



Propagation Systems, Inc.

Quality Broadcast Antenna Systems

**Directional FM Antenna
Radio Free Moscow, Inc.
KRFP
Moscow, ID**

A standard model PSIFML-HR antenna was used in conjunction with the customer's Rohn SSV tower and existing support mast to create the necessary directional radiation pattern. The final antenna consists of two radiating elements secured to the mast with custom mounting brackets. There is one horizontal parasitic element and one vertical parasitic element per bay. The antenna bays are .735-wavelength spaced and each radiating element receives equal power and phase.

Pattern testing was performed using a 1/3 scale model element, tower and mast. 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, tower and mast under test were 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 270.9 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 92.8% of the envelope RMS.

The antenna is to be mounted with the center of radiation at 48.7 meters (159.7 ft.) above ground level on the support mast. At this elevation the antenna is within the allowed +/- 2m/4m tolerance from the approved 47 meter center of radiation. The antenna is to be positioned 0° 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 .659 kW will be required at the antenna input in order to reach the licensed 1.1 kW ERP. The transmitter output power requirements are dependent upon the transmission line size and length used to feed the antenna.

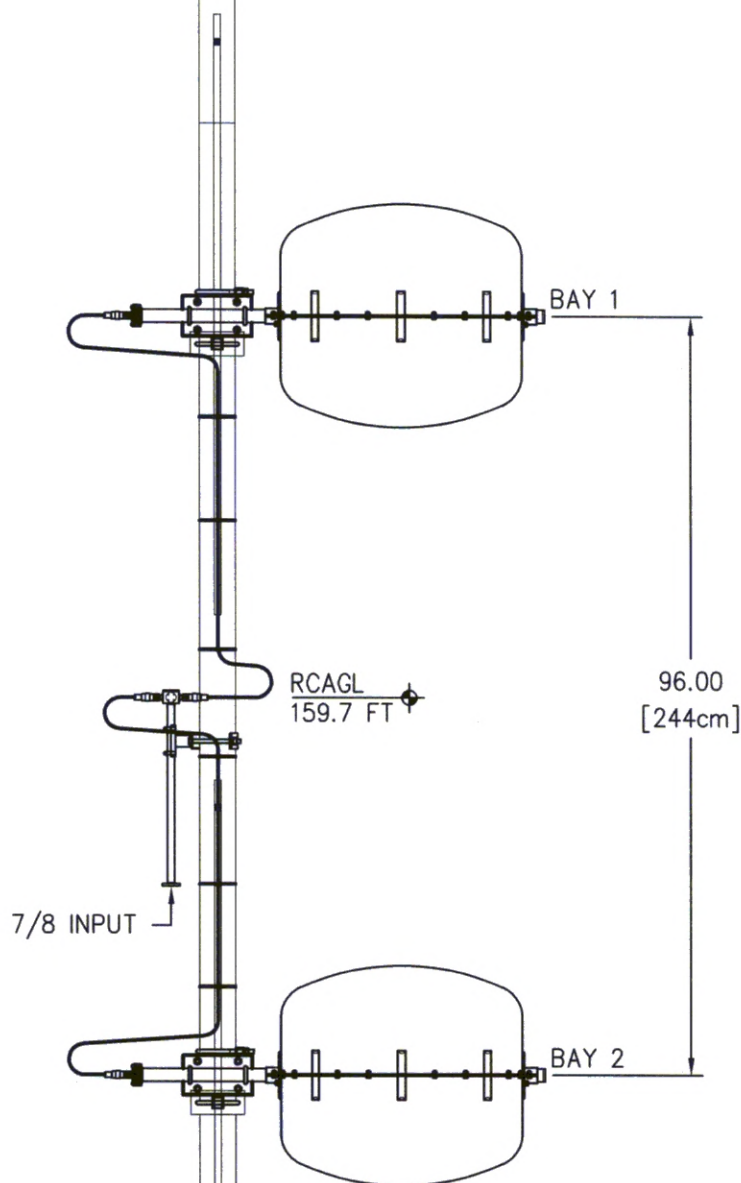
Antenna Specifications

Antenna Model	PSIFML-2A-HR-DA
Type	2-bay directional FM antenna
Bay Spacing	.735-wavelength spaced elements with radomes
Frequency	90.3 MHz
Polarization	Circular
Envelope RMS	.789
Composite RMS	.732
Gain (h-pol)	1.67 (2.23 dB)
Gain (V-pol)	1.62 (2.10 dB)
Antenna input power	.659 kW
ERP	1.1 kW (.41 dBK)
Input	7/8" EIA center fed input
Power rating	1.0 kW
Length (aperture)	8.0 ft.
Antenna Weight	181 lbs.
Antenna Wind Area	15.1 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.

