Performance evaluation of four RF fiber optic transmitters and receivers

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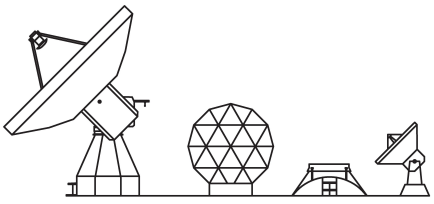


1 Introduction

The aim of this report is to show the performance evaluation of four RF optic fiber transmitters (serial numbers, 27696, 27697, 27698 and 27699) and four RF optic fiber receivers (serial numbers, 27684, 27685, 27686 and 27687) in order to check the proper operation comparing the obtained results with those given by the manufacturer (see Apendix A for more detail). The objective of these devices is to convert the RF signal into an optic one in order to reduce the transmission losses at this frequencies and also to increase the transmission speed.

The work frequency range for the RF signals goes between 0.5 GHz up to 18 GHz. The optic fiber transmits in the second window at 1310 nm.

Firstly, the measurement setup will be described together with the instrumentation required for this purpose. Finally several graphs will show different measured parameters, S11, S12, S21 (Gain) and noise figure. All of them measured for the four combinations between transmitters and receivers (TX sn 27696 vs. RX sn 27684, TX sn 27697 vs. RX sn 27685, TX sn 27698 vs. RX sn 27686, TX sn 276999 vs. RX sn 27687).

2 Measurement setup

The instrumentation used consists of the following elements:

- 10 MHz - 67 GHz PNA network analyzer from Keysight, model N5277A.
- 3 Hz - 50 GHz PXA signal analyzer from Keysight, model N9030A.
- Low loss SMA coaxial cable.
- Fiber optic cable.
- Four 500 MHz-18GHz, 1300 nm RF fiber optic transmitters from Microwave Photonic, model MP-6000TX-18G-13-001.
- Four 500 MHz-18GHz, 1300 nm RF fiber optic receiver from Microwave Photonic, model MP-6000TX-18G-001.
- Noise source from Keysight, model 346CK01.

Optical transmitter serial number 27696 is shown in Figure 1 , and optical receiver module (including serial numbers 27686 and 27687) is shown in Figure 2.

The first measurement setup is shown in Figure 3 where the port 1 of the PNA network analyzer is connected at the RF input of the transmitter, its optic output is connected at the input optic of the receiver by fiber and the RF output of the receiver does to the port 2 of the vector network analyzer. With this configuration S11, S12 and S21 parameters were obtained for the frequency range between 0.5-20 GHz.

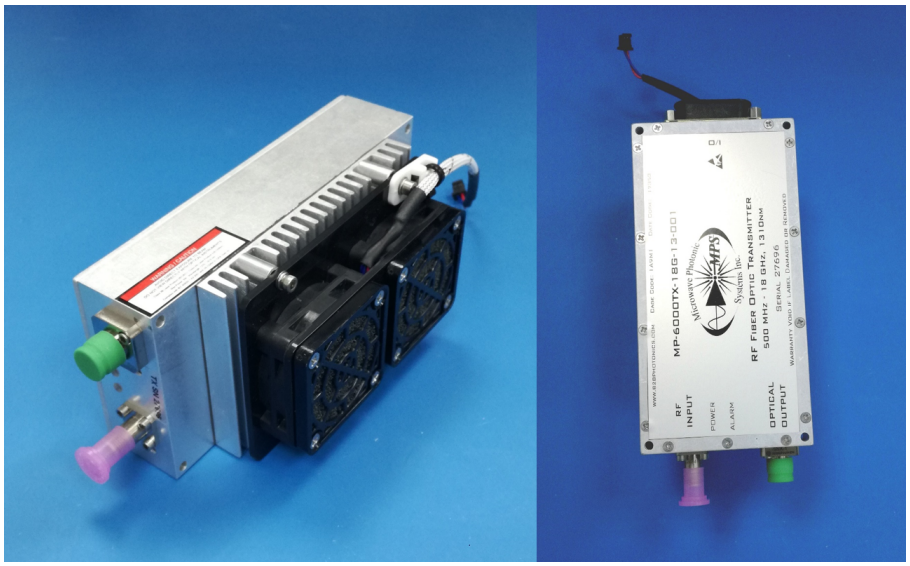


Figure 1: Optical transmitter sn 27696.

For the next configuration (Figure 4) a noise source is needed in order to measure the noise figure. This device has to be calibrated at first, and then it is connected at the RF input of the optic transmitter. The RF output of the optic receiver is connected to the RF analyzer. Optic transmitter and receiver are connected together by optic fiber (as in the previous configuration).

3 Results

In this section several graphs (Figures 5-8) show the previously mention parameters.

Figure 2: Optical receivers sn 27686 and 27687.

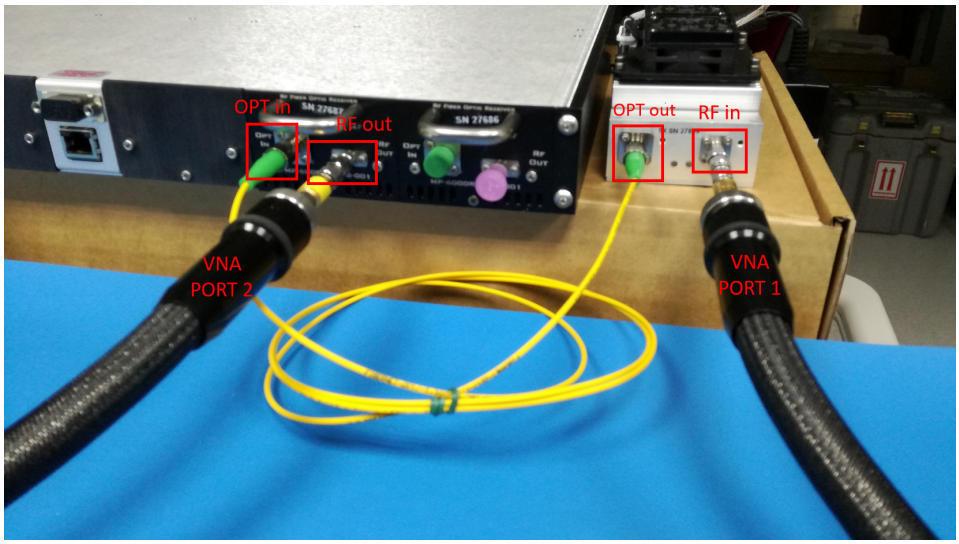


Figure 3: First measurement setup with the vector network analyzer.

Figure 4: Noise figure measurement setup.

