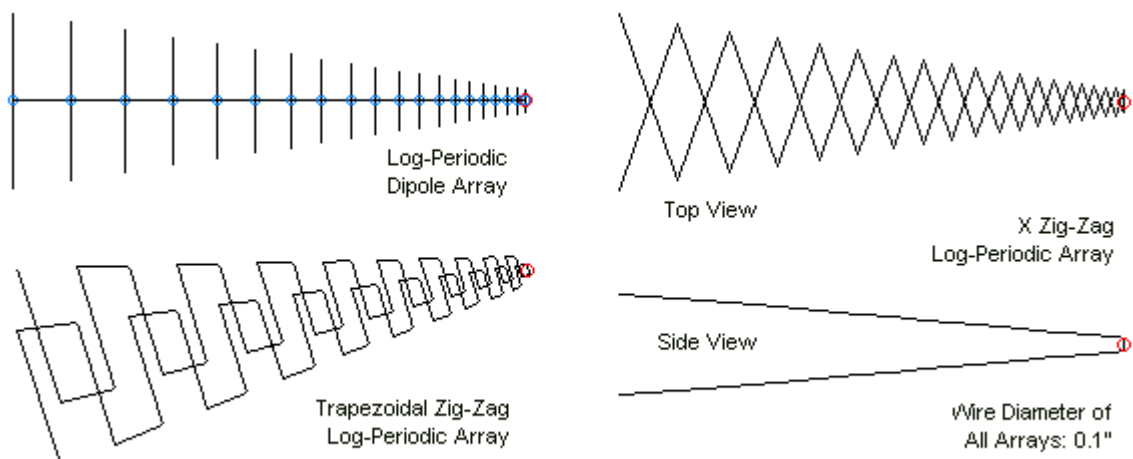


A Tale of Three LPAs: Some Notes on Zig-Zag Log-Periodic Arrays Data Appendix

L. B. Cebik, W4RNL

The volume of data and its graphical representation for zig-zag LPAs is large enough to exceed the limits of the original series of articles. Therefore, I am adding this appendix to present the complete data set for each of the models considered in the main text. The data appear in three successive groups: trapezoidal zig-zag LPAs, X (or saw tooth) zig-zag LPAs, and LPDAs. All models use 20 elements (per bay), with $\tau = 0.9$, $\alpha = 17^\circ$, and ψ variable. The effective value of σ is 0.167. For all models, the lossless wire diameter is 0.1". All modeling used EZNEC Pro/4 (NEC-4). The following sketch is a reminder of the relative shapes of each type of array. Zig-zag sketches do not show the central boom used in many models.



A Tale of Three Log-Periodic Arrays

All arrays are modeled in free space. The data for each log-periodic model consists of the following reports and graphics:

1. Table of sample performance values at 50, 100, 150, and 200 MHz
2. Gallery of E-plane and H-plane patterns for the same 4 frequencies
3. Table of summary statistical data from the frequency sweeps
4. Graph across passband of free-space forward gain and 180° front-to-back ratio
5. Graph across passband of the feedpoint resistance, reactance, and SWR

Sweep information covers 50 to 200 MHz in 0.5-MHz increments.

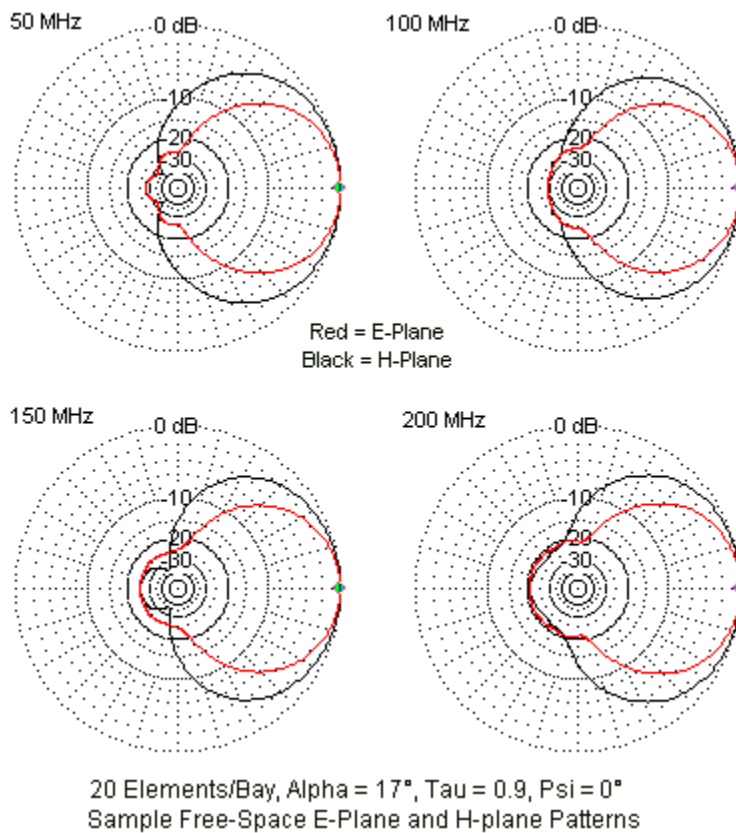
Trapezoidal Zig-Zag Log-Periodic Arrays

A. Trapezoidal Zig-Zag Arrays with Boom

1. 20 elements/bay, $\alpha = 17^\circ$, $\tau = 0.9$, $\psi = 0^\circ$ (flat array, 4" separation between bays)