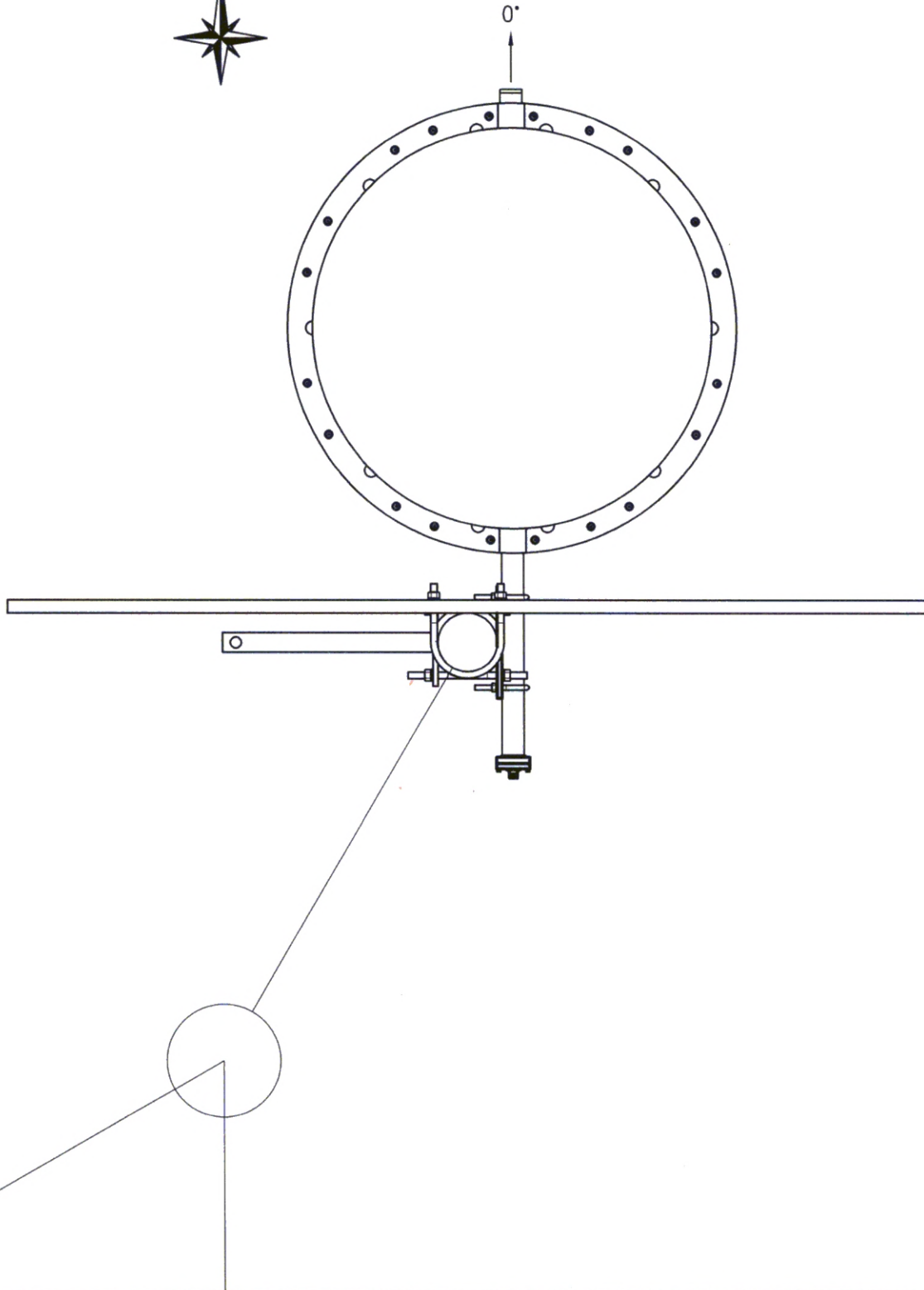
 8/1/2017
Douglas A. Ross
President
Propagation Systems Inc.



SPECIFICATIONS	
SPACING:	0.735λ
LENGTH:	14.25 FT [4.34m]
APERTURE:	8 FT [2.44m]
RATING:	1 kW
GAIN:	1.67 (2.23 dB)
WEIGHT:	181 LB [82.1 Kg]
WINDAREA:	15.1 FT ²
TIA-222-F (NO ICE)	

A	B.K.SCHILLING	7/28/17	CHANGED APERTURE PER CUSTOMER REQUEST
	MADE BY	DATE	CHANGE
REV.	CHECKED BY	DATE	CHANGE
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			SIZE A

PROPAGATION SYSTEMS, INC.			
Ebensburg, Pennsylvania USA 814-472-5540			
ANTENNA ELEVATION AND SPECIFICATIONS			
MODEL:	PSIFML-2A-HR-DA	DRAWN BY:	B.K.SCHILLING
CHANNEL/FREQUENCY:	90.3 MHz	APPROVED BY:	
SCALE:		DRAWING NO.:	1746-001
			REV. A



PROPAGATION SYSTEMS, INC.

