

# **Exhibit D**

# Reflector Design

## Designed for Low Sidelobes

- ITU Recommendation S-580-5
  - $29-25 \log(\theta)$   $1.0^\circ < \theta < 20.0^\circ$
  - $-3.5 \text{ dBi}$   $20.0^\circ < \theta < 26.3^\circ$
  - $32-25 \log(\theta)$   $26.3^\circ < \theta < 48.0^\circ$
  - $-10 \text{ dBi}$   $48.0^\circ < \theta < 180.0^\circ$
- ALSO FCC CFR-47 §25.209

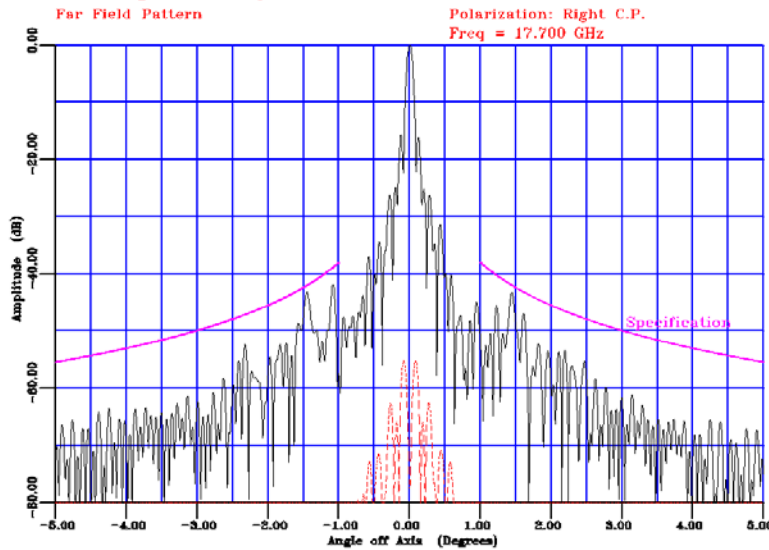