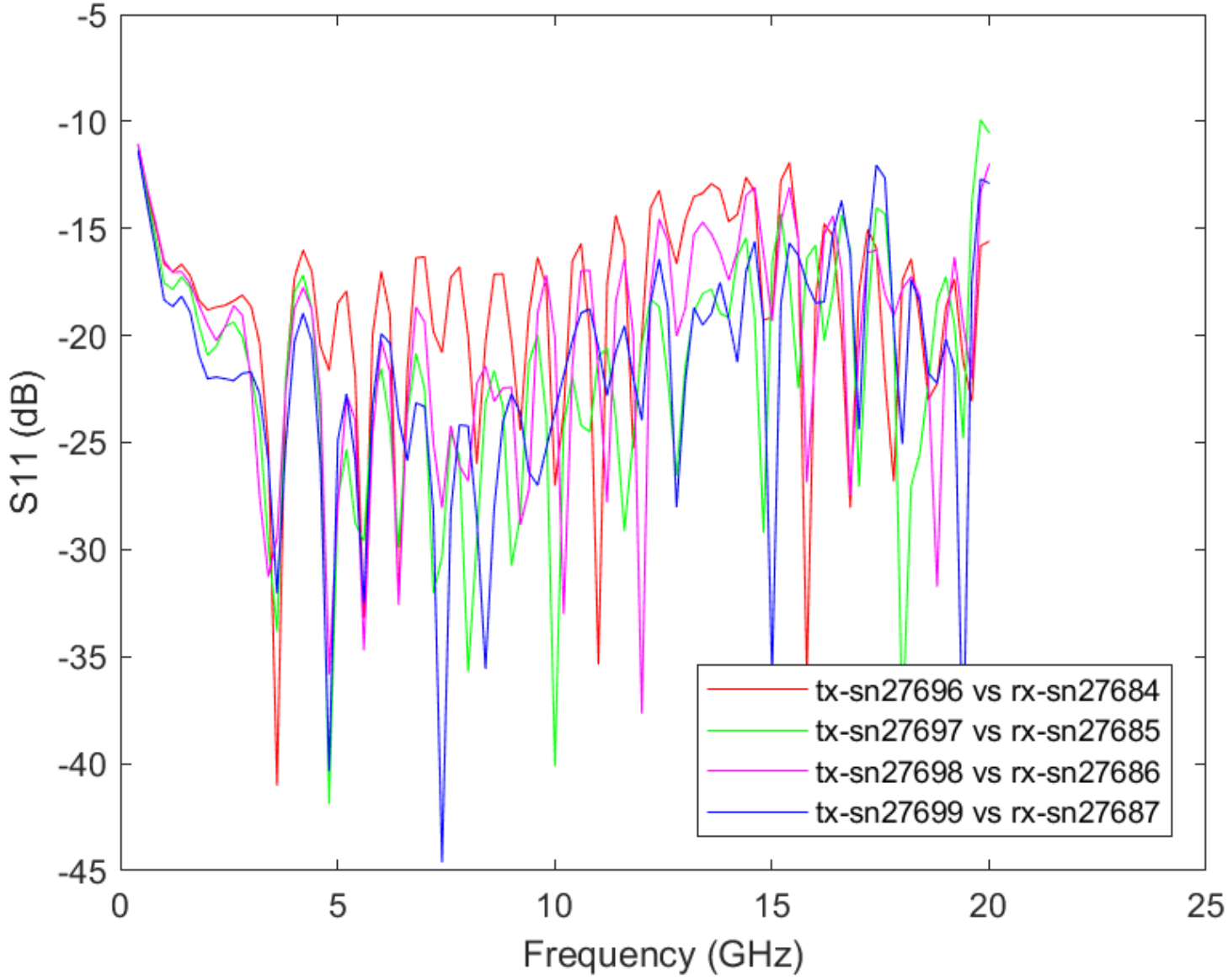


Figure 5: S11 measured in frequency range 0.5-20 GHz for the four different combinations between transmitters and receivers.

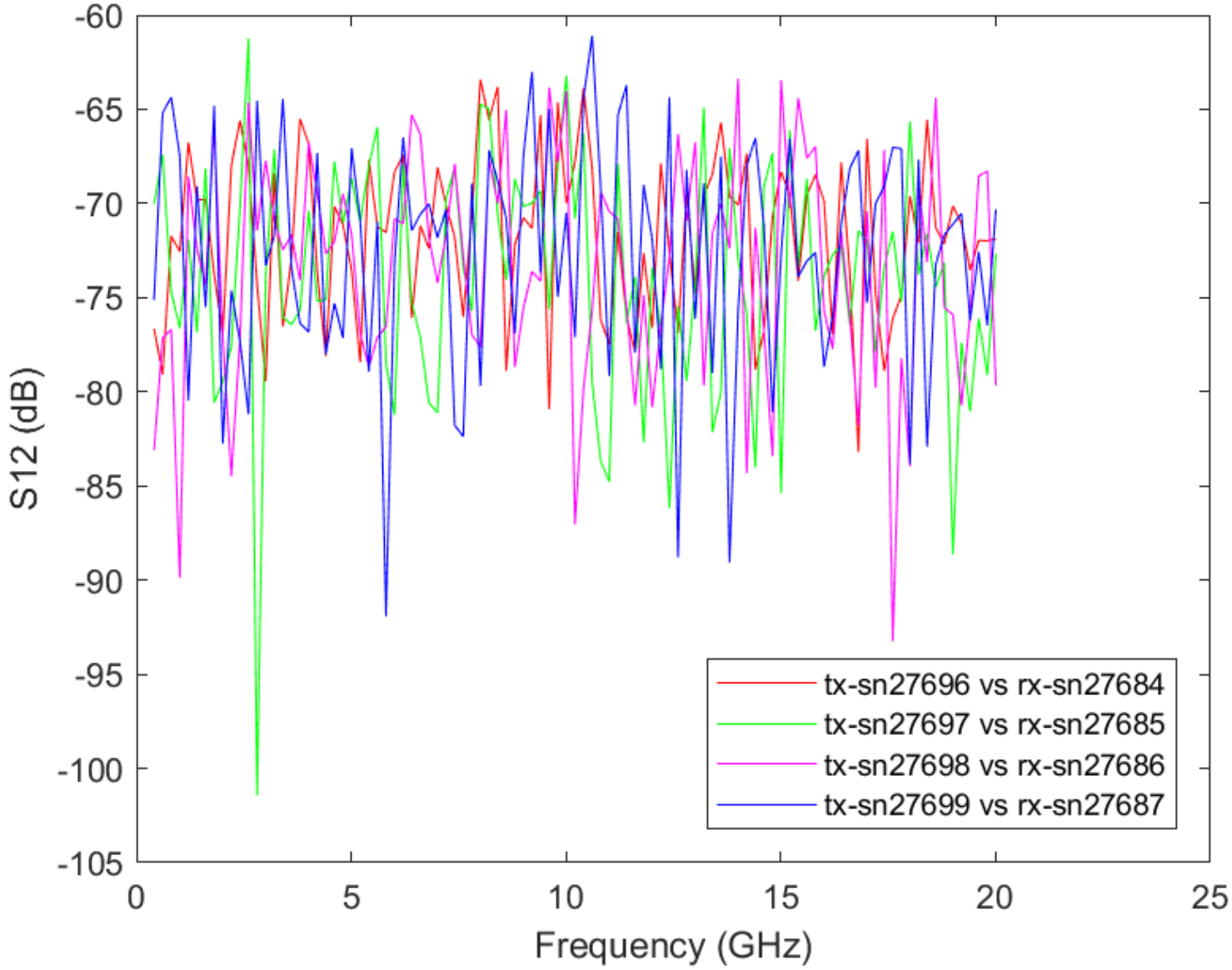


Figure 6: S12 measured in frequency range 0.5-20 GHz for the four different combinations between transmitters and receivers.

