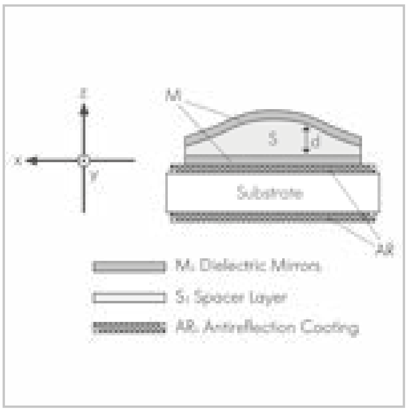
Optics

Gaussian Mirrors

Gaussian mirrors, also known as VRM (variable reflecting mirrors), are characterized by a degree of reflection that slopes from the center of the optic in a Gaussian distribution. LASER COMPONENTS is one of the few manufacturers worldwide that offers this special type of mirror.

The mirrors are used in unstable resonators where they help produce high quality laser beams with low beam divergence at high pulse energies. In frequency-doubled systems they are used to achieve a greater pump efficiency. The Gaussian mirrors are extremely stable and therefore suited for the highest power levels.

Assembly



The working principle of Gaussian mirrors is based on a Fabry Pérot interferometer with a position-depending mirror spacing – a so-called etalon.

The adjoining picture shows the cross-section of a coating that exhibits a change in the reflection R(r) for monochromatic light depending on its position.

A so-called distance layer S with varying thickness d is surrounded by two identical mirror layers M. If d is an even multiple of $\lambda/4$, the system is transparent for the wavelength and does not exhibit a reflection for λ. If d is an odd multiple of $\lambda/4$, the total reflection is determined by the reflection of the mirror layers M.

Measurement

The gaussian optics are manufactured with extreme precision according to customer specifications, they are characterized and measured in a very detailed manner. Using an innovative measuring system leads to a consistently high quality of the optics and strict adherence to the desired specifications of the customer.

Detailed measurement diagrams are available for all Gaussian optics.

12/20 / V02 / HB:IF / lc-optics/coatings/gaussian_mirror

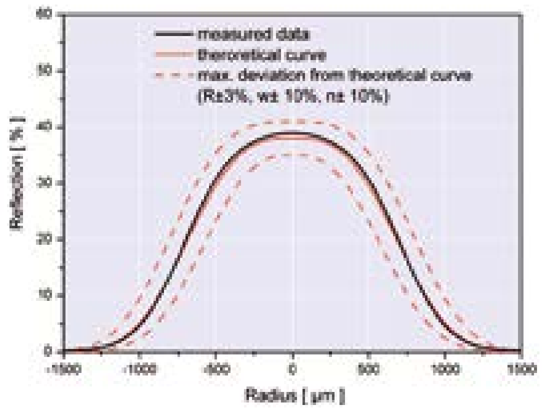
Germany & Other Countries
Laser Components Germany GmbH
Tel: +49 8142 2864 – 0
Fax: +49 8142 2864 – 11
info@lasercomponents.com
www.lasercomponents.com

France
Laser Components S.A.S.
Tel: +33 1 39 59 52 25
Fax: +33 1 39 59 53 50
info@lasercomponents.fr
www.lasercomponents.fr

United Kingdom
Laser Components (UK) Ltd.
Tel: +44 1245 491 499
Fax: +44 1245 491 801
info@lasercomponents.co.uk
www.lasercomponents.co.uk

Nordic Countries
Laser Components Nordic AB
Tel: +46 31 703 71 73
Fax: +46 31 703 71 01
info@lasercomponents.se
www.lasercomponents.se

USA
Laser Components USA, Inc.
Tel: +1 603 821 – 7040
Fax: +1 603 821 – 7041
info@laser-components.com
www.laser-components.com



Nomenclature

GR	1064	/35	- 1.3	- 4	CX1025-4.0UV
Gaussian mirror	Wavelength in nm	R_0: Reflectivity in center area in %	w: Radius $1/e^2$	n: Order	Substrate

When requesting a quotation, the following information is required:

To determine the Gaussian profile you have to use the following formula:

$$R(r) = R_0 \cdot \exp\left[-2\left(\frac{r}{w}\right)^n\right] + R_{out}$$

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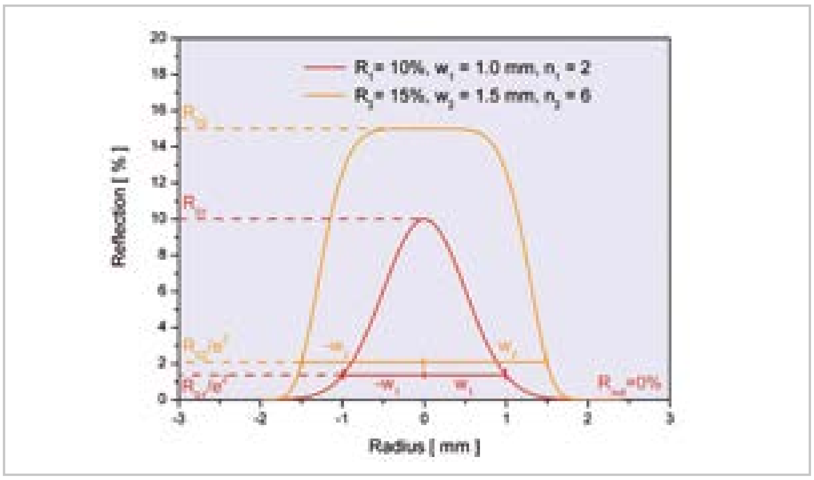
- **Reflection values R_0 , R_{out}**
  Two important parameters are the reflection values in the outer and central zone (see figure below).
  All coatings where $R_0 > R_{out}$ are defined as Gaussian mirrors; this contains the so-called Super Gaussian Mirrors with a Gaussian order greater than 2. It is often assumed that $R_{out} = 0$; however, other values can be specified. For reflection in the central zone, it is possible to specify values up to 90 %.
- **Lateral dimension w**
  The lateral dimension w is half the diameter of the spot and is defined by the position $1/e^2$.
- **Gaussian order n**
  The Gaussian order n is the exponent of the Gaussian function. With it, the slope and shape can be determined.
- **Working wavelength λ**
  Dielectric coatings with a defined reflection function R(r) are generally monochromatic.
  The Gaussian profile is only valid for a single specified wavelength.
  LASER COMPONENTS has Gaussian mirrors for 1064 nm available on a standard basis.
  Additional wavelengths can be manufactured upon request.
- **Laser beam parameters**
  For cw lasers: laser power density in W/cm^2.
  For pulsed lasers: energy density in J/cm^2 and pulse length as well as repetition rate.

GR1064/10-1.0-2

GR1064/15-1.5-6



Reflection versus radius

Germany & Other Countries
Laser Components Germany GmbH
Tel: +49 8142 2864 – 0
Fax: +49 8142 2864 – 11
info@lasercomponents.com
www.lasercomponents.com

France
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Tel: +33 1 39 59 52 25
Fax: +33 1 39 59 53 50
info@lasercomponents.fr
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Fax: +46 31 703 71 01
info@lasercomponents.se
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Tel: +1 603 821 – 7040
Fax: +1 603 821 – 7041
info@laser-components.com
www.laser-components.com