LO Buffer at 100 MHz, 500 MHz and 1 GHz using ABA-5X563

Application Note 5222

Introduction

Avago Technologies' ABA-5X563 RFICs are a series of silicon broadband amplifiers designed to operate from a 5V voltage supply. Offering a flat gain (>20 dB) across a wide frequency band, good input and output return losses, unconditional stability, good reverse isolation (30 dB), and flat output power characteristics, these amplifiers are suitable for buffer applications. An example of a LO buffer application using the ABA-5X563 is shown in Figure 1. The use of this series as a LO buffer amplifier at 2 GHz has been greatly discussed in Application Note 5095. As mentioned in that note, the amplifier can also be used at other frequency ranges without much change on the SMT components due to its wideband characteristics. Therefore, this note discusses the application of this series as LO buffers at extended frequencies, specifically at 100 MHz, 500 MHz and 1 GHz.

ABA-5X563 Performance

This note demonstrates the characteristics of the ABA-5X563 device at 100 MHz, 500 MHz, and 1 GHz based on the following conditions:

1. Input versus output power
2. Gain versus frequency
3. Isolation versus frequency
4. Input and output return loss
5. Current versus input power
6. Second harmonic versus frequency

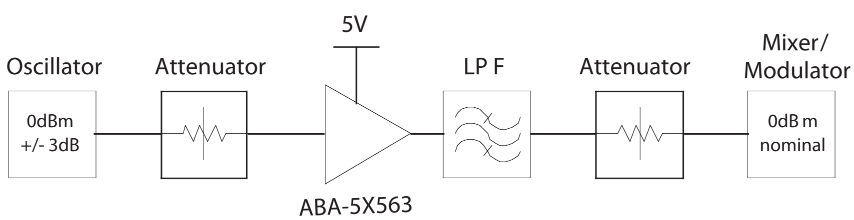

Figure 1. Example of LO buffer application using ABA-3X563.

Although the performance over temperature is not being measured here, the variation is very minimal since the internal circuits help limit the variation due to temperature as discussed in AN5095. The following characterization data was obtained from small samples of ABA-3X563 devices. The results can be used as a reference on the performance, but shall not be used as final design values.

The measurements were taken using a device soldered onto the test board DEMO-ABA-5X563 with the components listed in Figure 2. The test board and the ABA-5X563 samples can be ordered from *http://www.Avago.com/view/rf/* under the section titled "Si and GaAs Amplifier ICs."

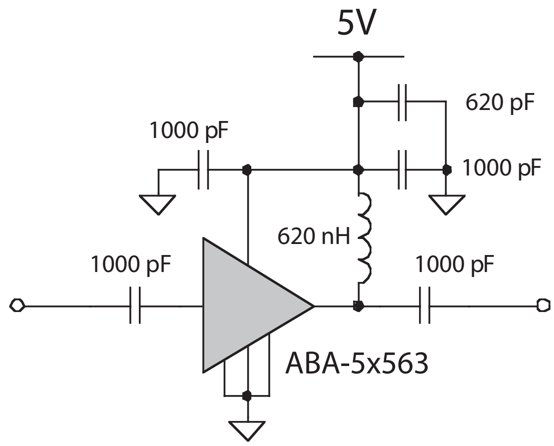

Figure 2. Schematic and components for wideband application board.

1. Input versus output power

These devices exhibited constant output power over a wide range of input power as can be seen from Figures 3a to 3c. Table 1 summarizes the performance of the ABA-5X563 at 100 MHz, 500 MHz, and 1 GHz with input power of -5 dBm to +5 dBm.

Table 1. Output power of ABA-5X563 with input power of -5 dBm to +5 dBm.

Frequency	ABA-51563	ABA-52563	ABA-53563	ABA-54563
100 MHz	+16.0 dBm	+15.5 dBm	+17.0 dBm	+19.5 dBm
500 MHz	+13.5 dBm	+14.0 dBm	+16.0 dBm	+18.5 dBm
1 GHz	+11.0 dBm	+13.0 dBm	+15.0 dBm	+18.0 dBm

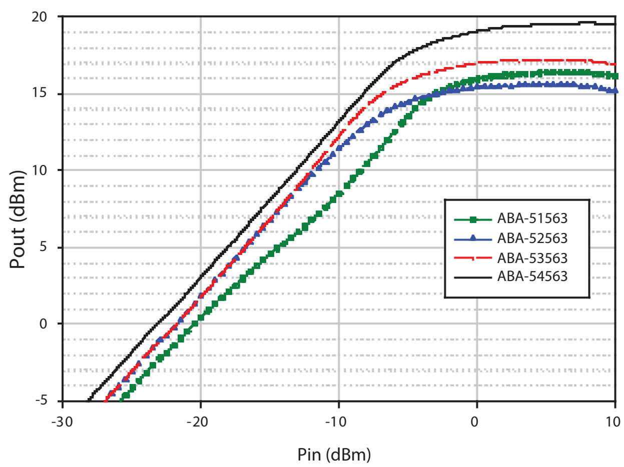

Figure 3a. ABA-5X563 output versus input power at 100 MHz.

