.0/3.5/xx-G**	UMPF-2.0	97 / 3.81	5.3 / 0.2	50.8 / 2.0
UMPR-2.5/xx	**UMPR-2.5/xx-G**	UMPF-2.5	78 / 3.07	5.3 / 0.2	63.5 / 2.5
UMPR-3.0/xx	**UMPR-3.0/xx-G**	UMPF-3.0	tbc	5.85 / 0.23	76.2 / 3.0
UMPR-4.0/xx	**UMPR-4.0/xx-G**	UMPF-4.0	116.1 / 4.57	5.85 / 0.23	101.6 / 4.0
UMPR-5.0/xx	**UMPR-5.0/xx-G**	UMPF-5.0	141.5 / 5.57	5.85 / 0.23	127 / 5.0
*) free aperture diameter xx in mm / inch with or without knife wedge needs to be specified on order					

Gigahertz-Optik

UM Series Components

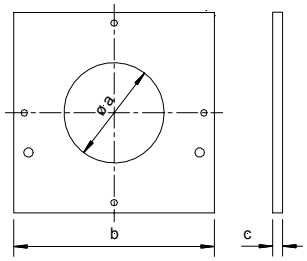
UMDP Detector Ports

Detector ports are required to mount 37 and 45 mm diameter photometric, radiometric and color detectors to UM series integrating spheres.
The plastic ring that holds the detector electrically and thermally isolates the detector from the sphere.
It's free aperture can be increased according to the detector diffuser size. The sphere surface side of the detector adapters are coated with barium sulfate.
Simple adapters that fit into the detector port allow detector heads with different outside diameters to be mounted.



Ordering Information & Specifications				
Model	**Detector dia.**	**Free aperture diameter *) a**	**Outside diameter b**	**Height c**
UMDP-37	37 mm	10 to 38 mm	46 mm	13 mm
UMDP-45	42 & 45 mm	10 to 47 mm	56.9 mm	13 mm
*) machined on order. Only available in order with UMB basic sphere				

UMPF-LSOK Port Frames for Light Source LS-OK30 & LS-OK45



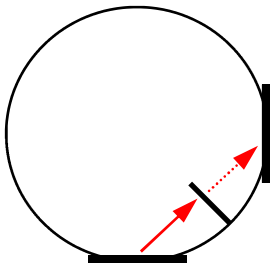
These port frames are needed to mount LS-OK30 and LS-OK34 external light sources to the integrating sphere. Typically these light sources are used together with the LS-OK30-VA variable attenuator.

Ordering Information & Specifications		
Model	**Aperture Dia. a**	**Dimension (mm)**
UMPF-LSOK30	30 mm	60 x 60
UMPF-LSOK45	45 mm	tbc
Only available with UMB basic sphere order		

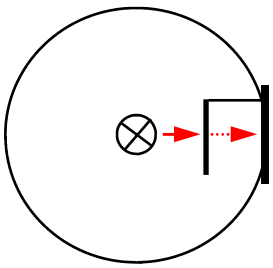
UMPB Port Baffles

Baffles are employed to shield ports from direct irradiation from an other port, a lamp, probe or from first reflection off the sphere surface.
UMDB-SM baffles are direct mounted to the sphere housing. They are typically used between two ports or between inside assembled lamps and ports.
UMDB-PM baffles are used in front of detector ports to prohibit direct irradiation of the detector from centrally mounted lamps. This baffles are typically post mounted.

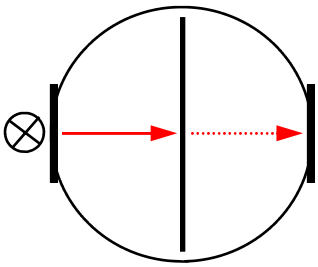
UMDB-IL baffles are uses between to ports in-line assembled to the sphere. This arrangement is typically used for uniform light source set-ups with an external lamp at one port and the light output at the other port.



