# Characterization and measurements of S parameters of FPA VGOS-MATERA and VGOS BSCU MATERA.

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# Contents

# 1 Introduction

This report aims to collect all the information related with all the necessary components of the FPA VGOS-MATERA and VGOS BSCU MATERA projects in order to get to know how the components in the following projects behave.

They have been measured with the vector analyzer, measuring the S parameters and explaining what it actually means. The vector analyzer has to be calibrated before measuring, thus the measured components are analyzed in the correct frequencies in order to know the components behaviour and assuming that they have been made correctly.

# 2 Block diagram and Components to be measured

FPA VGOS-MATERA is the Filter and Pre-amplifier Unit and follows the next block diagram: Figure 1. This FPA is placed in a rack with the following characteristics: Rack 2U 19" 340mm + top + base Schroff: 20860-606; and is mounted in a rack with the next characteristics: Mounting Plate 270mm Schroff: 20860-109. The power supply is the next one: Power Supply PSK-112 Schroff (12V/1.1A).

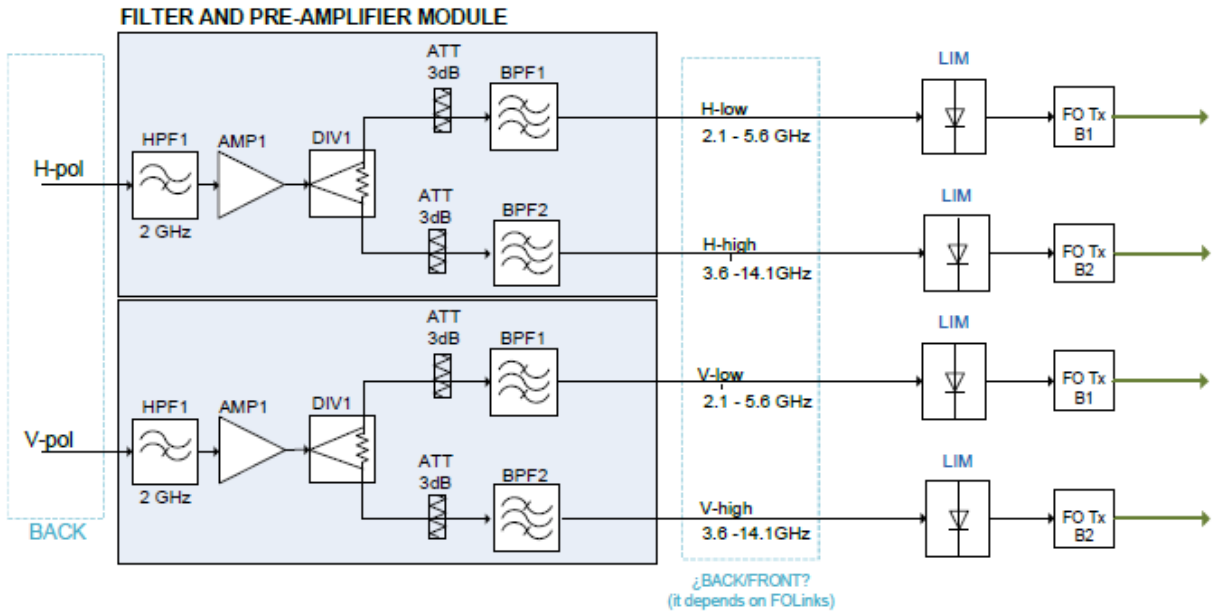



Figure 1: FPA BLOCK DIAGRAM.

FPA VGOS-MATERA components will be listed:

- HPF1: Chengdu E-Microwave EMHF-T-020-60S (HPF 2.1-14.1 GHz).

- AMP1: Chengdu E-Microwave EMLA-20160-2621 (Low Noise Amplifier (+26dB)).
- BPF1: Chengdu E-Microwave EMFT-T-BP-2100-5600 (BPF 2.1-5.6 GHz).
- BPF2: Chengdu E-Microwave EMFT-T-BP-3600-14100 (BPF 3.6-14.1 GHz).
- LIM: Power Limiter Herotek LS2018.