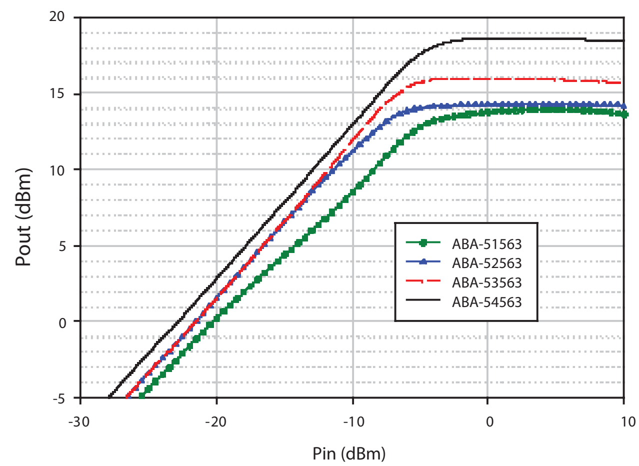

Figure 3b. ABA-5X563 output versus input power at 500 MHz.

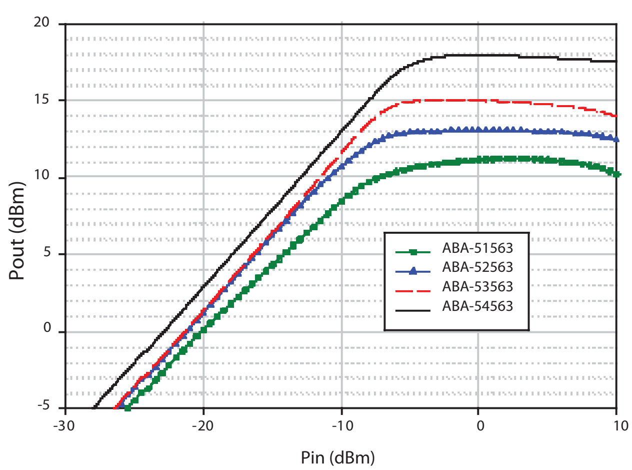

Figure 3c. ABA-5X563 output versus input power at 1 GHz.

2. Output power versus frequency

Using an input power of 0 dBm, the output power was measured against the frequency. Due to its wideband characteristic, the ABA series can easily deliver a constant gain over frequency with acceptable amplitude variation. Figures 4a to 4c illustrate the gain of the device over frequency using an input power of 0 dBm.

Table 2. Gain of ABA-5X563 with input power of 0 dBm.

Frequency	ABA-51563	ABA-52563	ABA-53563	ABA-54563
100 MHz ± 50 MHz	14.4 dB	14.7 dB	15.6 dB	18.8 dB
500 MHz ± 50 MHz	12 dB to 12.7 dB	13.6 dB to 14 dB	15.4 dB	18.4 dB
1 GHz ± 50 MHz	9.2 dB to 9.8 dB	12.8 dB to 13.0 dB	14.6 dB to 14.8 dB	18.2 dB

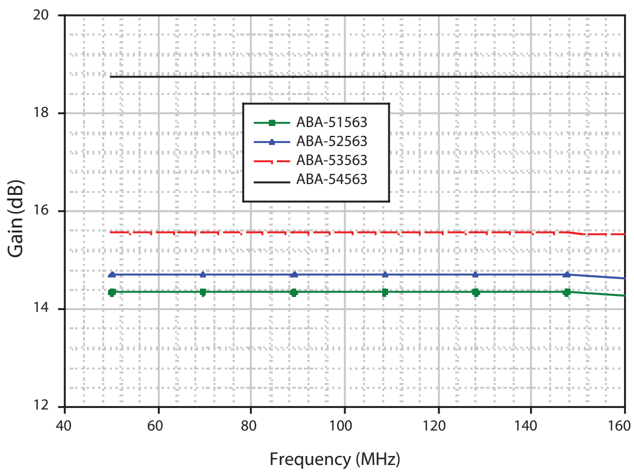

Figure 4a. ABA-5X563 gain versus frequency at 100 MHz with input power 0 dBm.

