Keywords: rf, rfic, gps, satellite, receiver, stability, rf ics

APPLICATION NOTE 1749

# MAX2655 GPS LNA Stability Measurements

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*Abstract: The MAX2655 operates in the GPS frequency of 1575MHz with 14.1dB of gain, 1.45dB noise figure, and only consumes 8.3mA. The MAX2655 is designed with high-input IP3 to improve operation in cellular applications where the cellular power amplifier leaks into the GPS receiver. The MAX2655 is an inherently stable device. Stability factors K and Delta have been measured, and results are presented.*

Additional Information:

- Wireless Product Line Page
- Quick View Data Sheet for the MAX2655
- Applications Technical Support


Click here for an overview of the wireless components used in a typical radio transceiver.

## Introduction

The MAX2655 high third-order intercept point (IP3), low-noise amplifier (LNA) is designed for applications in GPS. The MAX2655 incorporates on-chip internal output matching to 50Ω, eliminating the need for external matching components. A shutdown feature in the MAX2655 reduces the operating current to 0.1µA, eliminating the need for an external supply switch.

The MAX2655 operates in the GPS frequency of 1575MHz with 14.1dB of gain, 1.45dB noise figure, and only consumes 8.3mA. The MAX2655 is designed with high-input IP3 to improve operation in cellular applications where the cellular power amplifier leaks into the GPS receiver.

The IP3 of MAX2655 is adjustable by a single external bias resistor ($R_{BIAS}$), allowing supply current to be optimized for a specific application.

The MAX2655 operates from a +2.7V to +5.5V single supply and is available in the miniature 6-pin SC70 package.

The MAX2655 is an inherently stable device. Stability factors K and Delta have been measured as shown in the figures below. The maximum available unilateral transducer gain is shown in **Figure 11** and **Figure 12**. This is the maximum gain available when the input and output are matched.

## Measurement Setup

A MAX2655 Evaluation Kit [1] was used and configured with $V_{CC}$=3V, $I_{CC}$=8.3mA, $R_{BIAS}$=511Ω. The MAX2655 Printed Circuit Board (PCB) consists of 1oz. Copper on FR4 with a 10mil layer profile and dielectric constant of 4.6. The MAX2655 Evaluation Kit was modified by removing the input trace, output trace and input matching circuitry.

S-parameter measurements were performed with a Hewlett-Packard 8753 Vector Network Analyzer (VNA) calibrated with a SOLT (Short, Open, Load, Through) calibration. The contact between the VNA and the MAX2655 amplifier was made using Cascade Microtech 250um pitch Fixed Pitch Compliant (FPC) Ground-Signal (GS) wafer probes. These probes were used for the high degree of repeatability [2]. Cascade Microtech Impedance Standard Substrate 103-726 was the standard used for the SOLT. Probes were placed directly on the input (pin 3) and output (pin 6). The VNA was configured for -30dBm input power and swept from 500MHz to 3.7GHz.