VGOS BSCU MATERA is the Backend Signal Conditioning Unit and follows the next block diagram: Figure 2. This BSCU is placed in a rack with the following characteristics: Rack 2U 19" 340mm + top + base Schroff: 20860-606; and is mounted in a rack with the next characteristics: Mounting Plate 270mm Schroff: 20860-109. The power supply is the next one: Power Supply PSK-112 Schroff (12V/1.1A).

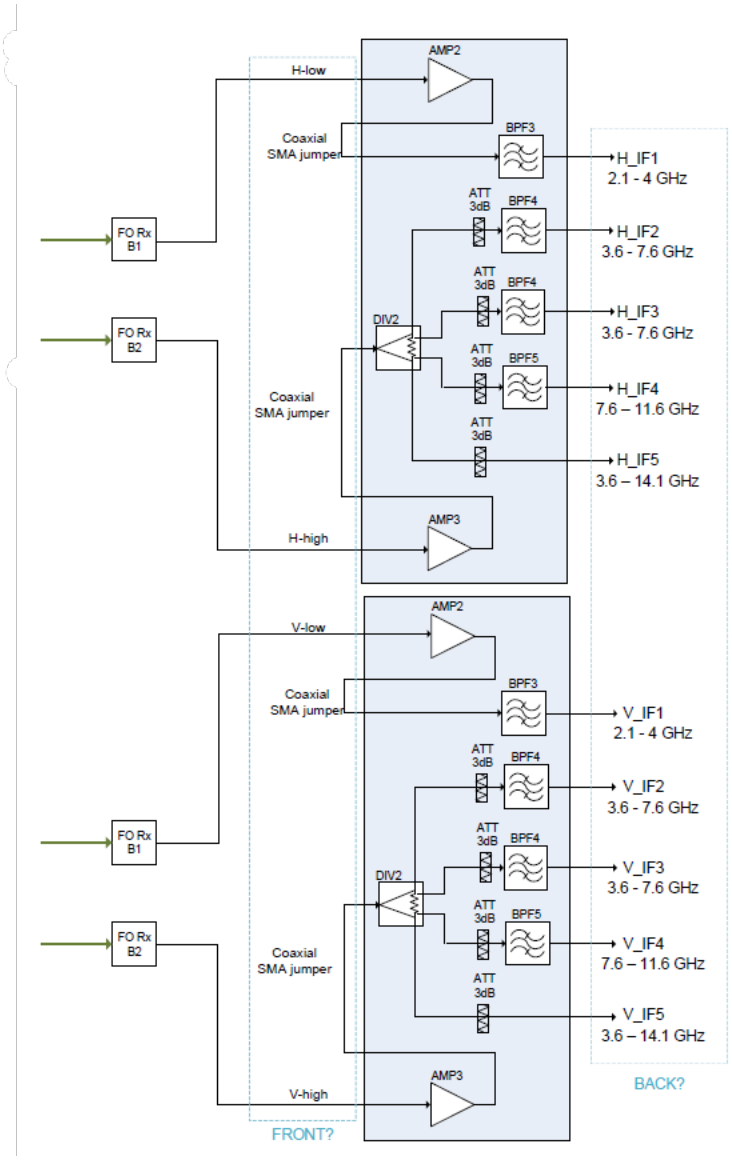



Figure 2: BSCU BLOCK DIAGRAM.

VGOS BSCU MATERA components will be listed:

- AMP2, AMP2: MiniCircuits ZVA-183-S+ (+26 dB).
- DIV2: ResponseMicrowave RMPD4.2-18.
- ATT3: MiniCircuits / BW-S3W2+, SMA (M,F).
- BPF3: Chengdu E-Microwave EMFT-T-BP-2100-4000 (BPF 2.1-4 GHz).
- BPF4: Chengdu E-Microwave EMFT-T-BP-3600-7600-1 (BPF 3.6-7.6 GHz).
- BPF5: Chengdu E-Microwave EMFT-T-BP-7600-11600 (BPF 7.6-11.6 GHz).

