

ENGINEERING STATEMENT
TECHNICAL INFORMATION IN SUPPORT OF A
DIGITAL CONSTRUCTION PERMIT FOR
AN EXISTING TELEVISION TRANSLATOR
K20HB-D, BILLINGS, MONTANA
CHANNEL 20 15 KW ERP DA MAX 1163 METERS RCAMSL

APRIL 2021

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WASHINGTON, D.C.

INTRODUCTION

This engineering statement has been prepared on behalf of Montana State University, licensee of K20HB, Billings, Montana (Facility ID #125475). This statement supports the licensee's request to convert to DTV operation on the currently licensed in-core analog Channel 20, commonly referred to as "flash-cut" with a DTV effective radiated power ("ERP") of 15 kW at a radiation center above mean sea level ("RCAMSL") of 1163 meters.

TRANSMITTER SITE

The proposed flashcut antenna will be mounted to an existing tower and replaces the currently licensed analog antenna. The previously authorized KTVQ(TV) analog facility is mounted on the top of the tower. The tower is located near Coburn Road, Mile Marker 2. The tower registration number is 1001064. The geographic coordinates of the site follow below.

North Latitude: 45° 46' 00"

West Longitude: 108° 27' 29.5"

NAD-83

North Latitude: 45° 46' 00"

West Longitude: 108° 27' 27"

NAD-27

Exhibit E-1 provides a tower sketch.

ELEVATION DATA

Elevation of site above mean sea level	1118.0 Meters 3668.0 Feet
Overall height above ground of the existing antenna structure (including appurtenances)	116.7 Meters 382.9 Feet

Overall height above mean sea level of the existing antenna structure (including appurtenances)	1234.7 Meters 4050.9 Feet
Antenna vertical height	3.0 Meters 10 Feet
Center of radiation of antenna above ground level	45 Meters 147.6 Feet
Center of radiation of antenna above mean sea level	1163 Meters 3815.6 Feet

Note: slight height differences may result due to conversion to/from metric.

EQUIPMENT DATA

Transmission Line: (existing)	Andrew, Type HJ7-50A air heliax, 50 ohm 1-5/8", FlexLine, 76 Meters (250 Feet) with 75.8% efficiency or equivalent
Emission Mask	Full-Service
Antenna:	ERI, Type ETU2U1-CSP1C-20 directional antenna with 0° electrical beam tilt. See Exhibit E-2 for manufacturer data.

POWER DATA

Transmitter Power Output	1.79 kW	2.53 dBk
Transmission Line Loss	75.8%	1.20 dB
Input Power to the Antenna	1.36 kW	1.33 dBk
Antenna Power Gain, Main Lobe Horiz	11.05	10.43 dB
Vert	11.05	10.43 dB
Effective Radiated Power, Maximum	15 kW	11.76 dBk

ALLOCATION ANALYSIS

A study of predicted interference caused by the proposed K20HB Channel 20 low-power digital flashcut has been performed using the Longley-Rice model contained in TVStudy 2.2 for which the source data has been posed by the Commission on its website at <https://www.fcc.gov/oet/tvstudy>. The model employs the Longley-Rice propagation methodology and evaluates grid cells of approximately 1 sq. km. Using one-second terrain data sampled approximately every 1.0 km at one-degree azimuth intervals with 2010 census centroids, all studies are based upon data in the current LMS database. The allocation study shows no impermissible interference. The study results and the included stations are listed in Exhibit E-3.

COVERAGE

A coverage map and tabulation of the contour data of the proposed flashcut facility has been included as Exhibit E-4 of this report.

OTHER BROADCAST FACILITIES

A brief analysis was completed to determine the presence of stations in the vicinity of the K20HB tower using data contained within The Commission's Consolidated Database System. It is noted that there is at least one station that filed for a construction permit to jointly operate with 2 other stations from this site with 100 kW and operate concurrently from the KMHK antenna. However, according to the client that facility plan has not been implemented. Therefore, this plan that has not been implemented is not studied further. There are no AM stations within 3.22 kilometers of the proposed site. Although no adverse effects are expected due to the proposed flashcut changes to K20HB, the licensee will install filters or take other measures necessary to resolve any problems provided they are related to the changes proposed in this application.

The proposed site for K20HB is located within an existing communications site.

The RF field contribution by the proposed Channel 20 digital flashcut operation will be calculated using the following formula:

$$S = \frac{33.4(F^2) \text{ Total ERP}}{R^2}$$

where:

S = power density in $\mu\text{W}/\text{cm}^2$

F = relative field factor

Total ERP = ERP Horizontal Polarization + ERP Vertical Polarization

R = RCAGL - 2 meters

ERP = RMS ERP in watts for DTV Stations

K20HB Digital Translator Facility (Proposed Flashcut)

Channel 20	Freq:	506-512 MHz range
	ERP =	15 kW
	Polarization =	Horizontal and Vertical
	RCAGL -2 meters =	43 meters

K20HB-D proposes to utilize an ERI, Type ETU2U1-CSP1C-20 antenna with 0° electrical beam tilt. The manufacturer's vertical plane pattern for the antenna indicates that the field factor will be less than 0.090 at any angle greater than 70 degrees below the horizon. A value of 0.090 will be used in the calculation.

$$S = \frac{33.4 (F^2) \text{ Tot ERP}}{R^2}$$

Tot ERP = 30,000 watts (Circular polarization)
R = 43 meters
F = 0.090 (field factor)

$$S \leq 4.4 \mu\text{W}/\text{cm}^2$$

K20HB proposed flashcut contributes less than $4.4 \mu\text{W}/\text{cm}^2$ at 2 meters above ground.

The limit for an uncontrolled environment is $f/1.5$ for a station broadcasting in the 300-1500 MHz range.

$$(509 \text{ MHz})/1.5 = 339.3 \mu\text{W}/\text{cm}^2 \text{ is the RFF limit for K20HB-D.}$$

Therefore:

K20HB-D digital translator facility contributes less than 2% RFF for an uncontrolled environment two meters above ground at the K20HB tower site. This digital operation will replace the K20HB analog operation and therefore termination of the analog operation will reduce the 2% RFF contribution assessment.

The total RFF contribution by the proposed K20HB DTV flashcut operation at 2 meters above ground level is less than two percent (2%) of the current FCC guidelines for general population exposure.

Authorized personnel and rigging contractors will be alerted to the potential zone of high field levels on the tower, and if necessary, the station will operate with reduced power or terminate the operation of the transmitter as appropriate when it is necessary for authorized personnel or contractors to perform work on the tower. Workers and the general public, therefore, will not be subjected to RFF levels in excess of the current FCC guidelines.

ENVIRONMENTAL ASSESSMENT

An environmental assessment ("EA") is categorically excluded under Section 1.1306 of the FCC Rules and Regulations because the tower structure is existing and will not be modified so as to invoke the need for environmental analysis. The existing tower is registered with the FCC, and approved by the FAA, and neither the ASR nor FAA approval will require modification. It was not constructed during 2001-2005 and thus is not a "twilight tower."

While some structural reinforcement of the tower may be required to support the modification, there will be no material change in visual appearance, since one antenna is being substituted for another with no increase in overall structure height, including the height of the dormant top-mounted analog Channel 20 antenna.

Compliance with OET Bulletin No. 65 (non-ionizing radiation) is discussed in the previous section of this exhibit.

ABOVE GROUND

ABOVE MEAN SEA LEVEL

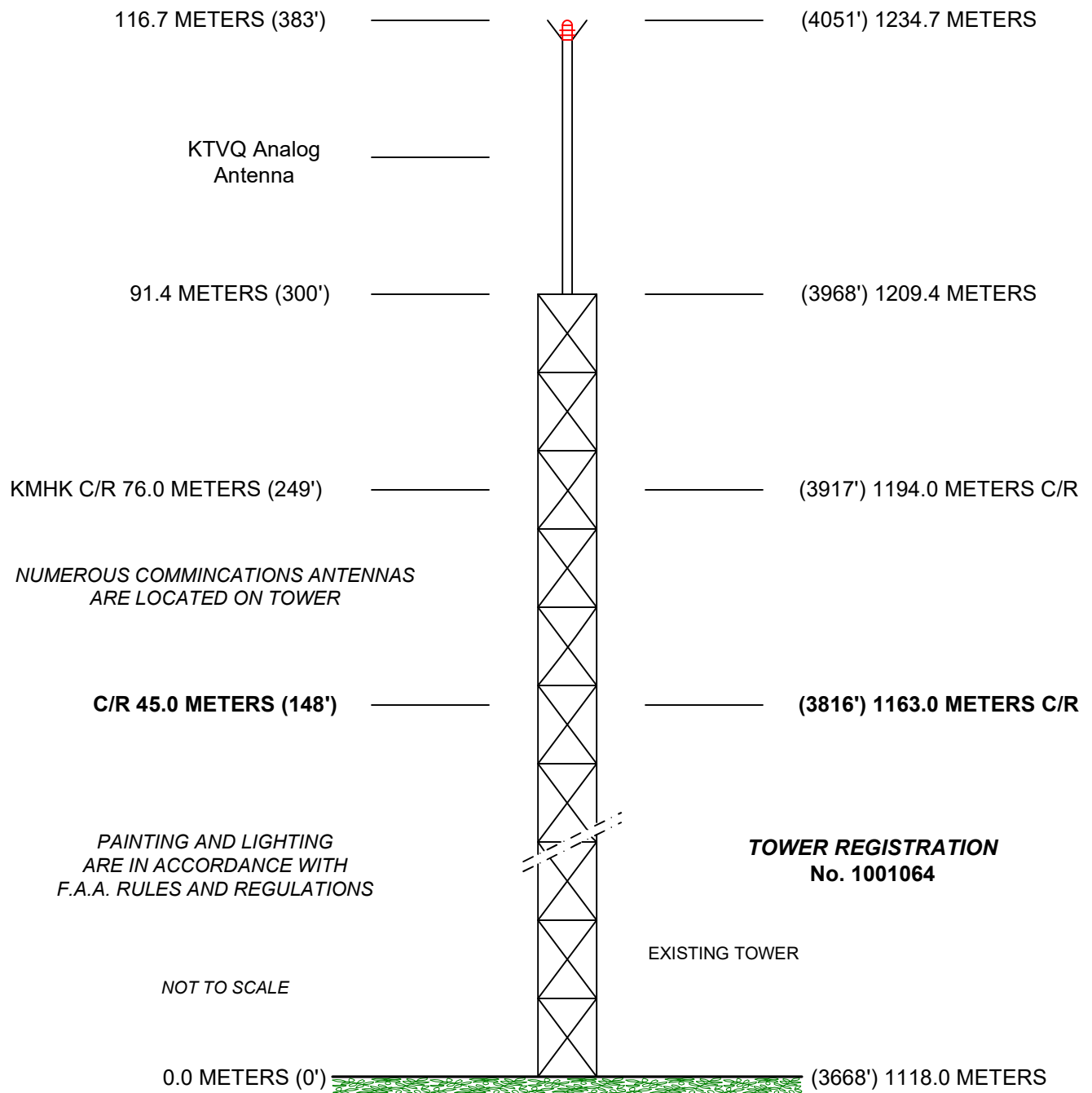


EXHIBIT E-1
VERTICAL SKETCH
FOR THE PROPOSED OPERATION OF
K20HB, BILLINGS, MONTANA
APRIL 2021

EXHIBIT E-2

ANTENNA MANUFACTURER DATA

Preliminary Specification for ETU Series Side Mounted UHF Circularly Polarized Panel Television Antenna