UMPB-SM



UMPB-PM



UMPB-IL

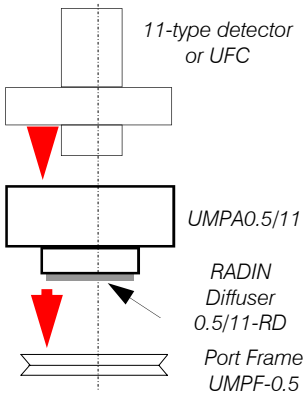
Ordering Information		
Model BaSO4	**Model Gold**	**Description**
UMPB-SM	**UMPB-SM-G**	Sphere mount baffle
UMPB-PM	**UMPB-PM-G**	Post mount baffle
UMPB-IL	**UMPB-IL-G**	In-Line spider mount baffle
Only available with UMB basic sphere order		

UMPA Port Adapter

Port adapters are universal tools used to assemble detectors, light guides, accessories and samples to UMPF sphere series port frames. The port adapter can be fixed in place by three M2.5 screws to the port frame's standard V-groove. The port adapters can be replaced by port plugs to close the port as required by the application.
The following list of port adapters represents only a small sample of available parts in Gigahertz-Optik's continuously expanding program. Please contact your local representative or the factory for detailed drawings and also to keep abreast of new product developments.

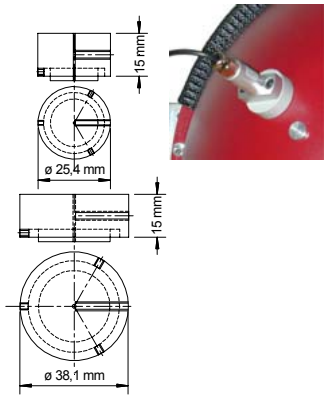
UMPA –0.5/11

Port adapter specially designed to mount standard Gigahertz-Optik 11-type housing detectors or UFC fiber connectors with 11-type adapter flanges to the UMPF-05 port frame.



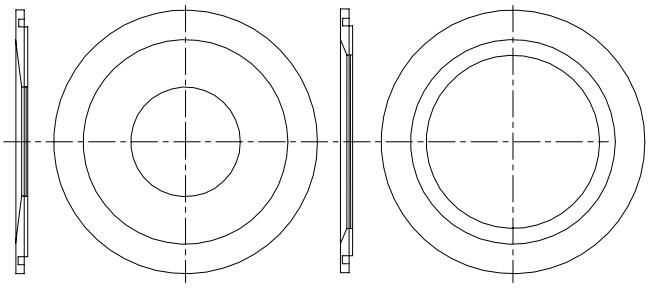
UMPA –0.5/F & -1.0/F

Port adapter for use on UMPF-0.5 and UMPF-1.0 port frames respectively. The standard 1 mm dia. hole can be easily modified to larger diameters up to 0.5 / 1 in. (12.5 / 25.4 mm) to mount light guides and other accessories.



UMPA-4.0/QD1.9 & UMPA-4.0/QD3.0

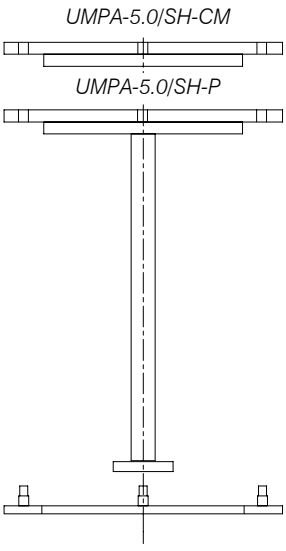
Port adapter designed for uniform light source set-ups requiring a diffuser window. The 48 mm / 1.9 in dia. (model 1.9/QD) or 76.2 mm / 3.0 in dia. (model 3.0/QD) diffuse quartz windows offer a useful wavelength range from 250-2500 nm.

