Directional FM Antenna
KVCI
VCY America, Inc.
Montezuma, IA

A standard model PSIFMR antenna element with high power input, custom mounts, radomes and parasitic elements was used in conjunction with a model of the customer's 36" face Bell Tower to create the necessary directional radiation pattern. The final antenna consists of ten radiating elements full wavelength spaced with two vertical and one horizontal parasitic element per bay. The antenna array is center fed. Each radiating element receives equal power and phase.

Pattern testing was performed using a 1/3-scale model element and tower. The azimuth plane measurements were taken on a ground reflection test range. This type of test range utilizes the reflected signal and direct signal from the source antenna to form an interference pattern on the antenna under test. The antenna and tower under test was mounted to a turntable that allowed the structure to be rotated 360° in the azimuth plane. The source antenna was located approximately 75 ft. from the antenna under test. The source height above ground was adjusted to peak the first lobe of the interference pattern at the antenna under test.

The test antenna was mounted in the center of rotation of the turntable. The antenna and mounting structure were rotated clockwise while data was recorded in a counter clockwise direction. All feed cables to the antenna were secured and grounded during pattern measurements. A Hewlett Packard 8753E-network analyzer operating at 269.1 MHz was used as both the source and receiver. The level of the received signal was compared with a standard dipole to establish the directivity of the final pattern. The final pattern measured does not exceed the envelope pattern and is 88.3% of the envelope RMS.

The antenna is to be mounted 136.5 meters (447.7 ft.) above ground level which is within the allowed tolerance of the approved 140-meter center of radiation in the construction permit. No other antenna can be installed within 10 ft of any radiating element. The antenna is to be mounted to a support mast that extends out from the northwest tower leg. The antenna bay is to be positioned 315° True and certified by a licensed surveyor.

It is recommended that a broadcast engineer is present to supervise the installation of the antenna and that he or she certifies the antenna has been installed according to the enclosed instructions.

An input power level of 9.56 kW will be required at the antenna input in order to reach the licensed 100 kW ERP. The principal minima at 170 degrees is 7.13 kW which is below the approved 8.3 kW. The transmitter output power requirements are dependent upon the transmission line size and length used to feed the antenna. The final length of transmission line must be determined after installation.