## Designed for Ka-Band Operation

## Designed for Maximum Gain

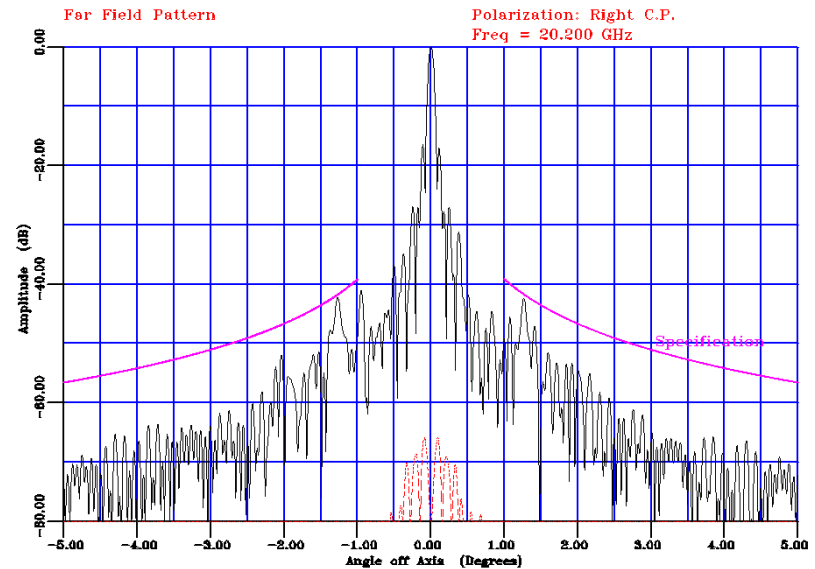
## Designed for Low Noise Temperature

# Ka-Band Receive Main Beam Pattern

13 Meter High Efficiency Ka-Band Antenna



13 Meter High Efficiency Ka-Band Antenna

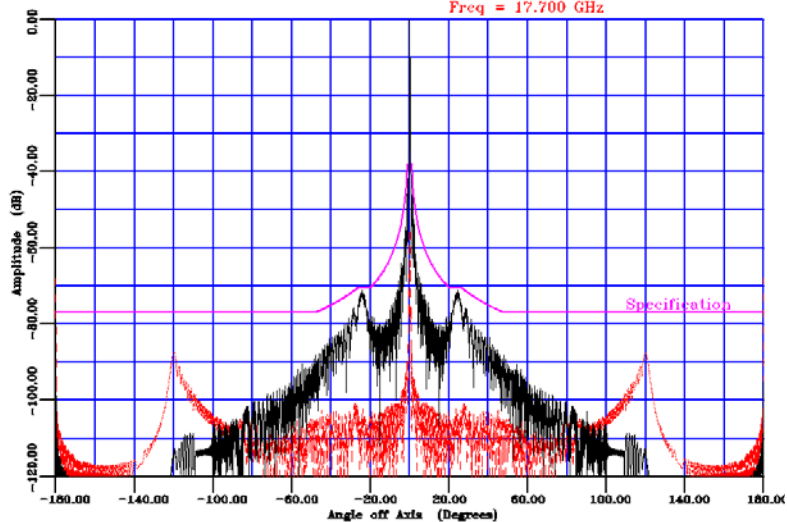


# Ka-Band Receive Wide Angle Sidelobes

13 Meter High Efficiency Ka-Band Antenna

Far Field Pattern

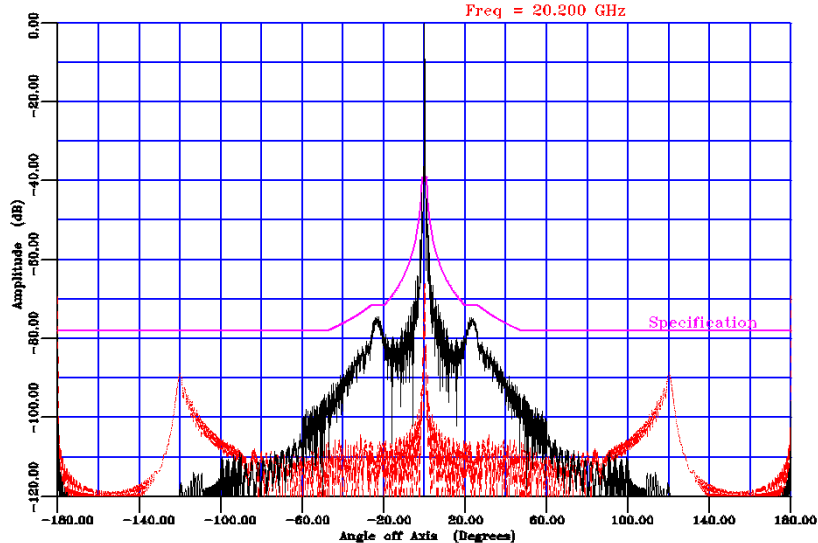
Polarization: Right C.P.  
Freq = 17.700 GHz