Ebensburg, Pennsylvania USA 814-472-5540

ANTENNA ORIENTATION AND PLAN VIEW

MODEL:	PSIFML-2A-HR-DA	DRAWN BY:	B.K.SCHILLING	DATE:	7/11/17
CHANNEL/ FREQUENCY:	90.3 MHz	APPROVED BY:		DATE:	
SCALE:		DRAWING NO.:	1746-002	REV.	

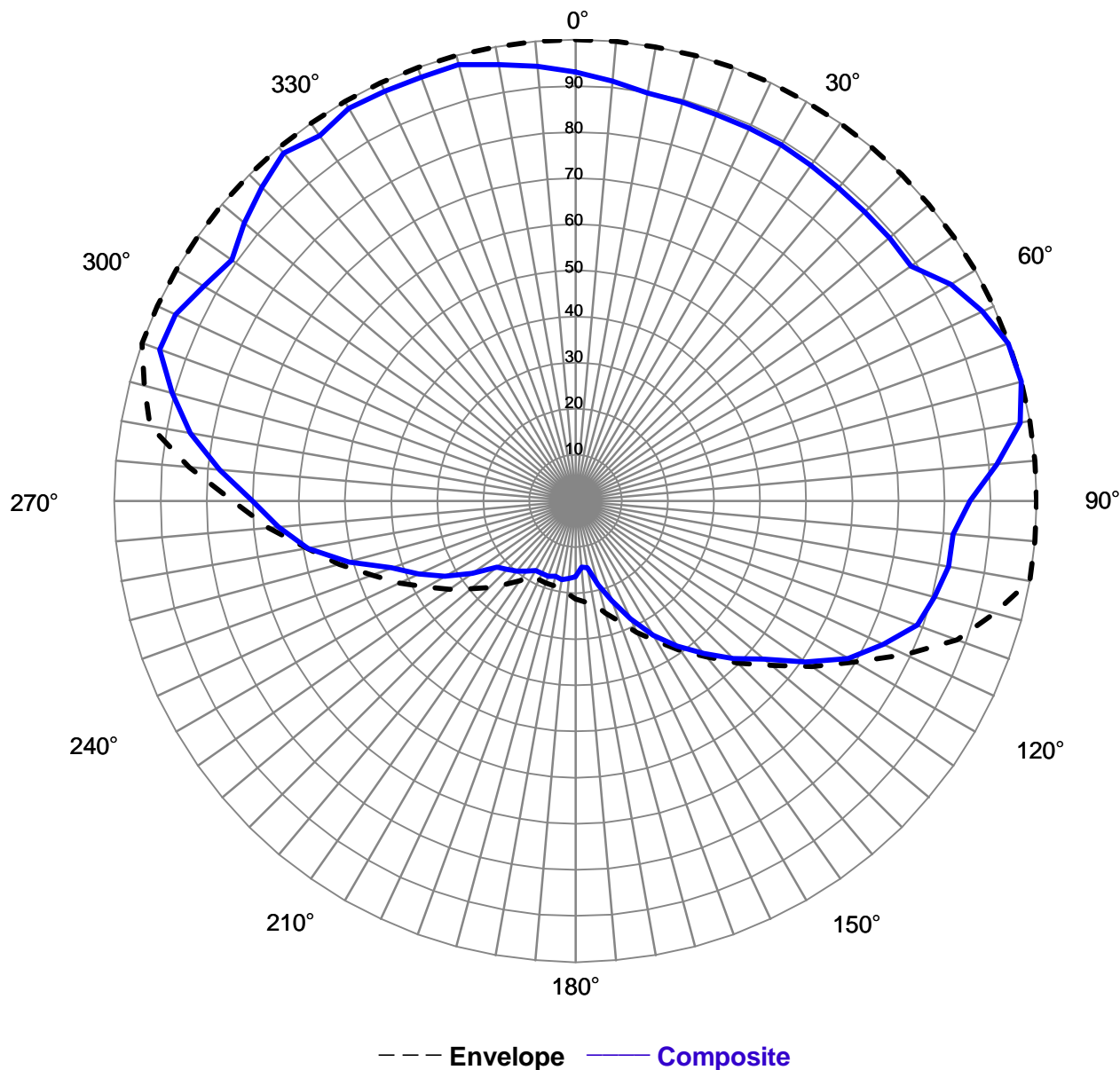
REV.	MADE BY	CHECKED BY	DATE	CHANGE

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SIZE
A



Relative Field Azimuth Plane Pattern



Pattern Type:	Measured Composite	Tower:	Rohn SSV
Antenna Model:	PSIFML-2A-HR-DA	Orientation:	0°
Polarization:	Circular	Station:	KRFP
Envelope RMS	0.789	Location:	Moscow, ID
Composite RMS	0.732	Date:	7/27/2017