**K20HB RF Channel 20
Cohen, Dippell and Everist, P.C., Billings, MT
March 30, 2021**

**Antenna Model:
ETU2U1-CSP1C-20**

**Specification Number
ETU1x2-031921r4**

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Your Single Source for Broadcast Solutions™ Call Toll-free at 877 ERI-LINE Visit Online at www.eriinc.com

**Preliminary Specification for
ETU Series Side Mounted
UHF Circularly Polarized
Panel Television Antenna**

Electrical Characteristics:

Channel:	20		
Frequency:	506 MHz to 512 MHz		
Service:	ATSC		
Azimuth Pattern Number:	Horizontal Polarization Vertical Polarization	ETUP1C-H ETUP1C-V	
Elevation Pattern Number:	Horizontal Polarization Vertical Polarization	ETU-2U1-H ETU-2U1-V	
Azimuth Directivity:	Horizontal Polarization Vertical Polarization	5.35 4.11	(7.28 dB) (6.14 dB)
Elevation Directivity:	Horizontal Polarization Vertical Polarization	4.75 4.75	(6.77 dBd) (6.77 dBd)
Peak Power Gain:	Horizontal Polarization Vertical Polarization	11.05 11.05	(10.43 dBd) (10.43 dBd)
Gain at Horizontal:	Horizontal Polarization Vertical Polarization	11.05 11.05	(10.43 dBd) (10.43 dBd)
Vertical/Horizontal Ratio:	1.00		
Electrical Beam Tilt:	0.00 Degrees		
Input Power Required:	1.36 kW (1.33 dBk)		
RF Input:	1-5/8-inch EIA, 50 Ω , flanged male		
Input Power Rating (maximum):	5 kW Average Power, 8VSB		
Antenna VSWR (maximum):	1.20 (Over UHF Band)		

Preliminary Specification for ETU Series Side Mounted UHF Circularly Polarized Panel Television Antenna

Antenna Mechanical Characteristics:

Mounting Configuration:	Side Mount		
Height of Antenna:	10.0 feet	(3.0 meters)	
Height of Center of Radiation (B):	5.0 feet	(1.5 meters)	
Overall Height (Includes two 3.5 ft lightning spurs) (A):	13.5 feet	(4.1 meters)	
Deicing:	Unpressurized element radome		
Radome Diameter (C):	45.3" x 17.7" x 8.1"	(1150mm x 450mm x 205mm)	
Radome Color:	Gray		
Climbing Device:	Not Applicable		
Calculated Weight ¹ :	No Ice	80.0 lb	36.3 kg
			0.0 kg
Windload Data ^{1,2} :	EPA	No Ice	TBD
		1/2" (13 mm) ice	TBD

Estimated Mounting Assembly Loads:

Preliminary Mounting Configuration:	Leg Mount		
Estimated Antenna Offset:	12		
Calculated Weight ¹ :	No Ice	80.0 lb	36.3 kg
	1/2" (13 mm) ice	120.0 lb	54.4 kg
¹ Effective Projected Area (EPA-ft ²):	No Ice	1.0 ft ²	(0.1 m ²)
	1/2" (13 mm) ice	1.6 ft ²	(0.1 m ²)

NOTES:

1) Please note, the listed weights and effective wind areas are based on the PRELIMINARY design of the antenna. Final As-Built values for the antenna are typically within +/-10% of the Preliminary design values, and will be provided in the technical manual that accompanies the antenna. Specified loads include the antenna, standard mounts, and power divider and jumper feed harnessing where applicable. Custom mounting brackets/adapters are NOT included.

2) Loads calculated in accordance with the ANSI/TIA-222-G standard.

3) Low Power UHF television antennas are shipped with 15-inch (381 mm) stand off brackets for mounting on poles or tower legs (non- tapered) from 1.5-inches (35 mm) to 7.5-inches (191 mm) OD. Stand off support pipes, face mount brackets, and mounts for larger diameter poles are available from ERI as optional items.

NOTE: The purchaser or their representative shall be required to contact the tower owner, state and/or local building officials for specific design requirements and suitable parameters for a particular structure. Any variation from the parameters shown above must be communicated to ERI for comprehensive assessment.

Broadcast Antenna System Power Analysis

K20HB **RF Channel: 20**
Cohen, Dippell and Everist, P.C.
Billings, MT
ETU2U1-CSP1C-20

Antenna Parameters

Azimuth Directivity:

Horizontal: 5.35 (7.28 dB)
 Vertical: 4.11 (6.14 dB)

Effective Radiated Power:

Horizontal: 15.00 kW (11.76 dBk)
 Vertical: 15.00 kW (11.76 dBk)

Elevation Directivity:

Horizontal: 4.75 (6.77 dB)
 Vertical: 4.75 (6.77 dB)

Peak Power Gain:

Horizontal: 11.05 numeric (10.43 dBd)
 Vertical: 11.05 numeric (10.43 dBd)

Transmission Line

Vertical Run:

Type: 1-5/8-Inch HJ7-50A Air HELIAX, 50Ω
 Length: 200 feet 61.0 meters
 Attenuation: 0.481 dB/100 feet 1.580 dB/100 mtrs

Antenna Input Power:

1.36 kW (1.33 dBk)

Horizontal Run:

Type: 1-5/8-Inch HJ7-50A Air HELIAX, 50Ω
 Length: 50 feet 15.2 meters
 Attenuation: 0.481 dB/100 feet 1.580 dB/100 mtrs

Transmission Line Losses:

-0.43 kW (1.204 dB)

Total Losses: 1.204 dB

RF System Losses:

0.00 kW (0.00 dB)

Line Efficiency: 75.79%

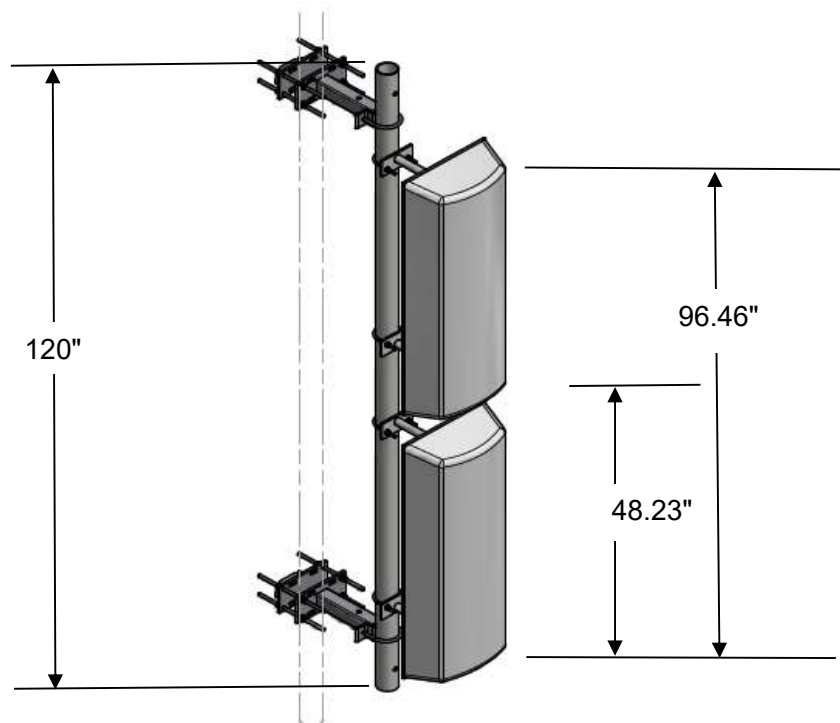
Total Losses:

-0.43 1.204

Transmitter Power Output:

1.79 kW
 (2.53 dBk)

Typical Mounting Configuration Shown. Actual Configuration May Vary.

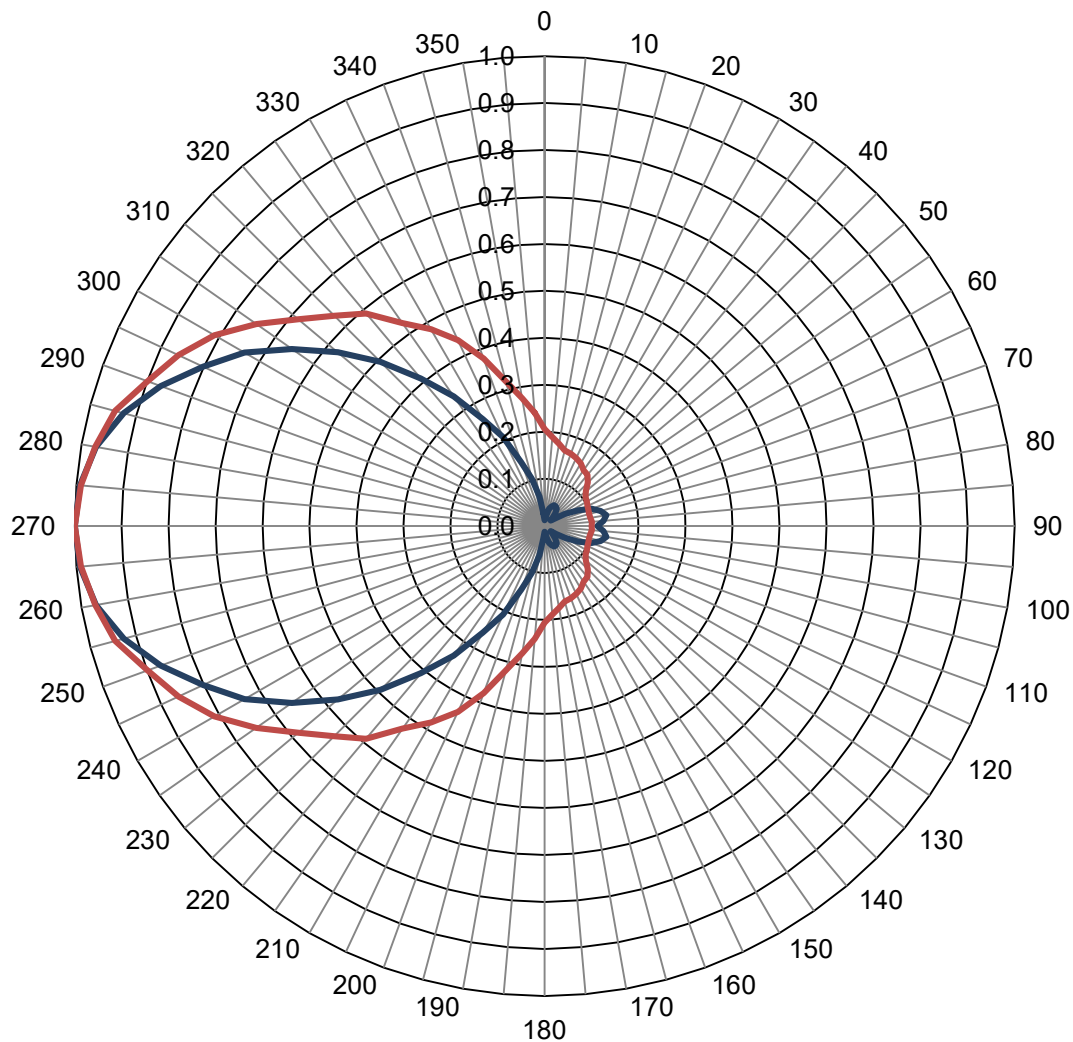


Horizontal vs. Vertical Azimuth Patterns

Type:	ETUP1C-H		Polarization:	Circular
Directivity (H-Pol):	5.35 numeric	(7.28 dB)	Frequency:	20 (ATSC)
Directivity (V-Pol):	4.11 numeric	(6.14 dB)	Location:	Billings, MT
Percent Horizontal:	43.47%		NOTE: Pattern shape and directivity may vary with channel and mounting	
Percent Vertical:	56.53%			
Power Ratio:	130.03%			
ERP V/H Ratio:	100.00%			