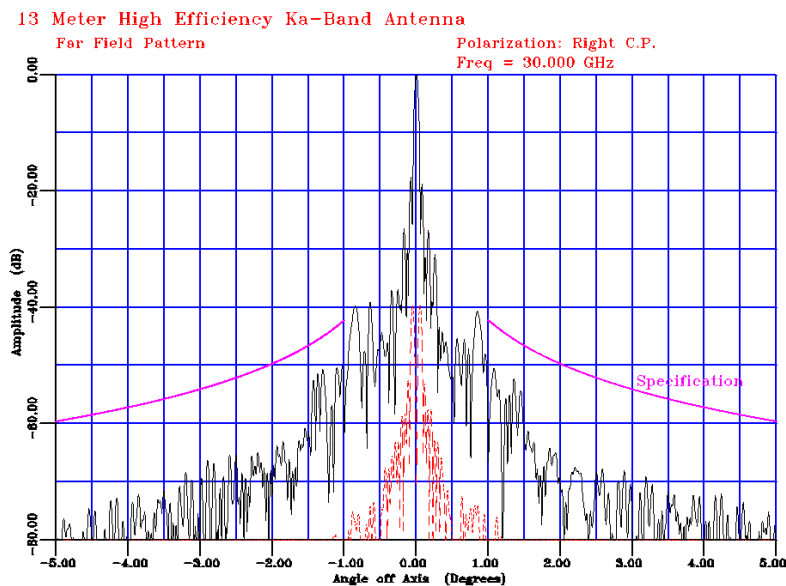
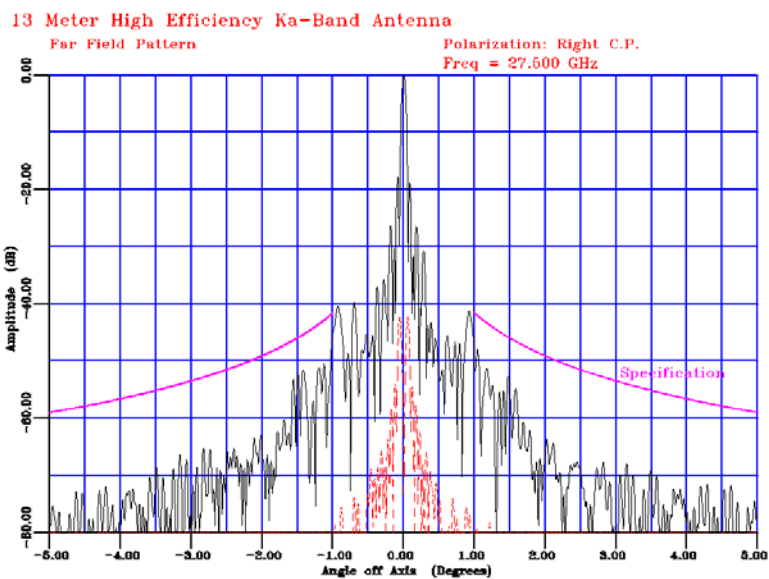
13 Meter High Efficiency Ka-Band Antenna

