

Features

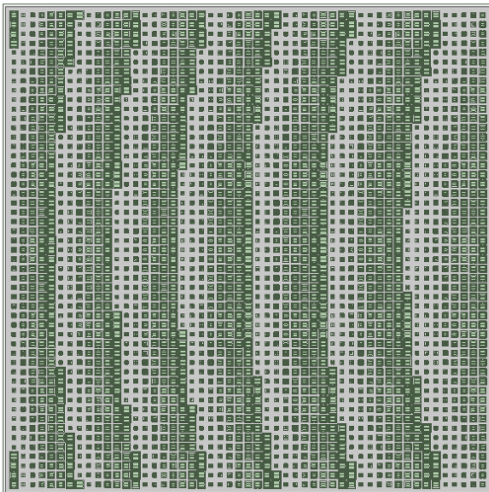
- Frequency coverage: 27-29 GHz
- 8 different commonly used reflection angles available
- Passive reflector so no power is required
- Bi-directional
- Distance coverage from 2 meters up to infinite
- Typical gain when reflector is placed at 2 meters away from BBox One is around 40 dB

Applications

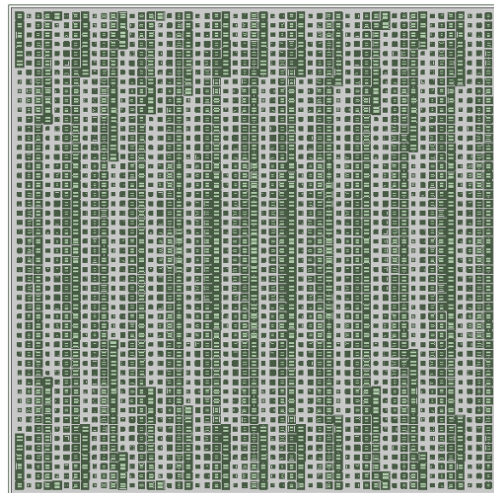
- Extension of 5G NR mmWave signal
- Improve the signal quality for weak or null 5G NR mmWave signal area
- Upgrade area where wiring is difficult with 5G NR mmWave signal

