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August 4, 2010

Cobham SATCOM Land Systems
704 North Clark Street,
Albion, Michigan 49224, USA
ATTN: Leslie Mishrell
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Phone: (517) 630-2688
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RE: X/S-Band Radio Astronomy Feed

Dear Rami,

Attached are the results of testing your X-Band / S-Band Radio Astronomy Feed on July 18, 2010, henceforth referred to as the antenna under test (AUT). The next page details the measurement procedures employed in characterizing the AUT, followed by individual pages of data summarizing the results of testing.

Matlab datasets of the final measurement data are provided, though other formats can be made available upon request. Each dataset contains a frequency vector variable 'freq_vect_Hz' listing the 201 frequency data points over which your antenna was characterized, and a three dimensional data array of complex E-field radiation pattern data 'PolData_gated'. While 201 frequency samples were taken, these cover a range of frequencies above and below your operating band. Because of time gating and the standard gain horn calibration method employed, data well outside of your operating band should not be assumed valid.

The dataset 'PolData_gated' can be indexed in Matlab as

'ComplexGainData(:,:) = PolData_gated(freq_index,:,:)'

Where 'freq_index' = index of the desired frequency depicted in 'freq_vect_Hz' . This results in a a 2-dimensional, dataset for the index frequency, which has the following format

ComplexGainData =

Angle	H-Pol Gain	V-Pol Gain	LHCP Gain	RHCP Gain	AxialRatio	Tilt
-89	hx+jhy	vx+jvy	lx+jly	rx+jry	ar(linear)	tilt(radians)
-88	hx+jhy	vx+jvy	lx+jly	rx+jry	ar(linear)	tilt(radians)
…						
…						

AUT gain can be obtained from the E-field radiation pattern as:

H_Pol_Gain_dB = 20*log10(abs(hx+jhy));

I hope this information is useful to you. Please feel free to call or e-mail with questions/concerns. If there is anything further we can provide to you, please let me know.

Sincerely,

Joe Brunett, Ph.D.
joe@wrtest.com

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General Setup Information:

In this testing, the AUT consisted of the dual mode radio telescope feed provided. The feed cable was made exit the AUT setup orthogonal to the radiating elements and transverse from the measurement plane in so much as possible. Between each AUT and the feed cable is a 6 dB coaxial attenuator to remove any unwanted ringing in the test cables for pattern and gain measurements.

AUT Pattern and Gain Measurement Procedure:

Pattern measurements are performed using an HP 8753/8720 Vector Network Analyzer (VNA) on our outdoor testing range. The AUT is placed on our rotator table at a height of 5 meters, and a Singer Quad-ridge test antenna was placed on our measurement mast at the same height, 10.5 meters from the AUT. Phase and amplitude data is collected for both horizontal and vertical polarizations at each angle as the AUT rotates. Gain and test antenna channel imbalance are computed by substitution with a standard gain horn antenna in each band for both horizontal and vertical polarizations.

After the data is collected, time gating is applied to ensure elimination of ground bounce/multipath influence on the free space gain measurement results desired. Left and right hand circular data is post-processed from the polarimetric H and V data.

AUT Input Impedance Measurement Procedure:

Because of time constraints, Cobham elected to return with their antenna at the end of the first day of testing and forgo collection of the VSWR and isolation data originally requested.

NOTES:

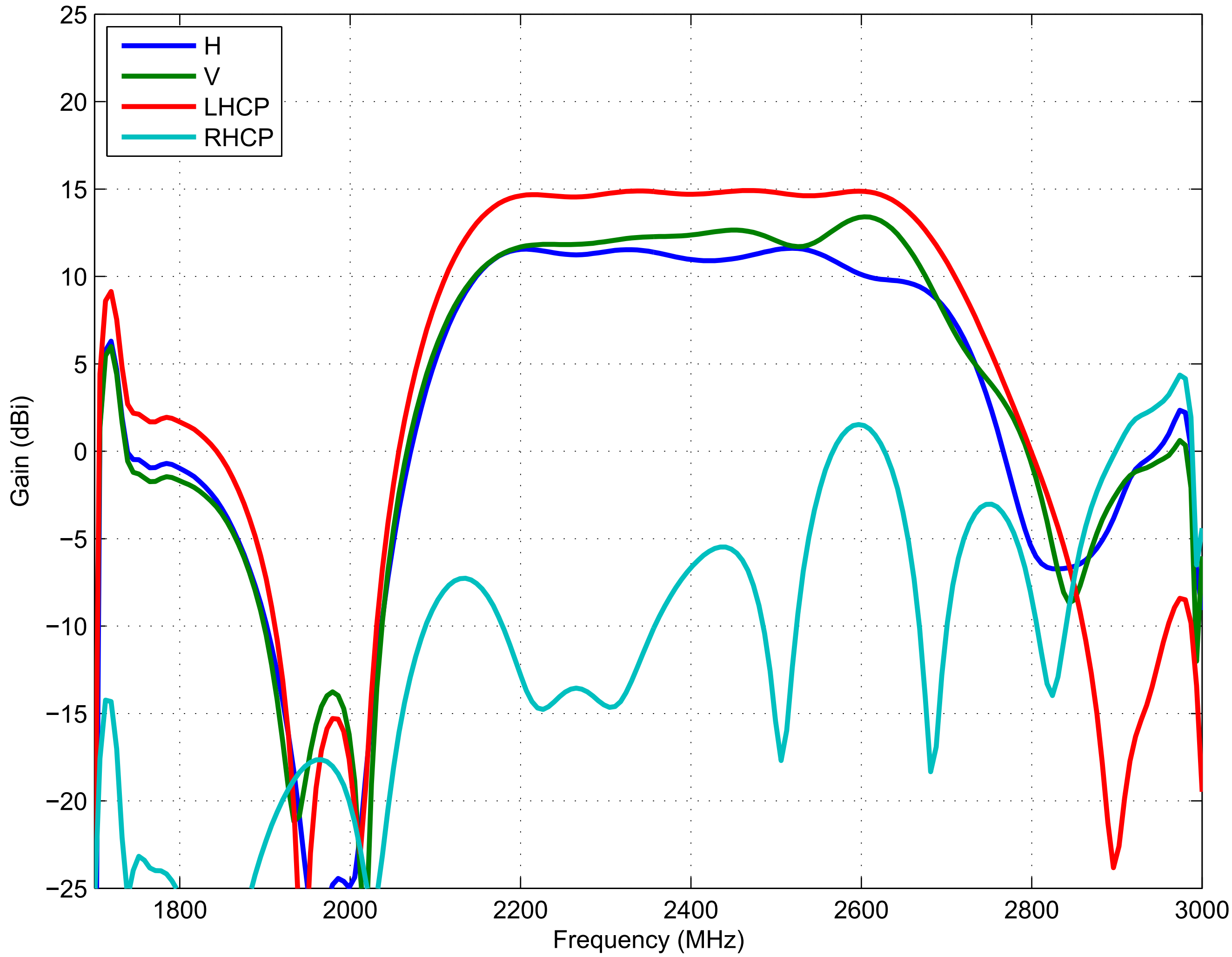
Overall, gain and pattern data is believed to be accurate and reflects the anticipated performance of the AUT.

One item of note, however, is an asymmetry of the computed phase uniformity in the main lobe. Time domain post-processing of the data collected demonstrated that the phase center of the AUT was not perfectly aligned, and fell outside of the preferred uniform phase region of the test antenna during the first 50% of the cut (-90 to 0 degrees - zenith). While gain measurements in the first 50% of the cut were not affected, phase information is sloped across this region. This was not observed in earlier test runs of the system as the standard gain horn antenna is much smaller in physical dimension and test antenna alignment is less critical.

The data collected in the second half of each cut (0 to +90 degrees) however exhibited minimal phase-center walk (looking at the time domain response) and is thus believed to be accurate. For this reason, the phase uniformity for the antenna is reported in the associated pdf summary pages only from zenith to +90 degrees off borsight.

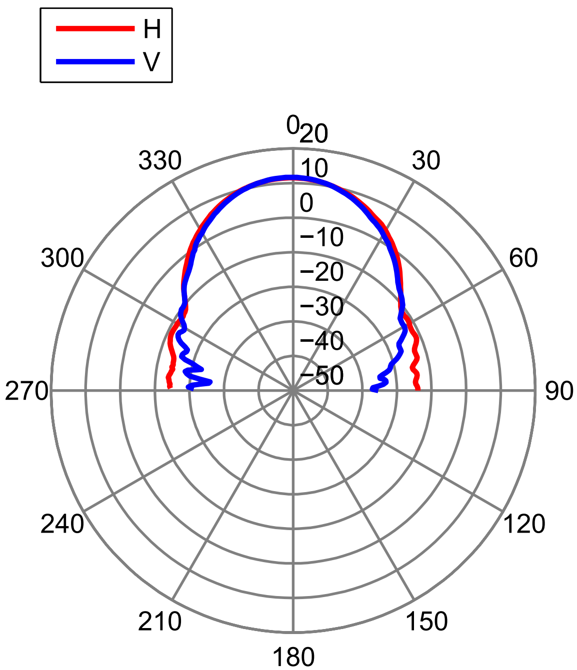
For future measurements, phase uniformity algorithms are now in place and this data can be immediately reviewed after an initial test run to ensure the AUT does not walk outside of the uniform phase region of the test antenna. Greater care will also be taken in aligning the center of the AUT with true center of the test antenna pattern.