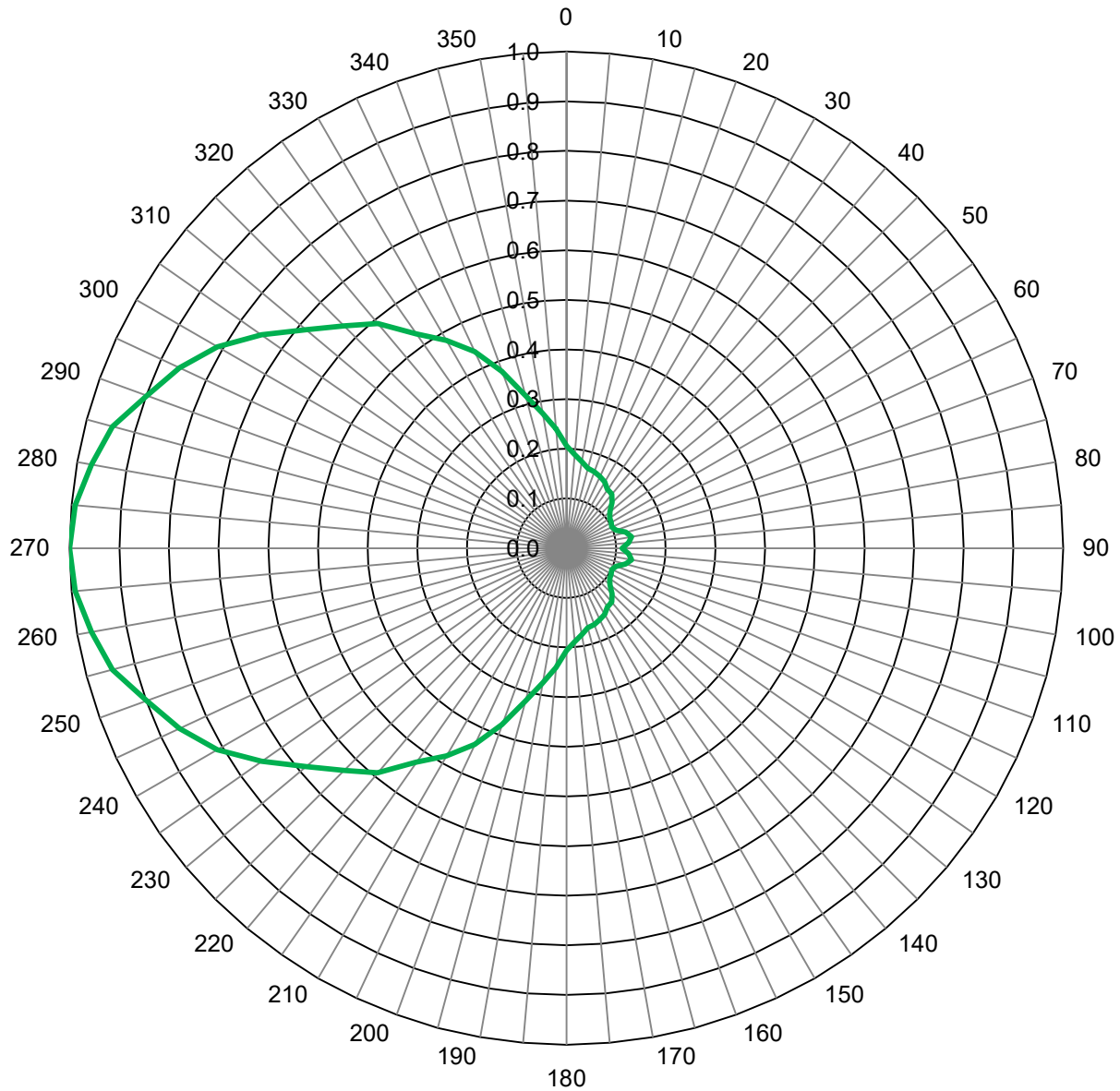
— Horizontal Relative Field

— Vertical Relative Field (scaled)



Composite Azimuth Pattern

Type:	ETUP1C-H	Polarization:	Horizontal
Directivity:	4.10 numeric (6.13 dB)	Frequency:	20 (ATSC)
Peak(s) at:		Location:	Billings, MT
		NOTE: Pattern shape and directivity may vary with channel and mounting configuration.	

