Technical Note (3)

High Average Power ACE Laser Performance

The policy of AOT is to be conservative in the design of ACE laser products so as to achieve reliable and consistent performance and allow users a long mean time between failure ie thousands of operating hours. The fundamental limit to power is set by the resonator optical components and the surface coatings, and their damage characteristics. AOT has designed the ACE Lasers to operate well within component limits and uses long-life, state of the art hard dielectric coatings.

As part of the Company policy of exploring the safe operating range of ACE laser technology, AOT has a programme investigating laser operation at power very significantly above that of currently offered products. In particular, an AOT-YVO-3Q model laser has been pumped with a diode power of up to x2 of that of the standard product. Some of the data collected in this study is shown in Fig (1).

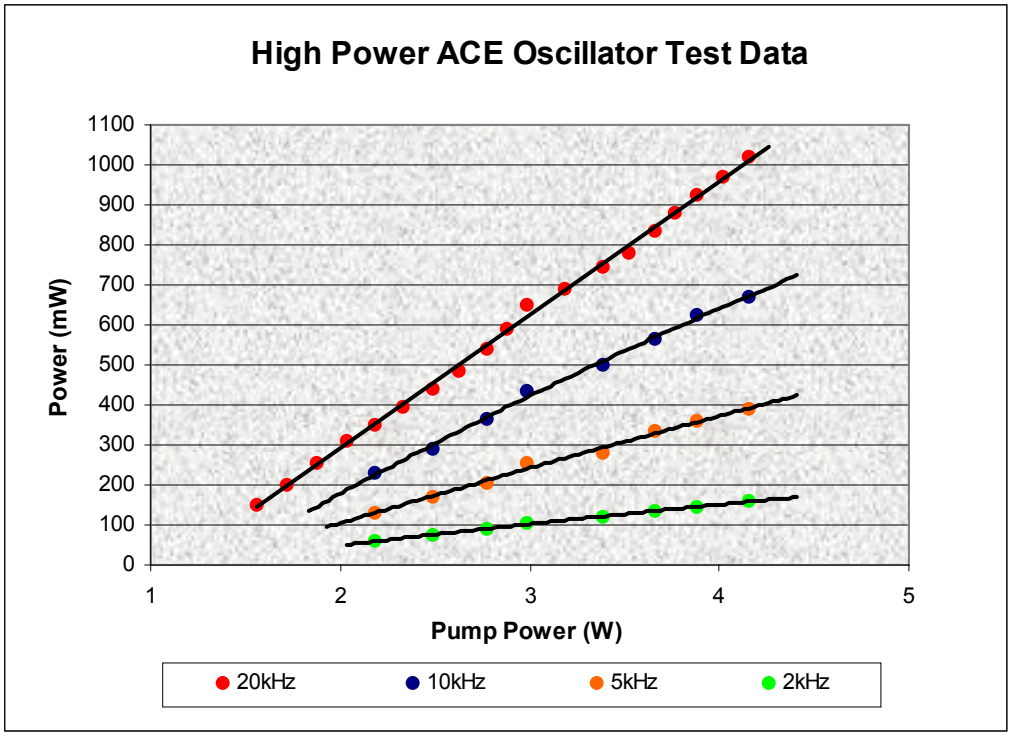

Figure (1)

The Company consider the results obtained as most satisfactory in that they show average output power can exceed 1W at 20kHz, and pulse energy exceed 80µJ at low repetition rates. Further, at these elevated power densities, no optical damage to laser components has been observed. This study is being continued to higher power and it is expected that it will allow

introduction of new ACE oscillator models to > 1W average power at high repetition rates. Certainly, the study, although not yet complete, provides results that assure confidence that the current ACE products operate at conservative power levels.

For future products at even higher power AOT are investigating oscillator/amplifier formats. As noted elsewhere, maintaining high laser operating efficiency and design simplicity are considered prerequisites by the Company in the policy of offering customers the most economic laser solutions for their applications. With these considerations in mind, the Company is undertaking a product development programme which includes the detailed characterisation of an ACE oscillator/amplifier and compares the performance with that of an ACE oscillator pumped at high power.

The oscillator/amplifier design that has proven most attractive is very simple, essentially comprising two AOT-YVO-3Q coupled optical modules. In this system, the amplifier has a measured small signal gain of up to ~ 6, and provides efficient performance without operation at excessive power densities. Fig (2) shows examples of the amplifier optical gain at 20kHz and with different oscillator input powers.