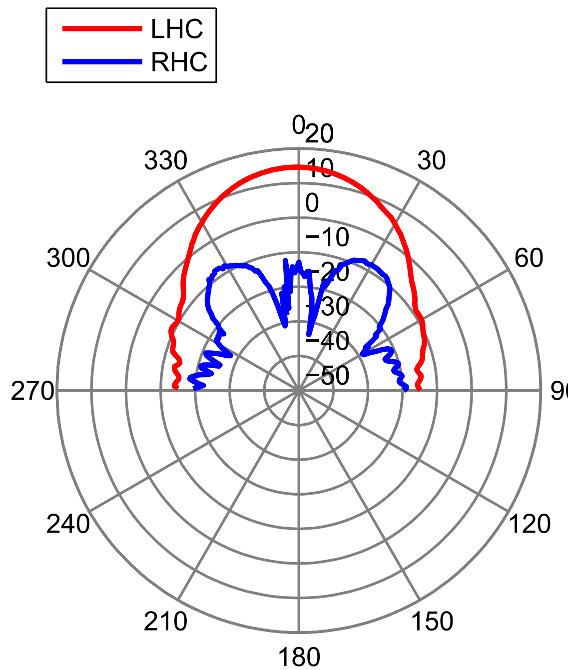
Cobham Port1 S−Band

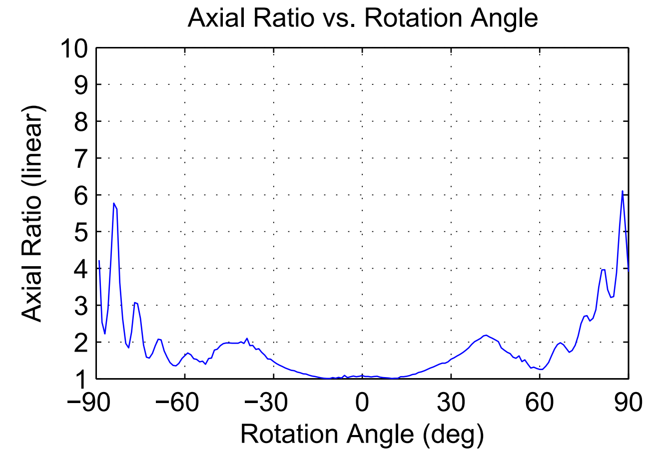


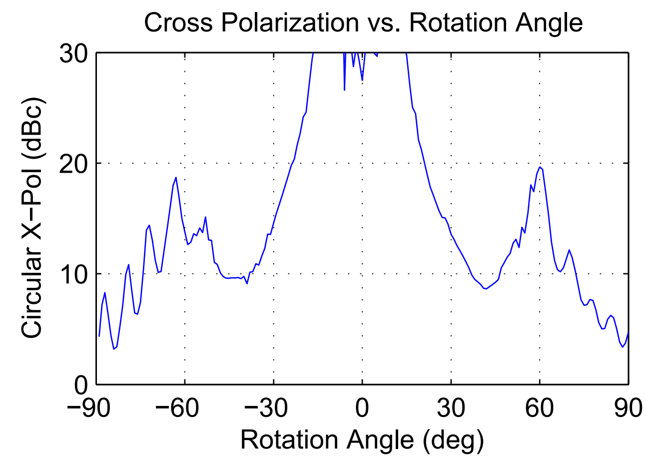
Cobham Port1 S−Band
Operating Frequency: 2200.5 MHz

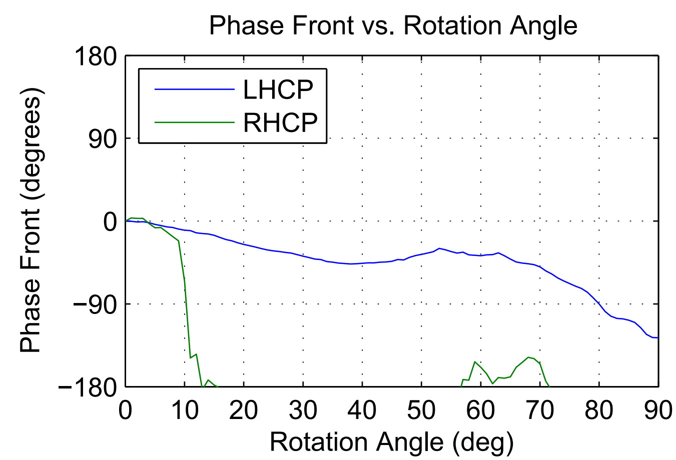
	MaxHorzGain (dBi)	MaxVertGain (dBi)	MaxLHCGain (dBi)	MaxRHCGain (dBi)	AR (linear)	CIRCX − Pol (dBc)
	11.6	11.7	14.6	−7.7	1.1	27.5
Angle(deg)	−1.0	−1.0	−1.0	−35.0	0.0	0.0





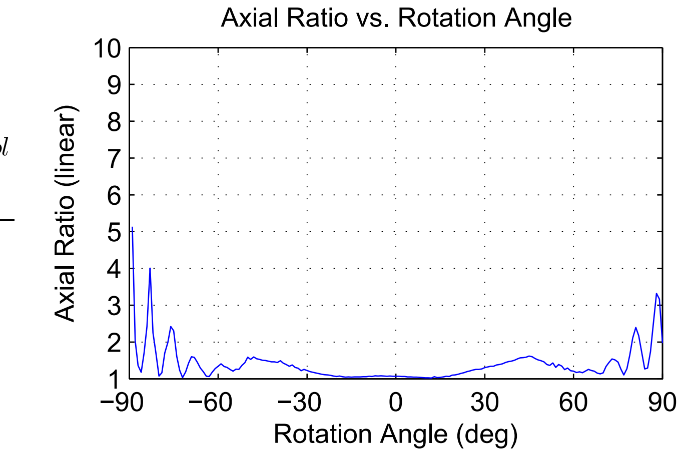


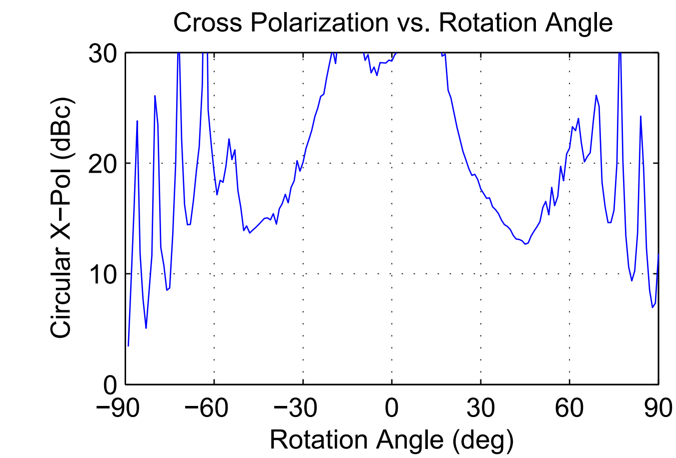


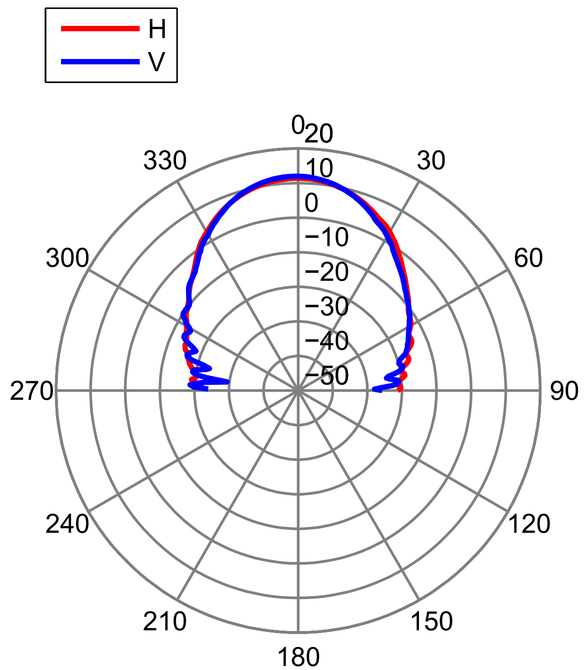


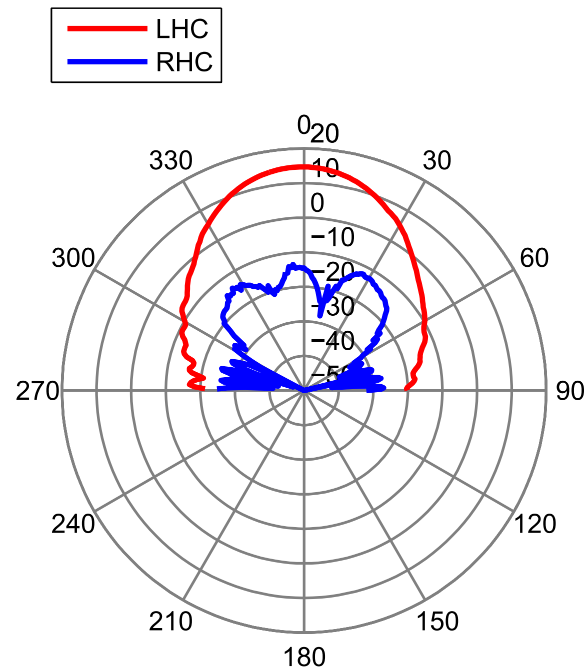
Cobham Port1 S−Band
Operating Frequency: 2298.0 MHz

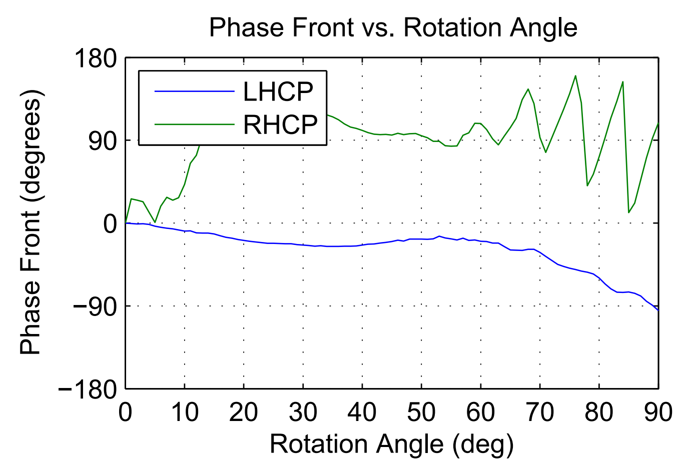
	MaxHorzGain (dBi)	MaxVertGain (dBi)	MaxLHCGain (dBi)	MaxRHCGain (dBi)	AR (linear)	CIRCX − Pol (dBc)
	11.4	12.0	14.7	−12.2	1.1	29.2
Angle(deg)	0.0	−1.0	−1.0	27.0	0.0	0.0





