Robust eye-safe compact laser

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***Abstract*— A compact eye-safe laser for atmosphere lidar was developed. The device is Nd:YLF laser with KTP OPO, wavelength is 1,54 um, repetition rate is 50 Hz and Q-switched pulse energy is 8 mJ. The laser rod and laser diodes are conductive cooled. The device has run tests with 5×10^5 shots without parameter decrease.**

Keywords*— *Eye-safe laser; OPO; optical parametric oscillator; Nd:YLF laser.

I. INTRODUCTION

Today there is a trend to make laser rangefinders in the eye-safe range [1-3]. The eye-safe range has a number of advantages comparing with 1 um range: high atmospheric transparence, higher eye damage threshold, efficient photodetectors, low aerosol scattering [3]. For the information efficiency we have to carry out high repetition rate.

We develop diode pumped Nd:YLF laser with electrooptic Q-switch and divergence 5 DL, 30 mJ pulse energy, supplied with KTP OPO operating at 50 Hz with 8 mJ pulse energy..

II. LASER DESING

The optical layout is shown in fig. 1.

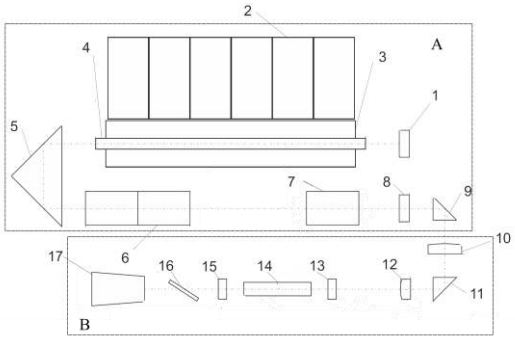

Fig. 1. Optical layout: A – Nd:YLF laser, B – OPO, 1 – mirror, 2 – laser diode bars, 3 – pump system, 4 – active rod, 5 – prism, 6 – Dove prism, 7 – EO Q-switch, 8 – output coupler, 9,11 – fold prisms, 10,12 – lenses, 13, 15 – OPO cavity mirrors, 14 – KTP, 16 – dichroic mirror, 17 – beam expander.

The Nd:YLF laser is realized with laser diode bar pumping, stable cavity and active Q-switch by lithium niobate crystal. The plane output coupler has 27% reflectivity and the concave mirror has 1500 mm radius. The active rod is Ø4x70 and has Nd concentration 1,1%@. The pump system has a 500 um slot for pump light coupling, the pump is provided by 6 180 W laser diode bars.

The 1,047 um beam is shaped and coupled to the OPO cavity, the active rod is reimaged to KTP. The OPO cavity is based on dichroic mirrors. The output 1,54 um beam is shaped by beam expander and has total divergence about 2 arc min.

As a result we obtain a device with 8 mJ 50 Hz Q-switched eye-safe output with stable parameters. The optical efficiency in free running mode for Nd:YLF laser is 11%, the OPO efficiency is 27%. The total divergence after the beam expander is 2 arc min.

The laser has passed exhaust test for 5×10^5 shots without parameter decay. The photo is presented in fig. 2.

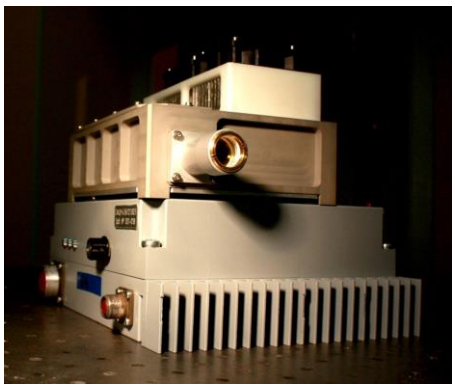

Fig. 2. The photo of developed laser with power supply.

III. SUMMARY

We developed 50 Hz eye-safe laser with output energy consistent with international sanitary standards. The laser has passed the longevity test without the parameter decay. The dimensions of the laser head is 250x255x97 mm^3.

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