Reflector Frontal View

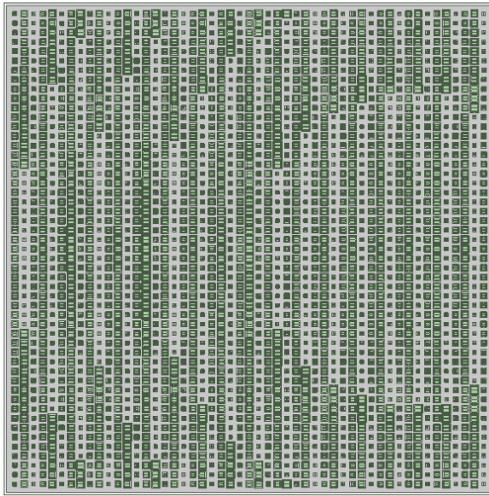
ES0015: INC. 0°, REF. 15°



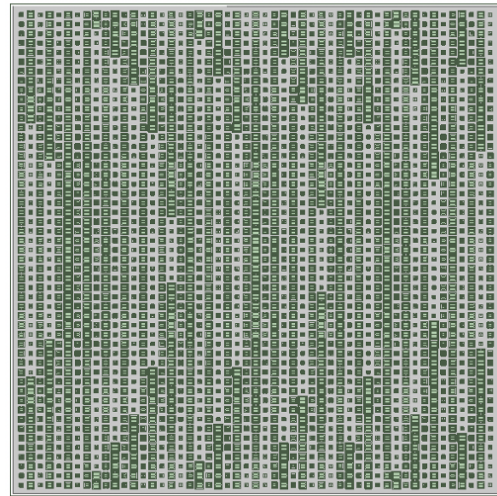
ES0030: INC. 0°, REF. 30°



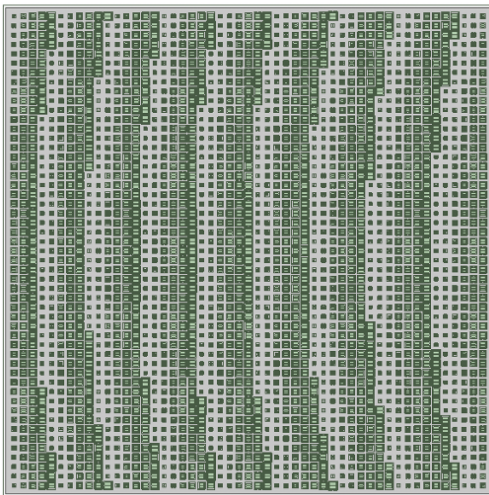
ES0045: INC. 0°, REF. 45°



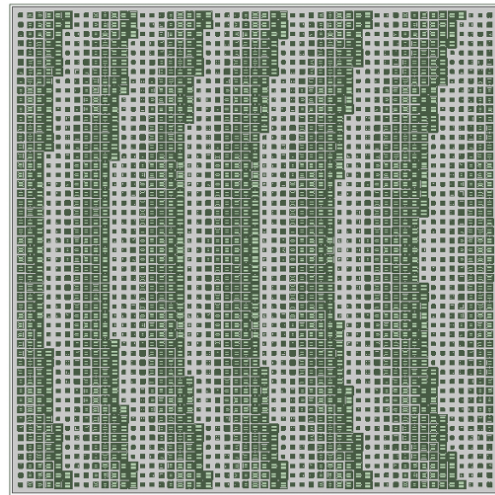
ES0060: INC. 0°, REF. 60°



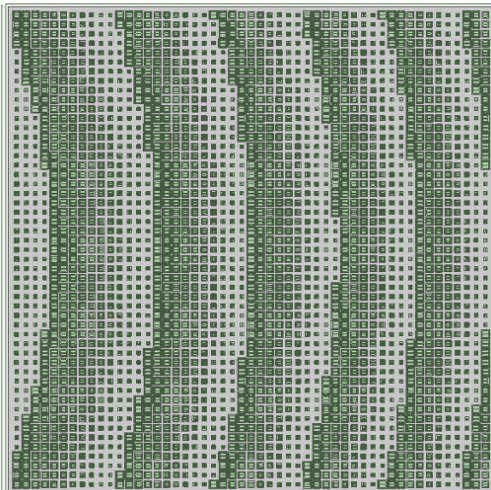
ES3010: INC. 30°, REF. -10°



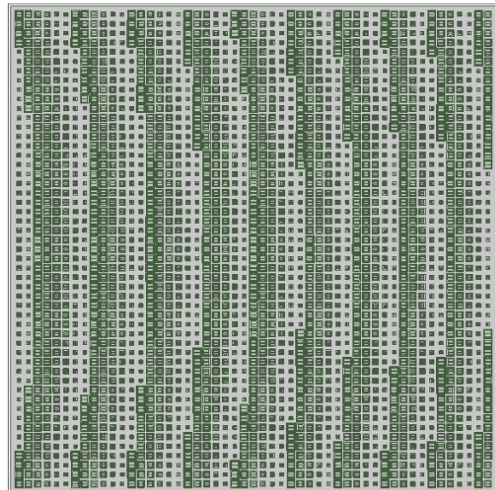
ES3015: INC. 30°, REF. -15°



ES3045: INC. 30°, REF. -45°



ES3060: INC. 30°, REF. -60°



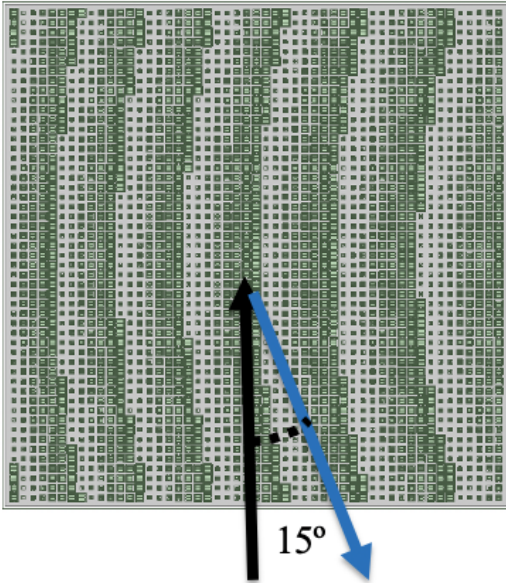
RF Specifications

Parameter	Unit	ES0015	ES0030	ES0045	ES0060
Frequency band	GHz	27 – 29			
Angle of Incidence	deg	0	0	0	0
Angle of Reflection	deg	15 ±1	30 ±1	45 ±2	60 ±3
RCS Gain @28GHz	dB	75.3	74.9	73.3	69.9
Realized Peak Gain (BBox One, as transmitter, is placed 2 m away from the reflector) @28GHz	dB	49.4	49	47.3	44
3 dB Beamwidth @28GHz	deg	2.0	2.2	2.6	3.8
Distance from transmitter	m	> 2 meters			
Reflector Size	mm	280 x 280 x 1.6			

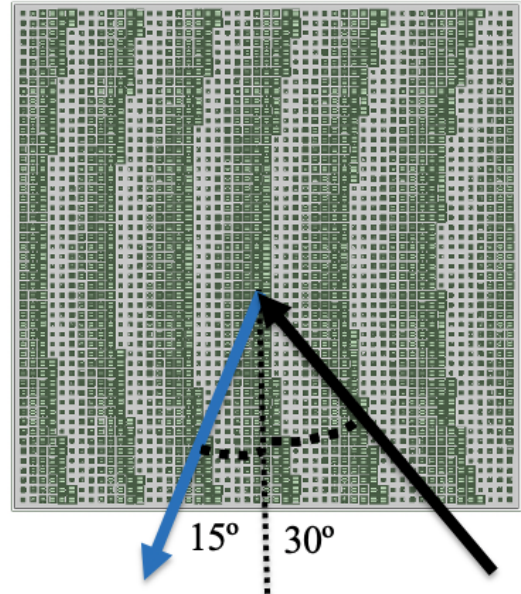
Parameter	Unit	ES3010	ES3015	ES3045	ES3060
Frequency band	GHz	27 – 29			