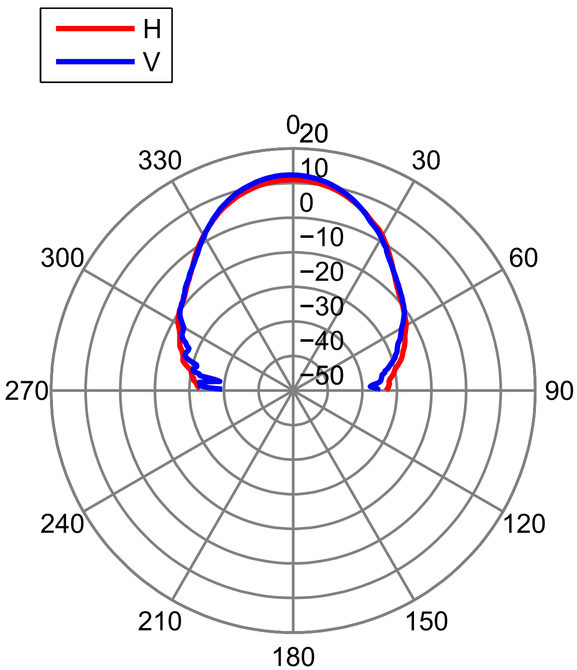


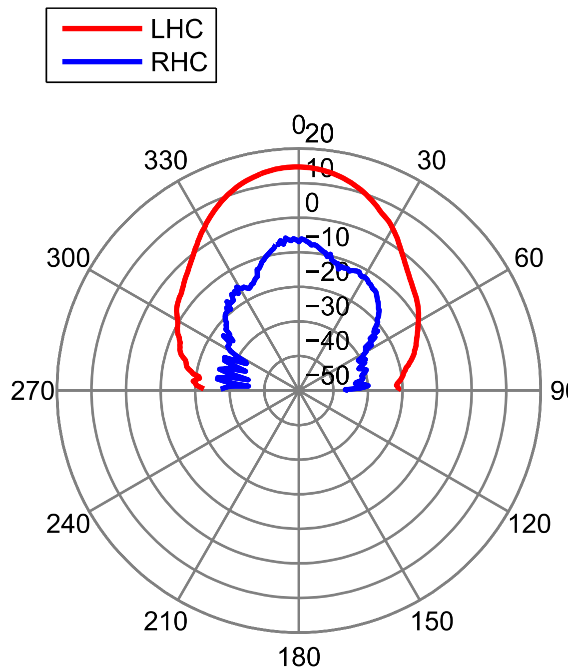


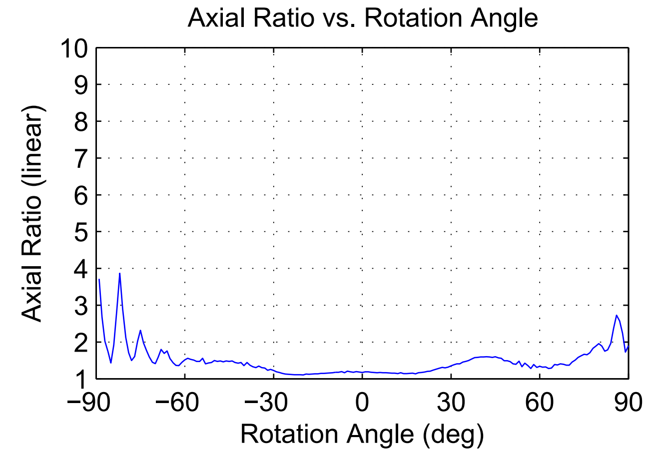


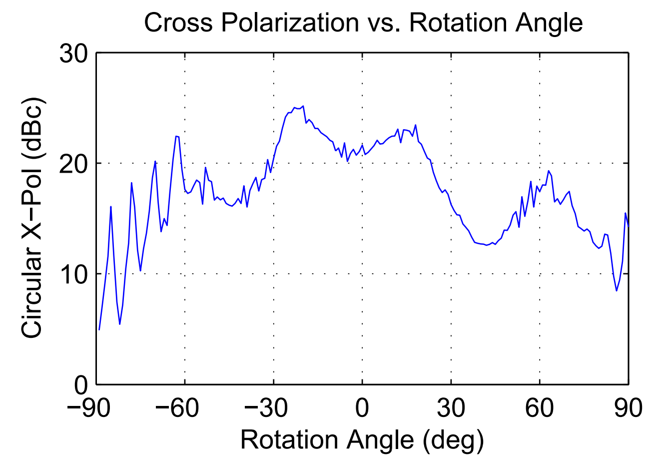
Cobham Port1 S−Band
Operating Frequency: 2395.5 MHz

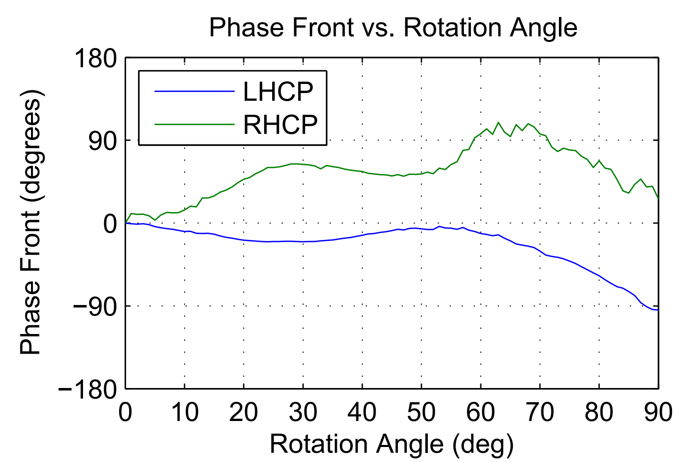
	MaxHorzGain (dBi)	MaxVertGain (dBi)	MaxLHCGain (dBi)	MaxRHCGain (dBi)	AR (linear)	CIRCX − Pol (dBc)
	11.0	12.4	14.7	−5.7	1.2	21.6
Angle(deg)	0.0	−2.0	−1.0	−5.0	0.0	0.0