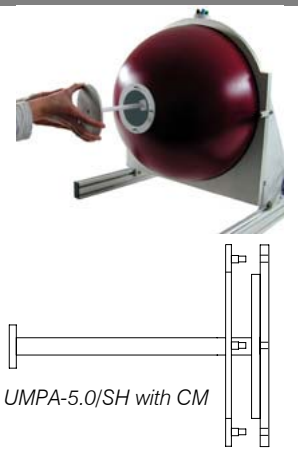


UMPA-4.0/QD1.9 UMPA-4.0/QD3.0

UMPA-5.0/SH, SH-P & SH-CM

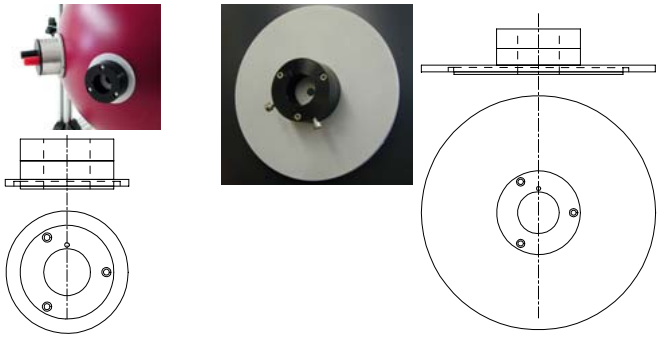
Model UMPA-5.0/SH is a universal sample holder system which fits onto the UMPF-5.0 port frame. A 101.6 mm (4 in.) diameter free aperture allows samples to be placed in front or inside the sphere. The **UMPA-5.0/SH-P** port plug can also be used for custom modifications. The **UMPA-5.0/SH-CM** adapter is used when samples should be placed in the sphere center.





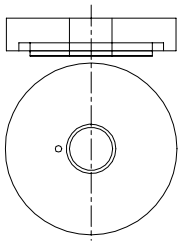
UMPA-2.0/LED5 & UMPA-5.0/LED5

Port adapter which allows the precise positioning of LEDs mounted in the LED-5xx mount series of Instrument Systems / Munich to the entrance port of Gigahertz-Optik's integrating spheres.



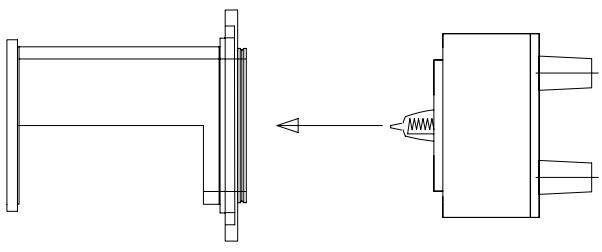
UMPA-1.5/LGA13

Port adapter to mount light guides with 13.2 mm dia. type adapter to the UM series integrating spheres.



UMPA-2.0/AXL

Port adapter to set-up an auxiliary lamp by using a LS-IS1.5-H10 external light source. The adapter includes a hemisphere baffle to protect ports and other components for direct illumination. The LS source can be direct mounted.



