May 24, 2005

App Note 3543: P(1dB) Characterization for the MAX2116 Satellite Tuner

P_{1db} measurement data is provided for the MAX2116 at particular combinations of RF and baseband gain settings throughout their ranges. The MAX2116/MAX2118 low-cost, direct-conversion tuner ICs are designed for use in digital direct broadcast satellite (DBS) television applications, professional VSAT systems, and two-way Internet through satellite applications. They directly convert L-band signals to baseband using a broadband I/Q downconverter. The operating frequency range extends from 925MHz to 2175MHz.

Introduction

P_{1db} measurement data is provided for the MAX2116 at particular combinations of RF and baseband gain settings throughout their ranges. This data is valuable for selecting gain-control settings that properly distribute front-end and back-end gain for adequate P_{1db} performance. In conjuction with noise figure data, these measurements are useful for optimizing the dynamic range of the receiver system.

For large received signals, high P_{1db} is required to avoid saturation of the tuner. By adjusting the RF variable-gain amplifier for lower gain, the P_{1db} is increased significantly for reception of large signals. Since this RF gain reduction decreases tuner noise figure, careful system design tradeoffs are required between P_{1db} and the noise figure. This application note is a tool to facilitate these tradeoffs.

Operational Overview

Figure 1 shows a typical operating circuit for the MAX2116/MAX2118. Pins 4 and 5 are the differential RF inputs. At large input signal levels, the output amplifiers will limit C/N. One of the limiting factors is P_{1db}. At low input signal levels, system noise figure will limit the carrier-to-noise ratio (C/N) of the tuner.

Pin 7 (GC1) is the variable gain control for the RF front-end. The gain-control line is typically controlled by a filtered PWM signal that is generated by a baseband demodulator IC. In a closed-loop system, the filtered PWM output forces a constant amplitude signal on the MAX2116 I/Q output.

Pins 37 and 34 on the MAX2116 are the I/Q outputs. The single-ended output amplifier gains can be set to deliver 800mVP-P at the output.

After the mixer there is variable-gain baseband amplifier. This amplifier's gain is set by register GC2. GC2 is adjustable from 0 to 31 (decimal). System P_{1db} is set by the specific combination of GC1 and GC2.

