Juan Ali Ruiz Guzman
EE444L
20 April 2026

End To End Transceiver Lab

Introduction

The purpose of this lab was to analyze the performance of a complete RF transceiver system using the Dreamcatcher RF training kit. Unlike previous labs that focused on individual components such as mixers or oscillators, this experiment examined the full signal chain from transmission to reception.

A 50 MHz intermediate frequency (IF) signal was generated using a signal generator and then upconverted to an RF signal at approximately 868 MHz using a mixer and local oscillator set to 818 MHz. This RF signal was transmitted over the air using antennas and received by a separate receiver unit. The receiver then downconverted the signal back to 50 MHz for analysis using a spectrum analyzer.

This lab demonstrates how real-world RF communication systems operate, including frequency translation, signal transmission, filtering, and demodulation.

Results and Discussion

Transmitter Input Signal

The initial test verified the presence of the 50 MHz IF input signal. The spectrum analyzer showed a clear peak at:

- **50 MHz ≈ -57.73 dBm**

This confirms that the signal generator was correctly producing the IF signal used for upconversion.

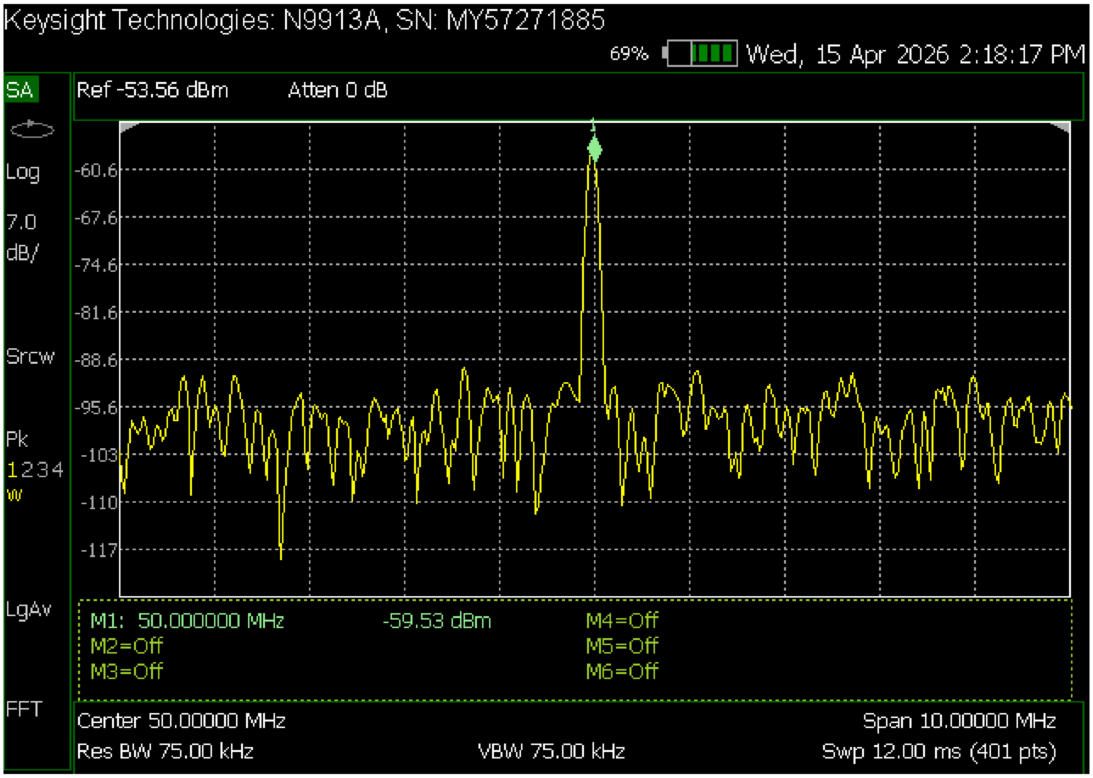

Figure 1. Spectrum of the 50 MHz input signal showing a peak at approximately -57.73 dBm.

Mixer Output and Frequency Conversion

After applying the 818 MHz local oscillator, the mixer output displayed the expected frequency components:

- **818 MHz (LO) ≈ -20.54 dBm**
- **868 MHz (RF = LO + IF) ≈ -29.62 dBm**
- **768 MHz (Image = LO − IF) ≈ -58.39 dBm**

This confirms correct mixer operation, producing both sum and difference frequencies.