Angle of Incidence	deg	30	30	30	30
Angle of Reflection	deg	-10 ±1	-15 ±1	-45 ±1	-60 ±2
RCS Gain @28GHz	dB	74.2	74.4	73.2	69.1
Realized Peak Gain (BBox One, as transmitter, is placed 2 m away from the reflector) @28GHz	dB	48.3	48.5	47.3	43.2
3 dB Beamwidth @28GHz	deg	2.0	2.0	2.6	3.9
Distance from transmitter	m	> 2 meters			
Reflector Size	mm	280 x 280 x 1.6			

Definition of Angle of Incidence and Angle of Reflection

Incidence at 0°, Reflection at 15°



Incidence at 30°, Reflection at -15°



Link Budget Calculations using Reflector Gain

Receiver power equation

$$P_{Received} = P_{Transmit} - Path Loss_{Transmitter\ to\ Reflector} + G_{RCS} - Path Loss_{Reflector\ to\ Receiver} + G_{Receiver} \quad (1)$$

Calculation example

Given

Reflector is placed **2 meters** away from the transmitter source directly pointing at the reflector (**Inc. 0°**).
 The receiver is placed **5 meters** away from the reflector with a tilt angle of 45° (**Ref. 45°**).
 Transmitter power is **41.5 dBm** (EIRP of BBox One).
 Receiver gain is **33 dB** (Receiver Maximum Gain of BBox Lite).