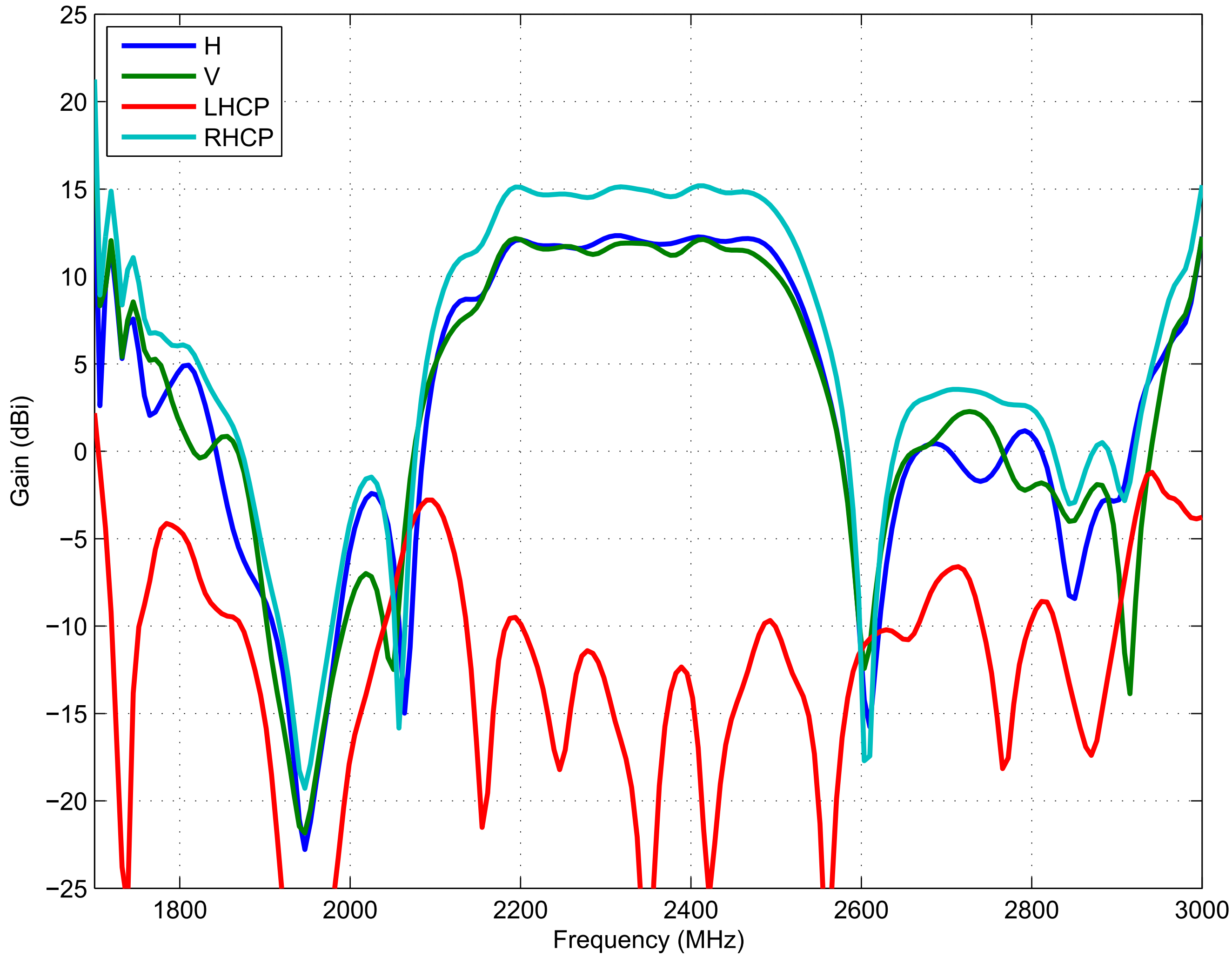






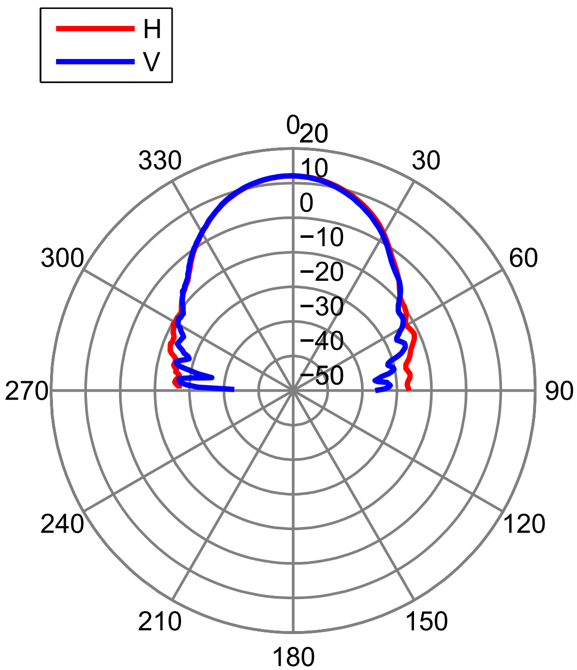


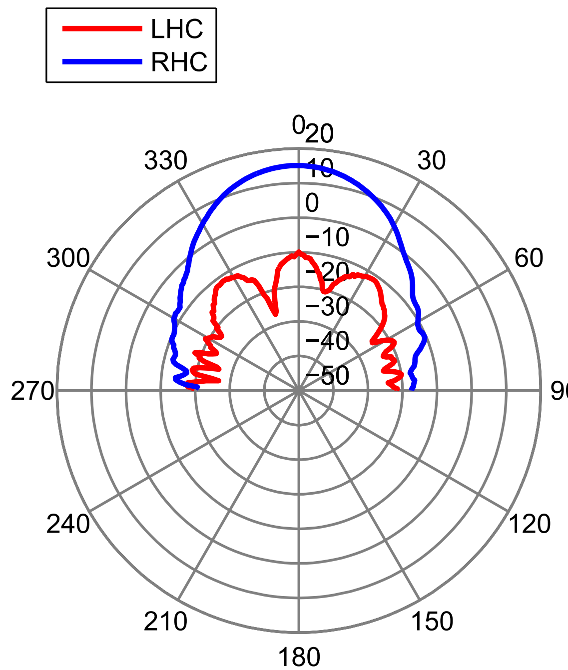
Cobham Port2 S−Band

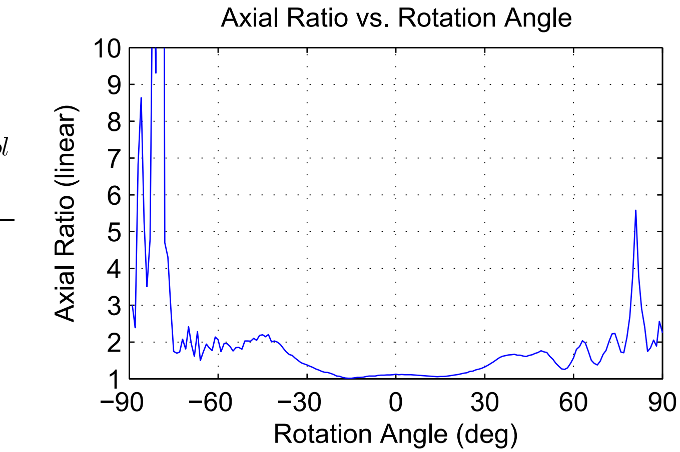


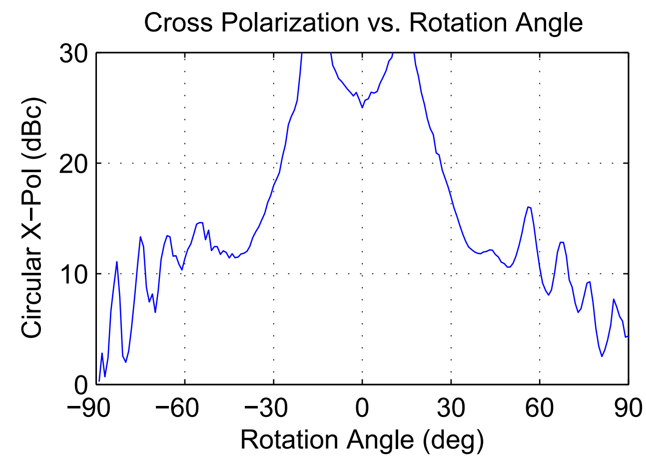
Cobham Port2 S−Band REV
Operating Frequency: 2200.5 MHz

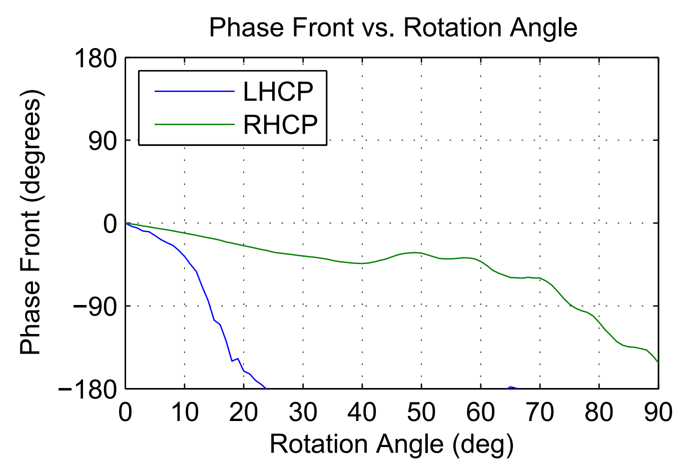
	MaxHorzGain (dBi)	MaxVertGain (dBi)	MaxLHCGain (dBi)	MaxRHCGain (dBi)	AR (linear)	CIRCX − Pol (dBc)
	12.1	12.1	−9.9	15.1	1.1	25.0
Angle(deg)	0.0	−1.0	0.0	0.0	0.0	0.0





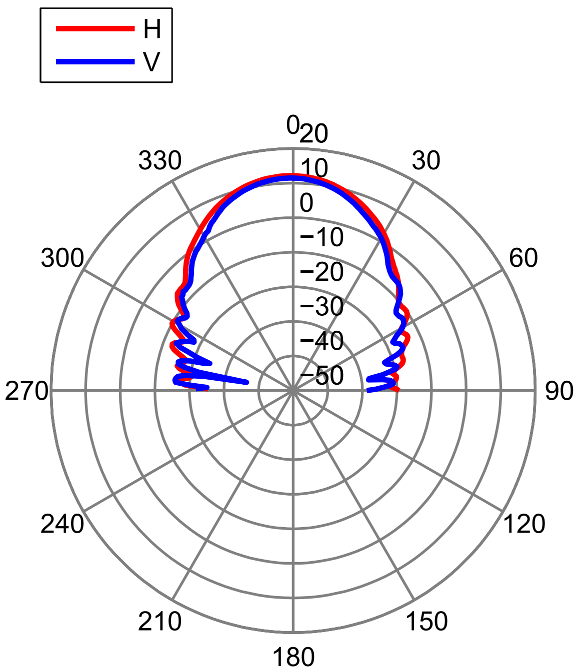


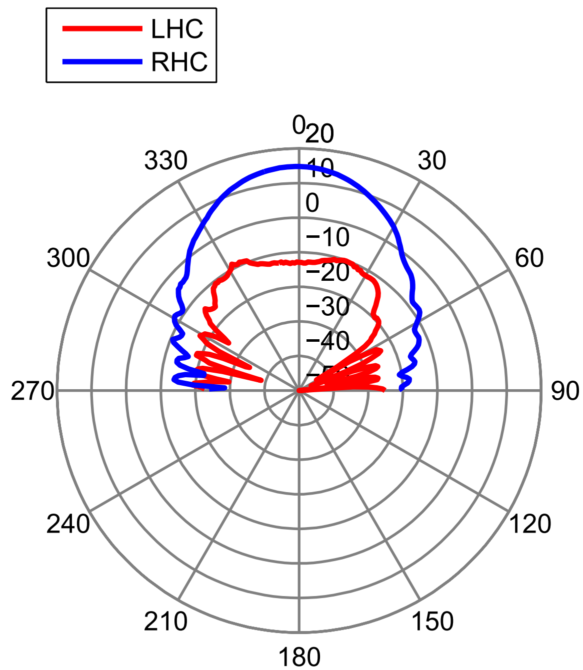


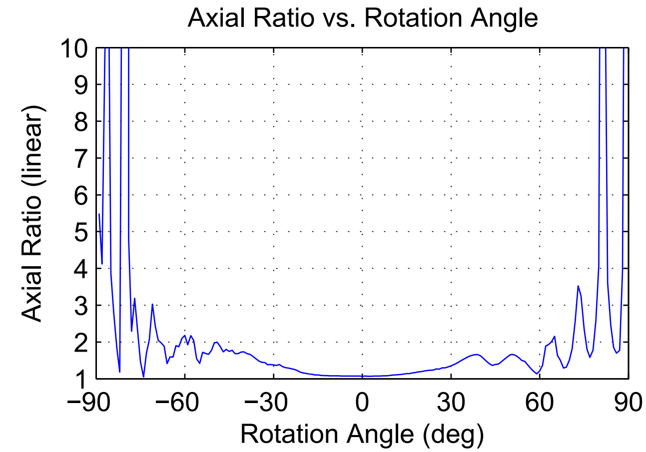


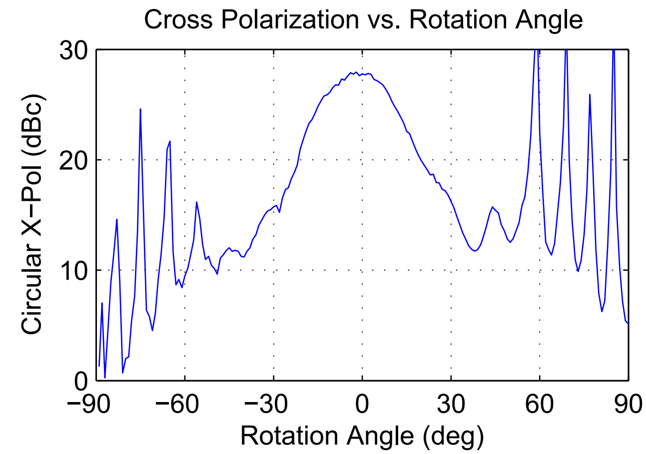
Cobham Port2 S−Band REV
Operating Frequency: 2298.0 MHz

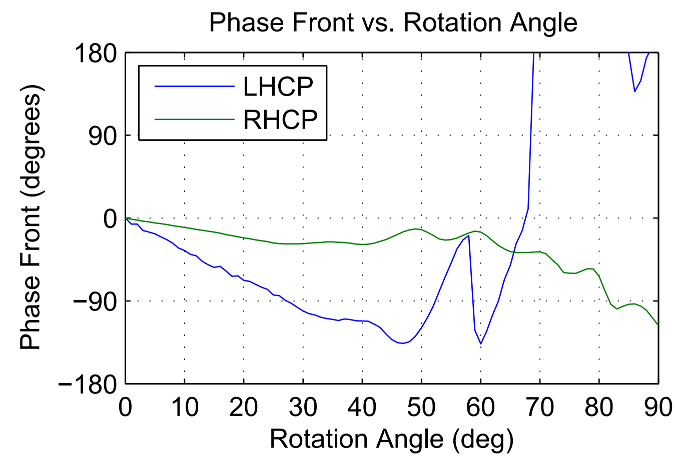
	$MaxHorzGain$ (dBi)	$MaxVertGain$ (dBi)	$MaxLHCGain$ (dBi)	$MaxRHCGain$ (dBi)	AR $(linear)$	$CIRCX-Pol$ (dBc)
	12.2	11.5	−8.6	14.8	1.1	27.8
$Angle(deg)$	−1.0	0.0	−28.0	−1.0	0.0	0.0