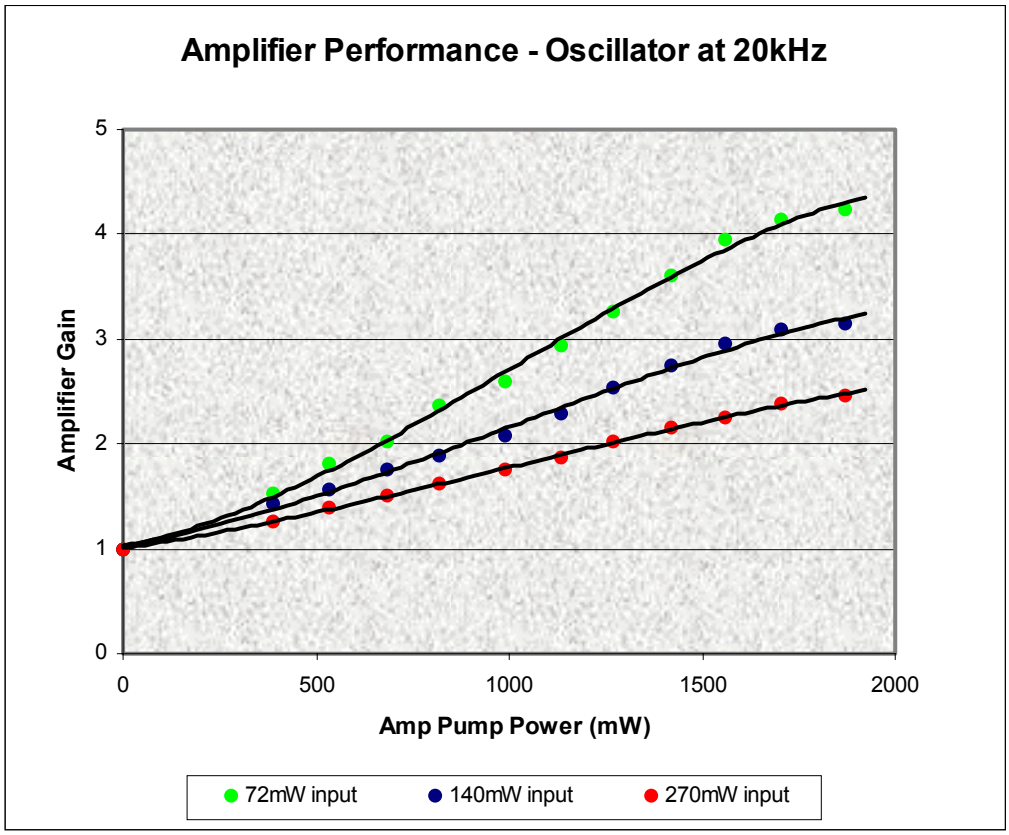

Figure (2)

Most important for future application in a cost-effective product is power extraction efficiency from the amplifier. Figs (3) and (4) show that, at high pump power and oscillator input, the amplifier performs very efficiently. The extraction efficiency under these conditions is > 50%, which is very good and similar to that of the AOT-YVO-3Q oscillator.

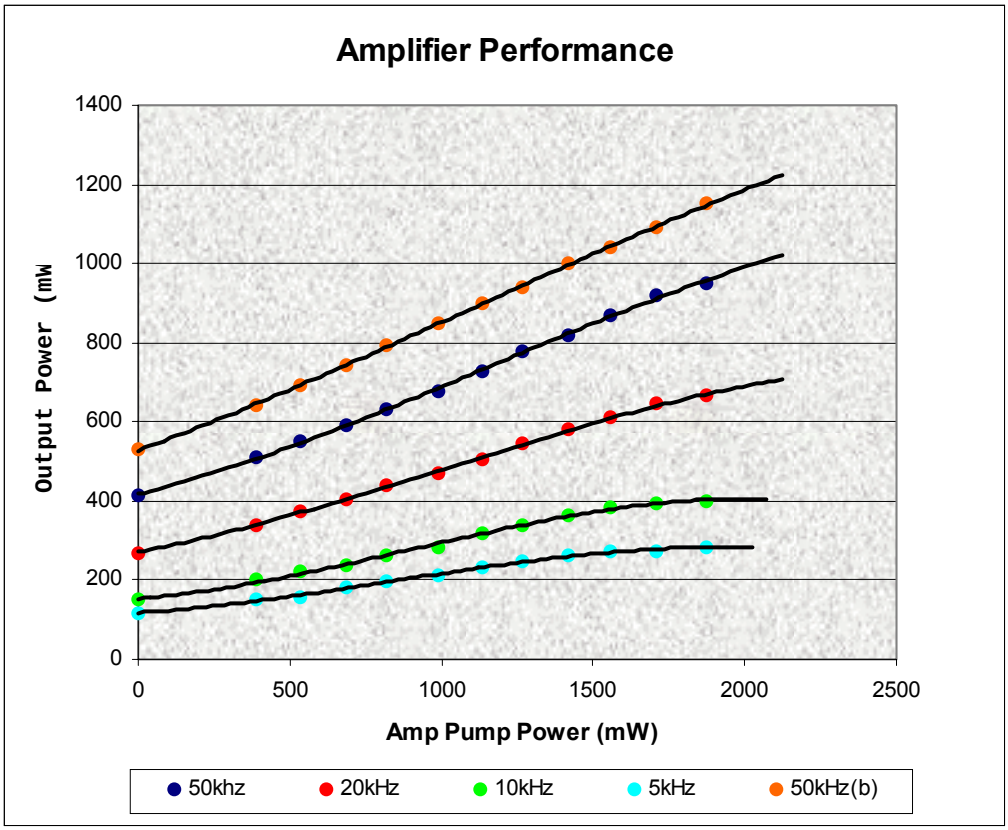

Figure (3)

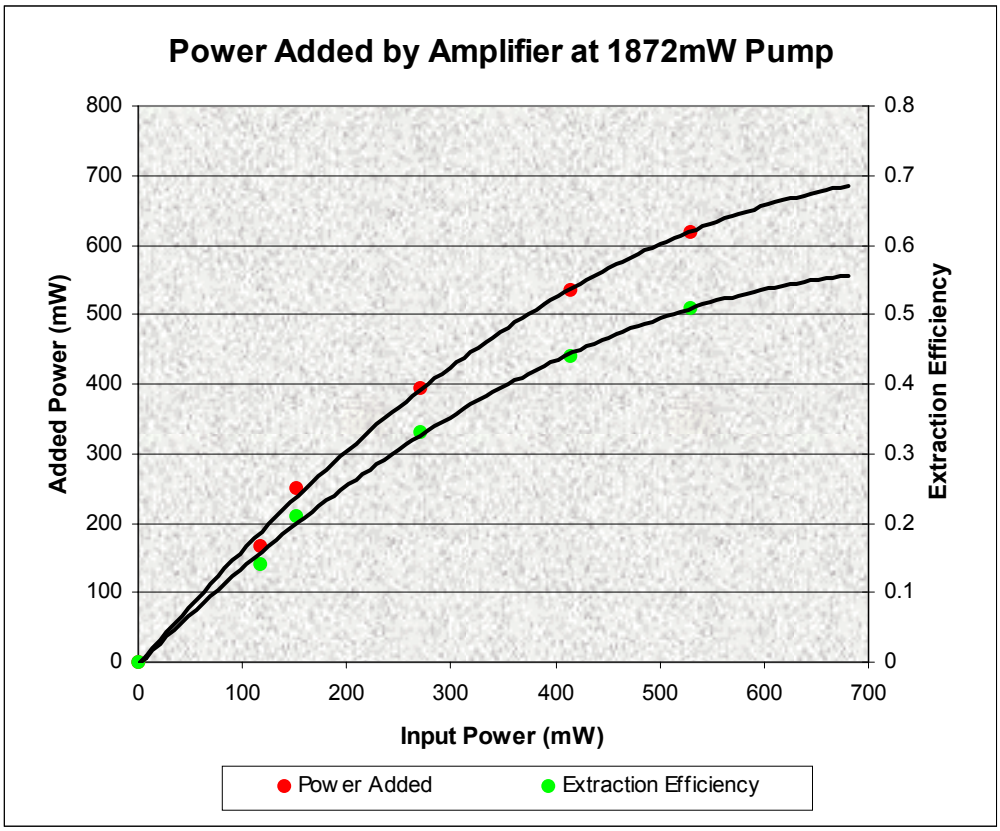

Figure (4)

We find that the amplifier performance is well modelled by the calculations based on the published data for Nd:YVO_4 and at the input beam parameters measured. As a result, we are confident that this simple oscillator/amplifier design is an efficient format for future ACE laser models providing subnanosecond and nanosecond TEMoo pulses in the range above 1W average power.

As the steps of this development work are completed over the next 12 months, AOT plan to introduce new ACE laser models comprising higher power oscillators and oscillator/amplifiers to extend average power performance of the product range to 3W.

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