Maximum Envelope Tabulation

Antenna: PSIFML-2A-HR-DA

Radio Free Moscow, Inc.

Station: KRFP

Frequency: 90.3 MHz

Location: Moscow, ID

Maximum ERP: 1.1 kW (.41 dBk)

Angle	Relative Field	ERP (kW)	ERP (dBk)
0	1.000	1.10	0.41
10	1.000	1.10	0.41
20	1.000	1.10	0.41
30	1.000	1.10	0.41
40	1.000	1.10	0.41
50	1.000	1.10	0.41
60	1.000	1.10	0.41
70	1.000	1.10	0.41
80	1.000	1.10	0.41
90	1.000	1.10	0.41
100	1.000	1.10	0.41
110	0.880	0.85	-0.70
120	0.699	0.54	-2.70
130	0.555	0.34	-4.70
140	0.441	0.21	-6.70
150	0.350	0.13	-8.70
160	0.278	0.09	-10.71
170	0.226	0.06	-12.50
180	0.213	0.05	-13.02
190	0.190	0.04	-14.01
200	0.190	0.04	-14.01
210	0.187	0.04	-14.15
220	0.235	0.06	-12.16
230	0.296	0.10	-10.16
240	0.373	0.15	-8.15
250	0.470	0.24	-6.14
260	0.591	0.38	-4.15
270	0.744	0.61	-2.15
280	0.937	0.97	-0.15
290	1.000	1.10	0.41
300	1.000	1.10	0.41
310	1.000	1.10	0.41
320	1.000	1.10	0.41
330	1.000	1.10	0.41
340	1.000	1.10	0.41
350	1.000	1.10	0.41

Composite Pattern Tabulation

Antenna: PSIFML-2A-HR-DA

Radio Free Moscow, Inc.

