7/27/07

9-3

- Installed ThorLabs VCSEL to test. Collimated beam. When through optical isolator, beam intensity cut ~~too~~ down visibly by factor of 2 at least. When use optical multimeter (after isolator) get 70.4 μW at 774.7 nm at 2.06 mA (max of power supply). When use optical multimeter before isolator, multimeter reads 256.3 μW at 776.1 nm at 2.06 mA. I even tried to turn a λ/2 plate before the isolator to get the most acceptable light into the isolator, but the intensity out of the back end did not change much.

- Put beam through long Fabry-Perot to see how multimode and modulation. The laser is very multimode with two orthogonal modes, and we were able to modulate with this power supply. ~~We also calculated wi the maximum amplitude~~ The maximum current is [2.77 mA] from the power supply with full amplitude on the function generator and max. current on the power supply.

- Calibrations using scope:
  We plug the ~~red~~ + sense into the + of ~~the a~~ BNC to the oscilloscope to measure the offset in the voltage.

  knob (dc current) all the way to the left: scope reads ~~1.60V~~ −1.60 V with no fun. gen.
  laser turns on at 2.87 V from the + sense
  knob (dc current) all the way to the right: scope reads 3.84 V
  dc current max, f.g. current max., amp. max.: scope gives 1.68 V p-p

dc current	Voltmeter	Scope
knob way left	−.02 V	−1.60 V
turn on laser	1.20 V	2.87 V
knob way right	2.06 V	3.84 V

Ulm #3

8/29/07

9-12

- Cleaned soldering table of debris and organized tools.

- Installed new VCSEL into system. Collimated beam to wall.

Wavelength/Power Measurements: ~~1mA~~, 24.04 °C, before optical isolator

Current (mA)	Power (μW)	Wavelength (nm)
.6	1.7	796.1
.7	24.1	791.8
.8	68.3	794.3
.9	111.4	794.8
1.0	153.8	794.9
1.1	196.4	795.2
1.2	234.8	795.3
1.3	272.9	795.4
~~1.4~~		
~~1.5~~		

(.9–1.0 mA: GREAT NEWS!)

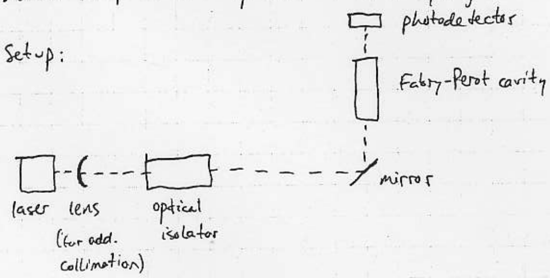
- After installing the optical isolator, got 122 μW ~~and~~ at 795.3 nm for 1.0 mA. I turned down the temp. and current to try to get to 794.7 nm, but didn't really. Installed a Rb vapor cell with photodetector to try and see resonances in cell, but didn't.

5/7/07

9-12

didn't work 5/4

- Moved setup to other optical table for analyzing of VCSELs.
- Setup:



- We had to add an additional convex lens to help collimate the laser, because the focus was very short.
- We saw the ~~*~~ signal on the oscilloscope ~~with~~ from the photodetector, but for the ThorLabs VCSEL we saw two modes orthogonal to each other. This was tested by turning a $\lambda/2$ lens in the beam path and observing the height on the oscilloscope, when the current was near the threshold current.
- After seeing the two modes, I installed the "better" (supposedly single-mode) VCSEL into the setup. I was not able to get light through the isolator, but we removed it just to see the signal. There may be two modes in this VCSEL also, but we will test tomorrow to see if there is or is not.

5/8/07

9-12

- Collimating lens has focal length of 4.516 mm and a size of Ø6.4 x 6.3 mm. It is part # 336-1027-785 from Optima.
- On Roithner VCSELs:
  - pin 1 - Anode - Red (from current source)
  - pin 2 - Cathode - Black (from current source)
- Connected Bias-T to diode and connected to laser system. Used microwave generator to get RF field for input of Bias-T. Take measurements at different frequencies and amplitudes of RF field.

500 MHz

Amplitude	File Name	Comments
-30 dBm	D926	
-23	D927	
-18	D928	
-15	D929	
-10	D930	

1.0 GHz

Amplitude	
-30	D931
-24	D932
-20	D933
-16	D934
-12	D935

2.0 GHz

Amplitude	File # ~~Amplitude~~
-30	D936
-24	D937
-20	D938
-16	D939
-12	D940

2.5 GHz

-30	D941
-24	D942 ← skip
-20	D944
-16	D945
-12	D946
-18	D947

3.5 ~~3.0~~ GHz

-30	D949
-24	D950
-20	D951
-16	D952
-12	D953
-10	D954 ← skip
-8	D956

4GHz

A	#
-30	D957
-20 ~~-24~~	D958
-15	D959
-10	D960
-8	D961
-6	D962

500 MHz

A	
-25	D963

See next page for good list.