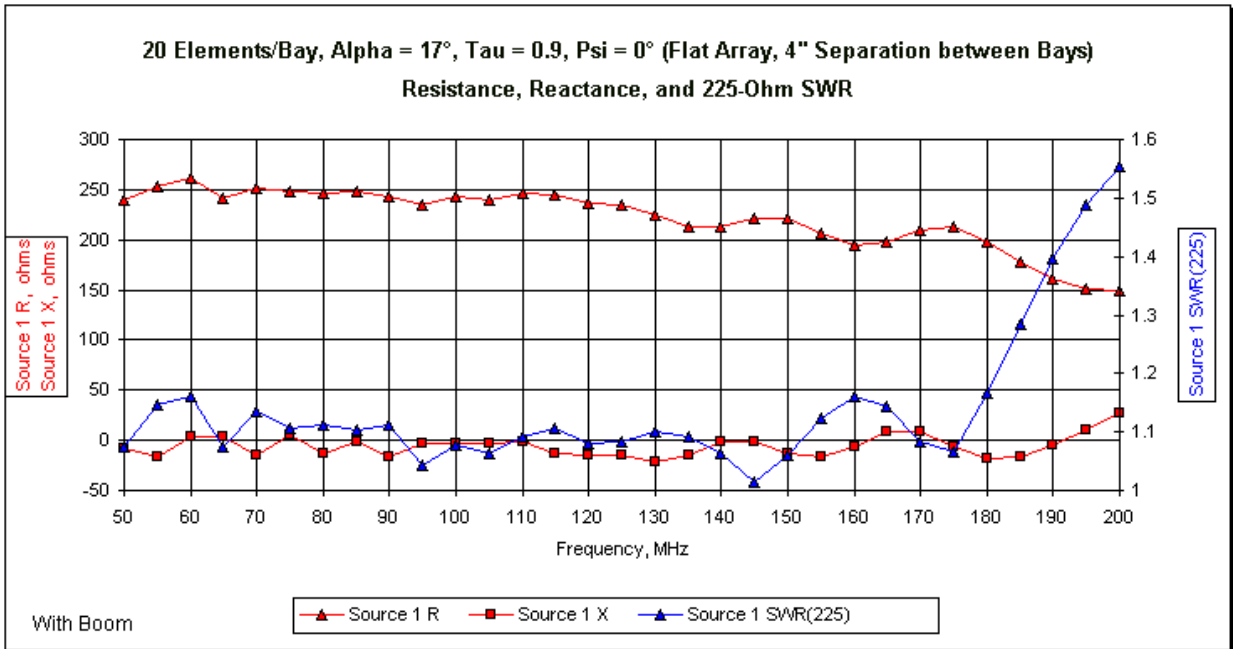
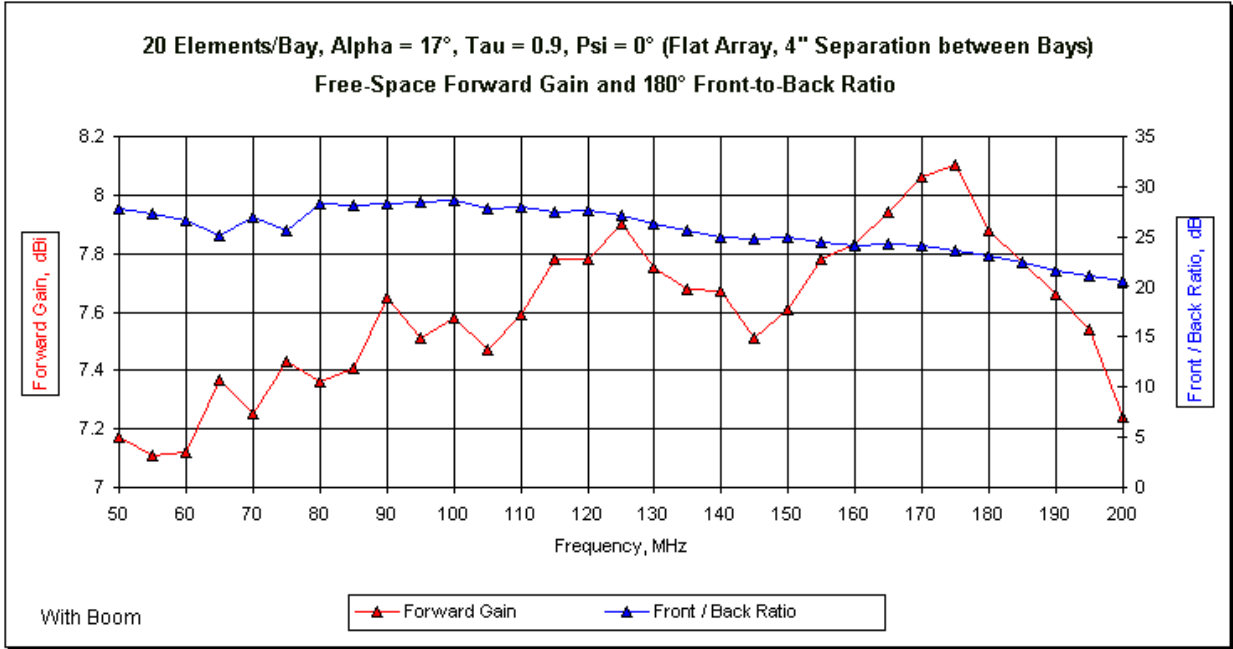
Sample performance values

