# Characterisation and Measurements of High Pass Filters and Notch Filters

S. de-la-Fuente, P. García

November 2024

Observatorio de Yebes
Apdo. 148, E-19080
Guadalajara, Spain


# Table of Contents



# List of Figures



# Acronyms

**HPF** High Pass Filter

**NF** Notch Filter

**SN** Serial Number

# 1 Introduction

This report aims to gather information on the characterisation of two Narrowband High Pass Filters and two Notch Filters.

The purpose of using these components is to obtain the output resulting from the combination of both types of devices, utilising components previously acquired by Yebes Observatory.

The components used in this report are as follows:

- **High Pass Filters (HPFs):** Passband from $3\,GHz$ up to $18\,GHz$.
- **Notch Filters (NFs):** Passband from $3.518\,GHz$ up to $3.8\,GHz$.

# 2 Notch Filters

The model of the Notch Filters used is `CNF03518M03800Q14A`, manufactured by Concept Microwave. Two filters have been used with the following Serial Numbers (SNs) `20240300564` and `20240300565`.

These devices have the following specifications:

- **Notch Band:** $3.518\,GHz$ - $3.8\,GHz$.
- **Passband:** $DC$ - $3.485\,GHz$ & $4\,GHz$ - $14\,GHz$.
- **Rejection:** $\geq 50\,dB$.

A picture of the device is shown in Figure 2.1, and the data sheet is provided in Appendix A.


**Figure 2.1:** Picture of a NF. SN: `20240300564`.

Figures 2.2 and 2.3 show the $S$-parameters of the NF with SNs `20240300564` and `20240300565`, respectively. As seen in Figure 2.2, measurements of the $S_{21}$ indicate that the $BW_{3\,dB}$ is about $300\,MHz$, ranging from $3.5\,GHz$ up to $3.8\,GHz$. Similar measurements are presented in Figure 2.3. Both filters exhibit an insertion loss of approximately $0.6\,dB$, measured at $3.2\,GHz$. As shown in both figures the rejection of both filters exceeds $50\,dB$.