Solution

$$P_{Received} = 41.5\ dBm - 67.41\ dB + 73.3\ dB - 75.36\ dB + 33\ dB = 5.03\ dBm$$

Tabulated examples using Equation (1)

Angle of Incidence = 0 deg

Angle of Reflection = 45 deg

Transmit Power (dBm)	Transmitter to Reflector		RCS Gain (dB)	Reflector to Receiver		Receiver Gain (dB)	Received Power (dBm)
	Distance (m)	Pathloss (dB)		Distance (m)	Pathloss (dB)		
41.5	2	67.41	73.3	5	75.36	33	5.03
41.5	3	70.93	73.3	5	75.36	33	1.51
41.5	4	73.43	73.3	5	75.36	33	-0.99
41.5	5	75.36	73.3	5	75.36	33	-2.93
41.5	6	76.95	73.3	5	75.36	33	-4.51
41.5	7	78.29	73.3	5	75.36	33	-5.85
41.5	8	79.45	73.3	5	75.36	33	-7.01
41.5	9	80.47	73.3	5	75.36	33	-8.03
41.5	10	81.38	73.3	5	75.36	33	-8.95
41.5	11	82.21	73.3	5	75.36	33	-9.78
41.5	12	82.97	73.3	5	75.36	33	-10.53
41.5	13	83.66	73.3	5	75.36	33	-11.23
41.5	14	84.31	73.3	5	75.36	33	-11.87
41.5	15	84.91	73.3	5	75.36	33	-12.47
41.5	16	85.47	73.3	5	75.36	33	-13.03
41.5	17	85.99	73.3	5	75.36	33	-13.56
41.5	18	86.49	73.3	5	75.36	33	-14.05
41.5	19	86.96	73.3	5	75.36	33	-14.52
41.5	20	87.41	73.3	5	75.36	33	-14.97
41.5	21	87.83	73.3	5	75.36	33	-15.39
41.5	22	88.23	73.3	5	75.36	33	-15.80
41.5	23	88.62	73.3	5	75.36	33	-16.18
41.5	24	88.99	73.3	5	75.36	33	-16.55
41.5	25	89.34	73.3	5	75.36	33	-16.91

More tabulated examples using Equation (1)