Frequency MHz	Max. Gain dBi	Front-Back Ratio dB	E BW degrees	H BW degrees	Impedance R +/- jX Ω	225- Ω SWR
50	7.17	27.83	70.6	113.8	240 - j 9	1.08
100	7.58	28.60	68.8	106.5	242 - j 2	1.08
150	7.61	24.91	67.8	107.4	222 - j 13	1.06
200	7.24	20.60	71.4	111.4	149 + j 28	1.55



Frequency sweep summary: 50-200 MHz

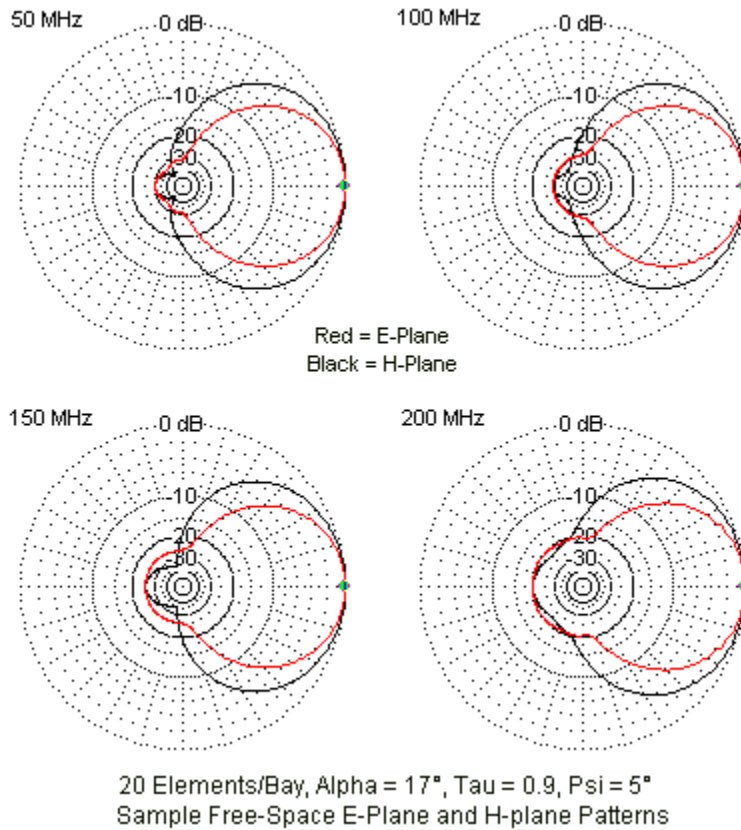
Category	Minimum	Maximum	Δ	Average
Gain dBi	7.11	8.10	0.99	7.60
Front-Back dB	20.60	28.60	8.00	25.70
E Beamwidth °	65.0	71.6	6.6	68.4



