Anechoic Chamber: Horn Antenna Characterization

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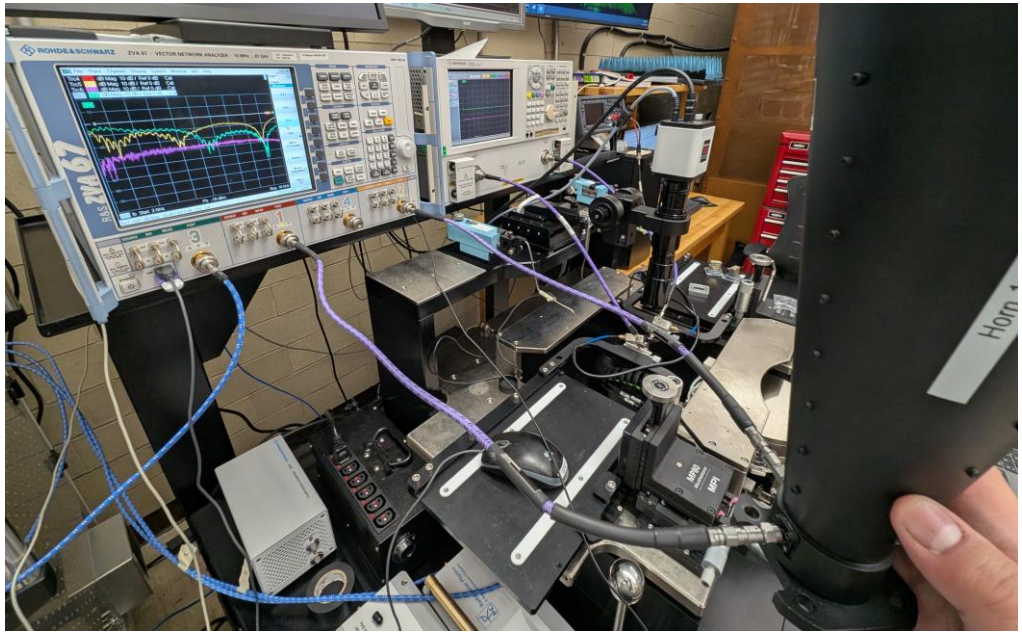
S-Parameters

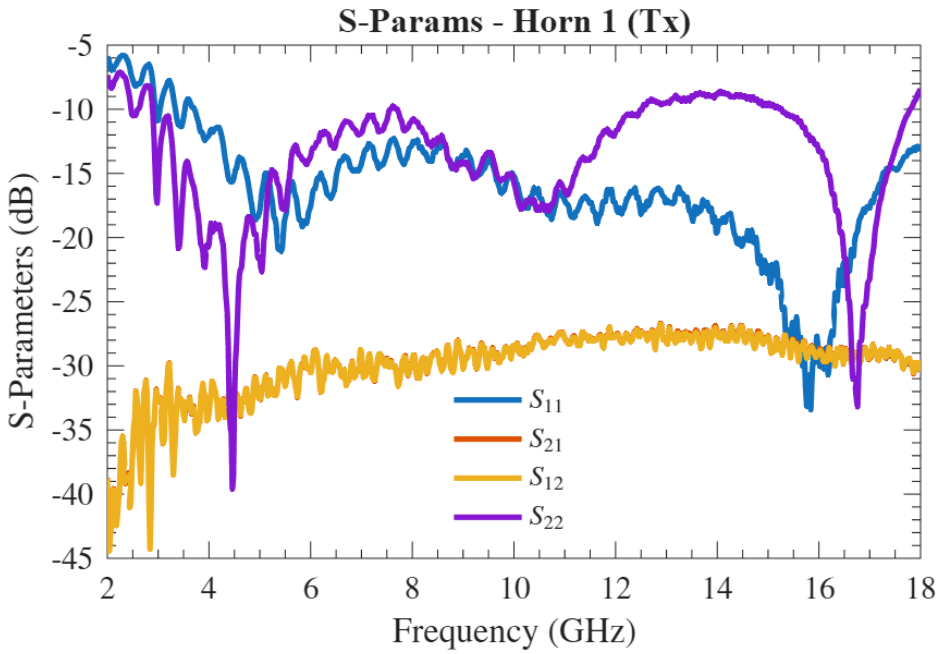
Sample Measurement

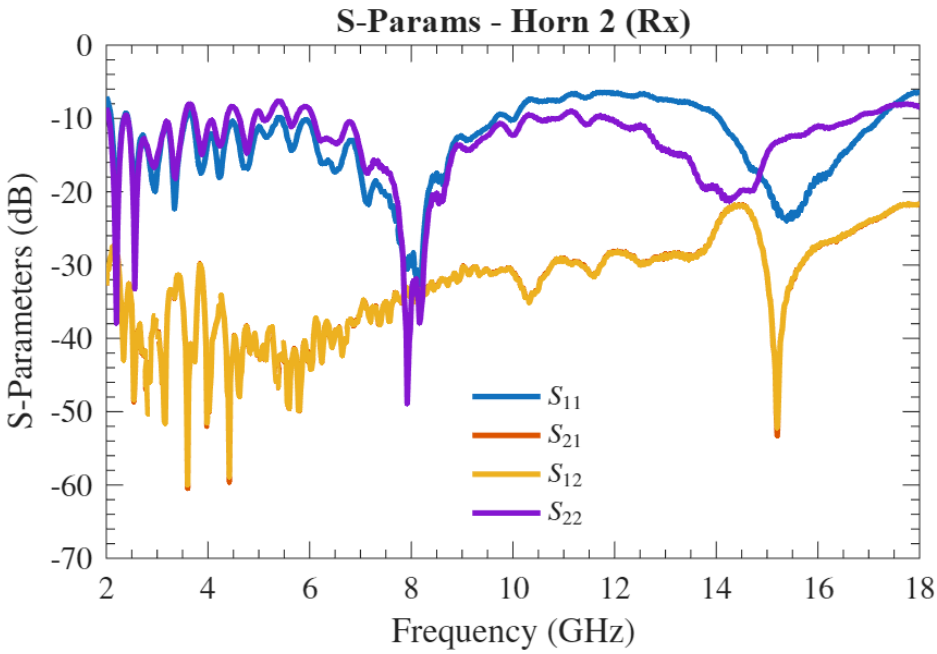
- S-parameters of the **Tx and Rx** (“Horn 1” and “Horn 2”) are measured
  - VNA used: R&S ZVA67



In the actual measurement, the horn antennas were pointed to the furthest wall to minimize measuring reflected power

S-Parameters

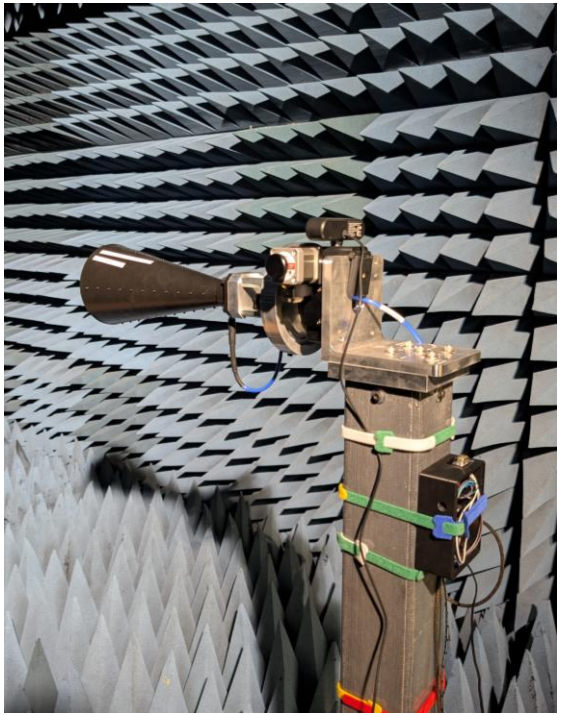


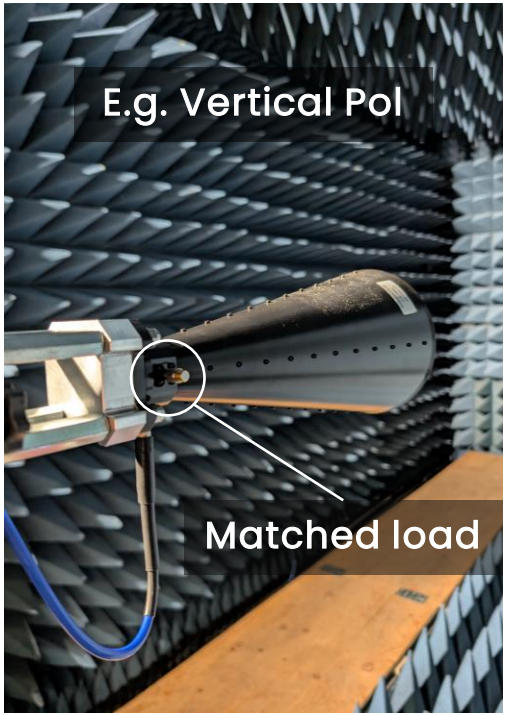


Measurement Setup

Rx Antenna

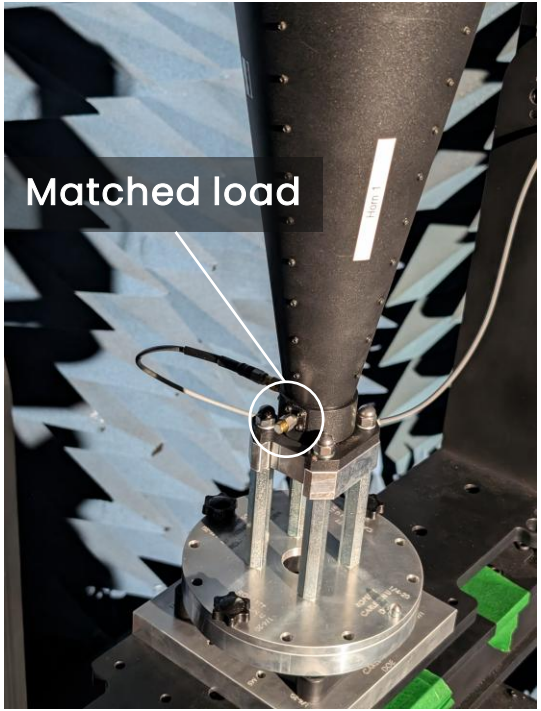
- The RF cable is only switched on this antenna to measure vertical and horizontal polarizations



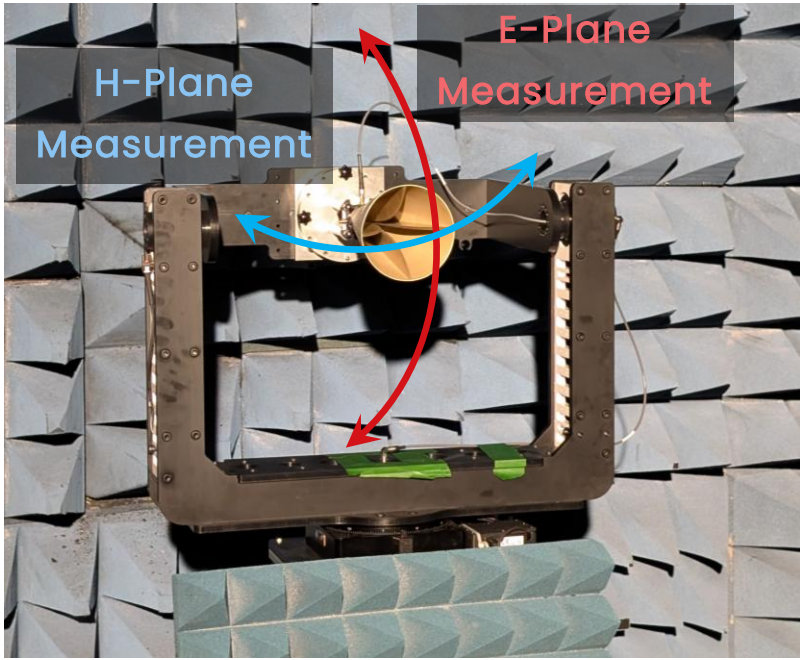


Tx Antenna

- RF Cable is fixed at this port for the Tx antenna



Measuring the Patterns



Measured Patterns

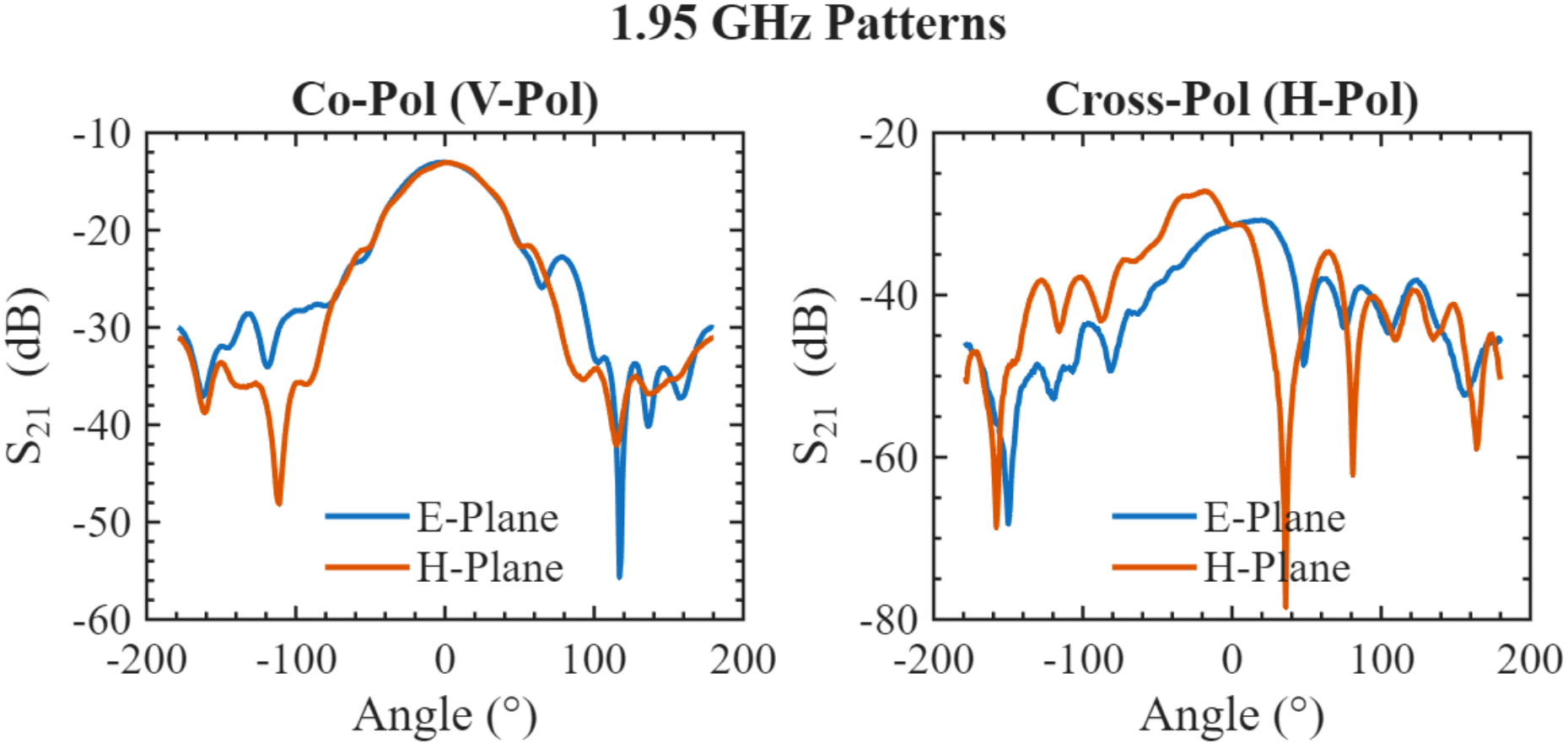
Software Settings

- For all measurements:
  - $P_{\text{in}} = 0$ dBm
  - Frequency Range: **1 to 20 GHz**
  - Number of Points: **101**
  - Angular step size: **1°**
  - Measurement Hold Time: **5 seconds**

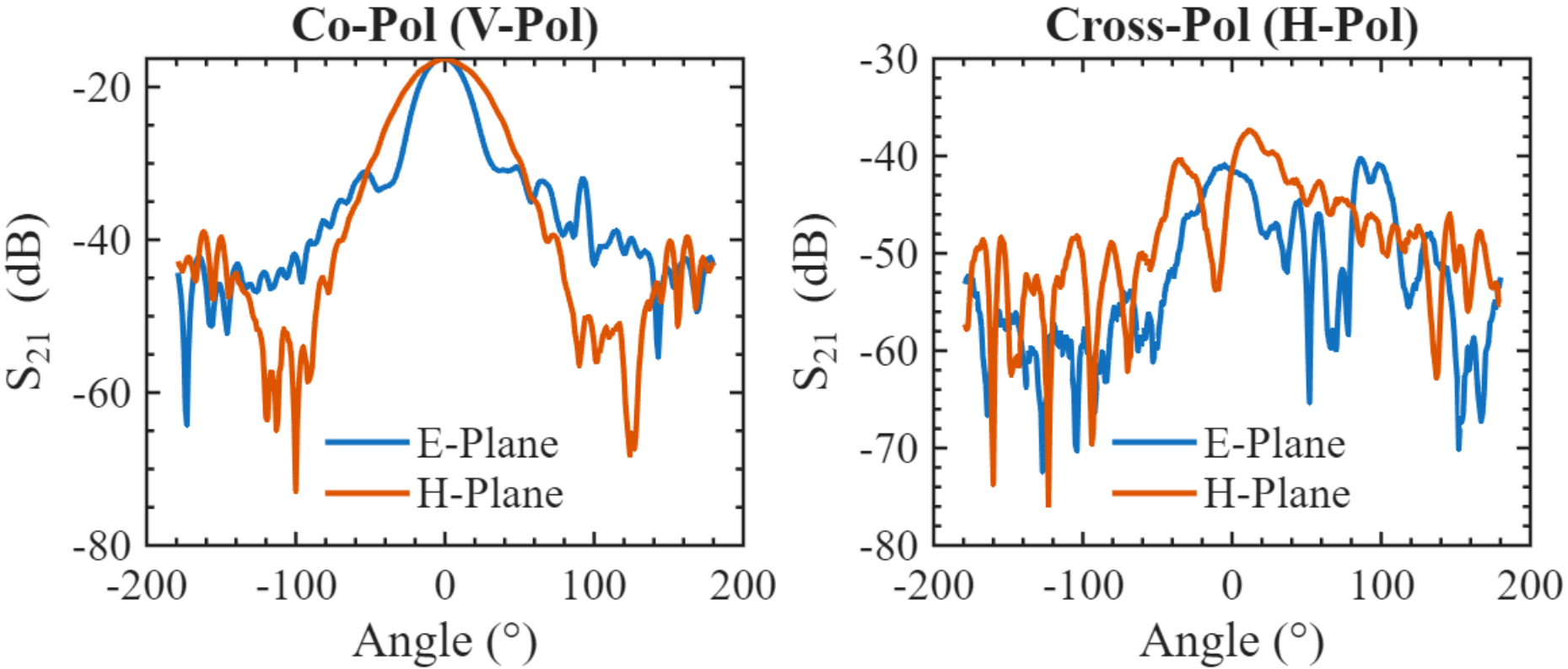
- To measure E-plane:
  - $\phi = 0°$
  - $-180° \leq \theta \leq 180°$

- To measure H-plane:
  - $\theta = 90°$
  - $-180° \leq \phi \leq 180°$

2 GHz

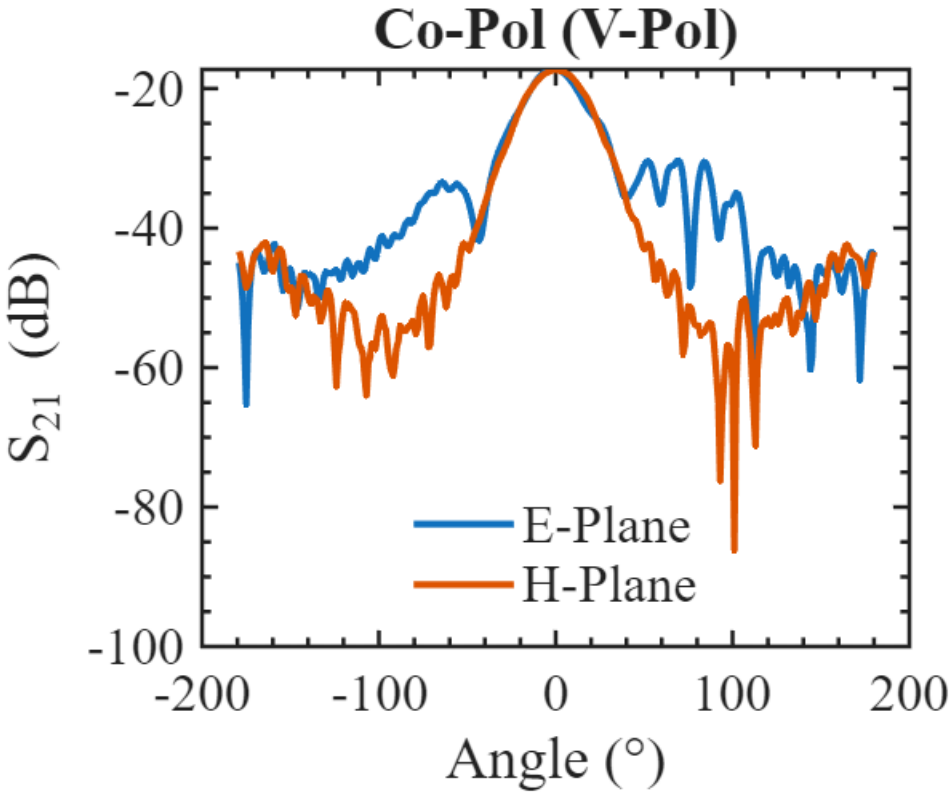

1.95 GHz Patterns
Co-Pol (V-Pol)
Cross-Pol (H-Pol)
S21 (dB)
Angle (°)
E-Plane
H-Plane
-10
-20
-30
-40
-50
-60
-80
-200
-100
0
100
200

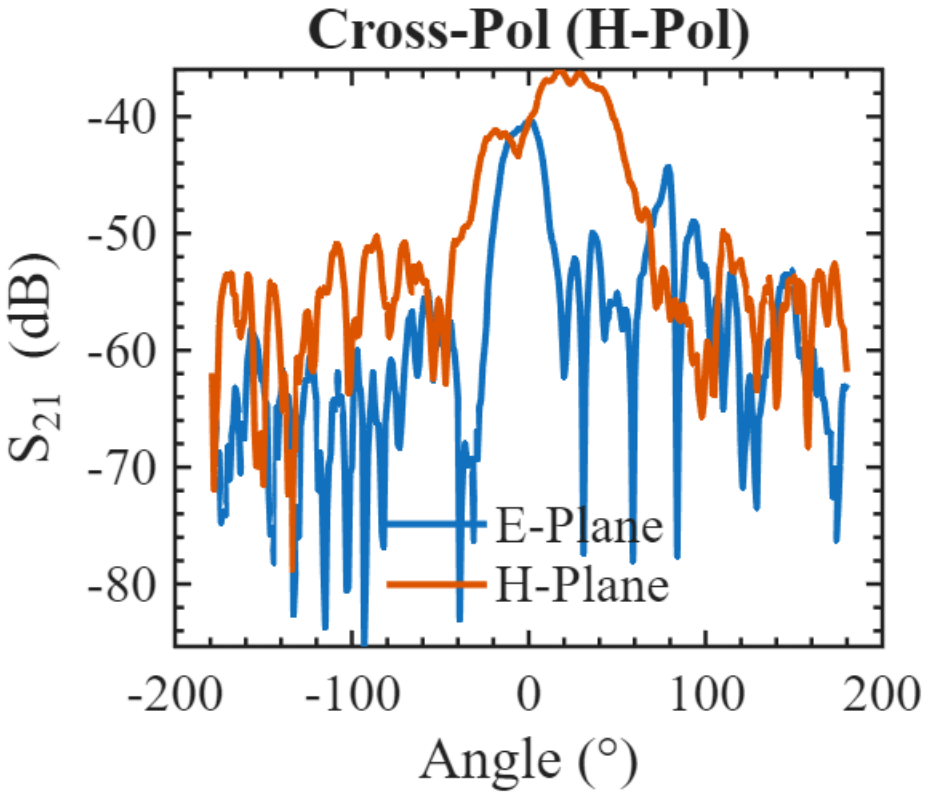
4 GHz


4.04 GHz Patterns
Co-Pol (V-Pol)
Cross-Pol (H-Pol)
S21 (dB)
Angle (°)
E-Plane
H-Plane
-20
-40
-60
-80
-30
-50
-70
-200
-100
0
100
200

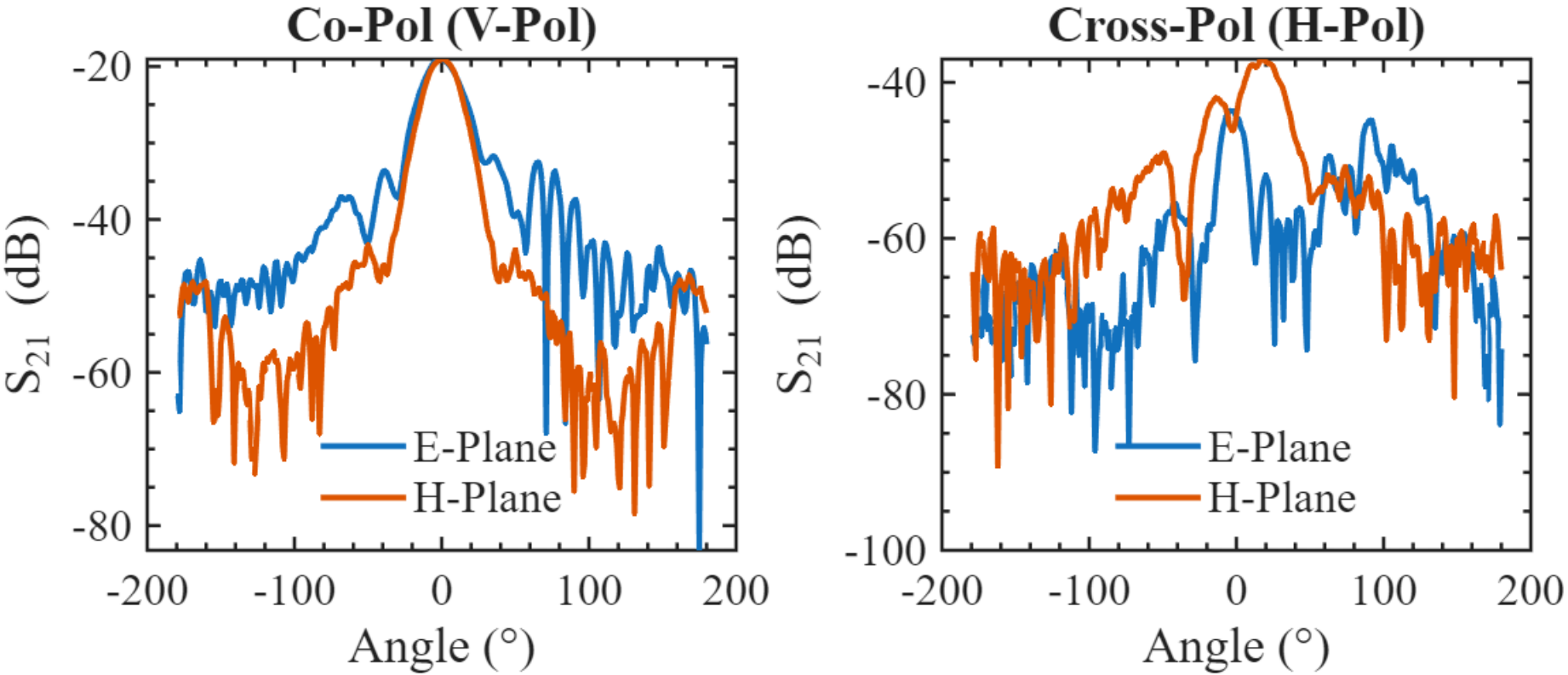
6 GHz

5.94 GHz Patterns

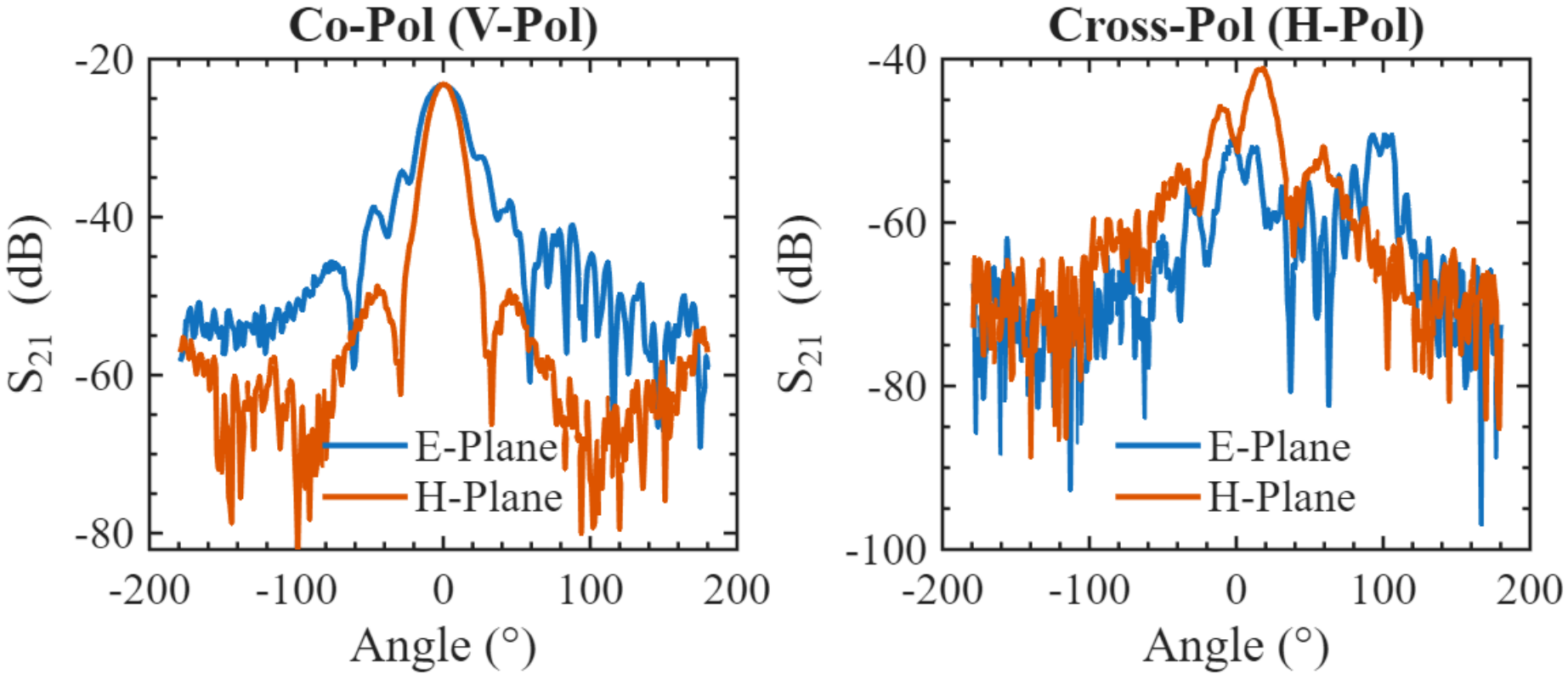




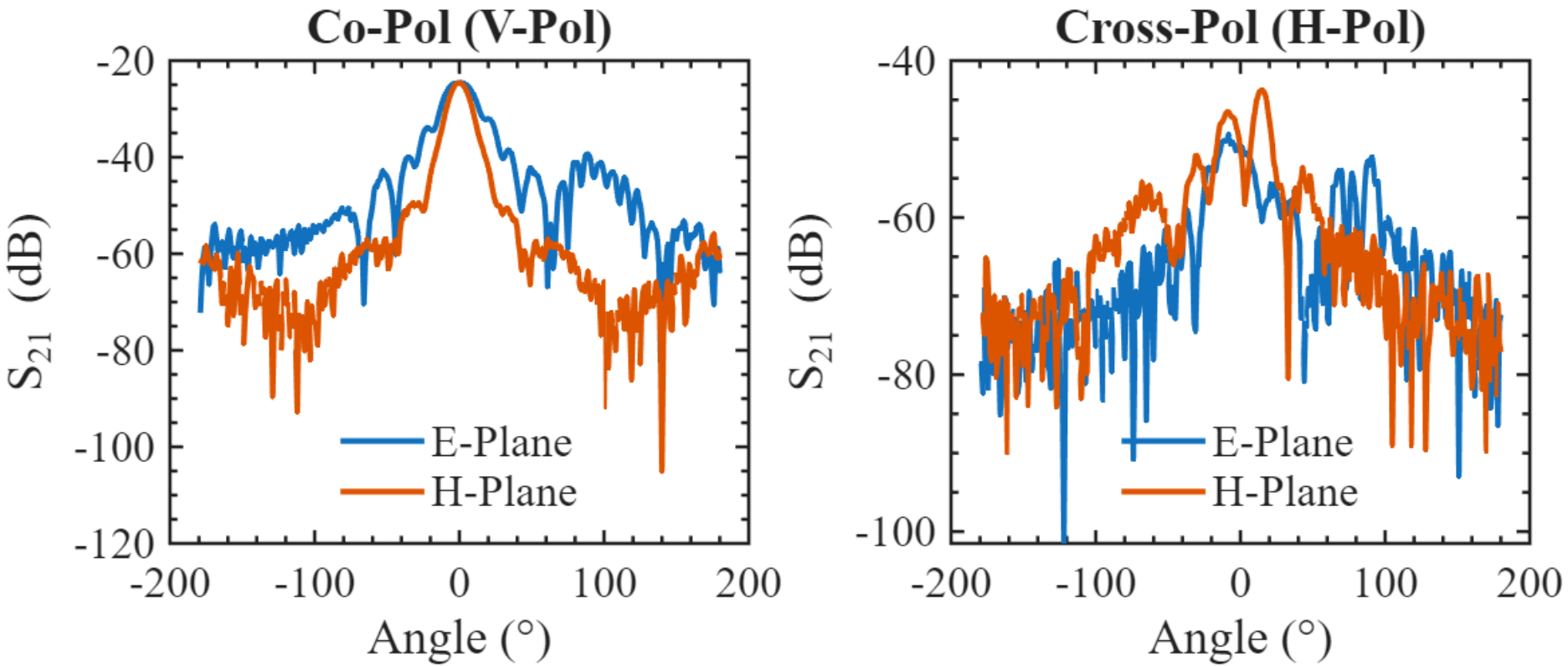
8 GHz


8.03 GHz Patterns
Co-Pol (V-Pol)
Cross-Pol (H-Pol)
S21 (dB)
Angle (°)
E-Plane
H-Plane
-20
-40
-60
-80
-100
-200
-100
0
100
200

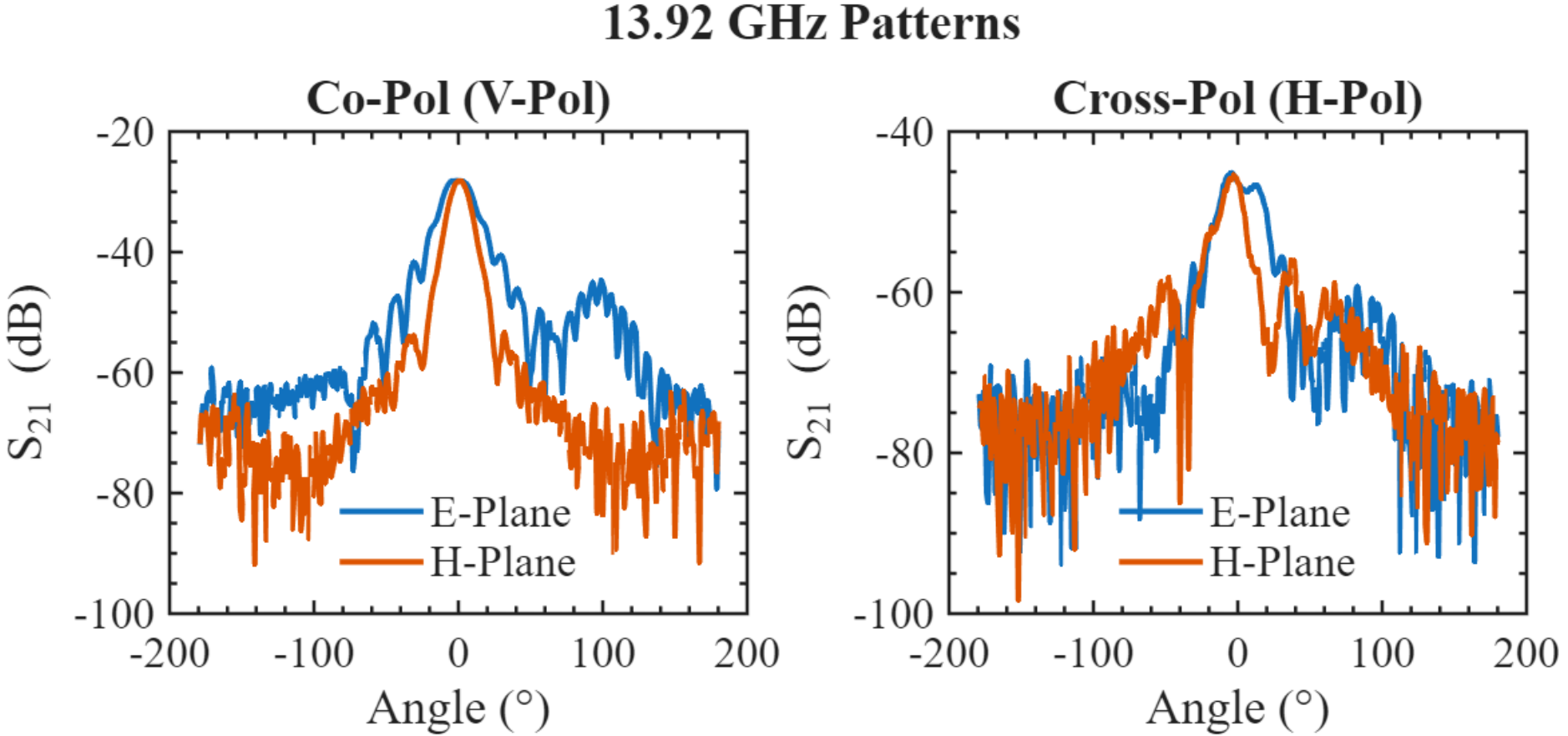
10 GHz


9.93 GHz Patterns
Co-Pol (V-Pol)
Cross-Pol (H-Pol)
S21 (dB)
Angle (°)
E-Plane
H-Plane
-20
-40
-60
-80
-100
-200
-100
0
100
200

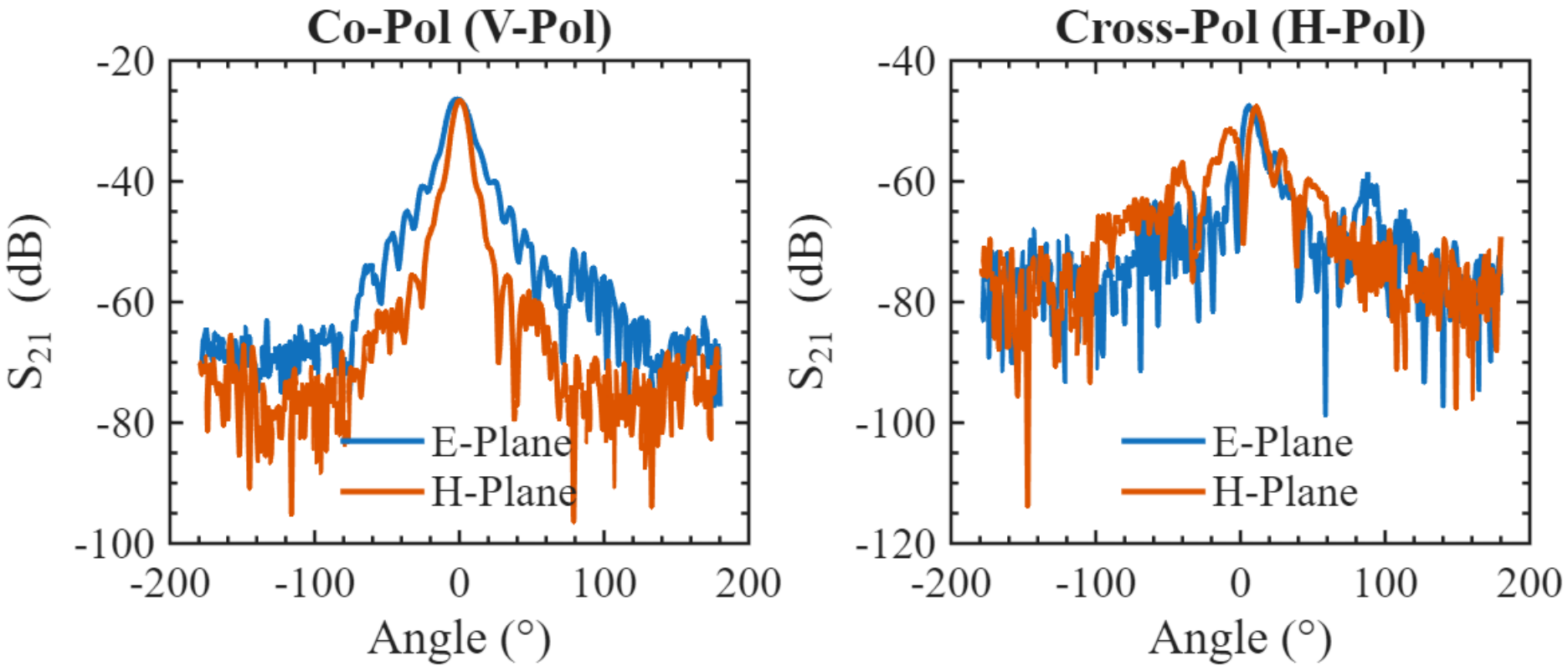
12 GHz


12.02 GHz Patterns
Co-Pol (V-Pol)
Cross-Pol (H-Pol)
S21 (dB)
Angle (°)
E-Plane
H-Plane
-20
-40
-60
-80
-100
-120
-200
-100
0
100
200

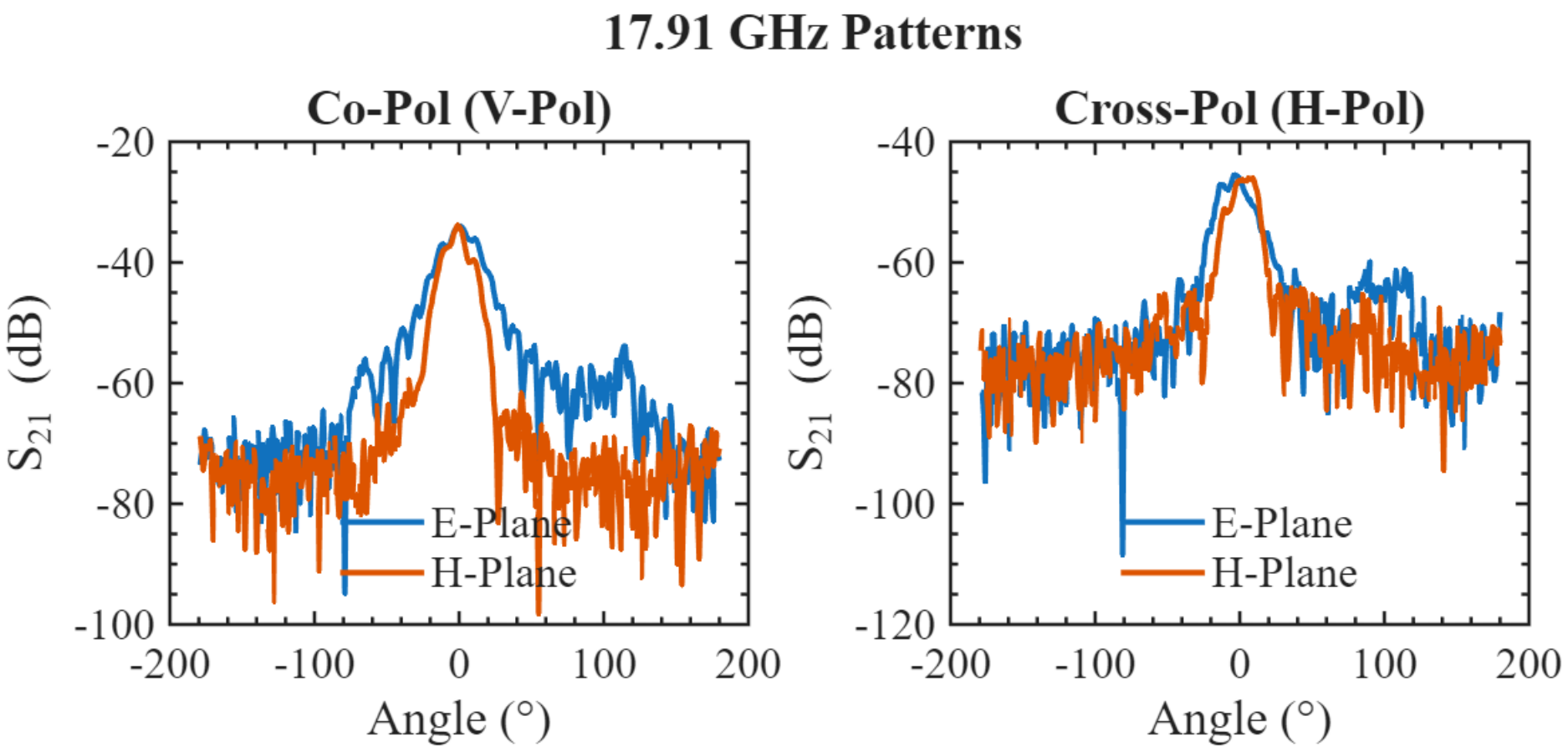
14 GHz


13.92 GHz Patterns
Co-Pol (V-Pol)
Cross-Pol (H-Pol)
S21 (dB)
Angle (°)
E-Plane
H-Plane
-20
-40
-60
-80
-100
-200
-100
0
100
200

16 GHz

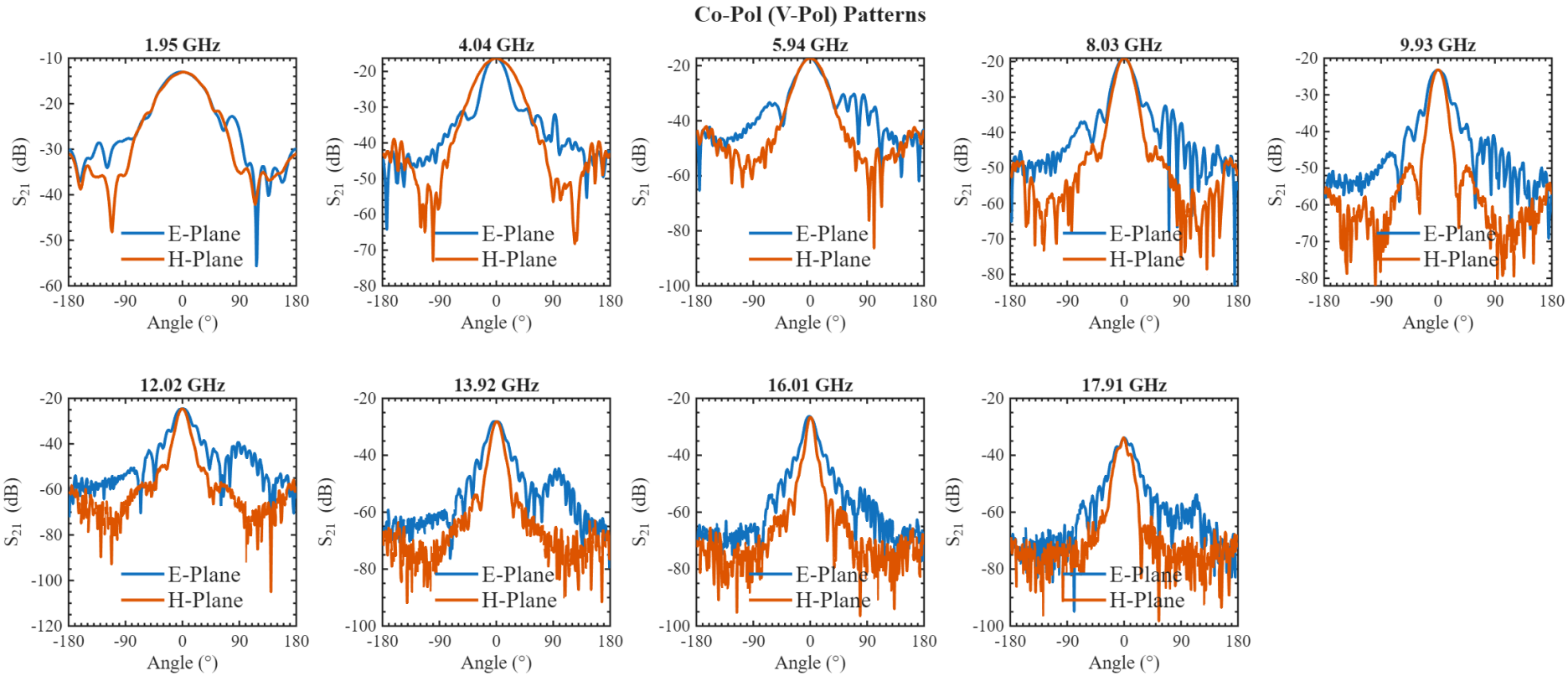

16.01 GHz Patterns
Co-Pol (V-Pol)
Cross-Pol (H-Pol)
S21 (dB)
Angle (°)
E-Plane
H-Plane
-20
-40
-60
-80
-100
-120
-200
0
100
200

18 GHz

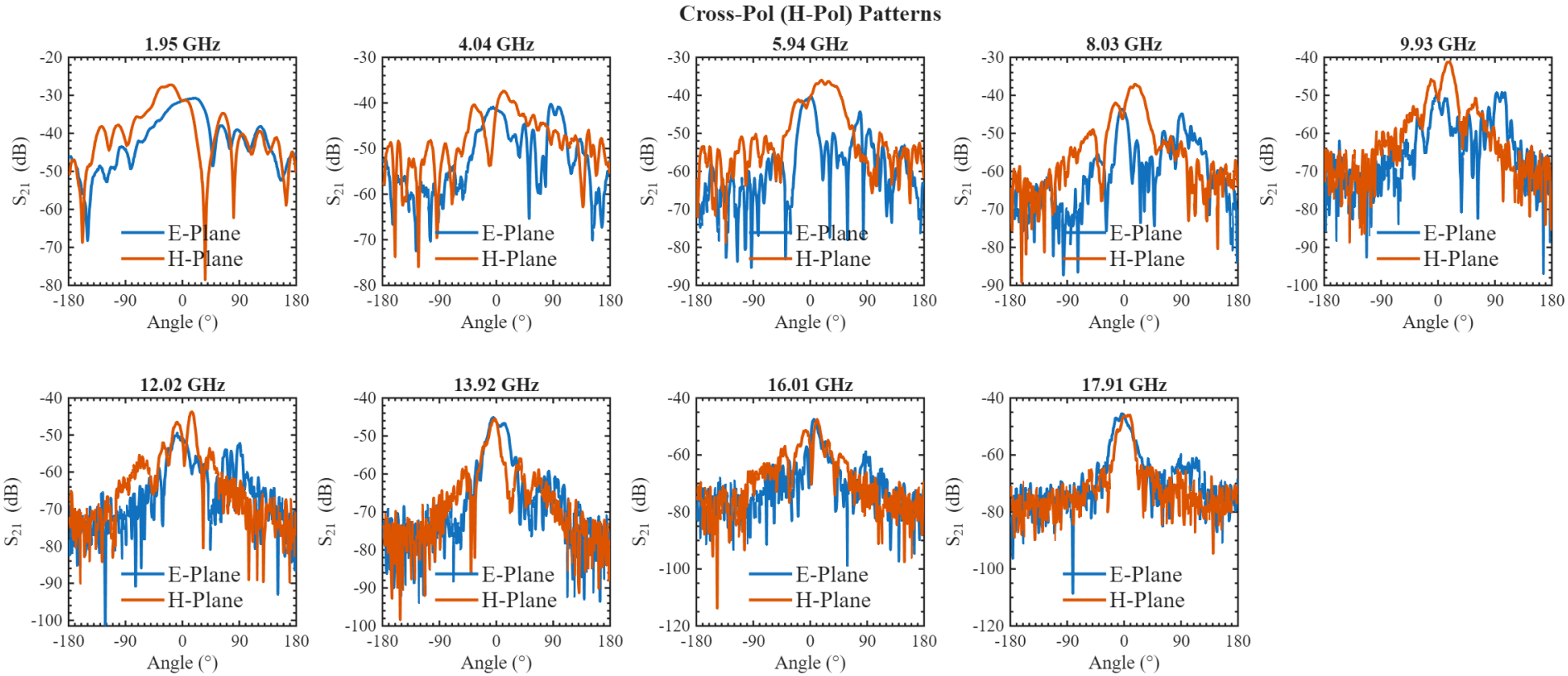

17.91 GHz Patterns
Co-Pol (V-Pol)
Cross-Pol (H-Pol)
S21 (dB)
Angle (°)
E-Plane
H-Plane
-20
-40
-60
-80
-100
-120
-200
0
100
200

Summary of Patterns

Co-Pol (V-Pol) Plots

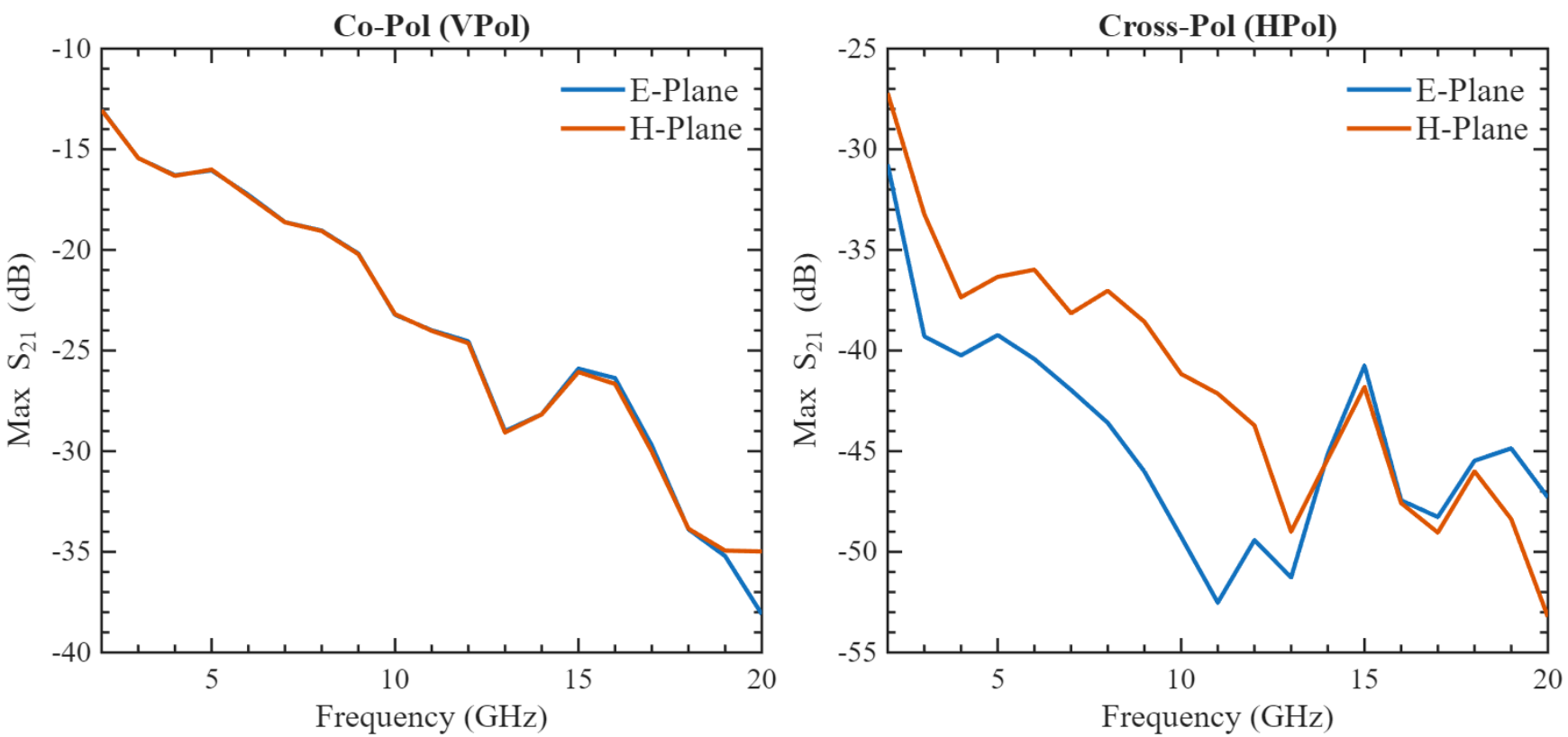


Cross-Pol (H-Pol) Plots



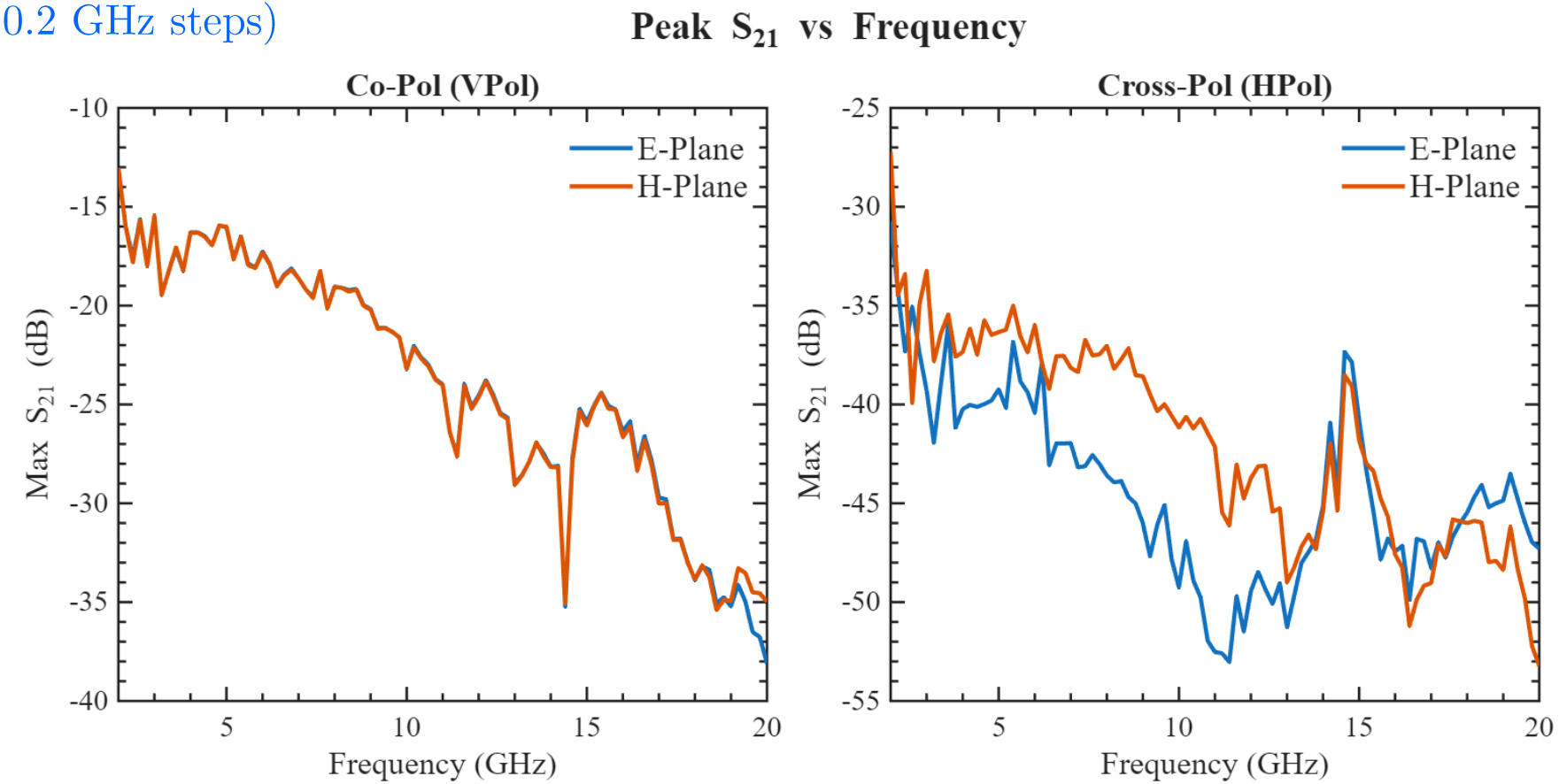
Peak S21 vs Frequency

(1 GHz steps)



Peak S21 vs Frequency

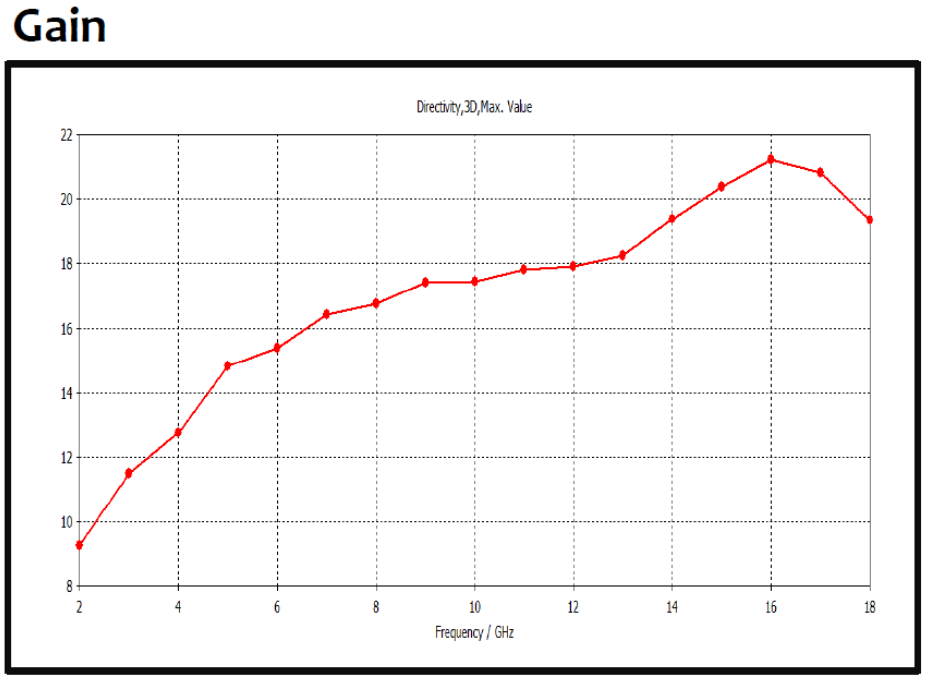
(0.2 GHz steps)



Gain Conversion

Extracted Gain Curve

- The gain curve provided in the horn antenna's datasheet was extracted using WebPlotDigitizer



Extracted Gain Curve

- See the file: `Standard Horn – Gain Offset.csv`
  - **Frequency:** in GHz
  - **Offset (dB):** this is the offset you should apply to your measurements
    - E.g. If measuring radiation pattern at 3 GHz, you should add 26.56 dB onto all your measured $|S_{21}|$ values
  - **Gain (dB):** This is the peak gain of the horn antenna extracted from the data sheet.
  - **Peak S21 (dB):** Peak $|S_{21}|$ measured for the horn antenna with an input power of 0 dBm from the VNA
    - **The offset data in this file is with reference to a 0 dBm input power.** You will need to adjust the offset if your input power is different

	A	B	C	D
1	Frequency	Offset (dB)	Gain (dB)	Peak S21 (dB)
2	2	22.5	8.79	-13.71
3	2.1	24.18	8.91	-15.27
4	2.2	25.51	9.06	-16.45
5	2.3	26.52	9.21	-17.31
6	2.4	26.17	9.36	-16.81
7	2.5	25.33	9.51	-15.82
8	2.6	26.19	9.66	-16.53
9	2.7	27.63	9.83	-17.8
10	2.8	27.58	9.98	-17.6
11	2.9	27.37	10.14	-17.23
12	3	26.56	10.32	-16.24
13	3.1	26	10.39	-15.61
14	3.2	28.01	10.49	-17.52