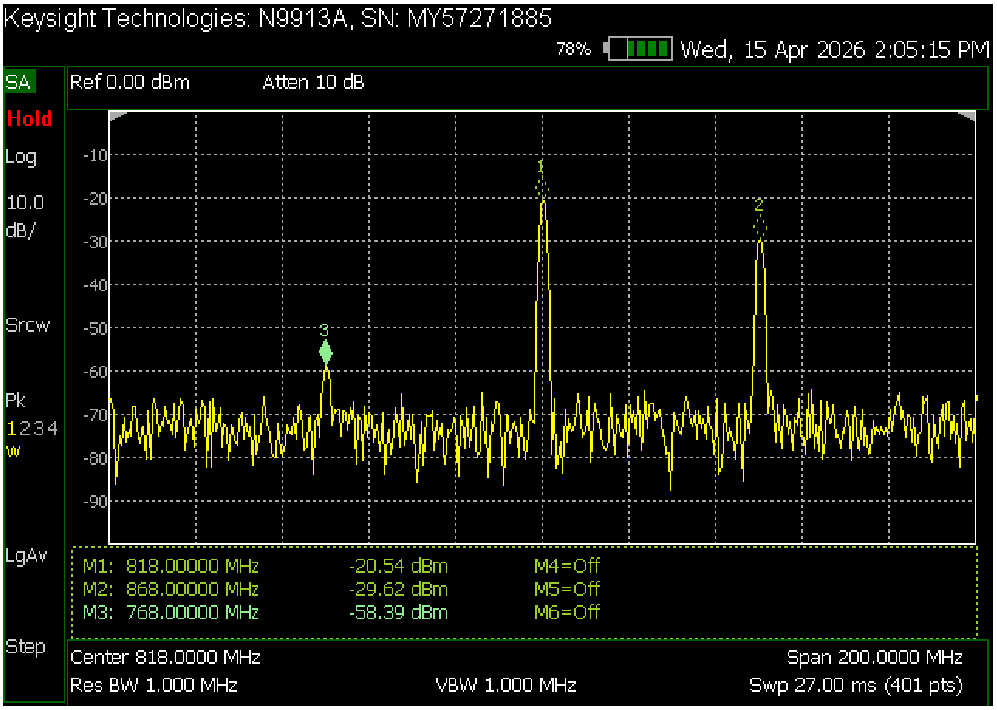

Figure 2. Wideband spectrum showing LO, RF, and image frequency components.

RF Signal Amplification and Filtering

After amplification and filtering, the RF signal at approximately 818 MHz became significantly stronger:

- **818 MHz ≈ -6.5 dBm to -8.6 dBm**

This indicates proper operation of the amplifier stage and improved signal strength.