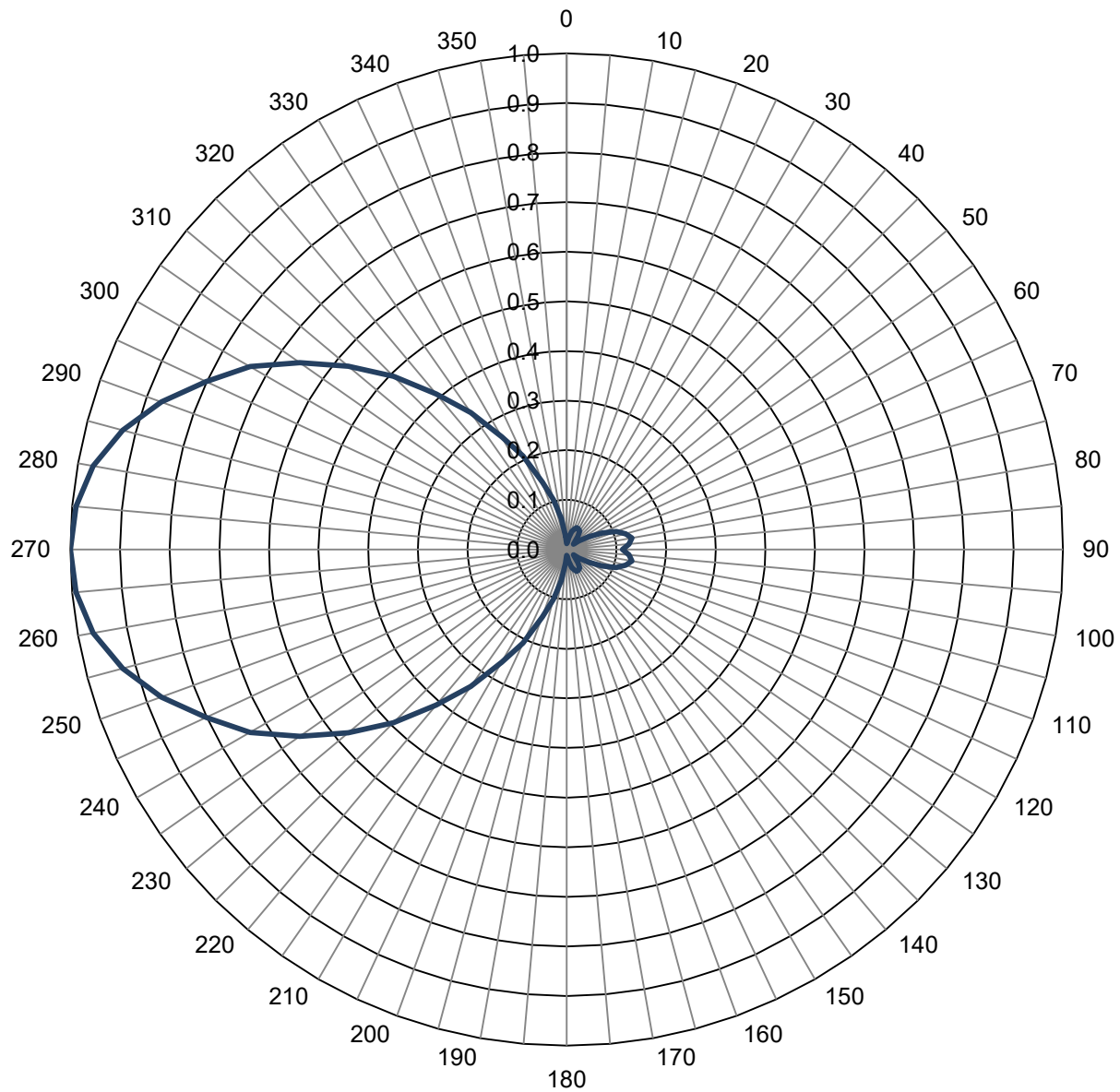
Relative Field

Tabulated Data for Composite Azimuth PatternType: ETUP1C-H

Angle	Field	dB	Angle	Field	dB	Angle	Field	dB	Angle	Field	dB
0	0.206	-13.73	100	0.133	-17.50	200	0.379	-8.44	300	0.811	-1.82
2	0.196	-14.16	102	0.136	-17.31	202	0.401	-7.93	302	0.786	-2.09
4	0.193	-14.29	104	0.128	-17.83	204	0.424	-7.44	304	0.762	-2.36
6	0.184	-14.72	106	0.123	-18.24	206	0.441	-7.11	306	0.736	-2.66
8	0.178	-14.99	108	0.116	-18.73	208	0.455	-6.83	308	0.711	-2.97
10	0.177	-15.03	110	0.107	-19.45	210	0.483	-6.32	310	0.684	-3.29
12	0.174	-15.19	112	0.099	-20.13	212	0.494	-6.12	312	0.680	-3.35
14	0.168	-15.48	114	0.100	-19.97	214	0.514	-5.78	314	0.648	-3.77
16	0.166	-15.62	116	0.100	-19.97	216	0.539	-5.36	316	0.622	-4.13
18	0.165	-15.63	118	0.102	-19.85	218	0.565	-4.96	318	0.615	-4.22
20	0.164	-15.72	120	0.104	-19.66	220	0.591	-4.57	320	0.591	-4.57
22	0.162	-15.80	122	0.105	-19.54	222	0.615	-4.22	322	0.565	-4.96
24	0.162	-15.83	124	0.106	-19.46	224	0.622	-4.13	324	0.539	-5.36
26	0.157	-16.08	126	0.109	-19.26	226	0.648	-3.77	326	0.514	-5.78
28	0.157	-16.10	128	0.113	-18.96	228	0.680	-3.35	328	0.494	-6.12
30	0.154	-16.24	130	0.115	-18.78	230	0.684	-3.29	330	0.483	-6.32
32	0.150	-16.46	132	0.122	-18.29	232	0.711	-2.97	332	0.455	-6.83
34	0.147	-16.67	134	0.128	-17.87	234	0.736	-2.66	334	0.441	-7.11
36	0.143	-16.91	136	0.131	-17.69	236	0.762	-2.36	336	0.424	-7.44
38	0.143	-16.88	138	0.136	-17.30	238	0.786	-2.09	338	0.401	-7.93
40	0.142	-16.95	140	0.142	-16.95	240	0.811	-1.82	340	0.379	-8.44
42	0.136	-17.30	142	0.143	-16.88	242	0.815	-1.77	342	0.354	-9.03
44	0.131	-17.69	144	0.143	-16.91	244	0.845	-1.46	344	0.330	-9.62
46	0.128	-17.87	146	0.147	-16.67	246	0.871	-1.20	346	0.316	-10.00
48	0.122	-18.29	148	0.150	-16.46	248	0.885	-1.07	348	0.301	-10.42
50	0.115	-18.78	150	0.154	-16.24	250	0.899	-0.93	350	0.276	-11.20
52	0.113	-18.96	152	0.157	-16.10	252	0.918	-0.74	352	0.265	-11.54
54	0.109	-19.26	154	0.157	-16.08	254	0.939	-0.55	354	0.250	-12.03
56	0.106	-19.46	156	0.162	-15.83	256	0.953	-0.42	356	0.233	-12.65
58	0.105	-19.54	158	0.162	-15.80	258	0.965	-0.31	358	0.219	-13.21
60	0.104	-19.66	160	0.164	-15.72	260	0.971	-0.26	360	0.206	-13.73
62	0.102	-19.85	162	0.165	-15.63	262	0.984	-0.14			
64	0.100	-19.97	164	0.166	-15.62	264	0.990	-0.09			
66	0.100	-19.97	166	0.168	-15.48	266	0.995	-0.04			
68	0.099	-20.13	168	0.174	-15.19	268	0.999	-0.01			
70	0.107	-19.45	170	0.177	-15.03	270	1.000	0.00			
72	0.116	-18.73	172	0.178	-14.99	272	0.999	-0.01			
74	0.123	-18.24	174	0.184	-14.72	274	0.995	-0.04			
76	0.128	-17.83	176	0.193	-14.29	276	0.990	-0.09			
78	0.136	-17.31	178	0.196	-14.16	278	0.984	-0.14			
80	0.133	-17.50	180	0.206	-13.73	280	0.971	-0.26			
82	0.130	-17.70	182	0.219	-13.21	282	0.965	-0.31			
84	0.127	-17.90	184	0.233	-12.65	284	0.953	-0.42			
86	0.123	-18.20	186	0.250	-12.03	286	0.939	-0.55			
88	0.118	-18.60	188	0.265	-11.54	288	0.918	-0.74			
90	0.112	-19.00	190	0.276	-11.20	290	0.899	-0.93			
92	0.118	-18.60	192	0.301	-10.42	292	0.885	-1.07			
94	0.123	-18.20	194	0.316	-10.00	294	0.871	-1.20			
96	0.127	-17.90	196	0.330	-9.62	296	0.845	-1.46			
98	0.130	-17.70	198	0.354	-9.03	298	0.815	-1.77			

Azimuth Pattern

Type:	ETUP1C-H	Polarization:	Horizontal
Directivity:	5.35 numeric (7.28 dB)	Frequency:	20 (ATSC)
Peak(s) at:		Location:	Billings, MT
		NOTE: Pattern shape and directivity may vary with channel and mounting configuration.	

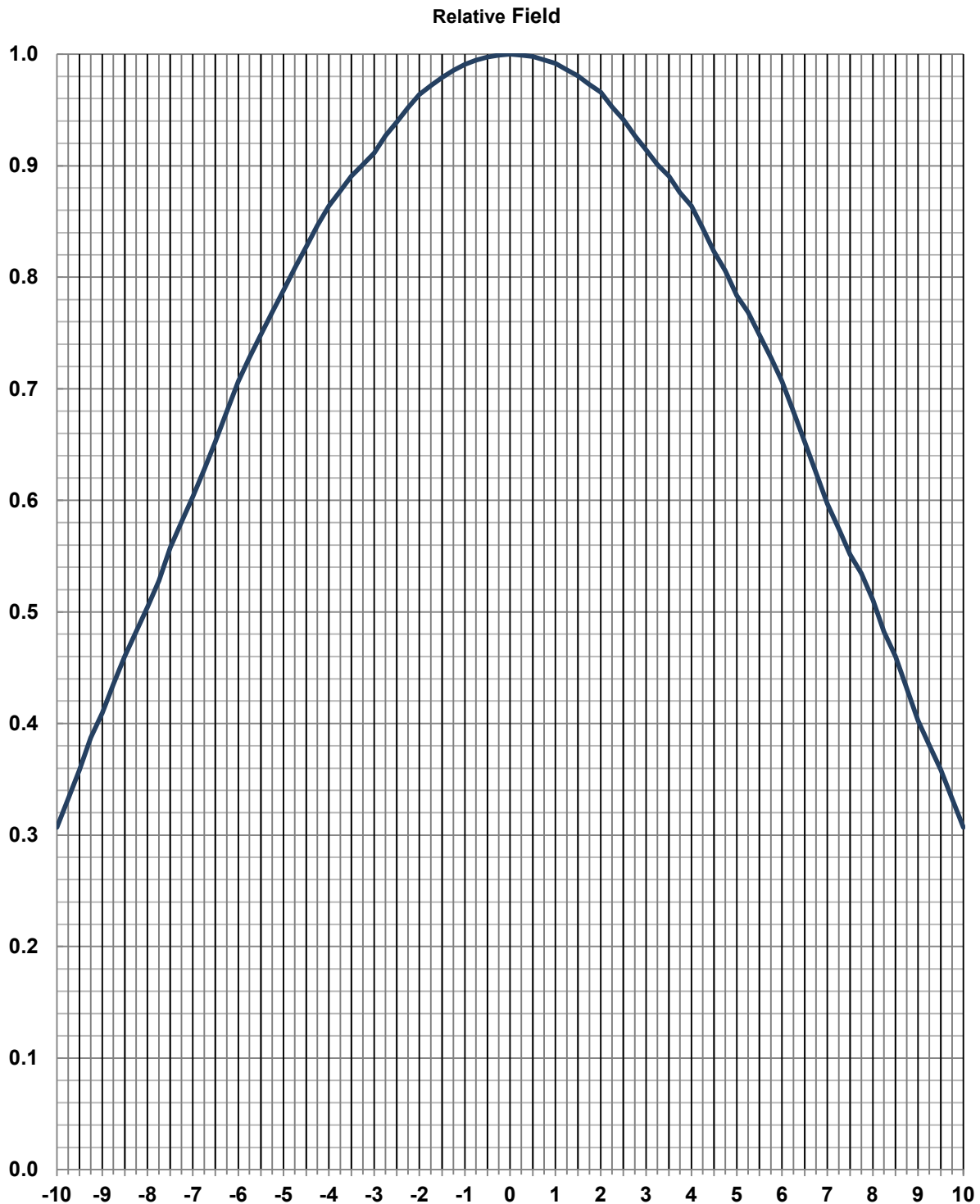
Relative Field

Tabulated Data for Azimuth PatternType: ETUP1C-H

Angle	Field	dB	Angle	Field	dB	Angle	Field	dB	Angle	Field	dB
0	0.012	-38.20	100	0.133	-17.50	200	0.144	-16.83	300	0.737	-2.65
2	0.010	-39.66	102	0.136	-17.31	202	0.166	-15.61	302	0.707	-3.02
4	0.010	-39.83	104	0.128	-17.83	204	0.186	-14.61	304	0.668	-3.51
6	0.014	-37.02	106	0.123	-18.24	206	0.208	-13.62	306	0.642	-3.85
8	0.020	-34.15	108	0.116	-18.73	208	0.233	-12.65	308	0.612	-4.26
10	0.024	-32.29	110	0.107	-19.45	210	0.262	-11.62	310	0.574	-4.82
12	0.031	-30.23	112	0.096	-20.35	212	0.281	-11.02	312	0.535	-5.43
14	0.034	-29.32	114	0.088	-21.08	214	0.322	-9.85	314	0.512	-5.82
16	0.038	-28.38	116	0.076	-22.38	216	0.339	-9.39	316	0.473	-6.50
18	0.042	-27.58	118	0.068	-23.40	218	0.379	-8.42	318	0.444	-7.06
20	0.044	-27.17	120	0.051	-25.88	220	0.409	-7.76	320	0.409	-7.76
22	0.047	-26.58	122	0.043	-27.41	222	0.444	-7.06	322	0.379	-8.42
24	0.048	-26.30	124	0.031	-30.12	224	0.473	-6.50	324	0.339	-9.39
26	0.049	-26.21	126	0.022	-33.00	226	0.512	-5.82	326	0.322	-9.85
28	0.049	-26.25	128	0.019	-34.24	228	0.535	-5.43	328	0.281	-11.02
30	0.048	-26.41	130	0.017	-35.19	230	0.574	-4.82	330	0.262	-11.62
32	0.047	-26.58	132	0.019	-34.47	232	0.612	-4.26	332	0.233	-12.65
34	0.045	-26.96	134	0.022	-33.00	234	0.642	-3.85	334	0.208	-13.62
36	0.042	-27.51	136	0.028	-31.15	236	0.668	-3.51	336	0.186	-14.61
38	0.038	-28.31	138	0.031	-30.17	238	0.707	-3.02	338	0.166	-15.61
40	0.035	-29.17	140	0.035	-29.17	240	0.737	-2.65	340	0.144	-16.83
42	0.031	-30.17	142	0.038	-28.31	242	0.769	-2.29	342	0.124	-18.10
44	0.028	-31.15	144	0.042	-27.51	244	0.793	-2.01	344	0.108	-19.37
46	0.022	-33.00	146	0.045	-26.96	246	0.813	-1.79	346	0.089	-20.99
48	0.019	-34.47	148	0.047	-26.58	248	0.844	-1.47	348	0.075	-22.45
50	0.017	-35.19	150	0.048	-26.41	250	0.870	-1.21	350	0.063	-23.99
52	0.019	-34.24	152	0.049	-26.25	252	0.892	-0.99	352	0.049	-26.18
54	0.022	-33.00	154	0.049	-26.21	254	0.914	-0.78	354	0.038	-28.36
56	0.031	-30.12	156	0.048	-26.30	256	0.934	-0.59	356	0.026	-31.60
58	0.043	-27.41	158	0.047	-26.58	258	0.953	-0.42	358	0.018	-34.89
60	0.051	-25.88	160	0.044	-27.17	260	0.969	-0.27	360	0.012	-38.20
62	0.068	-23.40	162	0.042	-27.58	262	0.979	-0.18			
64	0.076	-22.38	164	0.038	-28.38	264	0.986	-0.12			
66	0.088	-21.08	166	0.034	-29.32	266	0.995	-0.04			
68	0.096	-20.35	168	0.031	-30.23	268	0.999	-0.01			
70	0.107	-19.45	170	0.024	-32.29	270	1.000	0.00			
72	0.116	-18.73	172	0.020	-34.15	272	0.999	-0.01			
74	0.123	-18.24	174	0.014	-37.02	274	0.995	-0.04			
76	0.128	-17.83	176	0.010	-39.83	276	0.986	-0.12			
78	0.136	-17.31	178	0.010	-39.66	278	0.979	-0.18			
80	0.133	-17.50	180	0.012	-38.20	280	0.969	-0.27			
82	0.130	-17.70	182	0.018	-34.89	282	0.953	-0.42			
84	0.127	-17.90	184	0.026	-31.60	284	0.934	-0.59			
86	0.123	-18.20	186	0.038	-28.36	286	0.914	-0.78			
88	0.118	-18.60	188	0.049	-26.18	288	0.892	-0.99			
90	0.112	-19.00	190	0.063	-23.99	290	0.870	-1.21			
92	0.118	-18.60	192	0.075	-22.45	292	0.844	-1.47			
94	0.123	-18.20	194	0.089	-20.99	294	0.813	-1.79			
96	0.127	-17.90	196	0.108	-19.37	296	0.793	-2.01			
98	0.130	-17.70	198	0.124	-18.10	298	0.769	-2.29			