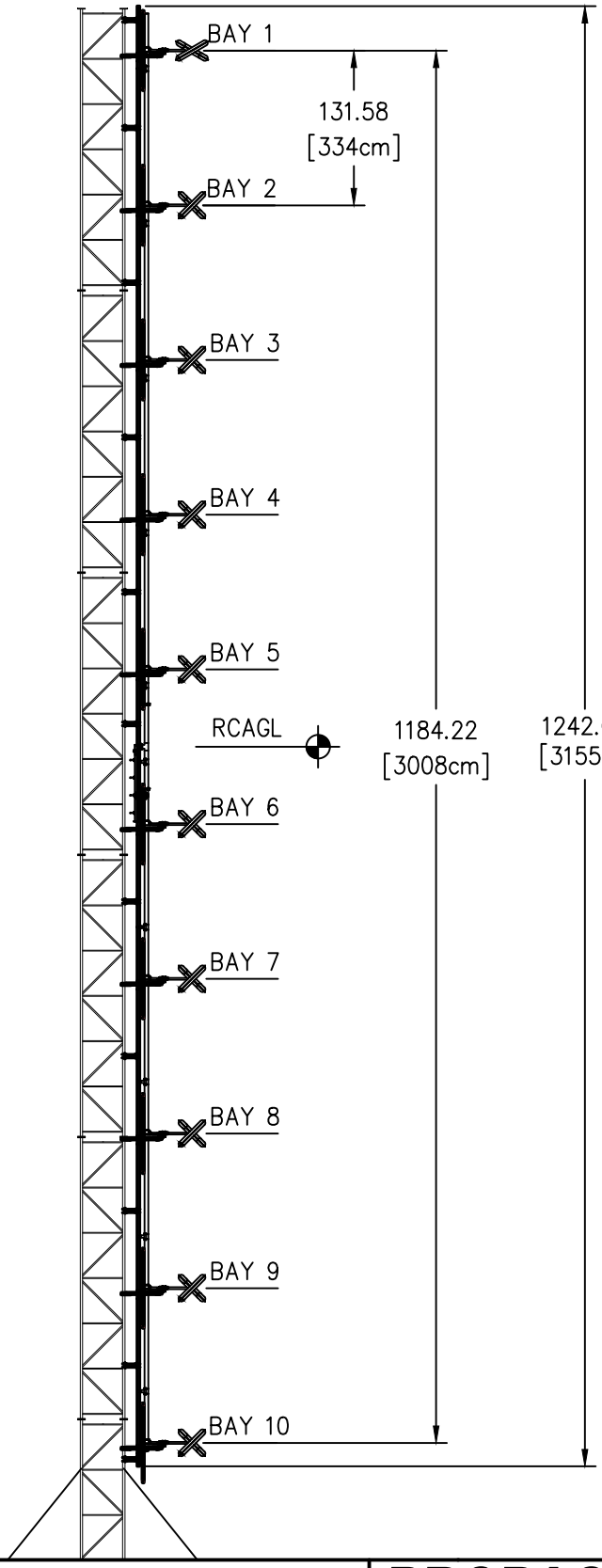
Antenna Specifications

Antenna Model	PSIFMRH-10C-R-DA
Type	10-bay High power directional FM antenna
Bay Spacing	Full wavelength spaced elements
Frequency	89.7 MHz
Polarization	Circular
Envelope RMS	.769
Composite RMS	.679
Gain (H-pol)	10.45 (10.19 dB)
Gain (V-pol)	9.01 (9.55 dB)
Input	3-1/8" EIA center fed input
Input power	9.56 kW
Power rating	20 kW
Length	103.5 ft.
Weight	956 lbs.
Wind Area	61.5 sq. ft.

Statement of Certification

This is to certify the antenna has been designed, fabricated and tested under my supervision and it meets the required envelope pattern limitations set forth in the stations construction permit.

Douglas A. Ross
President
Propagation Systems Inc.



SPECIFICATIONS	
SPACING:	λ
BAY SPACING ('S'):	131.58 IN
APERTURE ('A'):	98.69 FT (30.1 M)
LENGTH ('L'):	103.5 FT (31.5 M)
RCAGL:	447.7 FT (136.5 M)
WEIGHT:	956 LB (433 Kg)
WIND AREA:	61.5 FT^2 (5.71 M^2)
POWER RATING:	20 kW
GAIN:	10.45 (10.19 dB)
POLARIZATION	CIRCULAR

NOTE: 1. WEIGHT AND WIND AREA ARE ESTIMATED. WIND AREA IN ACCORDANCE WITH TIA/EIA-222-F Σ(CaAc) 2. TIE WRAP COAX. CABLE AT ±16" O.C.

