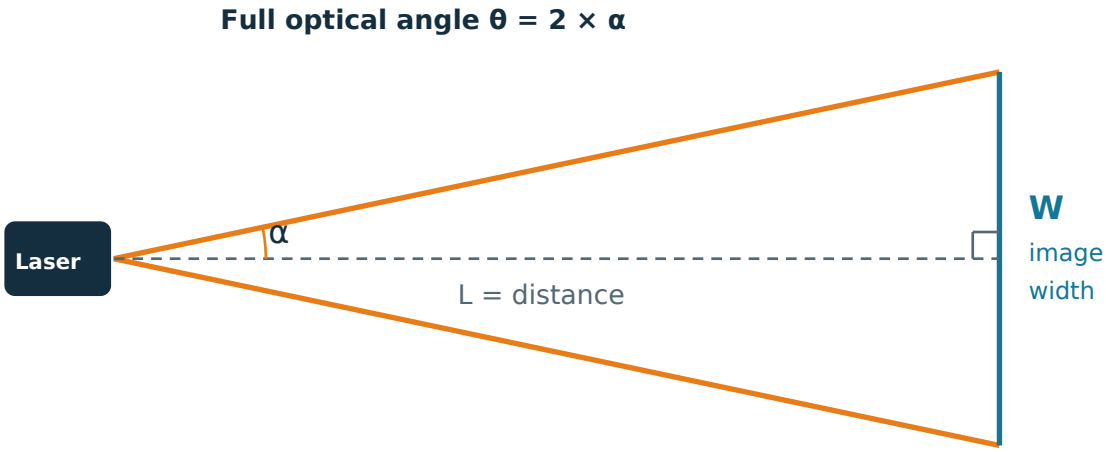
POLAR AUDIO SOLUTIONS

Laser scan angle

Image width, projection distance and the full optical scan angle

The scan angle describes how wide the scanner spreads the projected image. Calculate horizontal and vertical angles separately, using the matching image width or height.



Centered projection onto a flat screen perpendicular to the centerline.

Scan angle: θ = 2 × arctan(W / (2 × L))

Image width: W = 2 × L × tan(θ / 2)

Required distance: L = W / (2 × tan(θ / 2))

W and L must use the same length unit. Use degree mode on your calculator. θ is the total optical angle, not the mechanical mirror angle.

Worked examples

Known values	Result
10 m distance; 10 m image width	θ = 53.13°
50° scan angle; 10 m distance	W = 9.33 m
50° scan angle; 5 m image width	L = 5.36 m

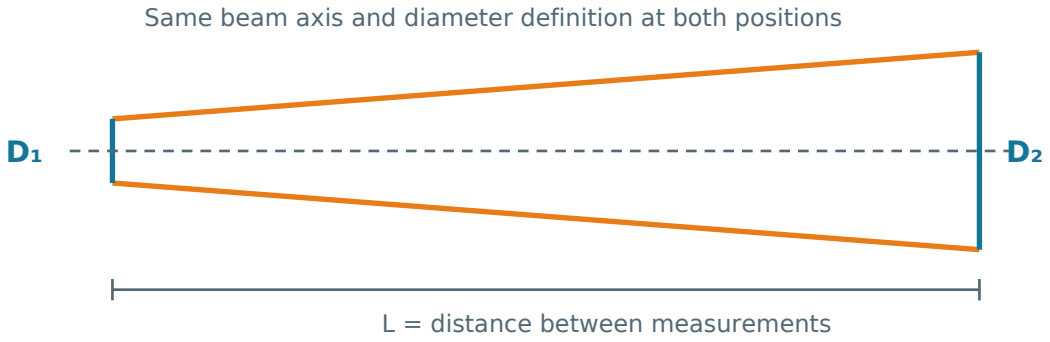
Practical takeaway: at 50° full optical angle, image width is about 93.3% of the projection distance. A 5 m wide image needs approximately 5.36 m of throw.

Scanner limit: maximum angle is not a guarantee of usable speed or image quality. Follow the scanner specification for the chosen pattern and point rate.

Laser beam divergence

Beam growth over distance - always state full angle or half angle

Divergence describes how an individual beam widens as it travels. Measure both X and Y: a diode beam can expand differently in each axis.



Full angle: $\Theta = 2 \times \arctan((D_2 - D_1) / (2 \times L))$

Half angle: $\beta = \Theta / 2$

Small-angle shortcut: Θ [mrad] ≈ (D_2 - D_1) [mm] / L [m]

For the arctan formula, use the same length unit for diameters and distance; its result follows your calculator mode. Convert radians to mrad by multiplying by 1,000. 1° = 17.4533 mrad.

Example: 5 × 5 mm at the aperture; 11 × 9 mm after 4 m

Axis	Growth	Full angle Θ	Half angle β
X	11 - 5 = 6 mm	≈ 1.50 mrad	≈ 0.75 mrad
Y	9 - 5 = 4 mm	≈ 1.00 mrad	≈ 0.50 mrad

Remember: 1 mrad full-angle divergence adds approximately 1 mm of beam diameter per meter. Starting at 5 mm, the beam is about 15 mm wide after 10 m: 5 mm initial diameter + 10 mm growth.

How to obtain useful measurements

• Measure at two known positions along the same beam; the first need not be at the aperture.
• Use the same beam-width definition at both points, such as 1/e² or FWHM. Do not mix them.
• A longer baseline, often 10 m or more, reduces the relative effect of reading errors. Distance alone does not guarantee accuracy.
• This is a practical geometric estimate. A focused beam or measurements near its waist need a more detailed propagation analysis.

Specification format: “X ≈ 1.50 mrad; Y ≈ 1.00 mrad; full angle; measured over 4 m.” Add the beam-width definition and measurement method when reporting test results.

Technical references
Pangolin: About scan angles - pangolinlegacy.com/userhelp/scanangles.htm
Gentec-EO: Beam divergence and diameter - gentec-eo.com/laser-calculators/beam-divergence-and-diameter