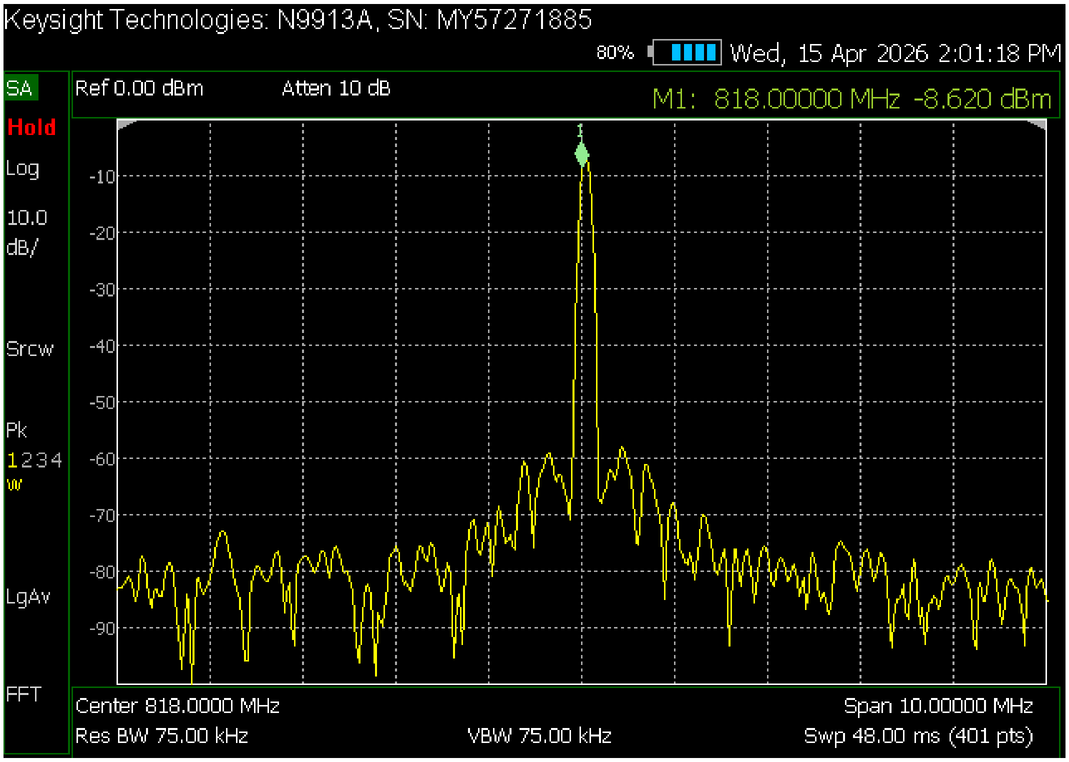

Figure 3. Zoomed spectrum showing amplified RF signal near 818 MHz.

Intermodulation and Additional Frequency Components

A wider scan revealed additional frequency components due to nonlinear mixing:

- 768 MHz
- 818 MHz
- 850 MHz
- 868 MHz

These peaks demonstrate the presence of intermodulation products, which are common in practical RF systems.

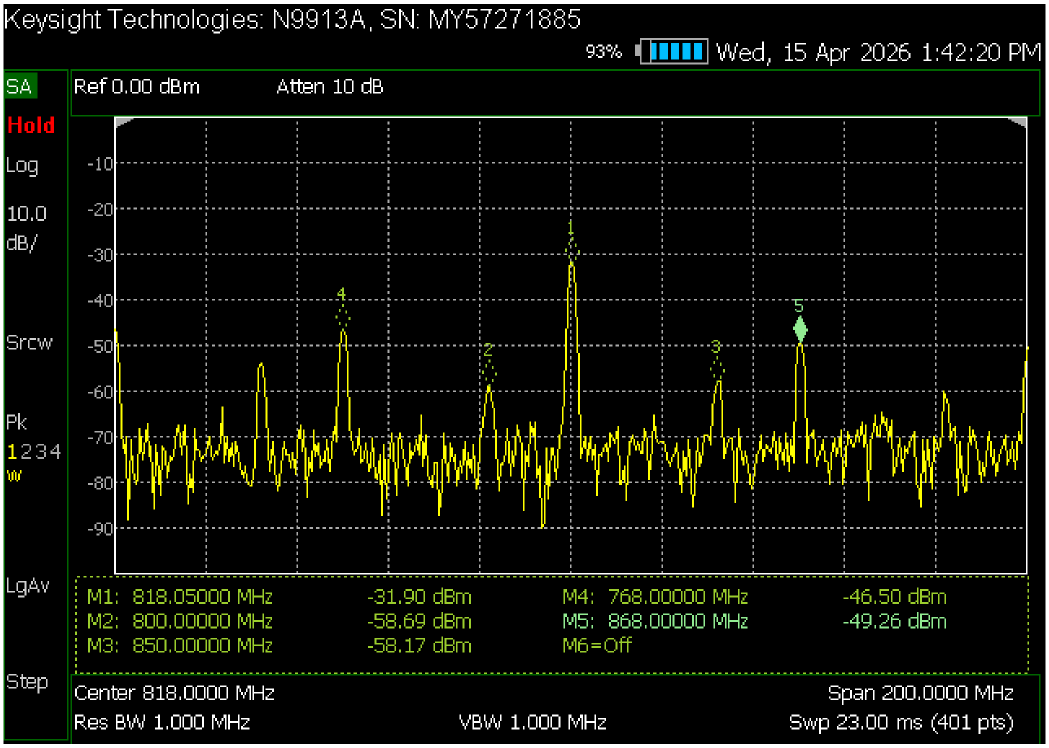

Figure 4. Spectrum showing multiple mixing products and harmonics.

Bandpass Filter Characteristics

The bandpass filter response was measured and showed a smooth frequency response centered near:

- **868 MHz peak ≈ -23.26 dBm**

The signal exhibited attenuation outside the passband, confirming proper filtering behavior.