# 3 S Parameters

As it has been said before, the components have been measured with the vector analyzer in order to see the behaviour of each one. Therefore, the results will be commented and analyzed.

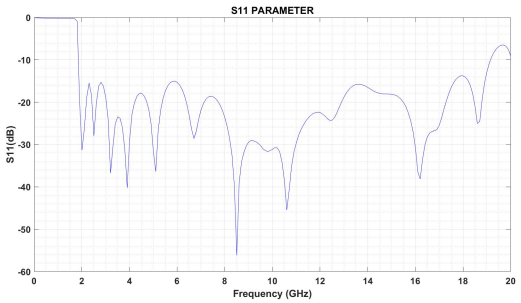
## 3.1 FPA VGOS-MATERA

### 3.1.1 High Pass Filter

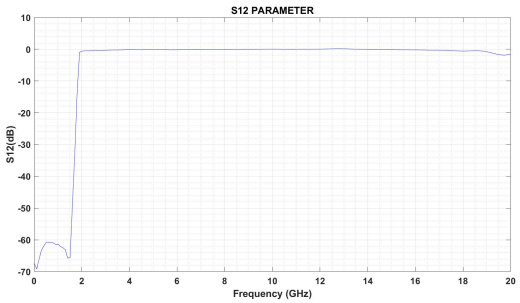
This component works as a high pass filter from 2 to 14.1 GHz. This are the S Parameters of the components. As we can see in Figure 3a, port one is completely matched between 2 and 14.1 GHz. The same happens with port two, that can be seen in Figure 3d. This filter is very selective from 2 GHZ as a high pass filter as we can see in Figure 3b and Figure 3c.

### 3.1.2 Low Noise Amplifier

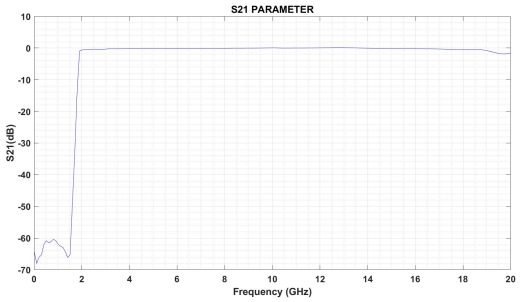
This component is a low noise amplifier which works between 2 and 16 GHz. It has 26 dB of gain with a noise figure of 3.5dB and a compression point at 1 dB that is 21 dBm. As we can see in Figure 4a, port one is completely matched between two and sixteen GHz. The same happens with port two, that can be seen in Figure 4d. As we can see in Figure 4b, port one does not amplify the power that comes from port two, whereas in Figure 4c we can see that the power inserted in port one is amplified with the correct gain.



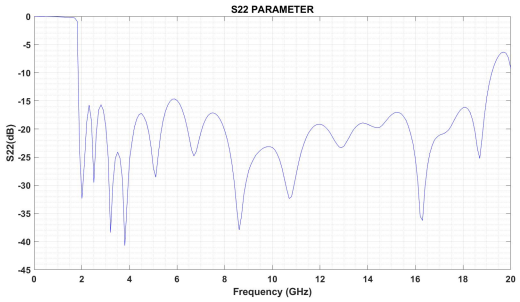

(a) S11 High Pass Filter.




(b) S12 High Pass Filter.

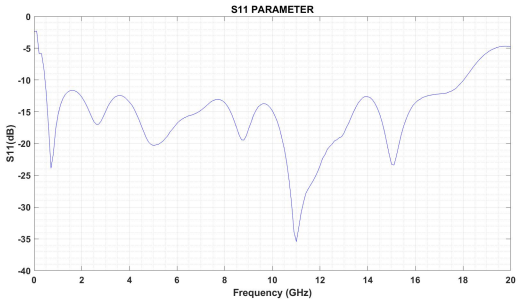



(c) S21 High Pass Filter.

