



Spectroscopy Module

Model No. D2-110

1.1. Description

The spectroscopy module provides the error signal to the Laser Servo for locking to the D2 hyperfine transitions in atomic rubidium. It contains a rubidium absorption cell, TEC, balanced photodetector, and associated mirrors and beamsplitting optics. Nominally, it takes two 1% samples from the input beam. Temperature control stabilizes the number density of atoms in the cell, and the balanced photodetection circuit compensates for intensity drifts giving stable control over the lock point for side locking applications. Two beamsteering adjustments are provided for optimizing overlap of the counter-propagating beams, and positioning on the signal photodiode. The photodiode output is shot-noise limited out to ~12 MHz for photocurrents of 50 μ A and above. The high bandwidth of the feedback enables tight solid locking that is immune to vibrations and shock.

Note: the spectroscopy module should not be placed closer than 3" from the DFB laser module because the magnetic fields from the isolator can interfere with the hyperfine transitions causing an unstable lock and shifting of the lock points.

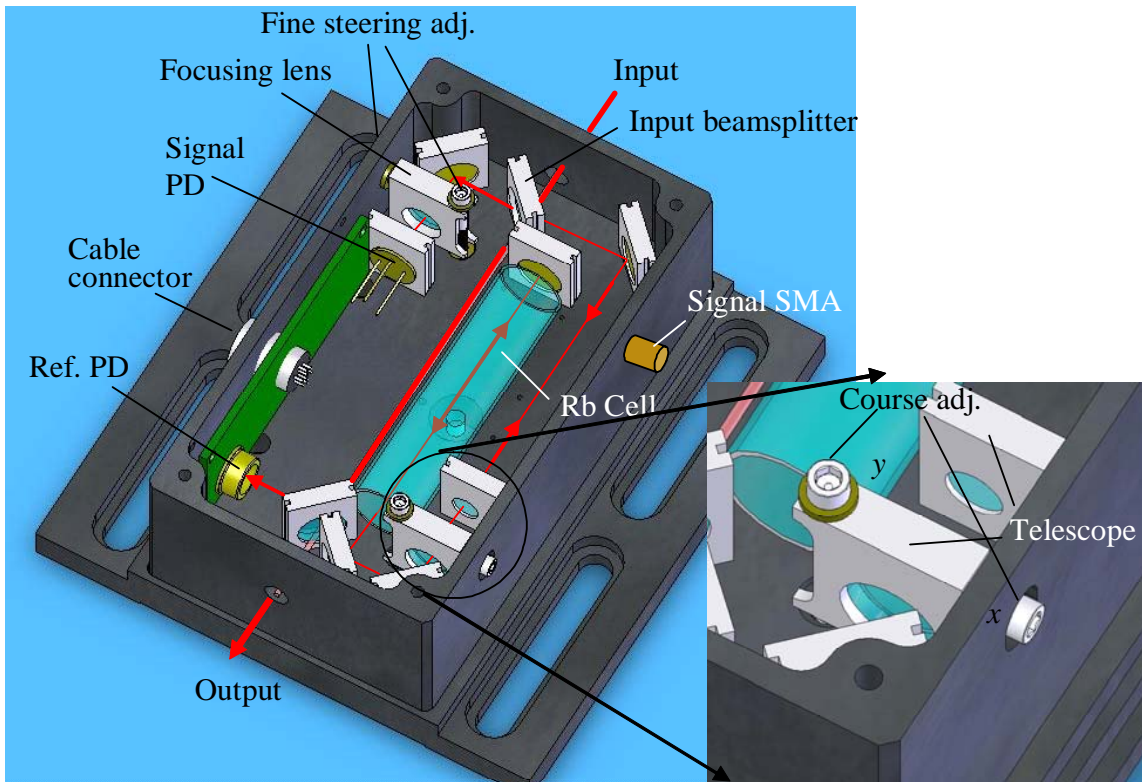
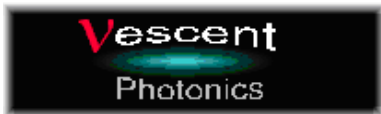


Figure 1. Spectroscopy Module with cover removed.