The measured 3 dB bandwidth was approximately:

- Lower: **867.65 MHz**
- Upper: **869.35 MHz**
- **Bandwidth ≈ 1.7 MHz**

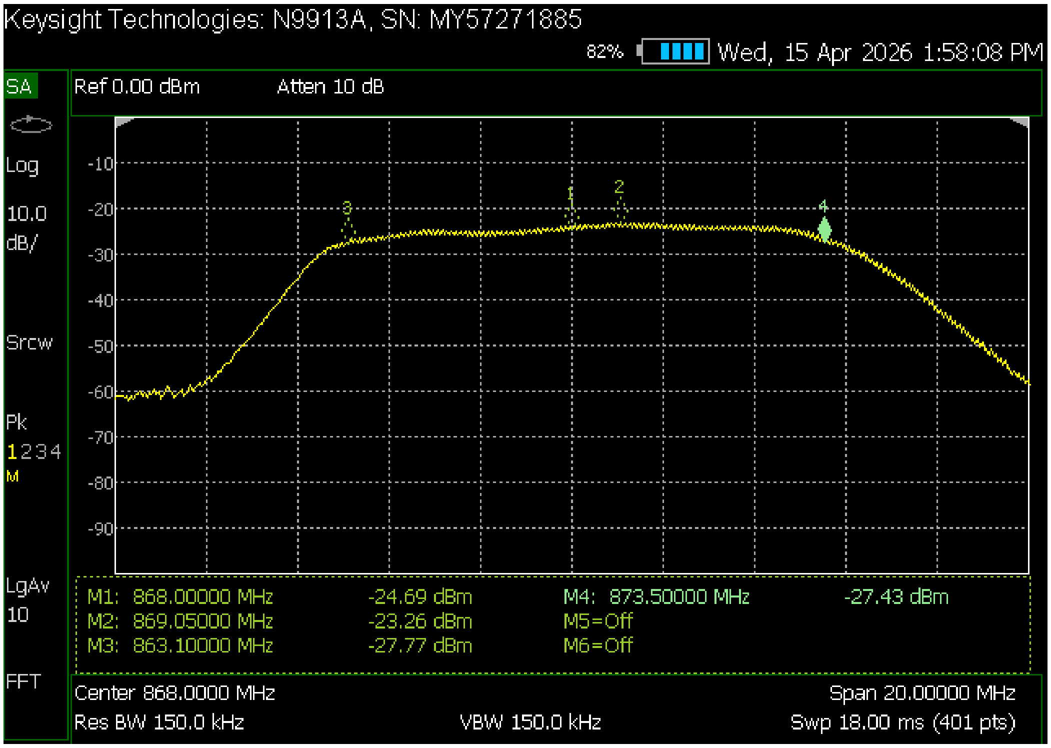

Figure 5. Bandpass filter response centered near 868 MHz.

Receiver Output and Downconversion

At the receiver, the transmitted RF signal was successfully downconverted back to the IF frequency:

- **50 MHz ≈ -75.53 dBm**

This confirms that the receiver chain correctly processed the incoming signal.