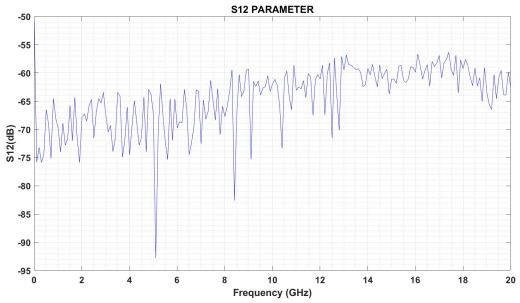



(d) S22 High Pass Filter.

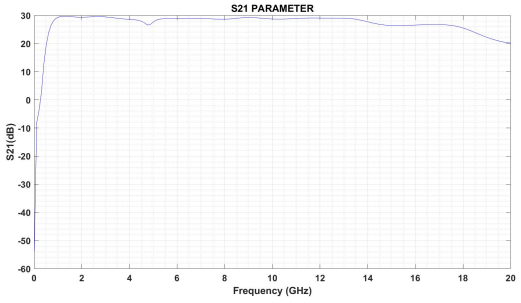
Figure 3: S Parameters High Pass Filter.



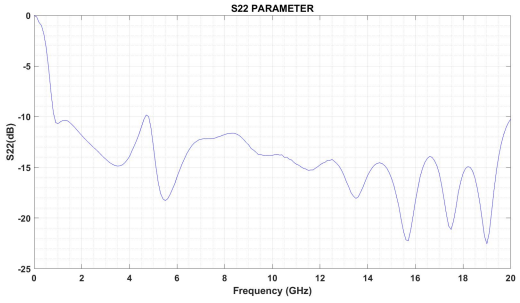

(a) S11 Low Noise Amplifier.




(b) S12 Low Noise Amplifier.




(c) S21 Low Noise Amplifier.

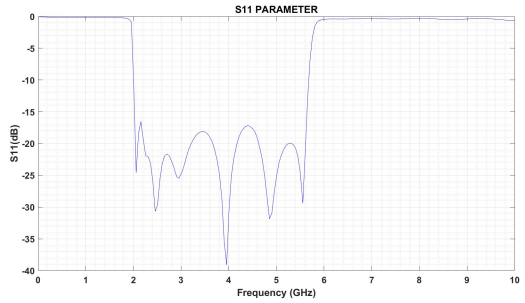



(d) S22 Low Noise Amplifier.

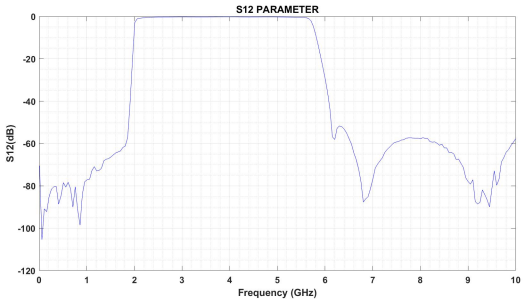
Figure 4: S Parameters Low Noise Amplifier.

### 3.1.3 2100-5600 MHz Band Pass Filter

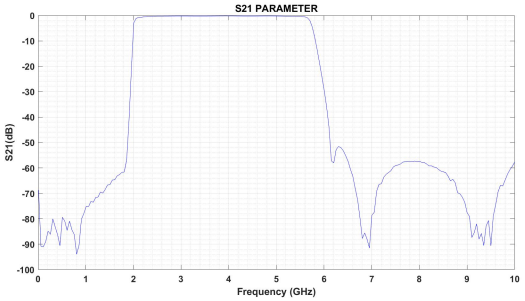
This component works as a band pass filter between 2100 and 5600 MHz. This are the S Parameters of the components. As we can see in Figure 5a, port one is completely matched between the frequencies filtered. The same happens with port two, that can be seen in Figure 5d. This filter works in the range between 2100 to 5600 MHz as we can see in Figure 5b and Figure 5c. It is very selective and the adaptation is remarkable.



