Lab 3 Report

Xikai Chen
School of Microelectronics
Southern University of Science and Technology
Shenzhen, China
12440044@mail.sustech.edu.cn

Wenting Song
School of Microelectronics
Southern University of Science and Technology
Shenzhen, China
12432979@mail.sustech.edu.cn

Minghu Zhao
School of Microelectronics
Southern University of Science and Technology
Shenzhen, China
12432967@mail.sustech.edu.cn

Yuncheng Tu
School of Microelectronics
Southern University of Science and Technology
Shenzhen, China
12111008@mail.sustech.edu.cn

I. VCO TUNING CHARACTERISTICS

1. Connect the 3 dB attenuator to the VCO output. Then connect the other end of the attenuator to the spectrum analyzer through an SMA cable.

2. Connect the output of Lab 1 function generator output to the Vtune terminal of the VCO. Modify the code to allow the function generator to output a constant voltage. Set the voltage to 0 V.

3. Power up the VCO:

a) Connect the voltage regulator to the Power terminal of the VCO;

b) Ground the GND terminal of the VCO;

c) Set the breadboard voltage regulator output to 5 V; power up the voltage regulator by turning on the battery packs.

4. Turn on the spectrum analyzer. Set appropriate measurement parameters,

5. Use a multimeter to monitor the voltage on the Vtune terminal. It read 0 at this point.

6. Adjust the function generator to set the Vtune voltage from 0 V to 5 V. Record the output frequency and power at each Vtune. The screen of the spectrum analyzer should look similar to Fig. 1.

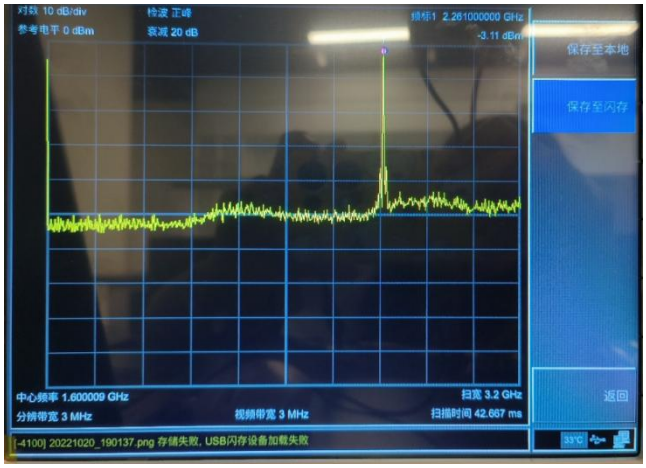

Fig. 1. Screenshot of the spectrum analyzer with Vtune=0V.

7. Plot the output frequency and output power with respect to Vtune.

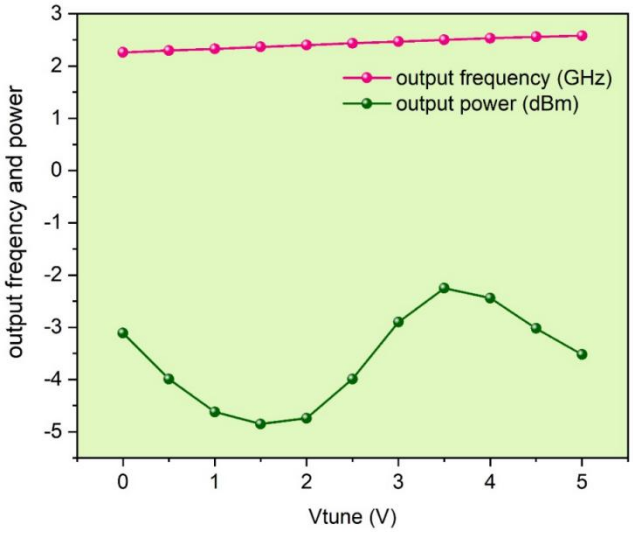

Fig. 2. Measured output frequency and power as a function of Vtune.