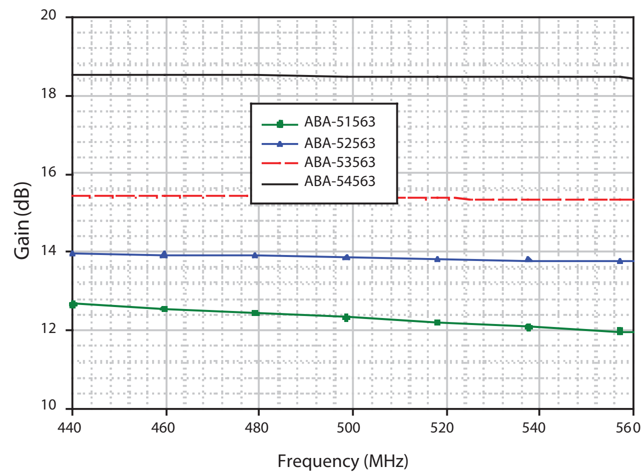

Figure 4b. ABA-5X563 gain versus frequency at 500 MHz with input power 0 dBm.

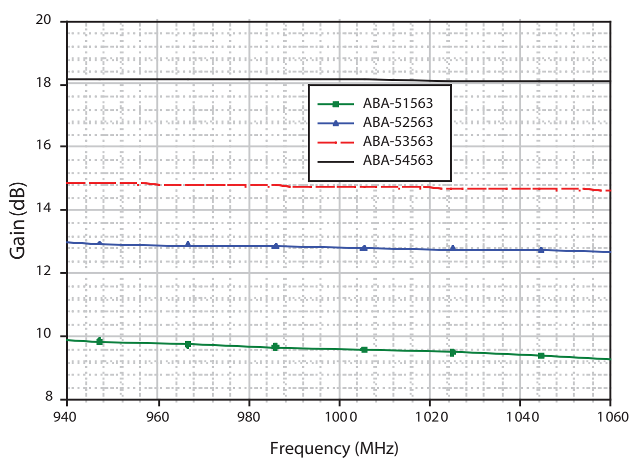

Figure 4c. ABA-5X563 gain versus frequency at 1 GHz with input power 0 dBm.

3. Isolation versus frequency

Another important characteristic of a buffer amplifier is the reverse isolation. Table 3 summarizes the measured isolation of the ABA-3X563 series using an input power of 0 dBm. The isolation curve over frequency is shown in Figure 5. The isolation can be improved by cascading two devices together.

Table 3. Reverse isolation of ABA-5X563 at input power of 0 dBm.

Frequency	ABA-51563	ABA-52563	ABA-53563	ABA-54563
100 MHz	28.0 dB	31.0 dB	31.0 dB	31.4 dB
500 MHz	28.2 dBm	31.2 dB	30.0 dB	31.6 dBm
1 GHz	28.8 dB	30.8 dB	30.0 dB	31.4 dBm

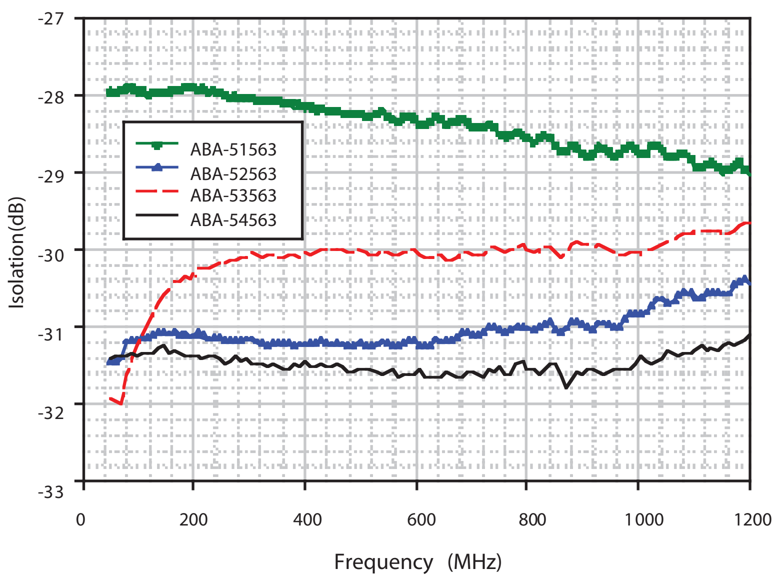

Figure 5. ABA-5X563 Isolation versus frequency.

4. Input and output return loss versus frequency

As the device is operating in the saturation region, the input and output return losses need to be understood. Using 0 dBm input power, the input and output return losses were measured over frequency and the results are summarized in Tables 4 and 5. The return losses are still very good at high input power across the range of frequencies.