2. 20 elements/bay, $\alpha = 17^\circ$, $\tau = 0.9$, $\psi = 5^\circ$

Sample performance values

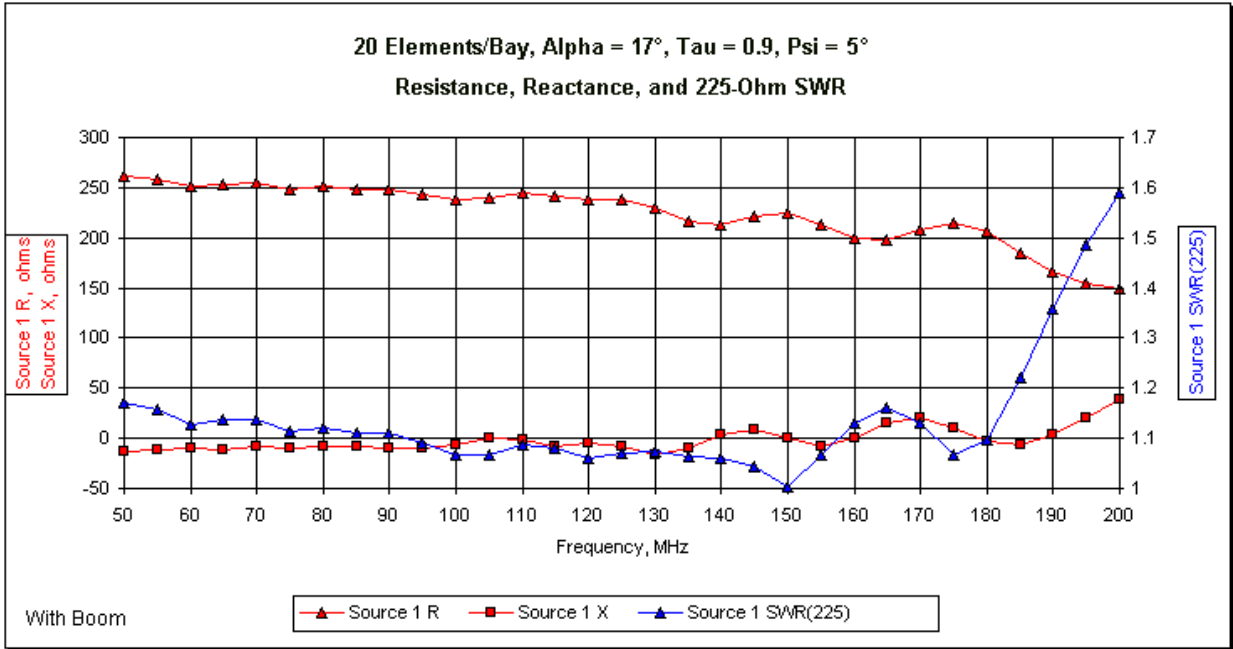
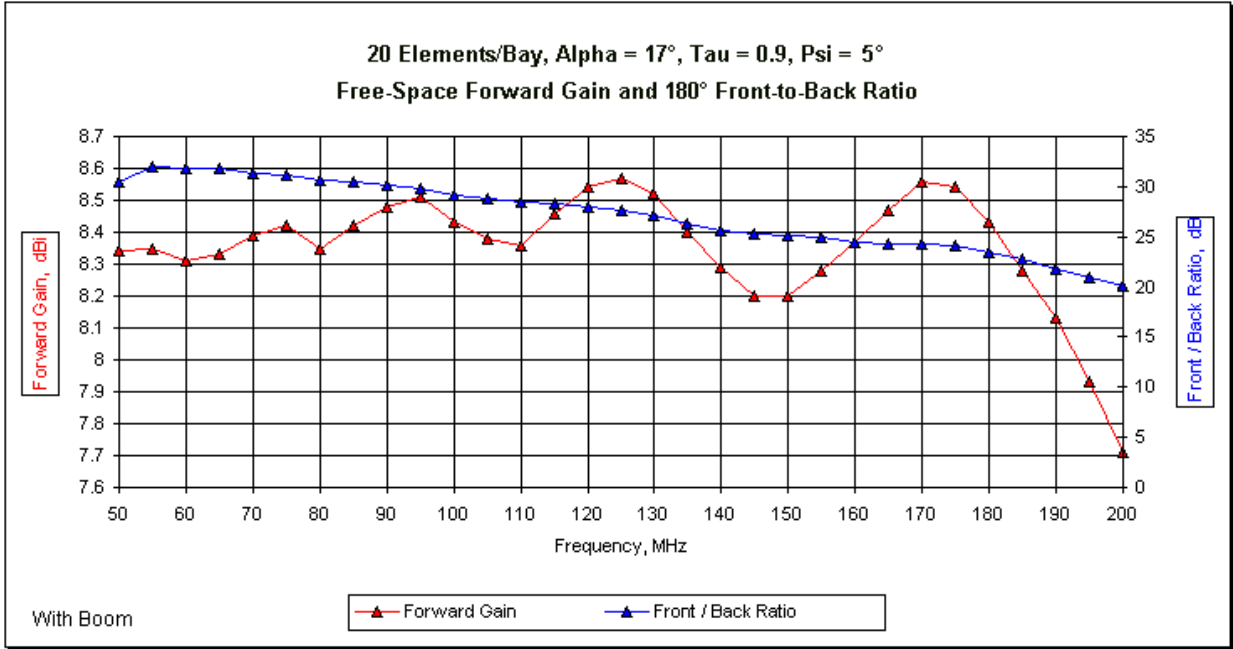
Frequency MHz	Max. Gain dBi	Front-Back Ratio dB	E BW degrees	H BW degrees	Impedance R +/- jX Ω	225- Ω SWR
50	8.34	30.50	65.1	94.4	261 - j 13	1.17
100	8.43	29.21	65.2	94.2	239 - j 6	1.07
150	8.20	25.16	65.4	97.4	225 - j 0	1.00
200	7.71	20.13	68.8	103.4	149 + j 39	1.59



Frequency sweep summary: 50-200 MHz

Category	Minimum	Maximum	Δ	Average
Gain dBi	7.71	8.57	0.86*	8.35
Front-Back dB	20.13	32.04	11.91	27.12
E Beamwidth °	63.0	68.8	5.8	65.0

