

GENERAL DYNAMICS

C4 Systems

Range Test Report 3.9m Shaped Gregorian Antenna System (Ka)

Feed Model #:	Test Feed
Feed Serial #:	NA
RF Specification:	975-2191E
Side lobe Specification:	ITU-RS-580
Test Plan:	Custom
Test Engineer:	Zukowski, W. Zuko

Test Report # 7282
Job #: 13143 (Unit 3)
04 February 2010

For
GDSATCOM Duluth

Prepared By: Zukowski, W. Zuko



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Table Of Contents

Introduction and Endorsements	1
Data Reduction Formulas	2
Summary of Antenna Performance	4
Measured Antenna Data:	

20.700 GHz

Gain (LHCP)	5
Co-Pol Patterns (LHCP)	6
Cross-Pol Patterns (LHCP)	10
Gain (RHCP)	12
Co-Pol Patterns (RHCP)	13
Cross-Pol Patterns (RHCP)	17

30.500 GHz

Gain (LHCP)	19
Co-Pol Patterns (LHCP)	20
Gain (RHCP)	24
Co-Pol Patterns (RHCP)	25

Supplemental Data:


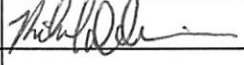

R.F. Specification (975-2191E)	29
Equipment List	31

INTRODUCTION

The test data presented in this report represents an evaluation of a 3.9m shaped Gregorian, Ka band reflector system. The tests were conducted at the SATCOM Technologies Kilgore, TX Test Range in accordance with a custom test plan of mid-band checks only. This report shows the antenna's performance for co-polarization side lobe suppression, on & off axis cross polarization, and antenna gain using the pattern integration method.

The receive co-polarization patterns were measured in both azimuth and elevation using a synthesized CW signal source located approximately 2.3 miles away from the antenna under test. The receive cross-polarization patterns were measured and placed under the corresponding co-polarization pattern for azimuth and elevation at multiple frequencies. (Note: Transmit cross polarization patterns were not taken due to limitations of the Long Range at the time of testing.) Antenna gain measurements were taken by the Gain by Patterns Integration method using Simpson's Rule calculated by SATCOM Technologies' antenna testing software package.

Gain by integration values were calculated from the antenna's co-polarization radiation patterns at 20.700 & 30.500 GHz. The patterns represented in this report meet or exceed specifications in RF spec 975-2191E in accordance with acceptable measurement errors set forth in EIA-411-A.

Job No.: 13143_Unit 3		FT No: 7282		Test Engineer: W. Zuko Zukowski	
Zukowski, W. Zuko		Davisson, Richard		Hofefer, Robert	
	9/16/10		2-10-10		02/10/10
Originator	Date	Approval	Date	Approval	Date

DATA REDUCTION FORMULAS

1. System Noise Temperature:

$$T_s = [T_h + (T_{LNA} + T_i)] / Y' \quad (^\circ K)$$

where: T_s = system noise temperature in degrees K

T_h = hot load temperature in degrees K

T_{LNA} = LNA noise temperature in degrees K

T_i = sum of noise temperature contributions of device(s) installed
between feed flange and LNA in degrees K

$$2. Y' = 10 \exp (Y_{dB}/10)$$

3. G/T_s :

$$T_s(dB) = 10 \text{ LOG}(T_s)$$

Where: T_s = System noise temp.($^\circ K$)

$$4. G/T_s(dB/^\circ K) = G - T_s (dB)$$

5. Antenna Gain:

$$G_A = 10 \text{ LOG}[(G_3+G_{10})/2]-L_{rms} -L_f$$

$$G_3 = 31,000 / (\text{az } 3dB)(\text{el } 3dB)$$

$$G_{10} = 91,000 / (\text{az } 10dB)(\text{el } 10dB)$$

where: $\text{az } 3dB$ = (cosine corrected) Azimuth Half Power Beamwidth, degrees

$\text{el } 3dB$ = Elevation Half Power Beamwidth, degrees

$\text{az } 10dB$ = (cosine corrected) Azimuth Beamwidth @ -10dB, degrees

$\text{el } 10dB$ = Elevation Beamwidth @ -10dB, degrees

L_{rms} = Reflector Surface Accuracy Loss, dB

$$L_{rms} = 4.92E^2F^2$$

E = RMS Surface Accuracy of Reflector, inches

F = Frequency, GHz

L_f = Feed Insertion Loss, dB

6. Azimuth Angle Corrected for Elevation Angle:

$$Az' = 2 \text{ SIN}^{-1} [\text{SIN}(Az/2)\text{COS } El]$$

Where: Az = Angle from 0° on axis

DATA REDUCTION FORMULAS CONTINUED

7. Sidelobe Envelope Specification: ITU-RS-580

For Angle A from 1 degree to 20 degrees _____ $29-25 \log(A)$

For Angle A from 20 to 26.3 degrees _____ -3.5 dBi

For Angle A from 26.3 to 48 degrees _____ $-32-25 \log(A)$

For Angle A from 48 to 180 degrees _____ -10 dBi

8. G/T : by Carrier to Noise Method

G/T dB/°K =

$C/N_0 \text{ dB-Hz} - 228.6 - \text{Satellite EIRP}_{\text{dBW}} + \text{Path Loss}_{\text{dB}} + \text{Aspect Correction}_{\text{dB}}$

9. C/N_O =

$C+N/N - 2.5\text{dB} + 10 \log_{10} (\text{NBW})$

SUMMARY OF ANTENNA PERFORMANCE:

Antenna Cross-Pol

Frequency (GHz): 20.700 30.500
Measured (dBi):

LHCP

AZ	33.23	**.**
EL	32.09	**.**

RHCP

AZ	31.08	**.**
EL	30.69	**.**

Spec. (dBi): 24.80 dB

Antenna Gain (Pattern Integration Method)

Frequency (GHz): 20.700 30.500
Measured (dBi):

<u>LHCP</u>	56.82	59.12
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<u>RHCP</u>	57.11	59.31
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Spec. (dBi): 56.60 59.20

Measurement accuracy estimated at +/- 0.47 dBi



Customer..... GDSatcom Duluth
 Date/Local Time..... 1-19-2010 at 151828
 Job Number..... 13143_03

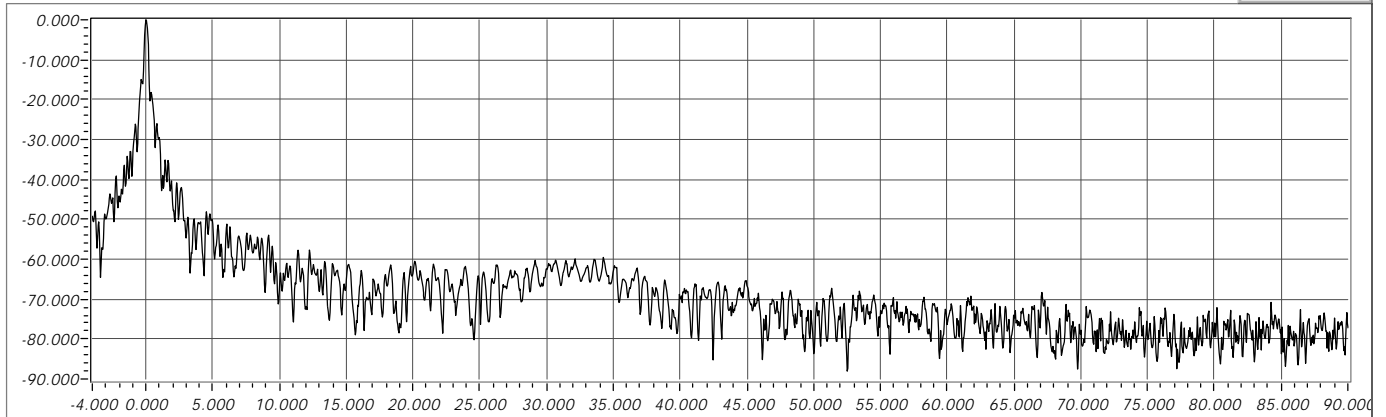
Model..... 3.9m Ka
 Location..... Kilgore, Tx
 Weather..... Clear
 Test Engineer..... Zukowski, W. Zuko
 Spacecraft..... Long Range
 Transponder..... NA

RX...LHCP Polarization...Gain by Integration...20.700 GHz

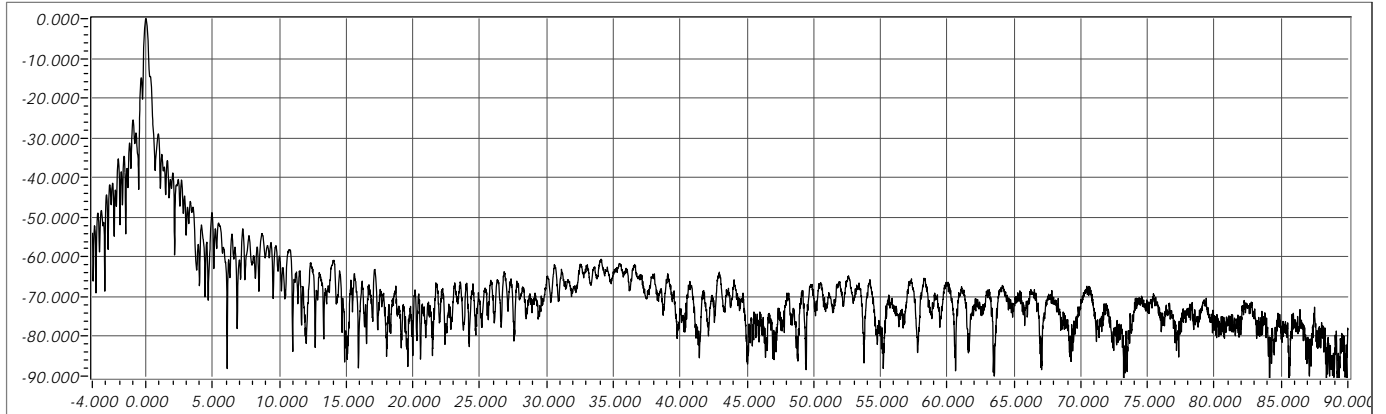
Spec. Gain (dBi): 56.600

Calculated Gain (dB): 56.82

AZ Pattern



EL Pattern



The Y-scale is power level (dB) relative to beam center; the X -scale is angle (degrees, AZ cosine corrected) relative to beam center.

Antenna Gain by Integration = $2 / (\text{Sum} [P_{\text{subTheta}} * \sin(\text{Theta}) * \text{deltaTheta}] - \text{FeedLoss} - \text{AngularExtentLoss} - \text{SparBlockageLoss} - \text{CrossPolLoss})$
 where the summation is performed for look angles (Theta) offset from beam center from 0 to 180 degrees (in practice the summation occurs on both sides of beam center and the average is taken) and where PsubTheta is the power relative to beam center power and measured at look angles offset from beam center.

SA Freq (Hz)=20700001748, AZ rate (deg/s)=1.029, EL rate (deg/s)=0.402, RBW (Hz)=30, VBW (Hz)=10

AZ Co-pol File % 100119 151828 13143_03 RC-175-LA-20.700.txt

EL Co-pol File % 100119 152604 13143_03 RC-90-LE-20.700.txt

Test Frequency (GHz) 20.700001748

AZ Ref. Level (dBm) -28.95

Azimuth (deg) 180.080

Elevation (deg) 1.870

Versions
 61030 FAST
 60129 PACK

The calculated gain is greater than the specified gain by 0.22 dB.

Points Displayed 2163

Feed Loss (dB) 0.60

Angular Extent Loss(dB) 0.05

Spar Blockage Loss (dB) 0.03

Cross-pol Loss (dB) 0.03



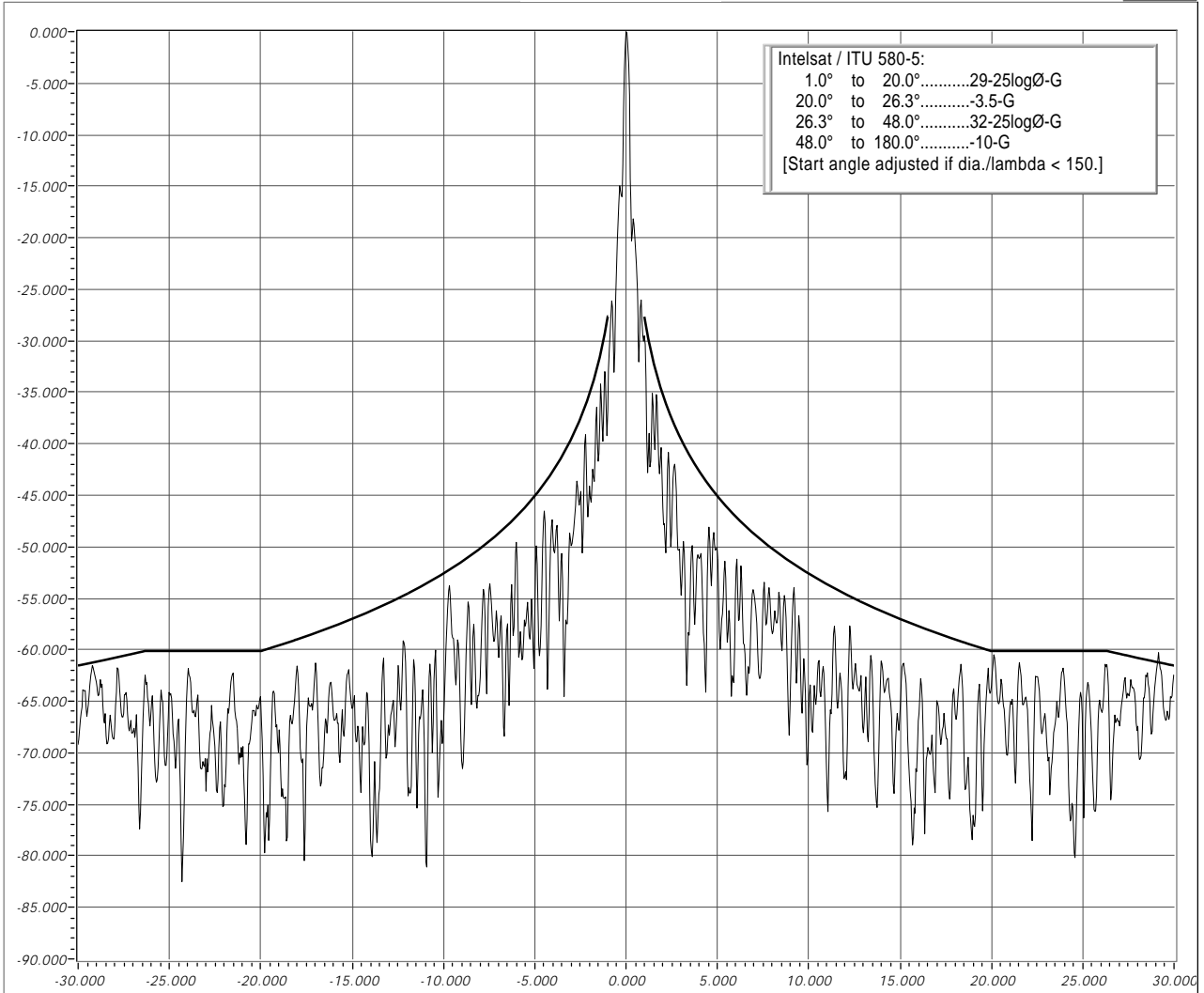
Customer..... GDSatcom Duluth
 Date/Local Time..... 1-19-2010 at 151828
 Job Number..... 13143_03

Model..... 3.9m Ka
 Location..... Kilgore, Tx
 Weather..... Clear
 Test Engineer..... Zukowski, W. Zuko
 Spacecraft..... Long Range
 Transponder..... NA

RX...Co-pol...LHCP polarization...20.700 GHz

Azimuth

% Over Curve



Y-scale is power level (dB) relative to beam center; x-scale is angle (degrees, cosine corrected) relative to beam center.

