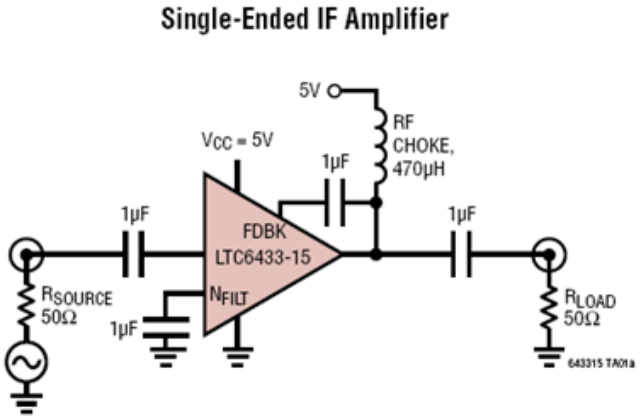
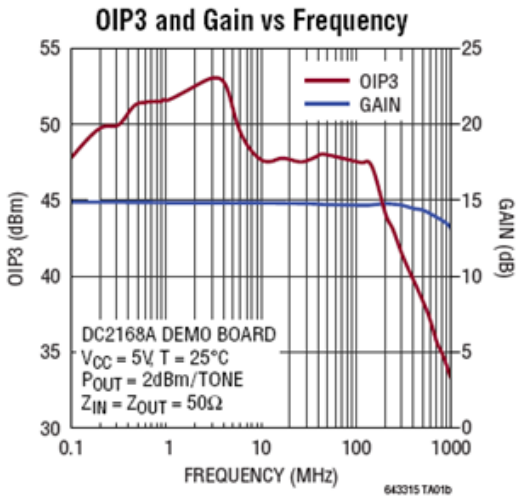
Tuned IF Amplifier Applications

by **John Chung**

Introduction

The LTC6431-20 and LTC6433-15 are single-ended RF/IF gain block amplifiers that feature very high OIP3 with low noise and a gain of 20dB and 15dB respectively. The unique combination of high linearity, low noise and low power dissipation make this an ideal candidate for many signal-chain applications. These fixed gain amplifiers are internally matched to 50Ω at both input and output with very wide frequency range. Both devices feature a on-chip bias and temperature compensation and are package i 4mm × 4mm QFN-24 with an exposed pad to maintain performance over environmental changes.





However, there are many IF signal chain applications where wideband response is not desirable. With a simple pull-up L and C bandpass filter or tank circuit, the amplifier can be optimized to commonly used IF frequencies such as 21.4MHz, 70MHz, 140MHz or 240MHz.

21.4 MHz Design Example

In this example design, an LC tank circuit of 220nH and 270pF is used for resonance at about 21.4MHz. Be sure to choose an inductor such as the Coilcraft 0603HP series which provides high Q and low DCR at the center frequency, and supports the OUT pin DC current requirement of 82

mA. The desired specifications are as follows:

- Center Frequency = 21.4MHz
- Bandwidth = 8MHz

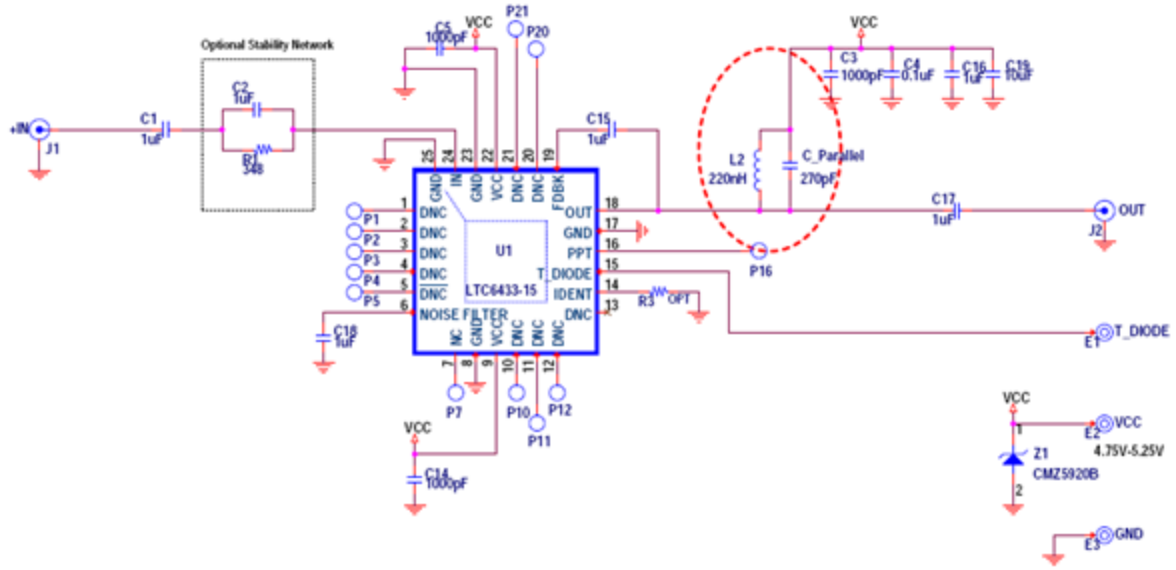


Figure 1: LTC6433-15's Schematic for Narrowband Application at 21.4MHz

Figure 2 shows the S-parameter performance at 21.4MHz of the LTC6433-15 with power gain slightly higher than 15dB. The input and output return losses with better than 10dB range from 17.5MHz to 25.5MHz. It is about 8MHz bandwidth. For more information about this circuit, please refer to the DC2168A demonstration circuit.

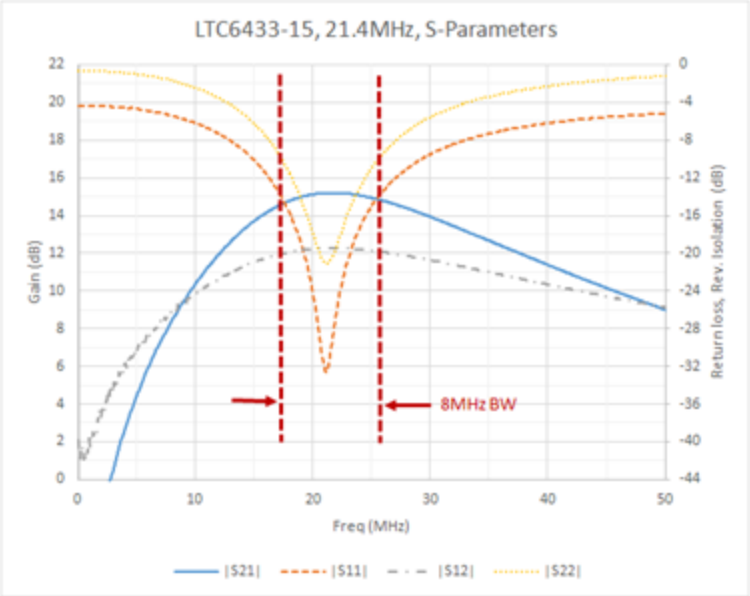


Figure 2: S-Parameter Performance of Narrowband Application at 21.4MHz

70 MHz Design Example

In this example design, an LC tank circuit of 68nH and 82pF is used for resonance at about 70MHz. Be sure to choose an inductor such as the Coilcraft 0603HP series which provides high Q and low DCR at the center frequency, and supports the OUT pin DC current requirement of 75 mA. The desired specifications are as follows:

- Center Frequency = 70MHz
- Bandwidth = 27MHz

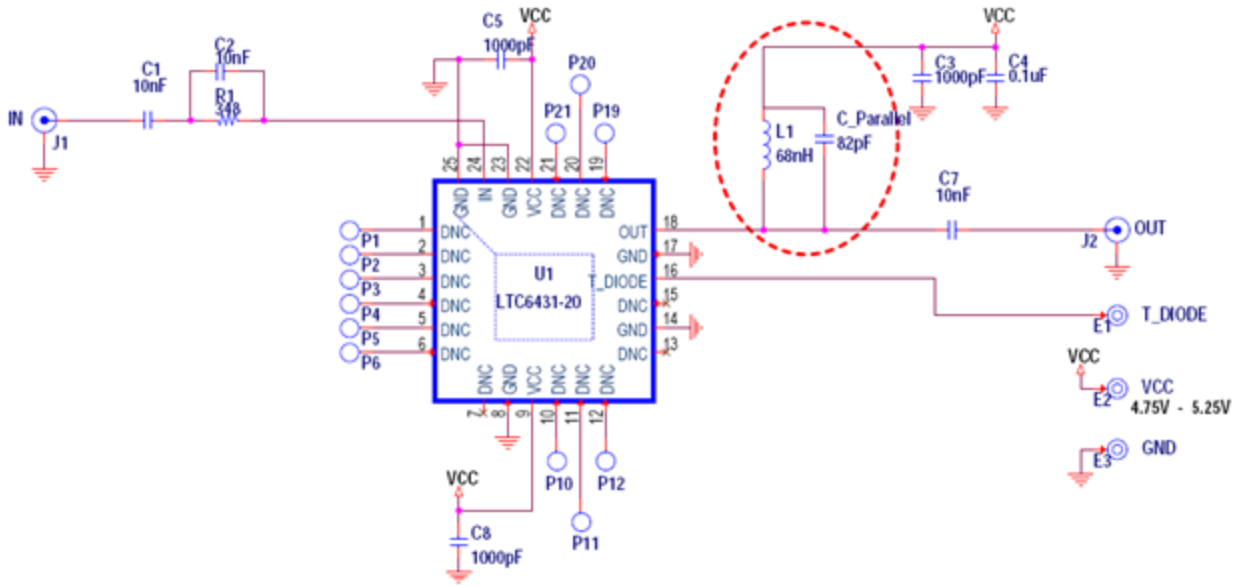


Figure 3: LTC6431-20 Schematic for Narrowband Application at 70MHz

Figure 4 shows the S-Parameters performance. The LTC6431-20 has a little more than 20dB gain at 70MHz. The input and output return losses with better than 10dB range from 55MHz to 82MHz, or 27MHz bandwidth. For more information about this circuit, please refer to the DC2077A demonstration circuit.

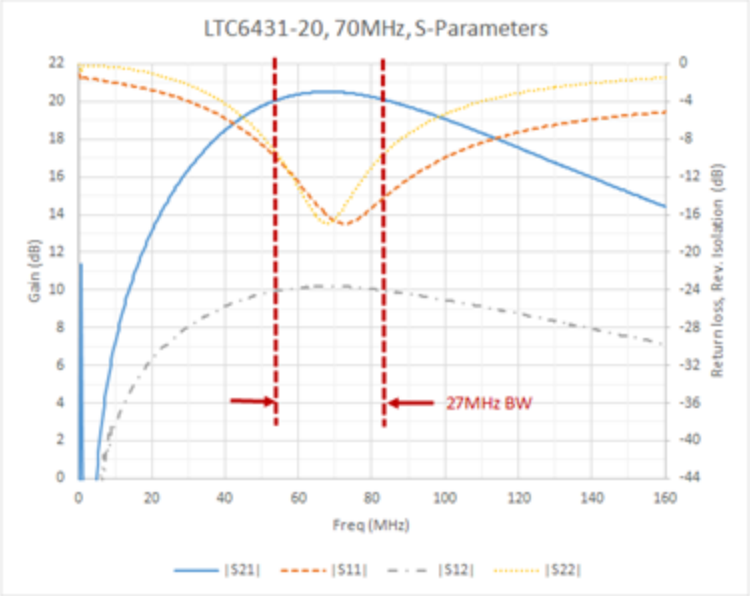


Figure 4: LTC6431-20 S-Parameters Performance of Narrowband Application at 70MHz

140 MHz Design Example

In this example design, an LC tank circuit of 39nH and 39pF is used for resonance at about 140MHz. Be sure to choose an inductor such as the Coilcraft 0603HP series which provides high Q and low DCR at the center frequency, and supports the OUT pin DC current requirement of 75 mA. The desired specifications are as follows:

- Center Frequency = 140MHz
- Bandwidth = 55MHz

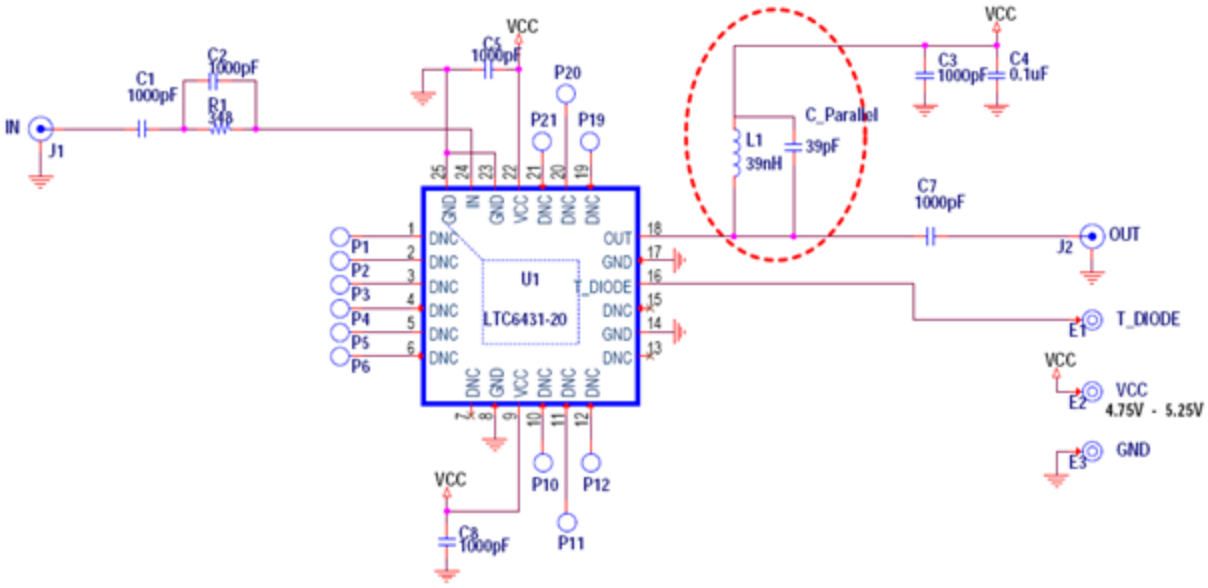


Figure 5: LTC6431-20 Schematic for Narrowband Application at 140MHz

Figure 6 shows the S-Parameters performance at 140MHz. The LTC6431-20's optimized circuit has slightly over 20dB gain. The input and output return losses with better than 10dB range from 117MHz to 172MHz or 55MHz bandwidth. For more information about this circuit, please refer to the DC2077A demonstration circuit.

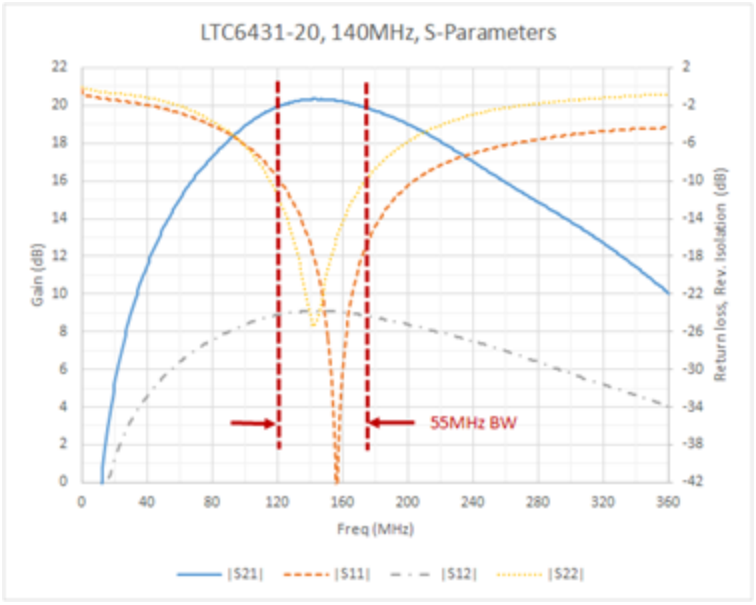


Figure 6: LTC6431-20 S-Parameters Performance of Narrowband Application at 140MHz

240 MHz Design Example

In this example design, an LC tank circuit of 18nH and 27pF is used for resonance at about 240MHz. Be sure to choose an inductor such as the Coilcraft 0603HP series which provides high Q and low DCR at the center frequency, and supports the OUT pin DC current requirement of 75 mA. The desired specifications are as follows:

- Center Frequency = 240MHz
- Bandwidth = 80MHz

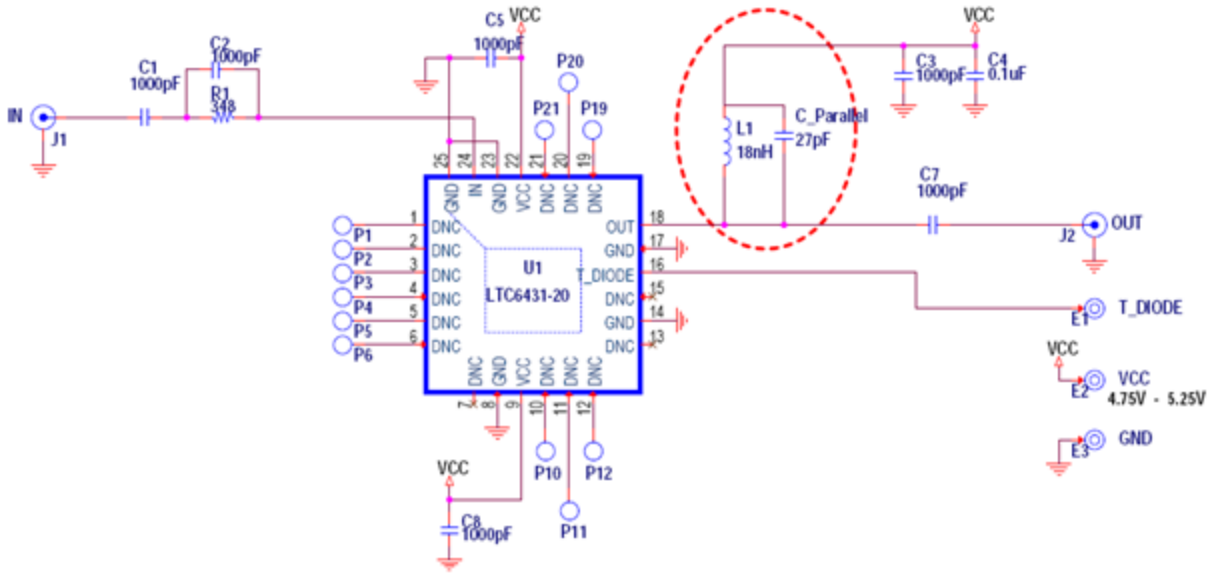


Figure 7: LTC6431-20 Schematic for Narrowband Application at 240MHz

Figure 8 shows the S-Parameters performance at 240MHz. LTC6431-20 has slightly over 20dB gain. The input and output return losses with better than 10dB range from 200MHz to 280MHz or 80MHz bandwidth. For more information about this circuit, please refer to the DC2077A demonstration circuit.

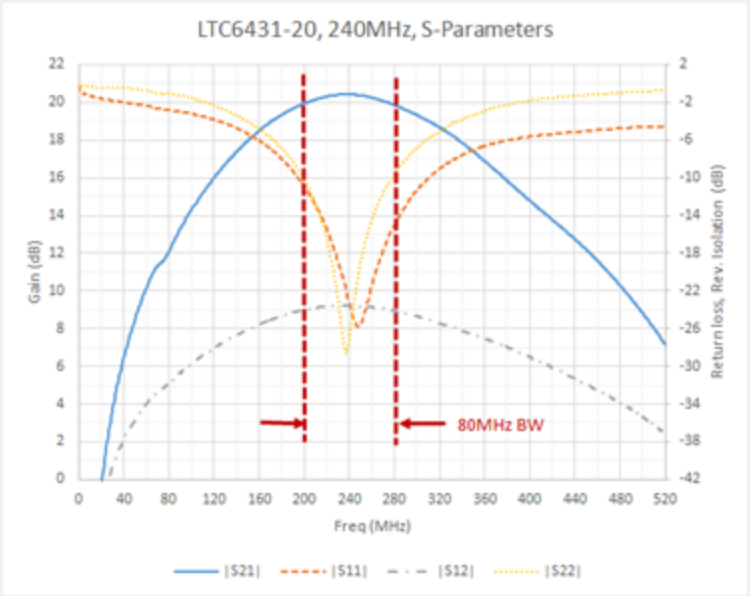


Figure 8: LTC6431-20 S-Parameters Performance of Narrowband Application at 240MHz

Conclusion

The LTC6431-20 and LTC6433-15 amplifiers starts with a classic RF gain-block topology but adds additional enhancements to achieve dramatically mproved linearity. Shunt and series feedback are added to lower the input/output impedance and match them simultaneously to the 50Ω source and load. Meanwhile, an internal bias controller optimizes the internal operating point for peak linearity over environmental changes. This circuit architecture provides low noise, excellent RF power handling capability and wide bandwidth—characteristics that are desirable for IF signal chain applications.

As shown, these amplifiers can be easily tuned for narrow band applications. At the same time, the device's state-of-art performance remains unchanged with the market best OIP3, low noise with nominal current consumption of the devices.

DC2168A Demo Board

Author

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