Reithner Third Test 6/13/07

SMA to SMA

Frequency (GHz)	Sent Pwr. (dBm)	Received Pwr. (dBm)
2.5	0	-2.7
3	0	-3.0
3.5	0	-3.6
4	0	-3.8
4.5	0	-4.1
5	0	-4.0
5.5	0	-4.6
6	0	-4.8
6.5	0	-4.8
6.8	0	-5.4

Frequency (GHz)	Power (dBm)	File Name
2.5	0	
	2	
	4	
	6	
3.5	0	
	2	
	4	
	6	
	8	
4	0	
	2	
	4	
	6	
	8	
	10	
5	0	
	2	
	4	
	6	
	8	
	10	

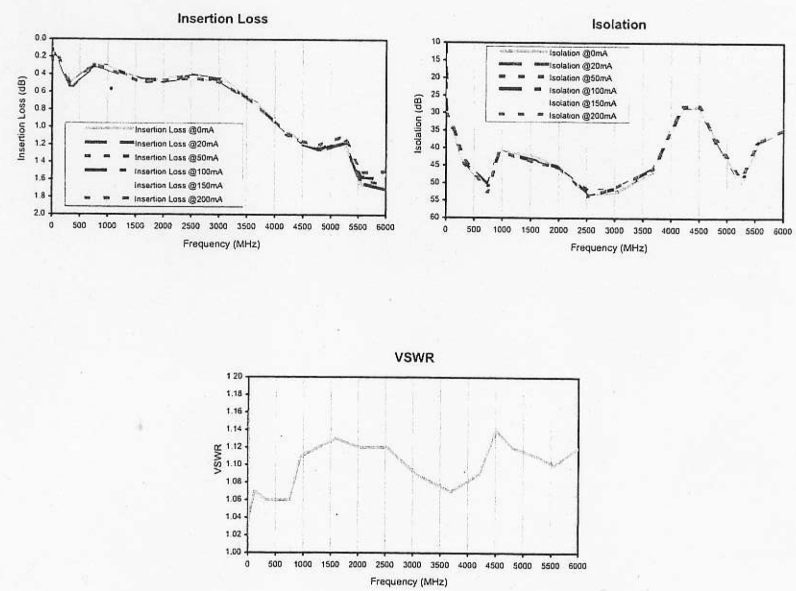
Frequency (GHz)	Power (dBm)	File Name		
5.5	0			
	2			
	4			
	6			
	8			
	10			
	12			
6.834	0	D901		
	2	D902		
	4	D903		
	6	D904	7	D908
	8	D905	7.4	D909
	10	D907	8.1	D906
	12			
3.4	0	D910		
	2	D911	4.6	D916
	4	D912	5	D915
	6	D913		
	8	D914		

- With the BNC to SMA, we were not able to get a good power transfer, especially ~~from~~ at higher frequencies. Made power transfer measurements on pgs. 69/70, and found the SMA to be <u>much</u> better. With Nate's help, I took the data on pg. 70, and will analyze it.

- From below, we see the maximum loss by the bias-t is ~2 dBm.

Bias Tee , Surface Mount — ZFBT-6GW-FT+

Typical Performance Curves



Switching Point of Roithner Polarizations 6/26/07

RF Freq.	RF power (dBm)	Turn On (mA)	Switching (mA)	Multimode (mA)	File Name (D___D0626)
500 MHz	-30	~~1.29~~ 1.34	1.80	3.75	339, 340, 341, 342
	-26	1.33	1.81	3.80	343, 344, 345, 346
	-22	1.40	1.81	3.92	347, 348, 349, 350
	-18	1.54	1.81	3.95	351, 352, 353, 354
	-15	~~1.68~~ 1.69	1.82	4.43	355, 356, 357, 358
1.7 GHz	-21	1.47	1.80	3.98	359, 360, 361, 362
	-18	1.51	1.80	4.18	363, 364, 365, 366
	-15	1.53	1.80	3.90	367, 368, 369, 370
	-12	1.67	1.80	4.26	371, 372, 373, 374
	-10	1.74	1.81	4.21	375, 376, 377, 378
3.4 GHz	-15	1.62	1.81	3.77	379, 380, 381, 382
	-12	1.66	1.81	3.87	383, 384, 385, 386
	-9	1.74	1.81	4.14	387, 388, 389, 390
	-6	turn on above switching so starts w/ P2		3.87	391, 392
	-3	" " " " " " " "		4.03	393, 394
5.1 GHz	-9	1.35	1.81	3.84	395, 396, 397, 398
	-6	1.37	1.81	3.80	399, 400, 401, 402
	-3	1.41	1.80	3.83	403, 404, 405, 406
	0	1.51	1.78	4.20	407, 408, 409, 410
	3	1.66	1.75	3.98	411, 412, 413, 414
6.8 GHz	0	1.37	1.81	4.17	415, 416, 417, 418
	3	1.37	1.80	3.82	419, 420, 421, 422
	6	1.38	1.79	4.26	423, 424, 425, 426
	9	1.40	1.77	4.33	427, 428, 429, 430
	12	1.49	1.74	4.30	431, 432, 433, 434