Station: KRFP

Frequency: 90.3 MHz

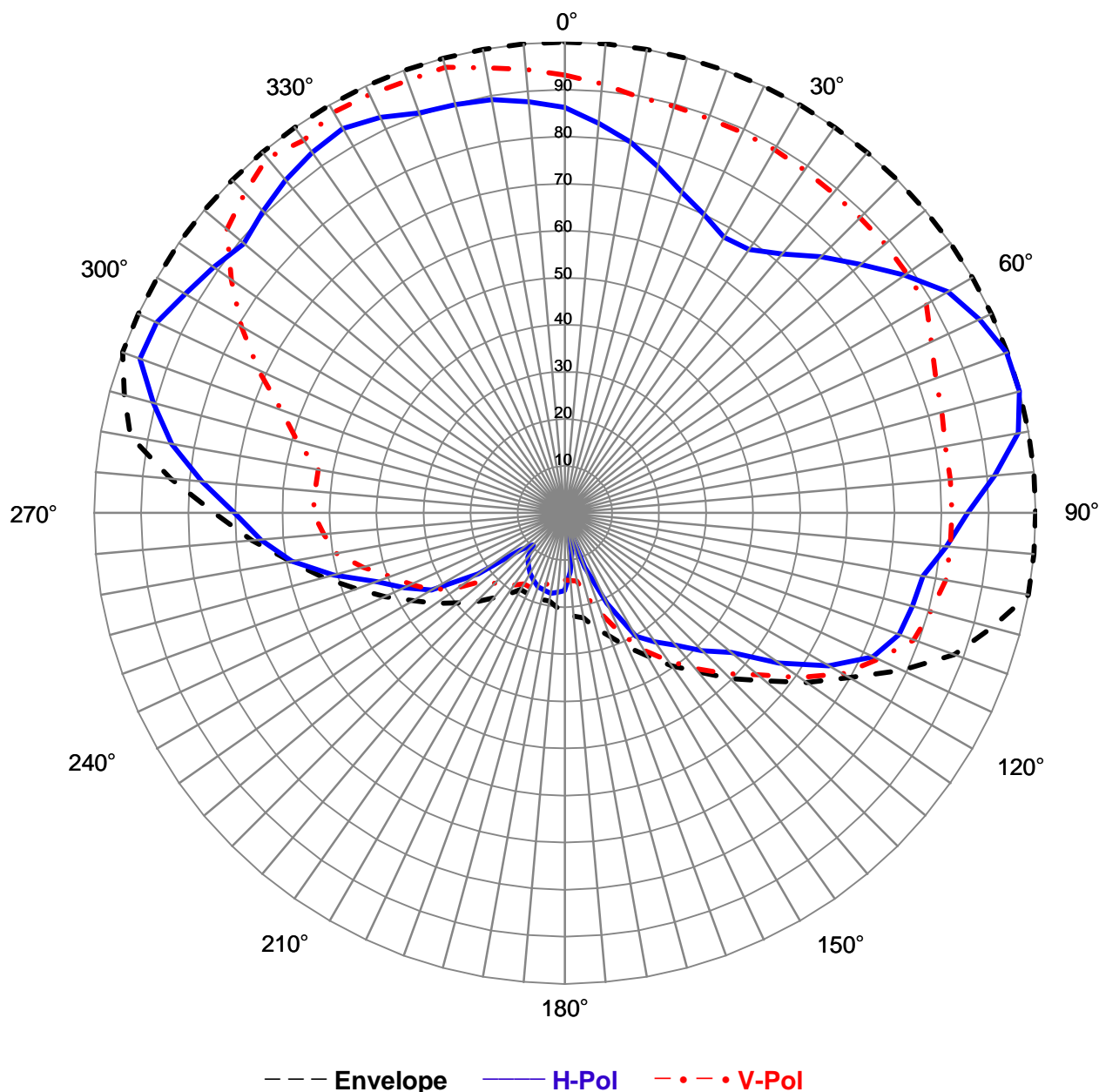
Location: Moscow, ID

Maximum ERP: 1.1 kW (.41 dBk)

Angle	Relative Field	ERP (kW)	ERP (dBk)
0	0.931	0.95	-0.21
10	0.898	0.89	-0.52
20	0.891	0.87	-0.59
30	0.891	0.87	-0.59
40	0.887	0.87	-0.63
50	0.888	0.87	-0.62
60	0.940	0.97	-0.12
70	0.998	1.10	0.40
80	0.978	1.05	0.22
90	0.855	0.80	-0.95
100	0.821	0.74	-1.30
110	0.788	0.68	-1.66
120	0.683	0.51	-2.90
130	0.534	0.31	-5.04
140	0.431	0.20	-6.90
150	0.336	0.12	-9.06
160	0.230	0.06	-12.35
170	0.147	0.02	-16.24
180	0.165	0.03	-15.24
190	0.173	0.03	-14.83
200	0.173	0.03	-14.83
210	0.174	0.03	-14.78
220	0.198	0.04	-13.65
230	0.223	0.05	-12.62
240	0.327	0.12	-9.30
250	0.425	0.20	-7.02
260	0.590	0.38	-4.17
270	0.701	0.54	-2.67
280	0.848	0.79	-1.02
290	0.960	1.01	0.06
300	0.931	0.95	-0.21
310	0.938	0.97	-0.14
320	0.985	1.07	0.28
330	0.983	1.06	0.26
340	0.978	1.05	0.22
350	0.960	1.01	0.06



Relative Field Azimuth Plane Pattern



Pattern Type:	Measured	Tower:	Rohn SSV
Antenna Model:	PSIFML-2A-HR-DA	Orientation:	0°
Polarization:	Circular	Station:	KRFP
Gain (H-pol):	1.67 (2.23 dB)	Location:	Moscow, ID
Gain (V-pol):	1.62 (2.10 dB)	Date:	7/27/2017

Measured Relative Field Tabulation

Antenna: PSIFML-2A-HR-DA

Radio Free Moscow, Inc.

Station: KRFP

Frequency: 90.3 MHz

Location: Moscow, ID

Horizontal Polarization

Angle	Relative Field	Power Gain	Gain (dB)
0	0.862	1.24	0.95
10	0.800	1.07	0.30
20	0.725	0.88	-0.56
30	0.676	0.76	-1.17
40	0.718	0.86	-0.64
50	0.821	1.13	0.52
60	0.940	1.48	1.70
70	0.998	1.67	2.22
80	0.978	1.60	2.04
90	0.855	1.22	0.87
100	0.773	1.00	0.00
110	0.755	0.95	-0.21
120	0.648	0.70	-1.53
130	0.461	0.36	-4.49
140	0.366	0.22	-6.50
150	0.302	0.15	-8.16
160	0.122	0.02	-16.04
170	0.088	0.01	-18.88
180	0.165	0.05	-13.42
190	0.173	0.05	-13.00
200	0.166	0.05	-13.36
210	0.148	0.04	-14.36
220	0.122	0.02	-16.04
230	0.122	0.02	-16.04
240	0.327	0.18	-7.47
250	0.425	0.30	-5.20
260	0.590	0.58	-2.35
270	0.701	0.82	-0.85
280	0.848	1.20	0.80
290	0.960	1.54	1.88
300	0.931	1.45	1.61
310	0.890	1.33	1.22
320	0.923	1.43	1.54
330	0.943	1.49	1.73
340	0.905	1.37	1.37
350	0.892	1.33	1.24