# Figures

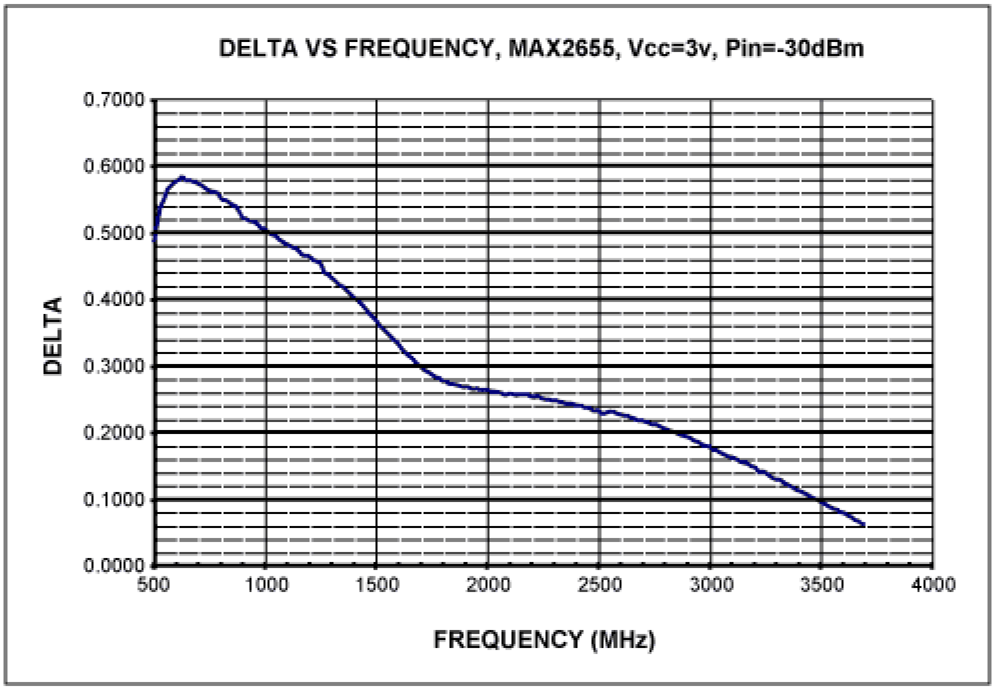


*Figure 1. Delta vs. frequency.*

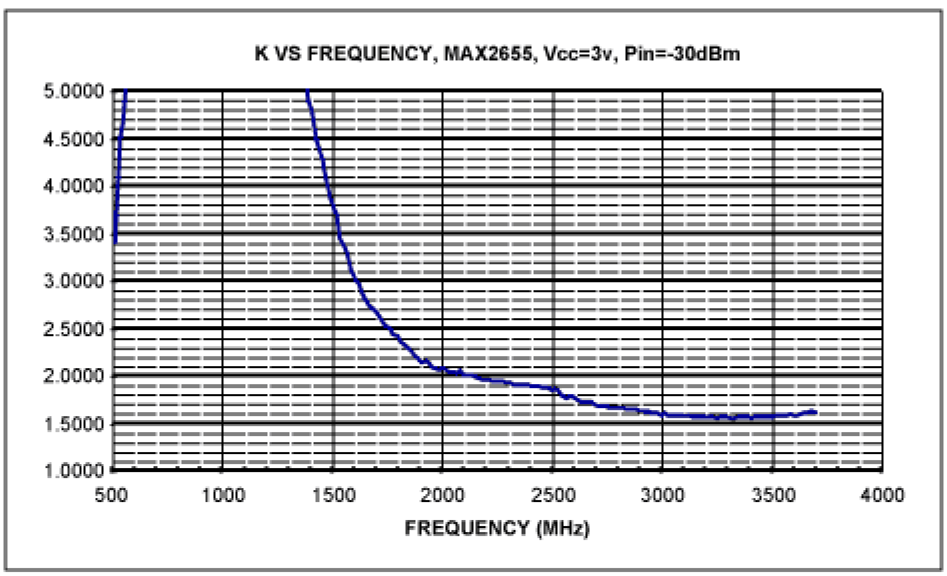


*Figure 2. K vs. frequency.*

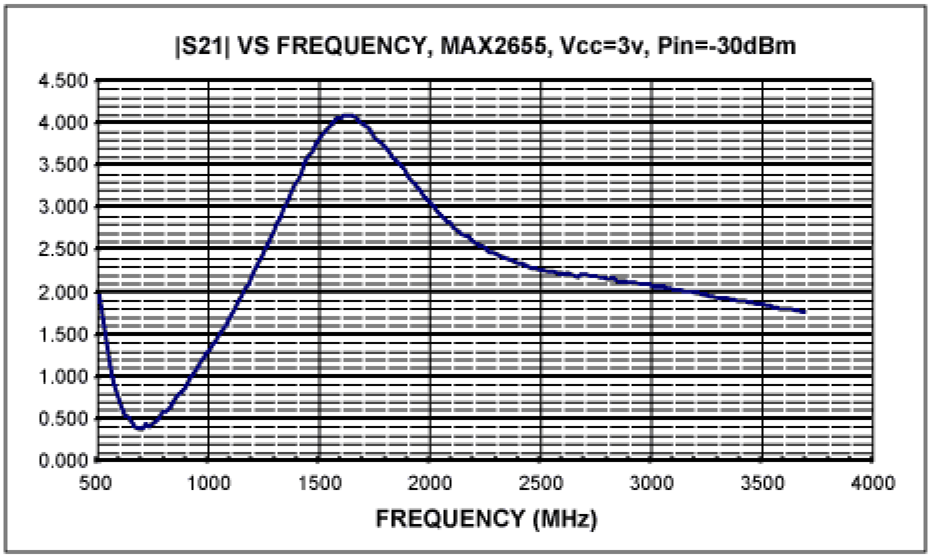


*Figure 3. S21 vs. frequency.*

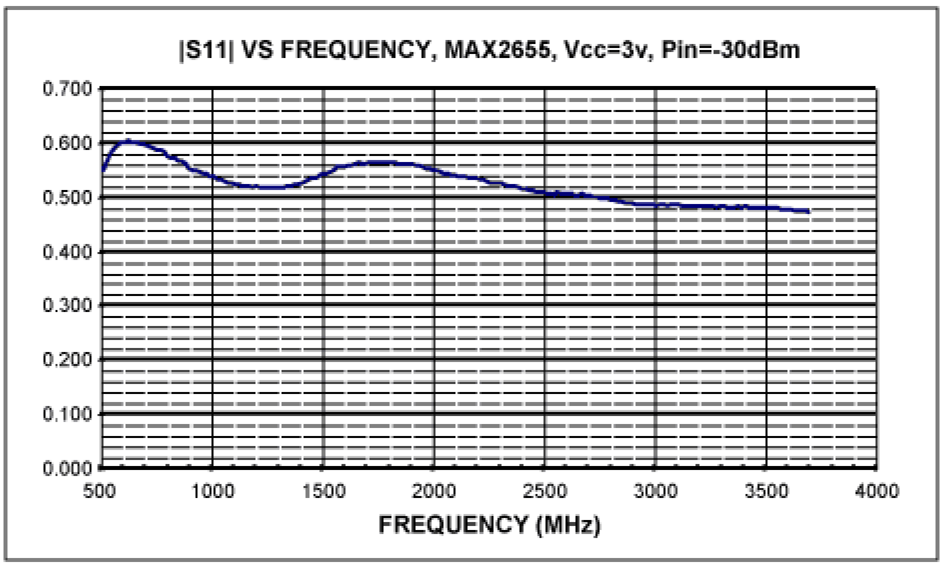


*Figure 4. S11 vs. frequency.*

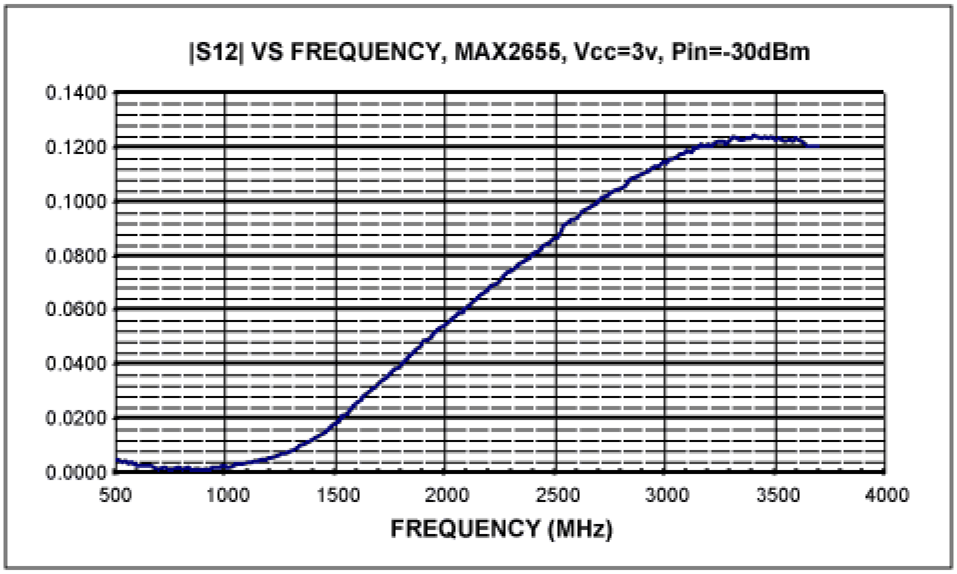