Elevation Pattern

Type:	ETU-2U1-H		Polarization:	Horizontal
Directivity:			Frequency:	20 (ATSC)
Main Lobe:	4.75 numeric	(6.77 dB)	Location:	Billings, MT
Horizontal:	4.75 numeric	(6.77 dB)	Beam Tilt:	0.00 degrees



Tabulated Data for Elevation PatternType: ETU-2U1-H

-5 to 10 degrees in 0.25 degree increments.

10 to 90 degrees in 0.50 degree increments.

Angle	Field	dB	Angle	Field	dB	Angle	Field	dB	Angle	Field	dB	Angle	Field	dB
-10.00	0.307	-10.26	2.25	0.953	-0.42	19.00	0.320	-9.90	43.50	0.010	-40.18	68.00	0.100	-20.01
-9.75	0.333	-9.56	2.50	0.941	-0.52	19.50	0.329	-9.65	44.00	0.020	-34.07	68.50	0.097	-20.22
-9.50	0.358	-8.91	2.75	0.927	-0.66	20.00	0.336	-9.48	44.50	0.028	-31.00	69.00	0.095	-20.43
-9.25	0.387	-8.24	3.00	0.914	-0.78	20.50	0.340	-9.38	45.00	0.035	-29.09	69.50	0.092	-20.76
-9.00	0.409	-7.76	3.25	0.901	-0.91	21.00	0.344	-9.27	45.50	0.045	-26.94	70.00	0.088	-21.10
-8.75	0.435	-7.23	3.50	0.891	-1.01	21.50	0.355	-9.00	46.00	0.052	-25.75	70.50	0.087	-21.21
-8.50	0.461	-6.74	3.75	0.876	-1.15	22.00	0.364	-8.77	46.50	0.060	-24.48	71.00	0.086	-21.30
-8.25	0.482	-6.33	4.00	0.864	-1.27	22.50	0.347	-9.20	47.00	0.068	-23.40	71.50	0.083	-21.62
-8.00	0.504	-5.95	4.25	0.844	-1.48	23.00	0.330	-9.64	47.50	0.074	-22.63	72.00	0.080	-21.94
-7.75	0.528	-5.55	4.50	0.823	-1.69	23.50	0.315	-10.04	48.00	0.082	-21.78	72.50	0.078	-22.15
-7.50	0.558	-5.07	4.75	0.806	-1.88	24.00	0.298	-10.51	48.50	0.087	-21.19	73.00	0.076	-22.34
-7.25	0.581	-4.72	5.00	0.783	-2.12	24.50	0.291	-10.73	49.00	0.096	-20.39	73.50	0.073	-22.67
-7.00	0.603	-4.39	5.25	0.769	-2.29	25.00	0.283	-10.97	49.50	0.101	-19.92	74.00	0.071	-23.00
-6.75	0.628	-4.04	5.50	0.748	-2.52	25.50	0.274	-11.25	50.00	0.106	-19.50	74.50	0.070	-23.10
-6.50	0.653	-3.71	5.75	0.728	-2.76	26.00	0.264	-11.57	50.50	0.110	-19.19	75.00	0.069	-23.21
-6.25	0.680	-3.35	6.00	0.707	-3.02	26.50	0.255	-11.87	51.00	0.115	-18.82	75.50	0.067	-23.47
-6.00	0.707	-3.01	6.25	0.680	-3.36	27.00	0.245	-12.20	51.50	0.119	-18.46	76.00	0.065	-23.76
-5.75	0.728	-2.76	6.50	0.652	-3.71	27.50	0.226	-12.93	52.00	0.125	-18.04	76.50	0.063	-24.07
-5.50	0.749	-2.52	6.75	0.625	-4.09	28.00	0.205	-13.75	52.50	0.128	-17.87	77.00	0.061	-24.31
-5.25	0.769	-2.29	7.00	0.597	-4.48	28.50	0.198	-14.04	53.00	0.130	-17.71	77.50	0.060	-24.44
-5.00	0.788	-2.07	7.25	0.574	-4.81	29.00	0.191	-14.37	53.50	0.133	-17.54	78.00	0.059	-24.61
-4.75	0.808	-1.85	7.50	0.551	-5.17	29.50	0.171	-15.35	54.00	0.136	-17.33	78.50	0.057	-24.87
-4.50	0.827	-1.65	7.75	0.534	-5.45	30.00	0.151	-16.42	54.50	0.136	-17.32	79.00	0.055	-25.13
-4.25	0.846	-1.45	8.00	0.511	-5.84	30.50	0.148	-16.58	55.00	0.137	-17.27	79.50	0.054	-25.27
-4.00	0.864	-1.27	8.25	0.482	-6.33	31.00	0.145	-16.78	55.50	0.140	-17.05	80.00	0.054	-25.38
-3.75	0.878	-1.13	8.50	0.460	-6.74	31.50	0.134	-17.47	56.00	0.142	-16.95	80.50	0.054	-25.43
-3.50	0.891	-1.01	8.75	0.432	-7.30	32.00	0.123	-18.22	56.50	0.142	-16.96	81.00	0.053	-25.47
-3.25	0.901	-0.91	9.00	0.403	-7.90	32.50	0.118	-18.53	57.00	0.140	-17.07	81.50	0.053	-25.55
-3.00	0.911	-0.81	9.25	0.380	-8.39	33.00	0.114	-18.83	57.50	0.142	-16.98	82.00	0.052	-25.66
-2.75	0.927	-0.66	9.50	0.358	-8.92	33.50	0.110	-19.16	58.00	0.144	-16.83	82.50	0.052	-25.73
-2.50	0.939	-0.55	9.75	0.333	-9.56	34.00	0.106	-19.53	58.50	0.141	-17.04	83.00	0.052	-25.75
-2.25	0.952	-0.43	10.00	0.307	-10.26	34.50	0.100	-19.96	59.00	0.137	-17.27	83.50	0.051	-25.81
-2.00	0.964	-0.32	10.50	0.248	-12.09	35.00	0.096	-20.35	59.50	0.137	-17.23	84.00	0.051	-25.90
-1.75	0.972	-0.25	11.00	0.199	-14.00	35.50	0.093	-20.60	60.00	0.137	-17.25	84.50	0.050	-25.97
-1.50	0.979	-0.18	11.50	0.151	-16.39	36.00	0.090	-20.92	60.50	0.136	-17.33	85.00	0.050	-25.99
-1.25	0.985	-0.13	12.00	0.096	-20.32	36.50	0.084	-21.55	61.00	0.135	-17.41	85.50	0.050	-26.06
-1.00	0.991	-0.08	12.50	0.053	-25.50	37.00	0.078	-22.11	61.50	0.132	-17.59	86.00	0.050	-26.07
-0.75	0.994	-0.05	13.00	0.006	-43.88	37.50	0.075	-22.46	62.00	0.129	-17.78	86.50	0.049	-26.11
-0.50	0.997	-0.02	13.50	0.032	-29.92	38.00	0.070	-23.06	62.50	0.127	-17.90	87.00	0.049	-26.18
-0.25	0.999	-0.01	14.00	0.076	-22.34	38.50	0.065	-23.78	63.00	0.125	-18.03	87.50	0.049	-26.20
0.00	1.000	0.00	14.50	0.109	-19.27	39.00	0.057	-24.82	63.50	0.124	-18.15	88.00	0.049	-26.21
0.25	0.999	-0.01	15.00	0.149	-16.57	39.50	0.050	-25.99	64.00	0.122	-18.29	88.50	0.049	-26.23
0.50	0.998	-0.02	15.50	0.179	-14.95	40.00	0.045	-26.86	64.50	0.118	-18.53	89.00	0.048	-26.32
0.75	0.995	-0.05	16.00	0.213	-13.44	40.50	0.036	-28.75	65.00	0.115	-18.77	89.50	0.048	-26.34
1.00	0.992	-0.07	16.50	0.234	-12.62	41.00	0.029	-30.75	65.50	0.111	-19.06	90.00	0.048	-26.41
1.25	0.986	-0.12	17.00	0.256	-11.82	41.50	0.022	-33.15	66.00	0.108	-19.36			
1.50	0.980	-0.17	17.50	0.288	-10.81	42.00	0.014	-36.77	66.50	0.106	-19.46			
1.75	0.973	-0.24	18.00	0.318	-9.94	42.50	0.005	-46.20	67.00	0.105	-19.57			
2.00	0.966	-0.30	18.50	0.321	-9.86	43.00	0.003	-49.63	67.50	0.102	-19.79			

Azimuth Pattern

Type: ETUP1C-V

Polarization: Vertical

Directivity: 4.11 numeric (6.14 dB)

