

THE QUANTUM THERAPY DEVICE "TERALASER-MF"

S. Vieru, V. Dorogan, T. Vieru

Micro-Optoelectronics Laboratory, Technical University of Moldova, Kishinev

E-mail: optolab@mail.ru, dorogan@adm.utm.md

At present in laser therapeutics various types of quantum devices are used. There are advantages of semiconductor lasers in comparison with other types of lasers: the small sizes, the low power consumption, increase in functionalities (high frequency of modulation of an optical signal, smooth adjustment of power emission into a wide range, possibility of use of the various optical nozzles, raised reliability). As a result of the analysis of large in number of quantum devices made in Russia, Ukraine, Germany, Vietnam and as a result cooperation with medical experts from institutions of Moldova and Romania us have been developed and made quantum devices "TERALASER" [1].

The new device "TERALASER-MF" with two independent terminals (Fig. 1,*a*) has been designed and made for use in clinics with a lot of patients or for simultaneous influence of quantum radiation on sick area and biologically active point for increasing of treatment efficiency. To ensure universality of use of optical terminals we have developed and made two types of terminals: type "pencil" with a set of optical nozzles for focusing or formations of flux optic corresponding to particular of various bodies treatment (Fig. 1,*c*), type



Fig. 1. The photo of quantum device "TERALASER-MF" (*a*) and emitting modules (*b*) with nozzles (*c*)

"hand-bell" (Fig. 1,*b*) with a constant magnet and with oscillators of various wavelengths on the basis of laser diodes (infra-red radiation) and electroluminescent diodes with a ultraviolet radiation. Using of ultraviolet radiation with antiseptic effect expands opportunities of device application in physiotherapy.

The laser diodes developed and made in the Micro-Optoelectronics Laboratory of Technical University of Moldova were used as oscillators of coherent radiation. The laser diodes with wavelengths of radiation 810, 850, 890, 950, and 980 nm were made on the basis of AlGaAs/GaAs heterostructures. To make laser diodes with wavelengths of radiation in an interval 1000–1300 nm were used multilayered InGaAs/GaAs, InGaAs/InGaAsP/InGaP/GaAs heterostructures, made by a gas-phase epitaxy method.

The structures with width of active area 5–50 microns have been realized using methods of a photolithography, anode oxidation, liquid phase epitaxy at the low temperatures for growth of layers and they allowed to improve essentially parameters and characteristics of radiation of laser diodes. To increase the reliability of laser diodes the fresh-chipped off mirrors were protected by in-situ evaporation of thin ZnSe layer. Then antireflecting and reflecting layers SiO₂ with reflection index 0.5 and 0.95 were formed. The electroluminescent diodes with small and medium power on the basis of InGaN compound were used as sources of ultraviolet radiation. Use of laser diodes in continuous radiation mode allows making quantum therapeutic devices with power of radiation more than existing analogues. Small power consumption of laser diodes with threshold current $I_{th} = 3$ mA assures independent work of device "TERALASER-MF" with accumulators of type AA within 10 hours per a continuous mode.

Thus, "TERALASER-MF" is the multifunctional device intended for physiotherapeutic treatment of various diseases. On the other hand, a wide variation range of radiation parameters (optical power, frequency, time) allows to select optimum modes of treatment for different illnesses and patients. Characteristics of the device are presented in Table 1.

Treatment of various diseases or stimulation of biologically active points by means of laser radiation has the maximal effect at various modulation frequencies of radiation flux. Therefore the device ensures a wide range of modulation frequency of the laser, namely: a continuous mode of radiation; modulation frequency from 1 Hz up to 10 kHz (it is set with accuracy ± 0.1 Hz); a mode of floating frequency in any frequency range.

For various modes of treatment it is required laser flux focused on one point or scanning of a different surface for a long time and in case of reflex therapy duration of influence by radiation should be all some seconds. Considering it, intervals of operating time of the device till 30 min with step 1 s have been set. Optical radiation power of the laser diode varies up to 50 mW with step 5 mW.