*Figure 5. S12 vs. frequency.*

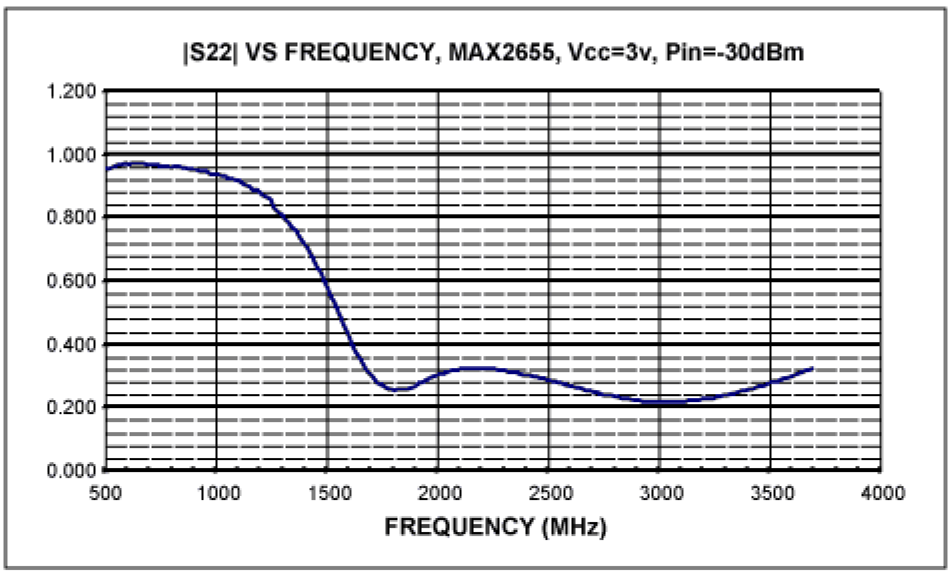


*Figure 6. S22 vs. frequency.*

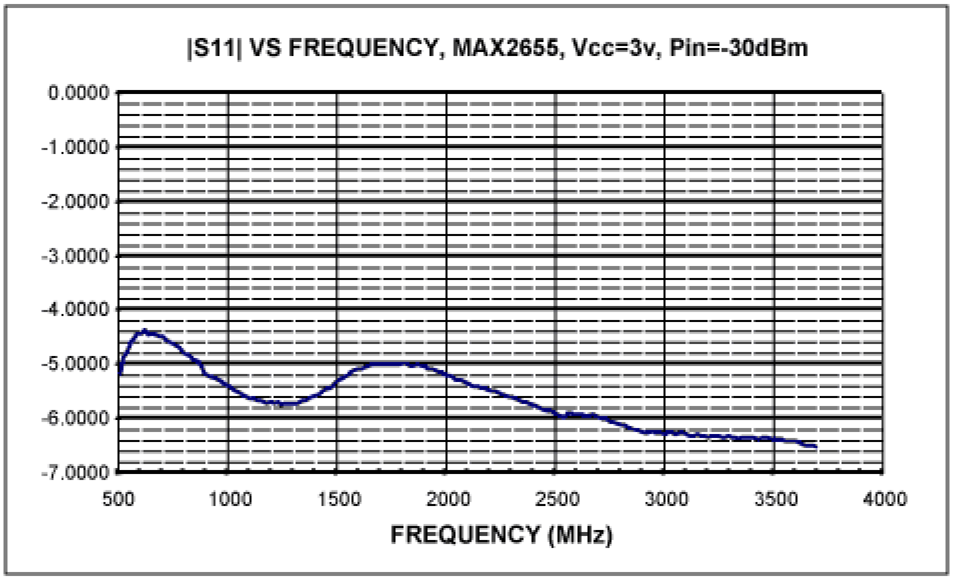


*Figure 7. Input return loss vs. frequency.*

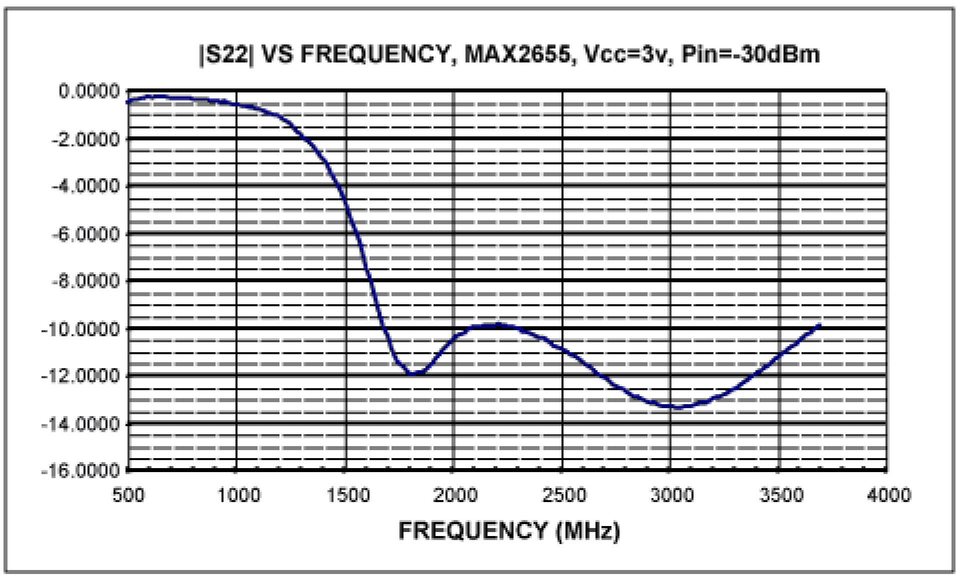


*Figure 8. Output return loss vs. frequency.*

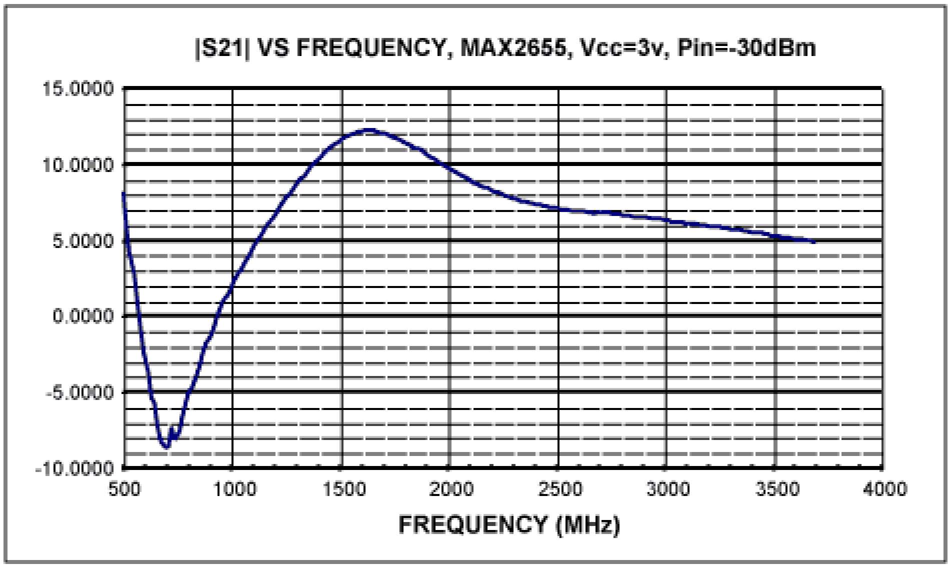


*Figure 9. Unmatched gain vs. frequency.*