REV.	MADE BY / CHECKED BY	DATE	CHANGE

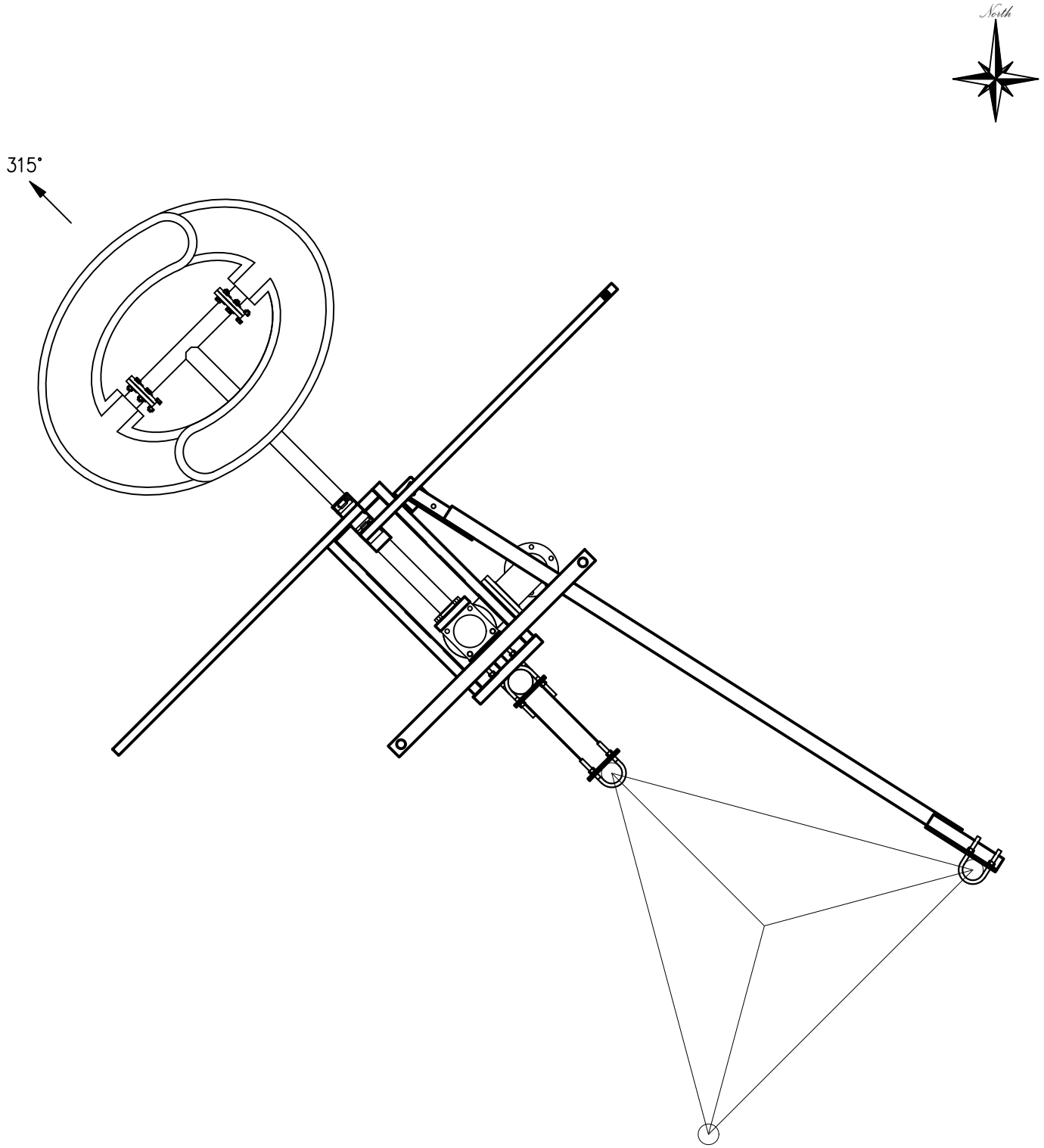
SIZE: A

PROPAGATION SYSTEMS, INC.

Ebensburg, Pennsylvania USA 814-472-5540

ANTENNA ELEVATION AND SPECIFICATIONS

MODEL:	DRAWN BY:	DATE:
PSIFMRH-10C-R-DA	H.POTTS	5/28/2020
CHANNEL/ FREQUENCY: 89.7 MHz	APPROVED BY:	DATE:
SCALE:	DRAWING NO.: 2145-001	REV.



REV.	MADE BY / CHECKED BY	DATE	CHANGE

SIZE: A

PROPAGATION SYSTEMS, INC.

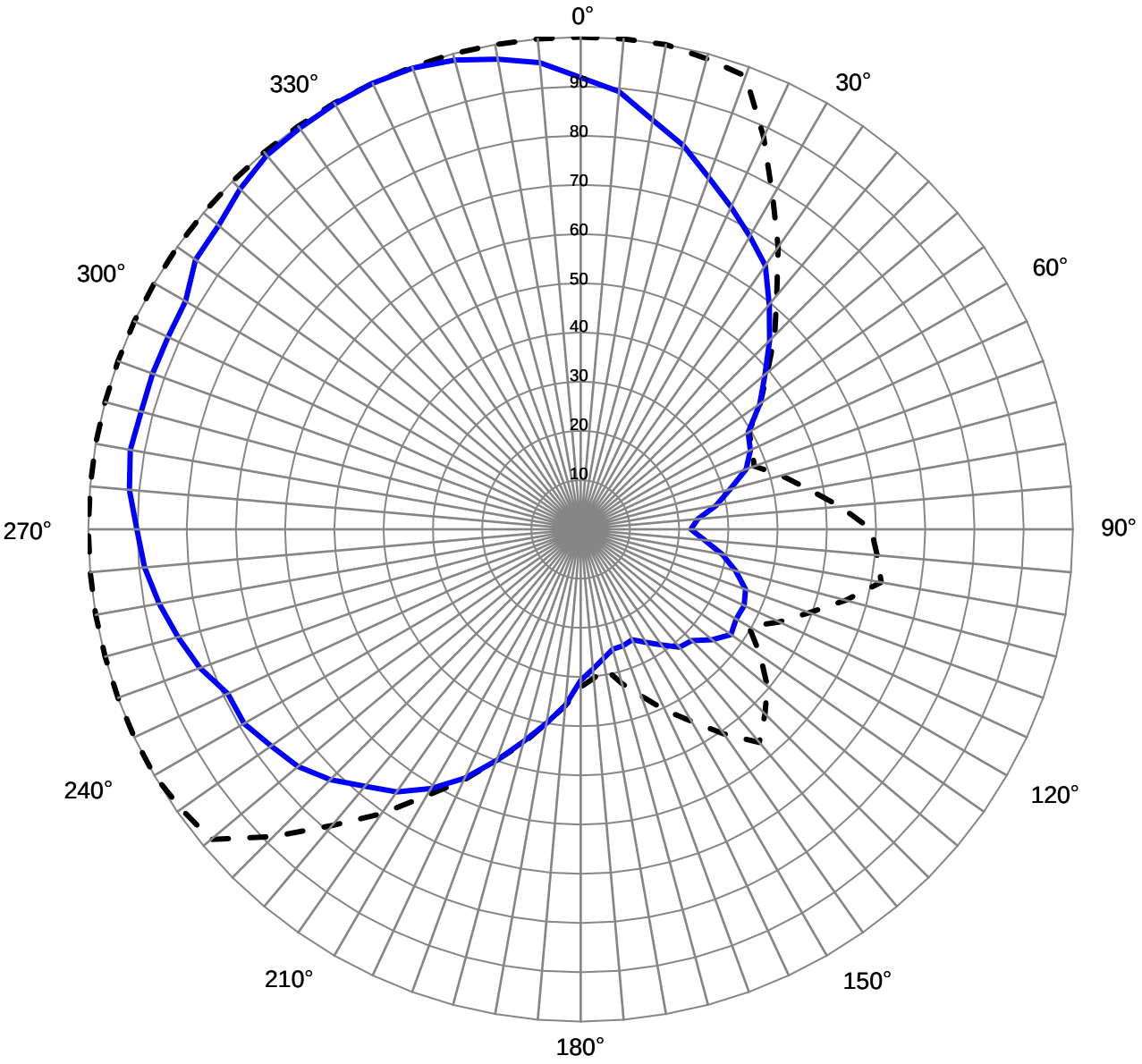
Ebensburg, Pennsylvania USA 814-472-5540

