Advanced Optical Technology Ltd

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Technical Note 16

Short Pulse Instrument Laser

The Model: AOT:YVO:25QI (instrument) laser is based on much of the same proven technology as other AOT products. It is primarily designed as a compact and reliable source for customers with a dedicated application in mind i.e. unlike our other models, the format does not offer users the option of a higher power amplified system or adding a standard harmonic unit.

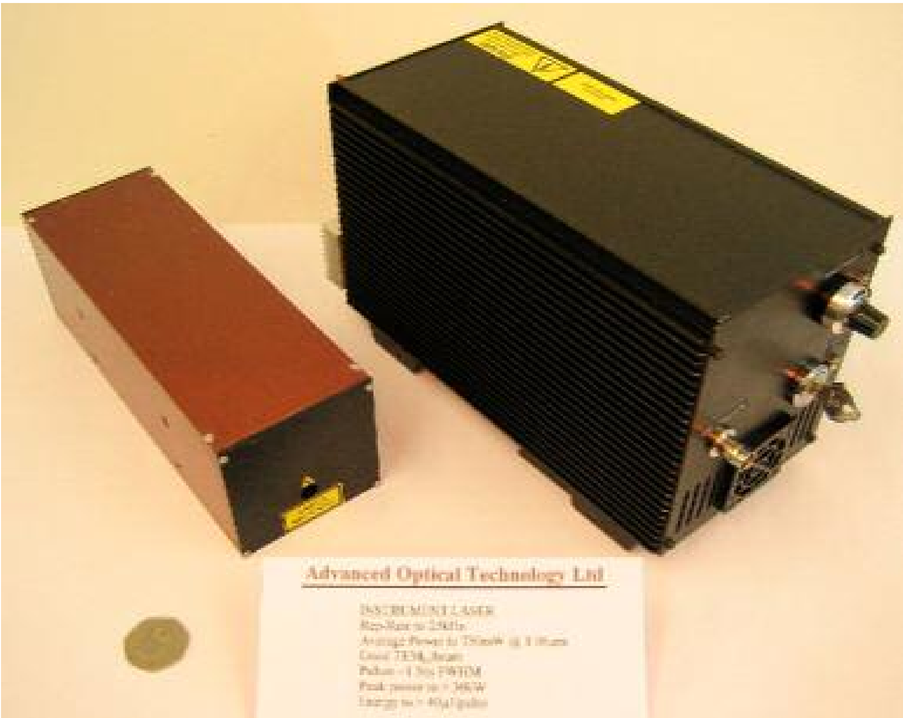

Fig (1) Instrument Laser

The development of the instrument laser has resulted in what AOT believe is a conservative specification. It is a non-trivial task for suppliers to choose the parameter set comprising a laser specification since not all parameter are independent. The pulse length, delay and jitter (from Trig input), pulse energy and peak power all depend to some degree on the rep-rate and pump level selected by the user. As a result, it is difficult to provide a single meaningful number to define a parameter value in a specification. Often, it is more helpful to users to state a range of values or, sometimes better, provide actual operating curves from which the user can select an optimum parameter set best suited for their particular application.

A good example highlighting the above difficulty is pulse width. Fig (2) shows typical results for the instrument laser