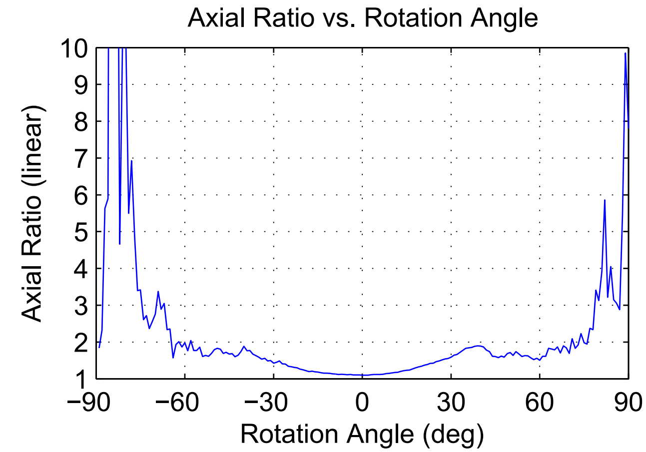


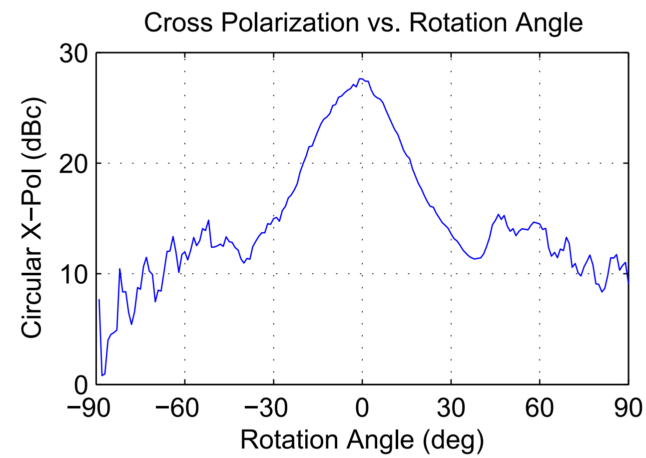


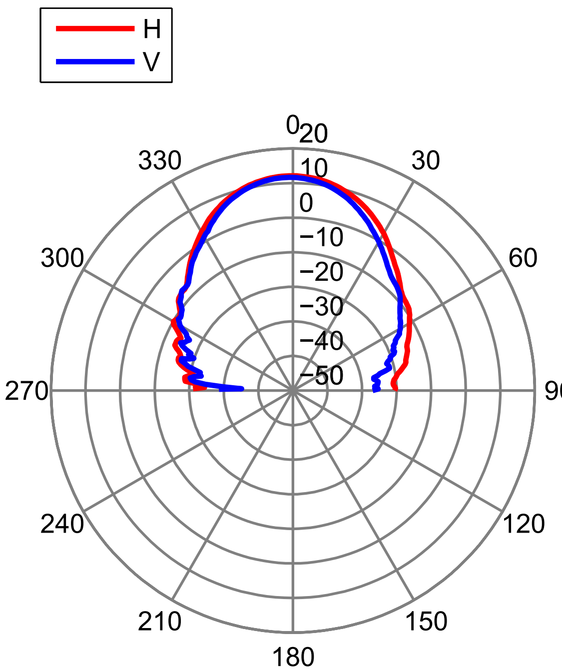


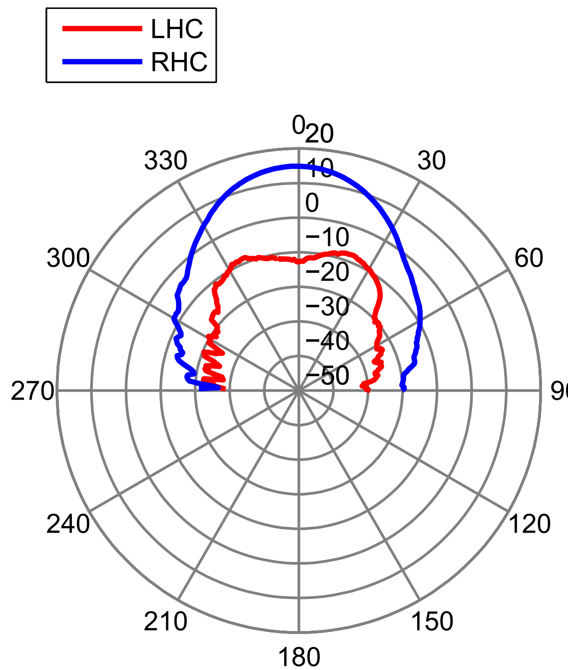
Cobham Port2 S−Band REV
Operating Frequency: 2395.5 MHz

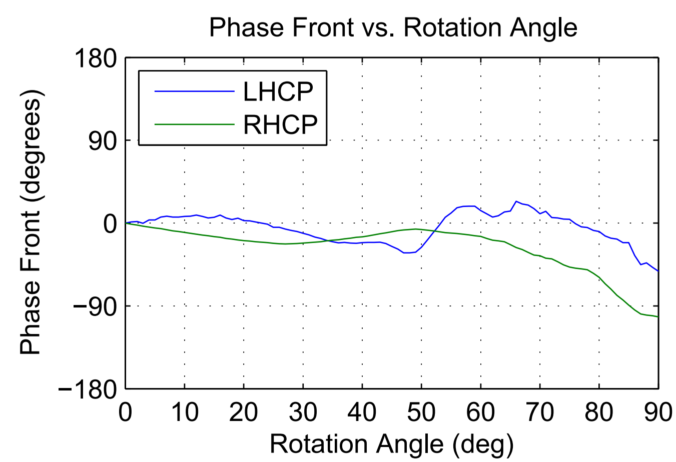
	MaxHorzGain (dBi)	MaxVertGain (dBi)	MaxLHCGain (dBi)	MaxRHCGain (dBi)	AR (linear)	CIRCX − Pol (dBc)
	12.1	11.7	−7.9	14.9	1.1	27.6
Angle(deg)	−1.0	−1.0	22.0	−1.0	0.0	0.0