ANTENNA ORIENTATION DETAILS

MODEL: PSIFMRH-10C-R-DA	DRAWN BY: H.POTTS	DATE: 6/3/2020	
CHANNEL/ FREQUENCY: 89.7 MHz	APPROVED BY:	DATE:	
SCALE:	DRAWING NO.: 2145-002	REV.	

Propagation Systems, Inc.

Relative Field
Azimuth Plane Pattern



Pattern Type:	**Measured Composite**	Tower:	**Triangular 36" Face**
Antenna Model:	**PSIFMRH-10C-R-DA**	Orientation:	**315°**
Polarization:	**Circular**	Frequency:	**89.7 MHz**
RMS (envelope)	**0.769**	Station:	**KVCI**
RMS (composite)	**0.679**	Date:	**4/24/2020**

Maximum Envelope Tabulation

Antenna Model: PSIFMRH-10C-R-DA

VCY America, Inc.

Station: KVCI

Frequency: 89.7 MHz

Location: Montezuma, IA

Maximum ERP: 100 kW

Angle	Relative Field	ERP (kW)	ERP (dBk)
0	1.000	100.00	20.00
10	1.000	100.00	20.00
20	0.980	96.04	19.82
30	0.780	60.84	17.84
40	0.620	38.44	15.85
50	0.495	24.50	13.89
60	0.395	15.60	11.93
70	0.375	14.06	11.48
80	0.470	22.09	13.44
90	0.590	34.81	15.42
100	0.620	38.44	15.85
110	0.495	24.50	13.89
120	0.395	15.60	11.93
130	0.495	24.50	13.89
140	0.565	31.92	15.04
150	0.450	20.25	13.06
160	0.360	12.96	11.13
170	0.288	8.29	9.19
180	0.320	10.24	10.10
190	0.400	16.00	12.04
200	0.500	25.00	13.98
210	0.625	39.06	15.92
220	0.785	61.62	17.90
230	0.980	96.04	19.82
240	1.000	100.00	20.00
250	1.000	100.00	20.00
260	1.000	100.00	20.00
270	1.000	100.00	20.00
280	1.000	100.00	20.00
290	1.000	100.00	20.00
300	1.000	100.00	20.00
310	1.000	100.00	20.00
320	1.000	100.00	20.00
330	1.000	100.00	20.00
340	1.000	100.00	20.00
350	1.000	100.00	20.00

Composite Pattern Tabulation

Antenna Model: PSIFMRH-10C-R-DA

VCY America, Inc.