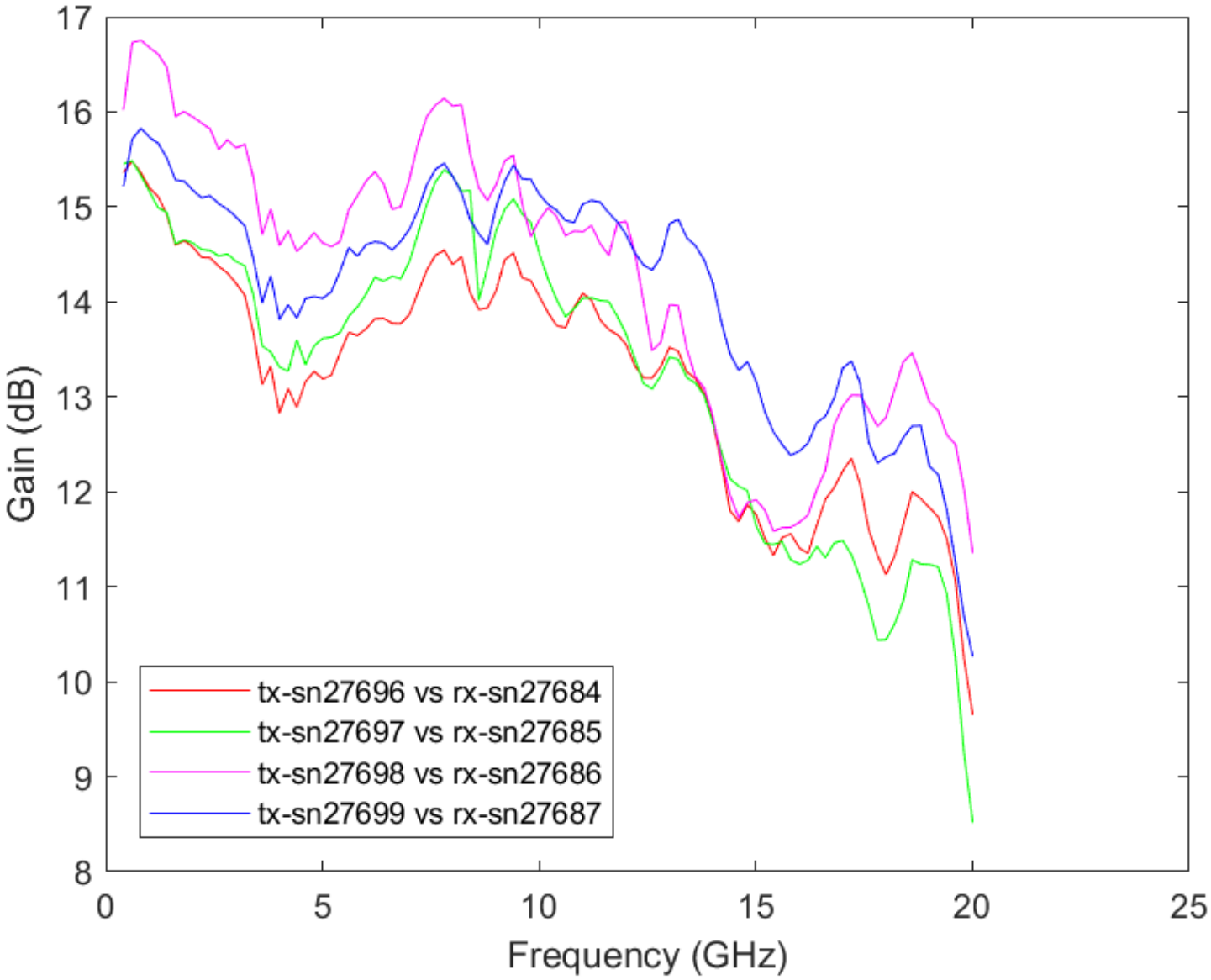


Figure 7: Gain (S21) measured in frequency range 0.5-20 GHz for the four different combinations between transmitters and receivers.

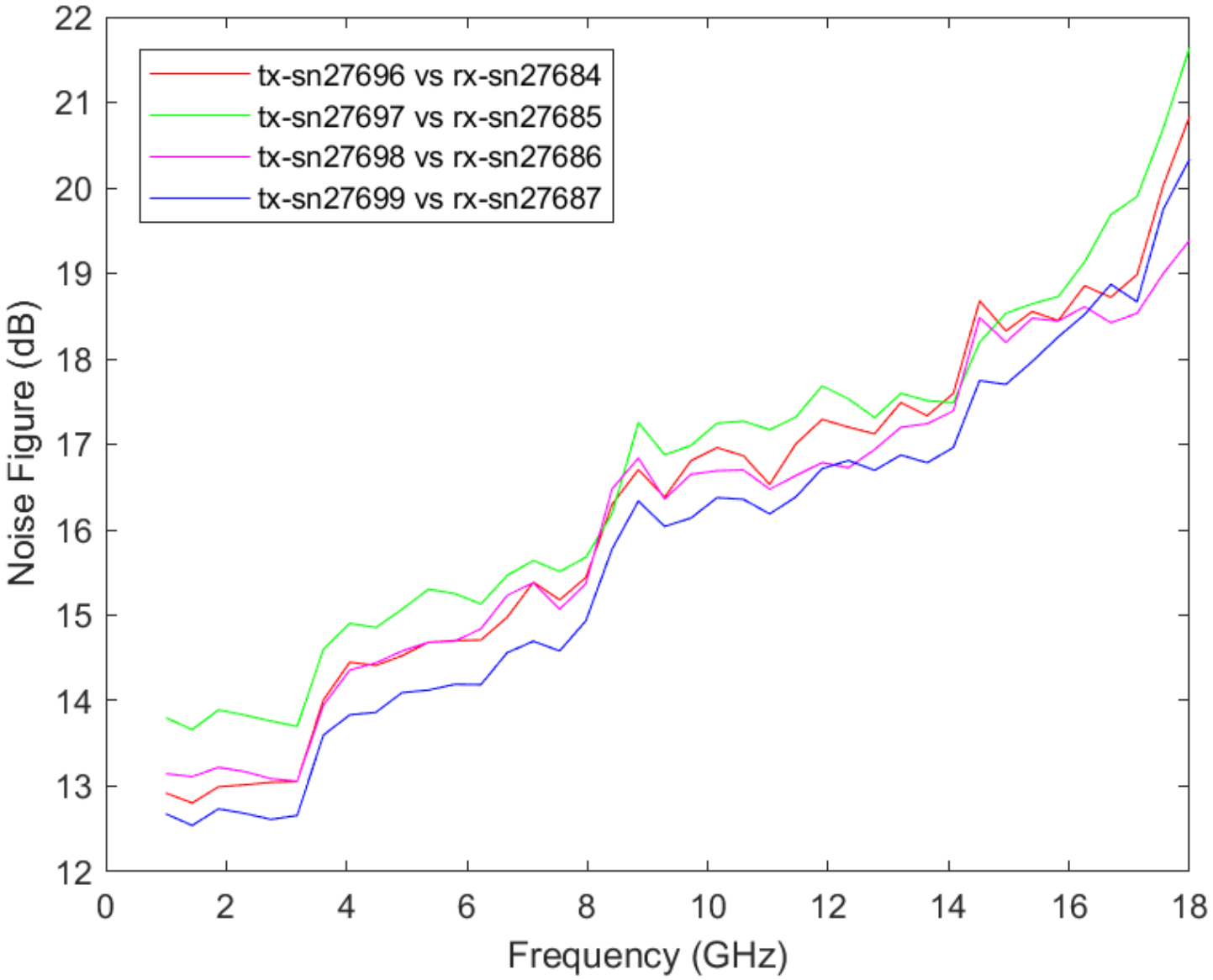


Figure 8: Noise figure measured in frequency range 1-18 GHz for the four different combinations between transmitters and receivers.

4 More fibre devices measurements

On January 2019, the same performance was carried out with two more transmitter and receivers. The serial number for the transmitter are 32422 and 32423, and 32424, 32425 for the receivers. the pair of tx-rx for the test was 32422-32424 and 32423-32425. S-parameters and noise figure was analyzed, and the results are shown in graphs [9-14].

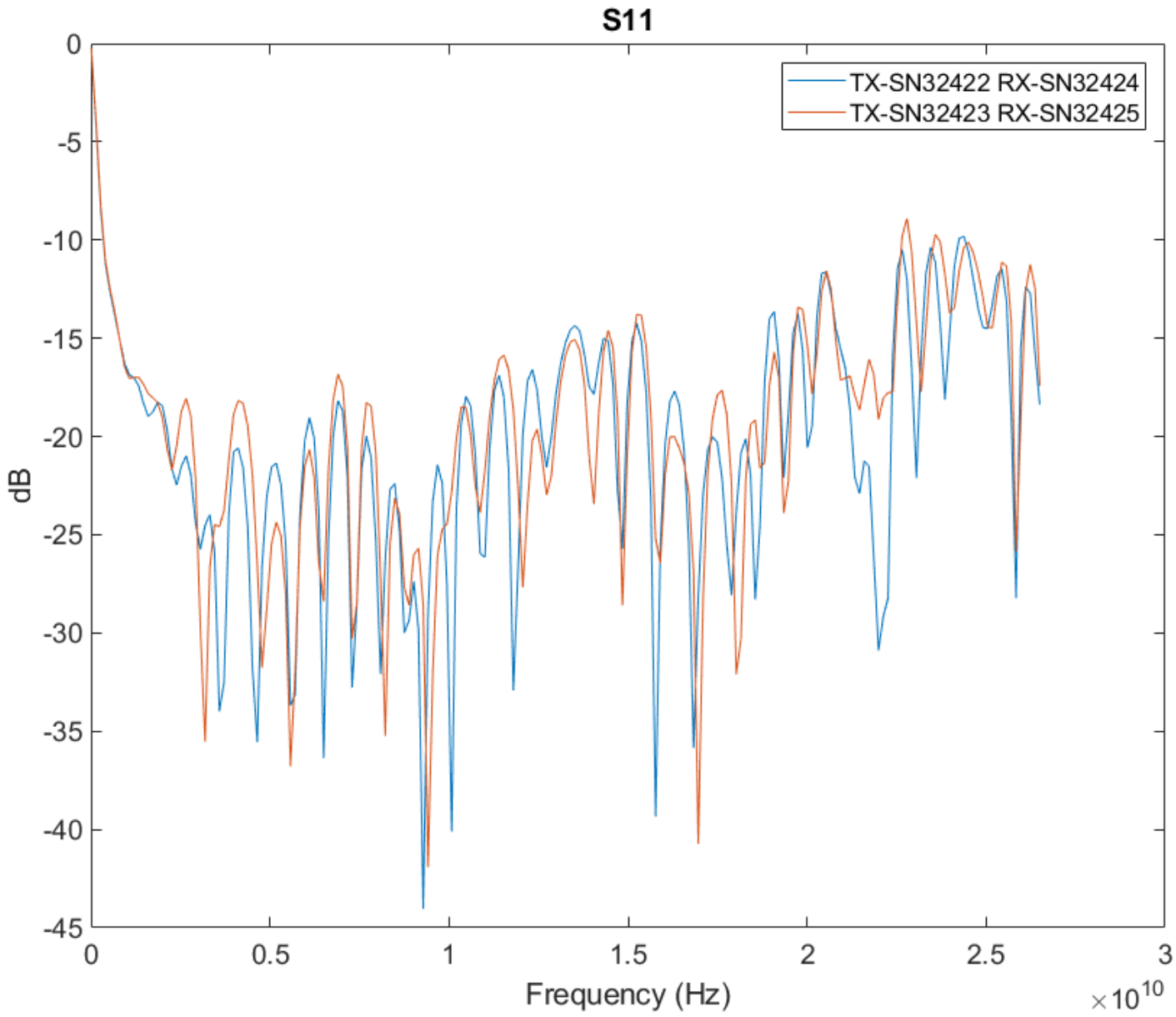


Figure 9: S11 parameter.

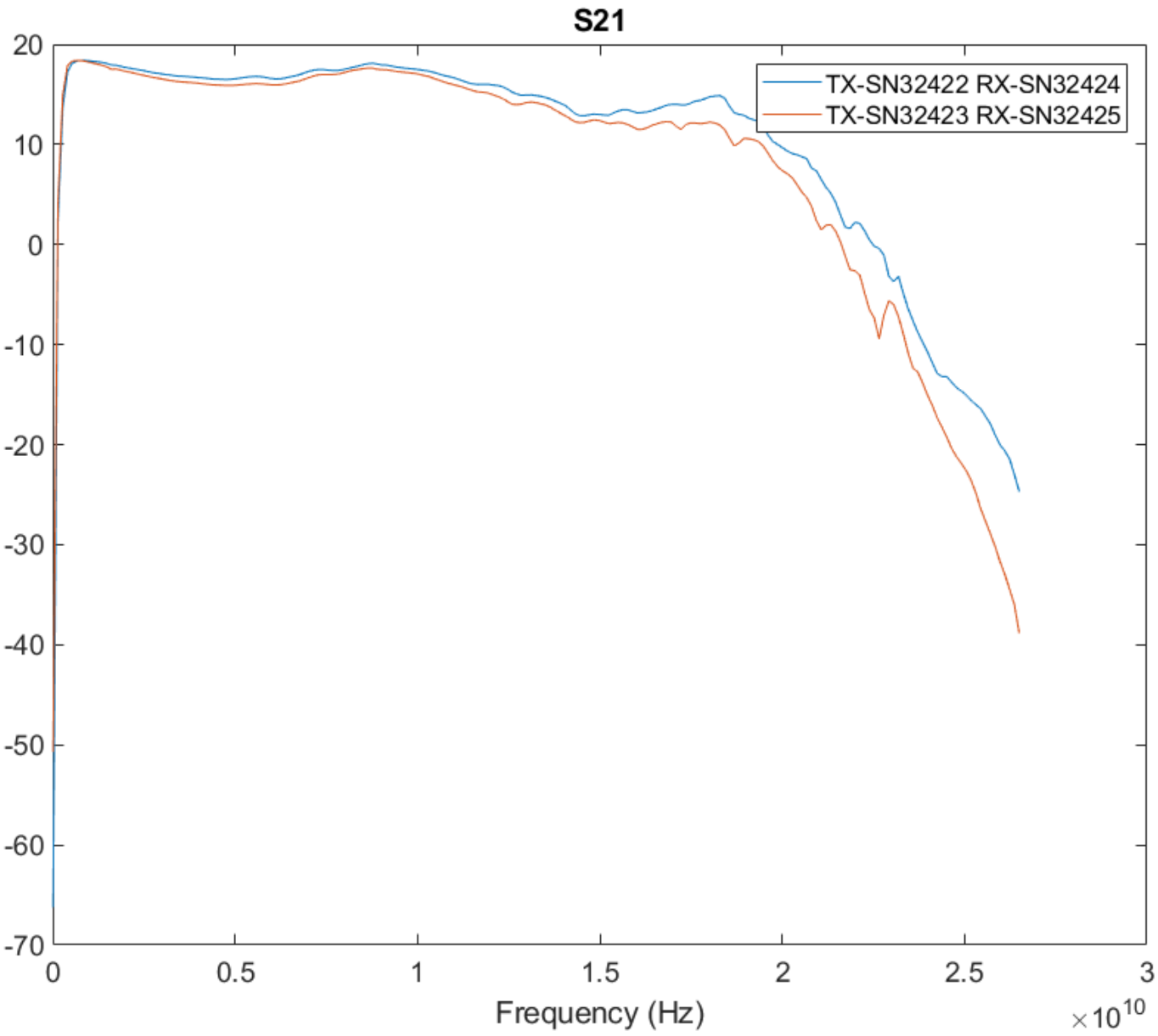


Figure 10: S21 parameter.

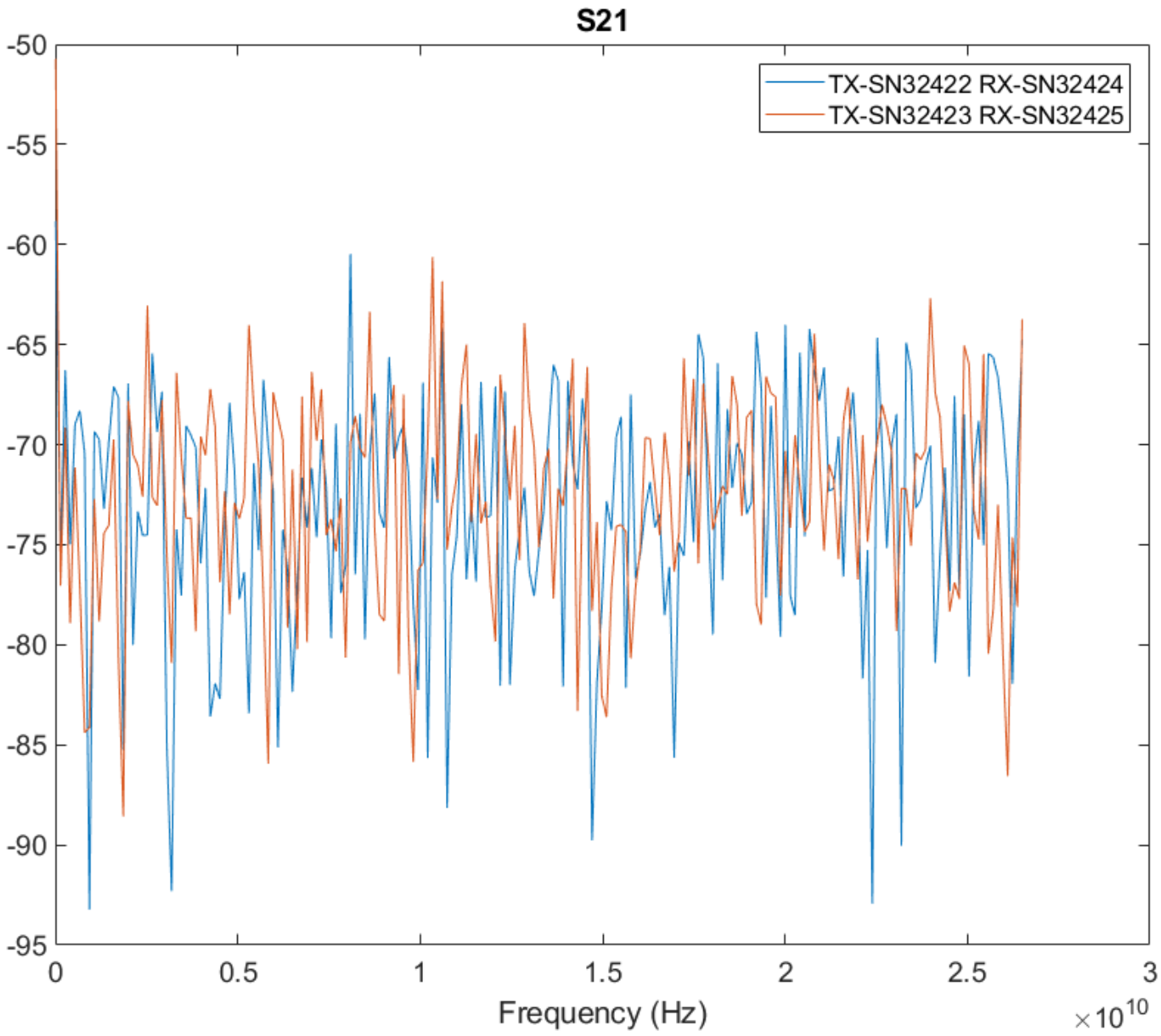


Figure 11: S12 parameter.