Angle of Incidence = 30 deg

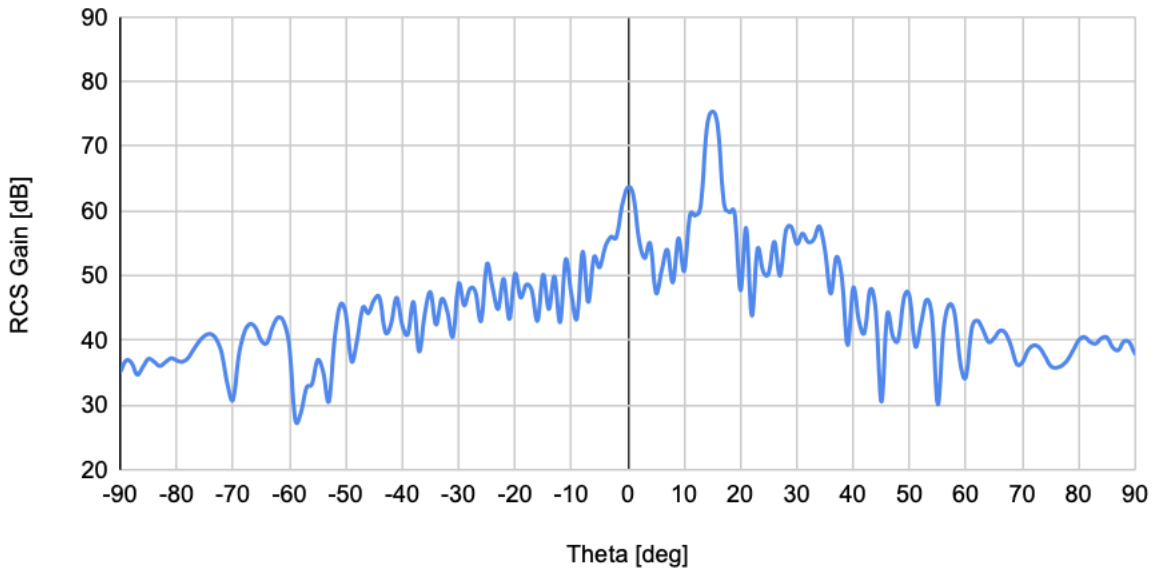
Angle of Reflection = -10 deg

Transmit Power (dBm)	Transmitter to Reflector		RCS Gain (dB)	Reflector to Receiver		Receiver Gain (dB)	Received Power (dBm)
	Distance (m)	Pathloss (dB)		Distance (m)	Pathloss (dB)		
41.5	5	75.36	74.2	0	0.00	33	73.34
41.5	5	75.36	74.2	1	61.38	33	11.95
41.5	5	75.36	74.2	2	67.41	33	5.93
41.5	5	75.36	74.2	3	70.93	33	2.41
41.5	5	75.36	74.2	4	73.43	33	-0.09
41.5	5	75.36	74.2	5	75.36	33	-2.03
41.5	5	75.36	74.2	6	76.95	33	-3.61
41.5	5	75.36	74.2	7	78.29	33	-4.95
41.5	5	75.36	74.2	8	79.45	33	-6.11
41.5	5	75.36	74.2	9	80.47	33	-7.13
41.5	5	75.36	74.2	10	81.38	33	-8.05
41.5	5	75.36	74.2	11	82.21	33	-8.88
41.5	5	75.36	74.2	12	82.97	33	-9.63
41.5	5	75.36	74.2	13	83.66	33	-10.33
41.5	5	75.36	74.2	14	84.31	33	-10.97
41.5	5	75.36	74.2	15	84.91	33	-11.57
41.5	5	75.36	74.2	16	85.47	33	-12.13
41.5	5	75.36	74.2	17	85.99	33	-12.66
41.5	5	75.36	74.2	18	86.49	33	-13.15
41.5	5	75.36	74.2	19	86.96	33	-13.62
41.5	5	75.36	74.2	20	87.41	33	-14.07
41.5	5	75.36	74.2	21	87.83	33	-14.49
41.5	5	75.36	74.2	22	88.23	33	-14.90
41.5	5	75.36	74.2	23	88.62	33	-15.28
41.5	5	75.36	74.2	24	88.99	33	-48.65
41.5	5	75.36	74.2	25	89.34	33	-49.01