Station: KVCI

Frequency: 89.7 MHz

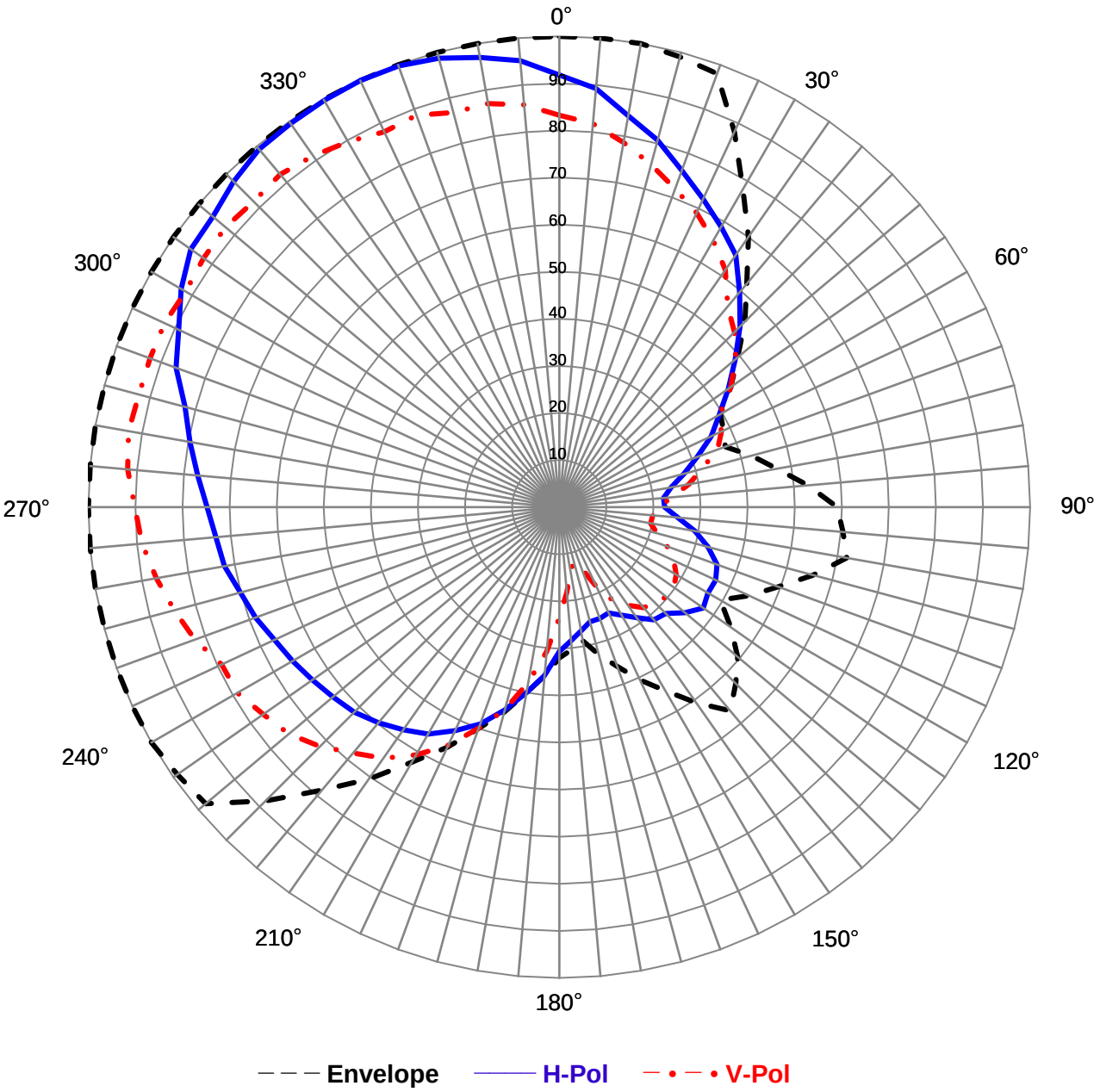
Location: Montezuma, IA

Maximum ERP: 100 kW

Angle	Relative Field	ERP (kW)	ERP (dBk)
0	0.918	84.28	19.26
10	0.844	71.29	18.53
20	0.761	57.92	17.63
30	0.688	47.29	16.75
40	0.596	35.52	15.50
50	0.489	23.93	13.79
60	0.393	15.43	11.88
70	0.358	12.79	11.07
80	0.279	7.80	8.92
90	0.224	5.01	7.00
100	0.293	8.56	9.33
110	0.356	12.70	11.04
120	0.365	13.30	11.24
130	0.349	12.15	10.85
140	0.312	9.75	9.89
150	0.265	7.01	8.46
160	0.252	6.33	8.02
170	0.267	7.13	8.53
180	0.307	9.42	9.74
190	0.400	16.00	12.04
200	0.500	24.96	13.97
210	0.608	36.93	15.67
220	0.681	46.42	16.67
230	0.749	56.16	17.49
240	0.789	62.26	17.94
250	0.823	67.76	18.31
260	0.869	75.52	18.78
270	0.901	81.26	19.10
280	0.929	86.24	19.36
290	0.925	85.56	19.32
300	0.927	85.93	19.34
310	0.960	92.16	19.65
320	0.992	98.41	19.93
330	0.998	99.60	19.98
340	0.997	99.49	19.98
350	0.970	94.08	19.74

Propagation Systems, Inc.

Relative Field
Azimuth Plane Pattern



Pattern Type:	**Measured Field**	Tower:	**Triangular 36" Face**
Antenna Model:	**PSIFMRH-10C-R-DA**	Orientation:	**315°**
Polarization:	**Circular**	Configuration:	**89.7 MHz**
Gain (H-pol):	**10.45 (10.19 dB)**	Station:	**KVCI**
Gain (V-pol):	**9.01 (9.55 dB)**	Date:	**4/24/2020**

Measured Relative Field Tabulation

Antenna Model: PSIFMRH-10C-R-DA

VCY America, Inc.