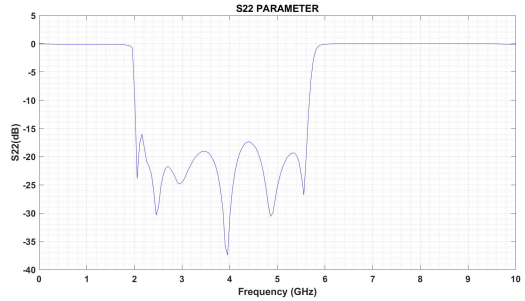

(a) S11 BPF (2100-5600 MHz).




(b) S12 BPF (2100-5600 MHz).




(c) S21 BPF (2100-5600 MHz).

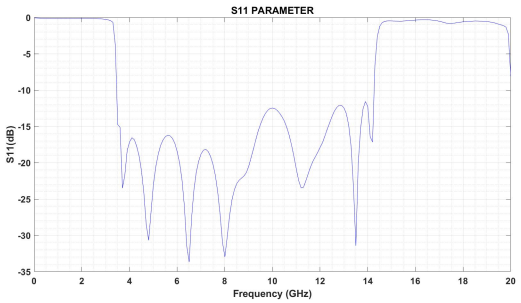



(d) S22 BPF (2100-5600 MHz).

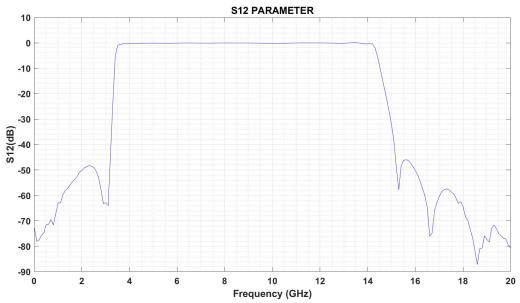
Figure 5: S Parameters BFP (2100-5600 MHz).

### 3.1.4 3600-14100 MHz Band Pass Filter

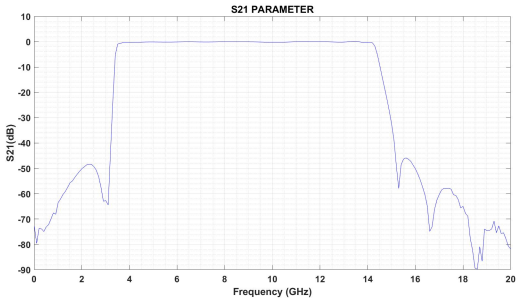
This component works as a band pass filter between 3600 and 14100 MHz. This are the S Parameters of the components. As we can see in Figure 6a, port one is completely matched between the frequencies filtered. The same happens with port two, that can be seen in Figure 6d. This filter works in the range between 3600 to 14100 MHz as we can see in Figure 6b and Figure 6c.



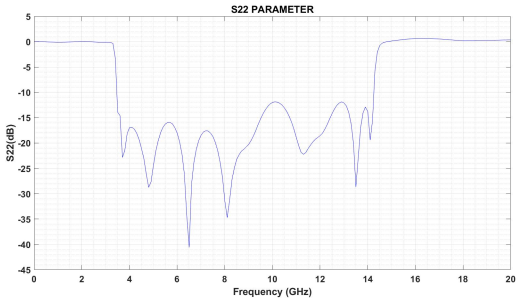

(a) S11 BPF (3600-14100 MHz).




(b) S12 BPF (3600-14100 MHz).




(c) S21 BPF (3600-14100 MHz).




(d) S22 BPF (3600-14100 MHz).

Figure 6: S Parameters BFP (3600-14100 MHz).

