Frequency tuning and alignment of the ECDL-7840R (W@M – October 2015)

The following experimental data specify the operation of the ECDL-7840R and might serve as references for its alignment.

Fig.1 shows the output power of the ECDL-7840R when the internal triangular-wave generator modulates the laser current. Almost horizontal sections in the basis of oscillogram correspond to subthreshold regime of the ECDL. Above the threshold the linear change of the current induces the nonlinear response of the output power due to mode structure of the laser. This is manifested in the form of mode hops and slope changes on the power-on-current dependence.

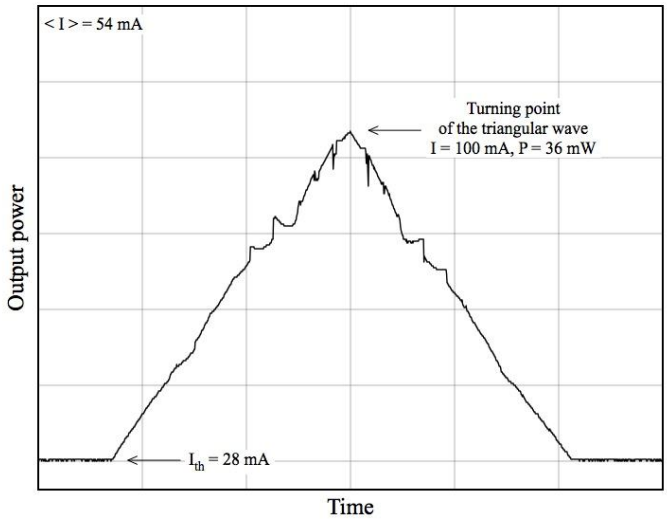

Fig.1. The dependence of the output power on the LD current. The LD current is changed by the symmetrical triangular wave.

The next oscillogram (Fig.2) is recorded at the constant LD current and linearly changing PZT voltage. The osillogram corresponds to one slope of the modulating signal. The scan amplitude is set to the maximum. At the scanning the output power of ECDL-7840R changes in the range of a few percent of its average value.

On the curve, which reflects the laser output power at the exit of ^{87}Rb cell, four consecutive extended-cavity mode hops are visible. The laser frequency changes by a few GHz from one to another mode hop (the value matched with the free spectrum range of the ECDL). In the regions of the continuous frequency tuning the lines of linear absorption are visible. They correspond to F_g=2 – F_e=1, 2, 3 transitions in ^{87}Rb. The cell of 5 cm long is slightly warmed up to increase the registered signal.

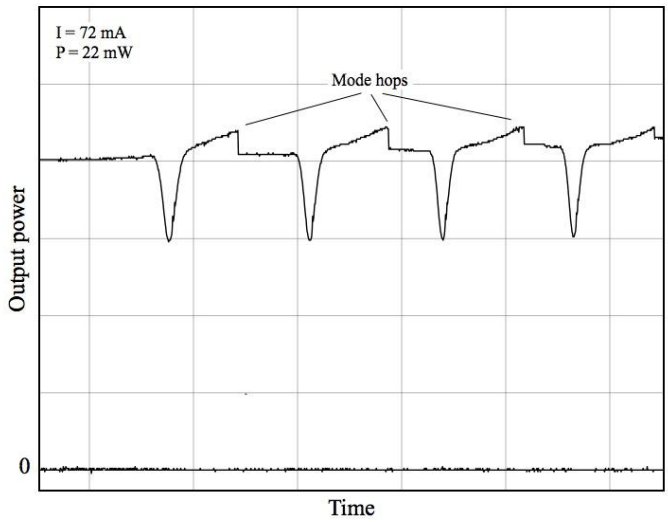

Fig.2. The transmission of the cell containing vapor of ^{87}Rb on the PZT voltage sweeping. The LD current is constant.

The change of injection current causes the change of the LD cavity optical length due to thermal expansion of the LD chip and variation of the refractive index of active media. This allows synchronizing in principal in a certain range the tuning of eigenmodes of a laser diode and of a compound extended cavity, and as a result to expand the continuous tuning range of ECDL-7840R.