Maximum Value

Field 1.000
Gain 1.67 (2.23 dB)
Azimuth Bearing 75 degrees

Minimum Field

Field 0.032
Gain .002 (-27.66 dB)
Azimuth Bearing 165 degrees

Vertical Polarization

Angle	Relative Field	Power Gain	Gain (dB)
0	0.931	1.45	1.61
10	0.898	1.35	1.30
20	0.891	1.33	1.23
30	0.891	1.33	1.23
40	0.887	1.32	1.19
50	0.888	1.32	1.20
60	0.887	1.32	1.19
70	0.838	1.17	0.70
80	0.821	1.13	0.52
90	0.822	1.13	0.53
100	0.821	1.13	0.52
110	0.788	1.04	0.17
120	0.683	0.78	-1.08
130	0.534	0.48	-3.21
140	0.431	0.31	-5.08
150	0.336	0.19	-7.24
160	0.230	0.09	-10.53
170	0.147	0.04	-14.42
180	0.142	0.03	-14.72
190	0.143	0.03	-14.66
200	0.173	0.05	-13.00
210	0.174	0.05	-12.95
220	0.198	0.07	-11.83
230	0.223	0.08	-10.80
240	0.326	0.18	-7.50
250	0.394	0.26	-5.86
260	0.493	0.41	-3.91
270	0.534	0.48	-3.21
280	0.532	0.47	-3.25
290	0.642	0.69	-1.61
300	0.793	1.05	0.22
310	0.938	1.47	1.68
320	0.985	1.62	2.10
330	0.983	1.62	2.09
340	0.978	1.60	2.04
350	0.960	1.54	1.88

Maximum Value

Field 0.985
Gain 1.62 (2.10 dB)
Azimuth Bearing 320 degrees

Minimum Field

Field 0.142
Gain .03 (-14.72 dB)
Azimuth Bearing 180 degrees

ERP Tabulation

Antenna: PSIFML-2A-HR-DA

Radio Free Moscow, Inc.

Station: KRFP

Frequency: 90.3 MHz

Location: Moscow, ID

Maximum ERP: 1.1 kW (.41 dBk)

Horizontal Polarization

Angle	Relative Field	ERP (kW)	ERP (dBk)
0	0.862	0.82	-0.88
10	0.800	0.70	-1.52
20	0.725	0.58	-2.38
30	0.676	0.50	-2.99
40	0.718	0.57	-2.46
50	0.821	0.74	-1.30
60	0.940	0.97	-0.12
70	0.998	1.10	0.40
80	0.978	1.05	0.22
90	0.855	0.80	-0.95
100	0.773	0.66	-1.82
110	0.755	0.63	-2.03
120	0.648	0.46	-3.35
130	0.461	0.23	-6.31
140	0.366	0.15	-8.32
150	0.302	0.10	-9.99
160	0.122	0.02	-17.86
170	0.088	0.01	-20.70
180	0.165	0.03	-15.24
190	0.173	0.03	-14.83
200	0.166	0.03	-15.18
210	0.148	0.02	-16.18
220	0.122	0.02	-17.86
230	0.122	0.02	-17.86
240	0.327	0.12	-9.30
250	0.425	0.20	-7.02
260	0.590	0.38	-4.17
270	0.701	0.54	-2.67
280	0.848	0.79	-1.02
290	0.960	1.01	0.06
300	0.931	0.95	-0.21
310	0.890	0.87	-0.60
320	0.923	0.94	-0.28
330	0.943	0.98	-0.10
340	0.905	0.90	-0.45
350	0.892	0.88	-0.58

Maximum Value (H-pol)

Field 1.000

ERP 1.1 kW (.41 dBk)

Azimuth Bearing 75 degrees

Minimum Field (H-pol)

Field 0.032

ERP .001 kW (-29.48 dBk)

