



Umbra Lab, Inc. | 133 E De La Guerra #39 Santa Barbara, CA 93101 | (805) 270-5069

Exhibit A - Antenna Patterns

Umbra SAR Block 1

FCC Form 312 Schedule S

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1.0 Objective

To supplement the information provided in Form 312 Schedule S Umbra is providing our Space Station antenna diagrams as required from question S8(e).

2.0 UPLINK – S-Band Command and Control Data

2.1.1 SPACE STATION RECEIVING ANTENNA RADIATION PATTERN (Phi = 0)

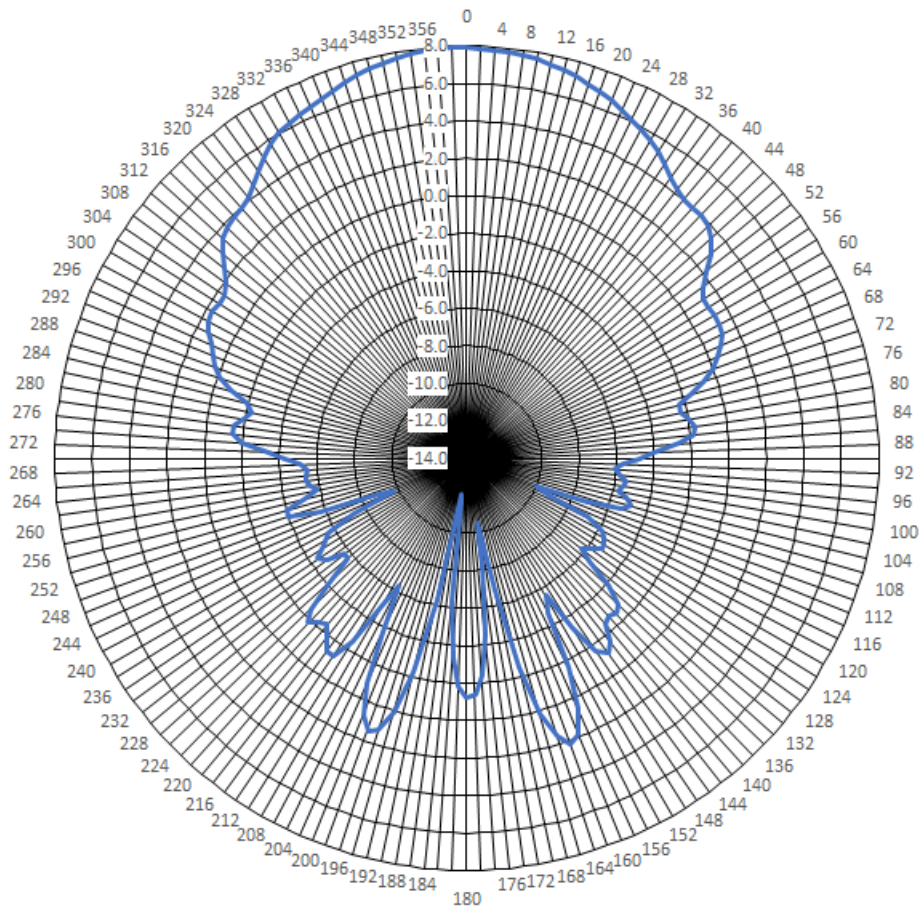


FIGURE 1: S-BAND SPACE ANTENNA H-PLANE (2075 MHZ)

2.1.2 SPACE STATION RECEIVING ANTENNA RADIATION PATTERN (Phi = 90)

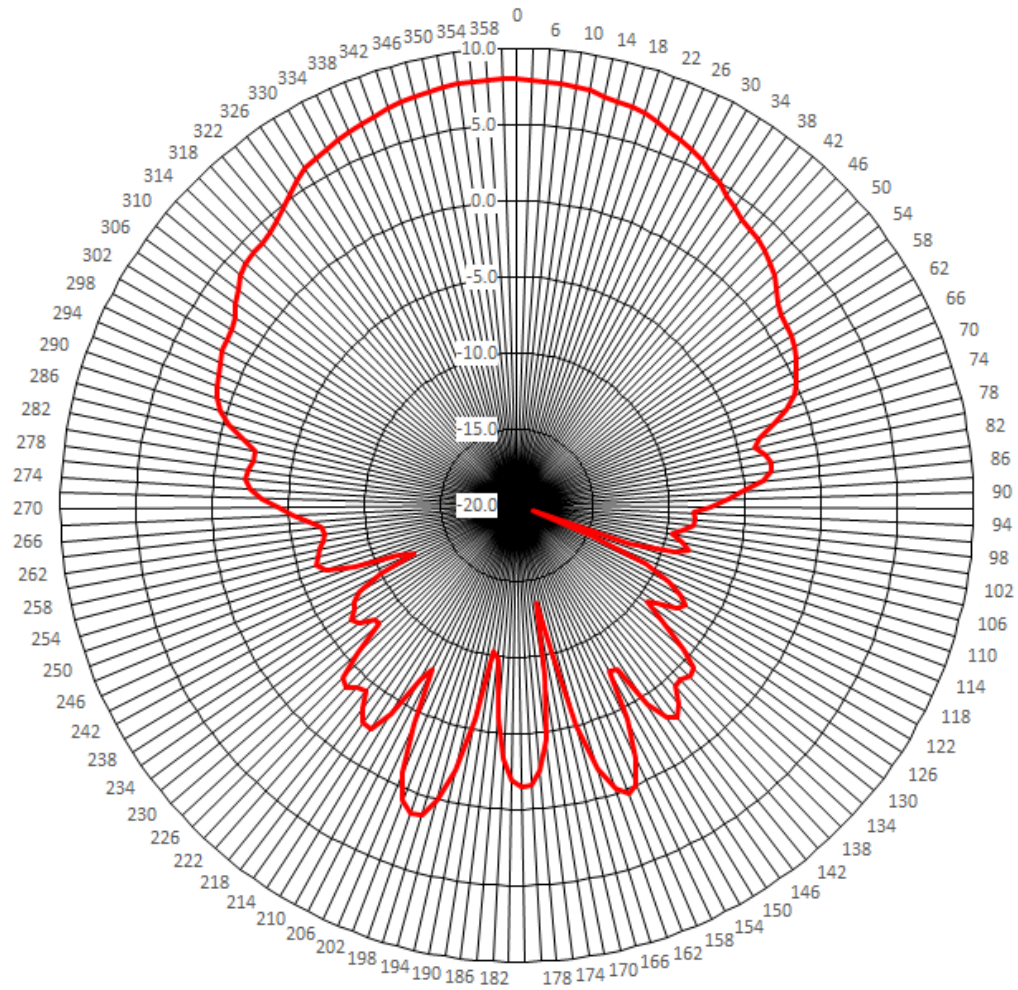


FIGURE 2: S-BAND SPACE ANTENNA V-PLANE (2075 MHZ)

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2.2 EARTH STATION TRANSMITTING ANTENNA RADIATION PATTERN – provided for reference.

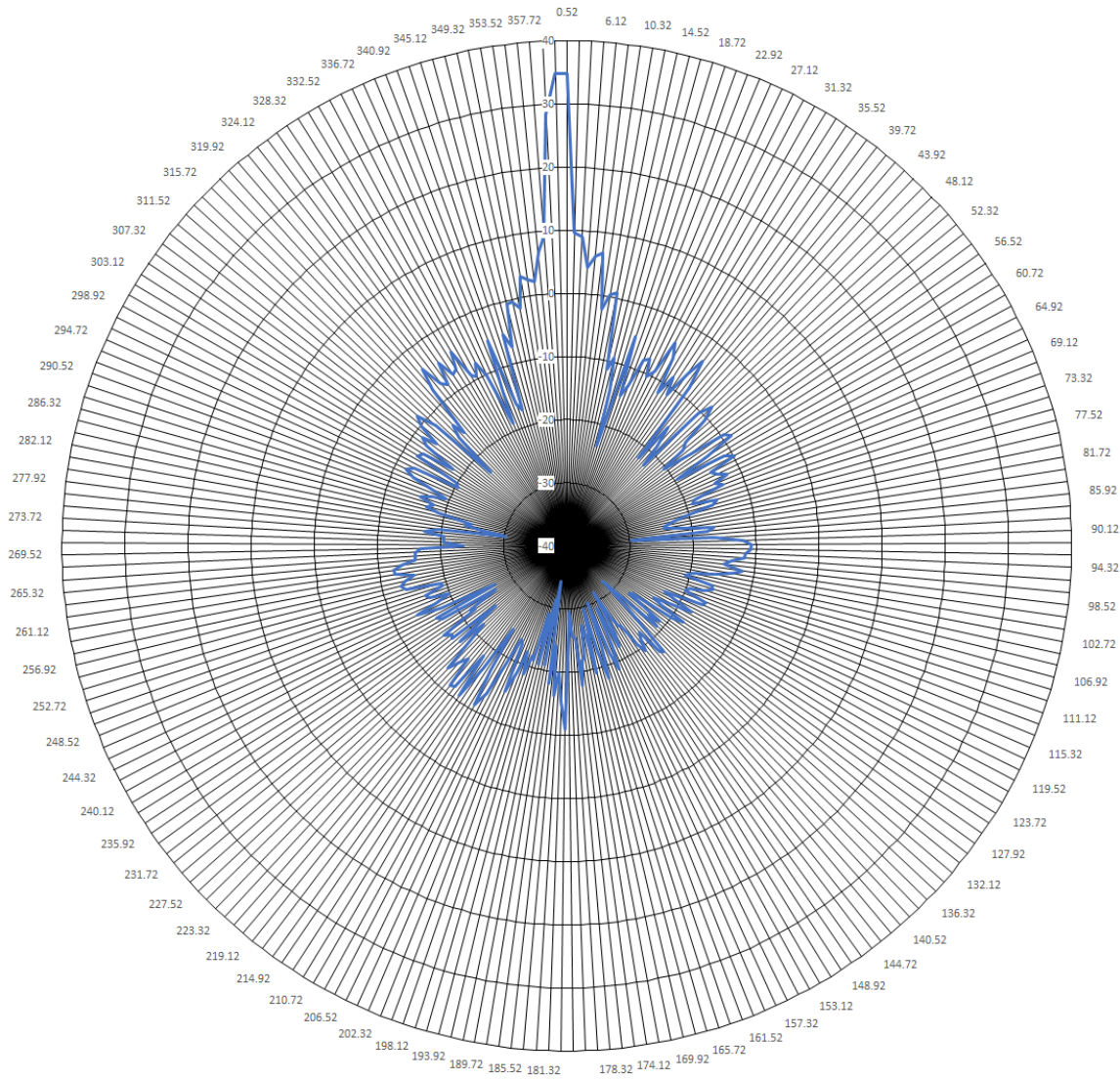


FIGURE 3: S-BAND GROUND ANTENNA (2081 MHZ)

3.0 DOWNLINK – S-Band TT&C Data

3.1.1 SPACE STATION TRANSMITTING ANTENNA RADIATION PATTERN (Phi = 0)

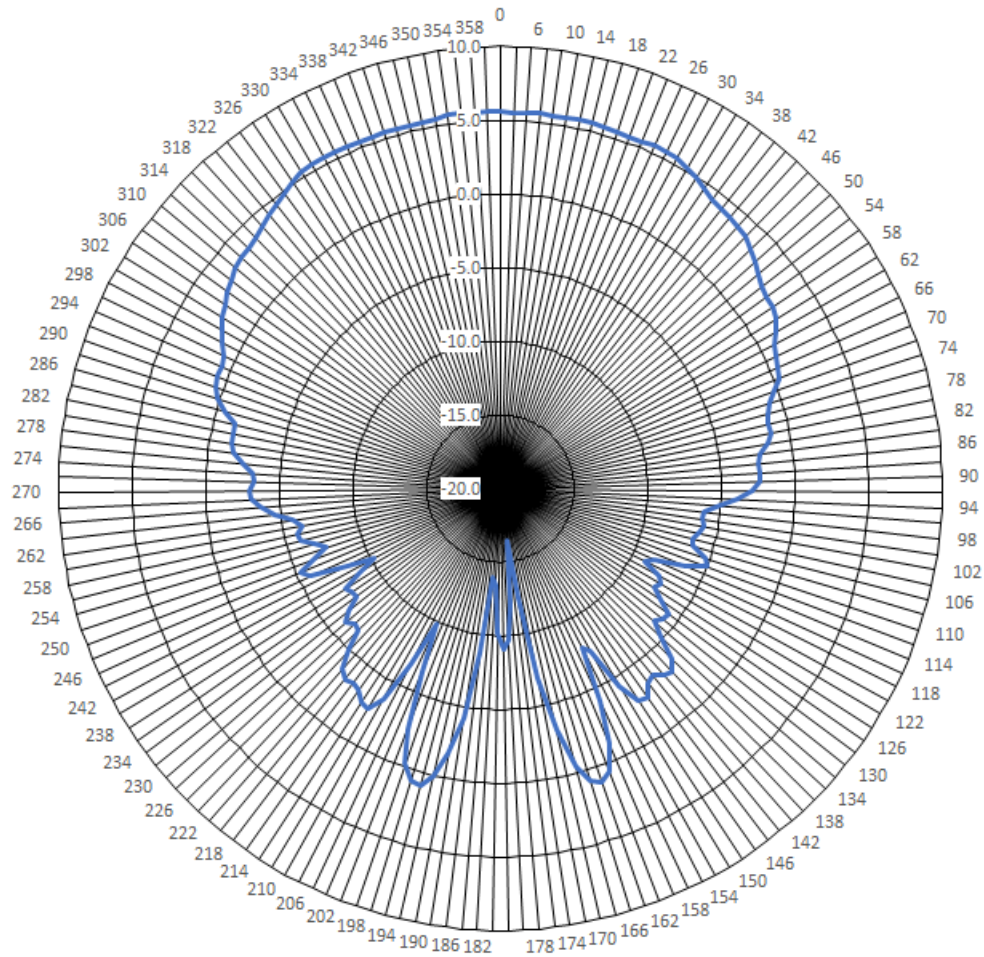


FIGURE 4: S-BAND SPACE ANTENNA H-PLANE (2250 MHZ)

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3.1.2 SPACE STATION RECEIVING ANTENNA RADIATION PATTERN (Phi = 90)

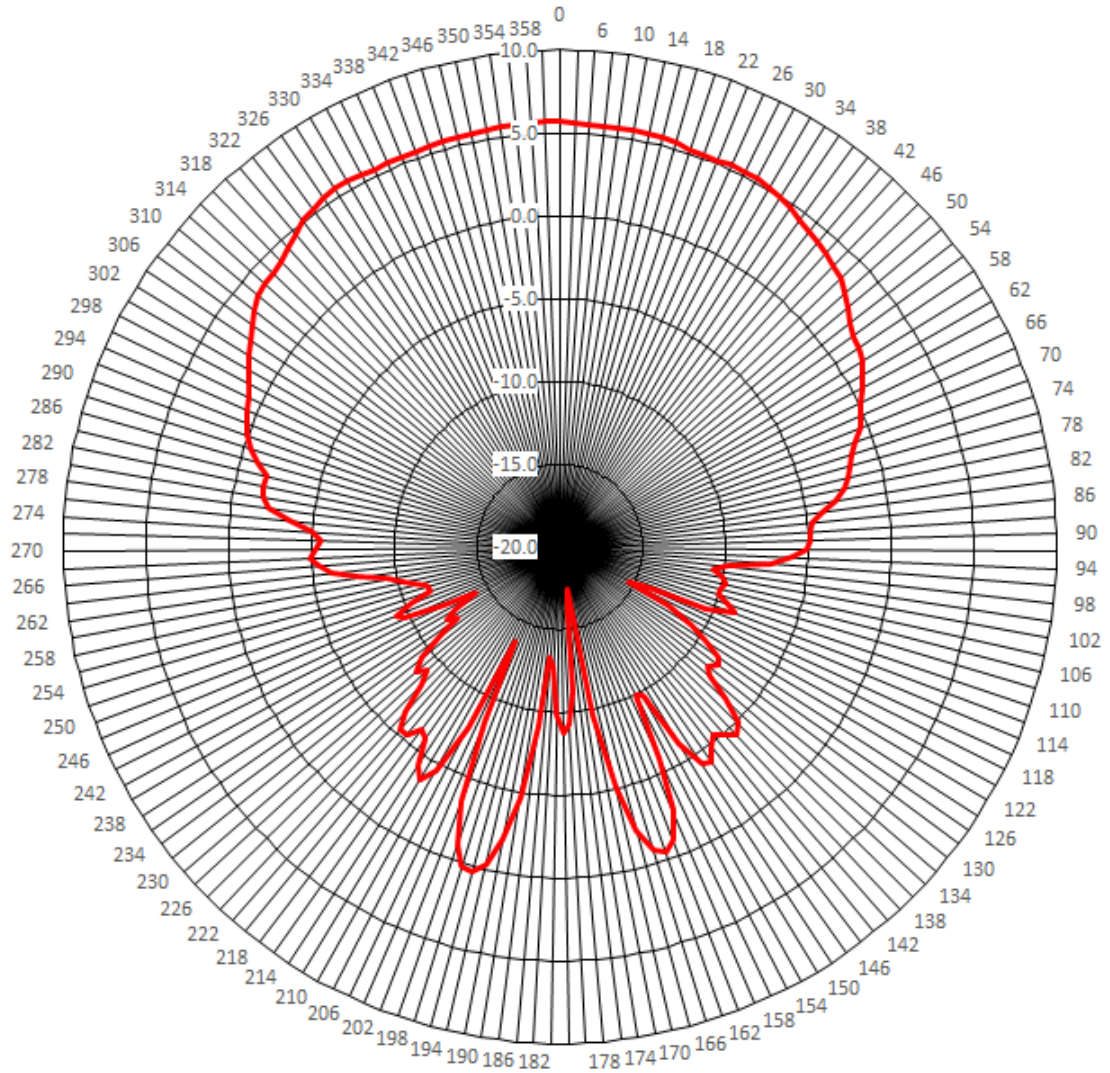


FIGURE 5: S-BAND SPACE ANTENNA V-PLANE (2250 MHZ)

3.2 EARTH STATION RECEIVING ANTENNA RADIATION PATTERN – provided for reference.

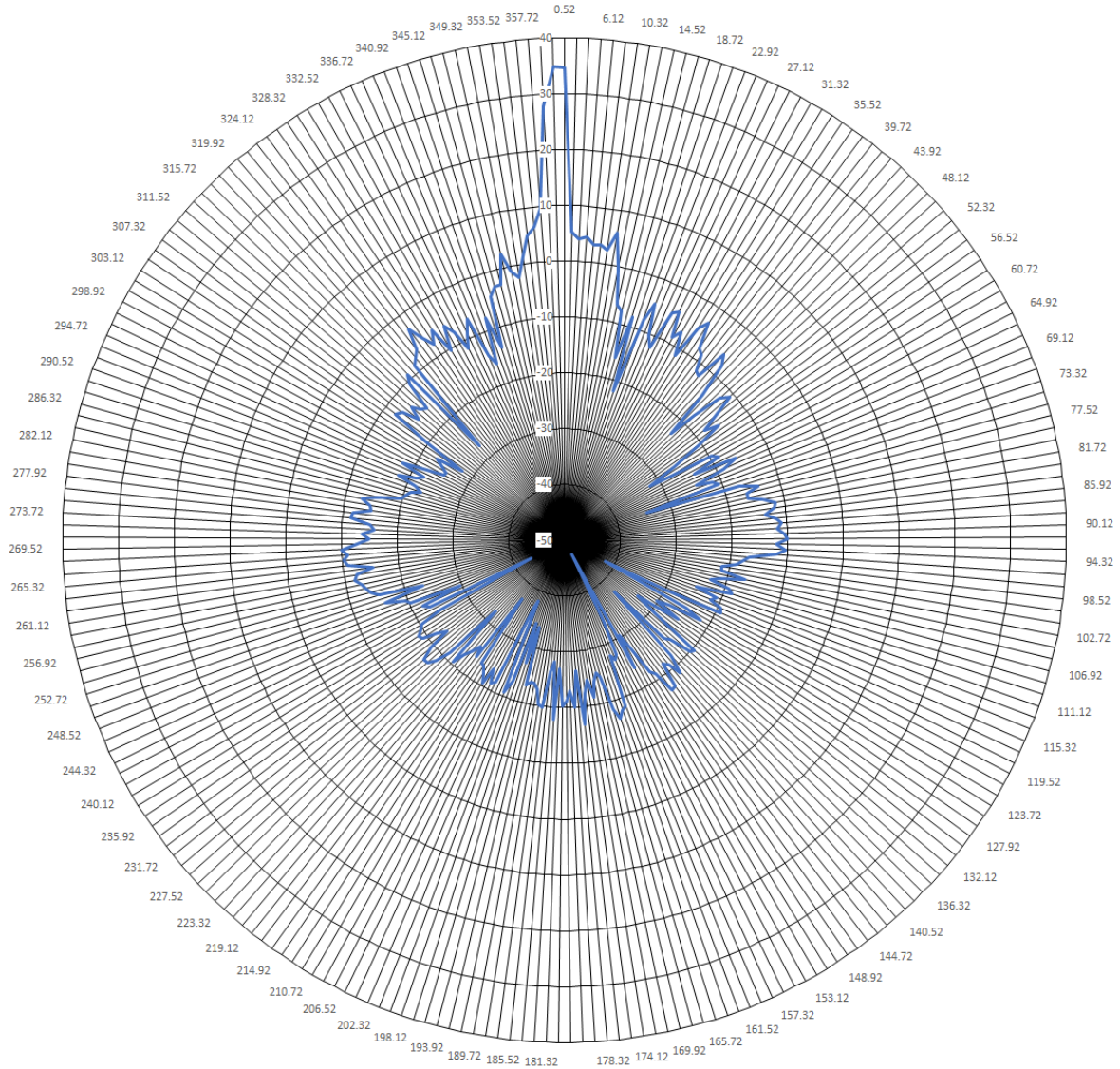


FIGURE 6: S-BAND GOUND ANTENNA (2250 MHZ)

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4.0 DOWNLINK – X-Band Mission Data

Transmissions of X-band mission data utilizes a different antenna for the first and subsequent vehicles. A wider beam and lower gain antenna is used on our first vehicle Umbra-2001 with a higher gain and more narrow beam for subsequent vehicles. The antenna patterns for these are below with Umbra-2001 covered in 4.1.1 and 4.1.2 and all subsequent vehicles using the antenna depicted in 4.1.3 and 4.1.4.

4.1.1 SPACE STATION TRANSMITTING ANTENNA RADIATION PATTERN (40°, Phi = 0)

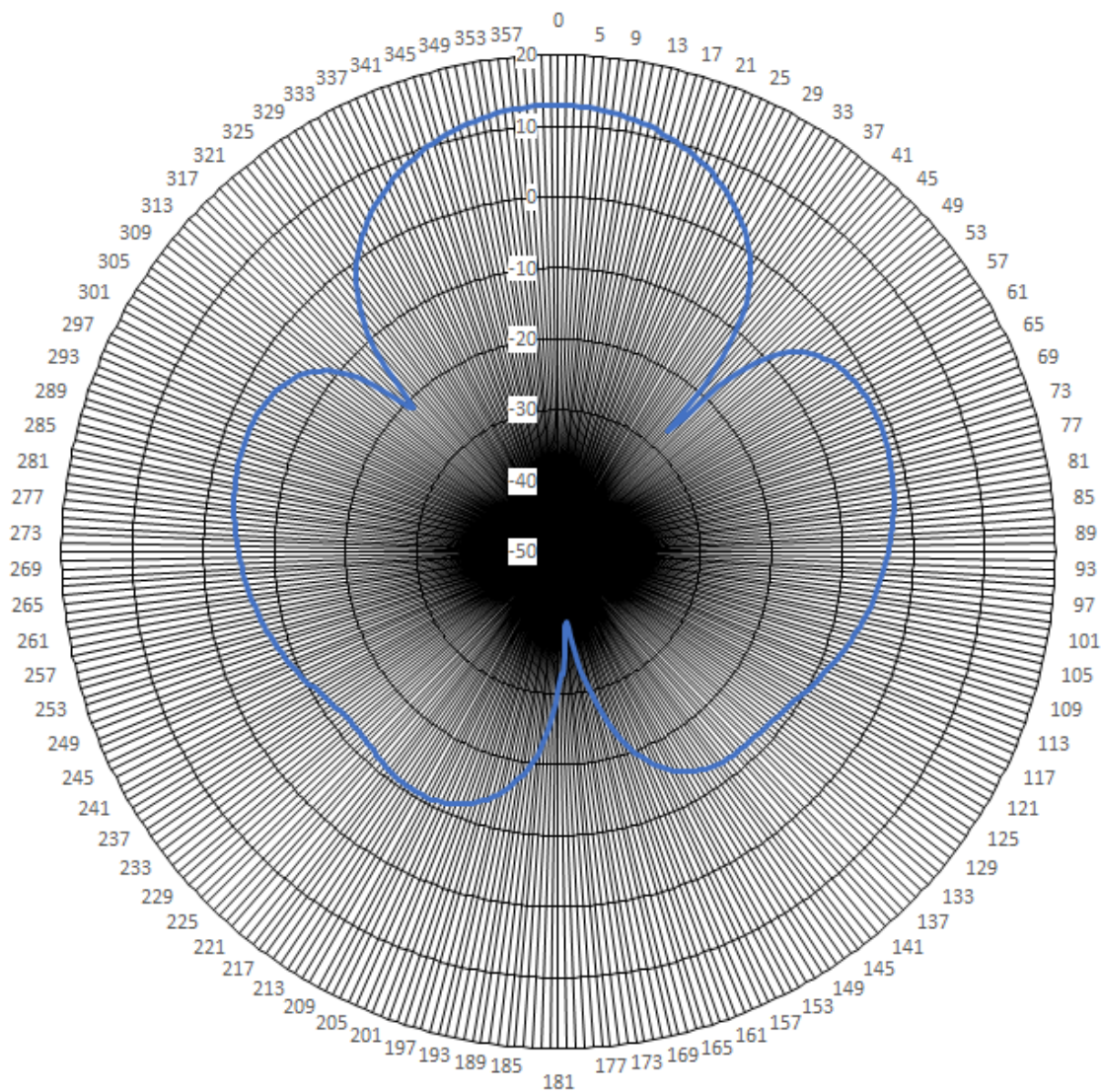


FIGURE 7: X-BAND SPACE ANTENNA 40° HPBW, Phi: 0 (8150 MHZ)

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4.1.2 SPACE STATION TRANSMITTING ANTENNA RADIATION PATTERN (40°, Phi = 90)

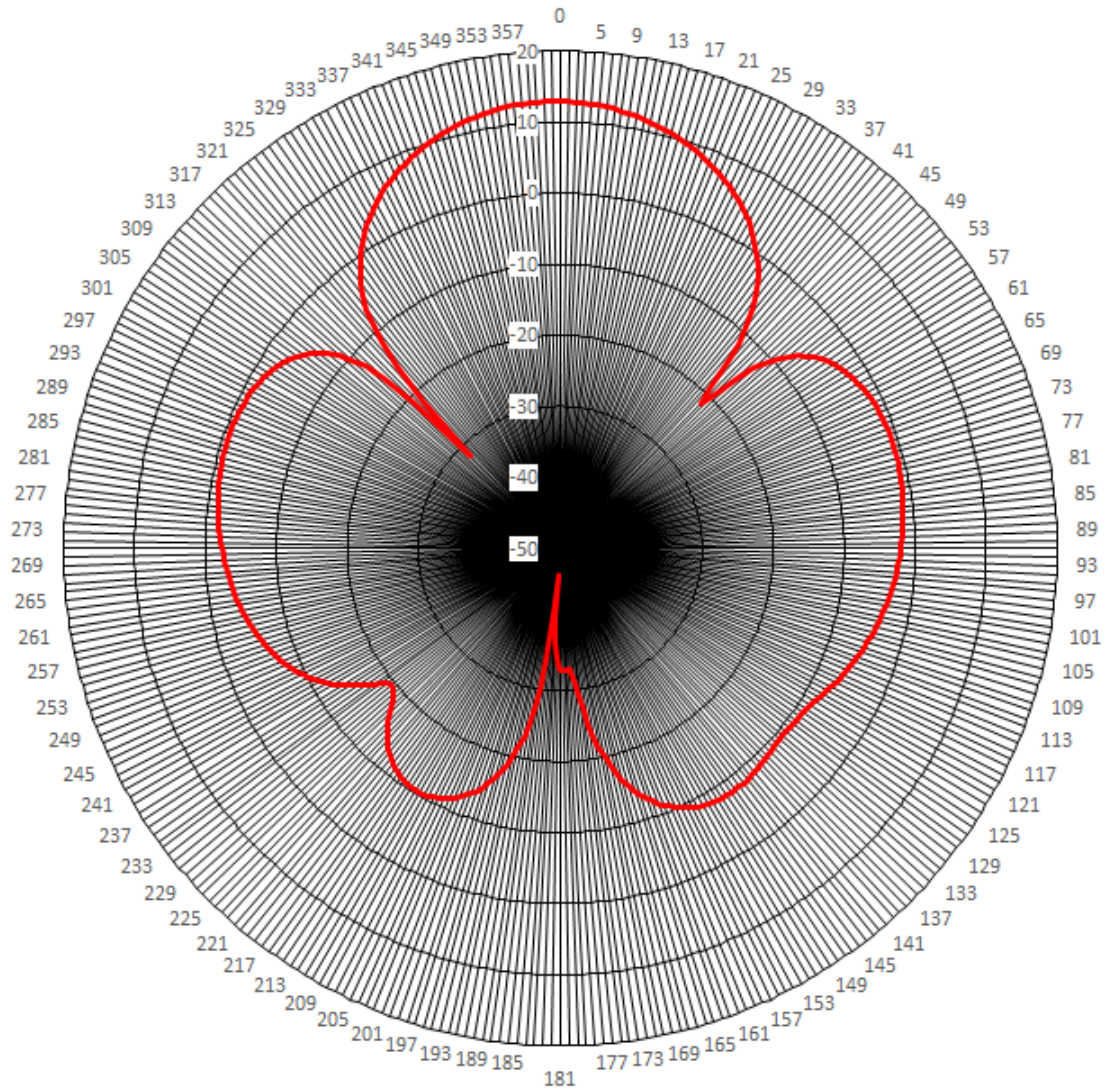


FIGURE 8: X-BAND SPACE ANTENNA 40° HPBW, Phi: 90 (8150 MHZ)

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4.1.3 SPACE STATION TRANSMITTING ANTENNA RADIATION PATTERN (18°, Phi = 0)

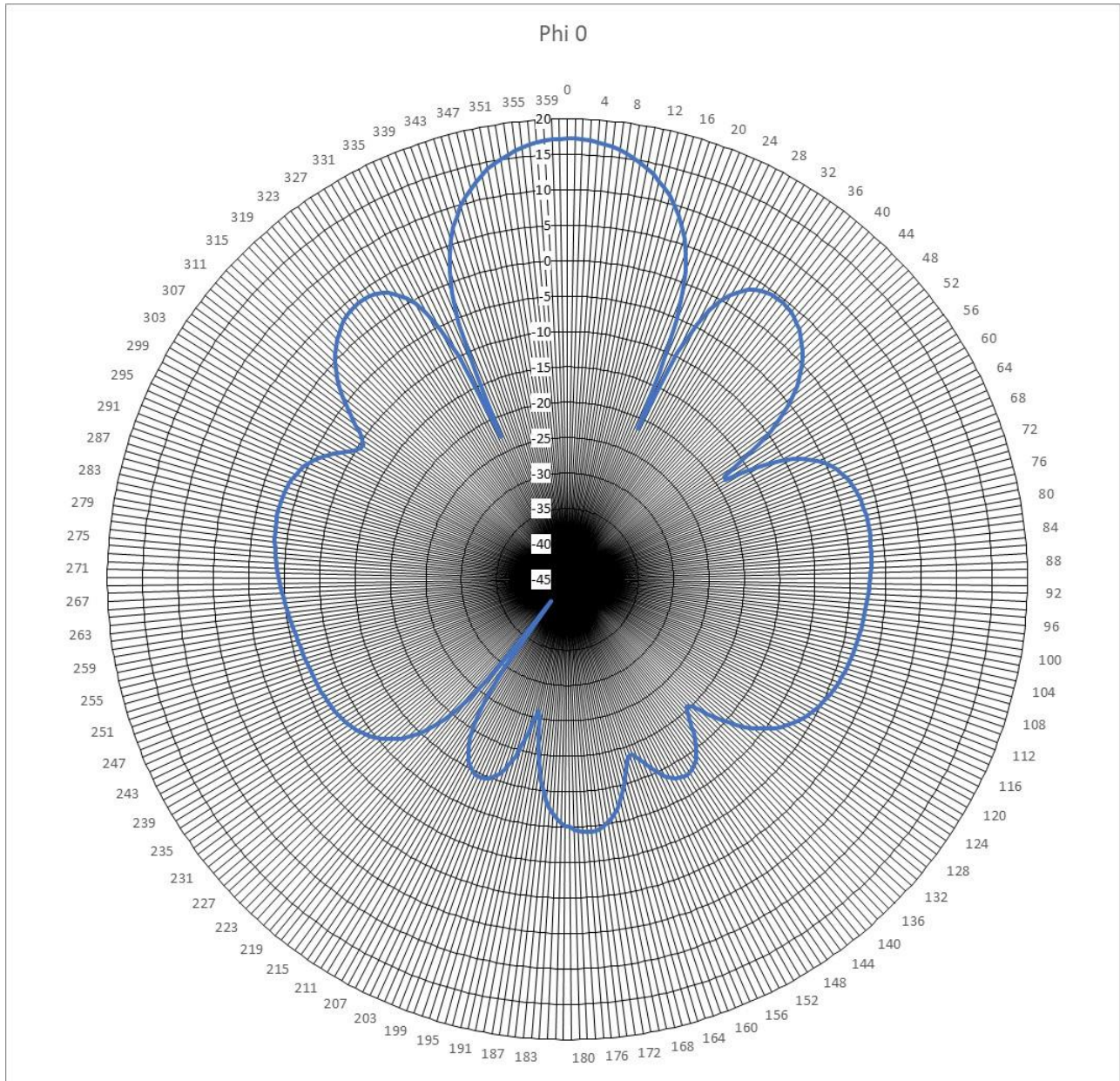


FIGURE 7: X-BAND SPACE ANTENNA 18° HPBW, Phi: 90 (8150 MHZ)

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4.1.4 SPACE STATION TRANSMITTING ANTENNA RADIATION PATTERN (18°, Phi = 90)

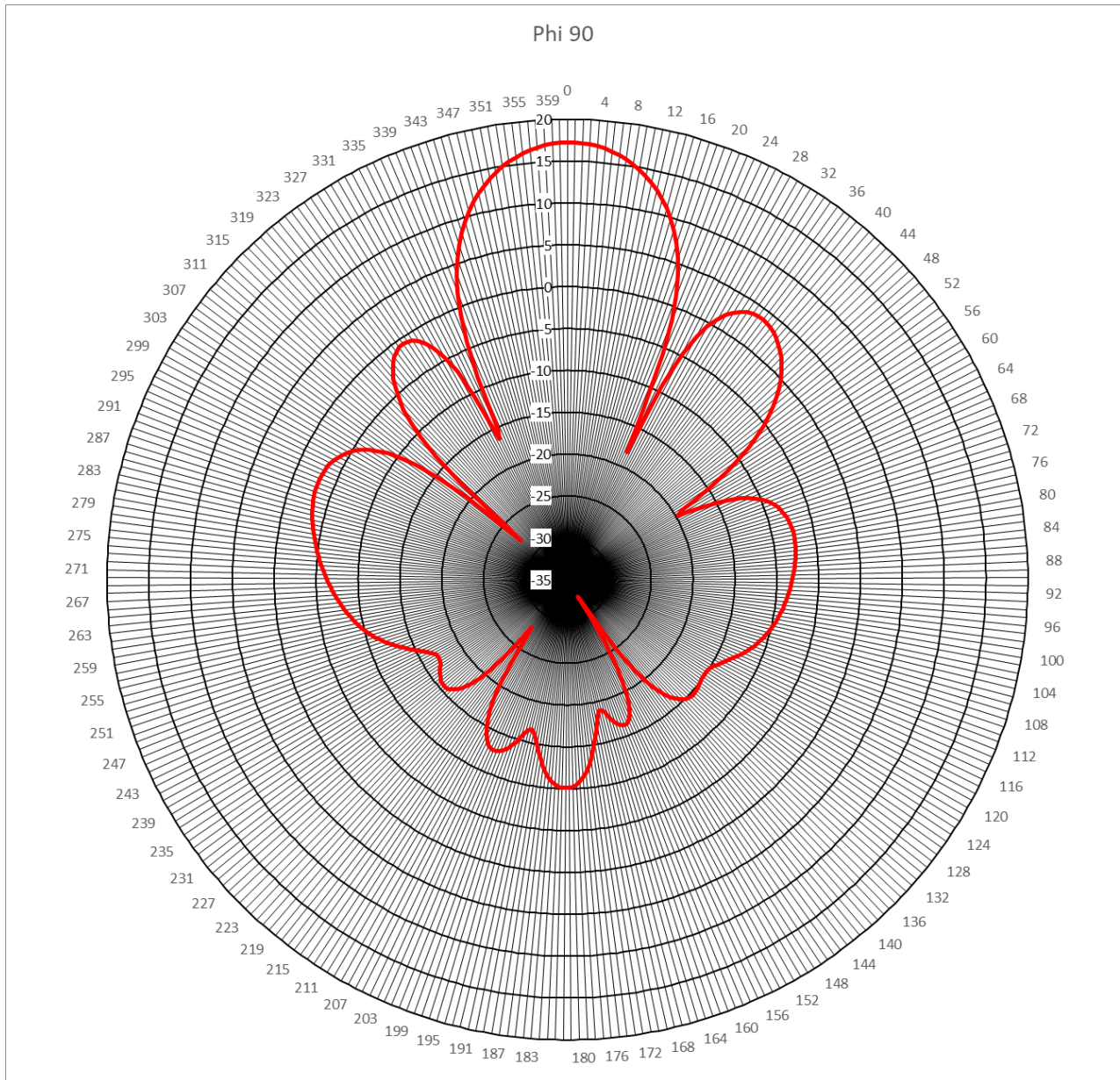


FIGURE 8: X-BAND SPACE ANTENNA 18° HPBW, Phi: 90 (8150 MHZ)

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4.2 EARTH STATION RECEIVING ANTENNA RADIATION PATTERN – provided for reference.

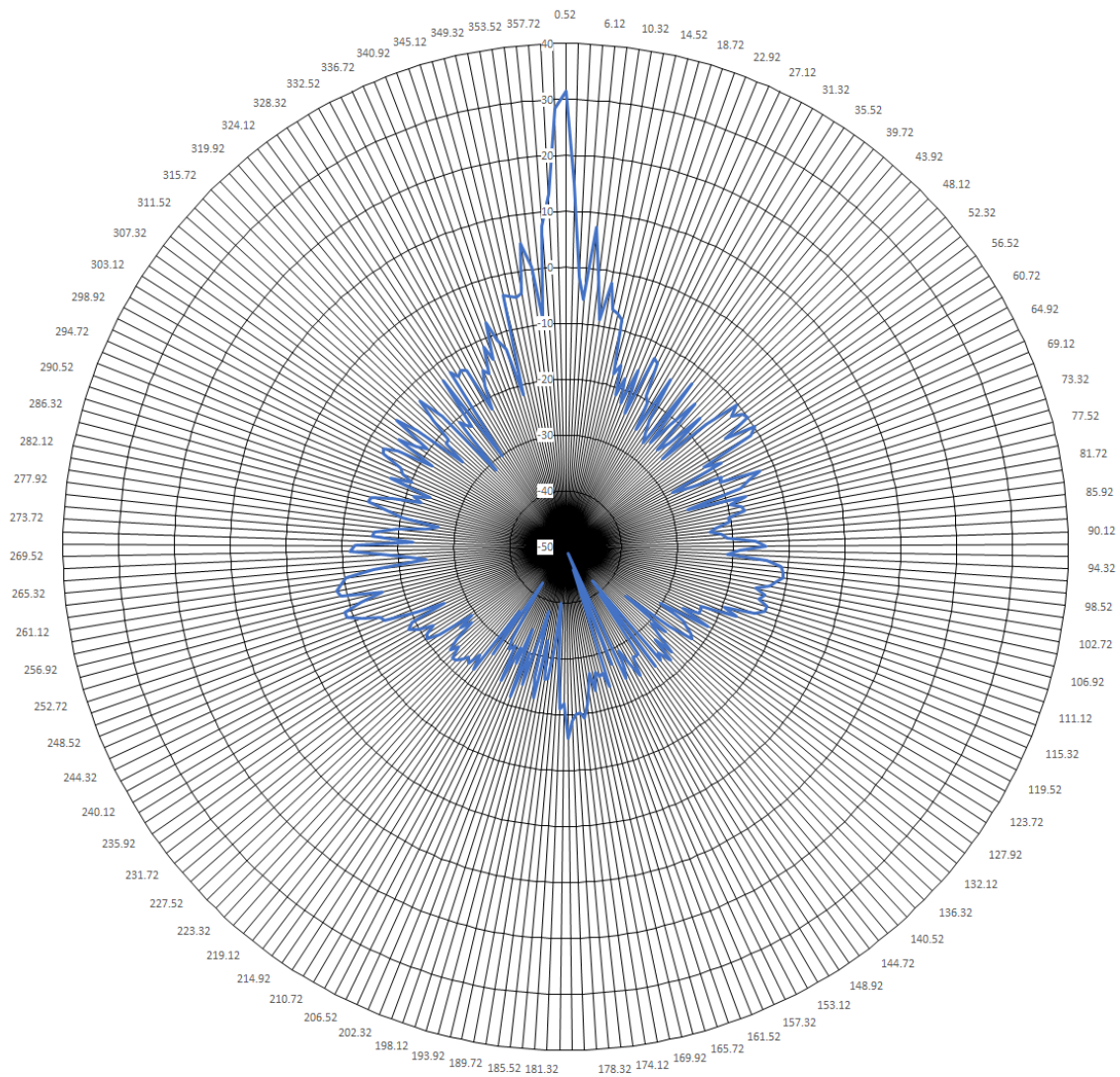


FIGURE 9: X-BAND GROUND ANTENNA (8200 MHZ)

5.0 SAR Payload Radiation Pattern

5.1.1 SPACE STATION TRANSMITTING ANTENNA – SAR summary

5.1.2 SPACE STATION TRANSMITTING ANTENNA RADIATION PATTERN IN POLAR FORMAT (H-PLANE)

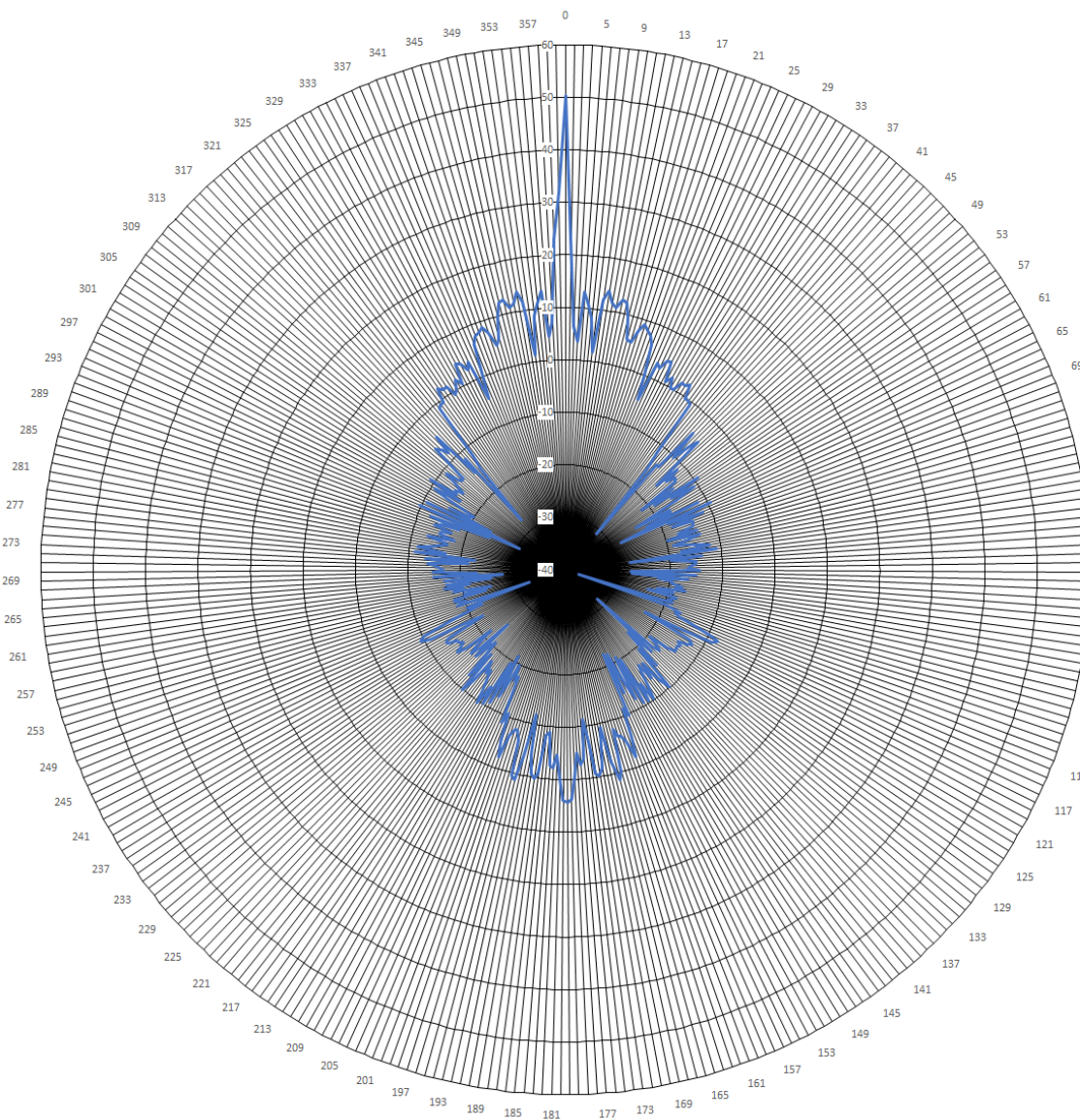


FIGURE 10: UMBRA-2001 SAR SPACE ANTENNA H-PLANE

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5.1.3 SPACE STATION TRANSMITTING ANTENNA RADIATION PATTERN IN POLAR FORMAT (V-PLANE)

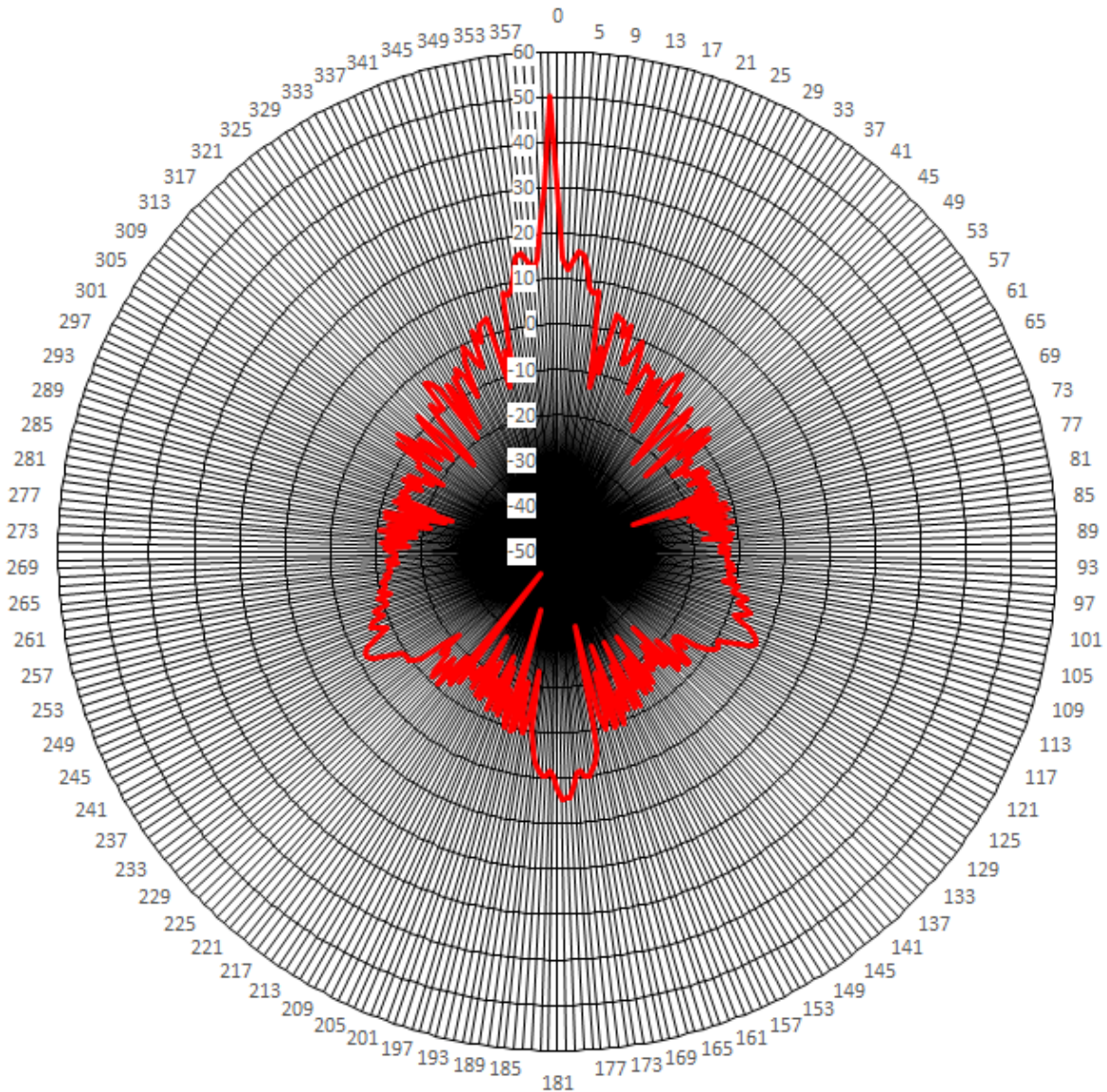


FIGURE 11: UMBRA-2001 SAR SPACE ANTENNA V-PLANE