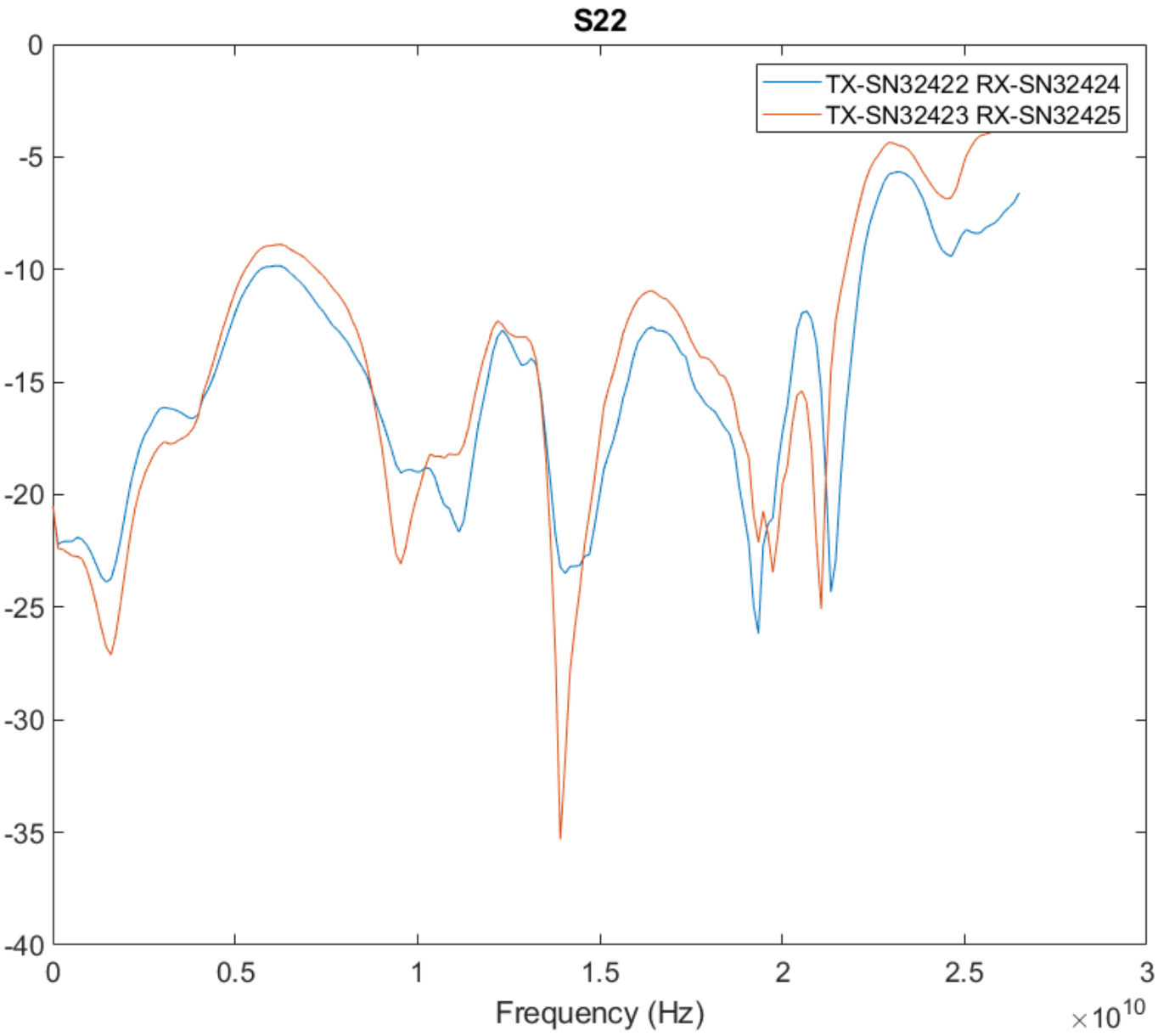


Figure 12: S22 parameter.

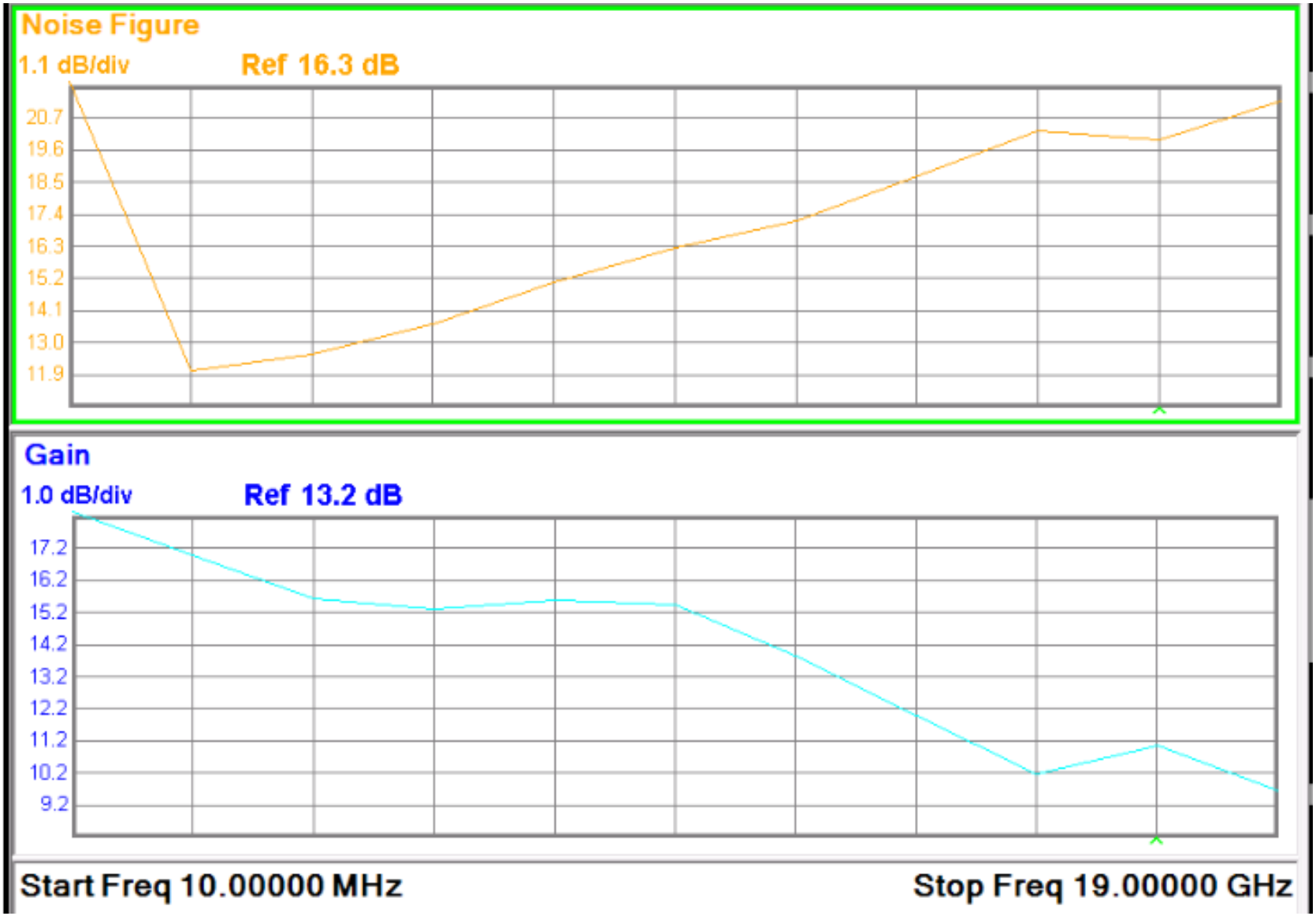


Figure 13: Noise figure for TX-SN23422 RX-SN23424.

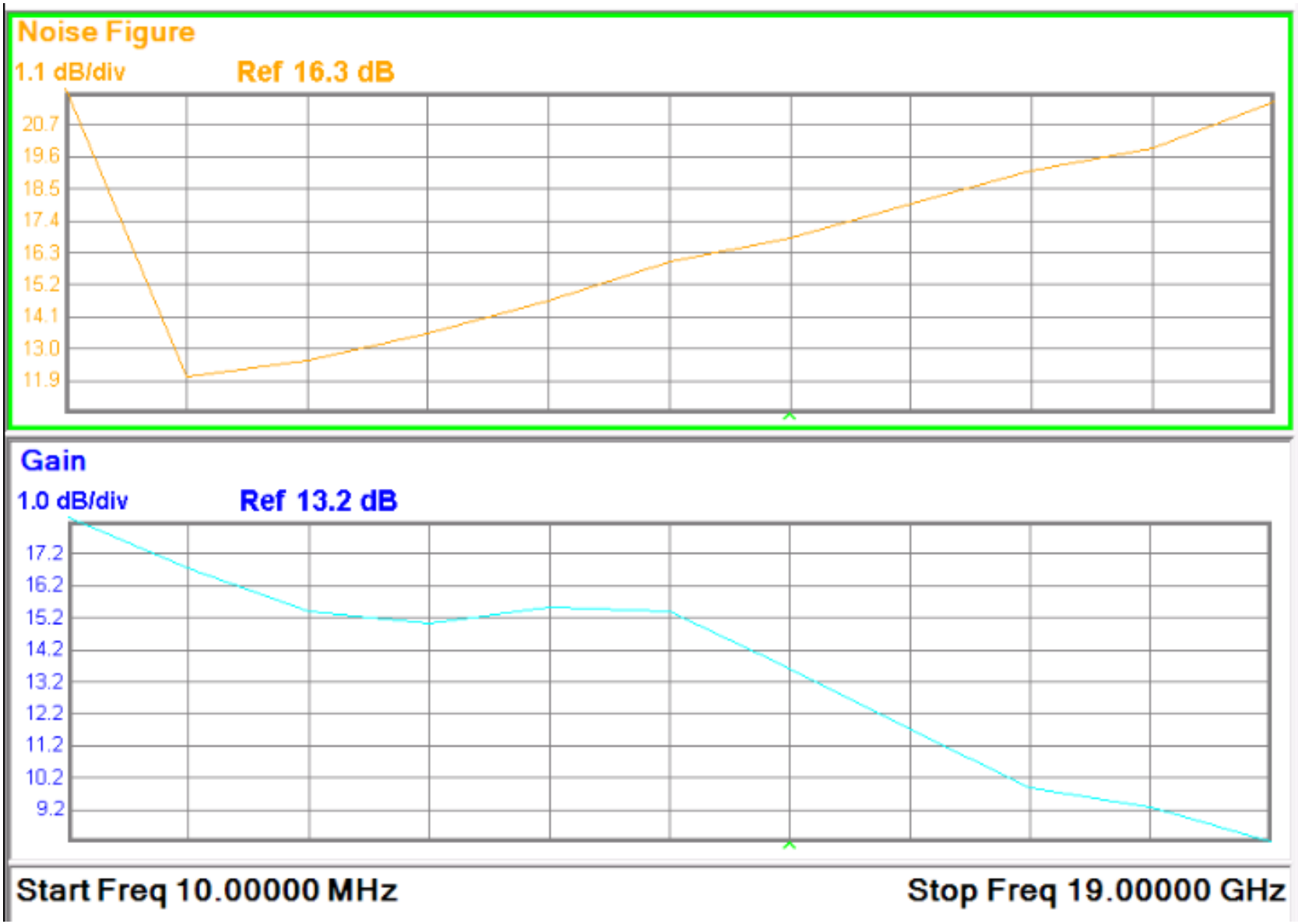
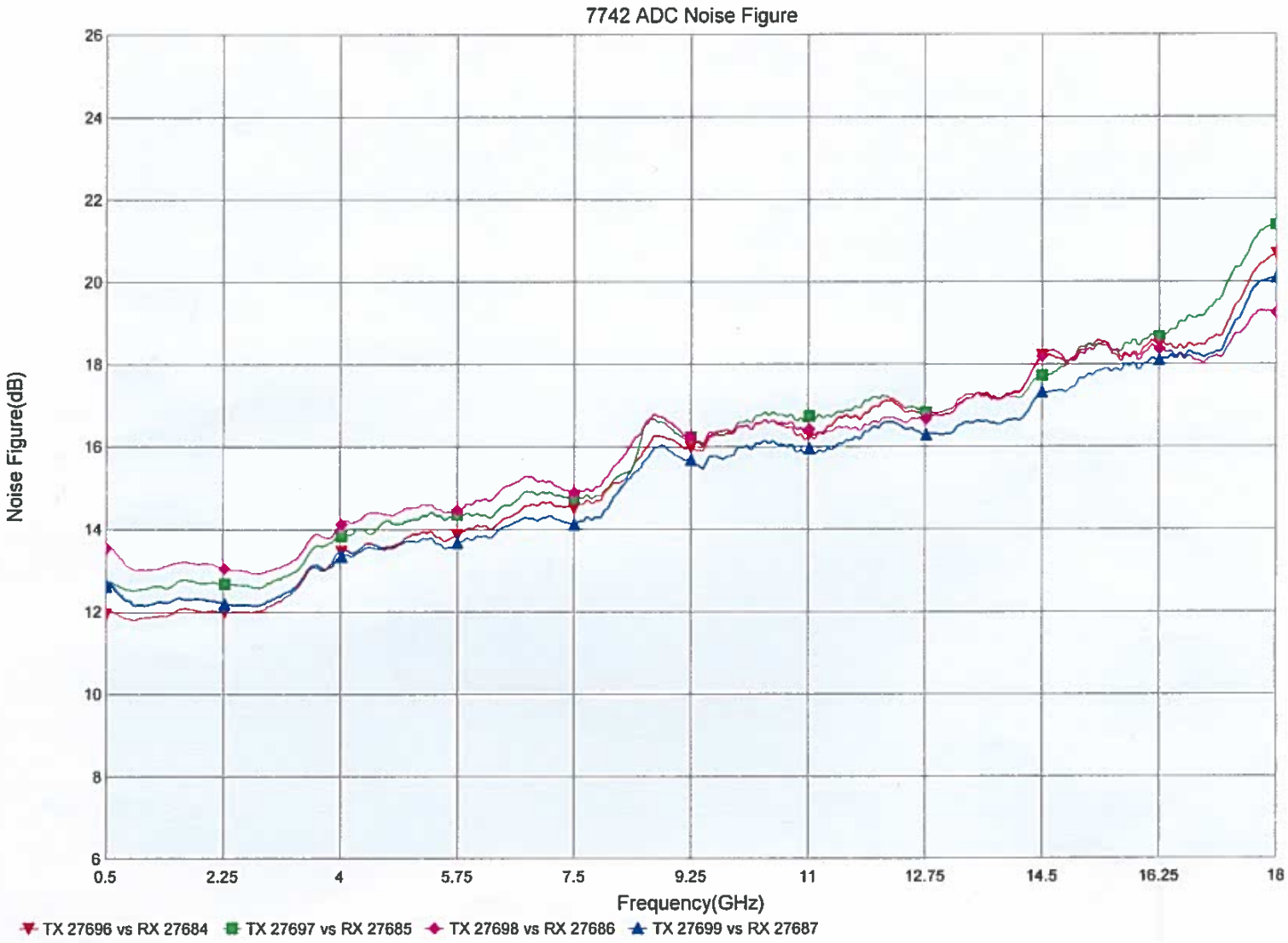