SA Freq (Hz)=20700001748, AZ rate (deg/s)=1.029, EL rate (deg/s)=0.402, RBW (Hz)=30, VBW (Hz)=10

File:
 Test Frequency (GHz):
 Ref. Level (dBm):
 # Points Displayed:

Versions
 61030 FAST
 60129 PACK

Specified Gain (dB):
 Azimuth Beam Center (deg):
 Elevation Beam Center (deg):
 Margin Under Curved (dB):



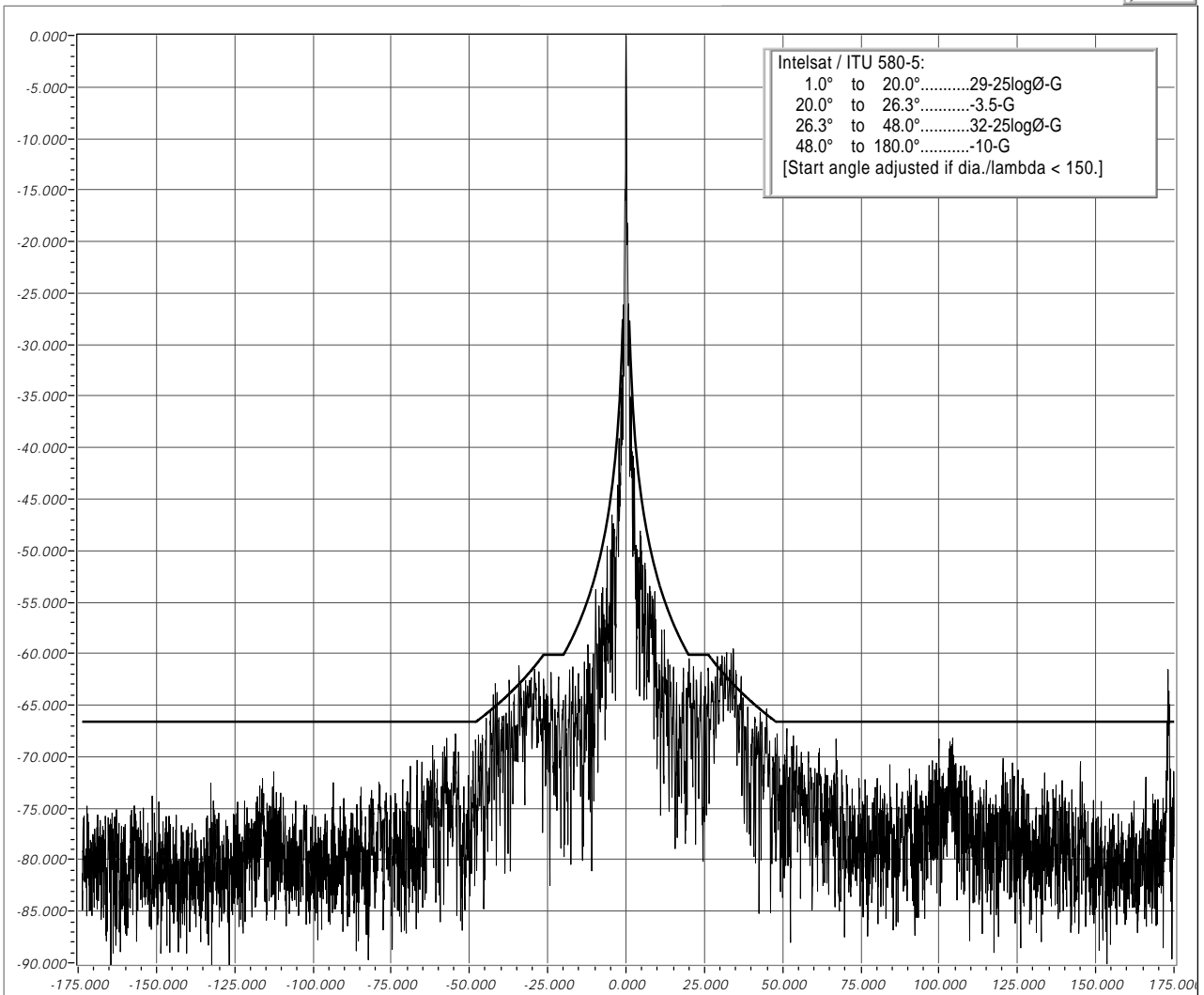
Customer..... GDSatcom Duluth
 Date/Local Time..... 1-19-2010 at 151828
 Job Number..... 13143_03

Model..... 3.9m Ka
 Location..... Kilgore, Tx
 Weather..... Clear
 Test Engineer..... Zukowski, W. Zuko
 Spacecraft..... Long Range
 Transponder..... NA

RX...Co-pol...LHCP polarization...20.700 GHz

Azimuth

% Over Curve 1.1



Y-scale is power level (dB) relative to beam center; x-scale is angle (degrees, cosine corrected) relative to beam center.

SA Freq (Hz)=20700001748, AZ rate (deg/s)=1.029, EL rate (deg/s)=0.402, RBW (Hz)=30, VBW (Hz)=10

File: % 100119 151828 13143_03 RC-175-LA-20.700.txt

Test Frequency (GHz): 20.700001748

Ref. Level (dBm): -28.95

Points Displayed: 8056

Versions
61030 FAST
60129 PACK

Specified Gain (dB): 56.600

Azimuth Beam Center (deg): 180.080

Elevation Beam Center (deg): 1.870

Margin Under Curved (dB): None



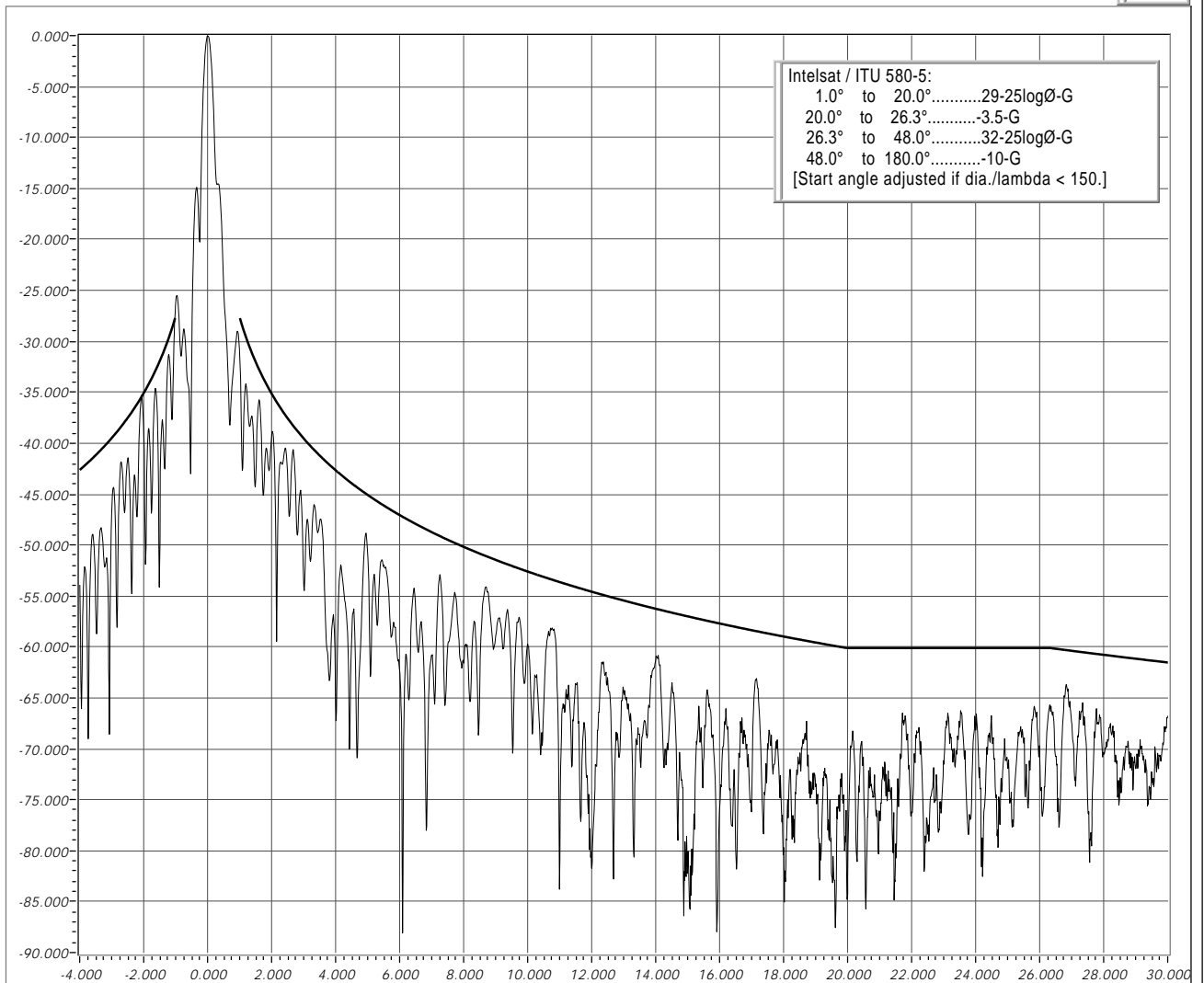
Customer..... GDSatcom Duluth
 Date/Local Time..... 1-19-2010 at 152604
 Job Number..... 13143_03

Model..... 3.9m Ka
 Location..... Kilgore, Tx
 Weather..... Clear
 Test Engineer..... Zukowski, W. Zuko
 Spacecraft..... Long Range
 Transponder..... NA

RX...Co-pol...LHCP polarization...20.700 GHz

Elevation

% Over Curve



Y-scale is power level (dB) relative to beam center; x-scale is angle (degrees, cosine corrected) relative to beam center.

SA Freq (Hz)=20700001748, AZ rate (deg/s)=1.029, EL rate (deg/s)=0.402, RBW (Hz)=30, VBW (Hz)=10

File:

Specified Gain:

Test Frequency (GHz):

Azimuth Beam Center (deg):

Ref. Level (dBm):

Elevation Beam Center (deg):

Points Displayed:

Margin Under Curve (dB):

Versions
 61030 FAST
 60129 PACK



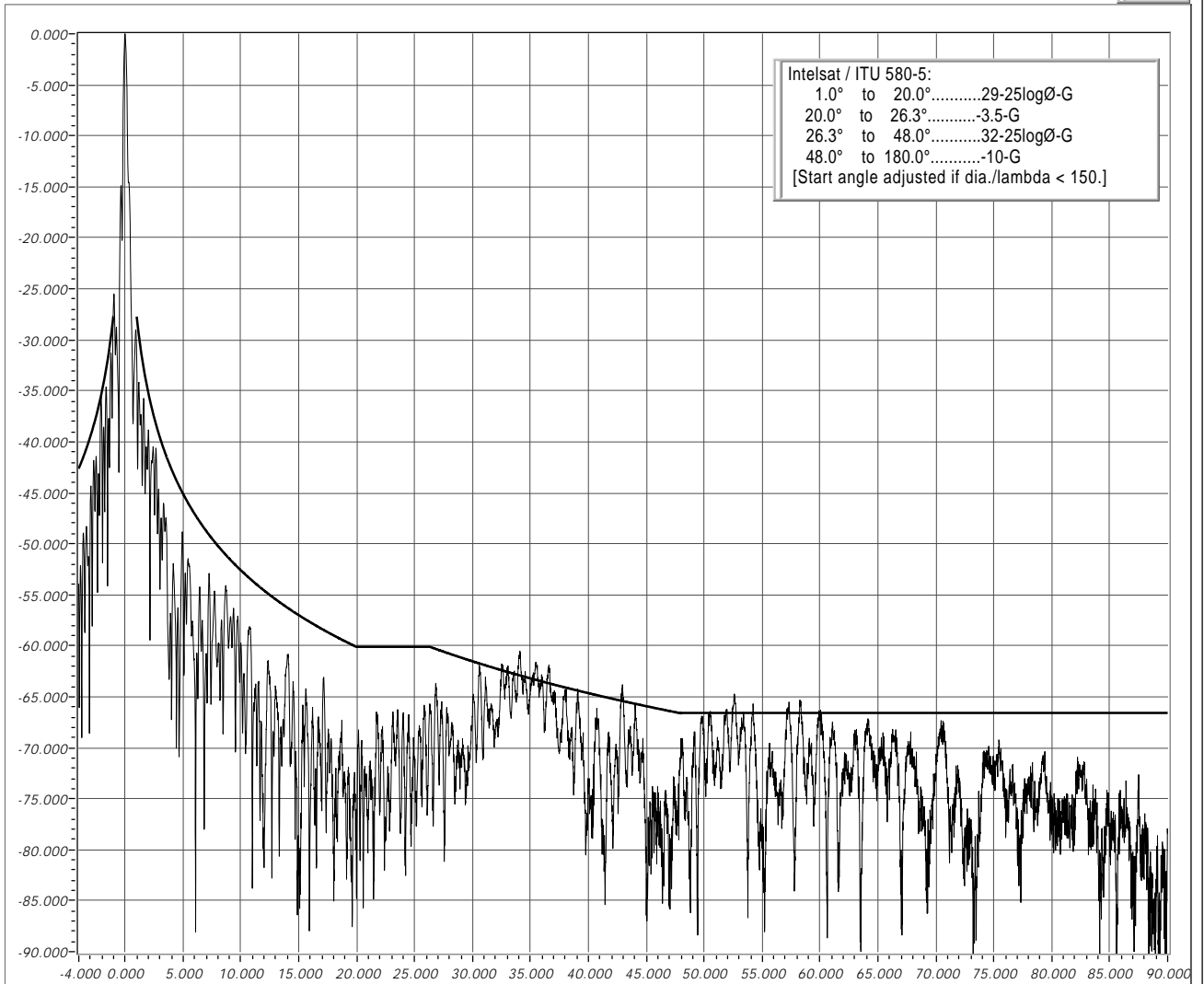
Customer..... GDSatcom Duluth
 Date/Local Time..... 1-19-2010 at 152604
 Job Number..... 13143_03

Model..... 3.9m Ka
 Location..... Kilgore, Tx
 Weather..... Clear
 Test Engineer..... Zukowski, W. Zuko
 Spacecraft..... Long Range
 Transponder..... NA

RX...Co-pol...LHCP polarization...20.700 GHz

Elevation

% Over Curve 2.7



Y-scale is power level (dB) relative to beam center; x-scale is angle (degrees, cosine corrected) relative to beam center.