Station: KVCI

Frequency: 89.7 MHz

Location: Montezuma, IA

Horizontal Polarization

Angle	Relative Field	Power Gain	Gain (dB)
0	0.918	8.807	9.45
10	0.844	7.449	8.72
20	0.761	6.052	7.82
30	0.688	4.942	6.94
40	0.596	3.712	5.70
50	0.488	2.489	3.96
60	0.392	1.606	2.06
70	0.312	1.017	0.07
80	0.241	0.607	-2.17
90	0.224	0.523	-2.81
100	0.293	0.895	-0.48
110	0.356	1.327	1.23
120	0.365	1.390	1.43
130	0.349	1.270	1.04
140	0.312	1.019	0.08
150	0.265	0.733	-1.35
160	0.252	0.662	-1.79
170	0.267	0.745	-1.28
180	0.307	0.985	-0.07
190	0.400	1.672	2.23
200	0.490	2.510	4.00
210	0.557	3.237	5.10
220	0.598	3.734	5.72
230	0.627	4.112	6.14
240	0.654	4.467	6.50
250	0.686	4.918	6.92
260	0.722	5.447	7.36
270	0.748	5.847	7.67
280	0.796	6.621	8.21
290	0.866	7.837	8.94
300	0.927	8.980	9.53
310	0.960	9.631	9.84
320	0.992	10.283	10.12
330	0.998	10.408	10.17
340	0.997	10.397	10.17
350	0.970	9.831	9.93

Maximum Value

Field	1.000
Gain	10.45 (10.19 dB)
Azimuth Bearing	335 degrees

Minimum Field

Field	0.222
Gain	.515 (-2.88 dB)
Azimuth Bearing	85 degrees

Vertical Polarization

Angle	Relative Field	Power Gain	Gain (dB)
0	0.833	7.243	8.60
10	0.787	6.466	8.11
20	0.720	5.410	7.33
30	0.654	4.472	6.51
40	0.556	3.236	5.10
50	0.489	2.500	3.98
60	0.393	1.612	2.07
70	0.358	1.336	1.26
80	0.279	0.815	-0.89
90	0.212	0.470	-3.28
100	0.197	0.406	-3.92
110	0.244	0.621	-2.07
120	0.287	0.859	-0.66
130	0.297	0.920	-0.36
140	0.279	0.815	-0.89
150	0.228	0.544	-2.65
160	0.138	0.199	-7.00
170	0.138	0.198	-7.03
180	0.235	0.575	-2.40
190	0.377	1.487	1.72
200	0.500	2.608	4.16
210	0.608	3.859	5.87
220	0.681	4.851	6.86
230	0.749	5.868	7.69
240	0.789	6.506	8.13
250	0.823	7.081	8.50
260	0.869	7.892	8.97
270	0.901	8.492	9.29
280	0.929	9.012	9.55
290	0.925	8.941	9.51
300	0.916	8.770	9.43
310	0.925	8.946	9.52
320	0.922	8.890	9.49
330	0.896	8.399	9.24
340	0.886	8.196	9.14
350	0.870	7.918	8.99

Maximum Value

Field	0.929
Gain	9.01 (9.55 dB)
Azimuth Bearing	280 degrees

Minimum Field

Field	0.121
Gain	.153 (-8.15 dB)
Azimuth Bearing	165 degrees

ERP Tabulation

Antenna Model: PSIFMRH-10C-R-DA

VCY America, Inc.

Station: KVCI

Frequency: 89.7 MHz

Location: Montezuma, IA

Maximum ERP: 100 kW

Horizontal Polarization

Angle	Relative Field	ERP (kW)	ERP (dBk)
0	0.918	84.28	19.26
10	0.844	71.29	18.53
20	0.761	57.92	17.63
30	0.688	47.29	16.75
40	0.596	35.52	15.50
50	0.488	23.81	13.77
60	0.392	15.37	11.87
70	0.312	9.73	9.88
80	0.241	5.81	7.64
90	0.224	5.01	7.00
100	0.293	8.56	9.33
110	0.356	12.70	11.04
120	0.365	13.30	11.24
130	0.349	12.15	10.85
140	0.312	9.75	9.89
150	0.265	7.01	8.46
160	0.252	6.33	8.02
170	0.267	7.13	8.53
180	0.307	9.42	9.74
190	0.400	16.00	12.04
200	0.490	24.02	13.81
210	0.557	30.97	14.91
220	0.598	35.74	15.53
230	0.627	39.35	15.95
240	0.654	42.75	16.31
250	0.686	47.06	16.73
260	0.722	52.13	17.17
270	0.748	55.95	17.48
280	0.796	63.36	18.02
290	0.866	75.00	18.75
300	0.927	85.93	19.34
310	0.960	92.16	19.65
320	0.992	98.41	19.93
330	0.998	99.60	19.98
340	0.997	99.49	19.98
350	0.970	94.08	19.74

Maximum Value (H-pol)

Field 1.000

ERP 100 kW (20.0 dBk)