Table 4. Input return loss of ABA-5X563 at input power of 0 dBm.

Frequency	ABA-51563	ABA-52563	ABA-53563	ABA-54563
100 MHz	15 dB	17 dB	19 dB	25 dB
500 MHz	20 dB	17 dB	17 dB	21 dB
1 GHz	16 dB	15 dB	14 dB	17 dB

Table 5. Output return loss of ABA-5X563 at input power of 0 dBm.

Frequency	ABA-51563	ABA-52563	ABA-53563	ABA-54563
100 MHz	19 dB	13 dB	13 dB	17 dB
500 MHz	20 dB	14 dB	17 dB	17 dB
1 GHz	18 dB	13 dB	17 dB	16 dB

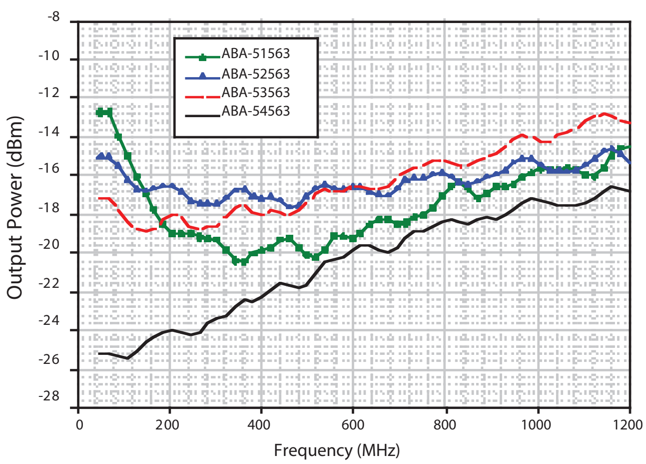

Figure 6. ABA-5X563 input return loss versus frequency.

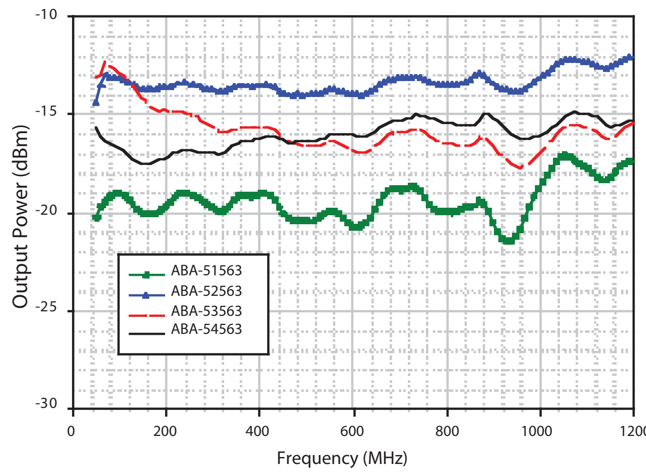

Figure 7. ABA-5X563 output return loss versus frequency.

5. Current versus input power

The current is another important factor that needs to be considered when operating at high input power. The following figures illustrate the change of current with input power using a fixed supply voltage at 5V. Generally, most of the ABA-5X563 series required much higher current at 100 MHz than at 1 GHz. The ABA-51563 experienced significant change in the current at 100 MHz than at 1 GHz. This characteristic is mainly due to the internal design of the device.

Table 6. Device current of ABA-5X563 at input power of 0 dBm.

Frequency	ABA-51563	ABA-52563	ABA-53563	ABA-54563
100 MHz	40 mA	45 mA	54 mA	80 mA
500 MHz	30 mA	40 mA	48 mA	80 mA
1 GHz	26 mA	40 mA	46 mA	80 mA

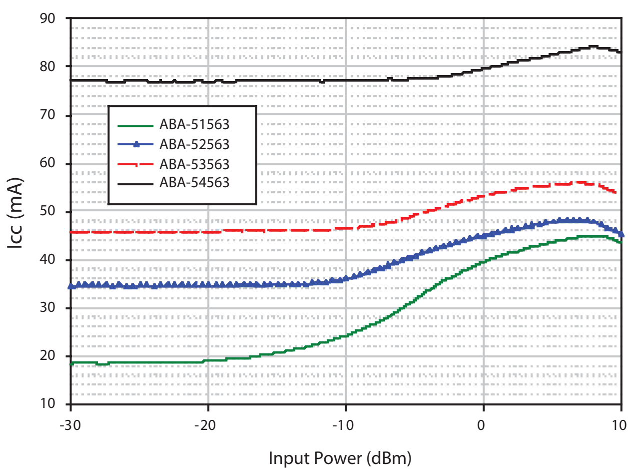

Figure 8a. ABA-5X563 Icc versus input power at 100 MHz.