Typical Performances

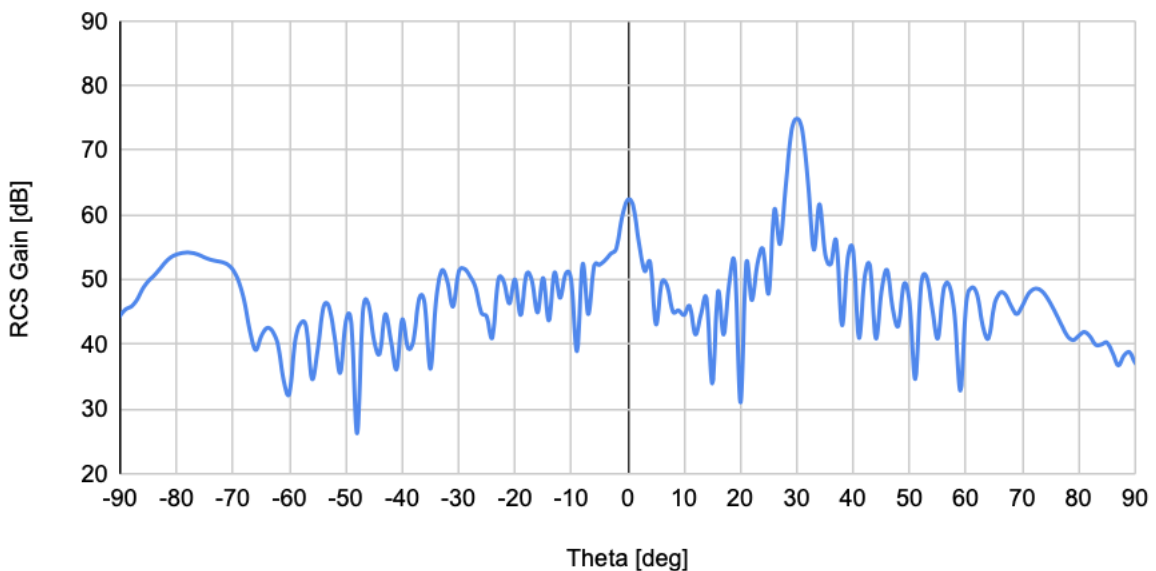
ES0015

INC. 0 deg, REF. 15 deg



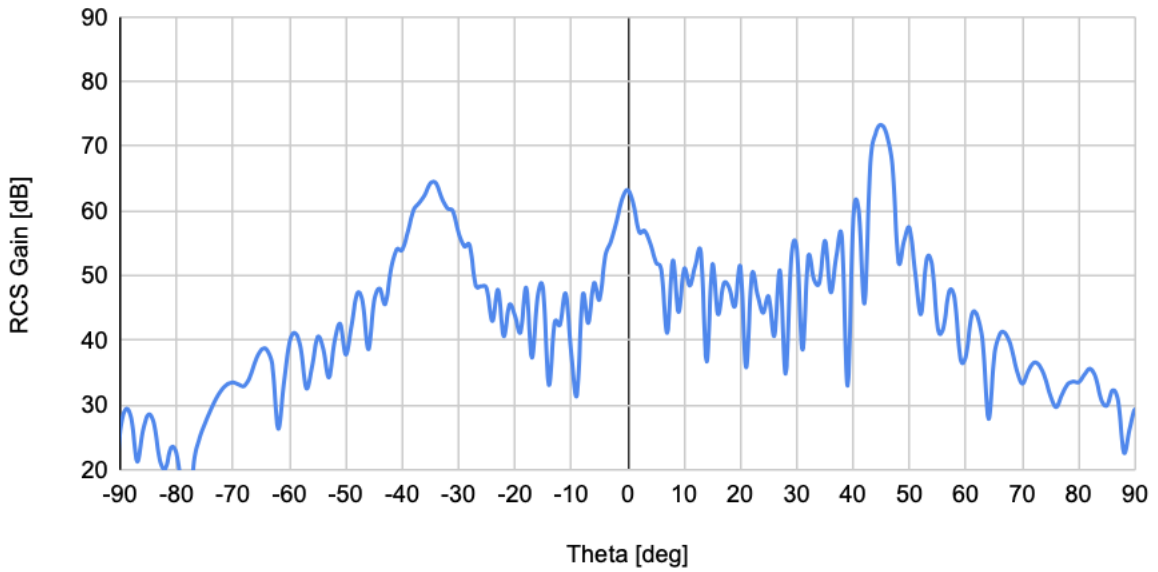
ES0030

INC. 0 deg, REF. 30 deg