Far Field Pattern

Polarization: Right C.P.  
Freq = 20.200 GHz



# Ka-Band Transmit Main Beam Pattern

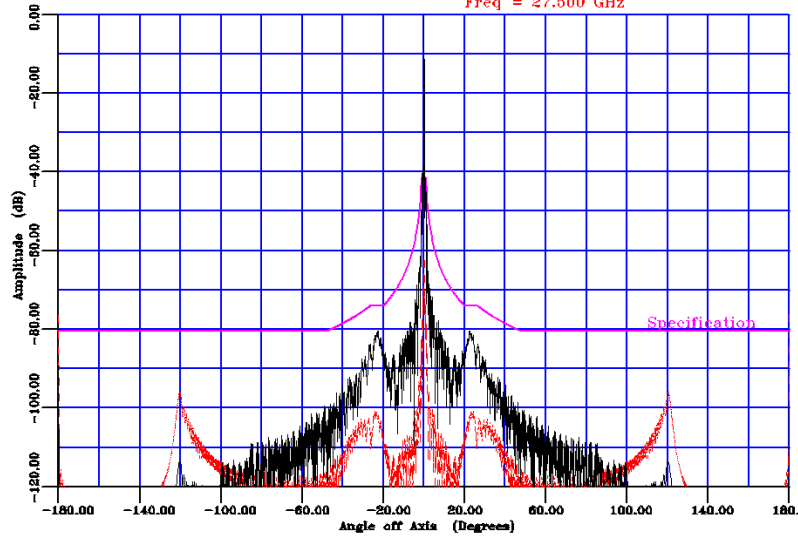


# Ka-Band Transmit Wide Angle Sidelobes

13 Meter High Efficiency Ka-Band Antenna

Far Field Pattern

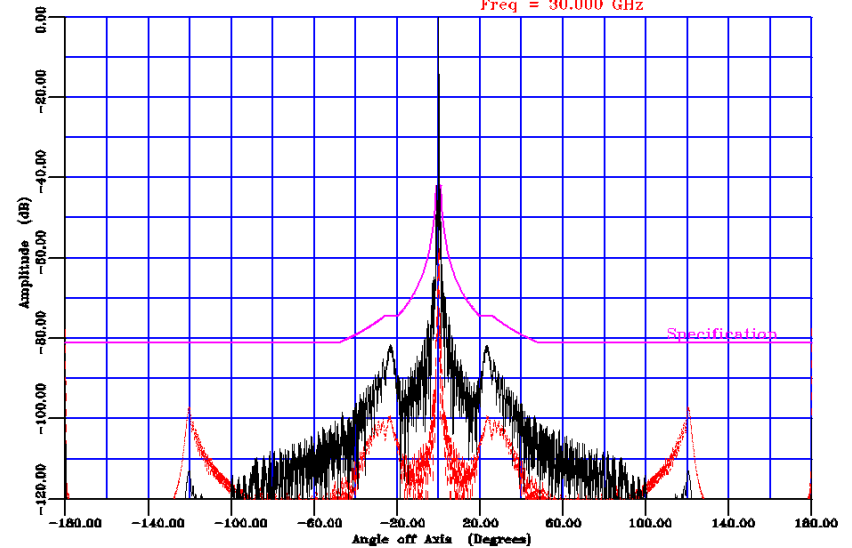
Polarization: Right C.P.  
Freq = 27.500 GHz