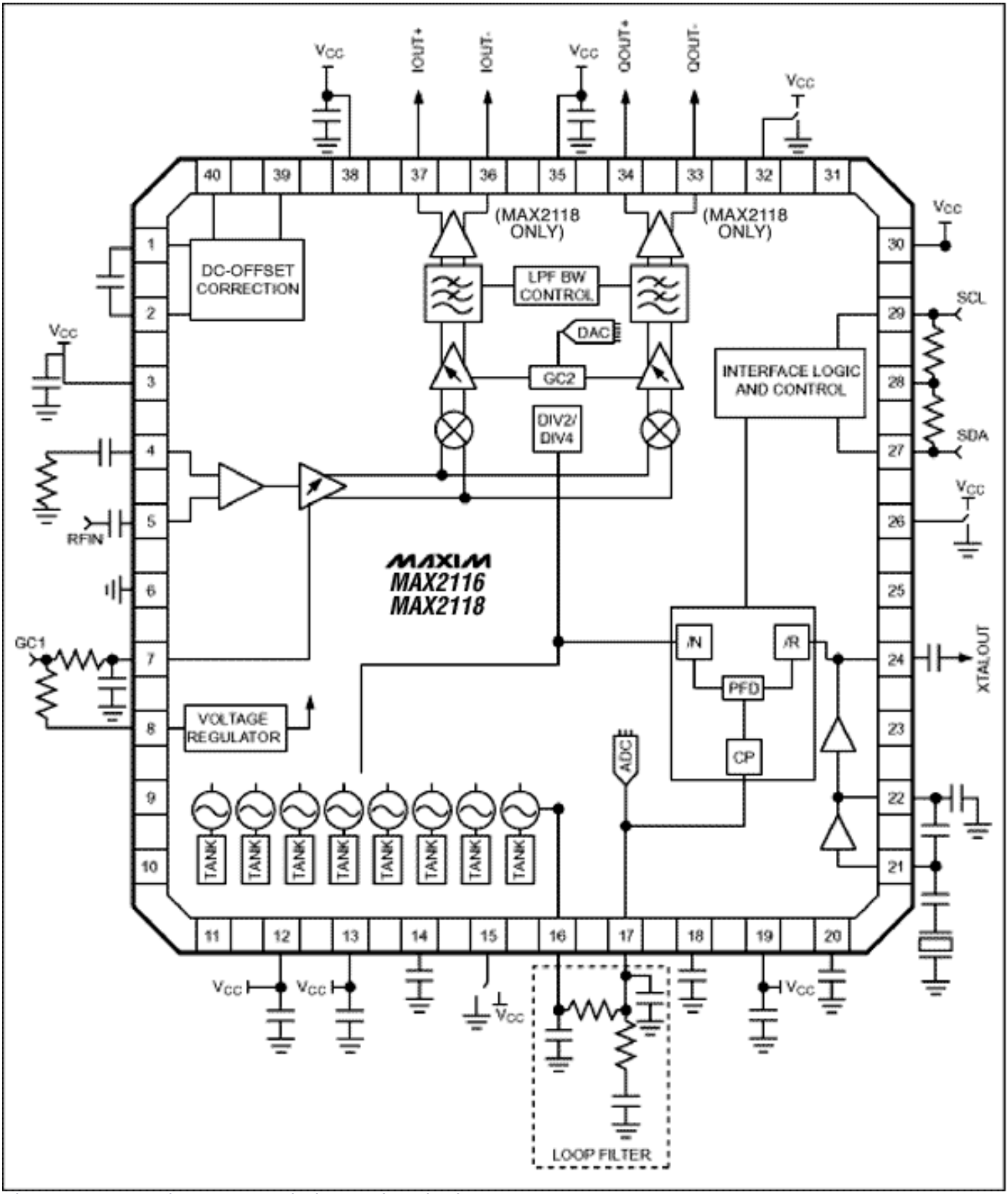

Figure 1. MAX2116/MAX2118 Typical Operating Circuit

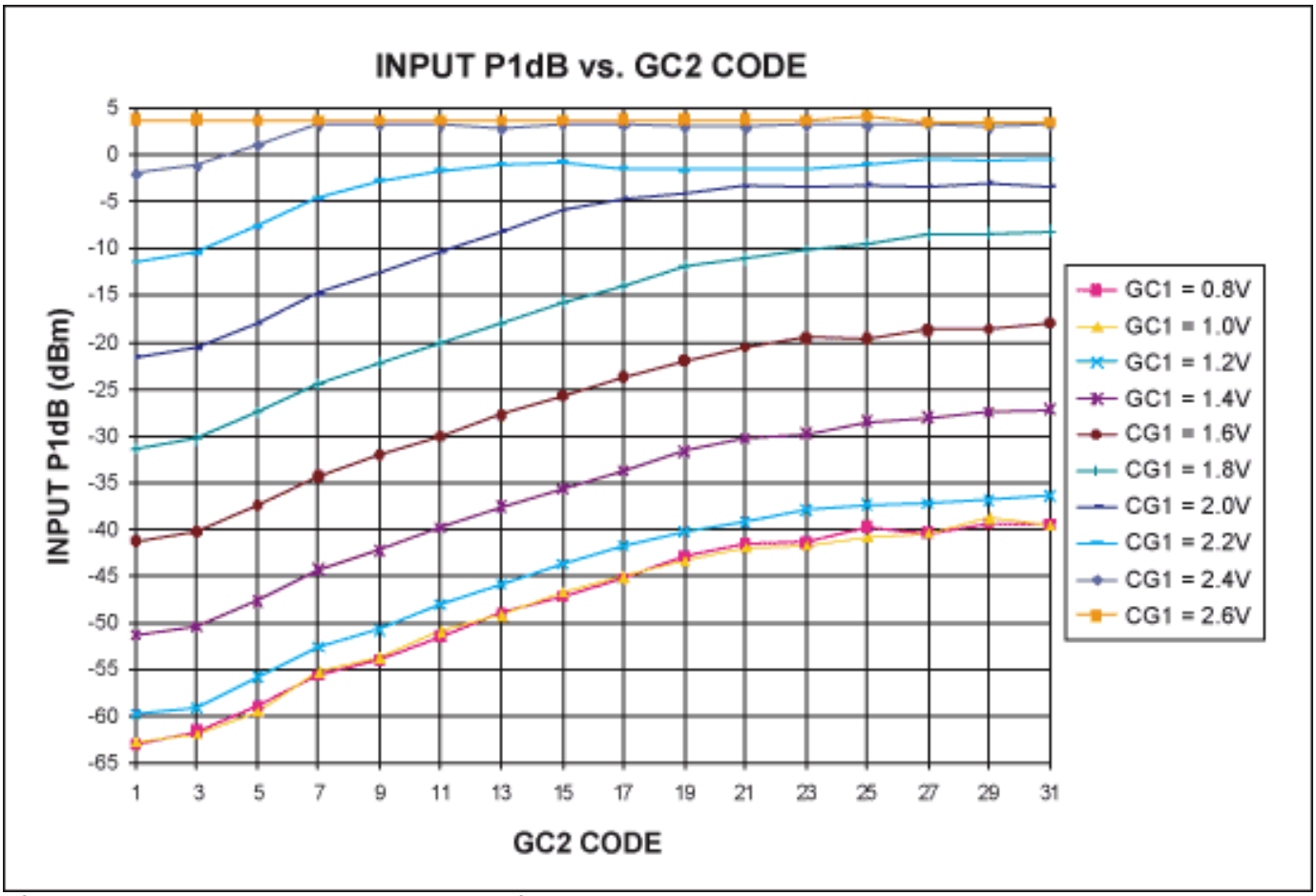

Figure 2. MAX2116 Input P_{1db} vs. GC2 Code

Figure 2 shows the P_{1db} of the MAX2116 for different RF and baseband gain-control settings. The trend of increasing P_{1db} as the front-end and back-end gains decrease is evident, with the front-end impact dominating. The P_{1db} limit of about +3.5dBm is reached for any GC2 setting at a minimum front-end gain setting of 2.6V. The data in Figure 2 is measured with a midband CW RF input at 1550MHz, and an IF frequency of 5MHz.