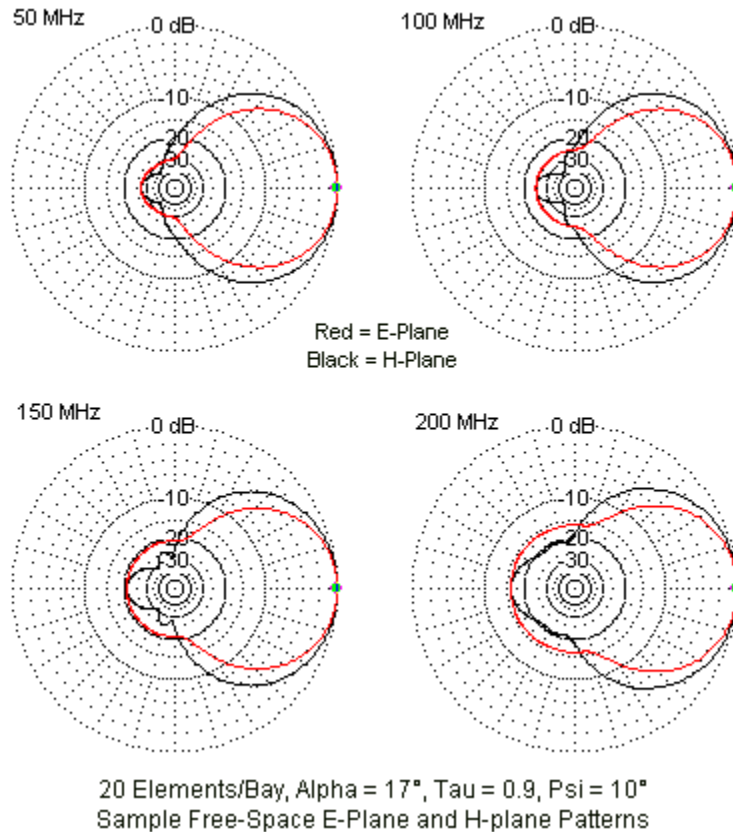
*Least variation across the passband of the group



3. 20 elements/bay, $\alpha = 17^\circ$, $\tau = 0.9$, $\psi = 10^\circ$

Sample performance values

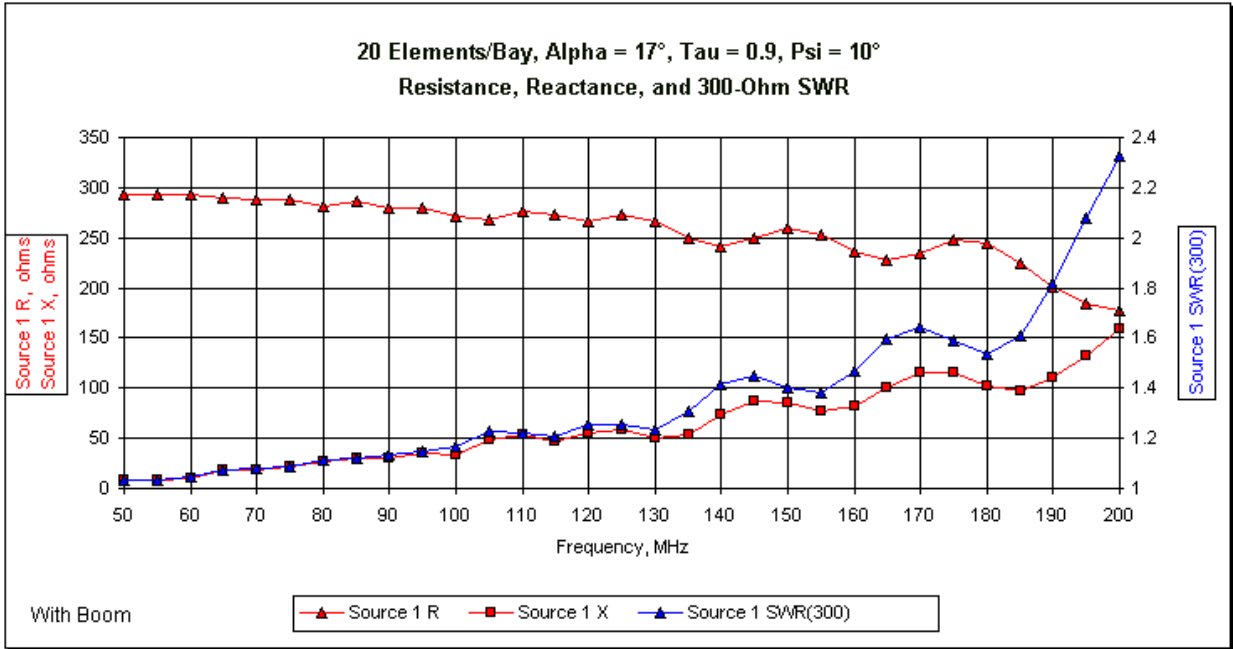
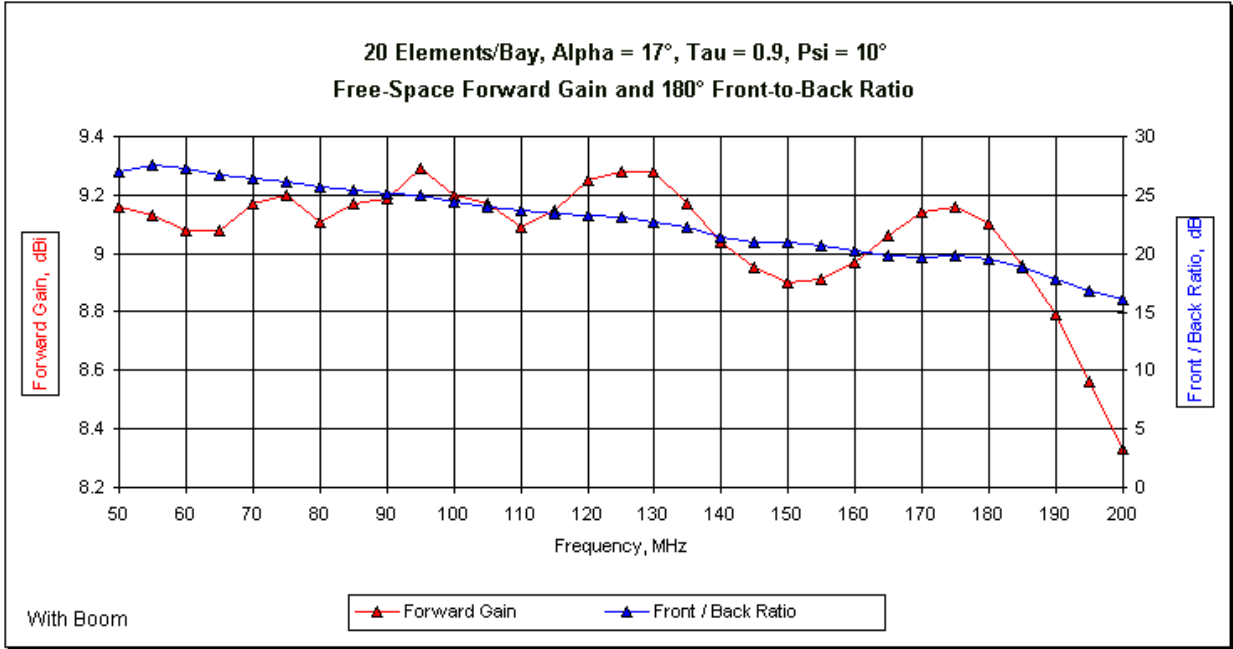
Frequency MHz	Max. Gain dBi	Front-Back Ratio dB	E BW degrees	H BW degrees	Impedance R +/- jX Ω	300- Ω SWR
50	9.16	26.94	64.0	82.8	293 + j 8	1.04
100	9.20	24.47	64.4	82.9	272 + j 33	1.17
150	8.90	20.91	65.0	85.6	259 + j 86	1.41
200	8.33	16.04	68.2	88.8	178 + j159	2.32