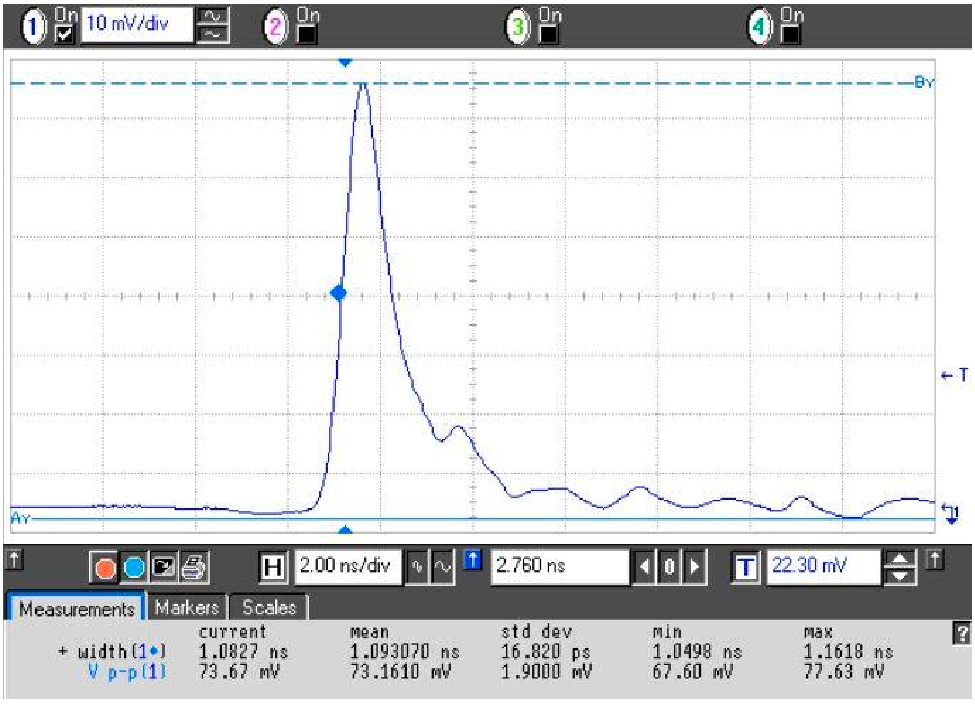

Fig 2(a): Laser Operating at 1kHz, 60mW

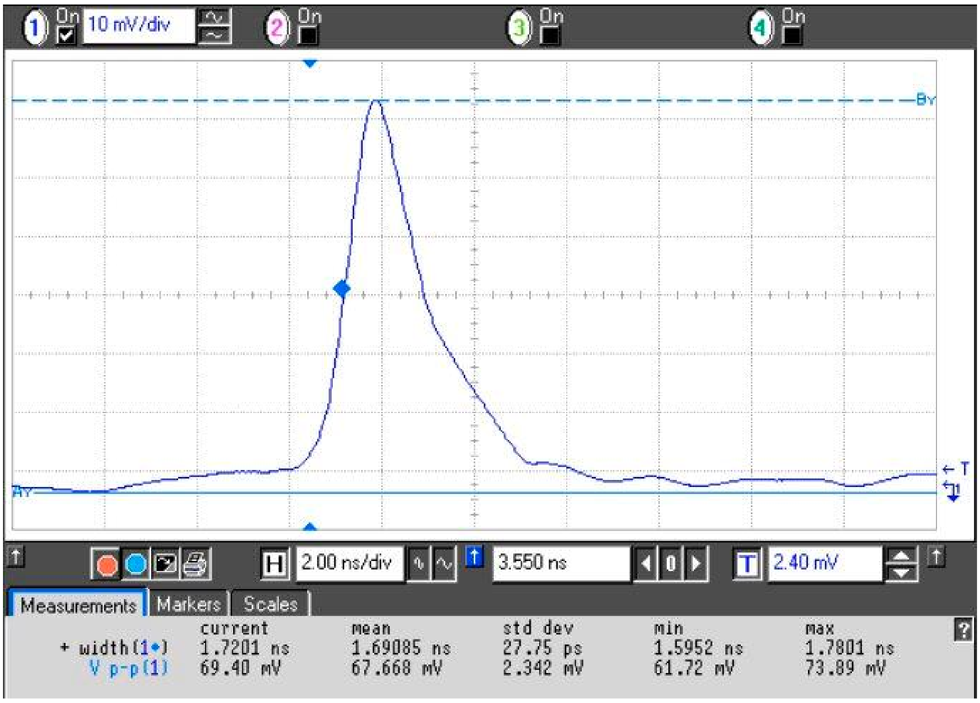

Fig 2(b): Laser Operating at 25kHz 850mW

Fig (2) shows the pulse length range at near maximum power. In this case, the traces were recorded with a fast detector, and a 1.5GHz bandwidth oscilloscope that also stored/displayed the data on pulse width and peak power. It can be seen that at low rep-rate (1kHz) the pulse FWHM is ~ 1.1ns, but has lengthened to ~ 1.7ns at the maximum rep-rate of 25kHz. Of-course, in this case, as a result of the pulse length change, the associated pulse energy and peak power have also changed with the rep-rate.

