



SYNRAD Technical Bulletin

026b

Technical Issue: High-Power Optics and Thermal Lensing in Integrated Laser Applications

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Models Affected: Systems Using Firestar i401, f400, and Pulstar p250 Lasers

Description:

There are several reported instances where high average power (>350 – 400 W) laser applications using various third-party optics in the beam path have been affected by significant thermal lensing effects. This phenomenon occurs when optics with low-power or low-quality coatings are used in high average power applications. Excessive heat absorbed by the optical coating heats the optic and changes its refractive index, causing a shift in focus at the focal point. This focus shift can occur rapidly—within the first one to three seconds of lasing. In long focal length (3-axis scan head) applications, shifts in focus up to 30 mm have been documented.

Although this problem can affect any beam delivery component containing a lens including beam expanders, collimators, and focusing lenses; beam expanders are most likely to be affected because the coating on the input optic is exposed to a much higher power density due to the smaller diameter (unexpanded) input beam.

If you suspect thermal lensing is occurring in your system, the first step is to remove the beam expander and check whether the focus shift is still occurring. Although the focused spot will be larger than normal, you should still be able to determine if the focal point now remains fixed.

If the focal point remains fixed, the beam expander's optical coating may be the root cause of the problem. Contact the manufacturer of your beam expander and verify the optic is coated with the appropriate high-power coating. Coatings rated "up to 500 watts" may not be sufficient, especially when the laser's average power output is approaching the upper limit of that range. Remember that the laser's rated output generally occurs at a duty cycle of 70-80%. At higher duty cycles, a Firestar i401 (400 W) laser for example, may produce over 500 watts of average power.

When troubleshooting processing system optics, be aware that once thermal lensing occurs, it may take several minutes for the optic surface to cool down before the focus shift returns to the correct position. Although the optical surface heats rapidly, within one to three seconds, in most cases the optical housing itself does not heat up enough to be detectable.

For further information contact SYNRAD at 1.800.796.7231; outside the U.S., dial +1.425.349.3500 or email us at synrad@synrad.com.