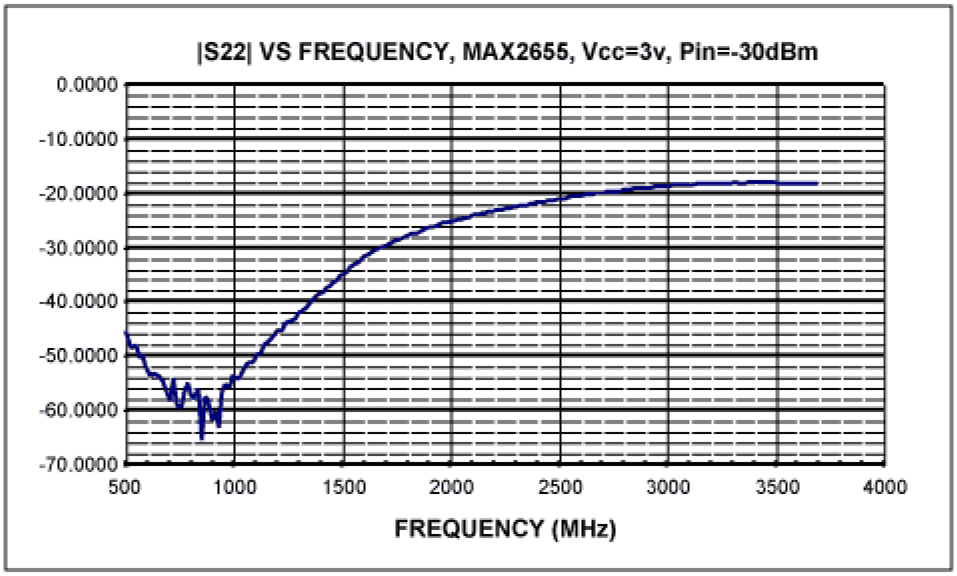


*Figure 10. Isolation vs. frequency.*

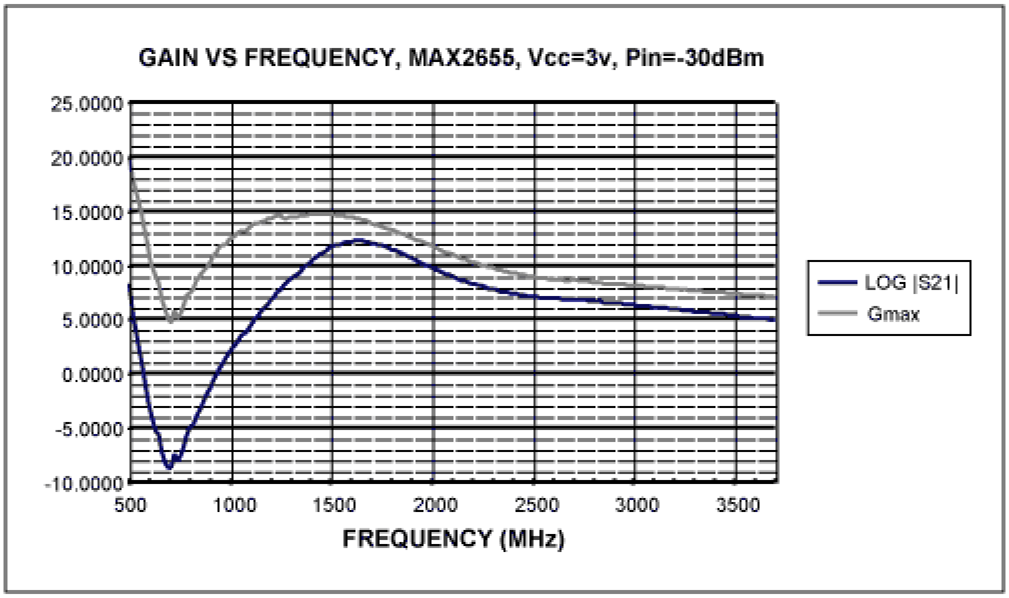


*Figure 11. Maximum gain and unmatched gain vs. frequency.*

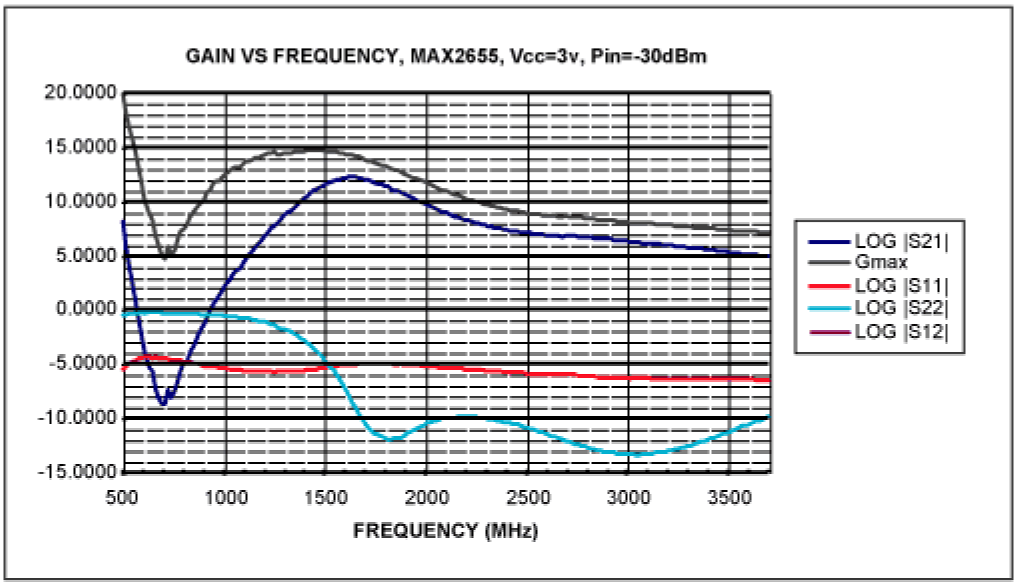


*Figure 12. Gain and return loss vs. frequency.*

Frequency Table

**Notes**


1. MAX2654/MAX2655/MAX2656 Evaluation Kit Data Sheet
2. E. Godshalk and G. Sundberg, *Characterization of Surface Mount Components at Microwave Frequencies Using Wafer Probes*, 53rd ARFTG Conference Digest. June 18, 1999, pp. 131-138.


**References**


1. Tri T. Ha, *Solid-State Microwave Amplifier Design*, John Wiley & Sons, New York, 1981, Chapter 2 pp. 34-37.
2. Marion Lee Edwards and Jeffrey H. Sinsky, *A new Criterion for Linear 2-Port Stability Using a*

*Single Geometrically Derived Parameter*, IEEE Transactions on Microwave Theory and Techniques, vol. 40, No.12, pp. 2303-2311, Dec. 1992.

3. MAX2654/MAX2655/MAX2656 Data Sheet
4. Cascade Microtech
5. Impedance Standard Substrate Data Sheet

| Related Parts | | |
|---|---|---|
| MAX2655 | 1575MHz/1900MHz Variable-IP3 Low-Noise Amplifiers | Free Samples |

**More Information**
For Technical Support: http://www.maximintegrated.com/support
For Samples: http://www.maximintegrated.com/samples
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APPLICATION NOTE 1749, AN1749, AN 1749, APP1749, Appnote1749, Appnote 1749