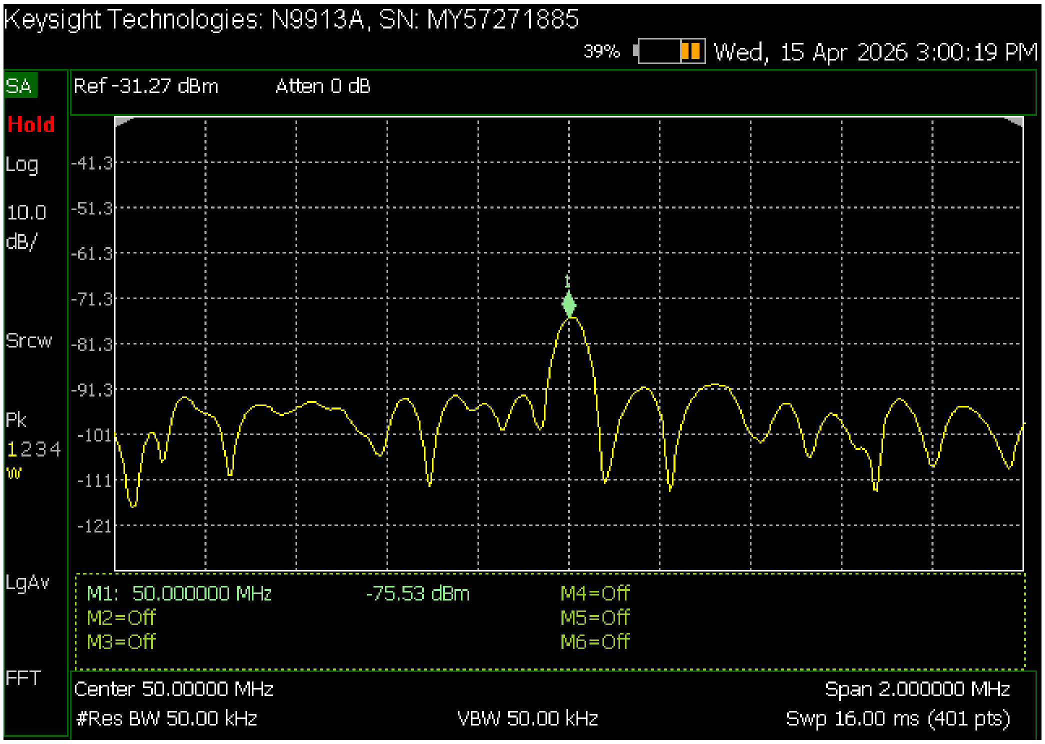

Figure 6. Recovered IF signal at 50 MHz after downconversion.

Signal Detection and Noise Comparison

A comparison between noise-only and signal-present conditions showed:

- Noise floor ≈ **-92.81 dBm**
- Signal present ≈ **-57.73 dBm**

This demonstrates a clear signal detection above the noise floor.

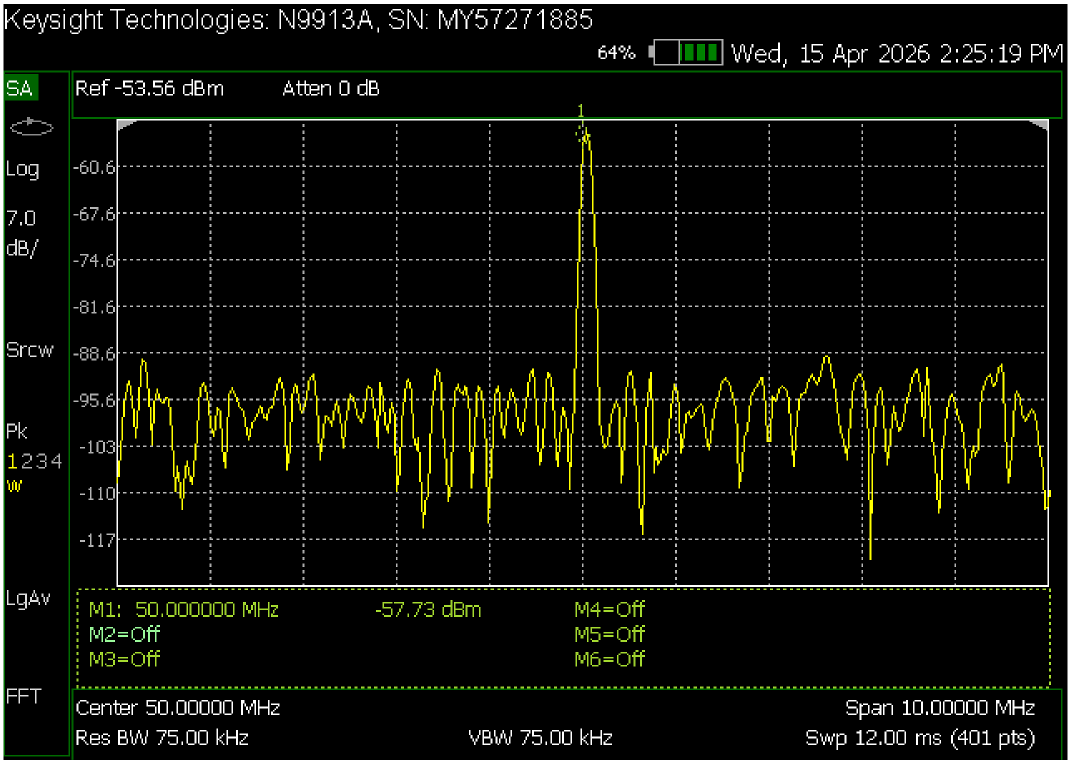

Figure 7. Comparison of noise floor and detected signal.

Conclusion

This lab demonstrated the complete operation of an RF transceiver system, including signal generation, upconversion, transmission, reception, and downconversion. The results confirmed that the system correctly translated a 50 MHz IF signal to an 868 MHz RF signal and back to 50 MHz at the receiver.

Key observations included the presence of image frequencies, the importance of bandpass filtering, and the effects of nonlinear mixing products. The experiment also showed how real-world RF systems rely on multiple stages working together to ensure accurate signal transmission and recovery.

Overall, this lab provided a comprehensive understanding of how RF communication systems operate in practice and reinforced the importance of filtering, frequency planning, and system design.