Working_with_spars_scikit_rf

September 20, 2023

[15]:
```
# This notebook uses scikit-rf, an open-source Python package for RF and␣
 ↪Microwave applications.
# Home Page https://scikit-rf.org
# The following is a Jupyter notebook highlighting the use of scikit-rf in␣
 ↪working with .s2p files for displaying
# the relevant plots
```

[16]:
```
# Import packages and display versions

import skrf as rf
from matplotlib import pyplot as plt

!python --version
!jupyter --version
print("skrf version     :", rf.__version__)
```

```
Python 3.10.10
Selected Jupyter core packages…
IPython          : 8.12.0
ipykernel        : 6.22.0
ipywidgets       : 8.0.6
jupyter_client   : 8.2.0
jupyter_core     : 5.3.0
jupyter_server   : 2.5.0
jupyterlab       : not installed
nbclient         : 0.7.3
nbconvert        : 7.3.1
nbformat         : 5.8.0
notebook         : 6.5.4
qtconsole        : 5.4.2
traitlets        : 5.9.0
skrf version     : 0.18.0
```

[17]:
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# HMC455LP3 is a device from Analog Devices, HMC455LP3_deembedded.s2p file was␣
 ↪downloaded from their website
```

[18]:
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HMC455LP3 = rf.Network('HMC455LP3_deembedded.s2p') # Create a Network object␣
↪from s2p file
```

[19]:
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HMC455LP3 # display the Network Object properties
```

[19]:
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2-Port Network: 'HMC455LP3_deembedded',  40.0-8000.0 MHz, 210 pts, z0=[50.+0.j
50.+0.j]
```

[20]:
```
# Attributes that can be called : HMC455LP3.s, HMC455LP3.z0, HMC455LP3.frequency
```

[31]:
```
# Plot dB Magnitude of S11 & S22 vs frequency

HMC455LP3.plot_s_db(m=0,n=0)
HMC455LP3.plot_s_db(m=1,n=1)
HMC455LP3.s11['1.8-2.2ghz'].plot_s_db(lw=5,label='Band of Interest')
HMC455LP3.s22['1.8-2.2ghz'].plot_s_db(lw=5,label='Band of Interest')
plt.title('dB Magnitude (S11 and S22) of HMC455LP3')
```

[31]:
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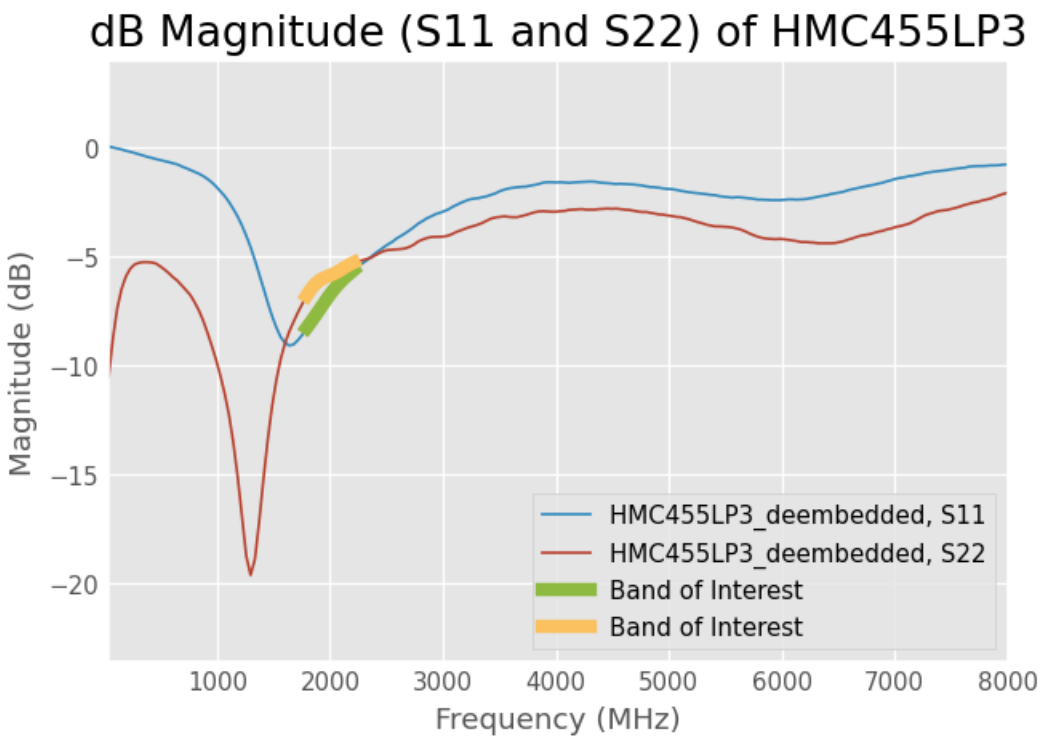
Text(0.5, 1.0, 'dB Magnitude (S11 and S22) of HMC455LP3')
```



[32]:
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# Plot dB Magnitude of S21 & S12 vs frequency

HMC455LP3.plot_s_db(m=0,n=1)
```

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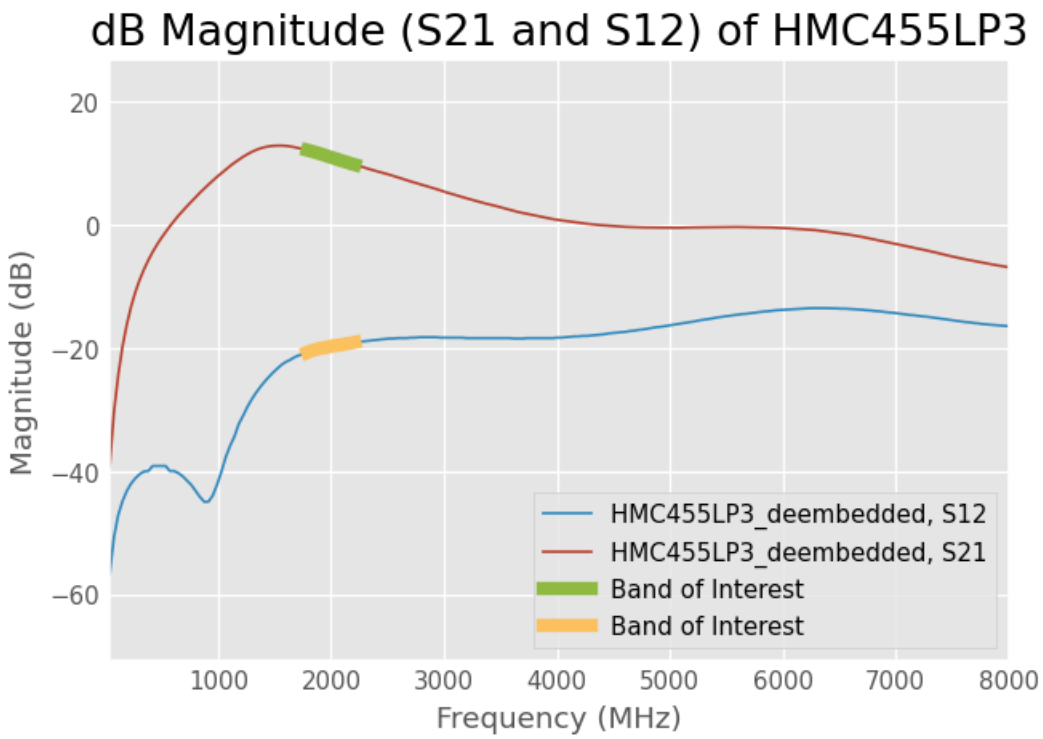
HMC455LP3.plot_s_db(m=1,n=0)
HMC455LP3.s21['1.8-2.2ghz'].plot_s_db(lw=5,label='Band of Interest')
HMC455LP3.s12['1.8-2.2ghz'].plot_s_db(lw=5,label='Band of Interest')
plt.title('dB Magnitude (S21 and S12) of HMC455LP3')
```

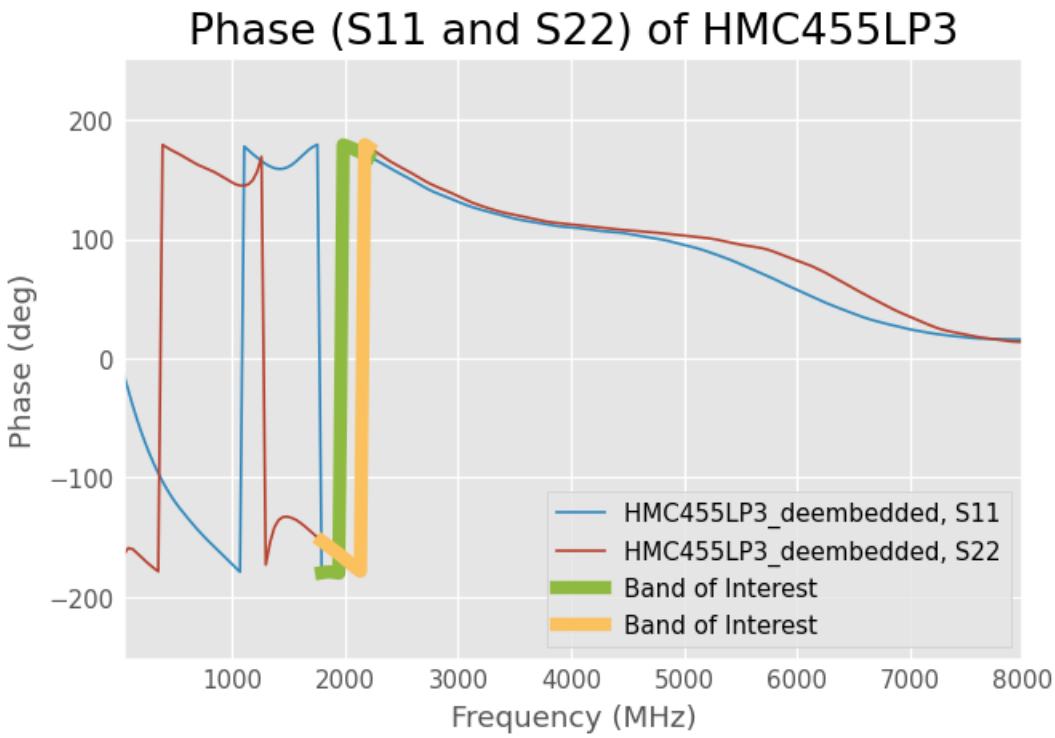
[32]: Text(0.5, 1.0, 'dB Magnitude (S21 and S12) of HMC455LP3')



[33]:
```
# Plot phase of S11 and S22 vs frequency

HMC455LP3.plot_s_deg(m=0,n=0)
HMC455LP3.plot_s_deg(m=1,n=1)
HMC455LP3.s11['1.8-2.2ghz'].plot_s_deg(lw=5,label='Band of Interest')
HMC455LP3.s22['1.8-2.2ghz'].plot_s_deg(lw=5,label='Band of Interest')
plt.title('Phase (S11 and S22) of HMC455LP3')
```

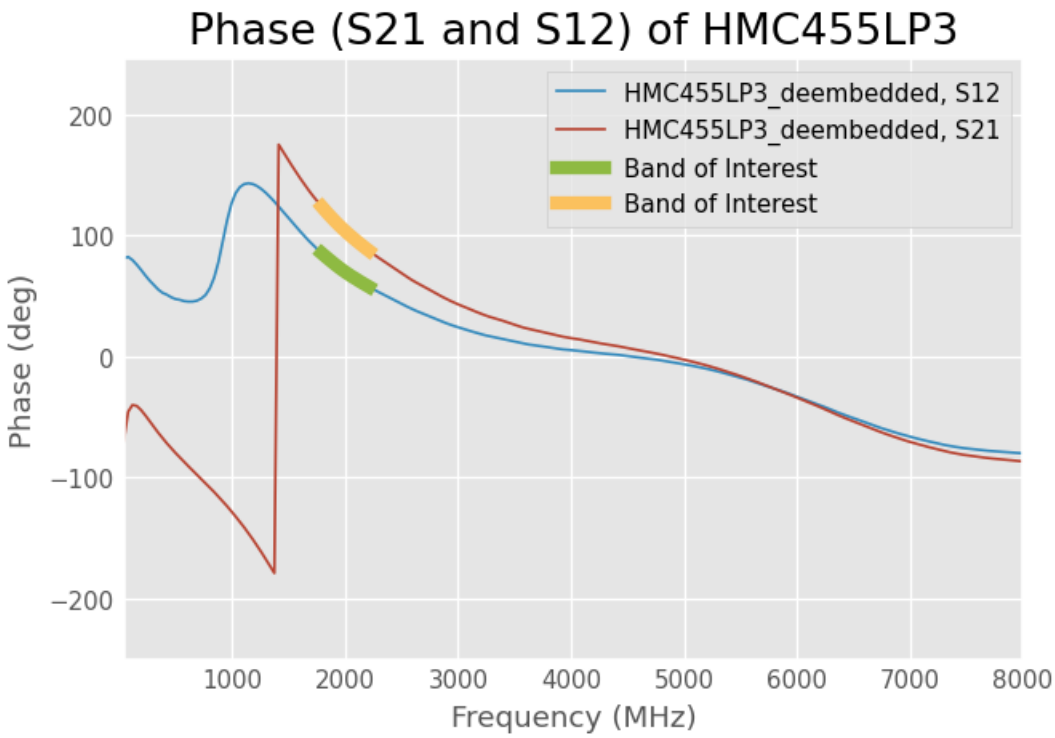
[33]: Text(0.5, 1.0, 'Phase (S11 and S22) of HMC455LP3')



[34]:
```
# Plot phase of S21 and S12 vs frequency

HMC455LP3.plot_s_deg(m=0,n=1)
HMC455LP3.plot_s_deg(m=1,n=0)
HMC455LP3.s12['1.8-2.2ghz'].plot_s_deg(lw=5,label='Band of Interest')
HMC455LP3.s21['1.8-2.2ghz'].plot_s_deg(lw=5,label='Band of Interest')
plt.title('Phase (S21 and S12) of HMC455LP3')
```

[34]:
```
Text(0.5, 1.0, 'Phase (S21 and S12) of HMC455LP3')
```

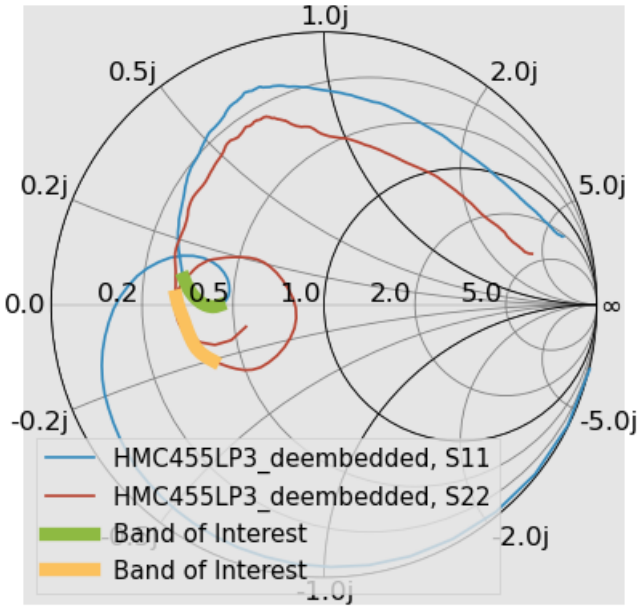


[35]:
```
# Plot S11 and S22 on Smith Chart

rf.stylely()
HMC455LP3.plot_s_smith(m=0,n=0,draw_labels=True)
HMC455LP3.plot_s_smith(m=1,n=1,draw_labels=True)
HMC455LP3.s11['1.8-2.2ghz'].plot_s_smith(lw=5,label='Band of Interest')
HMC455LP3.s22['1.8-2.2ghz'].plot_s_smith(lw=5,label='Band of Interest')

plt.title('Smith Chart (S11 and S22) of HMC455LP3')
```

[35]:
```
Text(0.5, 1.0, 'Smith Chart (S11 and S22) of HMC455LP3')
```

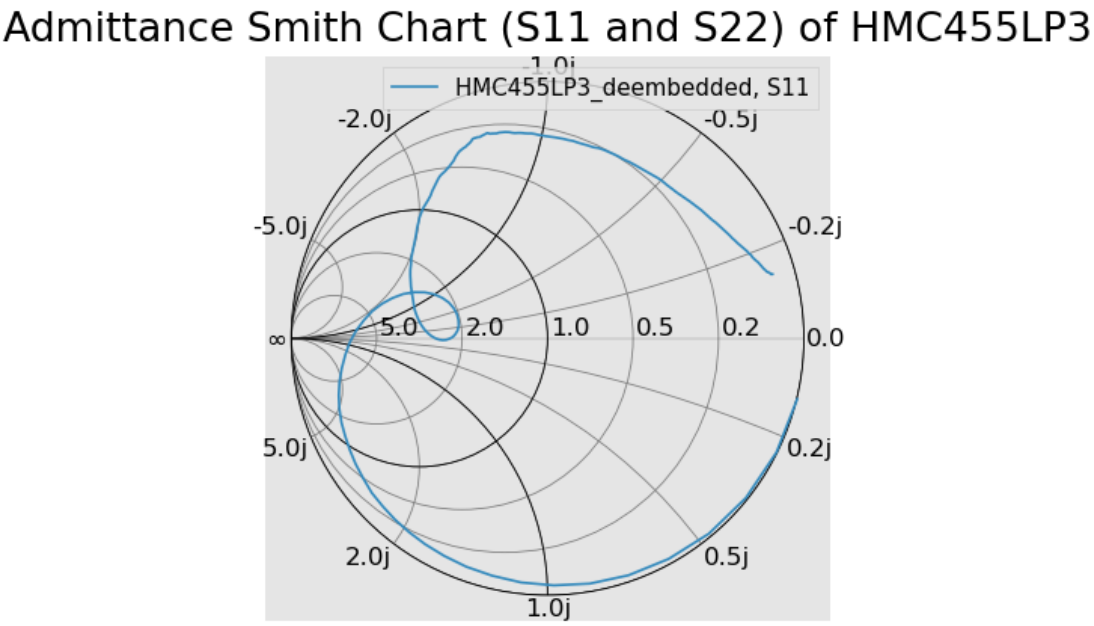


[26]:
```
# Other Network Parameters can be accessed as below :
#HMC455LP3.z    # z Parameters
#HMC455LP3.z_re # Real Part of z-Parameters
#HMC455LP3.z_im # Imaginary Part of z-parameters
#HMC455LP3.y    # y-parameters
#HMC455LP3.t    # T-Parameters
#HMC455LP3.a    # ABCD Parameters
#HMC455LP3.h    # H-Parameters
```

[36]:
```
# Plot Admittance Smith Chart

HMC455LP3.plot_s_smith(m=0,n=0,draw_labels=True,chart_type='y') # Y type Smith␣
 ↪Chart
plt.title('Admittance Smith Chart (S11 and S22) of HMC455LP3')
```

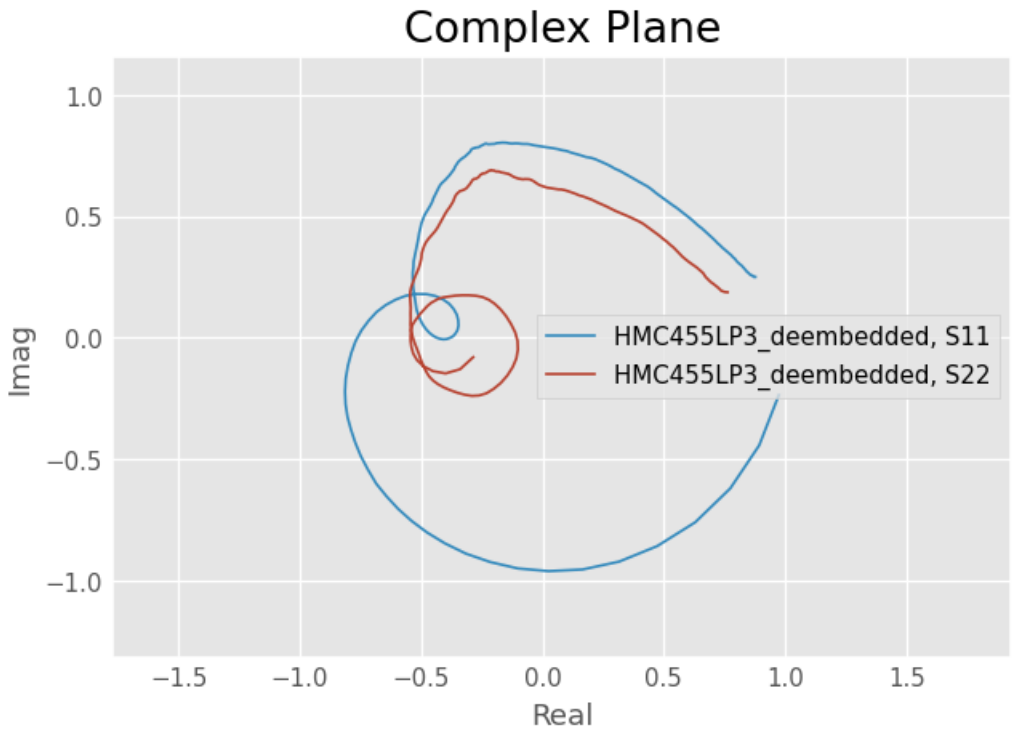
[36]:
```
Text(0.5, 1.0, 'Admittance Smith Chart (S11 and S22) of HMC455LP3')
```



[30]:
```
# Plot S11 & S22 in Complex Plane

HMC455LP3.plot_s_complex(m=0,n=0)
HMC455LP3.plot_s_complex(m=1,n=1)

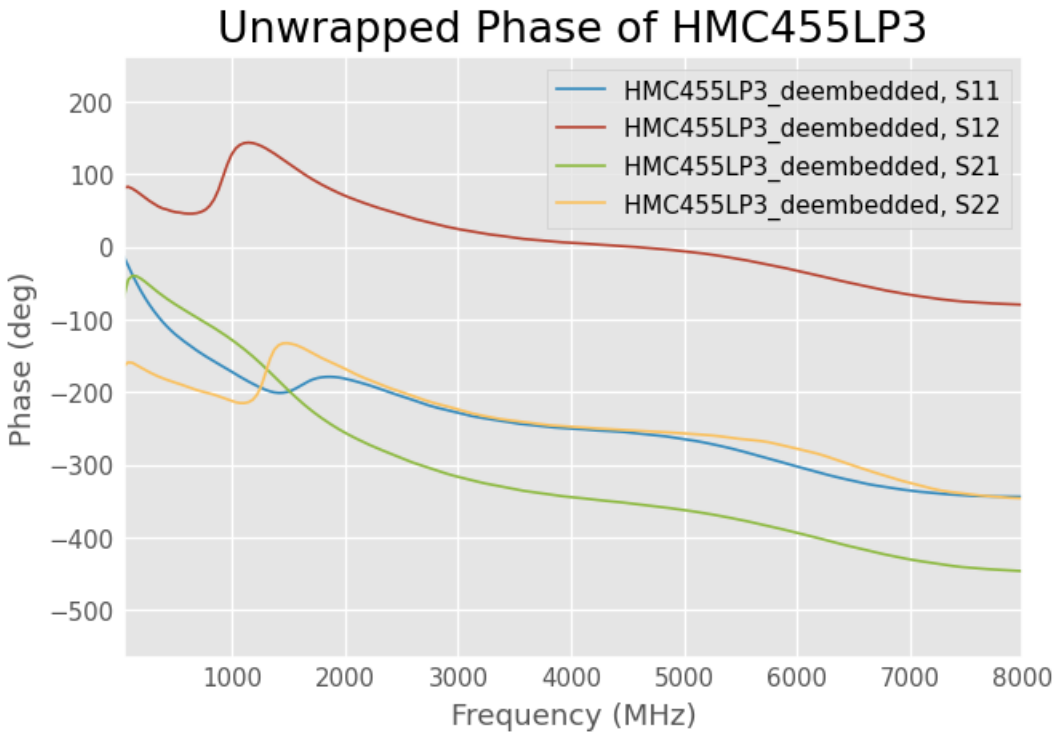
plt.axis('equal');
```



[37]:
```
# Plot unwrapped phase of s-parameters

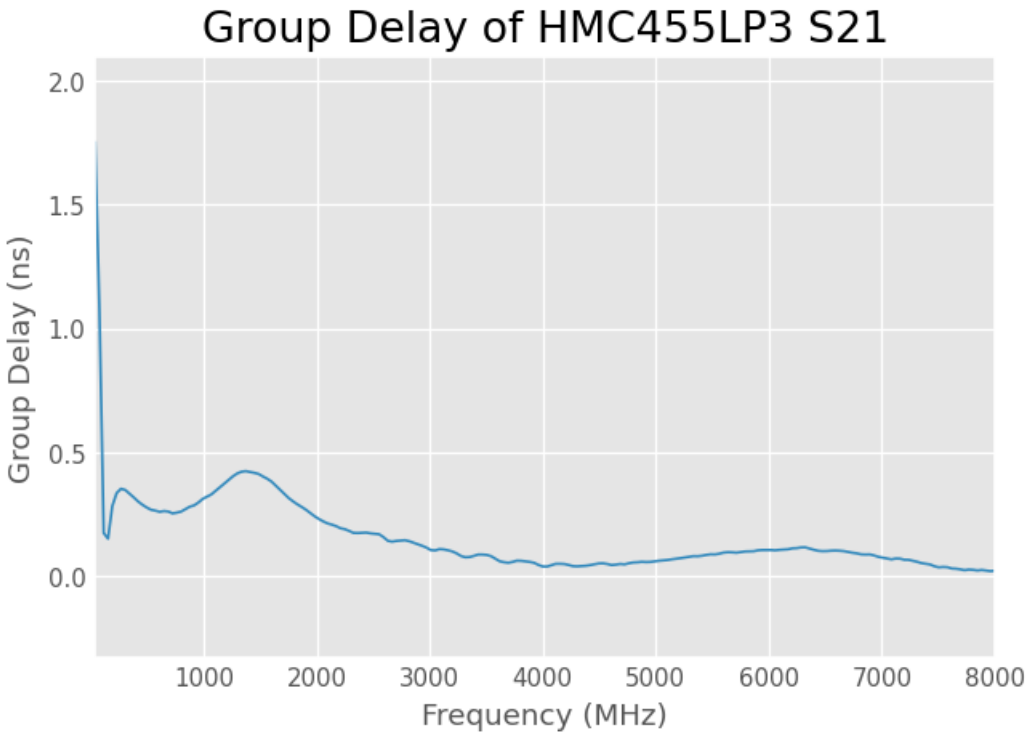
HMC455LP3.plot_s_deg_unwrap()
plt.title('Unwrapped Phase of HMC455LP3')
```

[37]: Text(0.5, 1.0, 'Unwrapped Phase of HMC455LP3')



[51]:
```
# Plot Group Delay of S21

gd = abs(HMC455LP3.s21.group_delay) *1e9 # in ns
HMC455LP3.plot(gd)
plt.ylabel('Group Delay (ns)')
plt.title('Group Delay of HMC455LP3 S21');
```


Group Delay of HMC455LP3 S21
Group Delay (ns)
2.0
1.5
1.0
0.5
0.0
1000
2000
3000
4000
5000
6000
7000
8000
Frequency (MHz)