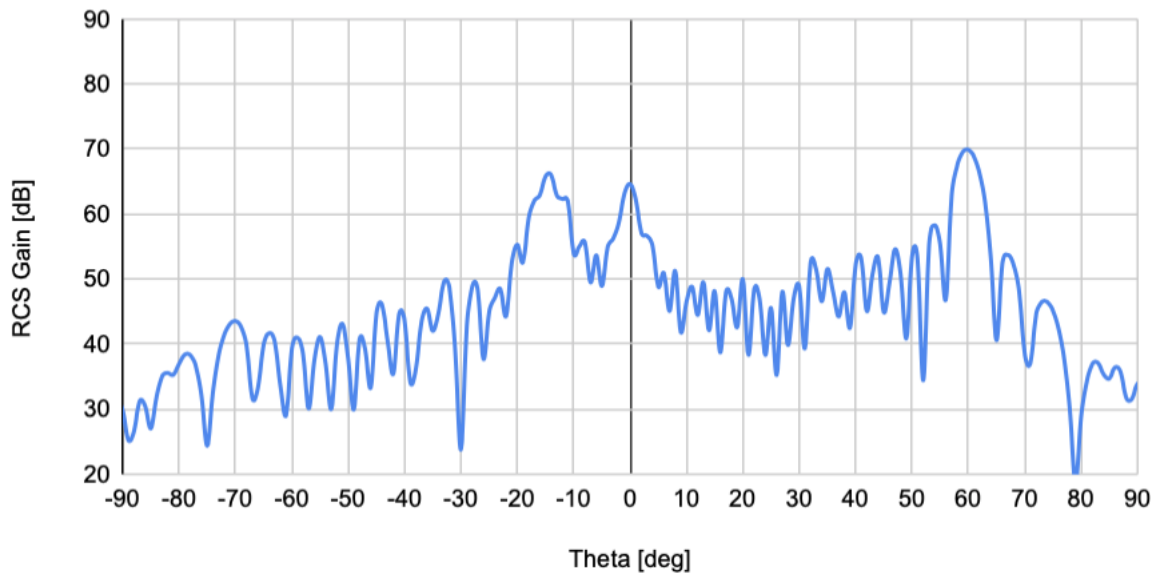
ES0045

INC. 0 deg, REF. 45 deg



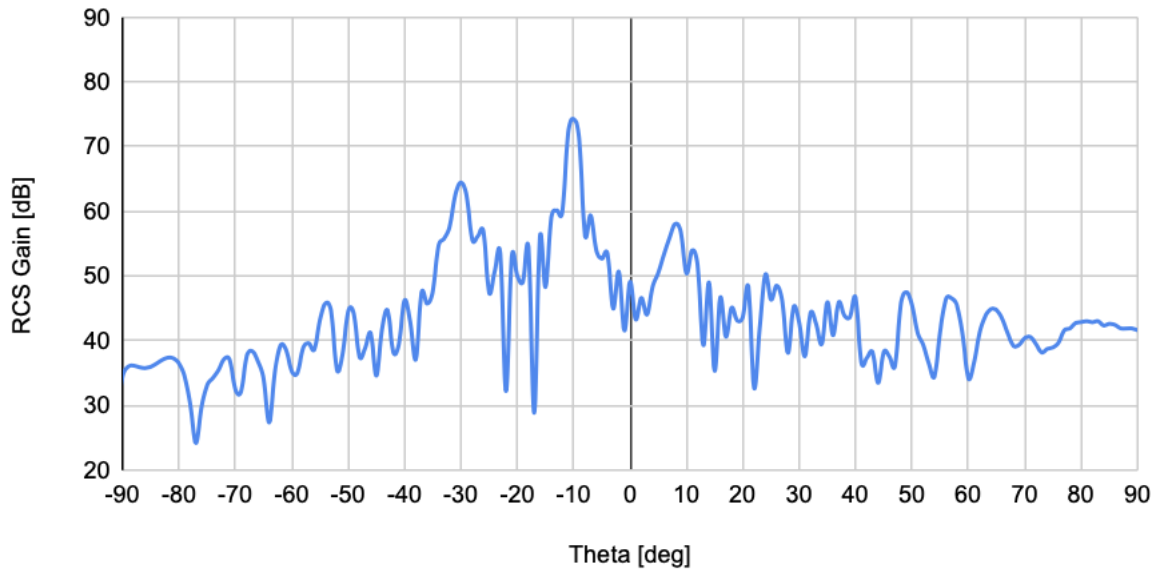
ES0060

INC. 0 deg, REF. 60 deg



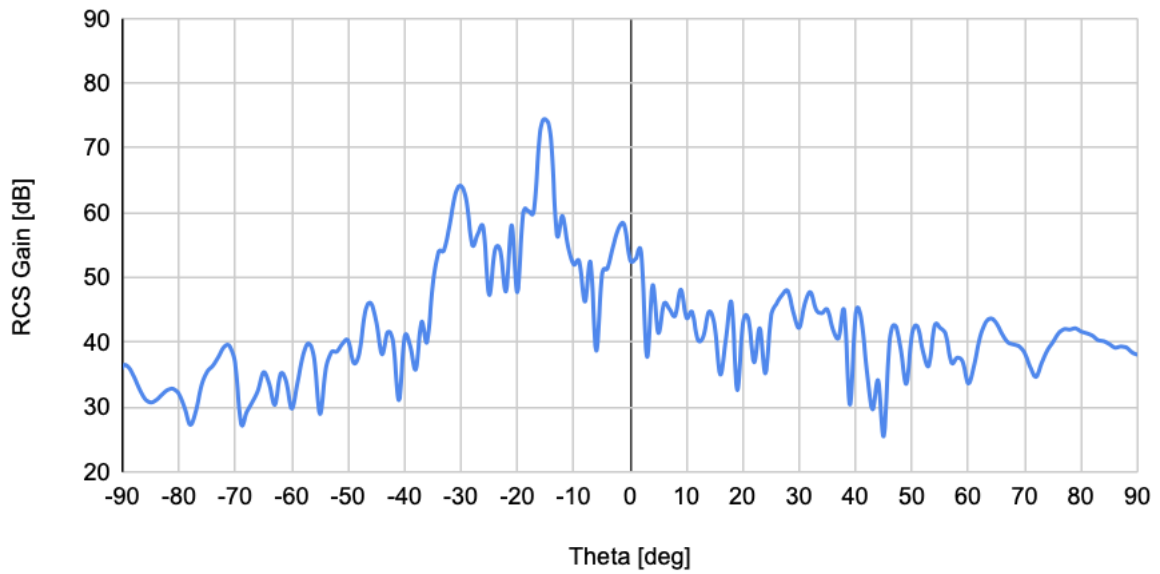