Table 1. Characteristics of device "TERALASER-MF"

Operating mode of laser diode		Continuous, pulse radiation
Number of terminals		2
Wavelength of radiation, the laser ultra-violet electroluminescent diodes	μm μm	0.67; 0.85 sau 0.98 0.25–0.405
Emitting power, laser electroluminescent diodes	mW mW	5; 10; 15; 30; 50. 200
Intervals of modulation frequency of radiation, Fixate Floating in each range		0,1 Hz–10 kHz (step 0,1 Hz) float
The operating time of device	s min	1–60 (pas 1 s) 1–30 (pas 1 min)
The control of laser radiation;	Program management from the keyboard	
The liquid-crystal display;	Memory of the device – 20 modes for each terminal	
The sound signal in the beginning and upon termination of a session of radiation		
Intensity of a magnetic field,	mT	30
Supply voltage, power circuit,	V	220
acumuloare	V	6
Power consumption,	W	< 1
Time of independent work in a continuous mode, ore		10
Weight with a set of accumulators,	g	780
Dimensions of the device,	mm	140×190×55

Rules of navigation in the menu are simple (Fig. 2). By means of buttons “up”, “down” it is moved on a vertical (“up”–upwards, “down”–downwards). By means of buttons “enter”, “esc” it is moved across (an input and an output to various options of the menu). At running of the device on the display a Main menu “Main Menu” appear with the first section “Laser Frequency”. In this section modulation frequency of the laser diode is established. For an input in this section it is pressed “enter”. Then there are 3 ways of the task of modulation frequency:

- Numeric–frequency is set by the fixed value from interval 0.1–10000 Hz;
- Float–frequency varies in the set interval;
- Continuous: the laser diode works in a continuous mode.

For installation of numeric modulation frequency it is pressed “enter” and we enter into the first way of the task of frequency. On the screen there are 6 zero, the cursor is on the first position and by means of buttons “up”/”down” value of this figure changes. Transition to a following position is made by keystroke „enter”, and return on previous is pressed “esc”. Pressing “enter”, when we reached last position, leads to an output from this section fixing the chosen frequency. Such way of the task is named digital installation of value. For floating frequency the similar way establishes at first - the minimal frequency, then maximal.