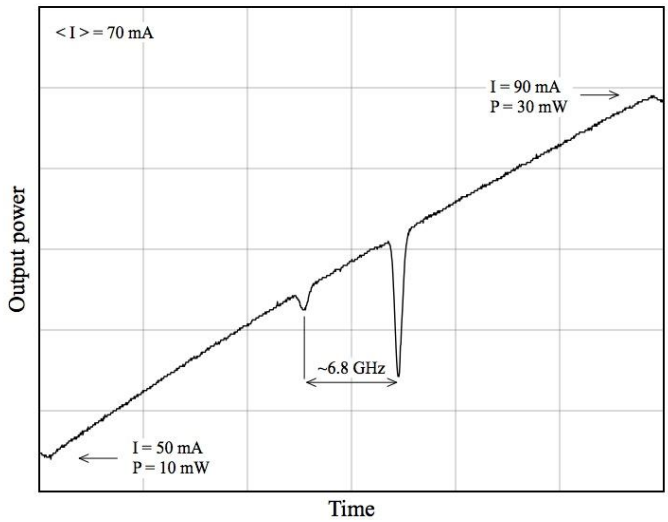

Fig.3. The transmission of the ^{87}Rb cell at the synchronous scan of the piezo and the LD current.

Fig.3 displays the transmissions of the ^{87}Rb cell at the synchronous scan of the PZT voltage and the LD current. All transitions of the rubidium 87 D2 line (F_g=1, 2 – F_e) are visible. The span of the piezoelement scan is set to the maximum while the amplitude of the current scan and the DC levels of the LD current and the PZT voltage are determined empirically till complete vanishing of mode-hops in a whole tuning range.

It should be noted that a certain delay exists in response to a control signal between the piezoelectric element and the LD current, which depends on the frequency and amplitude of the scanning. Therefore it is not always possible to get synchronous tuning of eigenmodes of a laser diode and of a compound extended cavity on both slopes of the control signal simultaneously and thus the ECDL frequency tuning might differ for different slopes of the control signal.

Readjustment of the ECDL-7840R.

Follow the way below, if the laser realignment is necessary.

1) Insert the fork-shaped lever from the maintenance kit (Fig.4) into the slot of the horizontal axle of the grating.

2) Gently press the lever up and down. Find the direction in which the movement of the lever reduces the LD threshold.

3) The clockwise rotation of the lock screw (M2) is applied if the move of the lever down (i.e. the laser beam reflected from the grating goes up) reduces the threshold. The counter clockwise rotation is needed at the up position of the lever. Typically a few degree rotation of the screw is enough to restore the operation of ECDL-7840R.

4) When the minimum of the threshold current is achieved, set if necessary the operation wavelength by tuning the horizontal screw which is accessible even in fully assembled optical unit.

Fig.4. The fork-shaped lever from the maintenance kit.

Common recommendations of the ECDL-7840R maintenance

1. Do not try to change the laser beam collimation. In the case of laser diode degradation the module has to be replaced as a whole by a manufacturer.

2. Do not violate the procedures of the laser activation and disabling.

3. Do not reduce the LD temperature below the dew point. The LD temperature can be estimated using the TCR (temperature coefficient of resistance) of the thermistor: TCR = - 4 %/°C.

4. Use an optical isolator to avoid unwanted reflections back into the laser.

5. Follow **the golden rule:** an ECDL as a part of an experimental setup must be switched on the last and switched off the first.

Specifications.

1. Wavelength @ 40mA, 72mA, **100**mA	**780.0** nm
2. Output power @ 40 mA @ 72 mA @ **100** mA	 5.8 mW 22 mW **37** mW
3. Continuos tuning range by PZT only by PZT+LD current	 7 GHz 24 GHz
4. Coarse tuning range	± 2 nm
5. Polarization	linear vertical
6. Beam shape	elliptical 5×1.5 mm^2
7. Threshold current	28 mA
8. Operating current (**D2Rb**)	**100** mA
9. Maximum current	110 mA
10. Thermistor	**17.0** kOhm
11. Optical head dimensions	66×50×34 mm^3
12. Optical head weight	170 g