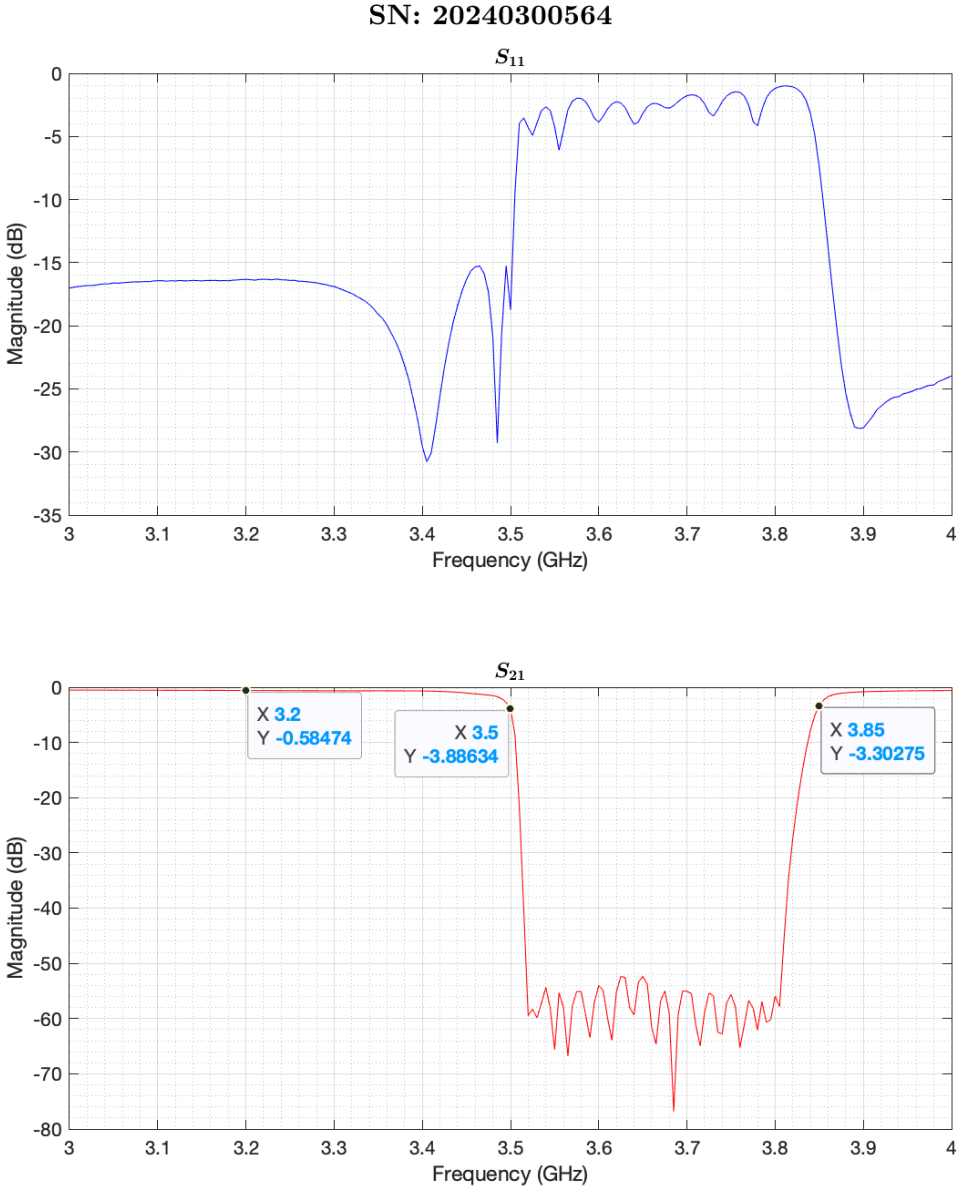



**Figure 2.2:** $S$-parameters of the NF. SN: 20240300564.

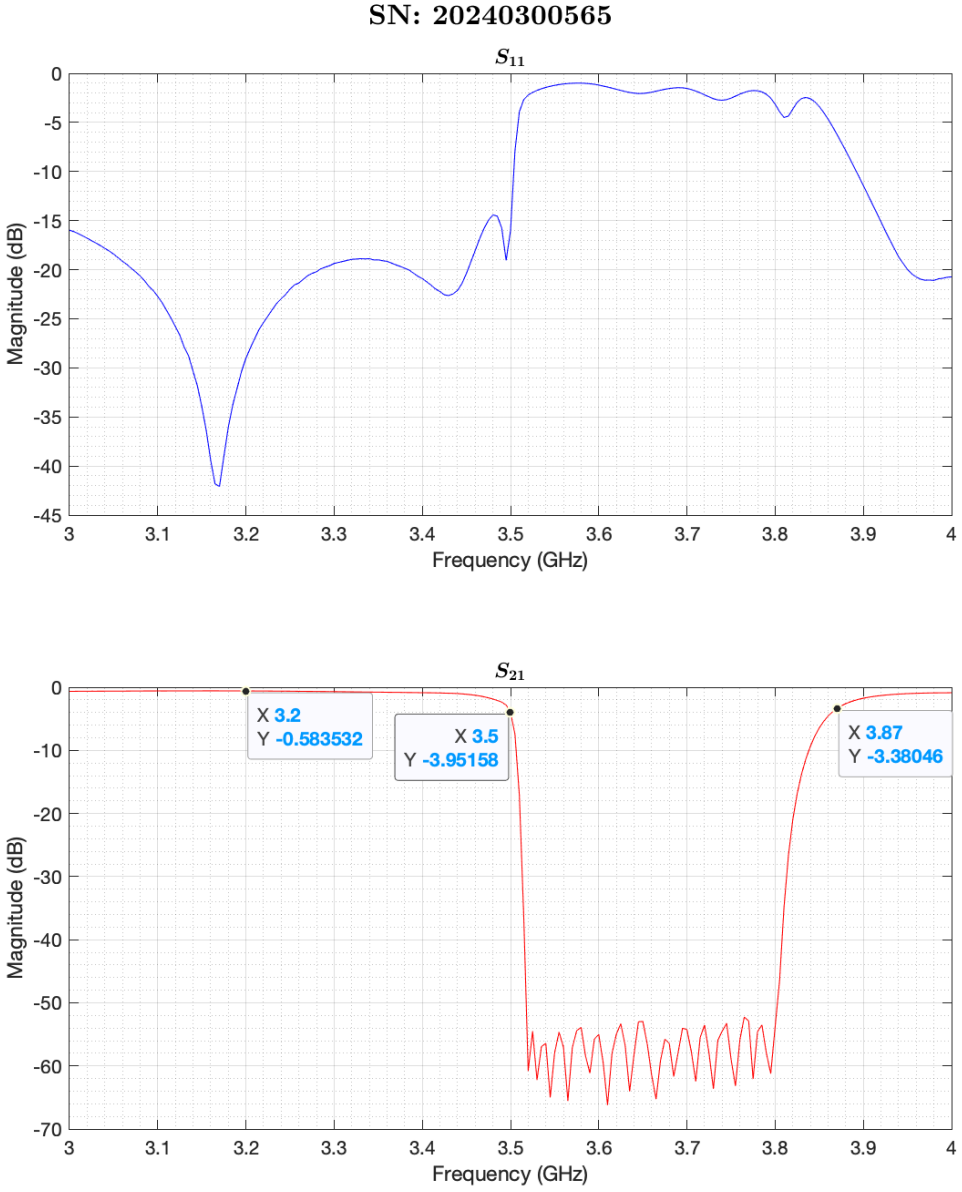



**Figure 2.3:** $S$-parameters of the NFs. SN: 20240300565.

# 3 High Pass Filters

The model of the High Pass Filters used is `NHPF0300.1800SM`, manufactured by NEOTech. Two filters have been used with SNs `21277001` and `21277002`.

These devices have the following specifications:

- **Passband:** $3\,GHz$ - $18\,GHz$.

A picture of the device is shown in Figure 3.1, and the data sheet is provided in Appendix B.