Azimuth Bearing 335 degrees

Minimum Field (H-pol)

Field 0.222

ERP 4.93 kW (6.93 dBk)

Azimuth Bearing 85 degrees

Vertical Polarization

Angle	Relative Field	ERP (kW)	ERP (dBk)
0	0.833	69.31	18.41
10	0.787	61.87	17.91
20	0.720	51.77	17.14
30	0.654	42.79	16.31
40	0.556	30.97	14.91
50	0.489	23.93	13.79
60	0.393	15.43	11.88
70	0.358	12.79	11.07
80	0.279	7.80	8.92
90	0.212	4.50	6.53
100	0.197	3.88	5.89
110	0.244	5.94	7.74
120	0.287	8.22	9.15
130	0.297	8.80	9.45
140	0.279	7.80	8.92
150	0.228	5.20	7.16
160	0.138	1.91	2.80
170	0.138	1.90	2.78
180	0.235	5.50	7.40
190	0.377	14.23	11.53
200	0.500	24.96	13.97
210	0.608	36.93	15.67
220	0.681	46.42	16.67
230	0.749	56.16	17.49
240	0.789	62.26	17.94
250	0.823	67.76	18.31
260	0.869	75.52	18.78
270	0.901	81.26	19.10
280	0.929	86.24	19.36
290	0.925	85.56	19.32
300	0.916	83.92	19.24
310	0.925	85.60	19.32
320	0.922	85.07	19.30
330	0.896	80.37	19.05
340	0.886	78.43	18.94
350	0.870	75.77	18.79

Maximum Value (V-pol)

Field 0.929

ERP 86.24 kW (19.36 dBk)

Azimuth Bearing 280 degrees

Minimum Field (V-pol)