Frequency sweep summary: 50-200 MHz

Category	Minimum	Maximum	Δ	Average
Gain dBi	8.33	9.29	0.96	9.07
Front-Back dB	16.04	27.52	11.48	22.63
E Beamwidth $^\circ$	62.7	68.2	5.5*	64.2

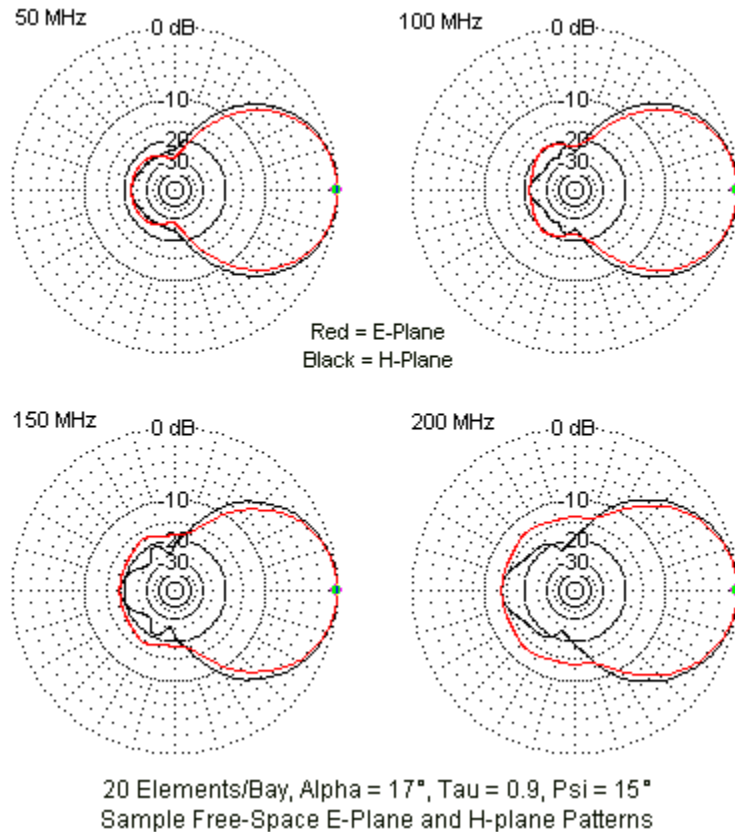
*Least variation across the passband of the group



