

PHOTONIC POWER TRACEABLE TO THE KILOGRAM FOR MANUFACTURING AND COMMUNICATIONS

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Summary: Laser-based manufacturing represents an area of industrial importance and commercial growth. Welding, cutting, and additive manufacturing are examples where manufacturers have seized the advantages of low maintenance and high efficiency of fiber and disk lasers. NIST has provided high-power laser measurements since the 1970s by means of thermal detectors that are relatively slow and massive. Recently we have demonstrated that it is possible to achieve fast and accurate measurements ranging from 10 W to 100 kW by means of photon momentum and radiation pressure. This provides us with an entirely new route for traceability. Rather than relying on the Volt and standard resistors, we now can rely on mass measurements and traceability to the kilogram. Above approximately 1 W, mass measurements provide lower uncertainties for optical power measurements, while below 1 W (less than 1 μg) radiation pressure provides lower uncertainty for mass measurements. Our techniques and instrumentation for photon momentum are unprecedented and provide a means to completely rethink classical radiometry.

We will present our latest developments in measurements and instrumentation related to photon momentum for laser-based manufacturing. In addition, we have recently observed that we can measure radio-frequency (near 15 GHz) in waveguide at the level of tens of Watts.