UMPA-2.0/AXL LS-IS1.5 optional

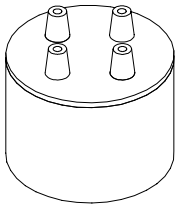
Gigahertz-Optik

UM Series Components

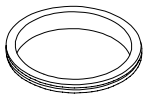
Ordering Information & Specifications				
Model	**Port Frame**	**Mechanical Interface**	**Outside Diameter**	**Height**
UMPA-0.5/11	UMPF-0.5	11-type detectors & UFC fiber couplers	25.4 mm / 1.0 in.	8.5 mm / 0.34 in.
UMPA-0.5/11-RD	-	RADIN diffuser to be glued into UMPA-0.5/11	12 mm / 0.47 in.	1 mm / 0.04 in.
UMPA-0.5/F	UMPF-0.5	1 mm dia., machineable up to 12.5 mm	25.4 mm / 1.0 in.	15 mm / 0.59 in.
UMPA-1.0/F	UMPF-1.0	1 mm dia., machineable up to 25.4 mm	38.1 mm / 1.5 in.	15 mm / 0.59 in.
UMPA-1.5/LGA13	UMPF-1.5	Socket for 13.2 mm dia light guide adapter	52.6 mm / 2.1 in	10.4 mm / 0.41 in
UMPA-2.0/AXL	UMPF-2.0	Auxiliary lamp adapter with baffle for LS-IS1.5-10	65.3 mm / 2.6 in	6.4 mm / 0.25 in
UMPA-2.0/LED5	UMPF-2.0	Socket for Instrument Systems LED-5xx LED adapter	65.3 mm / 2.57 in	25.85 mm / 1.01 in
UMPA-4.0/QD1.9	UMPF-4.0	48 mm / 1.9 in dia quartz diffuser	116.1 mm/ 4.57 in	3.7 mm / 0.15 in.
UMPA-4.0/QQ3.0	UMPF-4.0	76.2 mm / 3.0 in. diameter quart diffuser	116.1 mm / 4.57 in	3.7 mm / 0.15 in
UMPA-5.0/LED5	UMPF-5.0	Socket for Instrument Systems LED-5xx LED adapter	141.5 mm / 5.57 in	25,85 mm / 1.01 in
UMPA-5.0/SH	UMPF-5.0	101.6 mm / 4.0 in free aperture sample holder base	141.5 mm / 5.57 in	4.25 mm / 0.17 in.
UMPA-5.0/SH-P	UMPF-5.0	Universal sample holder plate	141.5 mm / 5.57 in	6 mm / 0.24 in.
UMPA-5.0/SH-CM	UMPF-5.0	Universal center mount sample holder	141.5 mm / 5.57 in	6 mm / 0.24 in.

UMLA Lamp Adapter for Center Mount

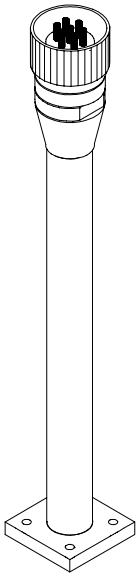
UMLA lamp adapters are designed to mount lamps in the center of the integrating sphere for luminous flux or radiant power measurements.
The **UMLA-1.5/B** base offers four banana sockets for current and voltage connections to the lamp sample. It's rugged connector socket permits mounting and connection of the UMLA-xx lamp adapters. A UMPF-1.5 port frame is needed to mount the UMLA.1.5/B adapter onto the sphere.
The **UMLA-xx** lamp holders are available in different lengths for compatibility with different size spheres. It's connector positioned at the top end of the UMLA-xx allows simple connection and mounting to the UMLA-1.5/B base socket. Lamp socket is supplied and assembled by the end-user.
The **UMLA-xx** includes a lamp socket specified by the end-user as a special order. Consult factory for assistance.



UMLA-1.5/B

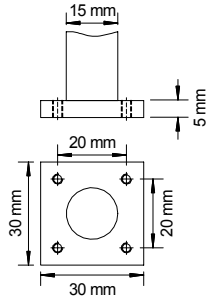


UMPF-1.5
(assembled in sphere)



UMLA-xxx assembling platform

UMLA-xxx



Ordering Information & Specifications		
Model	**Accessory**	**Description**
UMLA-1.5/B	UMPF-1.5	Base adapter for UMLA-xx lamp holder
UMLA-300	UMLA-1.5/B	Lamp holder for 300 mm / 12" diameter spheres
UMLA-500	UMLA-1.5/B	Lamp holder for 500 mm / 20" diameter spheres
UMLA-xx	UMLA-1.5/B	Lamp holder with lamp socket. Contact factory with detailed specs.
Lamp adapter and lamp holder for UMBB-1000 and UMBB-1600 available by request		