Azimuth Bearing 165 degrees

Vertical Polarization

Angle	Relative Field	ERP (kW)	ERP (dBk)
0	0.931	0.95	-0.21
10	0.898	0.89	-0.52
20	0.891	0.87	-0.59
30	0.891	0.87	-0.59
40	0.887	0.87	-0.63
50	0.888	0.87	-0.62
60	0.887	0.87	-0.63
70	0.838	0.77	-1.12
80	0.821	0.74	-1.30
90	0.822	0.74	-1.29
100	0.821	0.74	-1.30
110	0.788	0.68	-1.66
120	0.683	0.51	-2.90
130	0.534	0.31	-5.04
140	0.431	0.20	-6.90
150	0.336	0.12	-9.06
160	0.230	0.06	-12.35
170	0.147	0.02	-16.24
180	0.142	0.02	-16.54
190	0.143	0.02	-16.48
200	0.173	0.03	-14.83
210	0.174	0.03	-14.78
220	0.198	0.04	-13.65
230	0.223	0.05	-12.62
240	0.326	0.12	-9.32
250	0.394	0.17	-7.68
260	0.493	0.27	-5.73
270	0.534	0.31	-5.04
280	0.532	0.31	-5.07
290	0.642	0.45	-3.44
300	0.793	0.69	-1.60
310	0.938	0.97	-0.14
320	0.985	1.07	0.28
330	0.983	1.06	0.26
340	0.978	1.05	0.22
350	0.960	1.01	0.06

Maximum Value (V-pol)

Field 0.985

ERP 1.07 kW (.28 dBk)

Azimuth Bearing 320 degrees

Minimum Field (V-pol)

Field 0.142

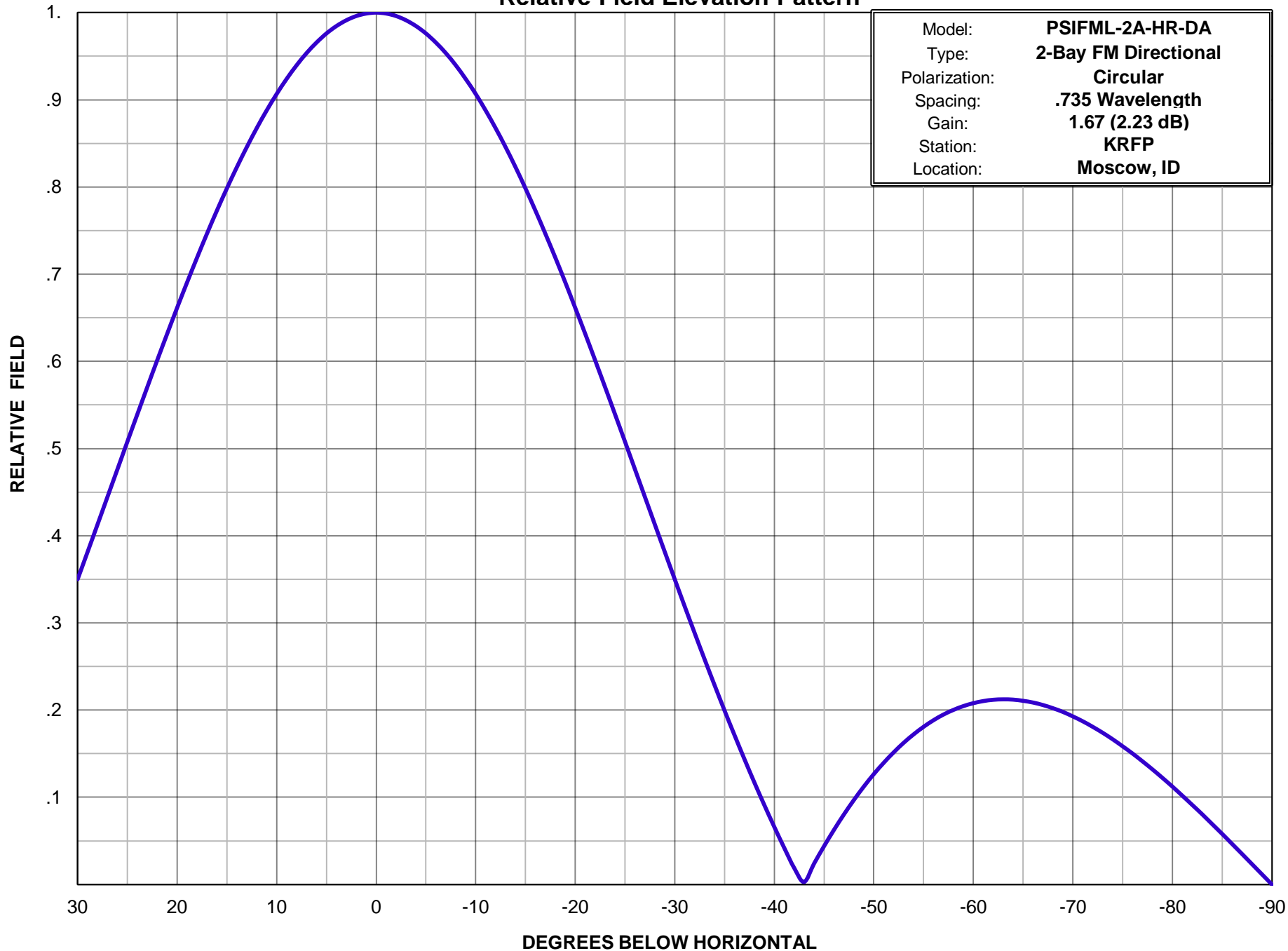
ERP .02 kW (-16.54 dBk)