SA Freq (Hz)=20700001748, AZ rate (deg/s)=1.029, EL rate (deg/s)=0.402, RBW (Hz)=30, VBW (Hz)=10

File: % 100119 152604 13143_03 RC-90-LE-20.700.txt

Specified Gain: 56.600

Test Frequency (GHz): 20.700001748

Azimuth Beam Center (deg): 180.080

Ref. Level (dBm): -28.73

Elevation Beam Center (deg): 1.870

Points Displayed: 7670

Margin Under Curve (dB): None



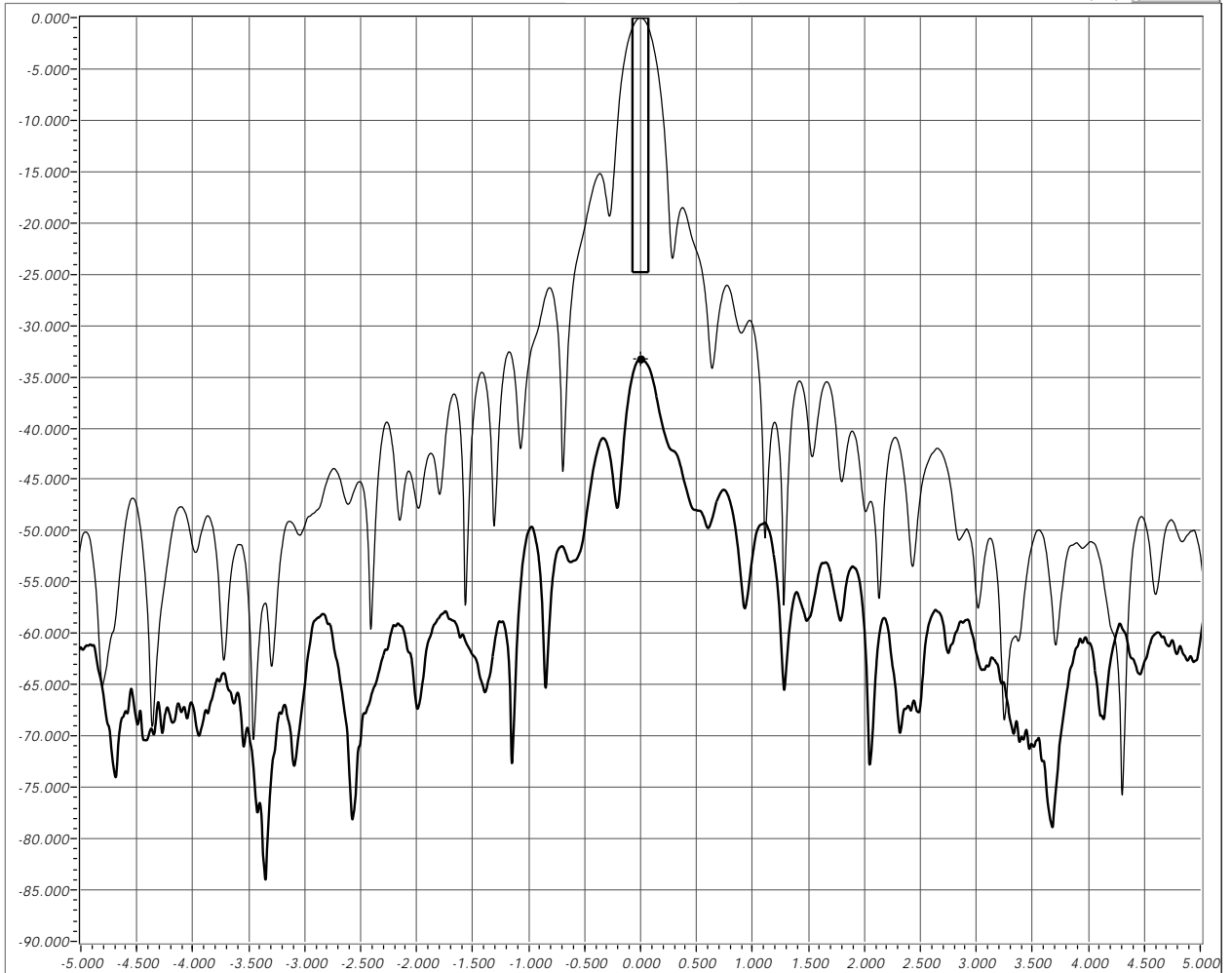
Customer..... GDSatcom Duluth
 Date/Local Time.... 1-19-2010 at 145815
 Job Number..... 13143_03

Model..... 3.9m Ka
 Location..... Kilgore, Tx
 Weather..... Clear
 Test Engineer..... Zukowski, W. Zuko
 Spacecraft..... Long Range
 Transponder..... NA

RX...Cross-pol under Co-pol...LHCP polarization...20.700 GHz

Azimuth

On-axis Isolation (dB): 33.23



The Y-scale is power level (dB) relative to beam center; the X-scale is angle (degrees, cosine corrected) relative to beam center.

SA Freq (Hz)=20700001747, AZ rate (deg/s)=1.029, EL rate (deg/s)=0.402, RBW (Hz)=30, VBW (Hz)=10

Co-pol File:	% 100119 150240 13143_03 RC-7-LA-20.700.txt	Azimuth Beam Center (deg):	180.080
Cross-pol File:	% 100119 145815 13143_03 RX-7-LA-20.700.txt	Elevation Beam Center (deg):	1.870
Test Frequency (GHz):	20.700001747	On-axis Spec. Isolation (dB):	24.800
Ref. Level (dBm):	-28.63	Off-axis Spec. Isolation (dB):	24.80
# Points Displayed:	6810		

Versions
 61030 FAST
 60129 PACK



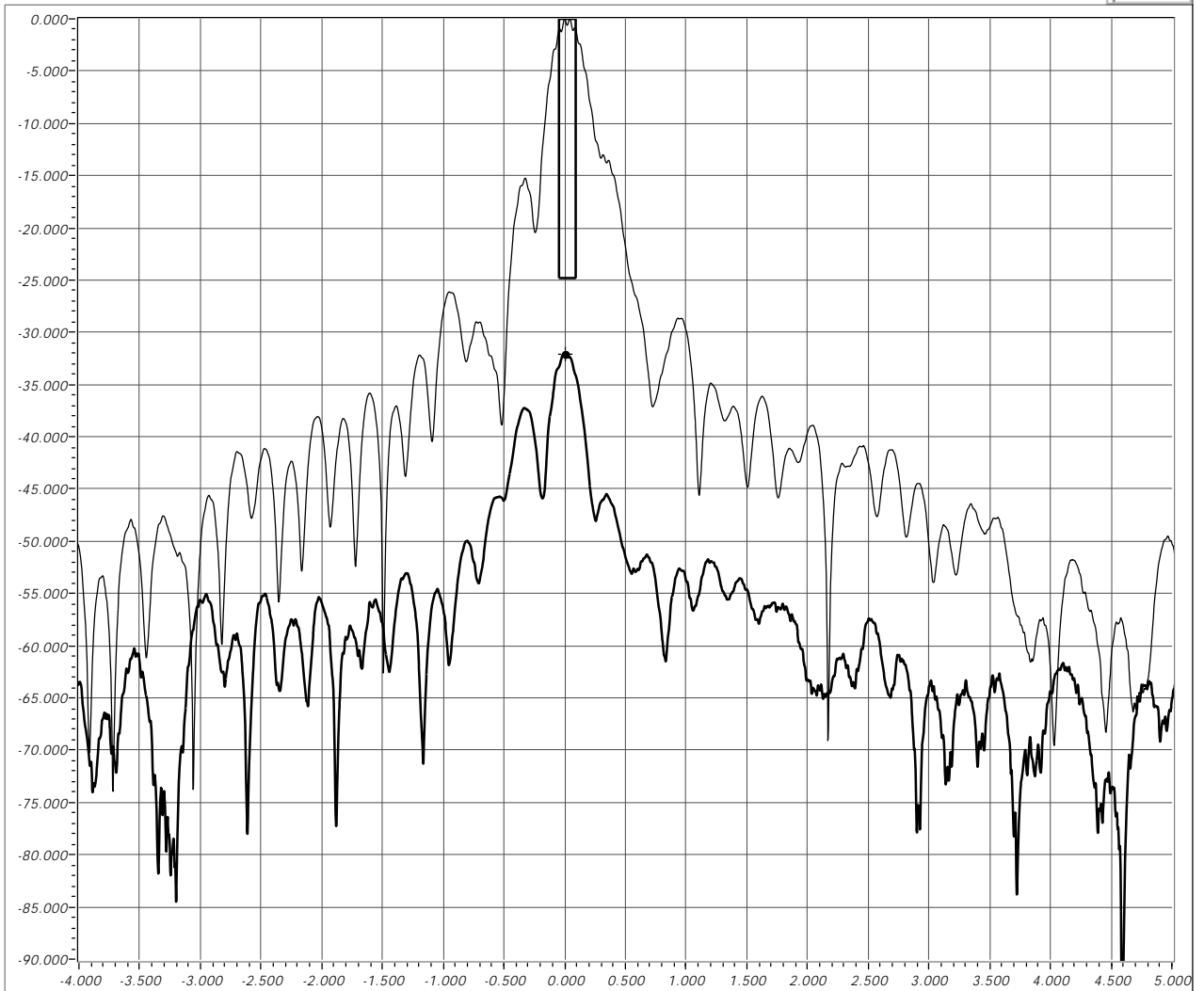
Customer..... GDSatcom Duluth
 Date/Local Time..... 1-19-2010 at 150358
 Job Number..... 13143_03

Model..... 3.9m Ka
 Location..... Kilgore, Tx
 Weather..... Clear
 Test Engineer..... Zukowski, W. Zuko
 Spacecraft..... Long Range
 Transponder..... NA

RX...Cross-pol under Co-pol...LHCP polarization...20.700 GHz

Elevation

On Axis Isolation (dB): 32.09



The Y-scale is power level (dB) relative to beam center; the X-scale is angle (degrees, cosine corrected) relative to beam center.

SA Freq (Hz)=20700001748, AZ rate (deg/s)=1.029, EL rate (deg/s)=0.402, RBW (Hz)=30, VBW (Hz)=10

Co-pol File:	<input type="text" value="% 100119 150358 13143_03 RC-7-LE-20.700.txt"/>	Azimuth Beam Center (deg):	<input type="text" value="180.080"/>
Cross-pol File:	<input type="text" value="% 100119 150038 13143_03 RX-7-LE-20.700.txt"/>	Elevation Beam Center (deg):	<input type="text" value="1.870"/>
Test Frequency (GHz):	<input type="text" value="20.700001748"/>	On-axis Spec. Isolation (dB):	<input type="text" value="24.800"/>
Ref. Level (dBm):	<input type="text" value="-28.63"/>	Off-axis Spec. Isolation (dB):	<input type="text" value="24.80"/>
# Points Displayed:	<input type="text" value="7206"/>		

Versions
 61030 FAST
 60129 PACK



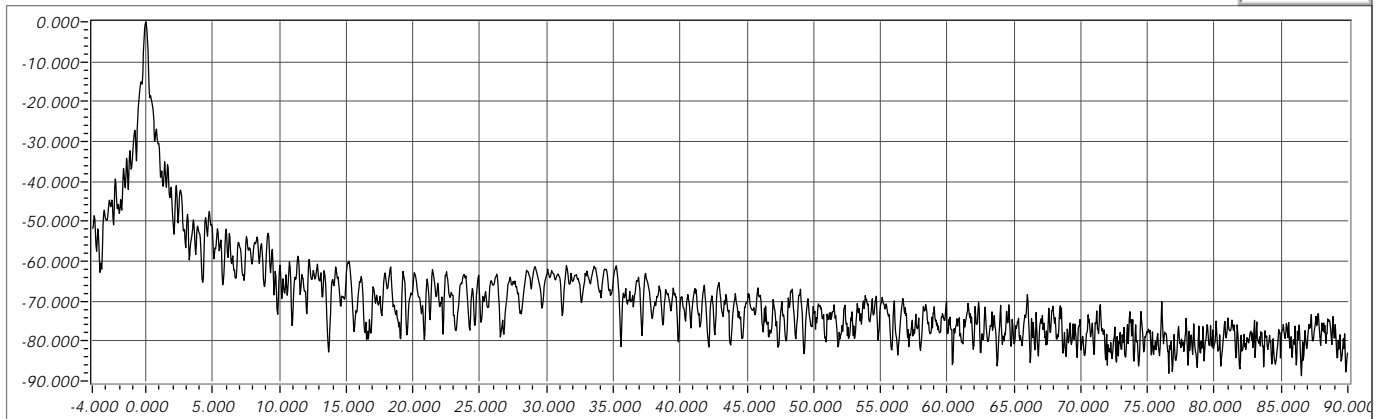
Customer..... GDSatcom Duluth
 Date/Local Time..... 1-19-2010 at 181437
 Job Number..... 13143_03

Model..... 3.9m Ka
 Location..... Kilgore, Tx
 Weather..... Clear
 Test Engineer..... Zukowski, W. Zuko
 Spacecraft..... Long Range
 Transponder..... NA

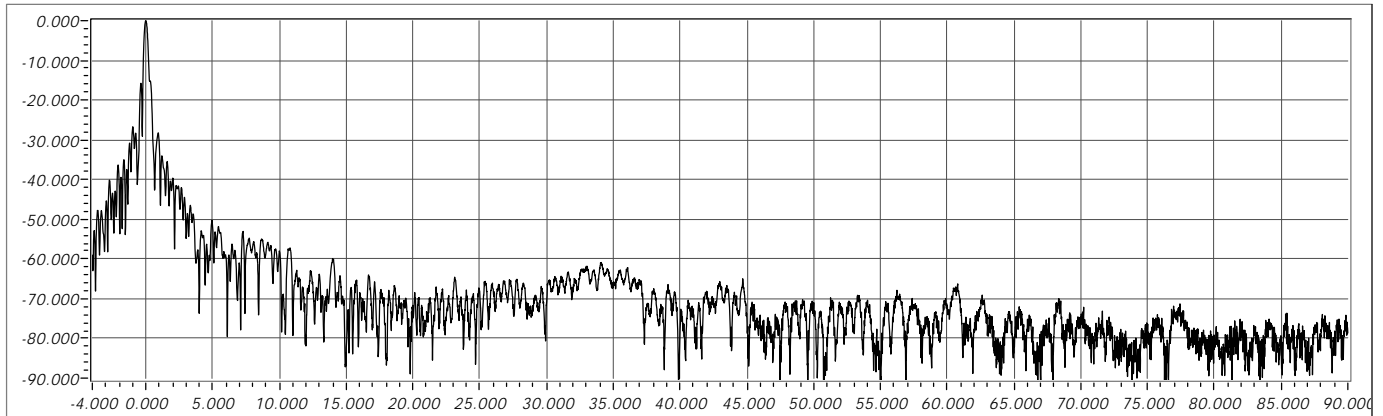
RX...RHCP Polarization...Gain by Integration...20.700 GHz

Spec. Gain (dBi): **56.600**
 Calculated Gain (dB): **57.11**

AZ Pattern



EL Pattern



The Y-scale is power level (dB) relative to beam center; the X -scale is angle (degrees, AZ cosine corrected) relative to beam center.

Antenna Gain by Integration = $2 / (\text{Sum} [P_{\text{subTheta}} * \sin(\text{Theta}) * \text{deltaTheta}] - \text{FeedLoss} - \text{AngularExtentLoss} - \text{SparBlockageLoss} - \text{CrossPolLoss})$
 where the summation is performed for look angles (Theta) offset from beam center from 0 to 180 degrees (in practice the summation occurs on both sides of beam center and the average is taken) and where PsubTheta is the power relative to beam center power and measured at look angles offset from beam center.

SA Freq (Hz)=20700001749, AZ rate (deg/s)=1.029, EL rate (deg/s)=0.402, RBW (Hz)=30, VBW (Hz)=10

AZ Co-pol File % 100119 181437 13143_03 RC-175-RA-20.700.txt

EL Co-pol File % 100119 182210 13143_03 RC-90-RE-20.700.txt

Test Frequency (GHz) 20.700001749

AZ Ref. Level (dBm) -28.52

Azimuth (deg) 180.080

Elevation (deg) 1.870

Versions
 61030 FAST
 60129 PACK

The calculated gain is greater than the specified gain by 0.51 dB.

