LINEAR TECHNOLOGY

DESIGN NOTES

High Input IP3 Mixer Enables Robust VHF Receivers

Design Note 515

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Introduction

An increasing number of applications occupy the 30MHz to 300MHz very high frequency (VHF) band. Television and radio broadcasting, navigation controls and amateur radios are a few examples. Modern RF component development is aimed at much higher frequency bands used for voice and data communications systems. Significant advances in circuit techniques and manufacturing processes are required to meet the demanding performance requirements of the next generation of radios. Applying these techniques to lower frequency designs can significantly improve performance.

The LTC®5567 is a wideband mixer designed and optimized for performance in the 300MHz to 4GHz frequency band. To create very compact circuit implementations, the LTC5567 contains integrated RF and LO transformers. The Input IP3 linearity performance benchmark is an excellent 30dBm for the LTC5567 in its specified frequency range. Going lower in frequency requires the built-in transformers to maintain this linearity as well as conversion gain. With such a high level of linearity to start from, it is worthwhile to modify the mixer circuit design and characterize the performance over lower VHF frequencies. The proof of performance is in the testing.

Impedance Match Design

Figure 1 shows an impedance match design with the LTC5567. Table 1 shows the design values extending input port match below 300MHz, down to 150MHz,

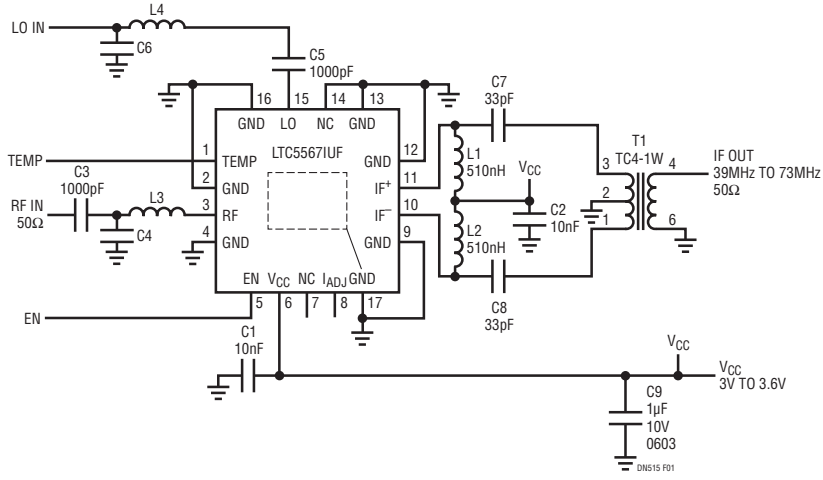

Figure 1. VHF Mixer Design

Table 1. VHF Impedance Match Design Values

MATCH	RF INPUT	L3	C4	LO INPUT	L4	C6
A	150MHz	8.2nH	56pF	200MHz	3.9nH	47pF
B	200MHz	6.8nH	39pF	250MHz	2.7nH	33pF
C	250MHz	3.9nH	27pF	300MHz	1.5nH	27pF

while still achieving outstanding performance. Test results are also provided.

Figure 2 shows the LTC5567 mixer gain and input IP3 versus input frequency. The mixer linearity performance improves as input frequency approaches 150MHz. Input, LO and output port return loss measurements are shown in Figures 3, 4 and 5, respectively. The overall performance is maintained in the VHF range compared to higher input frequencies. As a result, the high IP3 and conversion gain yields maximum dynamic range when used in radio designs. Higher dynamic range minimizes adjacent channel interference, improving selectivity. Operating the LTC5567 below 150MHz input is possible with reduced conversion gain, but not recommended, due to the internal transformer becoming lossy.

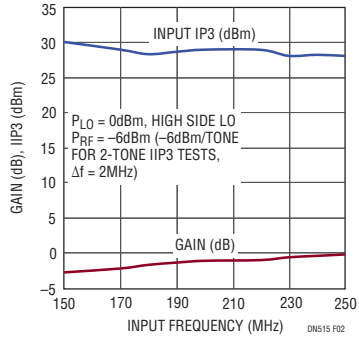

Figure 2. Mixer IIP3 and Gain Performance Results

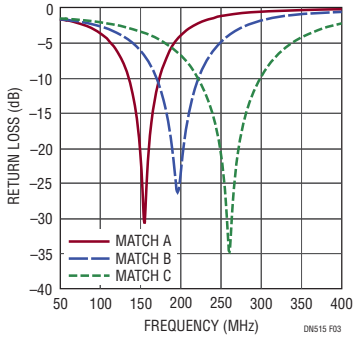

Figure 3. RF Input Return Loss

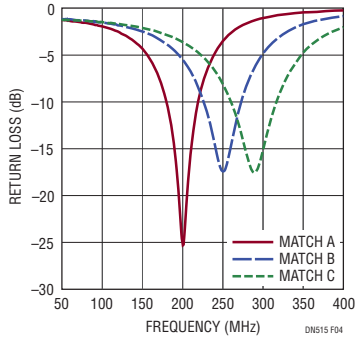

Figure 4. LO Input Return Loss

Conclusion

The LTC5567 offers very high linearity performance at VHF and UHF input frequencies. High IP3 figures and P1dB in (Table 2) make it an excellent choice for high performance radio design over a wide range of frequencies.

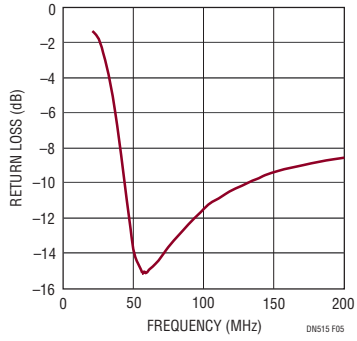

Figure 5. IF Output Return Loss

Table 2. P1dB Compression Point and LO Leakage Over Input Frequency. Output Frequency = 50MHz, HSLO

RF INPUT FREQUENCY (MHz)	P1dB (dBm)	LO TO IF LEAKAGE (dBm)
150	12.29	–35
160	12.9	–42
170	12.9	–42
180	12.75	–42
190	12.70	–41.2
200	11.61	–43
210	12.48	–43
220	12.7	–44
230	11.7	–44
240	11.08	–44
250	12.89	–44

Data Sheet Download

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