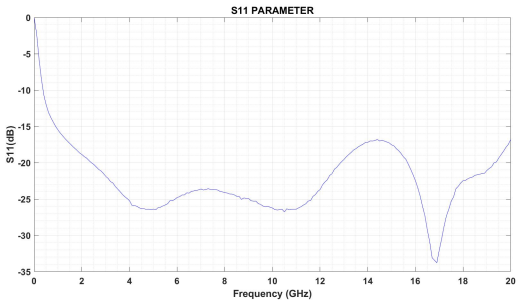
## 3.2 VGOS BSCU MATERA

### 3.2.1 Amplifiers

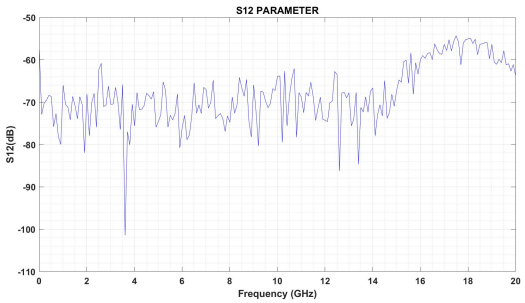
These amplifiers works in a similar way to the FPA amplifiers, having a 26 dB gain but the difference is that the compression point at 1 dB is 24 dBm rather than the 21 dBm that FPA ones had, and the noise figure is half dB lower (NF=3 dB) than FPA amplifiers (NF=3.5 dB) . These amplifiers work between 2 and 18 GHz. As we can see in Figure 7a, port one is completely matched between 2 and 18 GHz. The same happens with port two (Figure 47b). We can see in Figure 7b, port one does not amplify the power that comes from port two, whereas in Figure 7c we can see that the power inserted in port one is amplified with the correct gain.

### 3.2.2 2100-4000 MHz Band Pass Filter

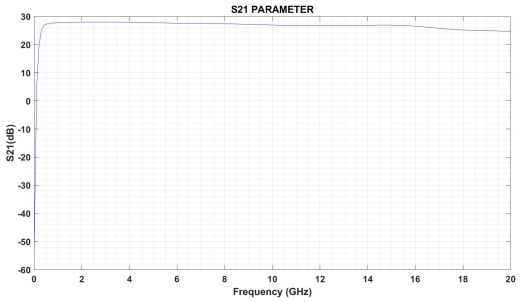
This component works as a band pass filter between 2100 and 4000 MHz. This are the S Parameters of the components. As we can see in Figure 8a, port one is completely matched between the frequencies filtered. The same happens with port two, that can be seen in Figure 8d. This filter works in the range between 2100 to 4000 MHz as we can see in Figure 8b and Figure 8c.



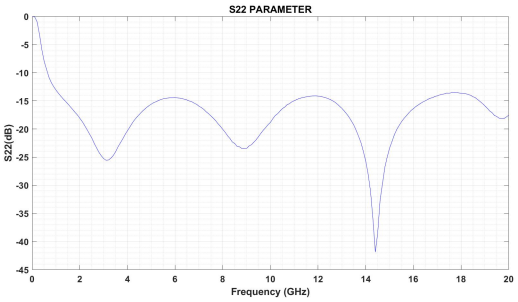

(a) S11 BSCU Amplifier.




(b) S12 BSCU Amplifiers.

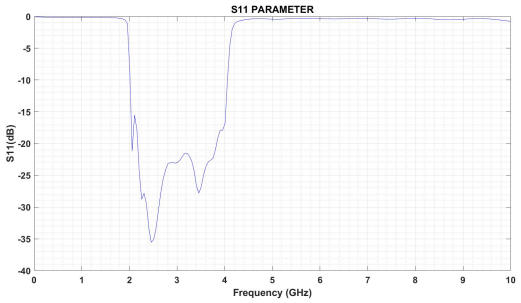



(c) S21 BSCU Amplifiers.