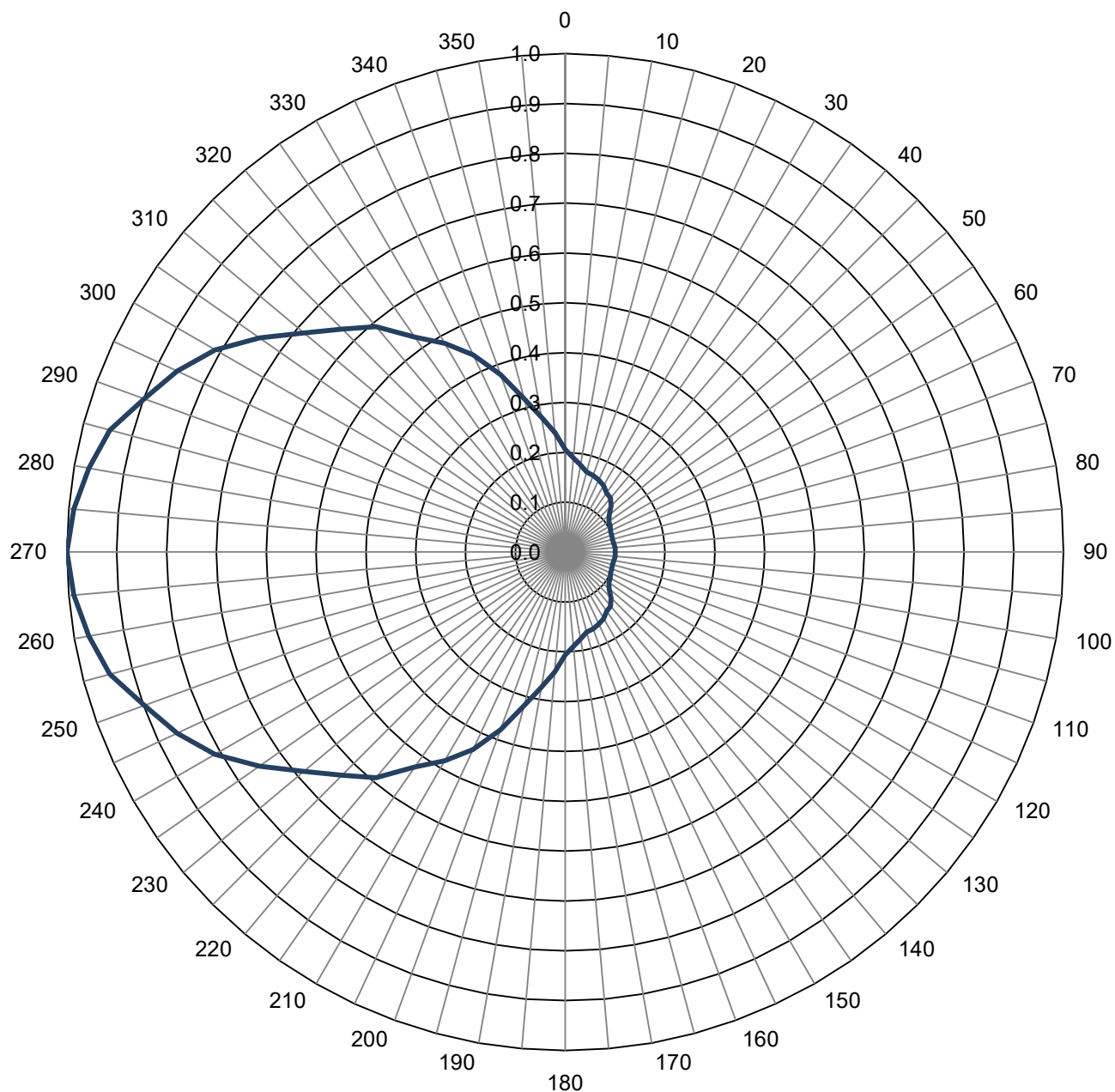
Frequency: 20 (ATSC)

Peak(s) at:

Location: Billings, MT

NOTE: Pattern shape and directivity may vary with channel and mounting configuration.

Relative Field



Tabulated Data for Azimuth Pattern

Type:

ETUP1C-V

Angle	Field	dB
0	0.206	-13.73
2	0.196	-14.16
4	0.193	-14.29
6	0.184	-14.72
8	0.178	-14.99
10	0.177	-15.03
12	0.174	-15.19
14	0.168	-15.48
16	0.166	-15.62
18	0.165	-15.63
20	0.164	-15.72
22	0.162	-15.80
24	0.162	-15.83
26	0.157	-16.08
28	0.157	-16.10
30	0.154	-16.24
32	0.150	-16.46
34	0.147	-16.67
36	0.143	-16.91
38	0.143	-16.88
40	0.142	-16.95
42	0.136	-17.30
44	0.131	-17.69
46	0.128	-17.87
48	0.122	-18.29
50	0.115	-18.78
52	0.113	-18.96
54	0.109	-19.26
56	0.106	-19.46
58	0.105	-19.54
60	0.104	-19.66
62	0.102	-19.85
64	0.100	-19.97
66	0.100	-19.97
68	0.099	-20.13
70	0.100	-20.04
72	0.099	-20.09
74	0.098	-20.15
76	0.097	-20.23
78	0.099	-20.08
80	0.099	-20.10
82	0.100	-20.02
84	0.101	-19.92
86	0.102	-19.82
88	0.101	-19.95
90	0.100	-20.00
92	0.101	-19.95
94	0.102	-19.82
96	0.101	-19.92
98	0.100	-20.02

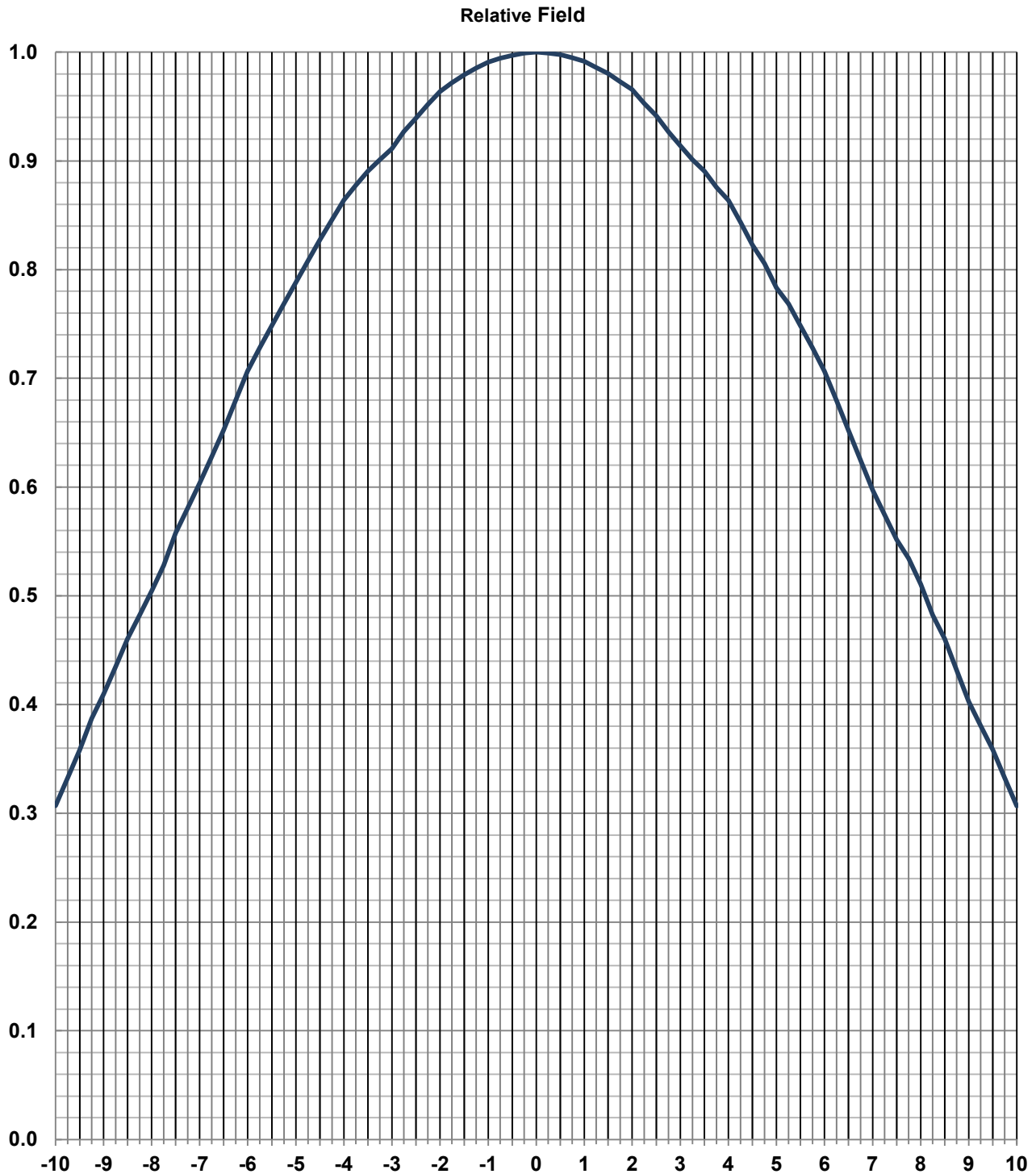
Angle	Field	dB
100	0.099	-20.10
102	0.099	-20.08
104	0.097	-20.23
106	0.098	-20.15
108	0.099	-20.09
110	0.100	-20.04
112	0.099	-20.13
114	0.100	-19.97
116	0.100	-19.97
118	0.102	-19.85
120	0.104	-19.66
122	0.105	-19.54
124	0.106	-19.46
126	0.109	-19.26
128	0.113	-18.96
130	0.115	-18.78
132	0.122	-18.29
134	0.128	-17.87
136	0.131	-17.69
138	0.136	-17.30
140	0.142	-16.95
142	0.143	-16.88
144	0.143	-16.91
146	0.147	-16.67
148	0.150	-16.46
150	0.154	-16.24
152	0.157	-16.10
154	0.157	-16.08
156	0.162	-15.83
158	0.162	-15.80
160	0.164	-15.72
162	0.165	-15.63
164	0.166	-15.62
166	0.168	-15.48
168	0.174	-15.19
170	0.177	-15.03
172	0.178	-14.99
174	0.184	-14.72
176	0.193	-14.29
178	0.196	-14.16
180	0.206	-13.73
182	0.219	-13.21
184	0.233	-12.65
186	0.250	-12.03
188	0.265	-11.54
190	0.276	-11.20
192	0.301	-10.42
194	0.316	-10.00
196	0.330	-9.62
198	0.354	-9.03

Angle	Field	dB
200	0.379	-8.44
202	0.401	-7.93
204	0.424	-7.44
206	0.441	-7.11
208	0.455	-6.83
210	0.483	-6.32
212	0.494	-6.12
214	0.514	-5.78
216	0.539	-5.36
218	0.565	-4.96
220	0.591	-4.57
222	0.615	-4.22
224	0.622	-4.13
226	0.648	-3.77
228	0.680	-3.35
230	0.684	-3.29
232	0.711	-2.97
234	0.736	-2.66
236	0.762	-2.36
238	0.786	-2.09
240	0.811	-1.82
242	0.815	-1.77
244	0.845	-1.46
246	0.871	-1.20
248	0.885	-1.07
250	0.899	-0.93
252	0.918	-0.74
254	0.939	-0.55
256	0.953	-0.42
258	0.965	-0.31
260	0.971	-0.26
262	0.984	-0.14
264	0.990	-0.09
266	0.993	-0.06
268	0.998	-0.02
270	1.000	0.00
272	0.998	-0.02
274	0.993	-0.06
276	0.990	-0.09
278	0.984	-0.14
280	0.971	-0.26
282	0.965	-0.31
284	0.953	-0.42
286	0.939	-0.55
288	0.918	-0.74
290	0.899	-0.93
292	0.885	-1.07
294	0.871	-1.20
296	0.845	-1.46
298	0.815	-1.77

Angle	Field	dB
300	0.811	-1.82
302	0.786	-2.09
304	0.762	-2.36
306	0.736	-2.66
308	0.711	-2.97
310	0.684	-3.29
312	0.680	-3.35
314	0.648	-3.77
316	0.622	-4.13
318	0.615	-4.22
320	0.591	-4.57
322	0.565	-4.96
324	0.539	-5.36
326	0.514	-5.78
328	0.494	-6.12
330	0.483	-6.32
332	0.455	-6.83
334	0.441	-7.11
336	0.424	-7.44
338	0.401	-7.93
340	0.379	-8.44
342	0.354	-9.03
344	0.330	-9.62
346	0.316	-10.00
348	0.301	-10.42
350	0.276	-11.20
352	0.265	-11.54
354	0.250	-12.03
356	0.233	-12.65
358	0.219	-13.21
360	0.206	-13.73

Elevation Pattern

Type:	ETU-2U1-V	Polarization:	Vertical
Directivity:		Frequency:	20 (ATSC)
Main Lobe:	4.75 numeric (6.77 dB)	Location:	Billings, MT
Horizontal:	4.75 numeric (6.77 dB)	Beam Tilt:	0.00 degrees



Tabulated Data for Elevation Pattern

Type:

ETU-2U1-V

-5 to 10 degrees in 0.25 degree increments.