For average power, tables or graphs are particularly useful to the user if they relate to a simple settable parameter. In the case of diode-pumped SSLs it is often the pump diode current that is used. Practicality dictates that only a small number of fixed but arbitrary rep-rates are selected for power characterization purposes. Fig (3) shows a set relating to the instrument laser. Powers at other rep-rates in the laser operating range can be found by simple interpolation.

Diode Current	25kHz	12.5kHz	6.25kHz	1kHz
(A)	(mW)	(mW)	(mW)	(mW)
2	186	165	122	25
2.2	270	233	166	31
2.4	353	298	201	37
2.6	434	352	232	42
2.8	508	398	258	45
3	556	439	275	50
3.2	617	477	296	53
3.4	680	518	318	57
3.6	731	549	340	59
3.8	796	589	358	62
4	849	618	374	64
4.2	892	644	385	66

Fig (3): Typical laser average Power at four selected rep-rates

The above table is similarly useful to the user in allowing individual pulse energy to be estimated at any rep-rate. It also shows that below ~ 5-6kHz, the laser pulse energy is insensitive to rep-rate.

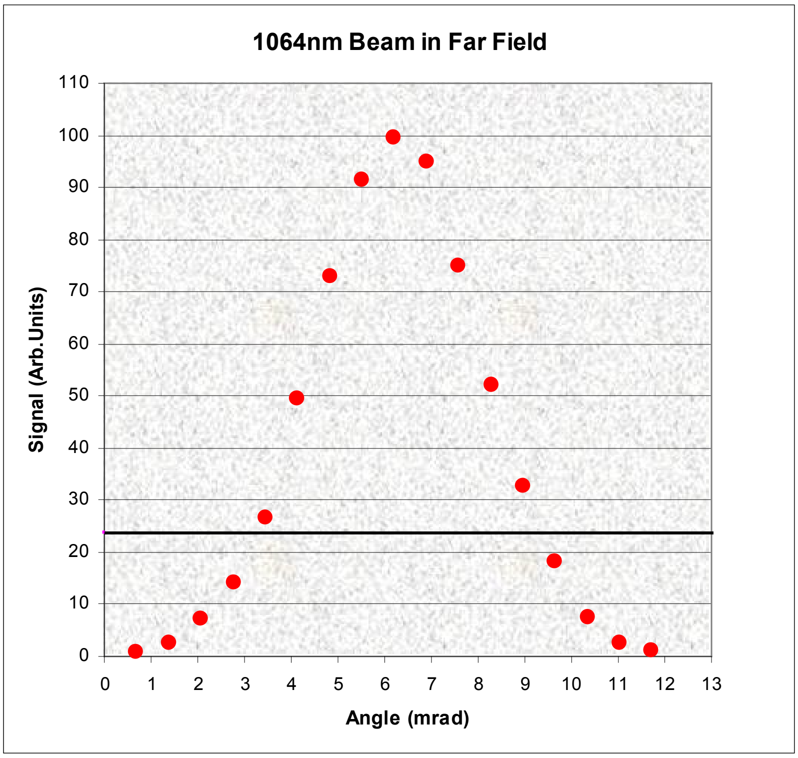

Fig (4): Beam in far-field measured by transmission of a scanned pin-hole

Critically, the beam quality is a key parameter for most laser applications, and the distribution requires careful characterization. We find that beam divergence is most reliably determined by measuring the transmission of a small (few x 100µm dia) pinhole moved across the diameter of the beam in the far-field ie at a large (> 1m) range. In the case of the instrument laser, the measured far field full angle was ~ 6mrad and, as with our other laser models, found to be only modestly (~ 10% max) sensitive to laser rep-rate or pump level. Fig (4) shows an example of the 1064nm beam distribution. Fig (4) was recorded to 25kHz and ~ 850mW, corresponding to 4A diode pump level - see data in Fig 3.

As a consequence of making a full range of laboratory measurements of this type, one achieves characterization of the laser. From the data, a specification can be distilled. In the case of the instrument laser, the chosen specification includes: rep-rate of 0-25kHz, TEMoo beam profile, 1.5ns (nominal) pulse length, pulse energy to 40µJ, peak power to 30kW, and 750mW maximum average power. However, as outlined above, a specification will always be a compromise due to practical constraints and it is open to prospective users to enquire of the supplier when more details are required. In such cases, AOT are always pleased to provide answers to enquiries regarding details of laser performance.

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