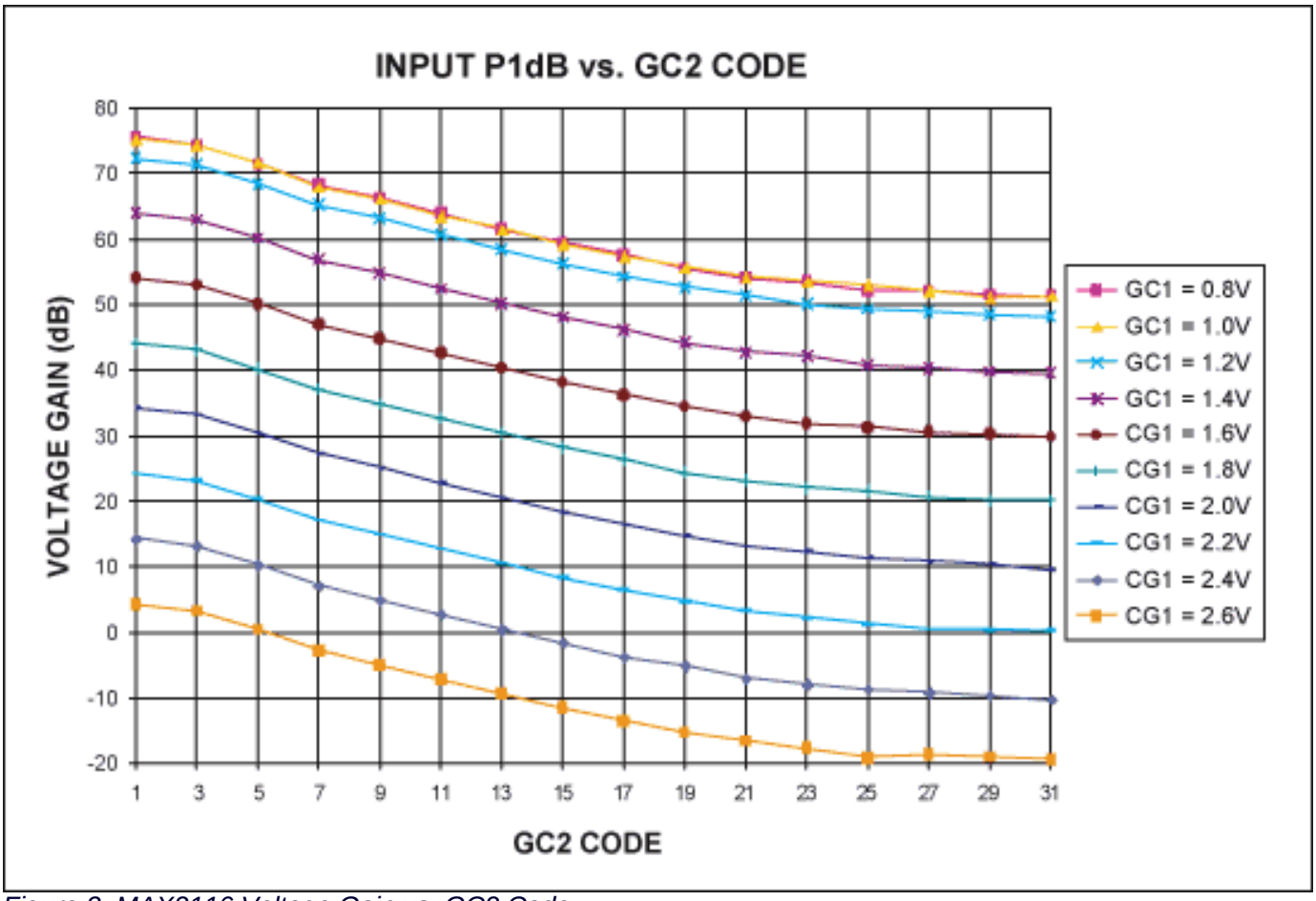

Figure 3. MAX2116 Voltage Gain vs. GC2 Code

Figure 3 shows the MAX2116 voltage gain at different gain-control settings corresponding to those shown in Figure 2. The maximum gain is 76dB, the GC1 range is 72dB, and the GC2 range is 22dB. Each of these is near the typical datasheet values.

Conclusion

P_{1db} data is presented throughout the ranges of the RF and baseband gain-control settings of the MAX2116. This data is useful for identifying the possible RF and baseband gain distributions that provide adequate P_{1db} performance.

Further Information

- Download: File containing data for Figures 2 and 3
- Maxim application note: "Extended Noise Figure Data for the MAX2118 Satellite Tuner"
- MAX2116 data sheet
- MAX2118 data sheet

More Information

MAX2116: QuickView -- Full (PDF) Data Sheet -- Free Samples