10 to 90 degrees in 0.50 degree increments.

Angle	Field	dB	Angle	Field	dB	Angle	Field	dB	Angle	Field	dB	Angle	Field	dB
-10.00	0.307	-10.26	2.25	0.953	-0.42	19.00	0.320	-9.90	43.50	0.010	-40.18	68.00	0.100	-20.01
-9.75	0.333	-9.56	2.50	0.941	-0.52	19.50	0.329	-9.65	44.00	0.020	-34.07	68.50	0.097	-20.22
-9.50	0.358	-8.91	2.75	0.927	-0.66	20.00	0.336	-9.48	44.50	0.028	-31.00	69.00	0.095	-20.43
-9.25	0.387	-8.24	3.00	0.914	-0.78	20.50	0.340	-9.38	45.00	0.035	-29.09	69.50	0.092	-20.76
-9.00	0.409	-7.76	3.25	0.901	-0.91	21.00	0.344	-9.27	45.50	0.045	-26.94	70.00	0.088	-21.10
-8.75	0.435	-7.23	3.50	0.891	-1.01	21.50	0.355	-9.00	46.00	0.052	-25.75	70.50	0.087	-21.21
-8.50	0.461	-6.74	3.75	0.876	-1.15	22.00	0.364	-8.77	46.50	0.060	-24.48	71.00	0.086	-21.30
-8.25	0.482	-6.33	4.00	0.864	-1.27	22.50	0.347	-9.20	47.00	0.068	-23.40	71.50	0.083	-21.62
-8.00	0.504	-5.95	4.25	0.844	-1.48	23.00	0.330	-9.64	47.50	0.074	-22.63	72.00	0.080	-21.94
-7.75	0.528	-5.55	4.50	0.823	-1.69	23.50	0.315	-10.04	48.00	0.082	-21.78	72.50	0.078	-22.15
-7.50	0.558	-5.07	4.75	0.806	-1.88	24.00	0.298	-10.51	48.50	0.087	-21.19	73.00	0.076	-22.34
-7.25	0.581	-4.72	5.00	0.783	-2.12	24.50	0.291	-10.73	49.00	0.096	-20.39	73.50	0.073	-22.67
-7.00	0.603	-4.39	5.25	0.769	-2.29	25.00	0.283	-10.97	49.50	0.101	-19.92	74.00	0.071	-23.00
-6.75	0.628	-4.04	5.50	0.748	-2.52	25.50	0.274	-11.25	50.00	0.106	-19.50	74.50	0.070	-23.10
-6.50	0.653	-3.71	5.75	0.728	-2.76	26.00	0.264	-11.57	50.50	0.110	-19.19	75.00	0.069	-23.21
-6.25	0.680	-3.35	6.00	0.707	-3.02	26.50	0.255	-11.87	51.00	0.115	-18.82	75.50	0.067	-23.47
-6.00	0.707	-3.01	6.25	0.680	-3.36	27.00	0.245	-12.20	51.50	0.119	-18.46	76.00	0.065	-23.76
-5.75	0.728	-2.76	6.50	0.652	-3.71	27.50	0.226	-12.93	52.00	0.125	-18.04	76.50	0.063	-24.07
-5.50	0.749	-2.52	6.75	0.625	-4.09	28.00	0.205	-13.75	52.50	0.128	-17.87	77.00	0.061	-24.31
-5.25	0.769	-2.29	7.00	0.597	-4.48	28.50	0.198	-14.04	53.00	0.130	-17.71	77.50	0.060	-24.44
-5.00	0.788	-2.07	7.25	0.574	-4.81	29.00	0.191	-14.37	53.50	0.133	-17.54	78.00	0.059	-24.61
-4.75	0.808	-1.85	7.50	0.551	-5.17	29.50	0.171	-15.35	54.00	0.136	-17.33	78.50	0.057	-24.87
-4.50	0.827	-1.65	7.75	0.534	-5.45	30.00	0.151	-16.42	54.50	0.136	-17.32	79.00	0.055	-25.13
-4.25	0.846	-1.45	8.00	0.511	-5.84	30.50	0.148	-16.58	55.00	0.137	-17.27	79.50	0.054	-25.27
-4.00	0.864	-1.27	8.25	0.482	-6.33	31.00	0.145	-16.78	55.50	0.140	-17.05	80.00	0.054	-25.38
-3.75	0.878	-1.13	8.50	0.460	-6.74	31.50	0.134	-17.47	56.00	0.142	-16.95	80.50	0.054	-25.43
-3.50	0.891	-1.01	8.75	0.432	-7.30	32.00	0.123	-18.22	56.50	0.142	-16.96	81.00	0.053	-25.47
-3.25	0.901	-0.91	9.00	0.403	-7.90	32.50	0.118	-18.53	57.00	0.140	-17.07	81.50	0.053	-25.55
-3.00	0.911	-0.81	9.25	0.380	-8.39	33.00	0.114	-18.83	57.50	0.142	-16.98	82.00	0.052	-25.66
-2.75	0.927	-0.66	9.50	0.358	-8.92	33.50	0.110	-19.16	58.00	0.144	-16.83	82.50	0.052	-25.73
-2.50	0.939	-0.55	9.75	0.333	-9.56	34.00	0.106	-19.53	58.50	0.141	-17.04	83.00	0.052	-25.75
-2.25	0.952	-0.43	10.00	0.307	-10.26	34.50	0.100	-19.96	59.00	0.137	-17.27	83.50	0.051	-25.81
-2.00	0.964	-0.32	10.50	0.248	-12.09	35.00	0.096	-20.35	59.50	0.137	-17.23	84.00	0.051	-25.90
-1.75	0.972	-0.25	11.00	0.199	-14.00	35.50	0.093	-20.60	60.00	0.137	-17.25	84.50	0.050	-25.97
-1.50	0.979	-0.18	11.50	0.151	-16.39	36.00	0.090	-20.92	60.50	0.136	-17.33	85.00	0.050	-25.99
-1.25	0.985	-0.13	12.00	0.096	-20.32	36.50	0.084	-21.55	61.00	0.135	-17.41	85.50	0.050	-26.06
-1.00	0.991	-0.08	12.50	0.053	-25.50	37.00	0.078	-22.11	61.50	0.132	-17.59	86.00	0.050	-26.07
-0.75	0.994	-0.05	13.00	0.006	-43.88	37.50	0.075	-22.46	62.00	0.129	-17.78	86.50	0.049	-26.11
-0.50	0.997	-0.02	13.50	0.032	-29.92	38.00	0.070	-23.06	62.50	0.127	-17.90	87.00	0.049	-26.18
-0.25	0.999	-0.01	14.00	0.076	-22.34	38.50	0.065	-23.78	63.00	0.125	-18.03	87.50	0.049	-26.20
0.00	1.000	0.00	14.50	0.109	-19.27	39.00	0.057	-24.82	63.50	0.124	-18.15	88.00	0.049	-26.21
0.25	0.999	-0.01	15.00	0.149	-16.57	39.50	0.050	-25.99	64.00	0.122	-18.29	88.50	0.049	-26.23
0.50	0.998	-0.02	15.50	0.179	-14.95	40.00	0.045	-26.86	64.50	0.118	-18.53	89.00	0.048	-26.32
0.75	0.995	-0.05	16.00	0.213	-13.44	40.50	0.036	-28.75	65.00	0.115	-18.77	89.50	0.048	-26.34
1.00	0.992	-0.07	16.50	0.234	-12.62	41.00	0.029	-30.75	65.50	0.111	-19.06	90.00	0.048	-26.41
1.25	0.986	-0.12	17.00	0.256	-11.82	41.50	0.022	-33.15	66.00	0.108	-19.36			
1.50	0.980	-0.17	17.50	0.288	-10.81	42.00	0.014	-36.77	66.50	0.106	-19.46			
1.75	0.973	-0.24	18.00	0.318	-9.94	42.50	0.005	-46.20	67.00	0.105	-19.57			
2.00	0.966	-0.30	18.50	0.321	-9.86	43.00	0.003	-49.63	67.50	0.102	-19.79			

EXHIBIT E-3

ALLOCATION STUDY

tvstudy v2.2.5 (4uoc83)

Database: localhost, Study: K20HB-15kW-Composite2-IX, Model: Longley-Rice

Start: 2021.03.30 12:48:29

Study created: 2021.03.30 12:48:29

Study build station data: LMS TV 2021-03-30

Proposal: K20HB D20 LD APP BILLINGS, MT

File number: K20HB-15kW-Composite2

Facility ID: 125475

Station data: User record

Record ID: 168

Country: U.S.