**Figure 3.1:** Picture of a HPF.

Figures 3.2 and 3.3 show the $S$-parameters of the HPF with SNs `21277001` and `21277002`, respectively. As seen in Figure 3.2, measurements of the $S_{21}$ indicate that the both filters exhibit an insertion loss of approximately $0.4\,dB$, measured at $5\,GHz$. The band pass begins just below $3\,GHz$, with insertion loss increasing near $11\,GHz$ up to $18\,GHz$, which marks the end of the passband. At $15\,GHz$, the insertion loss is about $0.9\,dB$.

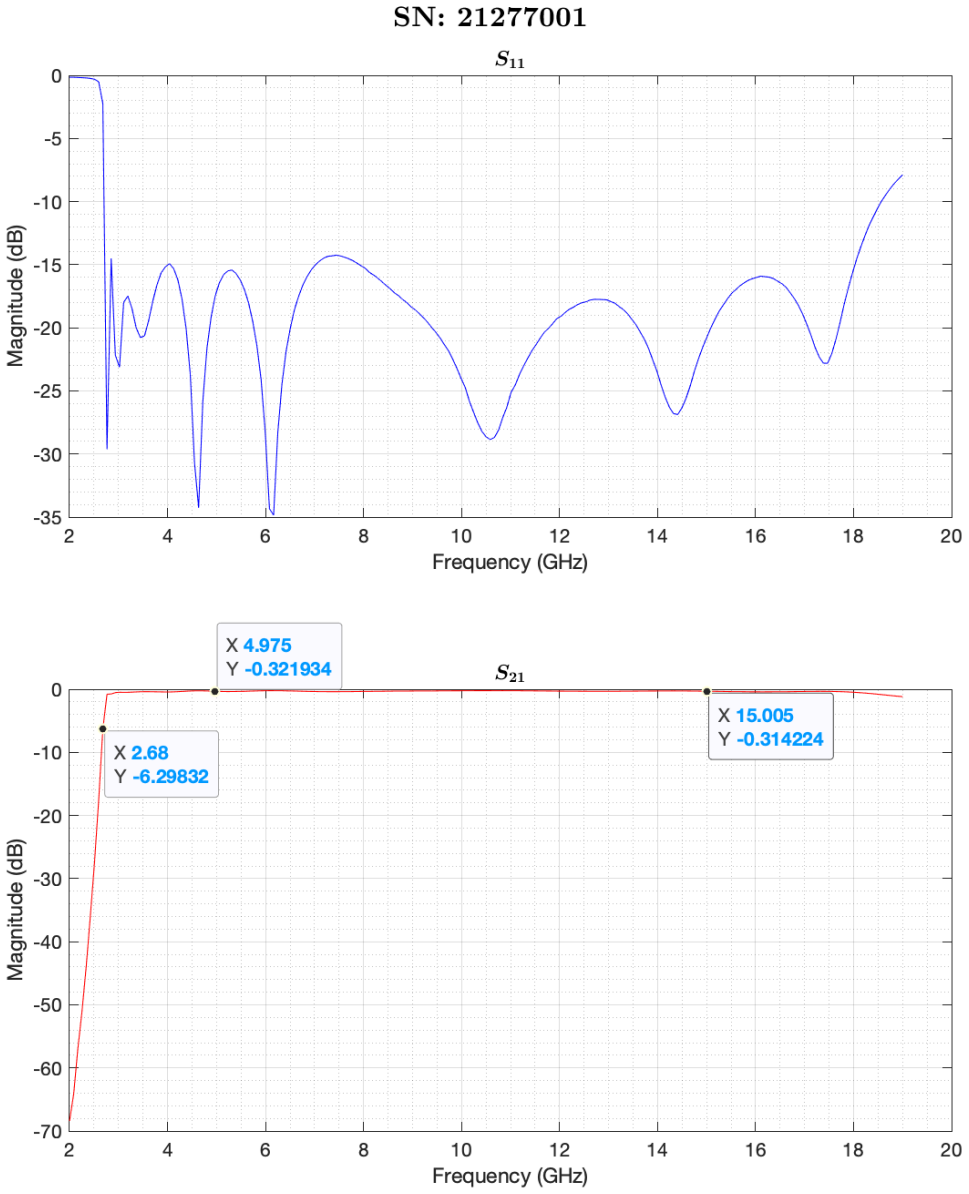