4. 20 elements/bay, $\alpha = 17^\circ$, $\tau = 0.9$, $\psi = 15^\circ$

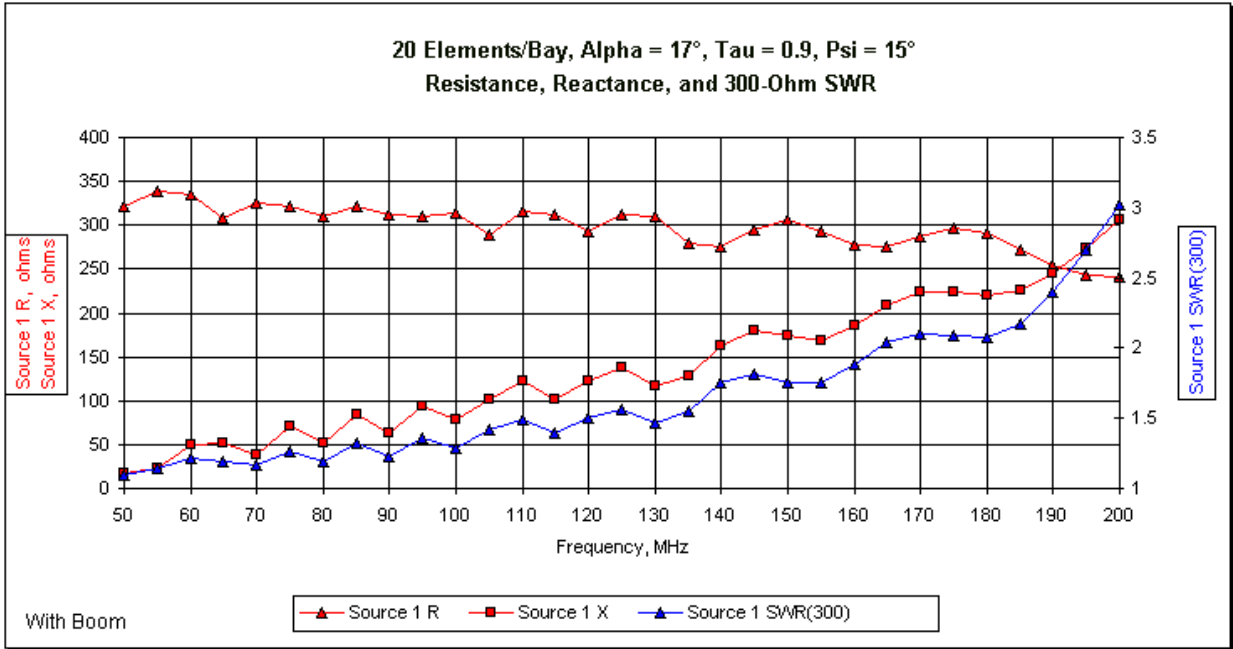
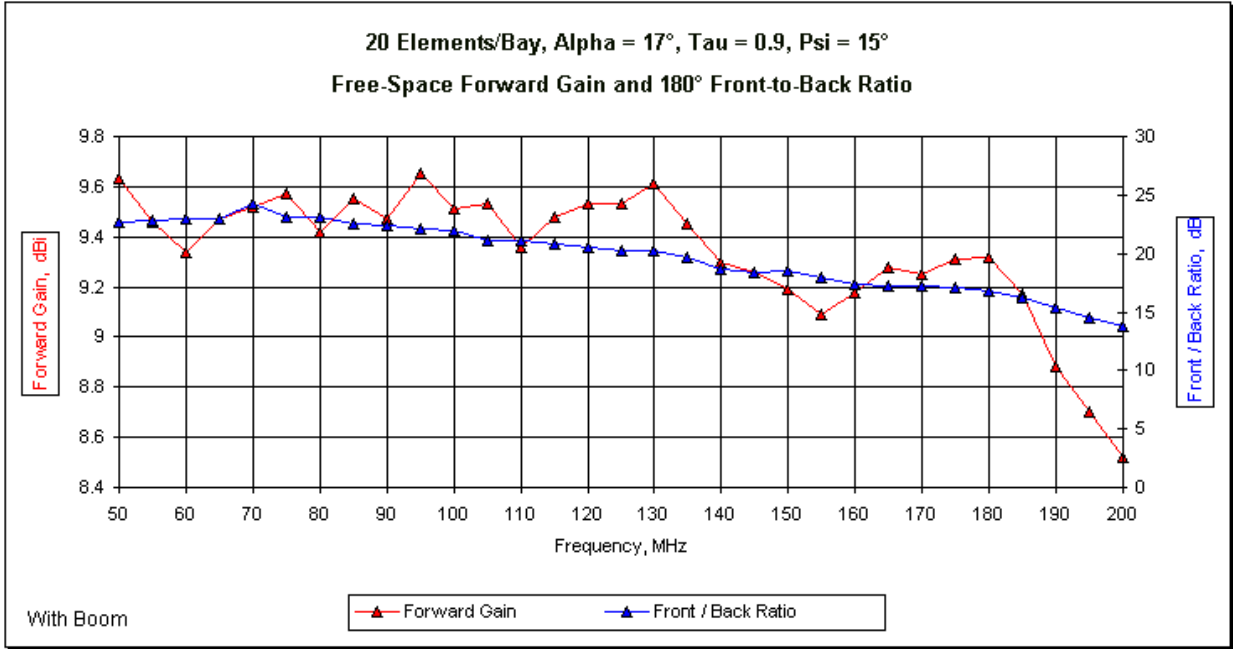
Sample performance values

Frequency MHz	Max. Gain dBi	Front-Back Ratio dB	E BW degrees	H BW degrees	Impedance R +/- jX Ω	300- Ω SWR
50	9.63	22.63	64.8	71.2	321 + j 17	1.09
100	9.51	21.90	65.3	72.4	314 + j 78	1.29
150	9.19	18.57	66.6	73.6	306 + j173	1.76
200	8.52	13.71	69.0	74.4	241 + j307	3.02