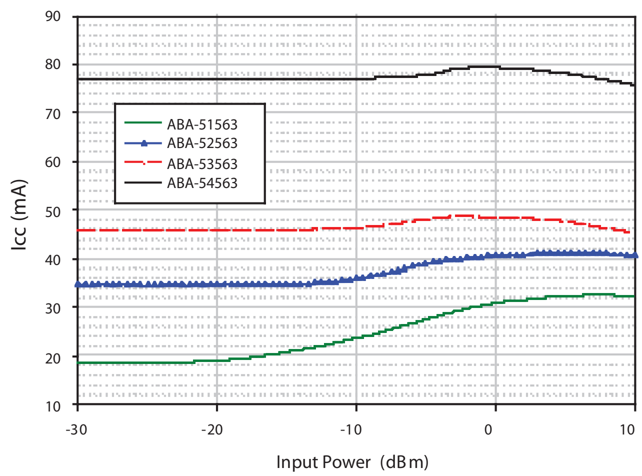

Figure 8b. ABA-5X563 Icc versus input power at 500 MHz.

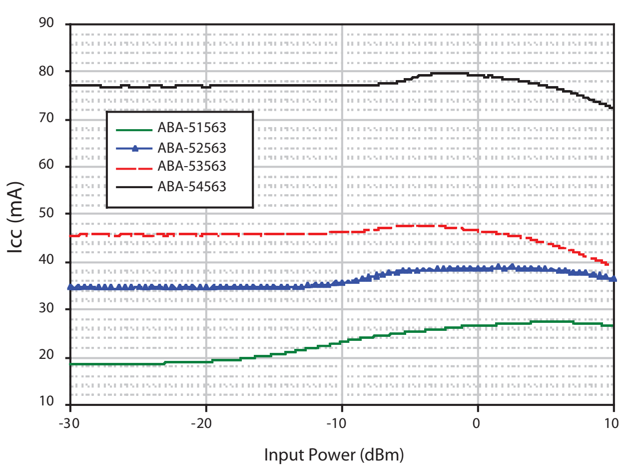

Figure 8c. ABA-5X563 Icc versus input power at 1 GHz.

6. Second harmonic versus frequency

When the amplifier is operating at a higher input power, the second harmonic performance becomes important. Using an input power of 0 dBm, the second harmonic was investigated across frequency. Use of a low pass filter (LPF) as shown in Figure 1 will eliminate the potential harmonic problem in the full design application.

Conclusion

Results show that all four ABA-5X563 devices display good performance under saturation conditions and are well suited for LO buffering applications. Higher reverse isolation can be achieved by cascading two or more ABA-5X563 devices appropriately.

References

[1] "LO Buffer Applications using Avago Technologies' ABA-5X563 Silicon Amplifiers." Avago Technologies' Application Note 5095.

Table 7. Second harmonic of ABA-5X563 at input power of 0 dBm.

Frequency	ABA-51563	ABA-52563	ABA-53563	ABA-54563
100 MHz	10 dBc	36 dBc	40 dBc	20 dBc
500 MHz	5 dBc	14 dBc	22 dBc	18 dBc
1 GHz	5 dBc	10 dBc	14 dBc	30 dBc

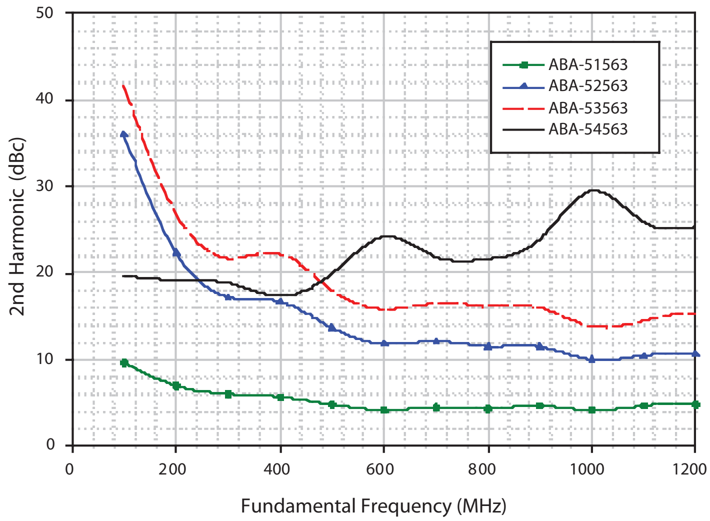

Figure 9. ABA-5X563 second harmonic versus frequency.

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