**Figure 3.2:** $S$-parameters of the HPFs. SN: 21277001.

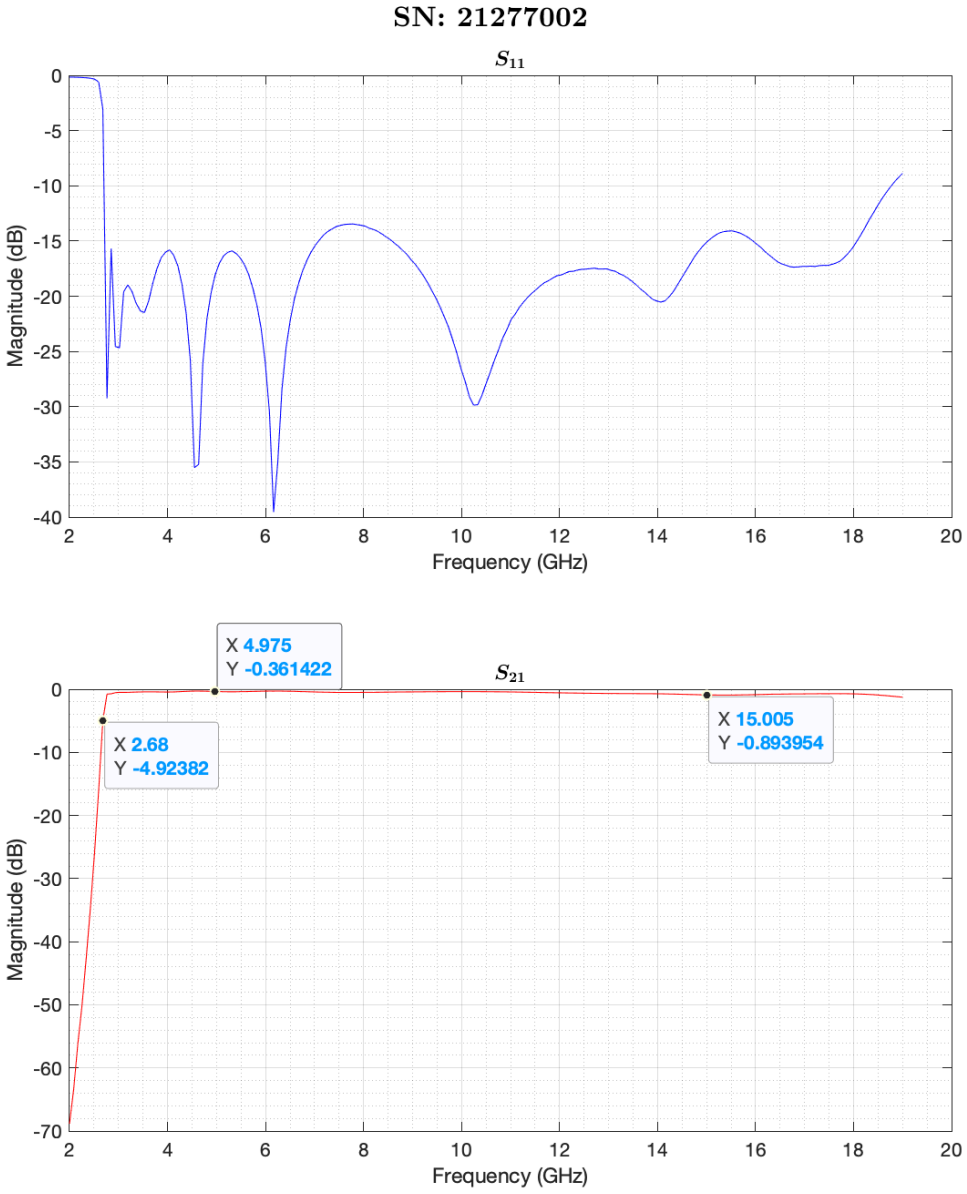



**Figure 3.3:** $S$-parameters of the HPFs. SN: 21277002.

# 4 Combination of HPFs and NFs

After characterising both types of filters, the final connection between them is illustrated in Figure 4.1.

The connections between these filters and the network analyser are as follows:

- Port 1 → SN: `21277001` (HPF) → SN: `20240300564` (NF) → Port 2
- Port 1 → SN: `21277002` (HPF) → SN: `20240300565` (NF) → Port 2

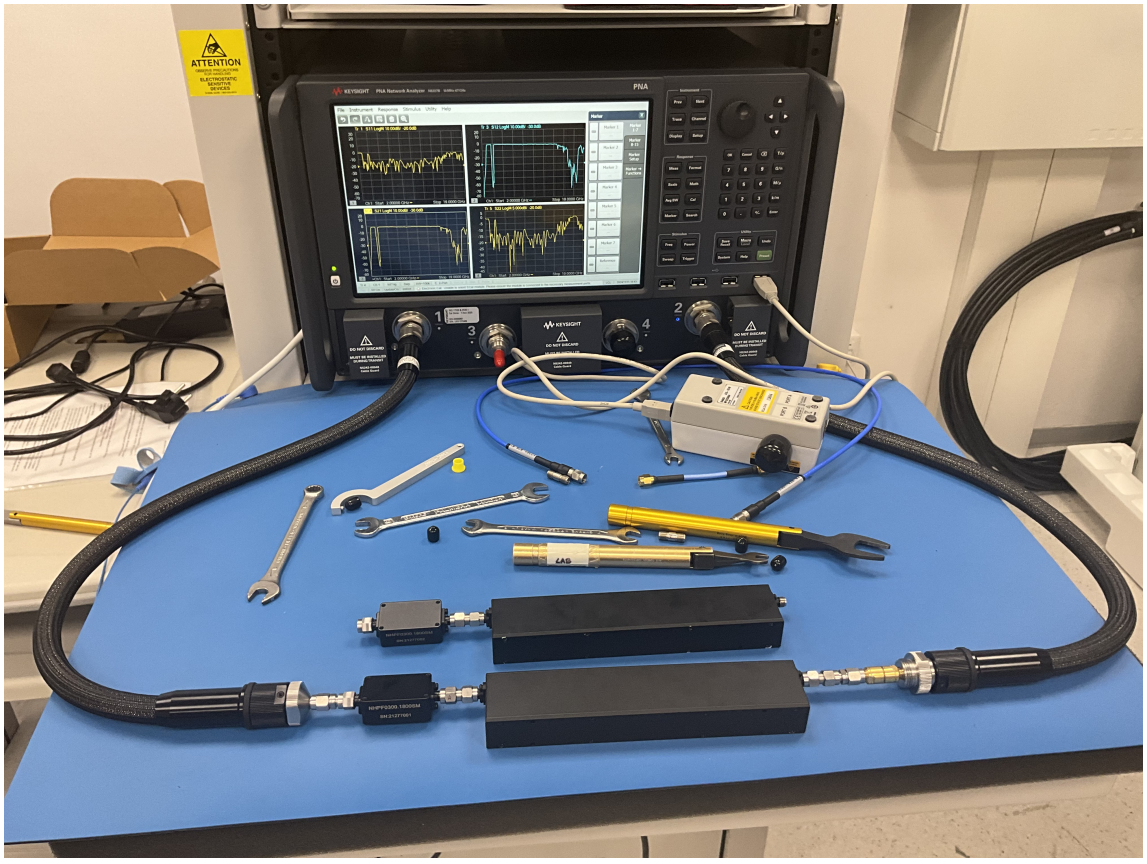



**Figure 4.1:** Combination of a NF and a HPF. SN: `21277001` → SN: `20240300564`.

Figures 4.2 and 4.3 show the $S$-parameters of the previously mentioned combinations. In both cases, insertion loss is measured at approximately $10\,GHz$.

The first combination exhibits an insertion loss of $1.34\,dB$, while the second one shows a slightly higher insertion loss of $1.47\,dB$. These figures highlight the notch produced by the NFs and the degradation about $14\,GHz$ as the passband of the NFs extends is up to $14\,GHz$.

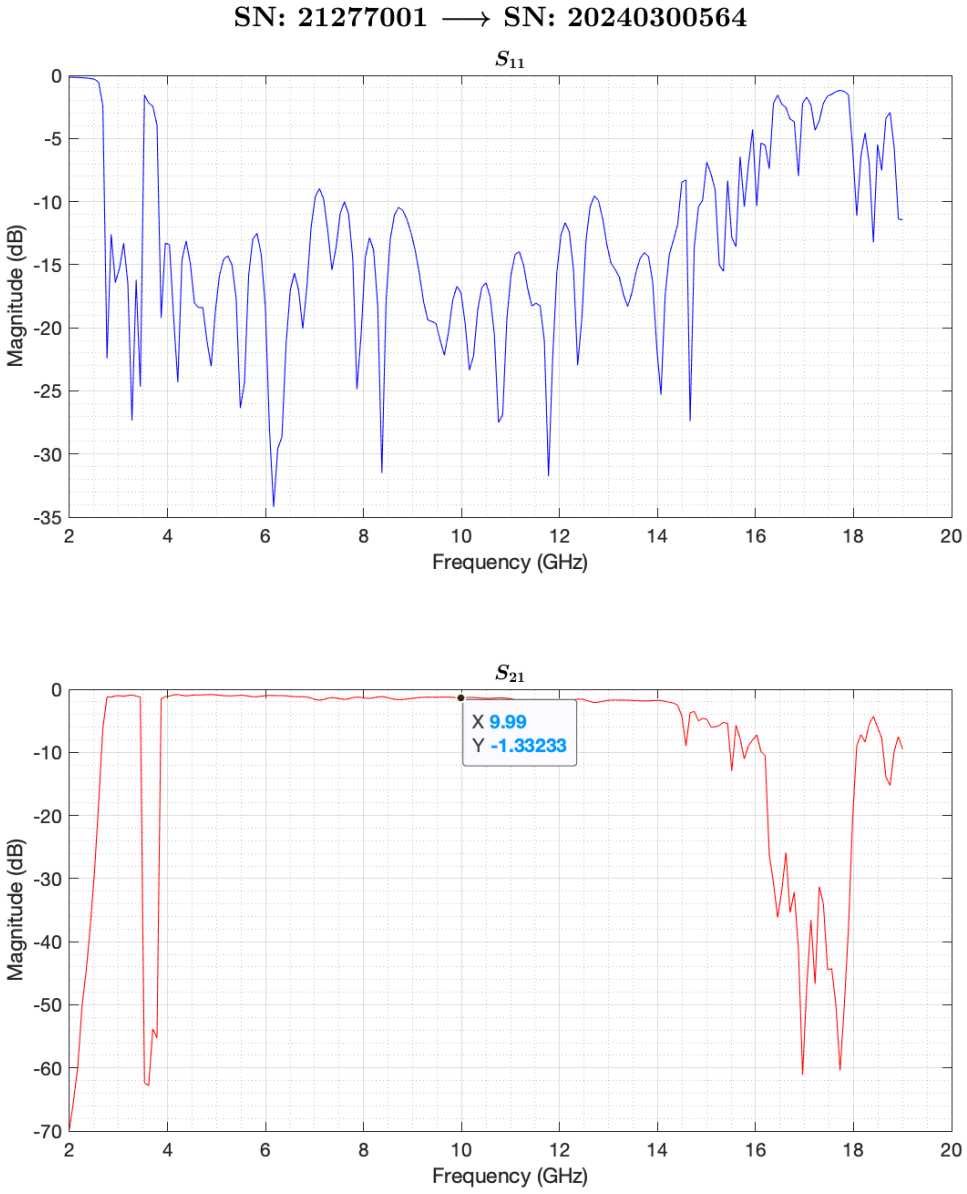



**Figure 4.2:** $S$-parameters of the combination of a NF and a HPF. SN: 21277001 → SN: 20240300564.

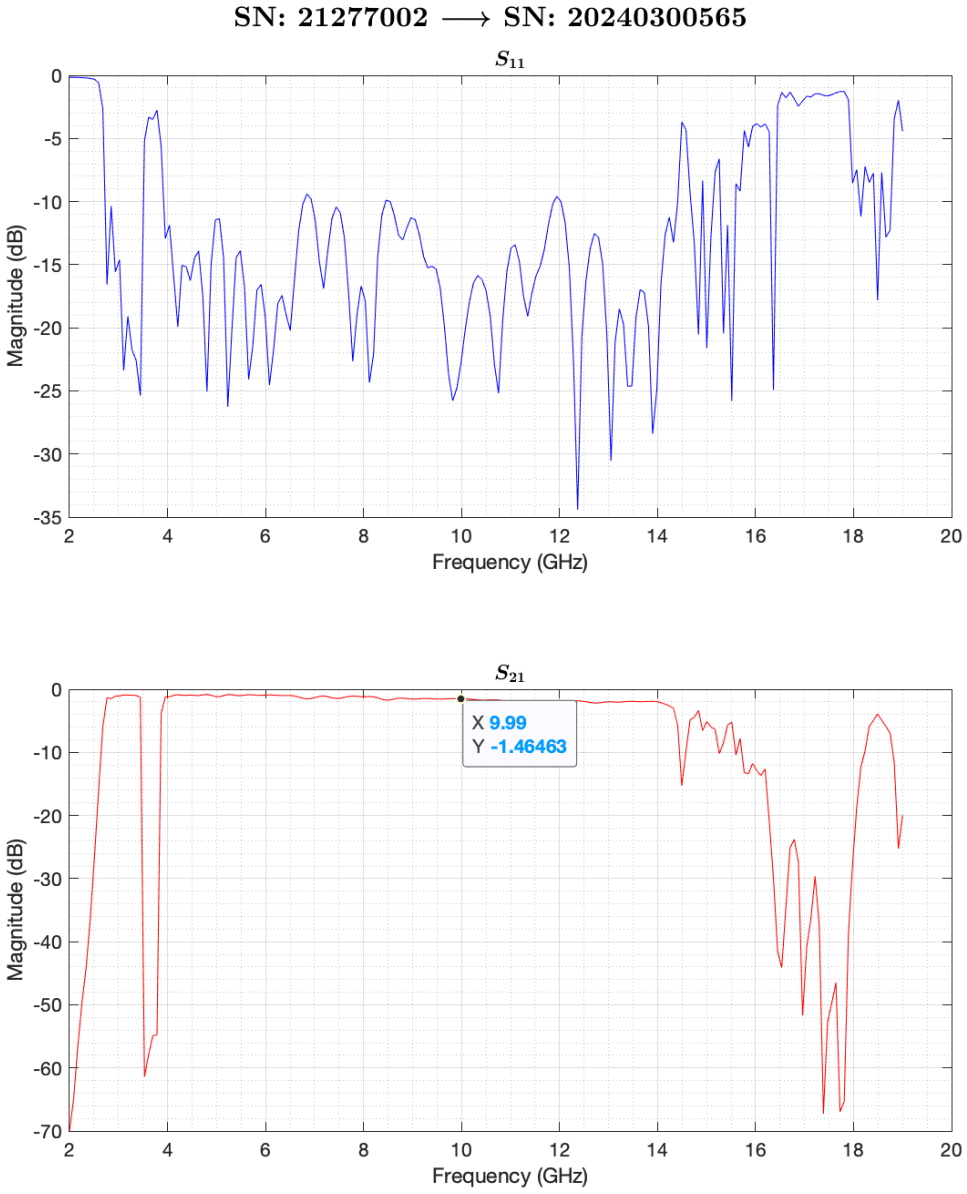



**Figure 4.3:** $S$-parameters of the combination of a NF and a HPF. SN: 21277002 → SN: 20240300565.

# A Data sheet: Notch Filter (CNF03518M03800Q14A)

## 1. Feature

- High Performance
- High Reliability
- RoHS Compliant

**Notch Filter**

**Part No: CNF03518M03800Q14A**

**Date: Feb.5th.2024**

**Revision No: Preliminary**

## 2. Electrical Specifications

| Parameter | Specification | Remark |
|---|---|---|
| Notch Band | 3518-3800MHz | |
| Rejection | ≥50dB | |
| Passband | DC-3485MHz & 4000-14000MHz | |
| Insertion loss | ≤2.0dB | |
| VSWR | ≤1.8 | |
| Average Power | ≤10W | |
| Impedance | 50Ω | |

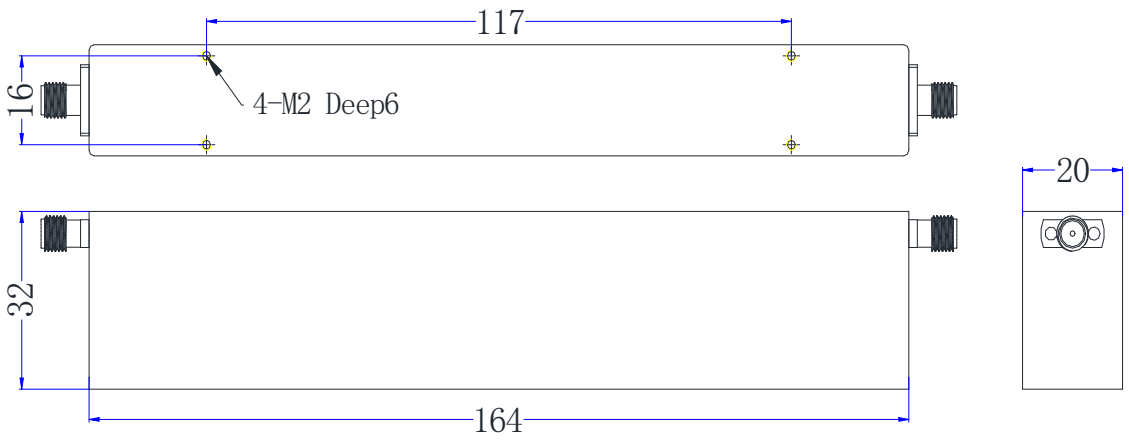
## 3. Mechanical Specifications

| Parameter | Specifications | Remark |
|---|---|---|
| Dimensions | 164.0 x 32.0 x 22.0 mm<br>( Not including the tuning screws and connectors ) | |
| Connector Type | SMA- female | |
| Surface Finish | Black Painting | |

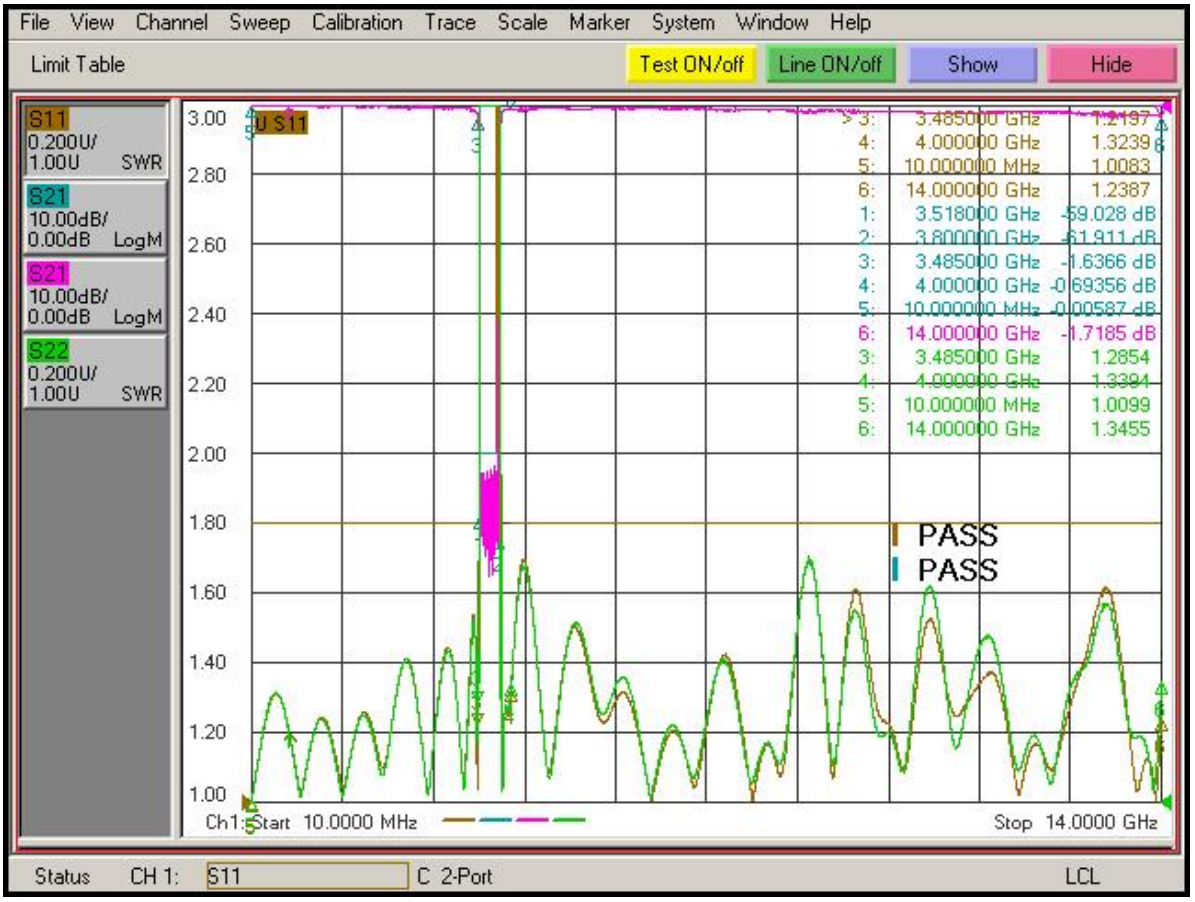
## 4. Temperature Specifications

| Parameter | Specifications | Remark |
|---|---|---|
| Operational Temperature | 0 to +50 ℃ | |
| Storage Temperature | -55 to +85 ℃ | |

**5.Outline Drawing (±0.5mm)**



**6.Test Curve**


File View Channel Sweep Calibration Trace Scale Marker System Window Help
Limit Table
Test ON/off
Line ON/off
Show
Hide
S11
0.200U/
1.00U SWR
S21
10.00dB/
0.00dB LogM
S21
10.00dB/
0.00dB LogM
S22
0.200U/
1.00U SWR
3.00
2.80
2.60
2.40
2.20
2.00
1.80
1.60
1.40
1.20
1.00
U S11
3: 3.485000 GHz 1.2197
4: 4.000000 GHz 1.3239
5: 10.000000 MHz 1.0083
6: 14.000000 GHz 1.2387
1: 3.518000 GHz -59.028 dB
2: 3.800000 GHz -61.911 dB
3: 3.485000 GHz -1.6366 dB
4: 4.000000 GHz -0.69356 dB
5: 10.000000 MHz -0.00587 dB
6: 14.000000 GHz -1.7185 dB
3: 3.485000 GHz 1.2854
4: 4.000000 GHz 1.3394
5: 10.000000 MHz 1.0099
6: 14.000000 GHz 1.3455
PASS
PASS
Ch1: Start 10.0000 MHz
Stop 14.0000 GHz
Status
CH 1:
S11
C 2-Port
LCL

# B Data sheet: High Pass Filter (NHPF0300.1800SM)

# NHPF0300.1800SM

HIGH PASS FILTER

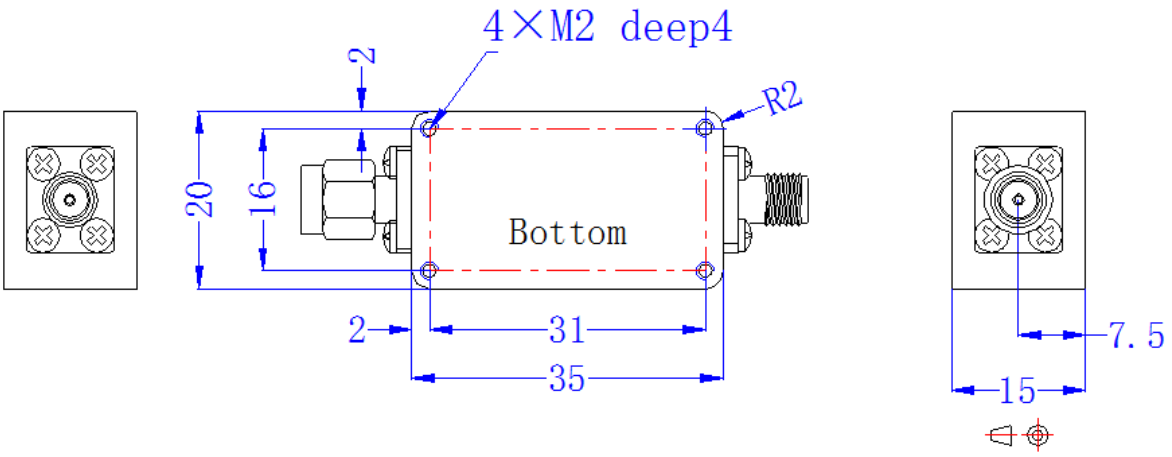
DATASHEET

## ELECTRICAL SPECIFICATIONS

| Parameter | Minimum | Typical | Maximum | Units |
|---|---|---|---|---|
| Frequency Range | 3 | - | 18 | GHz |
| Pass Band Insertion Loss | - | - | 1.2 | dB |
| Pass band Return loss | 12 | - | - | dB |
| Rejection at DC -2300Mhz | 40 | - | - | dB |
| Connector | SMA-Male (In)<br>SMA-Female (Out) | | | |
| Operating Temperature Range | -10 | - | +50 | ºC |
| Impedance | - | 50 | - | Ω |
| Finish | Black Paint | | | |

## OUTLINE DRAWING

- Dimensions in mm.
- Tolerance dimensions: +/-0.2mm




| Rev. | Description | Date | Approved by |
|---|---|---|---|
| | | | |
| | | | |