Build options:

Protect pre-transition records not on baseline channel

Search options:

Non-U.S. records included

Baseline record excluded if station has CP

Stations potentially affected by proposal:

IX	Call	Chan	Svc	Status	City, State	File Number	Distance
Yes	K45KS-D	D19	LD	CP	BILLINGS, MT	BLANK0000051841	0.3 km
No	K19JF-D	D19	LD	CP	FORSYTH, MT	BNPDTL20100506AET	148.7
No	K19JO-D	D19	LD	LIC	HARLOWTON, ETC, MT	BLDTT20120611ACE	145.3
No	K19FF	D19-	LD	CP	MILES CITY, MT	BLANK0000054413	214.4
No	K49AI	D19z	LD	LIC	CODY, POWELL, WY	BLANK0000074850	134.7
No	K19KW-D	D19	LD	LIC	GREYBULL, WY	BLANK0000064170	154.7
No	K20MQ-D	D20	LD	LIC	REXBURG, ID	BLANK0000080478	353.5
No	KTVM-TV	D20	DT	APP	BUTTE, MT	BLANK0000127624	309.4
No	K20LK-D	D20	LD	LIC	COLSTRIP, ETC., MT	BLDTT20120608AAV	120.6
No	K20KL-D	D20	LD	CP	DRUMMOND, MT	BLANK0000019042	375.5
No	K20KL-D	D20	LD	LIC	DRUMMOND, MT	BLDTT20131122AWR	375.5
No	K20JS-D	D20	LD	LIC	GLASGOW, MT	BLDTT20110705ABR	304.4
No	K20LX-D	D20	LD	CP	GLEN, MT	BNPDTL20100609AIO	332.1
No	K20KQ-D	D20	LD	LIC	LIVINGSTON, ETC., MT	BLDTT20130906AAU	163.3
No	KECI-TV	D20	DT	APP	MISSOULA, MT	BLANK0000127630	447.9
No	K20BP-D	D20	LD	LIC	PHILLIPS COUNTY, MT	BLDTT20111116AUB	241.1

No	KFNB	D20	DT	LIC	CASPER, WY	BLCDT20090225AAN	375.5
Yes	K20LT-D	D20	LD	LIC	DIAMOND BASIN, ETC., WY	BLDTT20130807AAN	152.1
No	K21NL-D	D21	LD	LIC	HOWARD, MT	BLANK0000124964	129.2
No	K21LJ-D	D21	LD	CP	WORDON, MT	BNPDTL20100510ABS	47.2
No	K21JU-D	D21	LD	LIC	MEETEETSE, WY	BLDTT20120321AAN	175.6
No	K21LM-D	D21	LD	CP	SHERIDAN, WY	BNPDTL20100505AHL	164.3
No	K23HI	N23z	TX	LIC	BILLINGS, MT	BLTTL20070809ABT	7.4
No	K27IM	N27z	TX	LIC	BILLINGS, MT	BLTT20060711ABH	0.1

No non-directional AM stations found within 0.8 km

No directional AM stations found within 3.2 km

Record parameters as studied:

Channel: D20
 Mask: Full Service
 Latitude: 45 46 0.00 N (NAD83)
 Longitude: 108 27 29.50 W
 Height AMSL: 1163.0 m
 HAAT: 0.0 m
 Peak ERP: 15.0 kW
 Antenna: Composite 0.0 deg
 Elev Pattn: Generic
 Elec Tilt: 1.00

49.4 dBu contour:

Azimuth	ERP	HAAT	Distance
0.0 deg	0.637 kW	174.7 m	33.9 km
45.0	0.254	151.7	27.9
90.0	0.188	77.5	19.5
135.0	0.254	62.0	19.0
180.0	0.637	37.5	18.4
225.0	6.01	98.3	39.9
270.0	15.0	183.9	50.8
315.0	6.01	126.2	42.4

Database HAAT does not agree with computed HAAT

Database HAAT: 0 m Computed HAAT: 114 m

Distance to Canadian border: 359.3 km

Distance to Mexican border: 1545.9 km

Conditions at FCC monitoring station: Grand Island NE
Bearing: 120.1 degrees Distance: 972.1 km

Proposal is not within the West Virginia quiet zone area

Conditions at Table Mountain receiving zone:
Bearing: 156.2 degrees Distance: 676.1 km

No land mobile station failures found

Study cell size: 1.00 km
Profile point spacing: 1.00 km

Maximum new IX to full-service and Class A: 0.50%
Maximum new IX to LPTV: 2.00%

Interference to BLANK0000051841 CP scenario 1

	Call	Chan	Svc	Status	City, State	File Number	Distance
Desired:	K45KS-D	D19	LD	CP	BILLINGS, MT	BLANK0000051841	
Undesireds:	K20HB	N20+	TX	LIC	BILLINGS, MT	BLTT20041123AKE	0.3 km
	K20HB	D20	LD	APP	BILLINGS, MT	K20HB-15kW-Composite2	0.3
	KSVI	D18	DT	LIC	BILLINGS, MT	BLCDT20090205ABS	10.1
	K19FF	D19-	LD	CP	MILES CITY, MT	BLANK0000054413	214.3
	K19JR-D	D19	LD	CP	WOLF POINT, MT	BLANK0000013205	336.7
	K49AI	D19z	LD	LIC	CODY, POWELL, WY	BLANK0000074850	134.5
	Service area	Terrain-limited		IX-free, before		IX-free, after	Percent New IX
	2781.3	146,604	2555.1	146,276	1734.8	142,546	1733.8 142,532 0.06 0.01
Undesired				Total IX	Unique IX, before	Unique IX, after	
K20HB N20+ TX LIC				0.0	0	0.0	0
K20HB D20 LD APP				4.0	14	1.0	14
KSVI D18 DT LIC				812.3	3,730	801.3	3,730

K49AI D19z LD LIC	16.0	0	8.0	0	8.0	0
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Interference to BLDTT20130807AAN LIC scenario 1

	Call	Chan	Svc	Status	City, State	File Number	Distance
Desired:	K20LT-D	D20	LD	LIC	DIAMOND BASIN, ETC., WY	BLDTT20130807AAN	
Undesireds:	K20HB	N20+	TX	LIC	BILLINGS, MT	BLTT20041123AKE	152.1 km
	K20HB	D20	LD	APP	BILLINGS, MT	K20HB-15kW-Composite2	152.1
	K49AI	D19z	LD	LIC	CODY, POWELL, WY	BLANK0000074850	27.1
	K19KW-D	D19	LD	LIC	GREYBULL, WY	BLANK0000064170	93.4
	K21JU-D	D21	LD	LIC	MEETEETSE, WY	BLDTT20120321AAN	39.9

Service area	Terrain-limited	IX-free, before	IX-free, after	Percent New IX
7600.9	27,476	5760.1	26,386	5497.1
		26,008	5494.1	26,008
				0.06
				0.00

Undesired	Total IX	Unique IX, before	Unique IX, after
K20HB N20+ TX LIC	0.0	0	0
K20HB D20 LD APP	3.0	0	3.0
K49AI D19z LD LIC	179.5	361	155.4
K19KW-D D19 LD LIC	3.0	0	0.0
K21JU-D D21 LD LIC	106.6	17	83.5

Interference to proposal scenario 1

	Call	Chan	Svc	Status	City, State	File Number	Distance
Desired:	K20HB	D20	LD	APP	BILLINGS, MT	K20HB-15kW-Composite2	
Undesireds:	K45KS-D	D19	LD	CP	BILLINGS, MT	BLANK0000051841	0.3 km
	K20LK-D	D20	LD	LIC	COLSTRIP, ETC., MT	BLDTT20120608AAV	120.6
	K20LT-D	D20	LD	LIC	DIAMOND BASIN, ETC., WY	BLDTT20130807AAN	152.1
	K21LJ-D	D21	LD	CP	WORDON, MT	BNPDTL20100510ABS	47.2

Service area	Terrain-limited	IX-free	Percent IX
3670.3	147,708	3267.9	146,995
		3235.6	146,868
			0.99
			0.09

Undesired	Total IX	Unique IX	Prcnt Unique IX
K45KS-D D19 LD CP	1.0	0	1.0
K20LK-D D20 LD LIC	8.1	0	8.1

K20LT-D D20 LD LIC	17.1	20	17.1	20	0.52	0.01
K21LJ-D D21 LD CP	6.1	107	6.1	107	0.19	0.07

TABLE I
COMPUTED COVERAGE DATA
FOR THE PROPOSED OPERATION OF
K20HB, BILLINGS, MONTANA
CHANNEL 20 15 KW DA ERP 1163 METERS RC/AMSL
APRIL 2021

Radial Bearing (N ° E, T)	Average* Elevation 3.2 to 16.1 km meters	Effective Height meters	Depression Angle degrees	ERP At Radio Horizon kW	<u>Distance to Contour F(50/90)</u>	
					58 dBu km	51 dBu km
0	1587.8	174.7	0.366	0.637	23.9	32.0
10	1564.1	198.4	0.390	0.470	23.6	31.8
20	1548.7	213.8	0.405	0.403	23.6	31.8
30	1540.3	222.2	0.413	0.356	23.4	31.6
40	1588.2	174.3	0.366	0.302	20.2	28.2
50	1633.8	128.7	0.314	0.198	15.5	23.1
60	1646.9	115.6	0.298	0.162	13.8	21.0
70	1644.2	118.3	0.301	0.172	14.2	21.5
80	1664.7	97.8	0.274	0.265	14.4	21.8
90	1685.0	77.5	0.244	0.188	11.8	17.6
100	1692.2	70.3	0.232	0.265	12.2	18.4
110	1697.2	65.3	0.224	0.172	10.7	15.5
120	1698.0	64.5	0.222	0.162	10.5	15.1
130	1701.5	61.0	0.216	0.198	10.7	15.7
140	1693.8	68.7	0.230	0.302	12.5	18.9
150	1698.3	64.2	0.222	0.356	12.6	19.1
160	1704.6	57.9	0.211	0.403	12.4	18.9
170	1721.7	40.8	0.177	0.470	10.7	15.9
180	1725.0	37.5	0.170	0.637	11.1	16.5
190	1713.3	49.2	0.194	1.143	14.8	22.3
200	1703.3	59.2	0.213	2.155	19.4	27.4
210	1691.5	71.0	0.233	3.499	23.5	31.6
220	1678.7	83.8	0.254	5.240	27.3	35.5
230	1642.7	119.8	0.303	7.018	32.6	40.8
240	1562.9	199.6	0.391	9.865	39.2	47.6
250	1569.8	192.7	0.385	12.123	39.9	48.3
260	1575.3	187.2	0.379	14.142	40.4	48.8
270	1578.6	183.9	0.376	15.000	40.5	48.9
280	1583.1	179.4	0.371	14.142	40.0	48.3

COHEN, DIPPELL, AND EVERIST, P.C.

TABLE I
COMPUTED COVERAGE DATA
FOR THE PROPOSED OPERATION OF
K20HB, BILLINGS, MONTANA
CHANNEL 20 15 KW DA ERP 1163 METERS RC/AMSL
APRIL 2021

Radial	Average*			ERP At	<u>Distance to Contour F(50/90)</u>	
<u>Bearing</u>	<u>Elevation</u>	<u>Effective</u>	<u>Depression</u>	<u>Radio</u>	<u>58 dBu</u>	<u>51 dBu</u>
(N ° E, T)	3.2 to 16.1 km	<u>Height</u>	<u>Angle</u>	<u>Horizon</u>	km	km
	meters	meters	degrees	kW		
290	1640.5	122.0	0.306	12.123	35.6	43.7
300	1655.6	106.9	0.286	9.865	33.3	41.4
310	1650.0	112.5	0.294	7.018	32.0	40.2
320	1621.2	141.3	0.329	5.240	32.5	40.8
330	1611.2	151.3	0.341	3.499	31.1	39.4
340	1589.4	173.1	0.364	2.155	29.9	38.2
350	1595.1	167.4	0.358	1.143	26.4	34.6