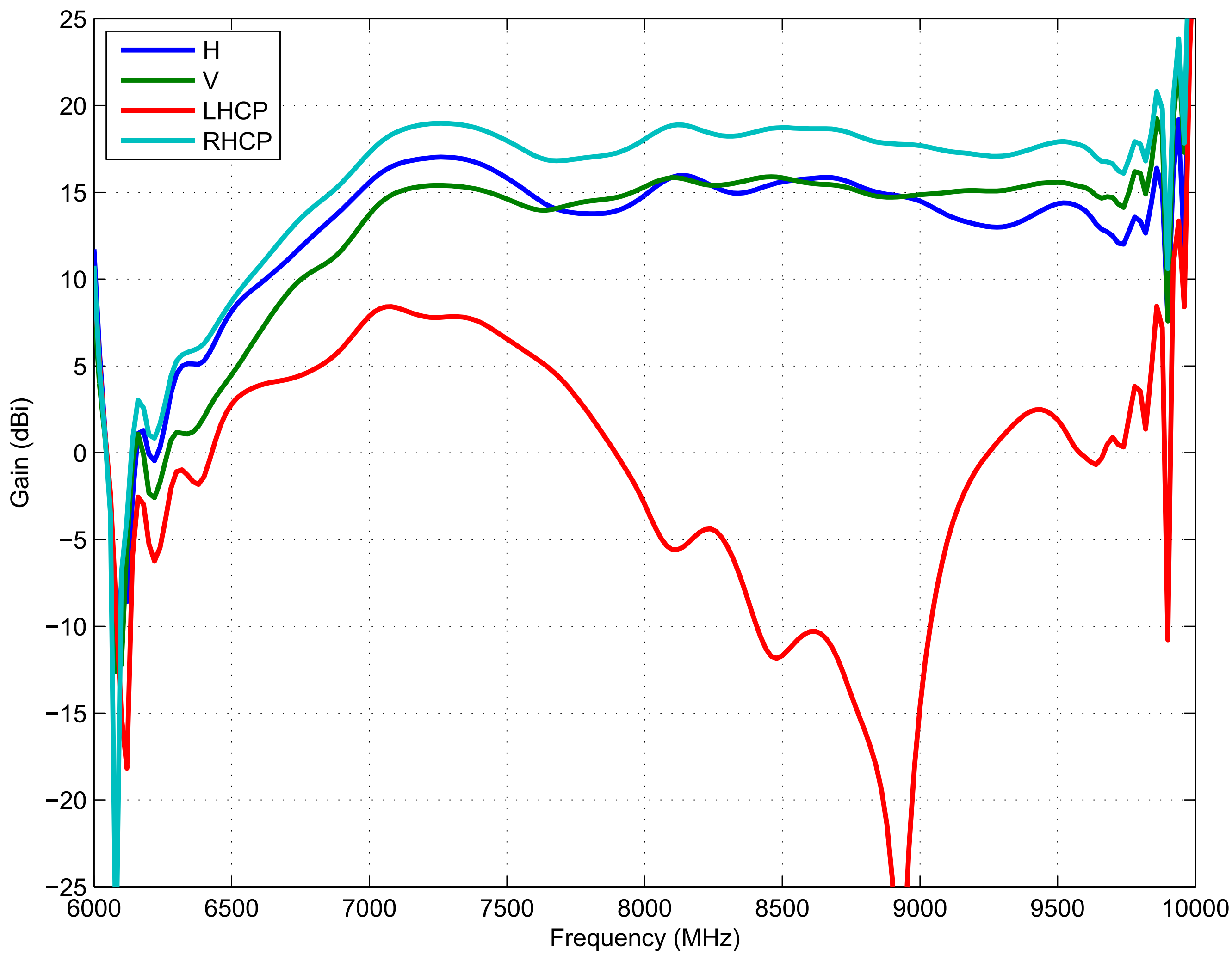






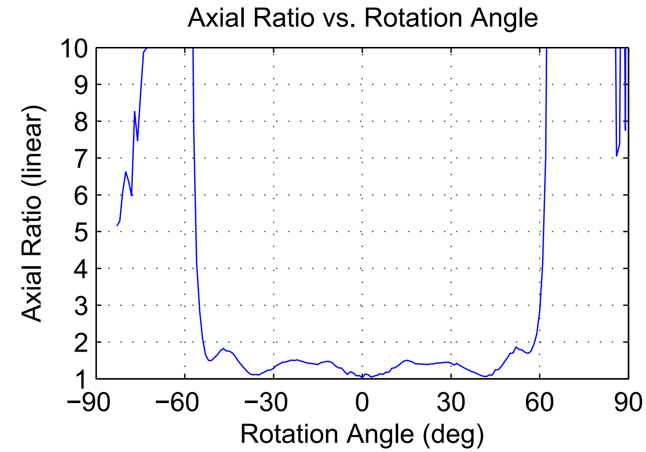


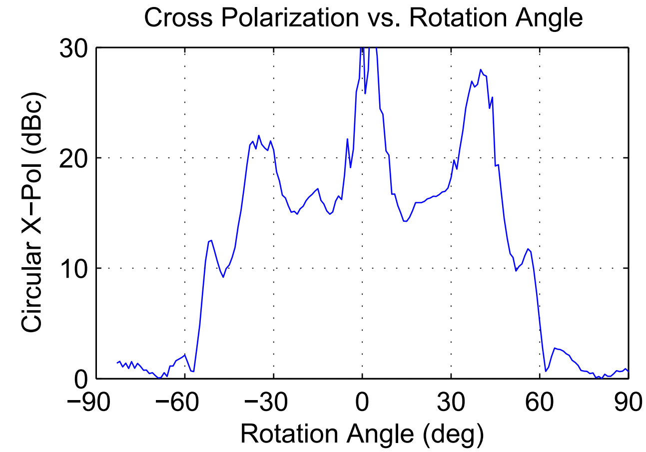
Cobham End Port X−Band

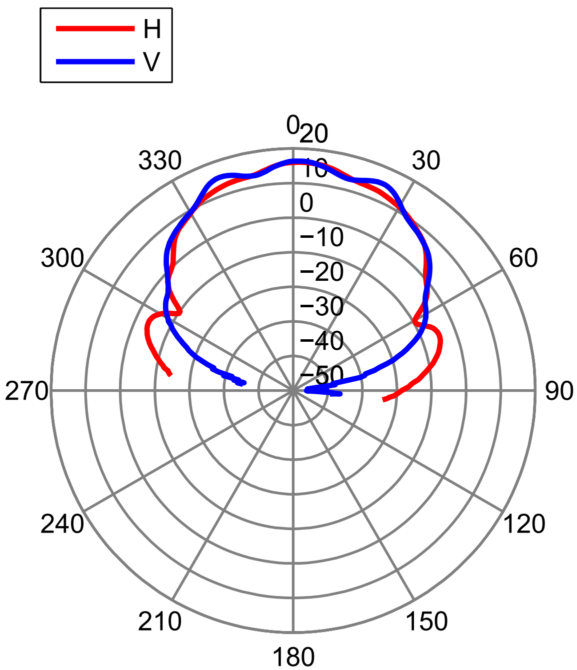


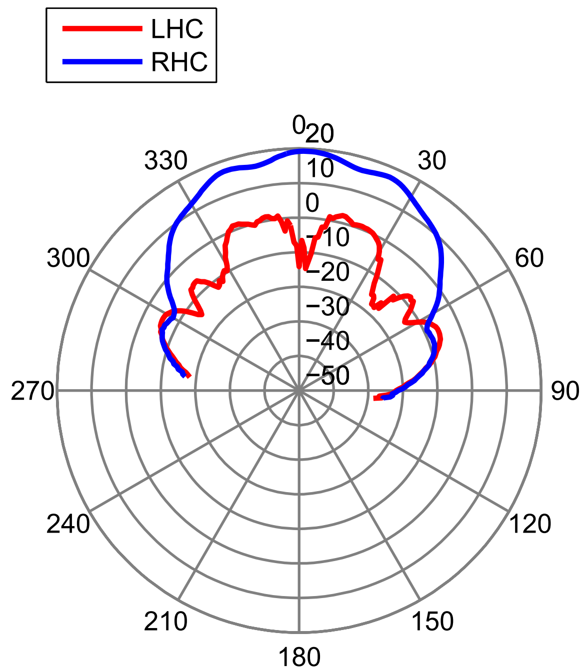
Cobham End Port X−Band
Operating Frequency: 8100.0 MHz

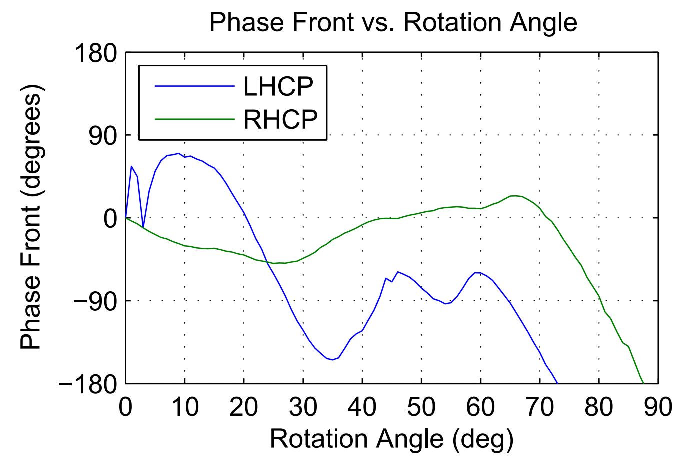
	MaxHorzGain (dBi)	MaxVertGain (dBi)	MaxLHCGain (dBi)	MaxRHCGain (dBi)	AR (linear)	CIRCX − Pol (dBc)
	16.1	16.4	2.2	19.2	1.0	33.3
Angle(deg)	1.0	2.0	14.0	2.0	0.0	0.0





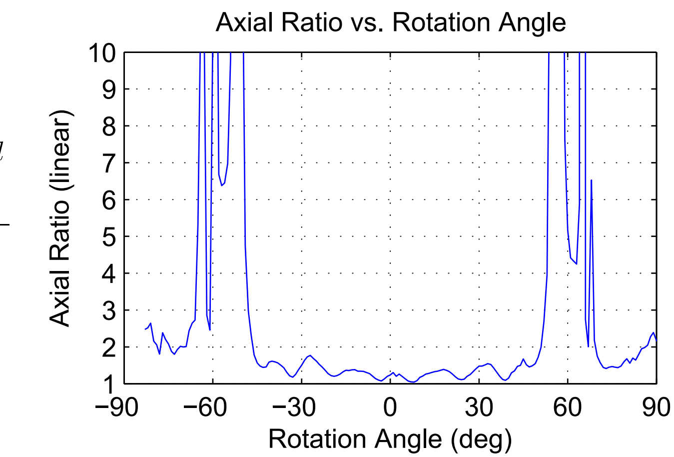


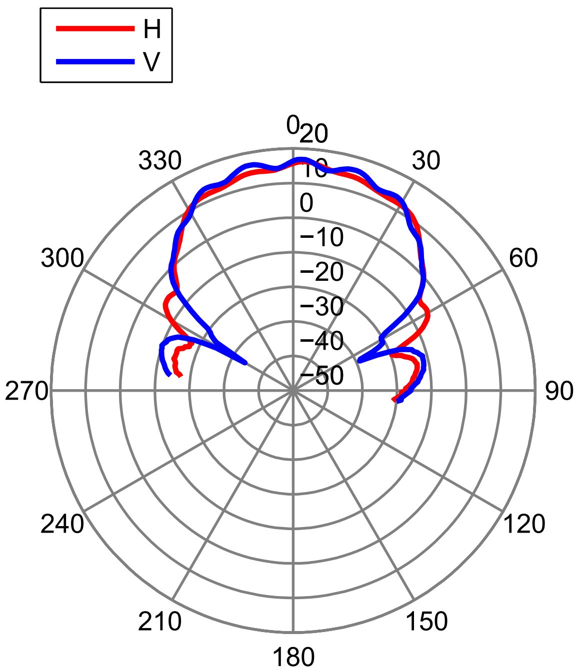


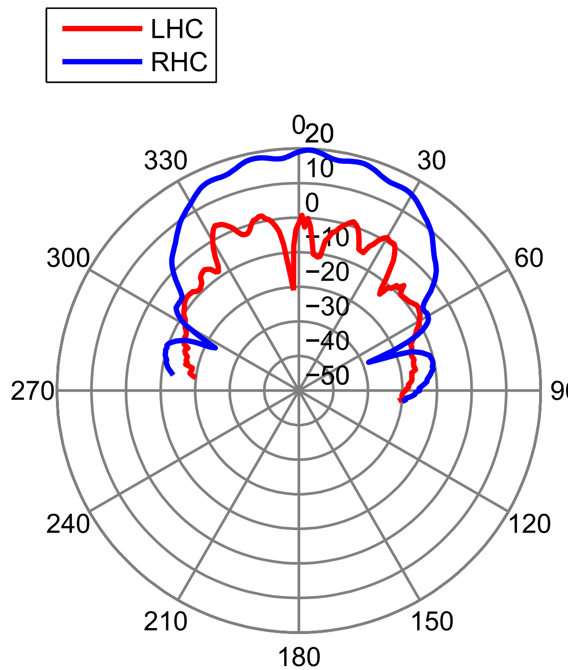


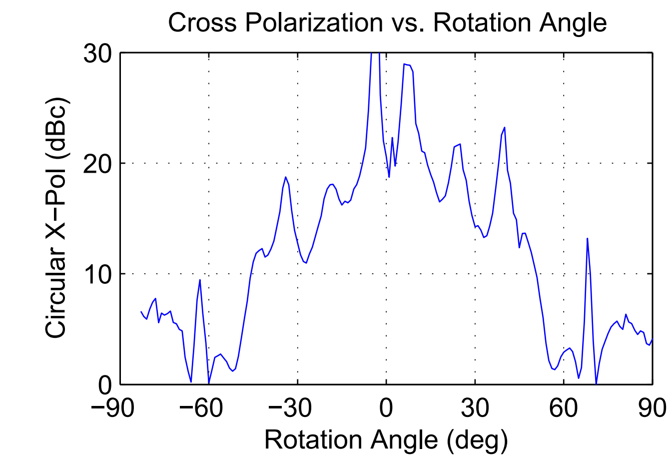
Cobham End Port X−Band
Operating Frequency: 8600.0 MHz

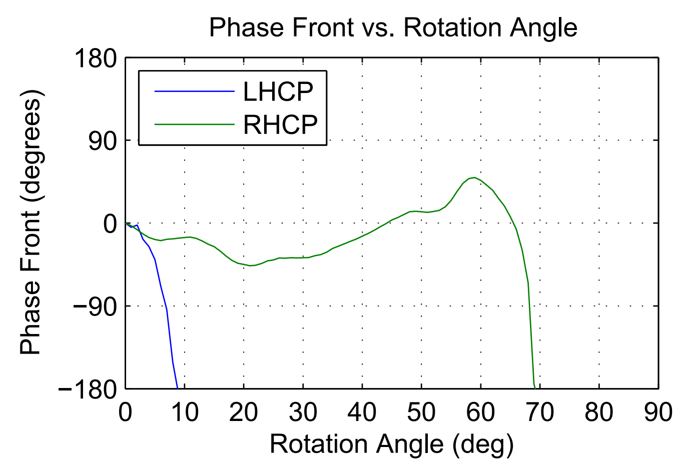
	$MaxHorzGain$ (dBi)	$MaxVertGain$ (dBi)	$MaxLHCGain$ (dBi)	$MaxRHCGain$ (dBi)	AR $(linear)$	$CIRCX - Pol$ (dBc)
	16.3	16.9	3.5	19.6	1.2	20.6
$Angle(deg)$	3.0	2.0	−27.0	2.0	0.0	0.0