# Points Displayed	2150
Feed Loss (dB)	0.60
Angular Extent Loss(dB)	0.05
Spar Blockage Loss (dB)	0.03
Cross-pol Loss (dB)	0.03



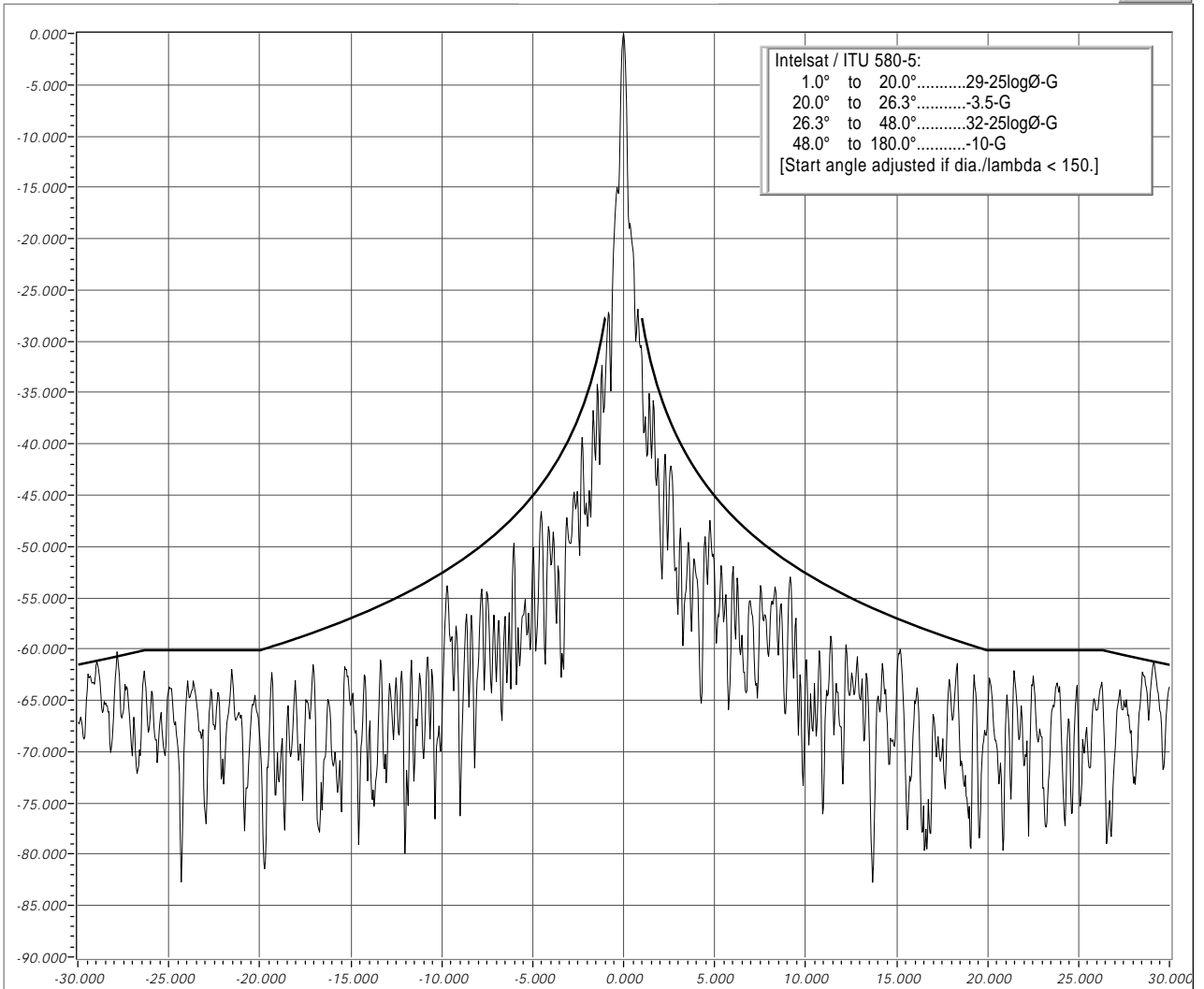
Customer..... GDSatcom Duluth
 Date/Local Time..... 1-19-2010 at 181437
 Job Number..... 13143_03

Model..... 3.9m Ka
 Location..... Kilgore, Tx
 Weather..... Clear
 Test Engineer..... Zukowski, W. Zuko
 Spacecraft..... Long Range
 Transponder..... NA

RX...Co-pol...RHCP polarization...20.700 GHz

Azimuth

% Over Curve



Y-scale is power level (dB) relative to beam center; x-scale is angle (degrees, cosine corrected) relative to beam center.

SA Freq (Hz)=20700001749, AZ rate (deg/s)=1.029, EL rate (deg/s)=0.402, RBW (Hz)=30, VBW (Hz)=10

File:

Test Frequency (GHz):

Ref. Level (dBm):

Points Displayed:

Versions
61030 FAST
60129 PACK

Specified Gain (dB):

Azimuth Beam Center (deg):

Elevation Beam Center (deg):

Margin Under Curved (dB):



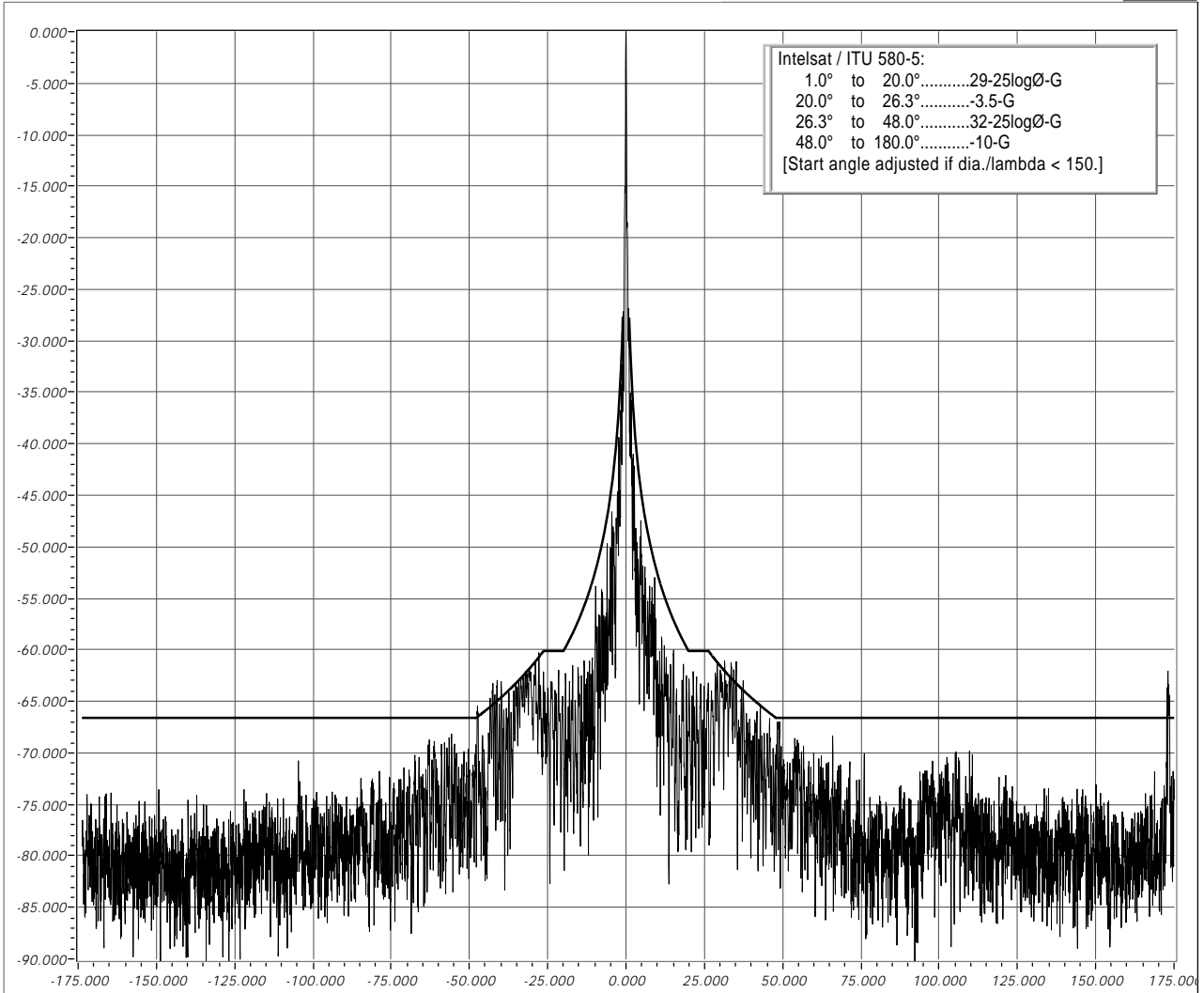
Customer..... GDSatcom Duluth
 Date/Local Time..... 1-19-2010 at 181437
 Job Number..... 13143_03

Model..... 3.9m Ka
 Location..... Kilgore, Tx
 Weather..... Clear
 Test Engineer..... Zukowski, W. Zuko
 Spacecraft..... Long Range
 Transponder..... NA

RX...Co-pol...RHCP polarization...20.700 GHz

Azimuth

% Over Curve



Y-scale is power level (dB) relative to beam center; x-scale is angle (degrees, cosine corrected) relative to beam center.

SA Freq (Hz)=20700001749, AZ rate (deg/s)=1.029, EL rate (deg/s)=0.402, RBW (Hz)=30, VBW (Hz)=10

File:

Test Frequency (GHz):

Ref. Level (dBm):

Points Displayed:

Versions
61030 FAST
60129 PACK

Specified Gain (dB):

Azimuth Beam Center (deg):

Elevation Beam Center (deg):

Margin Under Curved (dB):



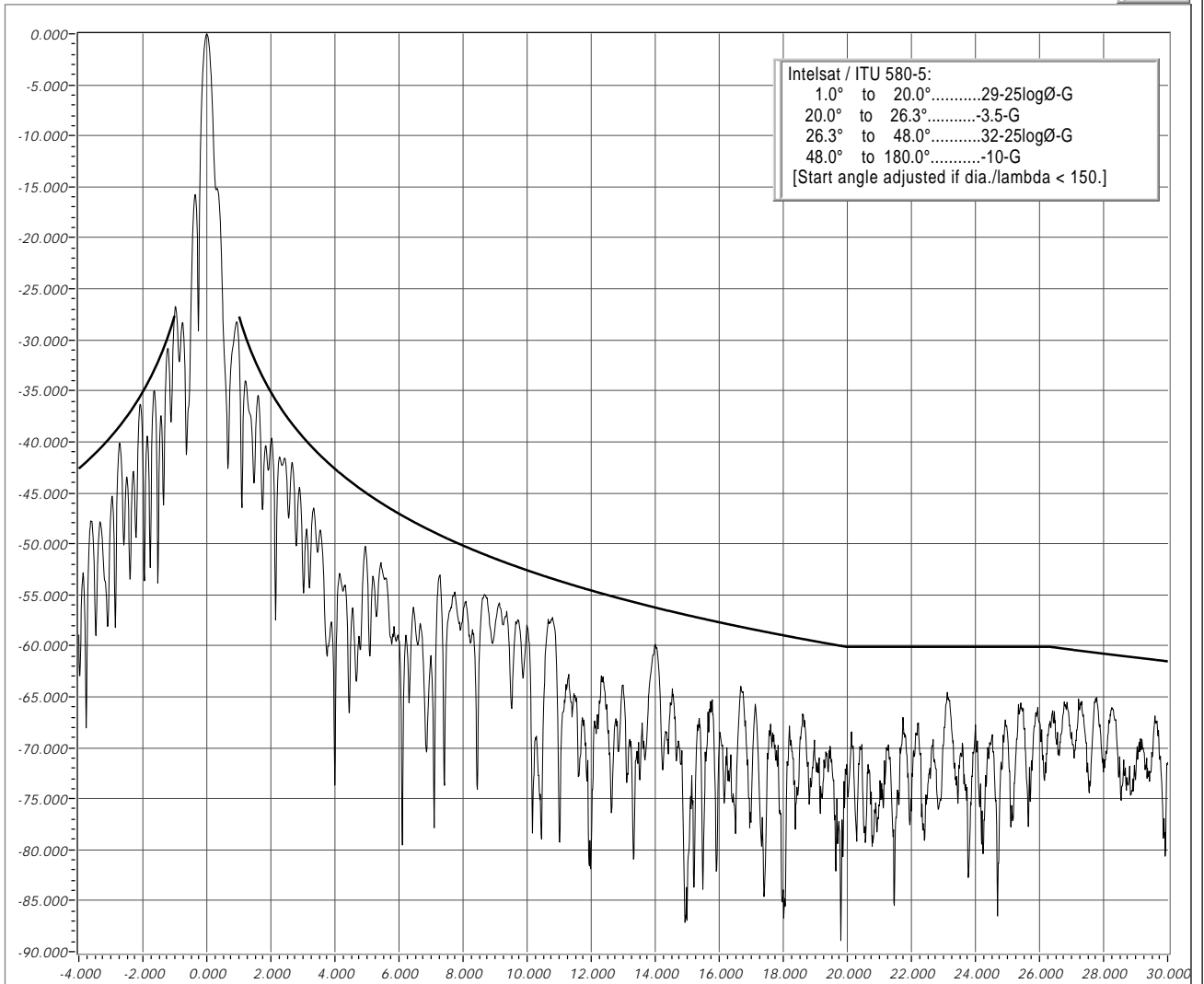
Customer..... GDSatcom Duluth
 Date/Local Time..... 1-19-2010 at 182210
 Job Number..... 13143_03

Model..... 3.9m Ka
 Location..... Kilgore, Tx
 Weather..... Clear
 Test Engineer..... Zukowski, W. Zuko
 Spacecraft..... Long Range
 Transponder..... NA

RX...Co-pol...RHCP polarization...20.700 GHz

Elevation

% Over Curve



Y-scale is power level (dB) relative to beam center; x-scale is angle (degrees, cosine corrected) relative to beam center.

SA Freq (Hz)=20700001749, AZ rate (deg/s)=1.029, EL rate (deg/s)=0.402, RBW (Hz)=30, VBW (Hz)=10

File:

Specified Gain:

Test Frequency (GHz):

Azimuth Beam Center (deg):

Ref. Level (dBm):

Elevation Beam Center (deg):

Points Displayed:

Margin Under Curve (dB):

Versions
 61030 FAST
 60129 PACK



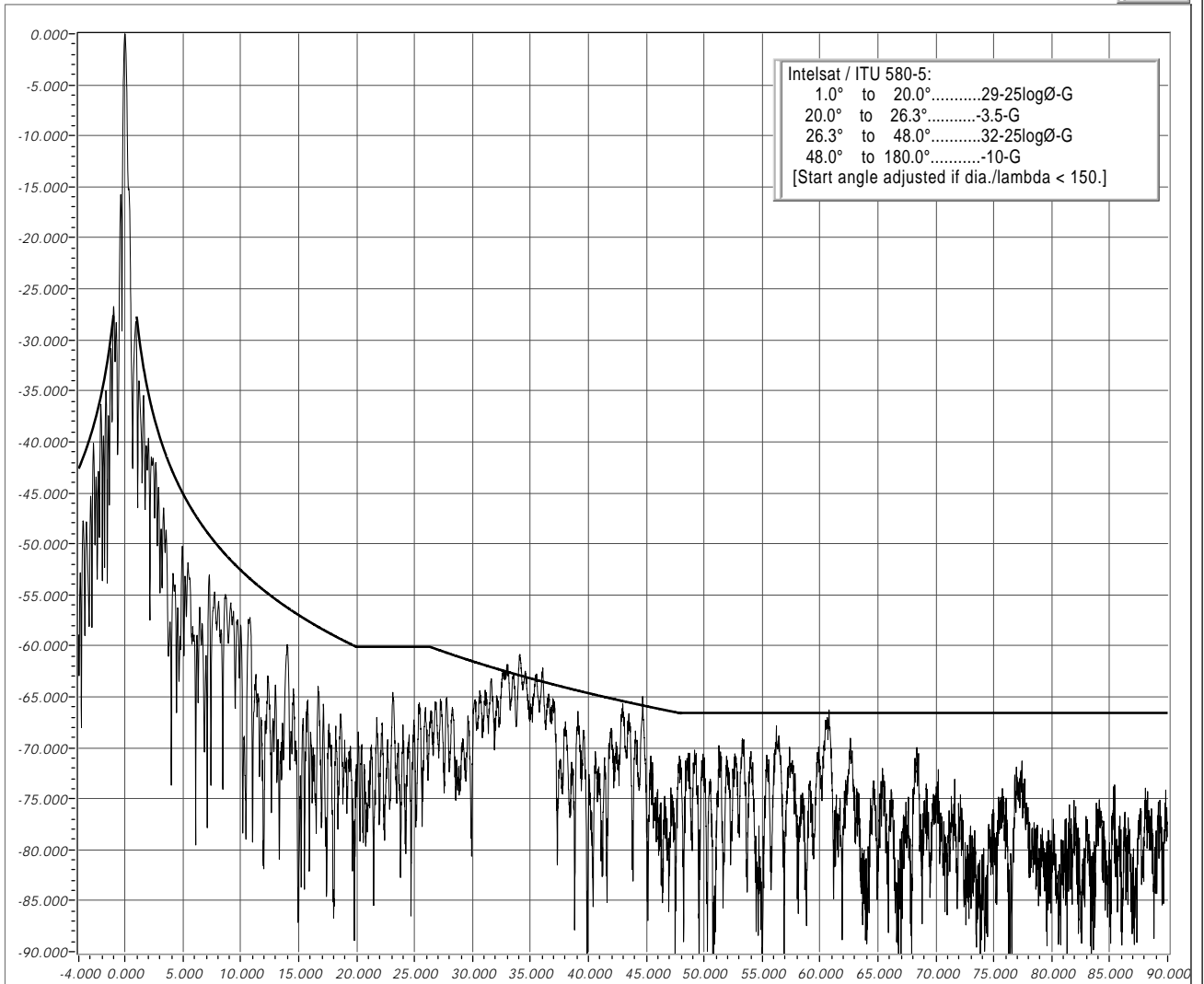
Customer..... GDSatcom Duluth
 Date/Local Time..... 1-19-2010 at 182210
 Job Number..... 13143_03

Model..... 3.9m Ka
 Location..... Kilgore, Tx
 Weather..... Clear
 Test Engineer..... Zukowski, W. Zuko
 Spacecraft..... Long Range
 Transponder..... NA

RX...Co-pol...RHCP polarization...20.700 GHz

Elevation

% Over Curve



Y-scale is power level (dB) relative to beam center; x-scale is angle (degrees, cosine corrected) relative to beam center.

