

# Optoelectronic complex for express laser diodes lifetime prediction

Vladimir Bliznyuk<sup>1,\*</sup>, Alexey Dolgov<sup>1</sup>, Vasily Parshin<sup>1</sup>, Alexey Rzhanov<sup>2</sup>, Olga Semenova<sup>1</sup>, and Alexander Tarasov<sup>1</sup>

<sup>1</sup>National Research University "Moscow Power Engineering Institute", 111250 Moscow, Russia

<sup>2</sup>Lomonosov Moscow State University, Faculty of Physics, 119991 Moscow, Russia

**Abstract.** This paper presents the optoelectronic complex, which provides both preparations for carrying out an express lifetime prediction of edge emitted strip single-mode laser diodes. It is shown that for this purpose the complex should consist of four operational units: an input control unit; a spectral radiation characteristics measurement unit; a laser lifetime forecasting unit and automatic processing hardware unit. The use of this complex makes it possible to predict the lifetime of a laser diode according to their spectral characteristics at the initial stage of its operation.

## 1 The internal structure of measuring complex

The concept used in the design of the optoelectronic complex is based on the necessity for measurements and numerical analysis of laser diodes (LD) radiation pattern and spectrum at the initial stage of their operation. The initial analysis time doesn't have to exceed 200 running hours.

According to this concept, there was developed an optoelectronic complex, consisting of four operational units. Three of them provide full-scale measurements of space-power, spectral parameters and radiation characteristics of LD. The fourth operational unit provides automatic processing of the measurement results.

The input control unit is designed for screening test of LDs with latent defects, measuring their current-voltage characteristics and watt-ampere characteristics, as well as the radiation pattern. It consists of three test benches and the climate control chamber (CCC) SM-30 / 100-80 TX.

The LD emitting power is used as a controlled parameter. It is measured twice at room temperature: when at the first switch-on and after 60 hours of presence in CCC at exceeding the room temperature by 20 degrees that is equivalent to 200 running hours under normal operational environment.

LD specimen is rejected, if after testing in CCC the radiation power is reduced by not less than 10% compared to the power at switching for the first time.

The results of full-scale measurements of the LD radiation power at switching for the first time and after 60 hours of presence in CCC are received as analog signals in the ADC and

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\* Corresponding author: 4059541@ mail.ru

then to the digital signal processing unit (DSPU). Within DSPU, signals are sent to the comparator with the LD rejection element according to the power level.

The third test bench is designed for measurements of strongly divergent laser radiation patterns in the plane that is perpendicular to the p-n- junction plane, and in the p-n- junction plane. For measurements of the radiation pattern the following blocks are used: power level and the LD radiation pattern axis position stability control devices, LD localization unit and a radiation beam scanning unit. Scanning is carried out by the laser module body rotation around the axis located in the LD edge mirror plane and over-the-center of the laser spot in the mirror parallel to and perpendicular to the p-n-junction plane correspondently [1,2]. Photodiodes are used as detector cells.

The measurement results of the LD radiation patterns are sent as a data array structure to ADC and therefrom to the inputs of DSPU. The laser operation of the examined LDs in the fundamental mode is determined by processing of received signals in accordance with the method described in [2]. After the completion of the LD radiation pattern measurements, the collimating optics are reinstalled at the laser modules.

Single-mode LDs are alternately fixed in the raitor opposite to the entrance slit of the MDR-23 monochromator - the main element of the spectral characteristic measurement unit.

## 2 The processing of measured data

The radiation incoming to the entrance slit of the monochromator is decomposed into a spectrum that is analyzed at 0.1 nm intervals. The grating rotation speed is adjustable by the spectrum scanning device. This allows to get a general picture of the radiation spectrum over a wide wavelength range or get a detailed picture in a tight wavelength range. The quantitative analysis of the full-scale measured LD spectral characteristics is carried out through the generalized spectral integral parameter  $A$  [3].

As follows from the analysis [3], the calculated experimental value  $A$  appears to be the prediction parameter of LDs lifetime. So specific devices from a set manufactured under an integrated process can be rejected by parameter  $A$ . As shown in [3] at  $A \rightarrow 1$  the experimental spectral function  $f_{emp}(\nu)$  tends to Gaussian function. This proves that there is a single-mode lasing. The carried out experiments by the optoelectronic complex have shown that LDs with larger values of the parameter  $A$  have a longer lifetime.

## References

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