8. Compare measurement result with the VCO's datasheet (Fig. 3).

V TUNE	TUNE SENS (MHz/V)	FREQUENCY (MHz)			POWER OUTPUT (dBm)		
		-55°C	+25°C	+85°C	-55°C	+25°C	+85°C
0.00	81.90	2267.6	2257.4	2249.2	5.54	5.14	4.51
0.50	74.61	2306.7	2297.3	2289.5	5.76	5.23	4.62
0.75	73.96	2325.2	2315.9	2308.2	5.87	5.27	4.67
1.00	73.76	2344.0	2334.4	2326.4	5.86	5.32	4.77
1.25	73.75	2362.7	2352.9	2344.6	5.86	5.38	4.83
1.50	74.01	2381.6	2371.3	2362.6	5.87	5.43	4.92
1.75	74.71	2400.7	2389.8	2380.6	5.87	5.52	5.03
2.00	74.15	2419.7	2408.5	2398.9	5.89	5.58	5.12
2.25	73.21	2438.5	2427.0	2417.2	5.90	5.62	5.21
2.50	71.91	2456.9	2445.3	2435.4	5.92	5.69	5.28
2.75	70.82	2475.0	2463.3	2453.3	6.00	5.73	5.33
3.00	68.45	2492.6	2481.0	2471.1	6.01	5.80	5.40
3.25	65.44	2509.4	2498.1	2488.3	6.09	5.87	5.44
3.50	61.36	2525.2	2514.5	2504.9	6.16	5.91	5.54
3.75	57.60	2540.3	2529.8	2520.7	6.18	5.97	5.58
4.00	53.56	2554.4	2544.2	2535.4	6.26	6.01	5.66
4.25	50.01	2567.6	2557.6	2549.0	6.30	6.08	5.70
4.50	45.62	2579.9	2570.1	2561.7	6.33	6.10	5.76
4.75	41.10	2591.0	2581.5	2573.3	6.38	6.15	5.79
5.00	36.26	2601.0	2591.8	2583.8	6.40	6.17	5.83

Fig. 3. Performance data of ROS-2536C-119+ in the datasheet.

Fig. 4 shows the variation of the frequency in the datasheet and the measured frequency with Vtune respectively. It can be observed that the measured frequency is slightly less than the datasheet frequency, and the slope (tuning sensitivity) is also slightly less than the datasheet frequency. There is little difference between the two. The measured data is basically the same as the standard data in the datasheet.

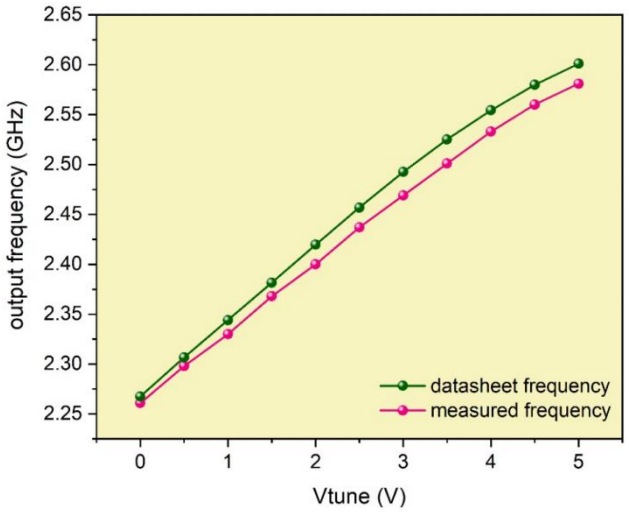

Fig. 4. The frequency in the data sheet and the frequency measured experimentally varies with Vtune.

The measured output power is about -3dB, which is quite different from the standard value of 6V in the data table. After considering the 3dB attenuator, it still cannot be matched. We guess the cable loss is around 9dBm.

9. Do a linear fit of the VCO frequency tuning characteristics.

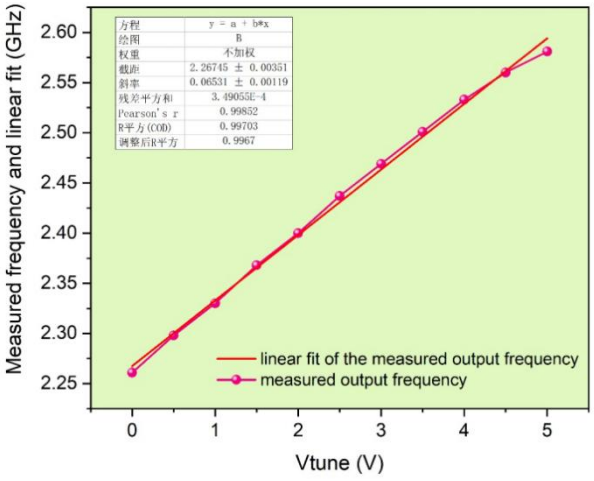

Fig. 5. The measured frequency and its linear fit.