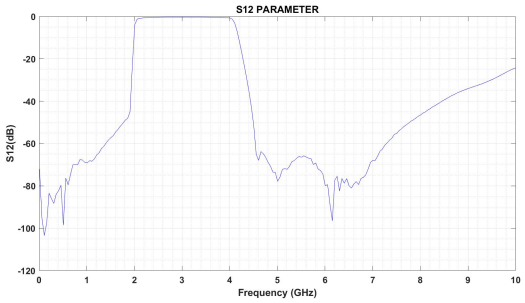



(d) S22 BSCU Amplifiers.

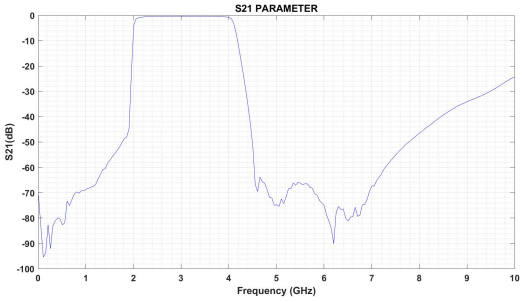
Figure 7: S Parameters BSCU Amplifiers.



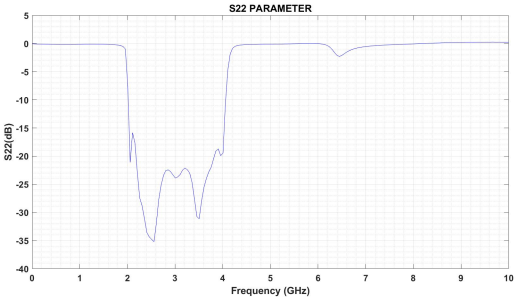

(a) S11 BPF (2100-4000 MHz).




(b) S12 BPF (2100-4000 MHz).




(c) S21 BPF (2100-4000 MHz).

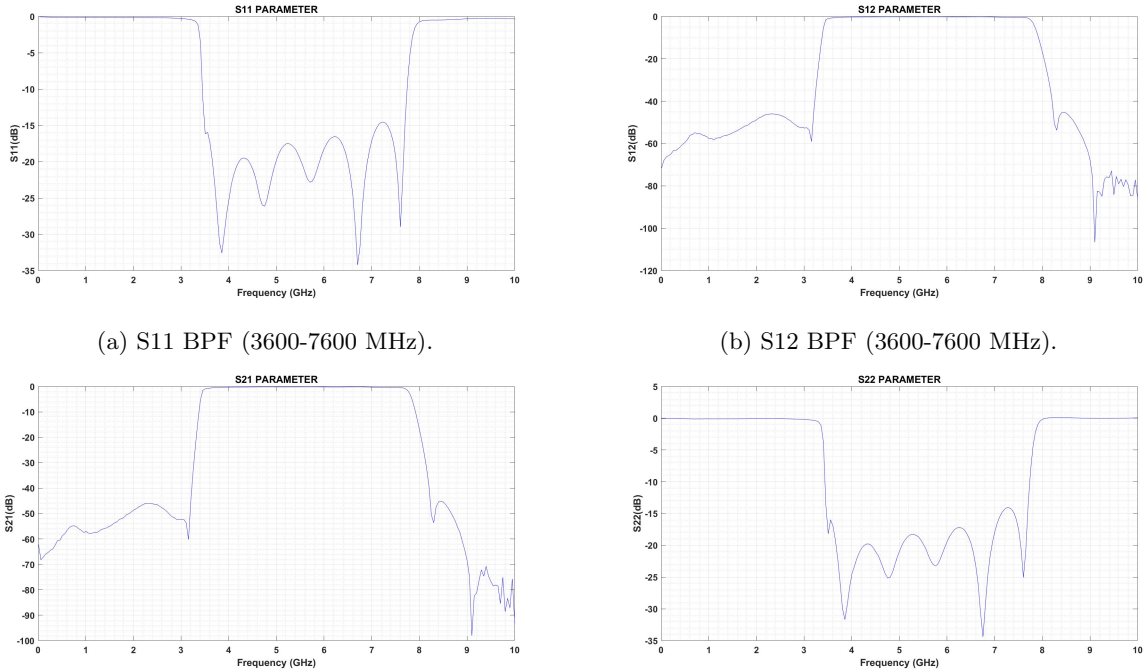



(d) S22 BPF (2100-4000 MHz).