1.2. Specifications

	Value	Units
Photodiode Amplifier		
Transimpedance (signal)	8000	Ω
Bandwidth (signal)	12	MHz
Noise @ 10 MHz (shot level)	14	nV/ $\sqrt{\text{Hz}}$
Set Temperature	35	$^{\circ}\text{C}$
Temperature Stability	~ 0.01	$^{\circ}\text{C}$
Beam Height	0.95	inches
Total package Size (L x W x H)	4.25 x 4 x 2	inches

1.3. Inputs, Outputs, and Controls

Input Connector (8-pin circular)

Power and temperature control signals from the Laser Servo are made through an 8-pin circular connector. The pin definitions (pin numbers are marked on the connectors) are

Pin	Signal
1	TEC+
2	TEC-
3	+15 V
4	GND
5	Rth
6	-15
7	NC
8	GND (not used)

Signal Output (SMA)

To minimize electro-magnetic interference, the photodiode signal to the Laser Servo is output through an SMA connector.

Course vertical and horizontal beam positioning

The spectroscopy module contains a 3x Galilean beam expander. The output lens is mounted on a spring-loaded mount with 2-56 screws that serve as a course adjustment for the beam positioning onto the signal photodiode and also to control the retro reflection of the reflecting mirror (Figure 1, inset).

Fine vertical and horizontal beam positioning

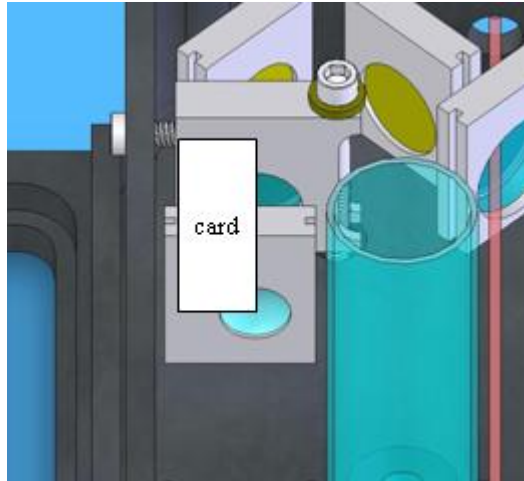


The spectroscopy module contains a focusing lens for the signal photodiode on a spring-loaded mount with 2-56 screws for fine adjustment of the beam onto the photodiode (Figure 1).

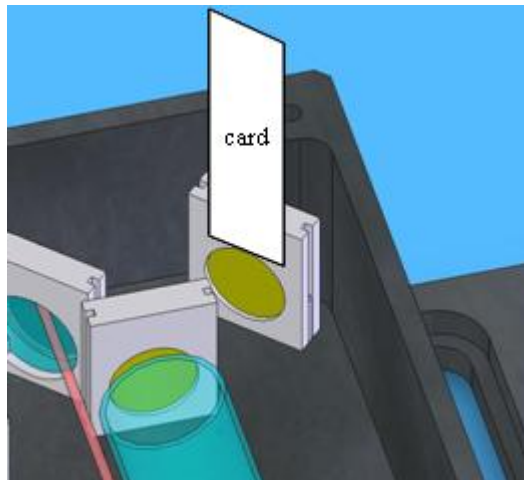
1.4. Aligning the Spectroscopy Module

The spectroscopy module is shipped factory aligned and should need only minor adjustments if any. To initially setup the module follow the quick setup procedure (available for download from <http://www.vescentphotonics.com/Downloads.html>) for the initial alignment of the spectroscopy module. If the quick setup procedure fails to work or if the system is clearly in need of realignment then follow the following procedure:

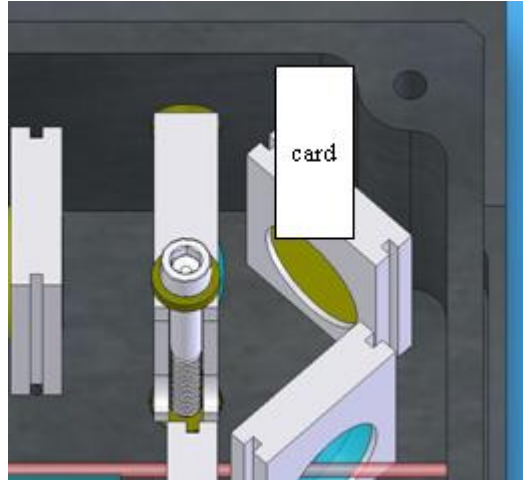
1. Loosen the three locking screws on the back of the DFB module.
2. Fashion two small 1 cm x 3 cm cards from an index card and use it as a viewing screen.
3. Remove the cover on the Spectroscopy Module.
4. Use the card and the vertical and horizontal positioning controls on the DFB module to center the beam onto the 6 mm diverging lens. This is the most critical alignment.



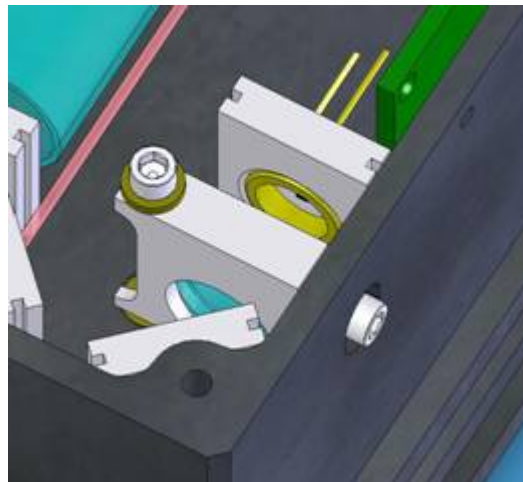
5. Retighten the locking screws on the DFB module.
6. Use the card to ascertain the position of the returned beam on the first corner mirror.



7. Use the course positioning controls to place the retro-reflected beam as close as possible to the ingoing beam.
8. Use the card to probe the opposite corner mirror (along short side) to see if the retro beam is now passing back through the input beamsplitter.

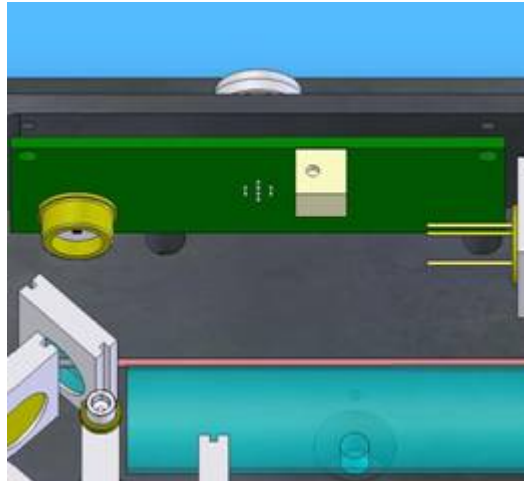


9. If the beam is visible on the card, center it with the course positioning controls. If not, repeat from Step 7.
10. Check to see that the beam is relatively well centered on the retro reflecting mirror at the end of the Rb cell. If not, the beam is not centered well enough on the 6 mm divergent lens. Start again from Step 4.
11. Fold the second card lengthwise (light goes through a single layer) and block the reference photodiode while monitoring the INPUT SIGNAL from the Laser Servo on an oscilloscope or voltmeter.
12. Use the Course and fine steering controls to maximize the signal on the voltmeter. Generally, the fine steering controls have little effect. You might find them useful if you wish to use the course controls to center the beam on the retro mirror and find this moves the beam off center from the signal diode.



The fine steering controls and signal PD

13. Remove the card from the reference photodiode.
14. Adjust the trimpot until a desired lockpoint for sidelocking crosses zero volts (with oscilloscope connected to the Error Input Monitor, or until an eyeball average of the hyperfine transitions lies near zero volts. This step determines how well the balancing circuit cancels intensity drifts. (Note: for peak locking applications this is not important since dc drifts have no affect on the lockpoint.)



15. The spectroscopy module is now ready for use. Replace the cover.