SA Freq (Hz)=20700001749, AZ rate (deg/s)=1.029, EL rate (deg/s)=0.402, RBW (Hz)=30, VBW (Hz)=10

File:

Specified Gain:

Test Frequency (GHz):

Azimuth Beam Center (deg):

Ref. Level (dBm):

Elevation Beam Center (deg):

Points Displayed:

Margin Under Curve (dB):



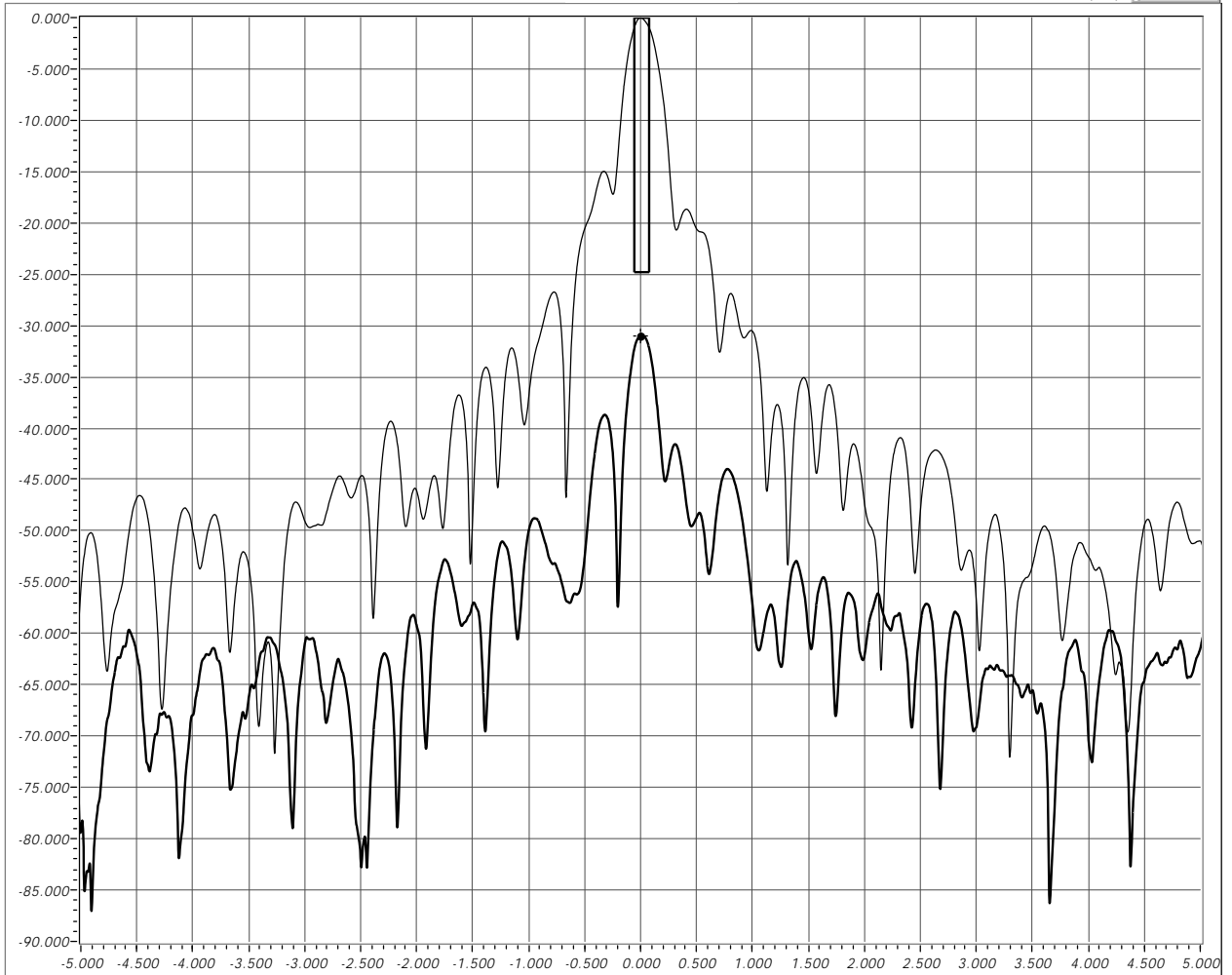
Customer..... GDSatcom Duluth
 Date/Local Time.... 1-19-2010 at 175754
 Job Number..... 13143_03

Model..... 3.9m Ka
 Location..... Kilgore, Tx
 Weather..... Clear
 Test Engineer..... Zukowski, W. Zuko
 Spacecraft..... Long Range
 Transponder..... NA

RX...Cross-pol under Co-pol...RHCP polarization...20.700 GHz

Azimuth

On-axis Isolation (dB): 31.08



The Y-scale is power level (dB) relative to beam center; the X-scale is angle (degrees, cosine corrected) relative to beam center.

SA Freq (Hz)=20700001744, AZ rate (deg/s)=1.029, EL rate (deg/s)=0.402, RBW (Hz)=30, VBW (Hz)=10

Co-pol File:	% 100119 180206 13143_03 RC-7-RA-20.700.txt	Azimuth Beam Center (deg):	180.080
Cross-pol File:	% 100119 175754 13143_03 RX-7-RA-20.700.txt	Elevation Beam Center (deg):	1.870
Test Frequency (GHz):	20.700001744	On-axis Spec. Isolation (dB):	24.800
Ref. Level (dBm):	-28.49	Off-axis Spec. Isolation (dB):	24.80
# Points Displayed:	6718		

Versions
 61030 FAST
 60129 PACK



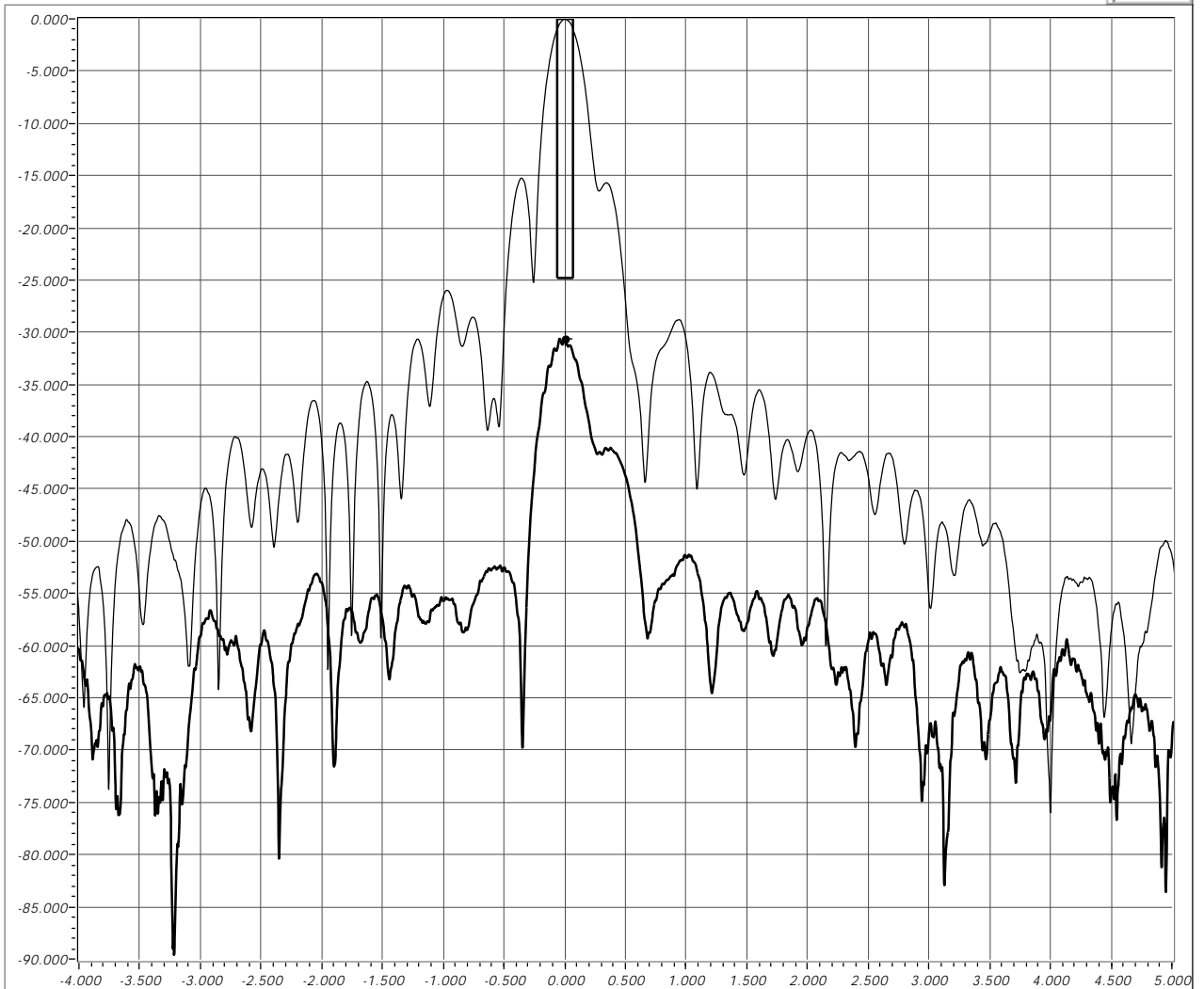
Customer..... GDSatcom Duluth
 Date/Local Time..... 1-19-2010 at 180322
 Job Number..... 13143_03

Model..... 3.9m Ka
 Location..... Kilgore, Tx
 Weather..... Clear
 Test Engineer..... Zukowski, W. Zuko
 Spacecraft..... Long Range
 Transponder..... NA

RX...Cross-pol under Co-pol...RHCP polarization...20.700 GHz

Elevation

On Axis Isolation (dB): 30.69



The Y-scale is power level (dB) relative to beam center; the X-scale is angle (degrees, cosine corrected) relative to beam center.

SA Freq (Hz)=20700001745, AZ rate (deg/s)=1.029, EL rate (deg/s)=0.402, RBW (Hz)=30, VBW (Hz)=10

Co-pol File:	% 100119 180322 13143_03 RC-7-RE-20.700.txt	Azimuth Beam Center (deg):	180.080
Cross-pol File:	% 100119 180018 13143_03 RX-7-RE-20.700.txt	Elevation Beam Center (deg):	1.870
Test Frequency (GHz):	20.700001745	On-axis Spec. Isolation (dB):	24.800
Ref. Level (dBm):	-28.49	Off-axis Spec. Isolation (dB):	24.80
# Points Displayed:	7113		

Versions
 61030 FAST
 60129 PACK



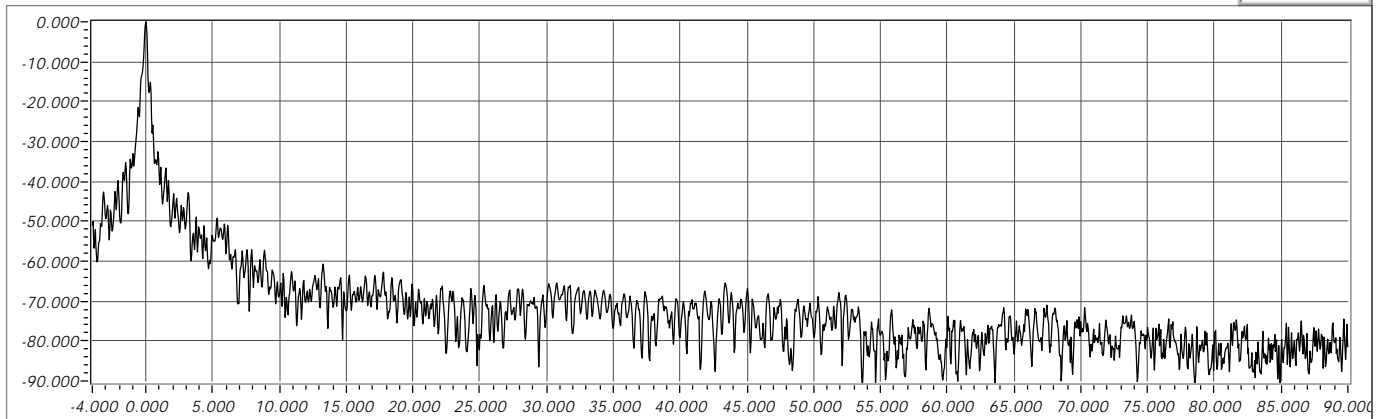
Customer..... GDSatcom Duluth
 Date/Local Time..... 1-19-2010 at 110008
 Job Number..... 13143_03

Model..... 3.9m Ka
 Location..... Kilgore, Tx
 Weather..... Clear
 Test Engineer..... Zukowski, W. Zuko
 Spacecraft..... Long Range
 Transponder..... NA

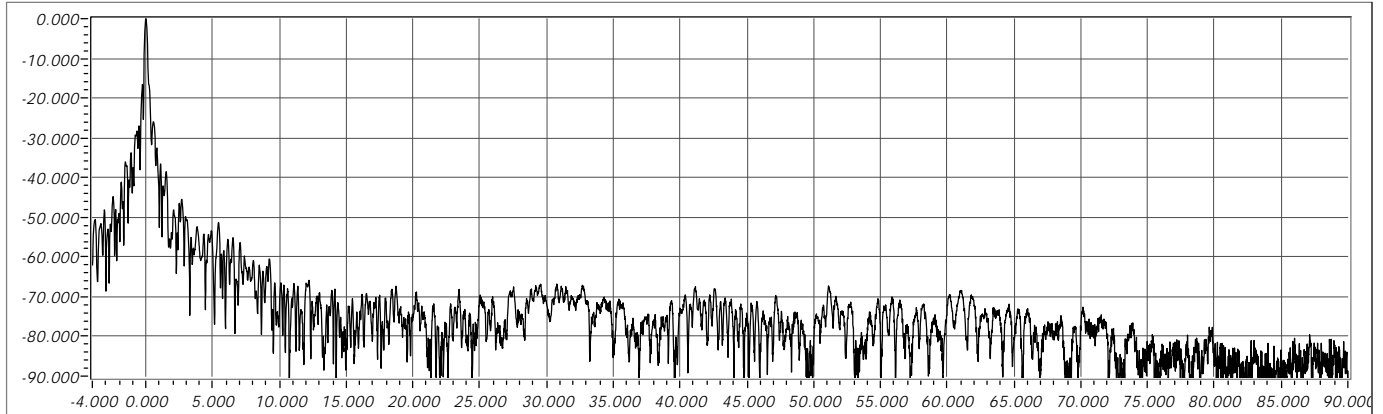
TX...LHCP Polarization...Gain by Integration...30.500 GHz

Spec. Gain (dBi): **59.200**
 Calculated Gain (dB): **59.12**

AZ Pattern



EL Pattern



The Y-scale is power level (dB) relative to beam center; the X -scale is angle (degrees, AZ cosine corrected) relative to beam center.