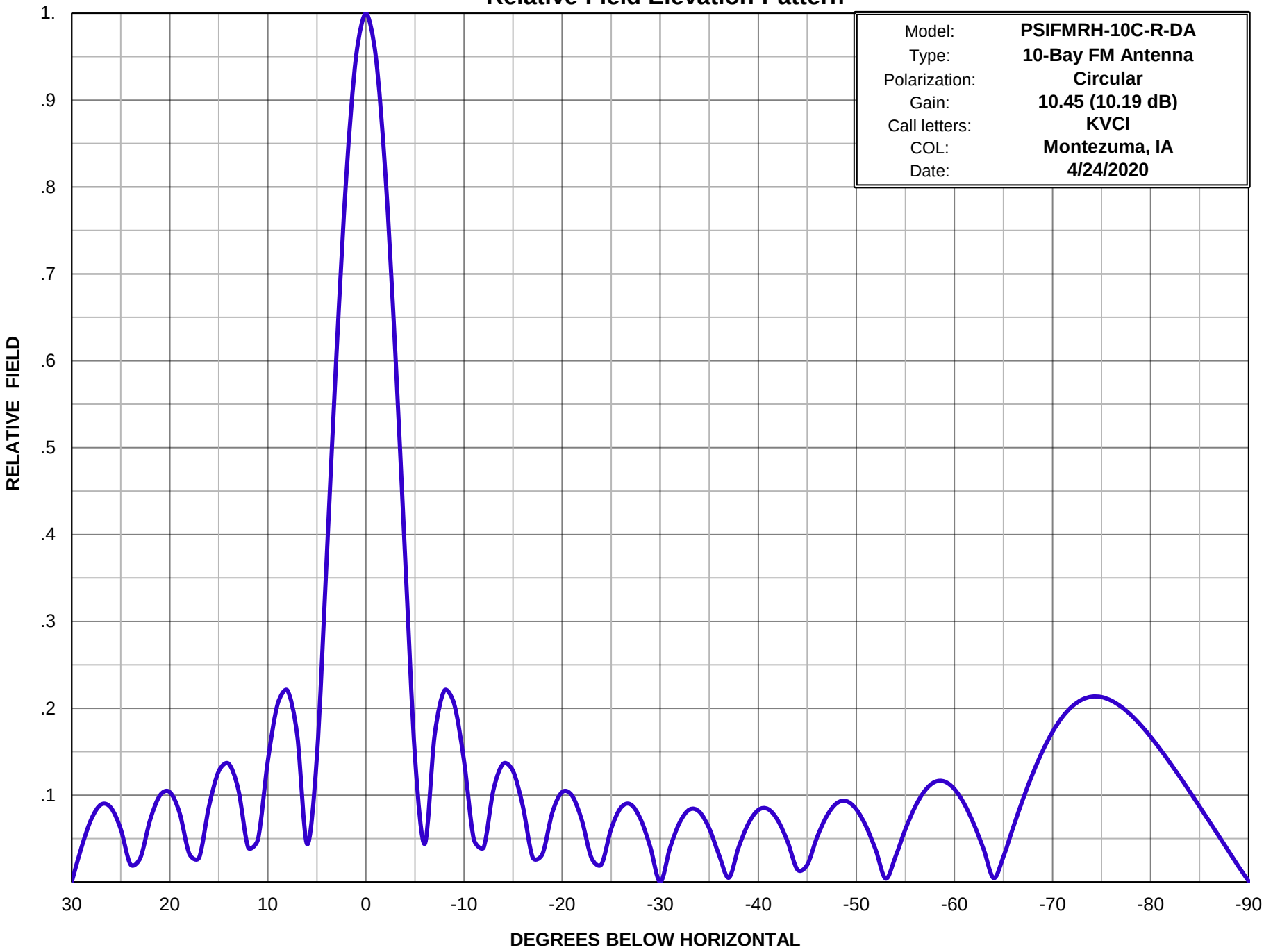
Field 0.121

ERP 1.46 kW (1.66 dBk)

Azimuth Bearing 165 degrees

Propagation Systems, Inc.

Relative Field Elevation Pattern



Propagation Systems Inc.

Relative Field Tabulation Elevation Pattern
Antenna Model: PSIFMRH-10C-R-DA
Gain: 10.45 (10.19 dBd)
Station: KVCI

Angle	Field	dB	Angle	Field	dB	Angle	Field	dB
-90	0.001	-60.00	-50	0.084	-21.55	-10	0.140	-17.11
-89	0.017	-35.18	-49	0.093	-20.63	-9	0.205	-13.77
-88	0.035	-29.16	-48	0.091	-20.86	-8	0.220	-13.13
-87	0.052	-25.63	-47	0.076	-22.36	-7	0.169	-15.46
-86	0.070	-23.15	-46	0.052	-25.74	-6	0.044	-27.14
-85	0.087	-21.23	-45	0.020	-33.98	-5	0.144	-16.82
-84	0.104	-19.66	-44	0.014	-36.93	-4	0.373	-8.57
-83	0.121	-18.36	-43	0.046	-26.70	-3	0.608	-4.32
-82	0.137	-17.27	-42	0.071	-22.99	-2	0.812	-1.81
-81	0.153	-16.33	-41	0.084	-21.52	-1	0.951	-0.44
-80	0.167	-15.53	-40	0.083	-21.63	0	1.000	0.00
-79	0.181	-14.87	-39	0.067	-23.42	1	0.951	-0.44
-78	0.192	-14.32	-38	0.040	-27.96	2	0.812	-1.80
-77	0.202	-13.90	-37	0.005	-46.02	3	0.608	-4.32
-76	0.209	-13.61	-36	0.031	-30.11	4	0.373	-8.56
-75	0.213	-13.44	-35	0.062	-24.18	5	0.145	-16.80
-74	0.213	-13.42	-34	0.081	-21.86	6	0.044	-27.20
-73	0.210	-13.56	-33	0.083	-21.57	7	0.168	-15.47
-72	0.202	-13.89	-32	0.069	-23.25	8	0.220	-13.13
-71	0.190	-14.43	-31	0.039	-28.12	9	0.205	-13.76
-70	0.173	-15.25	-30	0.001	-60.00	10	0.140	-17.10
-69	0.151	-16.42	-29	0.040	-27.96	11	0.049	-26.13
-68	0.125	-18.05	-28	0.072	-22.80	12	0.040	-28.06
-67	0.096	-20.39	-27	0.089	-20.99	13	0.106	-19.50
-66	0.063	-23.99	-26	0.086	-21.35	14	0.136	-17.32
-65	0.029	-30.68	-25	0.061	-24.28	15	0.128	-17.87
-64	0.005	-46.85	-24	0.020	-33.91	16	0.087	-21.18
-63	0.037	-28.61	-23	0.028	-31.14	17	0.028	-30.95
-62	0.066	-23.58	-22	0.072	-22.89	18	0.032	-29.82
-61	0.090	-20.92	-21	0.100	-20.03	19	0.080	-21.97
-60	0.107	-19.41	-20	0.103	-19.70	20	0.103	-19.70
-59	0.116	-18.74	-19	0.080	-21.95	21	0.100	-20.03
-58	0.115	-18.77	-18	0.032	-29.82	22	0.072	-22.89
-57	0.105	-19.55	-17	0.028	-30.95	23	0.028	-31.09
-56	0.087	-21.24	-16	0.087	-21.20	24	0.020	-33.91
-55	0.061	-24.35	-15	0.128	-17.87	25	0.061	-24.31
-54	0.029	-30.63	-14	0.136	-17.32	26	0.085	-21.37
-53	0.004	-48.09	-13	0.106	-19.49	27	0.089	-20.99
-52	0.036	-28.82	-12	0.040	-28.02	28	0.072	-22.80
-51	0.064	-23.88	-11	0.049	-26.15	29	0.040	-27.96