Azimuth Bearing 180 degrees



Propagation Systems, Inc.

Relative Field Elevation Pattern



Propagation Systems Inc.

Relative Field Tabulation Elevation Pattern

Antenna Model: PSIFML-2A-HR-DA

Gain: 1.67 (2.23 dBd)

KRFP Moscow, ID

Angle	Field	dB	Angle	Field	dB	Angle	Field	dB
-90	0.001	-60.00	-50	0.127	-17.96	-10	0.907	-0.85
-89	0.012	-38.66	-49	0.112	-18.99	-9	0.924	-0.69
-88	0.023	-32.64	-48	0.097	-20.28	-8	0.940	-0.54
-87	0.035	-29.12	-47	0.080	-21.91	-7	0.953	-0.41
-86	0.047	-26.65	-46	0.063	-24.07	-6	0.966	-0.30
-85	0.058	-24.73	-45	0.044	-27.17	-5	0.976	-0.21
-84	0.069	-23.19	-44	0.024	-32.42	-4	0.985	-0.14
-83	0.080	-21.89	-43	0.003	-50.82	-3	0.991	-0.08
-82	0.091	-20.80	-42	0.019	-34.45	-2	0.996	-0.03
-81	0.102	-19.84	-41	0.042	-27.54	-1	0.999	-0.01
-80	0.112	-18.99	-40	0.066	-23.60	0	1.000	0.00
-79	0.122	-18.25	-39	0.091	-20.81	1	0.999	-0.01
-78	0.132	-17.59	-38	0.117	-18.64	2	0.996	-0.03
-77	0.141	-17.00	-37	0.144	-16.85	3	0.991	-0.08
-76	0.150	-16.47	-36	0.171	-15.32	4	0.985	-0.14
-75	0.158	-16.00	-35	0.200	-14.00	5	0.976	-0.21
-74	0.167	-15.57	-34	0.229	-12.82	6	0.966	-0.30
-73	0.174	-15.19	-33	0.258	-11.76	7	0.953	-0.41
-72	0.181	-14.86	-32	0.288	-10.80	8	0.940	-0.54
-71	0.187	-14.56	-31	0.319	-9.93	9	0.924	-0.69
-70	0.193	-14.30	-30	0.350	-9.12	10	0.907	-0.85
-69	0.198	-14.07	-29	0.381	-8.37	11	0.888	-1.03
-68	0.202	-13.89	-28	0.413	-7.68	12	0.868	-1.23
-67	0.206	-13.73	-27	0.445	-7.04	13	0.846	-1.46
-66	0.209	-13.61	-26	0.476	-6.44	14	0.823	-1.69
-65	0.211	-13.53	-25	0.508	-5.88	15	0.798	-1.95
-64	0.212	-13.47	-24	0.539	-5.36	16	0.773	-2.24
-63	0.212	-13.46	-23	0.570	-4.88	17	0.747	-2.54
-62	0.212	-13.48	-22	0.601	-4.42	18	0.719	-2.87
-61	0.210	-13.54	-21	0.632	-3.99	19	0.691	-3.22
-60	0.208	-13.64	-20	0.661	-3.59	20	0.662	-3.59
-59	0.205	-13.78	-19	0.691	-3.22	21	0.632	-3.99
-58	0.200	-13.97	-18	0.719	-2.87	22	0.601	-4.42
-57	0.195	-14.21	-17	0.746	-2.54	23	0.570	-4.88
-56	0.188	-14.50	-16	0.773	-2.24	24	0.539	-5.36
-55	0.181	-14.86	-15	0.798	-1.96	25	0.508	-5.88
-54	0.172	-15.28	-14	0.823	-1.69	26	0.476	-6.44
-53	0.162	-15.79	-13	0.846	-1.46	27	0.445	-7.04
-52	0.152	-16.39	-12	0.867	-1.24	28	0.413	-7.68
-51	0.140	-17.11	-11	0.888	-1.03	29	0.381	-8.37