Antenna Gain by Integration = $2 / (\text{Sum} [P_{\text{subTheta}} * \sin(\text{Theta}) * \text{deltaTheta}] - \text{FeedLoss} - \text{AngularExtentLoss} - \text{SparBlockageLoss} - \text{CrossPolLoss})$
 where the summation is performed for look angles (Theta) offset from beam center from 0 to 180 degrees (in practice the summation occurs on both sides of beam center and the average is taken) and where PsubTheta is the power relative to beam center power and measured at look angles offset from beam center.

SA Freq (Hz)=30500002664, AZ rate (deg/s)=1.029, EL rate (deg/s)=0.402, RBW (Hz)=30, VBW (Hz)=10

AZ Co-pol File % 100119 110008 13143_03 TC-175-LA-30.500.txt

EL Co-pol File % 100119 110743 13143_03 TC-90-LE-30.500.txt

Test Frequency (GHz) 30.500002664

AZ Ref. Level (dBm) -37.43

Azimuth (deg) 180.080

Elevation (deg) 1.870

Versions
 61030 FAST
 60129 PACK

The calculated gain is less than the specified gain by 0.08 dB.

# Points Displayed	2174
Feed Loss (dB)	0.60
Angular Extent Loss(dB)	0.05
Spar Blockage Loss (dB)	0.03
Cross-pol Loss (dB)	0.03



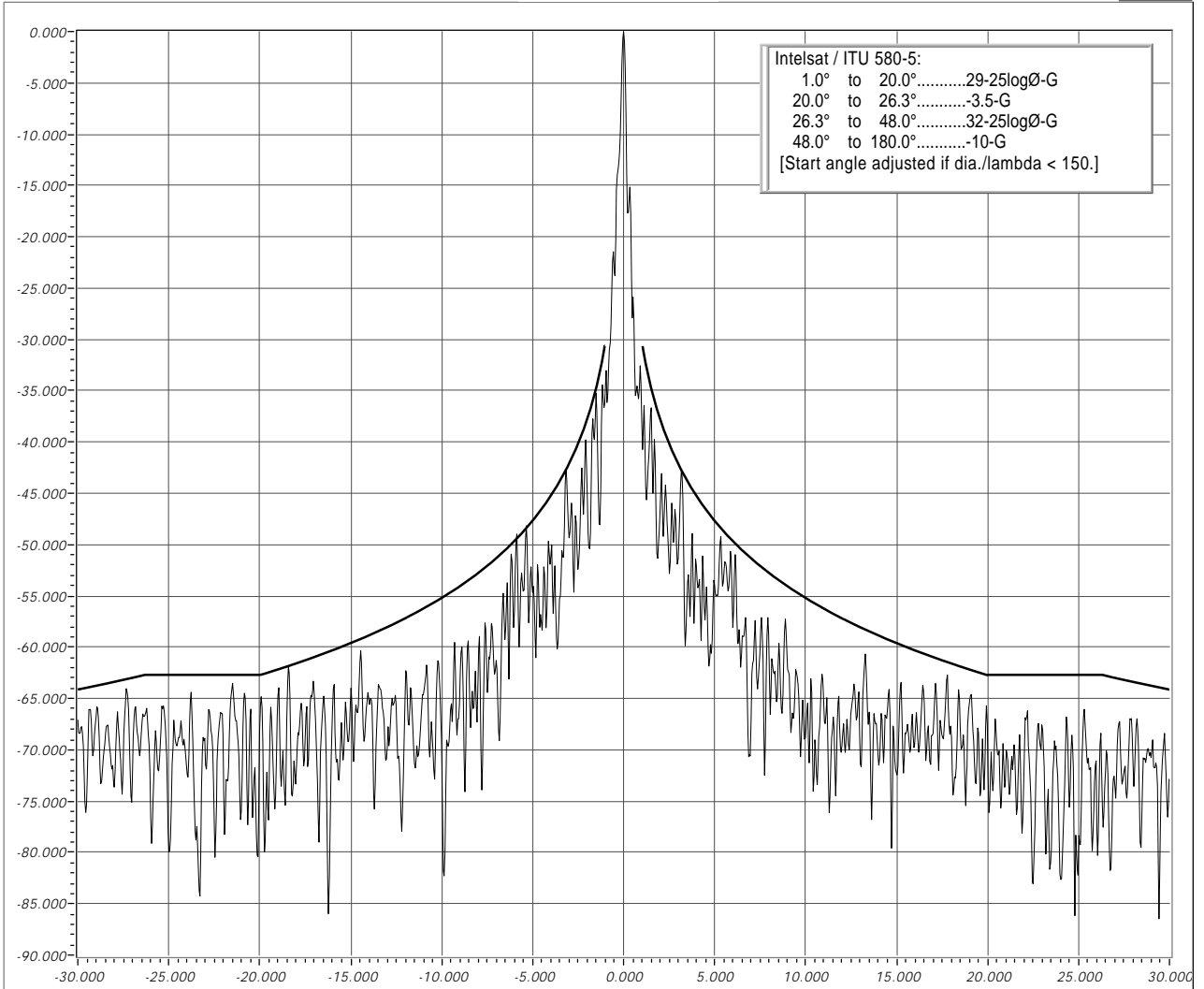
Customer..... GDSatcom Duluth
 Date/Local Time..... 1-19-2010 at 110008
 Job Number..... 13143_03

Model..... 3.9m Ka
 Location..... Kilgore, Tx
 Weather..... Clear
 Test Engineer..... Zukowski, W. Zuko
 Spacecraft..... Long Range
 Transponder..... NA

TX...Co-pol...LHCP polarization...30.500 GHz

Azimuth

% Over Curve



Y-scale is power level (dB) relative to beam center; x-scale is angle (degrees, cosine corrected) relative to beam center.

SA Freq (Hz)=30500002664, AZ rate (deg/s)=1.029, EL rate (deg/s)=0.402, RBW (Hz)=30, VBW (Hz)=10

File:

Test Frequency (GHz):

Ref. Level (dBm):

Points Displayed:

Versions
61030 FAST
60129 PACK

Specified Gain (dB):

Azimuth Beam Center (deg):

Elevation Beam Center (deg):

Margin Under Curved (dB):



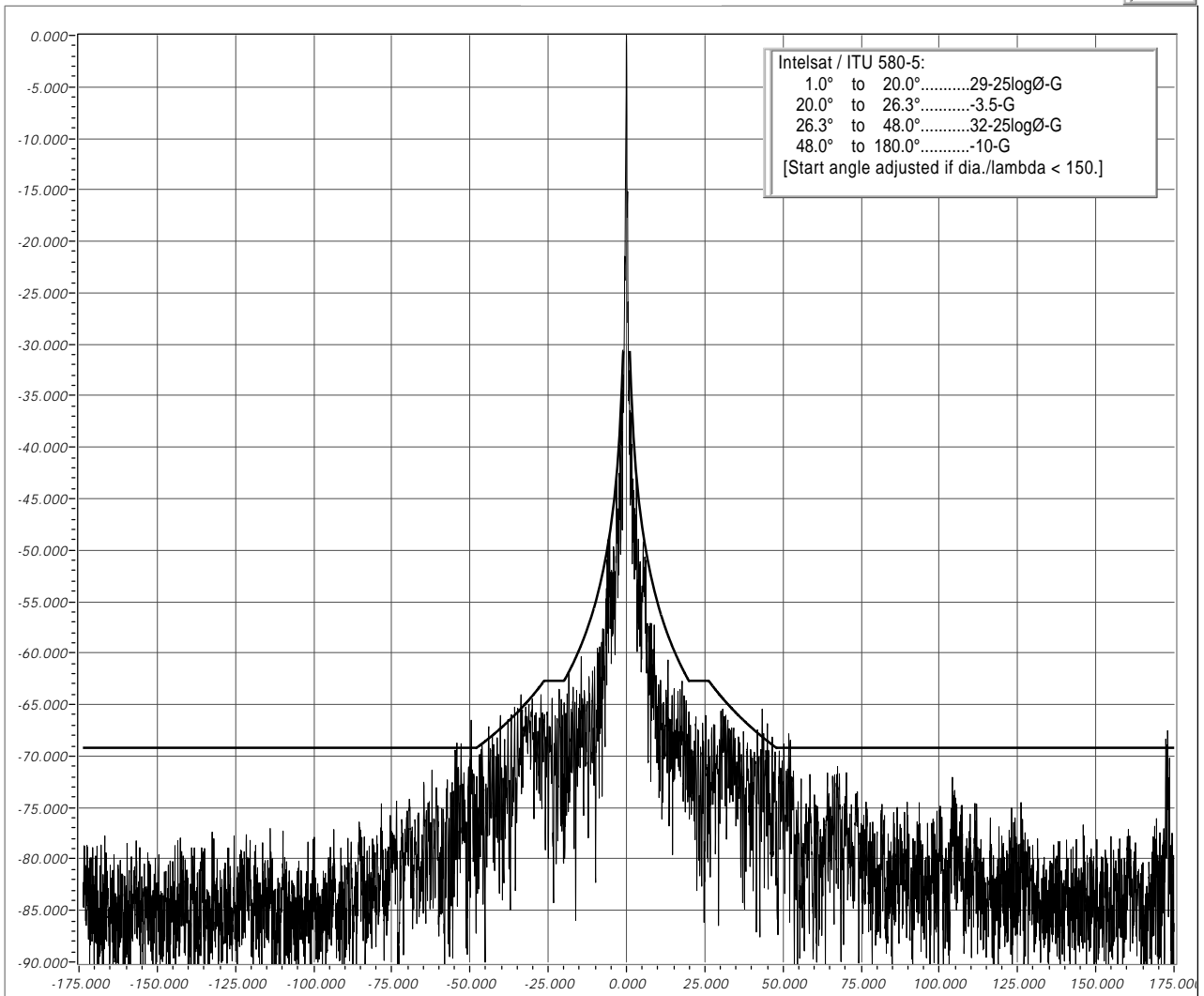
Customer..... GDSatcom Duluth
 Date/Local Time..... 1-19-2010 at 110008
 Job Number..... 13143_03

Model..... 3.9m Ka
 Location..... Kilgore, Tx
 Weather..... Clear
 Test Engineer..... Zukowski, W. Zuko
 Spacecraft..... Long Range
 Transponder..... NA

TX...Co-pol...LHCP polarization...30.500 GHz

Azimuth

% Over Curve



Y-scale is power level (dB) relative to beam center; x-scale is angle (degrees, cosine corrected) relative to beam center.

SA Freq (Hz)=30500002664, AZ rate (deg/s)=1.029, EL rate (deg/s)=0.402, RBW (Hz)=30, VBW (Hz)=10

File:

Test Frequency (GHz):

Ref. Level (dBm):

Points Displayed:

Versions
61030 FAST
60129 PACK

Specified Gain (dB):

Azimuth Beam Center (deg):

Elevation Beam Center (deg):

Margin Under Curved (dB):



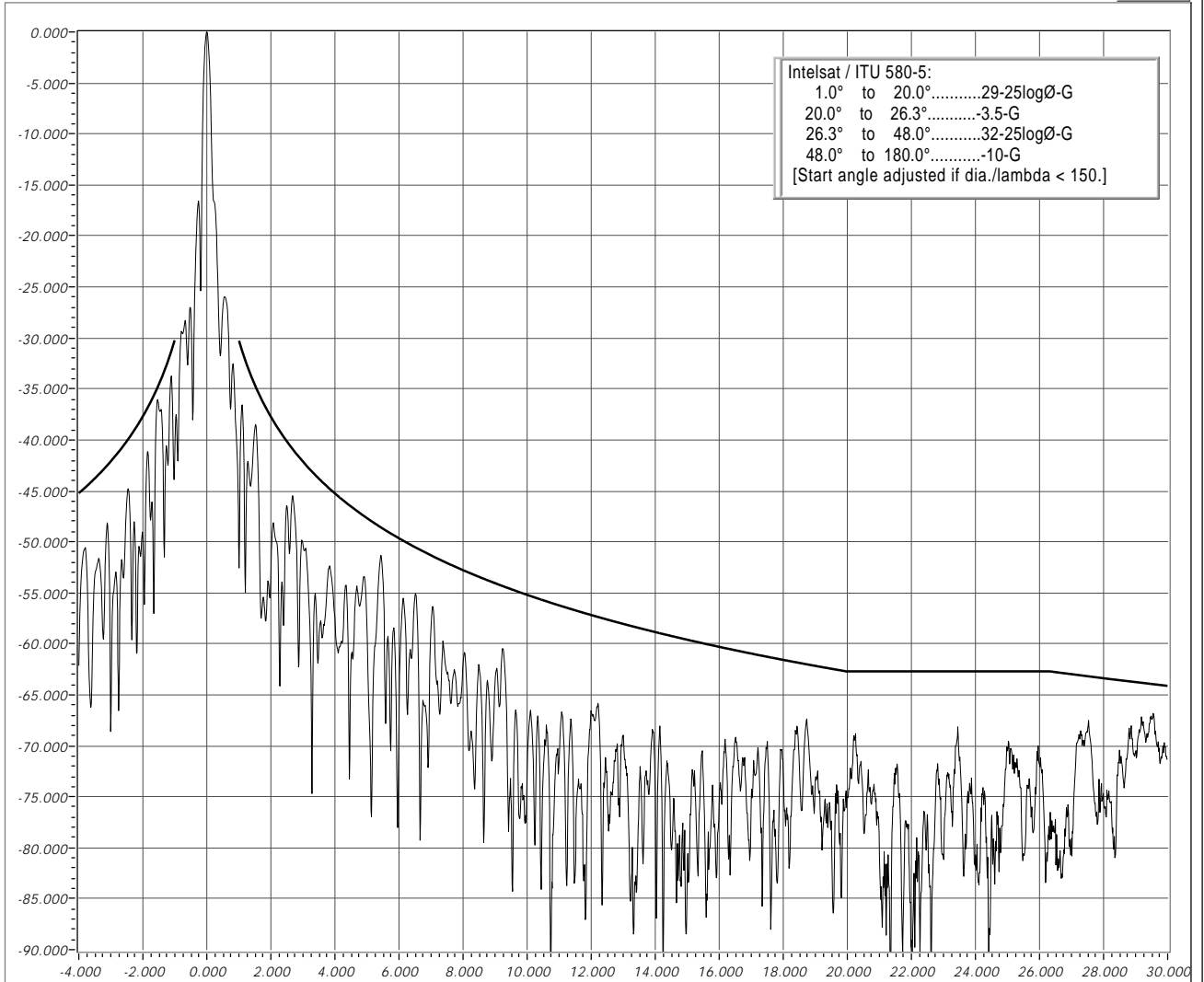
Customer..... GDSatcom Duluth
 Date/Local Time..... 1-19-2010 at 110743
 Job Number..... 13143_03

Model..... 3.9m Ka
 Location..... Kilgore, Tx
 Weather..... Clear
 Test Engineer..... Zukowski, W. Zuko
 Spacecraft..... Long Range
 Transponder..... NA

TX...Co-pol...LHCP polarization...30.500 GHz

Elevation

% Over Curve



Y-scale is power level (dB) relative to beam center; x-scale is angle (degrees, cosine corrected) relative to beam center.