Figure 8: S Parameters BFP (2100-4000 MHz).

### 3.2.3 3600-7600 MHz Band Pass Filter

This component works as a band pass filter between 3600 and 7600 MHz. This are the S Parameters of the components. As we can see in Figure 9a, port one is completely matched between the frequencies filtered. The same happens with port two, that can be seen in Figure 9d. This filter works in the range between 3600 to 7600 MHz as we can see in Figure 9b and Figure 6c. This filter is very selective.




(a) S11 BPF (3600-7600 MHz).

(b) S12 BPF (3600-7600 MHz).

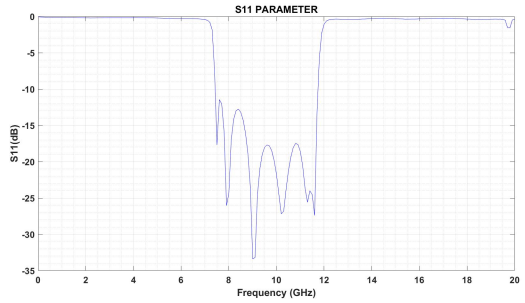
(c) S21 BPF (3600-7600 MHz).

(d) S22 BPF (3600-7600 MHz).

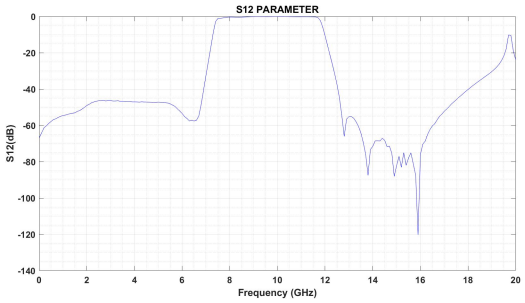
Figure 9: S Parameters BFP (3600-7600 MHz).

### 3.2.4 7600-11600 MHz Band Pass Filter

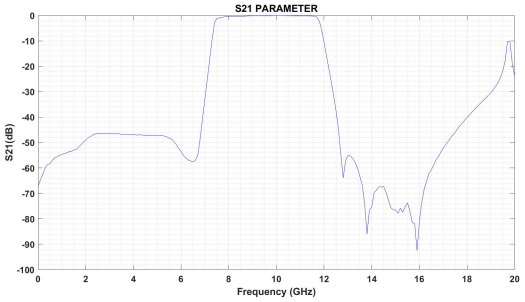
This component works as a band pass filter between 7600 and 11600 MHz. This are the S Parameters of the components. As we can see in Figure 10a, port one is completely matched between the frequencies filtered. The same happens with port two, that can be seen in Figure 10d. This filter works in the range between 7600 to 11600 MHz as we can see in Figure 10b and Figure 10c.



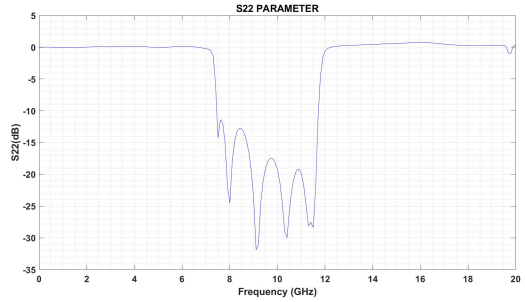

(a) S11 BPF (7600-11600 MHz).




(b) S12 BPF (7600-11600 MHz).




(c) S21 BPF (7600-11600 MHz).




(d) S22 BPF (7600-11600 MHz).

Figure 10: S Parameters BFP (7600-11600 MHz).