13 Meter High Efficiency Ka-Band Antenna

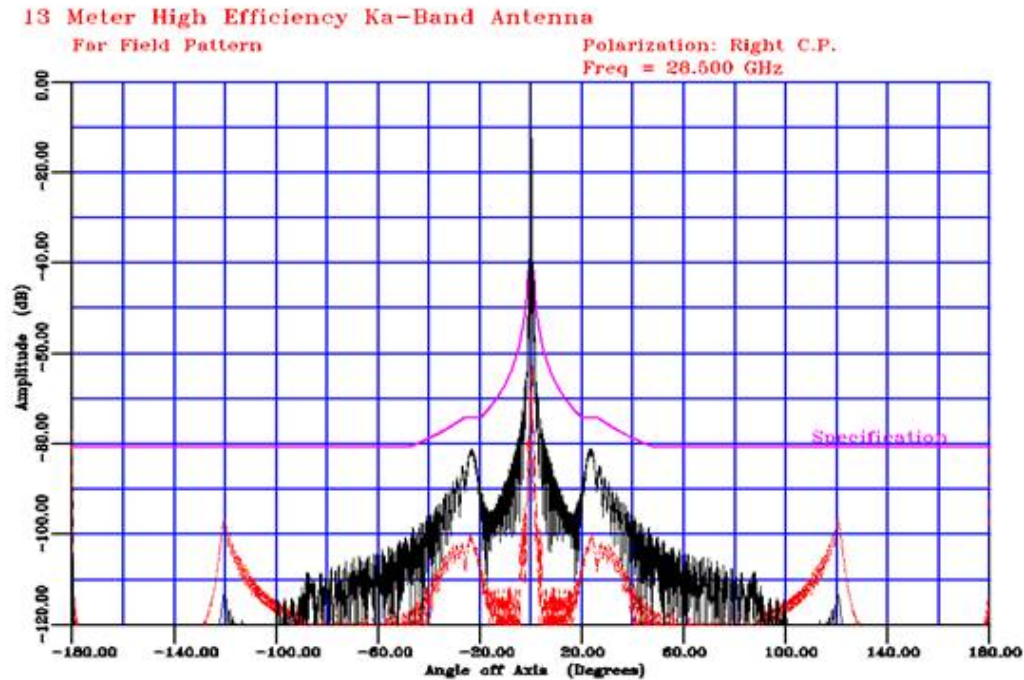
Far Field Pattern

Polarization: Right C.P.  
Freq = 30.000 GHz



# Ka-Band Transmit

## Wide Angle Sidelobes Mid Band



# Ka-Band Receive G/T Calculation

	Frequency					
	17.700 GHz		18.950 GHz		20.200 GHz	
Main Reflector RMS =	0.012					
Subreflector RMS =	0.003					
Ideal Gain	67.78 dBi		68.38		68.93	
Cross Polarization	%		%		%	
Spillover	0.998	-0.01 dB	0.998	-0.01 dB	0.998	-0.01 dB
Diffraction	0.993	-0.03 dB	0.994	-0.03 dB	0.995	-0.02 dB
Aperture Illumination	0.998	-0.01 dB	0.998	-0.01 dB	0.998	-0.01 dB
Phase Error	0.965	-0.15 dB	0.962	-0.17 dB	0.957	-0.19 dB
Surface Error	0.941	-0.26 dB	0.953	-0.21 dB	0.961	-0.17 dB
Blockage	0.947	-0.24 dB	0.940	-0.27 dB	0.932	-0.31 dB
Overall Efficiency	0.930	-0.32 dB	0.930	-0.32 dB	0.930	-0.32 dB
Calculated Gain at Feed Aperture	0.791		0.793		0.790	
Feed Loss		66.76 dBi		67.37 dBi		67.91 dBi
Feed VSWR Loss	1.45:1	-1.15 dB		-1.15 dB		-1.15 dB
Calculated Antenna Gain (Feed Output)		-0.15 dB		-0.15 dB		-0.15 dB
Specified Antenna Gain (Feed Output)		65.47 dBi		66.07 dBi		66.61 dBi
Margin		64.97 dBi		65.57 dBi		66.11 dBi
Antenna Temperature (20 deg. eL)		0.50 dB		0.50 dB		0.50 dB
Net Antenna Temperature		24.60 K		34.90 K		51.40 K
LNA System Noise Temperature		93.21 K		100.85 K		113.08 K
Calculated Antenna G/T		160.47 K		160.47 K		160.47 K
Specified Antenna G/T		41.42 dBi/K		41.90 dBi/K		42.24 dBi/K
Margin		40.92 dBi/K		41.40 dBi/K		41.74 dBi/K
		0.50 dBi/K		0.50 dBi/K		0.50 dBi/K



# Ka-Band Transmit Gain Calculation

	Frequency					
	27.500 GHz		28.750 GHz		30.000 GHz	
Main Reflector RMS =	0.012					
Subreflector RMS =	0.003					
Ideal Gain	71.61 dBi		72.00		72.37	
	%		%		%	
Cross Polarization	0.998	-0.01 dB	0.998	-0.01 dB	0.998	-0.01 dB
Spillover	0.998	-0.01 dB	0.998	-0.01 dB	0.998	-0.01 dB
Diffraction	0.998	-0.01 dB	0.998	-0.01 dB	0.998	-0.01 dB
Aperture Illumination	0.917	-0.38 dB	0.913	-0.40 dB	0.909	-0.41 dB
Phase Error	0.995	-0.02 dB	0.992	-0.03 dB	0.987	-0.06 dB
Surface Error	0.877	-0.57 dB	0.866	-0.62 dB	0.855	-0.68 dB
Blockage	0.930	-0.32 dB	0.930	-0.32 dB	0.930	-0.32 dB
Overall Efficiency	0.740		0.725		0.710	
Gain at Feed Aperture	70.30 dBi		70.60 dBi		70.88 dBi	
Feed Loss	-1.30 dB		-1.30 dB		-1.30 dB	
Feed VSWR Loss	1.45:1	-0.15 dB		-0.15 dB		-0.15 dB
Calculated Antenna Gain (Feed Output)	68.85 dBi		69.15 dBi		69.42 dBi	
Specified Antenna Gain (Feed Output)	68.35 dBi		68.65 dBi		68.92 dBi	
Margin	0.50 dB		0.50 dB		0.50 dB	