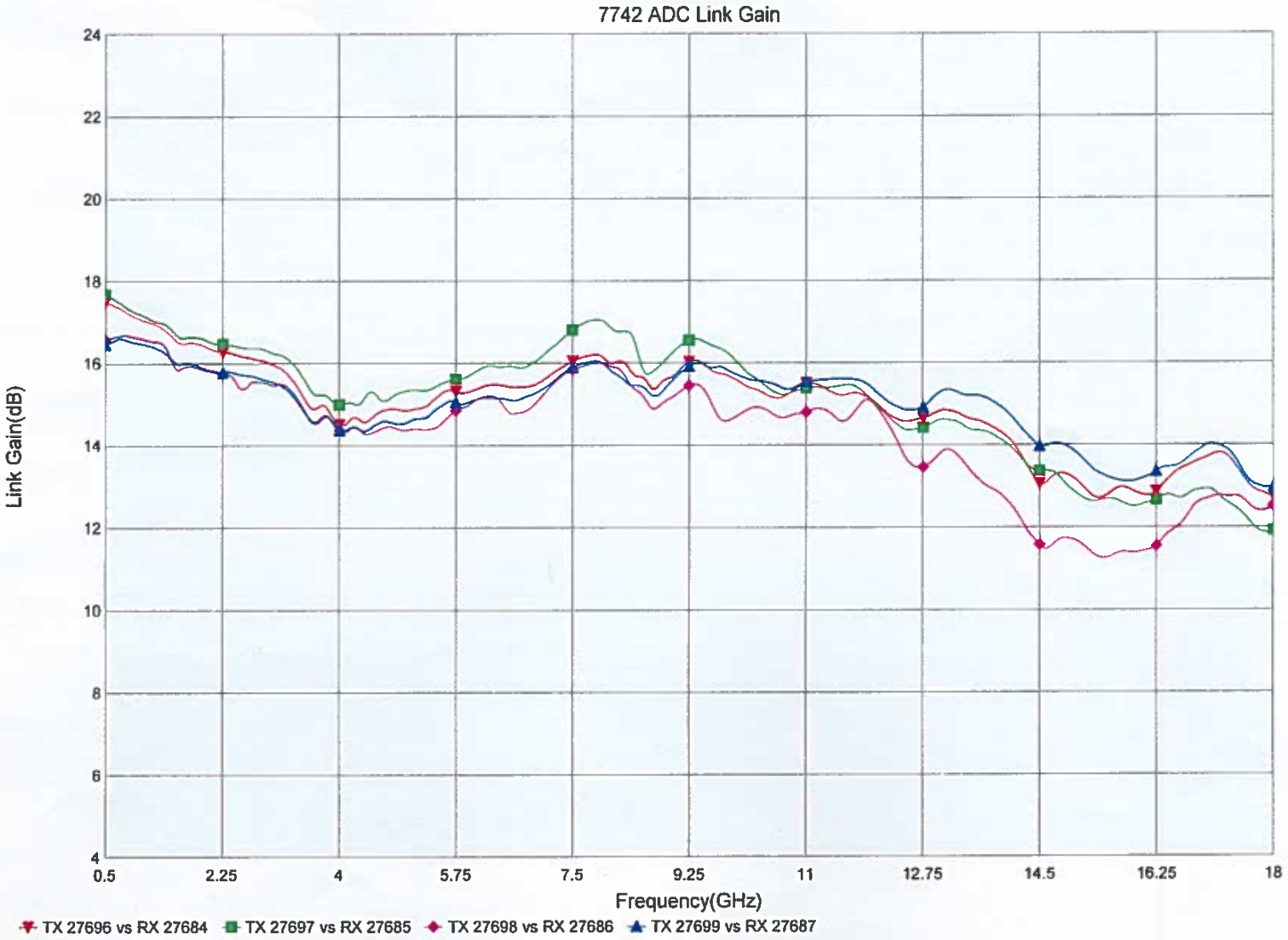
Figure 14: Noise figure for TX-SN23423 RX-SN23425.

5 Conclusion

The measurements are pretty similar to those ones given by the manufacturer.

A Manufacture's measurements of gain and noise figure


7742 ADC Noise Figure
Noise Figure(dB)
26
24
22
20
18
16
14
12
10
8
6
0.5
2.25
4
5.75
7.5
9.25
11
12.75
14.5
16.25
18
Frequency(GHz)
TX 27696 vs RX 27684
TX 27697 vs RX 27685
TX 27698 vs RX 27686
TX 27699 vs RX 27687


7742 ADC Link Gain
Link Gain(dB)
24
22
20
18
16
14
12
10
8
6
4
0.5
2.25
4
5.75
7.5
9.25
11
12.75
14.5
16.25
18
Frequency(GHz)
TX 27696 vs RX 27684
TX 27697 vs RX 27685
TX 27698 vs RX 27686
TX 27699 vs RX 27687