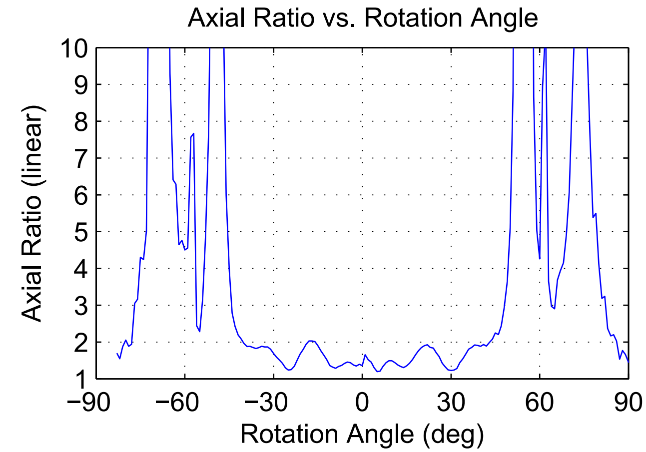


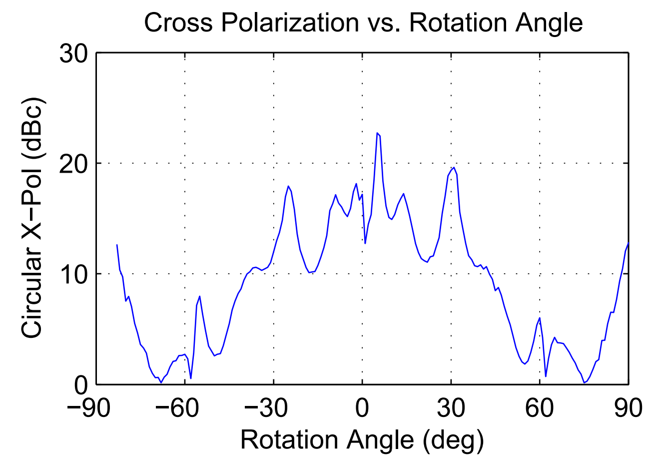


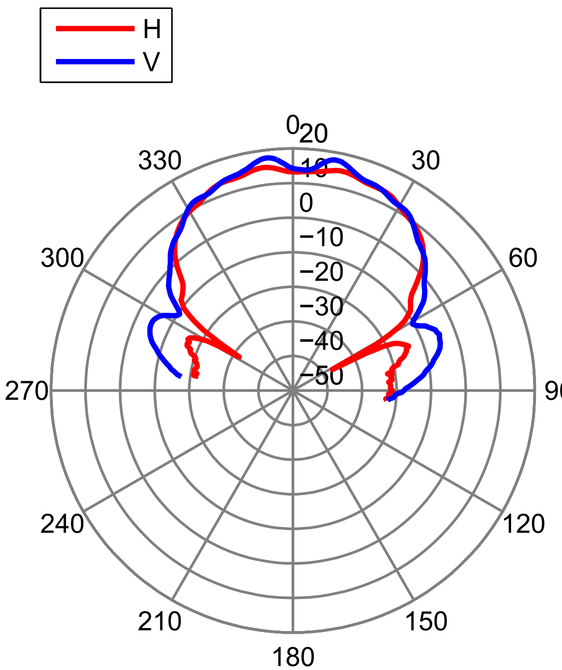


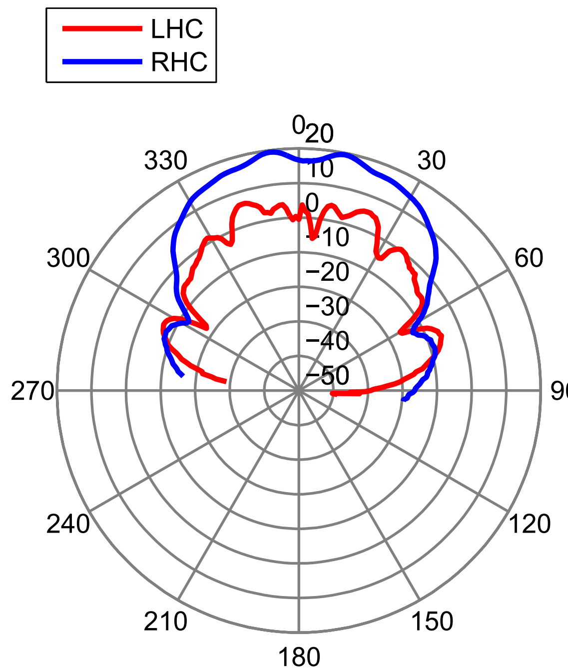
Cobham End Port X−Band
Operating Frequency: 9100.0 MHz

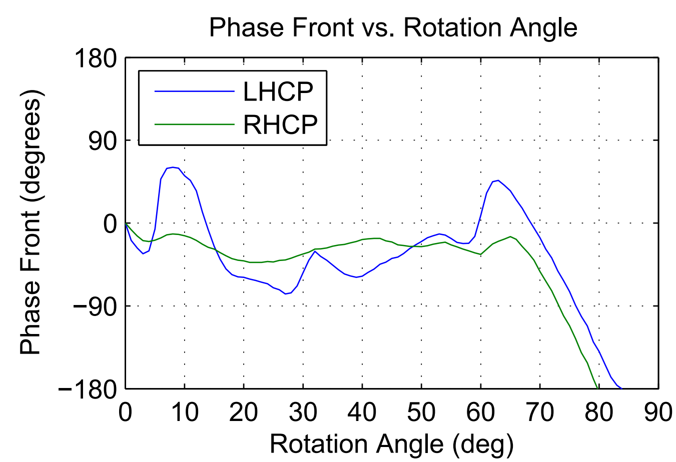
	$MaxHorzGain$ (dBi)	$MaxVertGain$ (dBi)	$MaxLHCGain$ (dBi)	$MaxRHCGain$ (dBi)	AR $(linear)$	$CIRCX-Pol$ (dBc)
	15.1	17.8	6.4	19.5	1.4	17.2
$Angle(deg)$	−8.0	11.0	−16.0	11.0	0.0	0.0