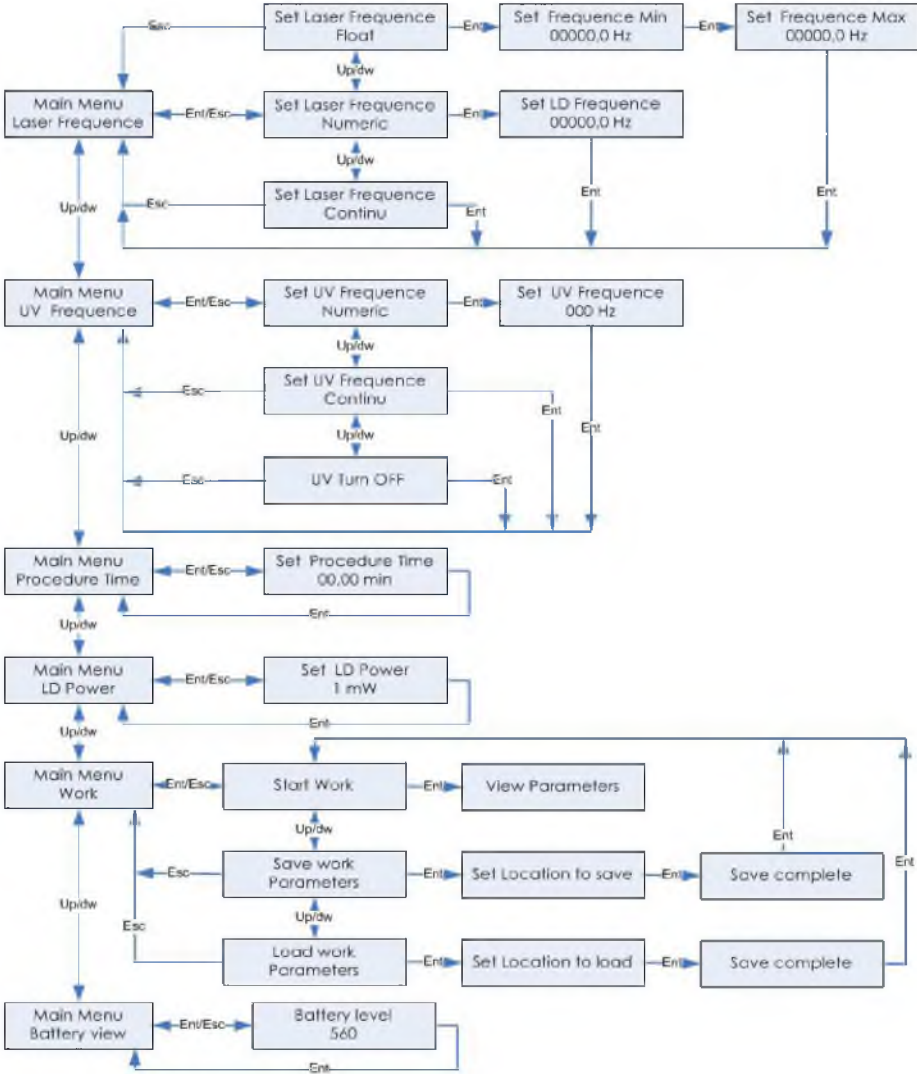


Fig. 2. The scheme of navigation of device "TERALASER-MF"

Transition in following section “UV Frequency”, where is set modulation frequency of ultra-violet diodes, carried out by buttons “up”/”down”. Here there are 3 ways of the task of modulation frequency of UV diodes:

- Numeric: the fixed frequency is set by method of digital installation of value;
- Continuous: ultra-violet diodes work in a continuous mode;
- OFF: switching-off of ultra-violet diodes.

The following section “Procedure Time” allows to establish duration of treatment procedure. By means of digital installation of value time of procedure in minutes and seconds gets out. The section “LD Power” allows to choose the laser diode power by means of buttons “up”/”down”. The section “Work” allows to run work of the device with the established parameters by pressing “enter”. On the display there will be current parameters and time control of procedure. In the same section it is possible to keep in memory of the device current parameters by a choice of an option “Save work parameters” with “enter”, then we choose a place of a kept by “up”/”down” and it is pressed “enter”. It is similarly possible to load parameters of work of the device from its memory, having chosen “Load work parameters”. The section “Battery view” allows to visualize a condition of accumulators, which are automatically recharged at work from a electric mains.

Medical devices of a series “TERALASER” were tested in a number of medical institutions of Moldova and Romania. Physicians have established positive effects at treatment: chronic pyelonephritis, chronic hepatites, cardiovascular diseases, locomotor diseases, infantile cerebral palsy, urolithiasis, bronchial asthma, alopecia, enuresis, infertility, arthrosis, chronic polyarthritis, posttraumatic inflammations. As a result of clinical testing the laser physiotherapy was recommended for use in urology, neurology, cardiology, stomatology, oncology, gynecology, pediatrics, traumatology, gastroenterology, pulmonology, dermatology, rheumatology, and reflexotherapy [2].

For the analysis of functionalities of the developed devices the Republican Seminar “Laser therapy: a urgency and prospects” has been organized where physiatrists of Moldova have presented results of use of series devices “TERALASER”, made in Laboratories of Micro-optoelectronics, emphasizing greater prospects and a urgency of laser therapy treatment methods.

1. *Dorogan V., Vieru S., Vieru T. et al. // The Physioterapy Quantum Device “TERALASER-M”. 2nd Int. Trade Fair of Innovations, Inventions, Useful Models, Ideas in Various Spheres of Scientific and Engineering. 2006, Kyiv. P. 65–66.*

2. *Dan S. Dumitraş. // Biofotonică, bazele fizice ale aplicațiilor laseri în medicină și biologie. Editura: All. București, România. 1999. 742 pag.*