SA Freq (Hz)=30500002664, AZ rate (deg/s)=1.029, EL rate (deg/s)=0.402, RBW (Hz)=30, VBW (Hz)=10

File:

Specified Gain:

Test Frequency (GHz):

Azimuth Beam Center (deg):

Ref. Level (dBm):

Elevation Beam Center (deg):

Points Displayed:

Margin Under Curve (dB):



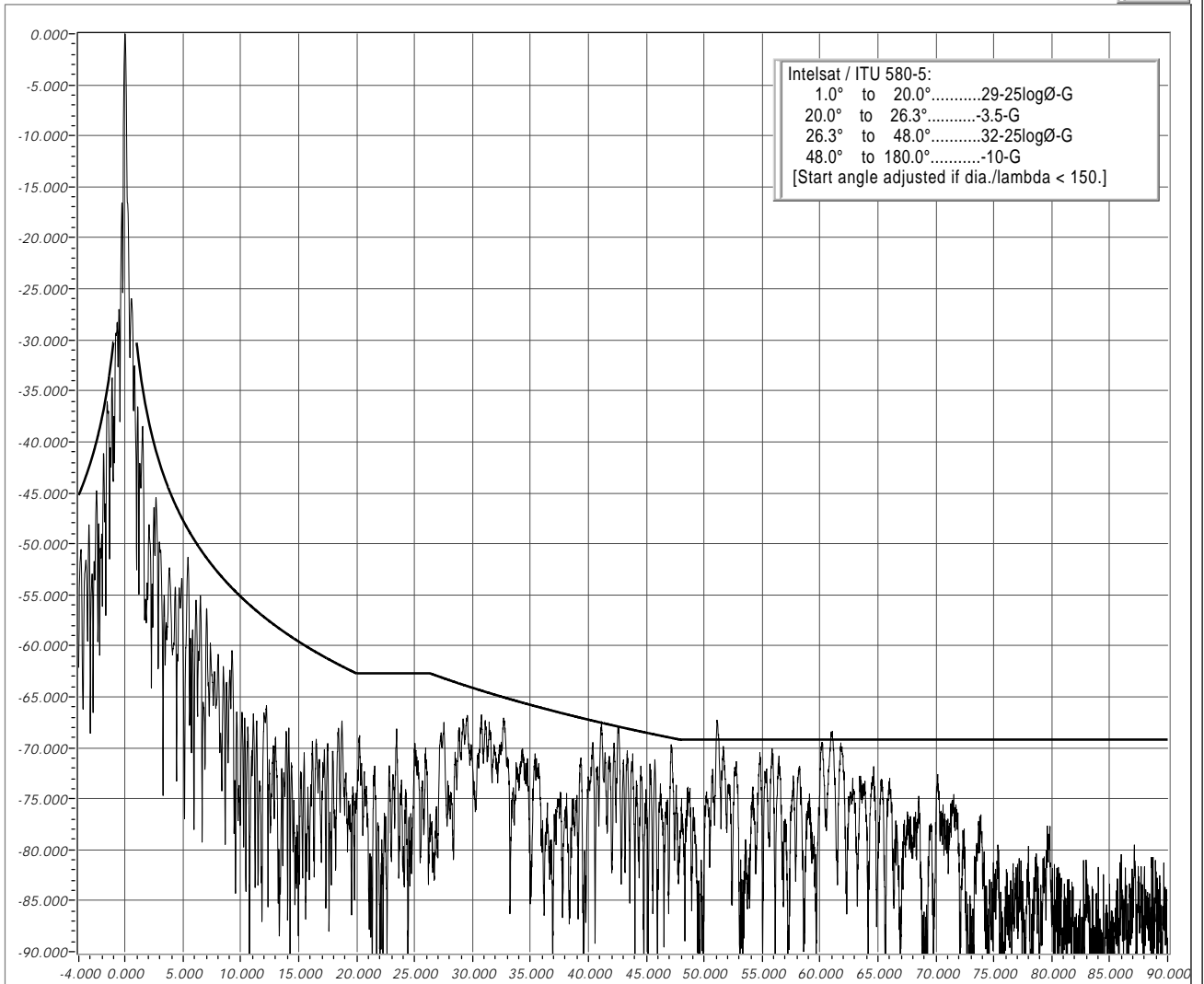
Customer..... GDSatcom Duluth
 Date/Local Time..... 1-19-2010 at 110743
 Job Number..... 13143_03

Model..... 3.9m Ka
 Location..... Kilgore, Tx
 Weather..... Clear
 Test Engineer..... Zukowski, W. Zuko
 Spacecraft..... Long Range
 Transponder..... NA

TX...Co-pol...LHCP polarization...30.500 GHz

Elevation

% Over Curve



Y-scale is power level (dB) relative to beam center; x-scale is angle (degrees, cosine corrected) relative to beam center.

SA Freq (Hz)=30500002664, AZ rate (deg/s)=1.029, EL rate (deg/s)=0.402, RBW (Hz)=30, VBW (Hz)=10

File:

Specified Gain:

Test Frequency (GHz):

Azimuth Beam Center (deg):

Ref. Level (dBm):

Elevation Beam Center (deg):

Points Displayed:

Margin Under Curve (dB):

Versions
 61030 FAST
 60129 PACK



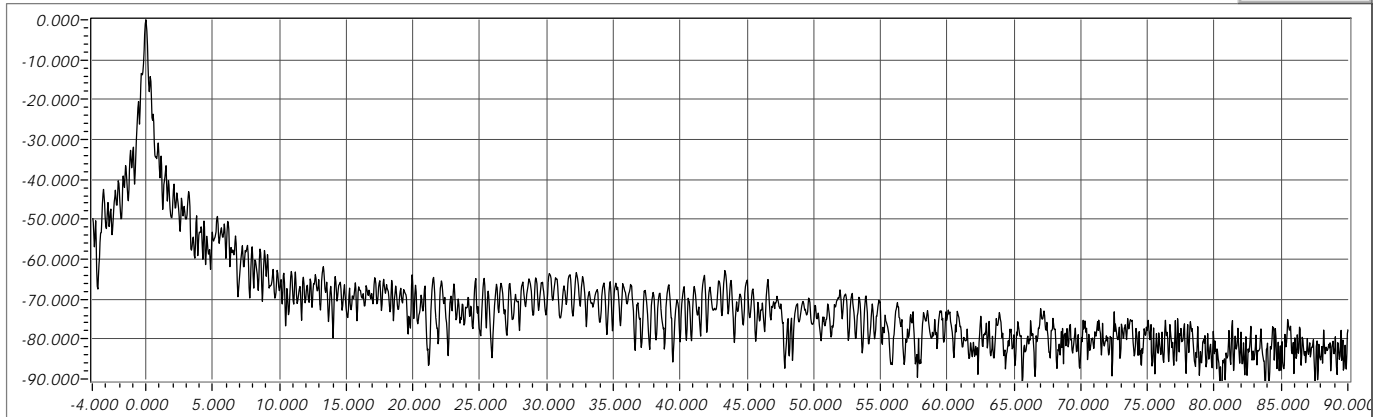
Customer..... GDSatcom Duluth
 Date/Local Time..... 1-18-2010 at 170611
 Job Number..... 13143_03

Model..... 3.9m Ka
 Location..... Kilgore, Tx
 Weather..... Clear
 Test Engineer..... Zukowski, W. Zuko
 Spacecraft..... Long Range
 Transponder..... NA

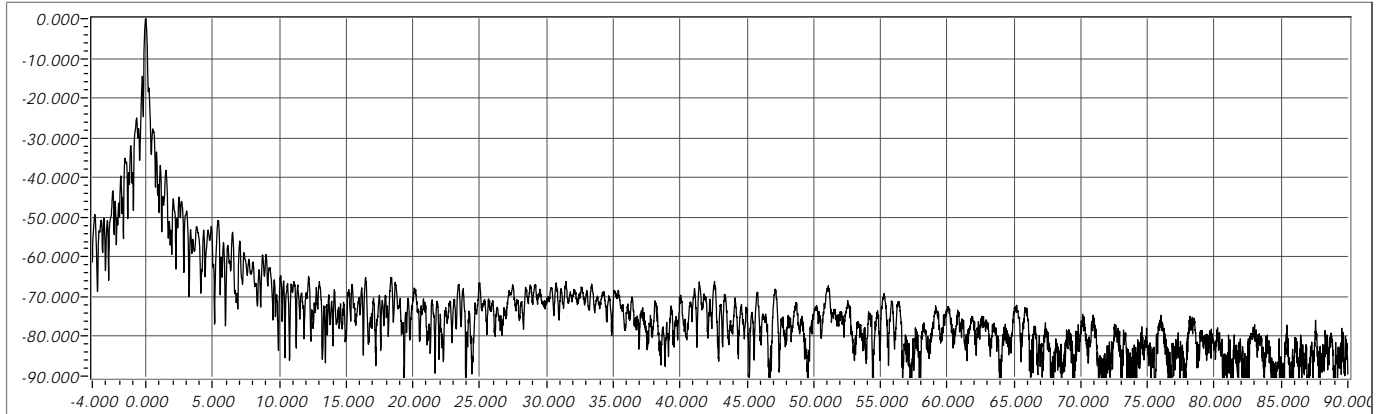
TX...RHCP Polarization...Gain by Integration...30.500 GHz

Spec. Gain (dBi):	59.200
Calculated Gain (dB):	59.31

AZ Pattern



EL Pattern



The Y-scale is power level (dB) relative to beam center; the X -scale is angle (degrees, AZ cosine corrected) relative to beam center.

Antenna Gain by Integration = $2 / (\text{Sum} [P_{\text{subTheta}} * \sin(\text{Theta}) * \text{deltaTheta}] - \text{FeedLoss} - \text{AngularExtentLoss} - \text{SparBlockageLoss} - \text{CrossPolLoss})$
 where the summation is performed for look angles (Theta) offset from beam center from 0 to 180 degrees (in practice the summation occurs on both sides of beam center and the average is taken) and where PsubTheta is the power relative to beam center power and measured at look angles offset from beam center.

SA Freq (Hz)=30500002701, AZ rate (deg/s)=1.065, EL rate (deg/s)=0.418, RBW (Hz)=30, VBW (Hz)=10

AZ Co-pol File % 100118 170611 13143_03 TC-175-RA-30.500.txt

EL Co-pol File % 100118 171801 13143_03 TC-90-RE-30.500.txt

Test Frequency (GHz) 30.500002701

AZ Ref. Level (dBm) -37.83

Azimuth (deg) 180.080

Elevation (deg) 1.870

Versions
 61030 FAST
 60129 PACK

The calculated gain is greater than the specified gain by 0.11 dB.

# Points Displayed	2231
Feed Loss (dB)	0.60
Angular Extent Loss(dB)	0.05
Spar Blockage Loss (dB)	0.03
Cross-pol Loss (dB)	0.03



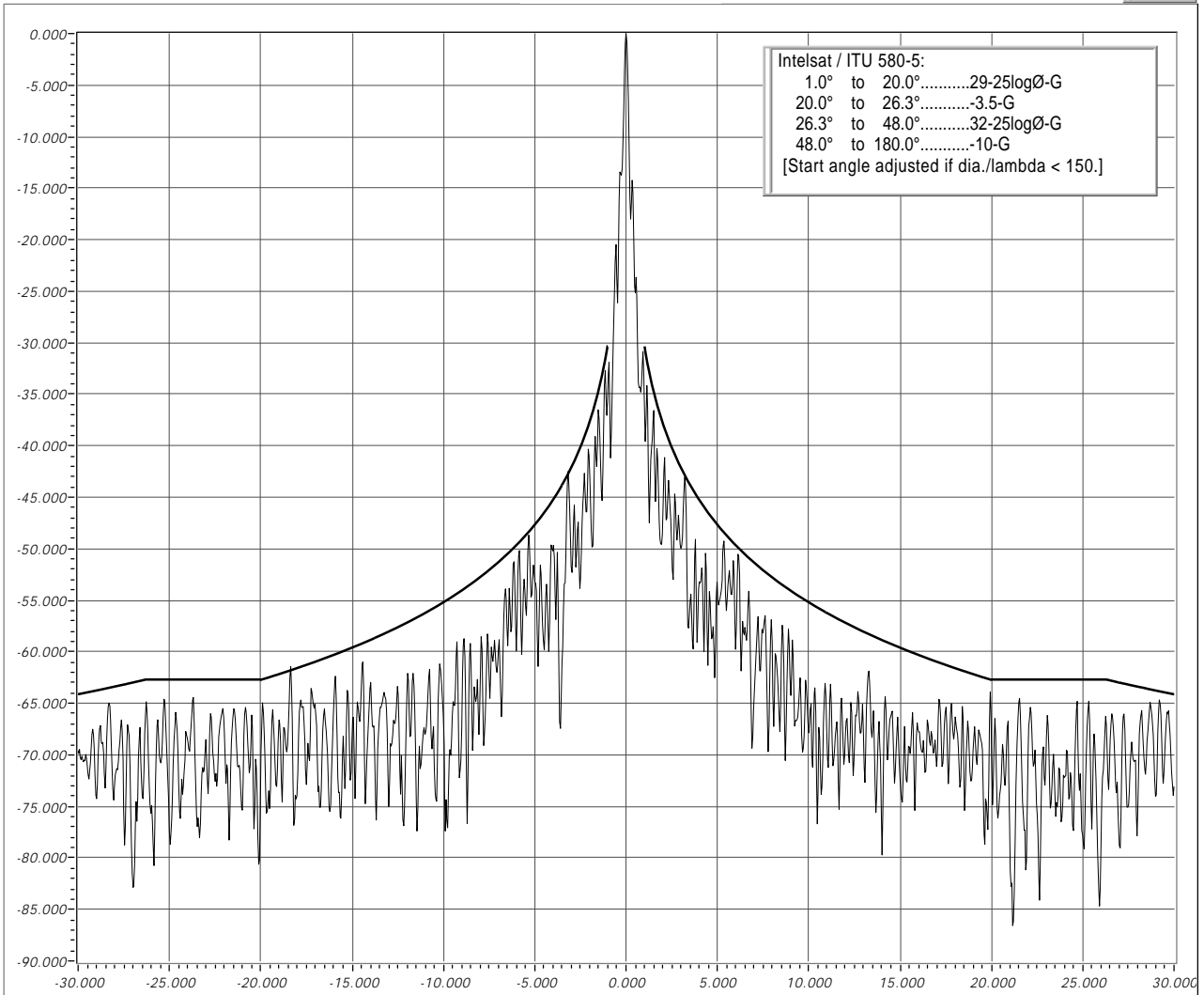
Customer..... GDSatcom Duluth
 Date/Local Time..... 1-18-2010 at 170611
 Job Number..... 13143_03

Model..... 3.9m Ka
 Location..... Kilgore, Tx
 Weather..... Clear
 Test Engineer..... Zukowski, W. Zuko
 Spacecraft..... Long Range
 Transponder..... NA

TX...Co-pol...RHCP polarization...30.500 GHz

Azimuth

% Over Curve



Y-scale is power level (dB) relative to beam center; x-scale is angle (degrees, cosine corrected) relative to beam center.