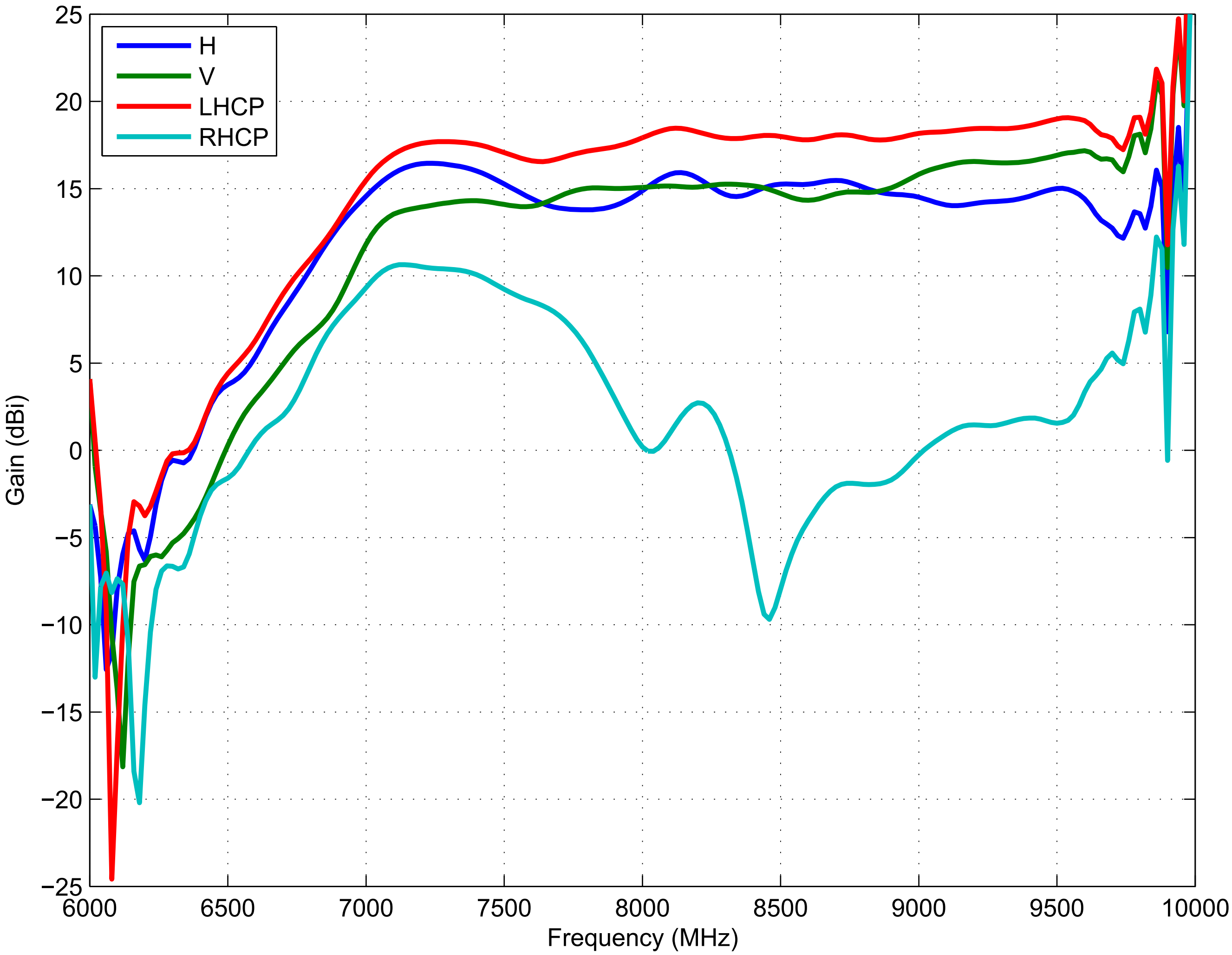






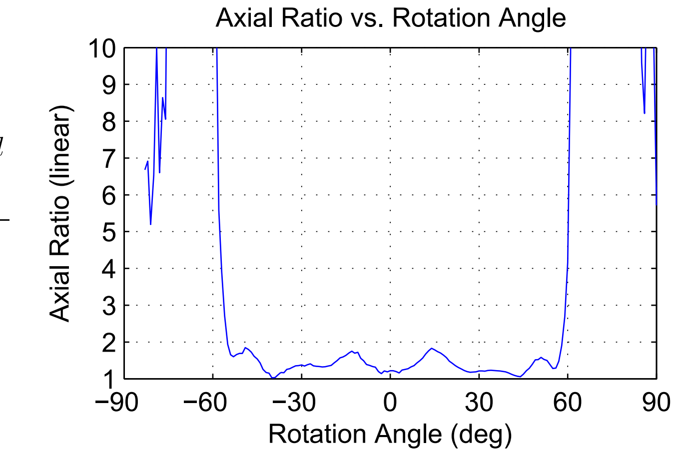


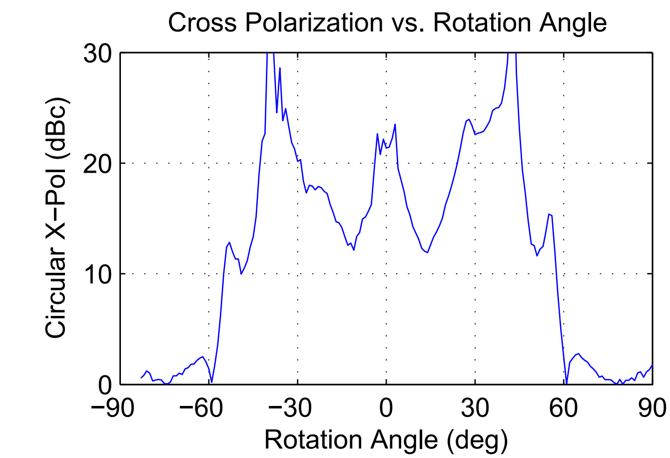
Cobham Side Port X−Band

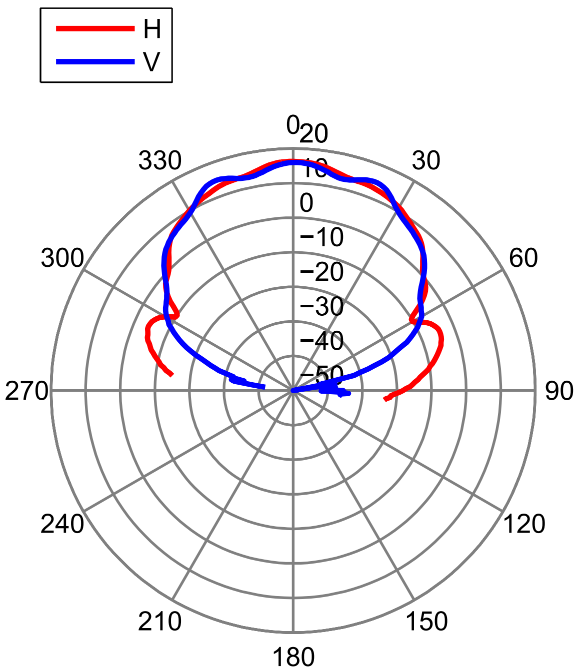


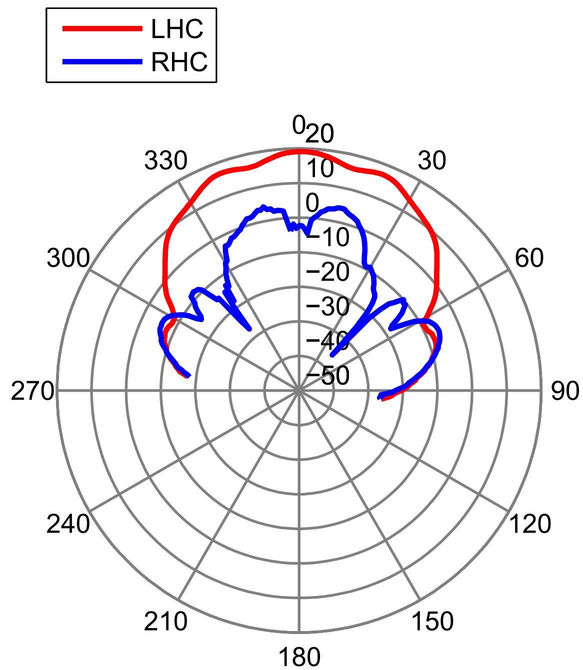
Cobham Side Port X−Band
Operating Frequency: 8100.0 MHz

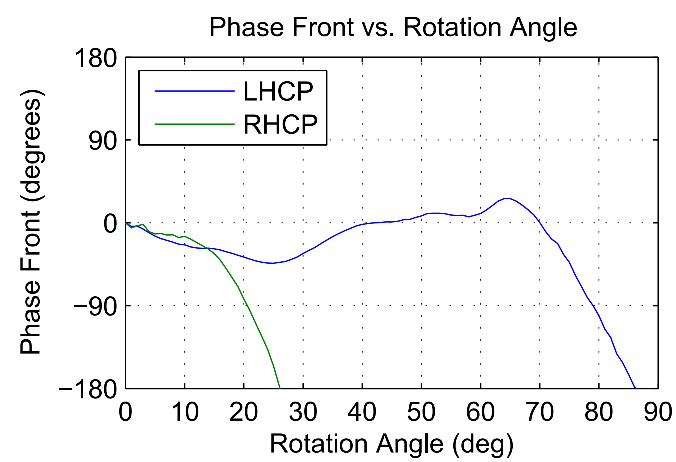
	MaxHorzGain (dBi)	MaxVertGain (dBi)	MaxLHCGain (dBi)	MaxRHCGain (dBi)	AR (linear)	CIRCX − Pol (dBc)
	16.3	16.0	19.1	4.1	1.2	21.4
Angle(deg)	−1.0	1.0	0.0	−11.0	0.0	0.0





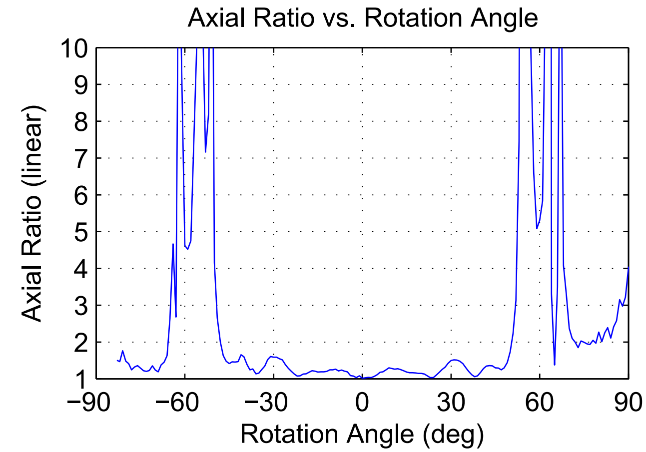


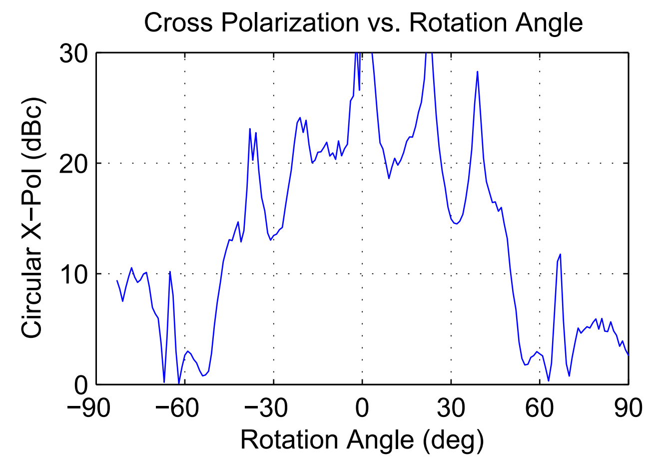


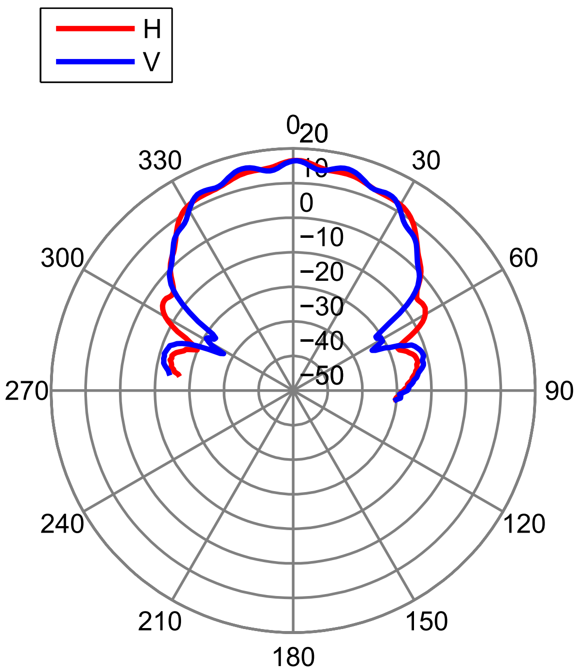


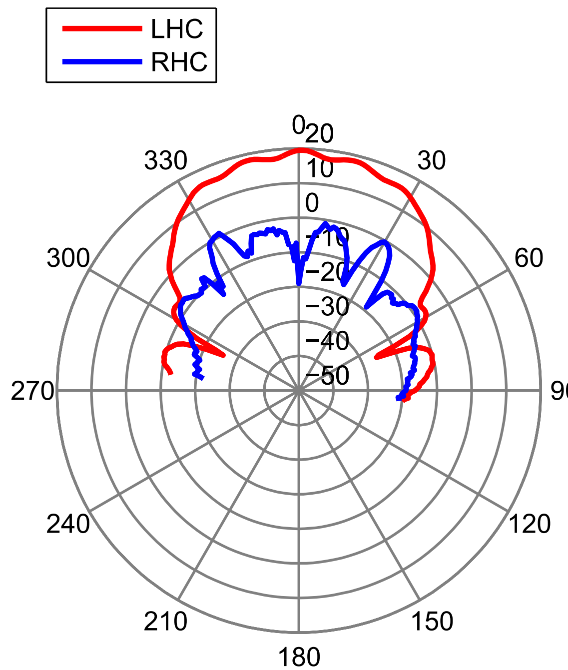
Cobham Side Port X−Band
Operating Frequency: 8600.0 MHz

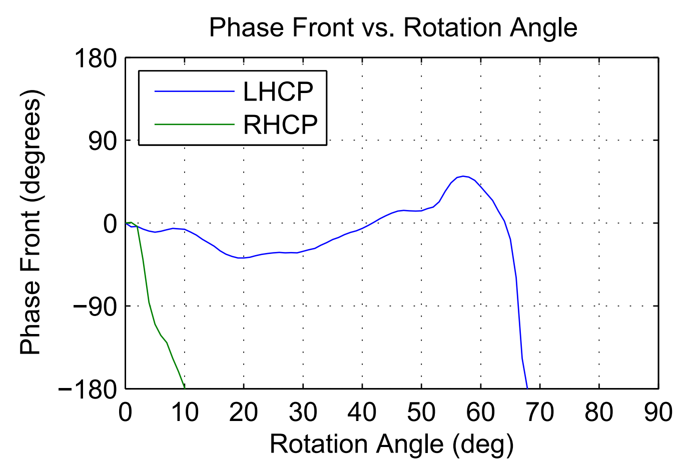
	$MaxHorzGain$ (dBi)	$MaxVertGain$ (dBi)	$MaxLHCGain$ (dBi)	$MaxRHCGain$ (dBi)	AR $(linear)$	$CIRCX-Pol$ (dBc)
	16.6	16.5	19.6	1.0	1.0	38.5
$Angle(deg)$	1.0	1.0	1.0	−27.0	0.0	0.0











Cobham Side Port X−Band
Operating Frequency: 9100.0 MHz

	$MaxHorzGain$ (dBi)	$MaxVertGain$ (dBi)	$MaxLHCGain$ (dBi)	$MaxRHCGain$ (dBi)	AR $(linear)$	$CIRCX-Pol$ (dBc)
	15.4	17.6	19.5	4.6	1.2	20.1
$Angle(deg)$	11.0	9.0	10.0	−17.0	0.0	0.0