- The order of screen shots is: turn on (P1), switching (P1), multimode (P1), multimode (P2).
- These numbers are with DC current only.

6/

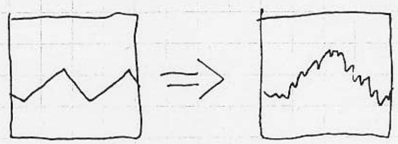
RF Freq	RF Power (dBm)	Turn On (mA)	Switching (mA)	Multimode (mA)	File Name (P_
500 MHz	-30	~~.38~~ .44	.68	1.34	(435) (436) 437, 4
	-26	.46	.70	1.34	439, 440, 441, 4
	-22	.46	.70	1.34	~~443~~, 444, 445, 44
	-18	.46	.70	1.35	447, 448, 449, 4.
	-15	.47	.70	1.34	451, 452, 453, 4
1.76 GHz	-21	.47	.70	1.34	455, 456, 457, 45
	-18	.45	.70	1.35	459, 460, 461, 4
	-15	.45	.70	1.36	463, 464, 465, 46
	-12	.46	.71	1.35	467, 468, 469, 4
	-10	.46	~~.69~~ .72	1.36	~~[illegible]~~ 471, 473, 474,
3.4 GHz	-15	.46	.70	1.36	476, 477, 478, 4
	-12	.47	.71	1.35	480, 481, 482, 4
	-9	.47	.71	1.33	484, 485, 486, 48
	-6	.46	.72	1.34	488, 489, 490, 49
	-3	.48	.74	1.33	492, 493, 494, 49
5.1 GHz	-9				
	-6				
	-3				
	0				
	3				
6.8 GHz	0	.46	.70	1.36	496, 497, 498, 499
	3	.46	.70	1.33	~~500~~, 501, 502, 503
	6	.47	.71	1.35	504, 505, 506, 507
	9	.47	.71	1.35	508, 509, 510, 511
	12	.46	.70	1.35	512, 513, 514, 515

- These numbers are for DC current plus the function generator set on ~1/3 of the way on.
- Clearly nothing really changes, so I guess that it has more to do with amplitude of the function generator than the frequency or RF power.

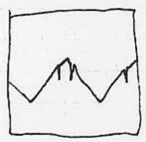
7/16/07

9-4

- Spent the morning trying to find (and finding) the resonance lines in the rubidium vapor cell. At first, there were difficulties in the signal, because the reflective lens on the photodetector and the rear face of the optical isolator were creating an etalon. The signal changed shape from a simple triangle wave to one will ridges in it.



Irina figured out that we needed to turn the photodetector, and when we did this we saw the plain triangle wave again. From there, I began to turn the temperature up, and maxed the peltier out at 36.4°C. At this temperature, we saw the resonances with approximately 1.70 mA.



- Tried to find a function generator with the ability to turn the amplitude all the way down. Tested in electronics lab:

Function Generator	Min. Amplitude (no attn.) peak-to-peak	Min. Amp. (-20 dB) peak-to-peak	Min. Amp. (-40 dB) peak-to-peak
EZ	1.26 V	136 mV	—
Circuitmate	400 mV	42 mV	—
Beckman Industrial	1.66V	160 mV	21.6 mV

- Changed function generators from Wavetek to Circuitmate. Did not see anything with amplitude all the way down, so turned up a little and saw resonances. Only able to get 1.31 mA max current, because laser starts at .07 mA (very close to same starting point that wire only has). The Circuitmate doesn't really have a trigger or place to use as a trigger, so just using Channel 3 to trigger. Took screen shots of resonances.

7/17/

9-4

- Yesterday afternoon I turned the amplitude on the function generator way up and fried the first Ulm VCSEL. We believe that it was reverse voltage that killed the laser, because we see no light from it at all. So, we have to make a better ~~pot~~ protection circuit that will minimize human error.

- The circuit looks like this: