Diffractive F-Theta with red Aiming beam (Dual Wavelength lens) in scanner systems for medical treatments

Using an F-Theta lens is a common way of generating a diffraction limited spot size in a specific scan field. For many laser scanning applications, such as welding and surgery, delivering a high-power infrared laser beam (usually of a CO2 laser) is required.

Since said wavelength is invisible to the human eye, it is difficult to determine where the beam is being directed. In order to direct the infrared beam to the correct location, an additional visible laser beam ("aiming beam"), which is coaxially superimposed on the infrared beam, is added.

Using two different wavelengths presents focal position-differences between the visible aiming beam and the infrared process beam. This deviation from ideal position reduces treatment effectiveness and may even cause damage in certain cases.

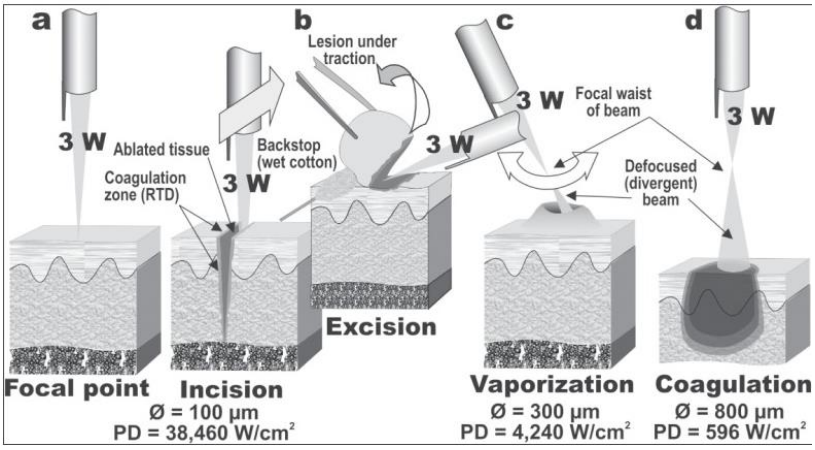

Figure 1: Different effects caused by laser defocus [1]

In order to correct this focal shift between the aiming beam and the process beam, a typical solution is to add a diffractive 'Dual Wavelength' lens. To correct field correction in a scanner system with regular F-Theta, it is required to locate the diffractive lens inside the scanner system (DOE must be inserted into the F-Theta or between mirrors), which is not always possible.

Holo/Or has designed a unique DOE element, used as both **F-Theta lens** and a **Dual-Wavelength lens**, which focuses both wavelength at the same focal plane and at the same field location.

Advantages of this solution:

1. Single element with reduced size (Ø25.4mm or smaller)
2. High NA (up to 0.6)
3. Easy to align, simple mechanical integration
4. Diffraction limited performance at all scan angles
5. Less sensitive to thermal lensing effects
6. Can be tailored to specific EFL, beam size, wavelengths, spot size and DOF

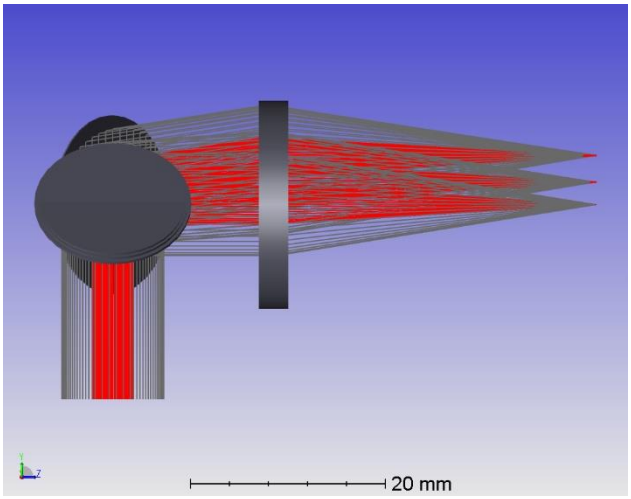

Figure 2: Diffractive F-Theta lens, ray diagram at different scan-fields for both aiming and process wavelengths

Standard product:

Part number	**FT-001**
Operation wavelength [um]	10.6
Aiming beam wavelength [um]	0.635
Scan field size [mm]	10x10
EFL [mm]	33
Working Distance [mm]	31.67
Focused spot size [um] (for TEM00)	70um
Element size [mm]	25.4
Clear aperture size [mm]	23.6
Element thickness [mm]	3
Material	ZnSe

For more information, please contact us at: holoor@holoor.co.il

References:

CO2 lasers applications:

[1] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3999431/

[2] https://cdn.intechopen.com/pdfs-wm/32644.pdf

Aiming beam:

[3] https://books.google.co.il/books?id=PQ3hCgAAQBAJ&lpg=PA239&ots=OFX2OfSDps&dq=co2%20aiming%20beam&pg=PA239#v=onepage&q=co2%20aiming%20beam&f=false

[4] https://books.google.co.il/books?id=W_a5DQAAQBAJ&pg=PA110&lpg=PA110&dq=co2+aiming+beam&source=bl&ots=g7afVZf4_r&sig=pmBQumQ36r7X-RMi4YeaAyPQJbQ&hl=en&sa=X&ved=0ahUKEwihm5SxzIHYAhXDJ8AKHVBTBDI4ChDoAQgmMAA#v=onepage&q=co2%20aiming%20beam&f=false

[5] https://books.google.co.il/books?id=qV8cBQAAQBAJ&pg=PA139&lpg=PA139&dq=co2+aiming+beam&source=bl&ots=iwehP2GkH9&sig=qS-ZNh5dIlAPOz-s6roc8KPktdg&hl=en&sa=X&ved=0ahUKEwjW39ay0IHYAhWnIcAKHYCyCx44FBDoAQgmMAA#v=onepage&q=co2%20aiming%20beam&f=false

[6] https://books.google.co.il/books?id=vkVY3JwqvrgC&pg=PA495&lpg=PA495&dq=co2+aiming+beam&source=bl&ots=Uyk-YkllbE&sig=S71W6hH1qCSxW_lXMSmlTe3N0QU&hl=en&sa=X&ved=0ahUKEwjW39ay0IHYAhWnIcAKHYCyCx44FBDoAQgyMAM#v=onepage&q=co2%20aiming%20beam&f=false

[7] https://books.google.co.il/books?id=Mw6o_BgfPjQC&pg=PA47&lpg=PA47&dq=co2+aiming+beam&source=bl&ots=Z56UOYXgA0&sig=zXH_Z4KjOm3OzvI8-CLdTRYwics&hl=en&sa=X&ved=0ahUKEwjW39ay0IHYAhWnIcAKHYCyCx44FBDoAQgvMAI#v=onepage&q=co2%20aiming%20beam&f=false