SA Freq (Hz)=30500002701, AZ rate (deg/s)=1.065, EL rate (deg/s)=0.418, RBW (Hz)=30, VBW (Hz)=10

File:

Test Frequency (GHz):

Ref. Level (dBm):

Points Displayed:

Versions
61030 FAST
60129 PACK

Specified Gain (dB):

Azimuth Beam Center (deg):

Elevation Beam Center (deg):

Margin Under Curved (dB):



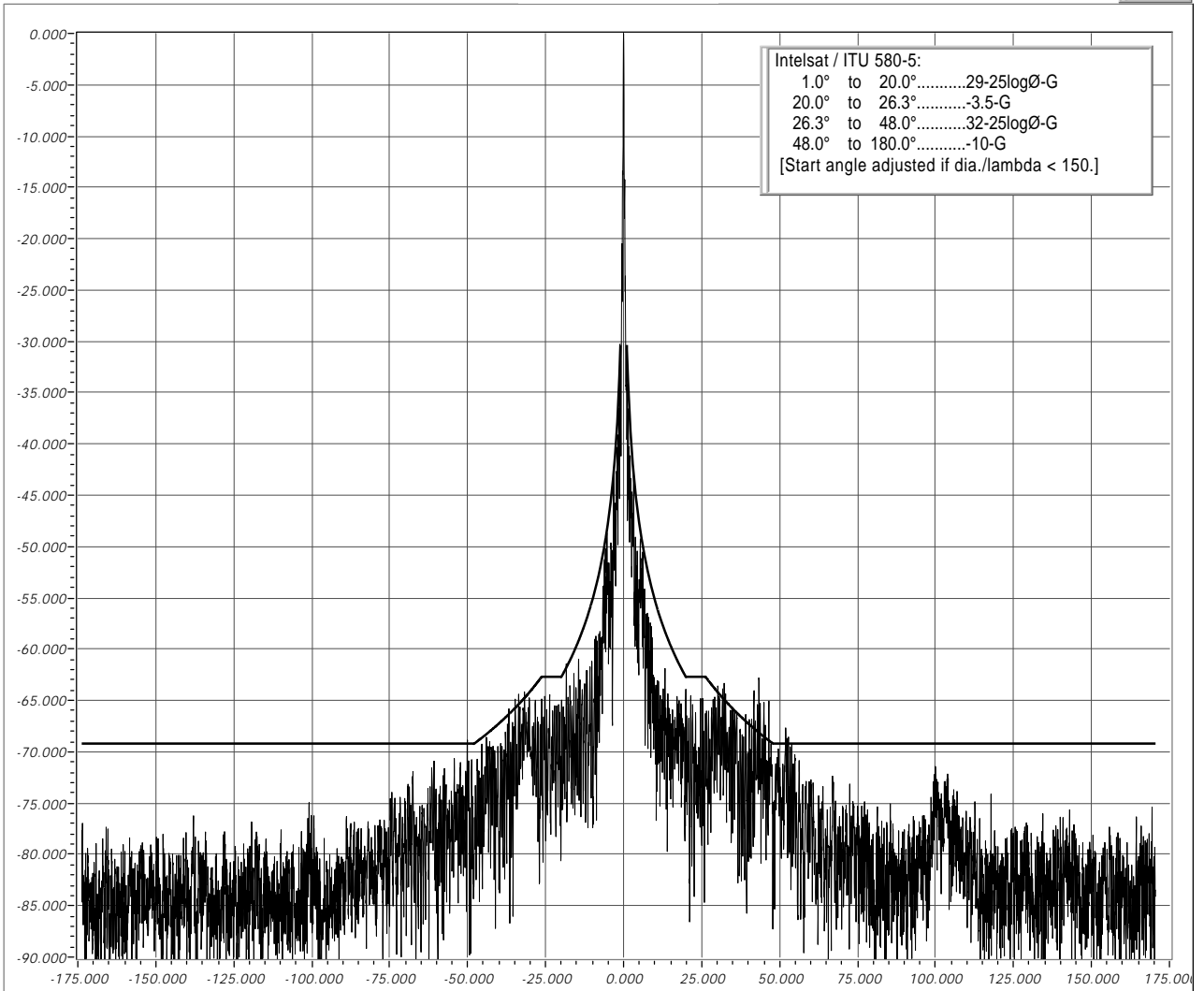
Customer..... GDSatcom Duluth
 Date/Local Time..... 1-18-2010 at 170611
 Job Number..... 13143_03

Model..... 3.9m Ka
 Location..... Kilgore, Tx
 Weather..... Clear
 Test Engineer..... Zukowski, W. Zuko
 Spacecraft..... Long Range
 Transponder..... NA

TX...Co-pol...RHCP polarization...30.500 GHz

Azimuth

% Over Curve



Y-scale is power level (dB) relative to beam center; x-scale is angle (degrees, cosine corrected) relative to beam center.

SA Freq (Hz)=30500002701, AZ rate (deg/s)=1.065, EL rate (deg/s)=0.418, RBW (Hz)=30, VBW (Hz)=10

File:

Test Frequency (GHz):

Ref. Level (dBm):

Points Displayed:

Versions
61030 FAST
60129 PACK

Specified Gain (dB):

Azimuth Beam Center (deg):

Elevation Beam Center (deg):

Margin Under Curved (dB):



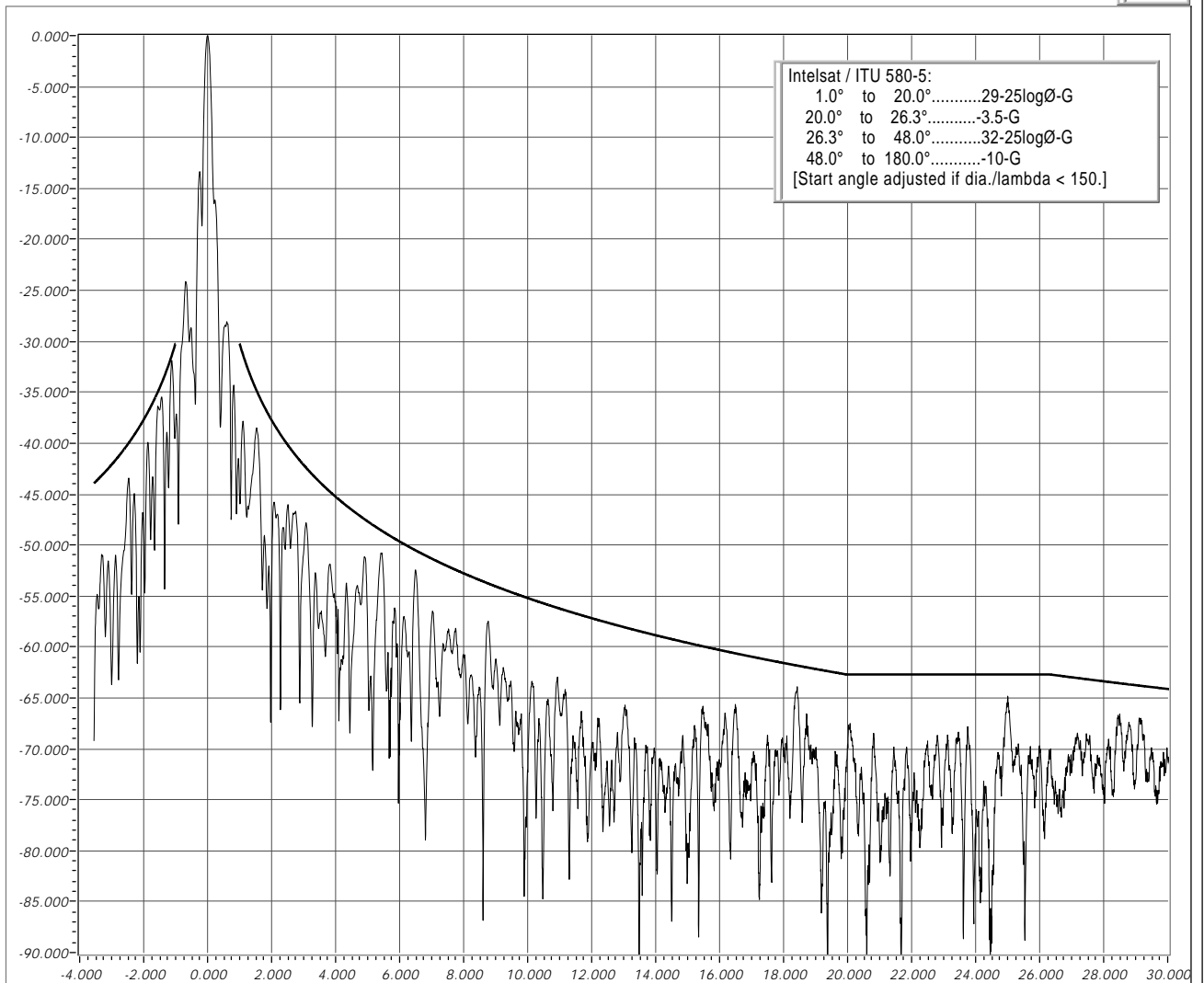
Customer..... GDSatcom Duluth
 Date/Local Time..... 1-18-2010 at 171100
 Job Number..... 13143_03

Model..... 3.9m Ka
 Location..... Kilgore, Tx
 Weather..... Clear
 Test Engineer..... Zukowski, W. Zuko
 Spacecraft..... Long Range
 Transponder..... NA

TX...Co-pol...RHCP polarization...30.500 GHz

Elevation

% Over Curve



Y-scale is power level (dB) relative to beam center; x-scale is angle (degrees, cosine corrected) relative to beam center.

SA Freq (Hz)=30500002701, AZ rate (deg/s)=1.065, EL rate (deg/s)=0.418, RBW (Hz)=30, VBW (Hz)=10

File:

Specified Gain:

Test Frequency (GHz):

Azimuth Beam Center (deg):

Ref. Level (dBm):

Elevation Beam Center (deg):

Points Displayed:

Margin Under Curve (dB):

Versions
 61030 FAST
 60129 PACK



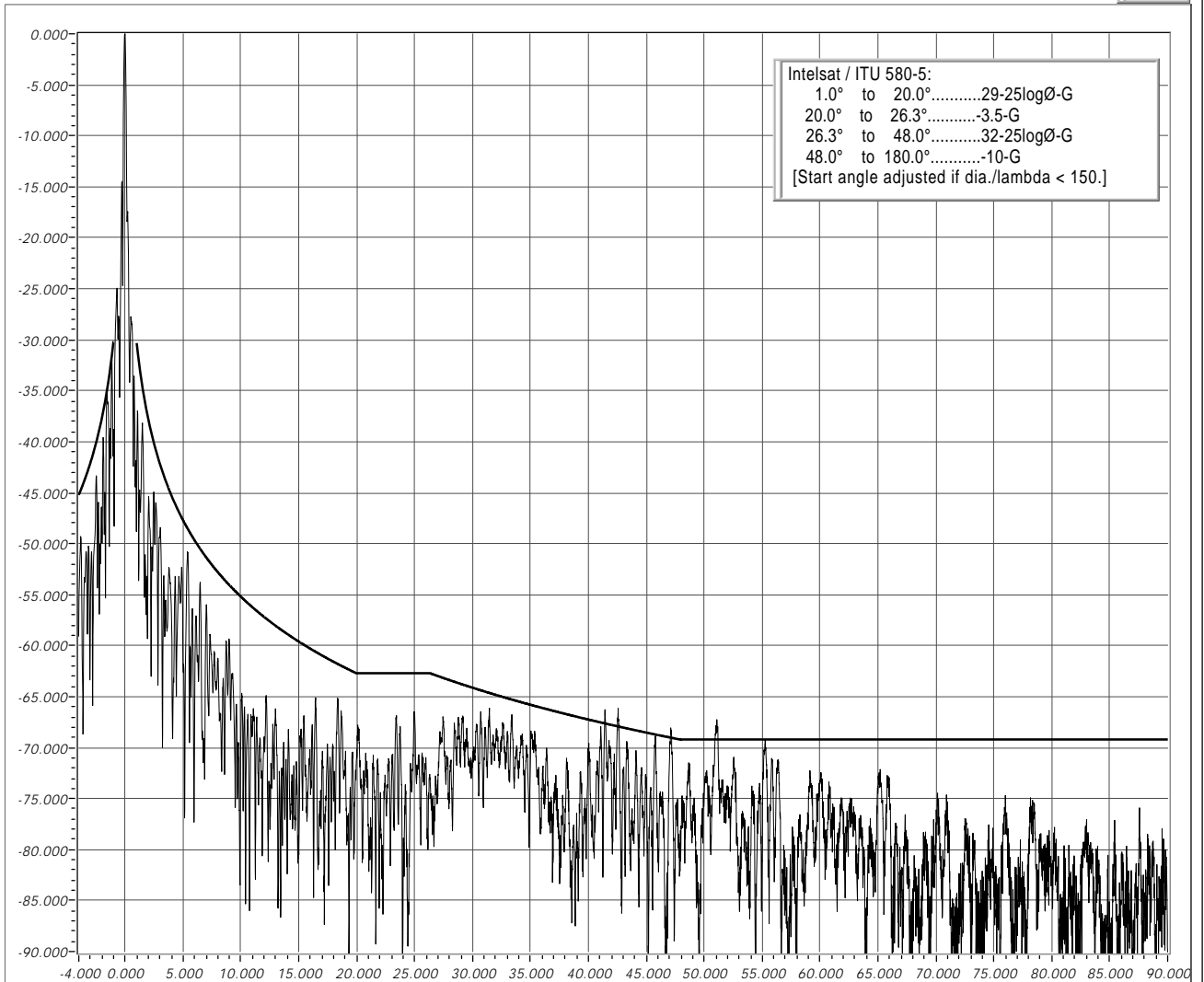
Customer..... GDSatcom Duluth
 Date/Local Time..... 1-18-2010 at 171801
 Job Number..... 13143_03

Model..... 3.9m Ka
 Location..... Kilgore, Tx
 Weather..... Clear
 Test Engineer..... Zukowski, W. Zuko
 Spacecraft..... Long Range
 Transponder..... NA

TX...Co-pol...RHCP polarization...30.500 GHz

Elevation

% Over Curve



Y-scale is power level (dB) relative to beam center; x-scale is angle (degrees, cosine corrected) relative to beam center.

SA Freq (Hz)=30500002701, AZ rate (deg/s)=1.065, EL rate (deg/s)=0.418, RBW (Hz)=30, VBW (Hz)=10

File:

Specified Gain:

Test Frequency (GHz):

Azimuth Beam Center (deg):

Ref. Level (dBm):

Elevation Beam Center (deg):

Points Displayed:

Margin Under Curve (dB):

Versions
 61030 FAST
 60129 PACK



R.F. Specification
for
VertexRSI 3.90 Meter Shaped Gregorian Antenna
With Four Port Circularly Polarized Feed
Preliminary Spec, RCP/LCP switchable
Receive Transmit

Frequency in GHz.....	20.200-21.200	30.000-31.000
Port Type.....	Rx1/Rx2	Tx1/Tx2
Polarization.....	Circular	Circular
Feed Port Polarizations.....	RHCP/LHCP	LHCP/RHCP
Antenna Gain (+/- 0.2 dB)		
20.200 / 30.000 GHz.....	56.40 dBi	59.10 dBi
20.700 / 30.500 GHz.....	56.60 dBi	59.20 dBi
21.200 / 31.000 GHz.....	56.80 dBi	59.20 dBi

Antenna Noise Temperature

5 degree Elevation.....	201 K
10 degree Elevation.....	157 K
20 degree Elevation.....	121 K
30 degree Elevation.....	102 K

Typical G/T at 20 deg Elevation 20.200 GHz , clear horizon

120 degree K LNA.....	32.6 dB/K
200 degree K LNA.....	31.3 dB/K

Pattern Beamwidth in degrees at 20.700 / 30.500 GHz

-3 dB Beamwidth.....	0.23	0.17
-15 dB Beamwidth.....	0.48	0.36

Sidelobes

For Angle A from 1 to 48 Degrees..... Meets ITU-RS-580

For Angles from 48 to 180 Degrees..... Meets ITU-RS-580

Cross Polarization Isolation

On Axis.....	24.8 dB	24.8 dB
Within 1.0 dB Beamwidth.....	24.8 dB	24.8 dB



R.F. Specification
for
VertexRSI 3.90 Meter Shaped Gregorian Antenna
With Four Port Circularly Polarized Feed
Preliminary Spec. RCP/LCP switchable
Receive Transmit

VSWR (Return Loss)-----	1.30:1(17.7dB)	1.30:1(17.7dB)
Axial Ratio-----	1.00 dB	1.00 dB
Feed Insertion or Ohmic Loss-----	0.60 dB	0.60 dB
Port to Port Isolation (Rx to Rx, Tx to Tx, Same Band)-----	17.0 dB	17.0 dB
Port to Port Isolation-----	0.0 dB (Input)	-50.0 dB
Port to Port Isolation-----	-85.0 dB	0.0 dB (Input)
Output Waveguide Flange Interface-----	WR-42	WR-28
Total Power Handling Capability-----		100 Watts

Notes - Other operational frequencies available

- 10% of sidelobes may exceed the sidelobe specifications where applicable.
- Power handling capability is based on and limited by the physical characteristics in the feed components. Microwave power at these levels may contribute to the radiation hazard or exceed certain offaxis EIRP specifications.

-G/T is calculated by bolting single LNA directly to the feed. It does not allow for any post LNA effects.

All values are at the rear feed output flange.

Equipment List

LNA's:

Miteq : AMFW-7F-18102200-120-10P-V _ S/N: 1422073

Miteq :AMFW-8F-27303100-180-8P-V _ S/N: 1347269

Analyzer's:

Agilent E4446A

S/N: MY43360127

Cal Date: 28JAN09

Cal Due : 28JAN10

Signal Generator:

Agilent E8257D

S/N: MY44320834

Cal Date: 30MAR09

Cal Due : 30MAR11

Source:

Feed Horn: Ka S/N: LNGKACP