As can be seen from Fig. 5, the fitting effect is very good, and the sum of squared residuals is only 3.49e-4.

II. VCO PUSHING CHARACTERISTICS

1. With the same setup as in part 1, set VTUNE=5V.

2. Adjust the VCO supply voltage using the potentiometer in your voltage regulator circuit from 5 V to 4 V. Record the VCO output frequency and power at each supply voltage. The screen of the spectrum analyzer should look similar to Fig. 6.

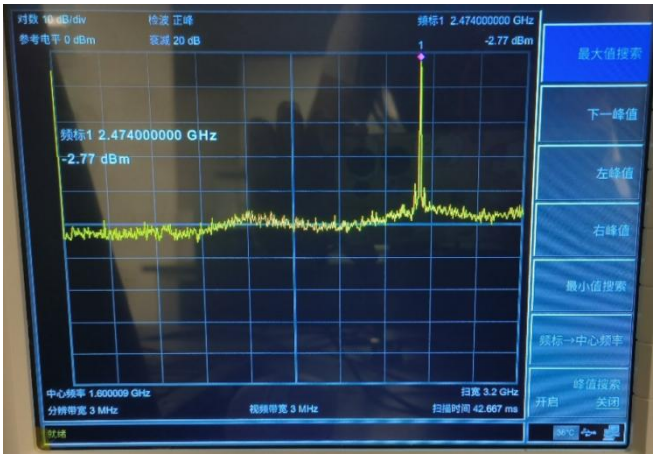

Fig. 6 Screenshot of the spectrum analyzer.

3. Plot the output frequency and output power with respect to Vcc. Compare the measurement result with the VCO's datasheet.

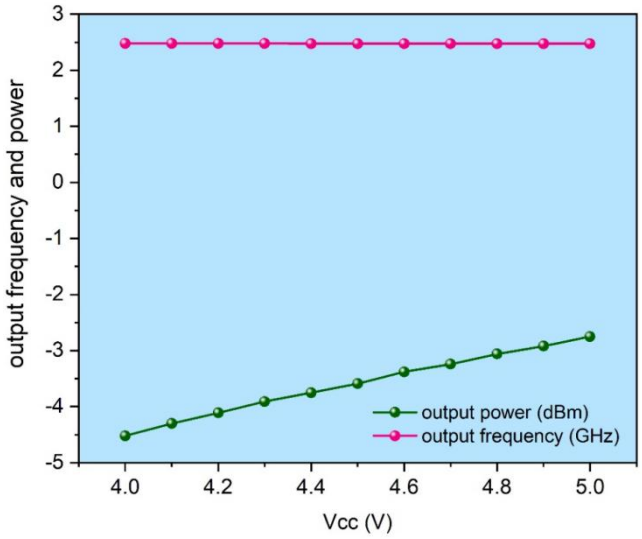

Fig. 7 Measured output frequency and power as a function of Vcc.

The Vcc is changed from 4V by 1V to 5V, the output frequency is changed from 2.474GHz to 2.48GHz, the frequency is changed by 6MHz. In the datasheet, when Vtune=5V, FREQ.PUSH is 4.89M/Hz. Compared with the data sheet, the relative error of the measured data is acceptable.

III. APPENDIX: MEASURED DATA

V Vtune	1.1 GHz f	dBm p	V Vcc	1.2 GHz f	dBm p
0	2.261	-3.11	5	2.474	-2.75
0.5	2.298	-3.99	4.9	2.474	-2.92
1	2.33	-4.62	4.8	2.474	-3.06
1.5	2.368	-4.85	4.7	2.474	-3.24
2	2.4	-4.74	4.6	2.474	-3.38
2.5	2.437	-3.99	4.5	2.474	-3.59
3	2.469	-2.9	4.4	2.474	-3.75
3.5	2.501	-2.25	4.3	2.48	-3.91
4	2.533	-2.44	4.2	2.48	-4.11
4.5	2.56	-3.02	4.1	2.48	-4.3
5	2.581	-3.52	4	2.48	-4.52

Fig. 8. Appendix data.