ES3010

INC. 30 deg, REF. -10 deg



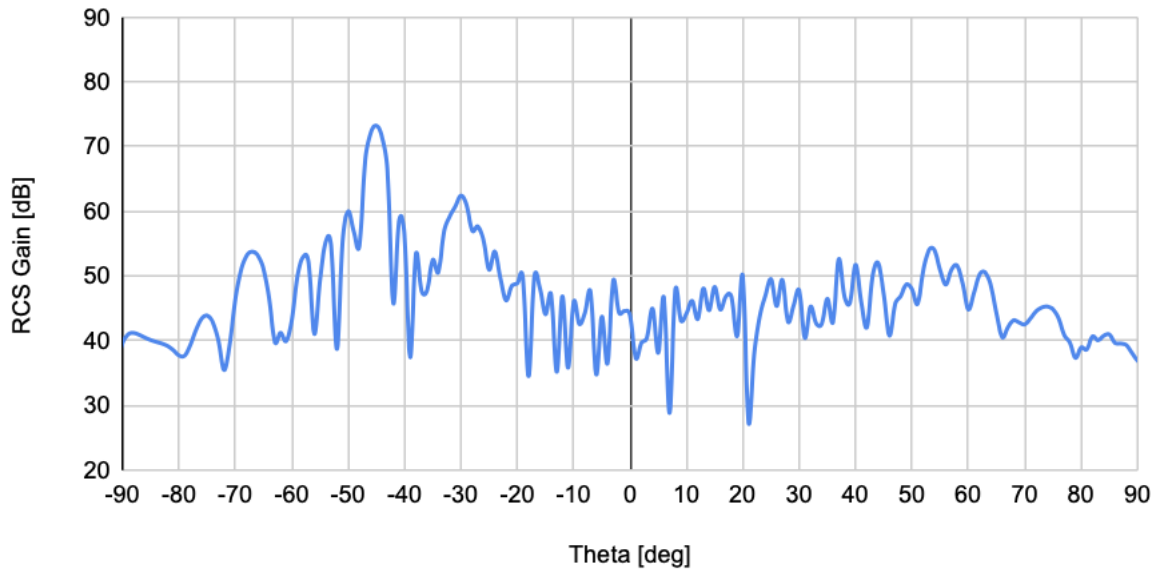
ES3015

INC. 30 deg, REF. -15 deg



ES3045

INC. 30 deg, REF. -45 deg



ES3060

INC. 30 deg, REF. -60 deg