Frequency sweep summary: 50-200 MHz

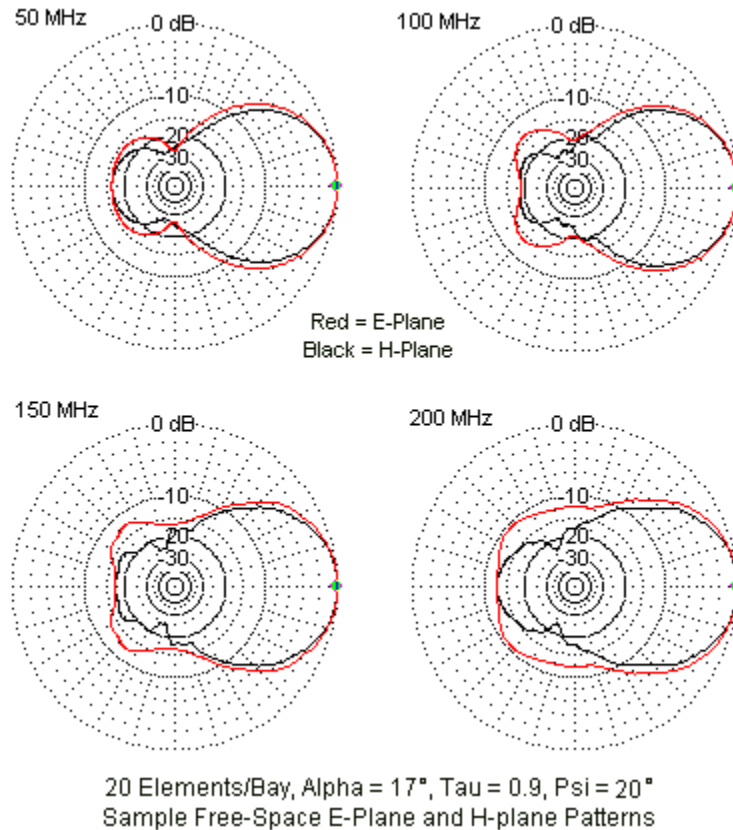
Category	Minimum	Maximum	Δ	Average
Gain dBi	8.52	9.65	1.13	9.34
Front-Back dB	13.71	24.29	10.58	19.79
E Beamwidth $^\circ$	63.2	69.0	5.8	65.4



5. 20 elements/bay, $\alpha = 17^\circ$, $\tau = 0.9$, $\psi = 20^\circ$

Sample performance values

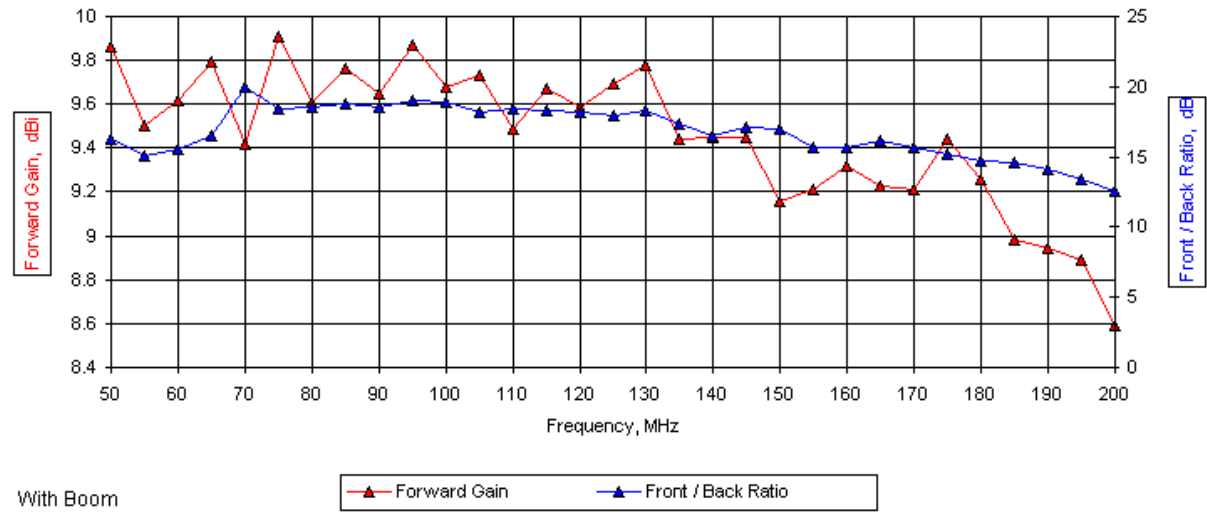
Frequency MHz	Max. Gain dBi	Front-Back Ratio dB	E BW degrees	H BW degrees	Impedance R +/- jX Ω	300- Ω SWR
50	9.86	16.26	67.2	60.8	326 + j 10	1.09
100	9.68	18.87	67.1	61.1	351 + j 96	1.40
150	9.16	17.00	72.4	61.8	348 + j244	2.12
200	8.59	12.56	72.0	62.4	345 + j460	3.80



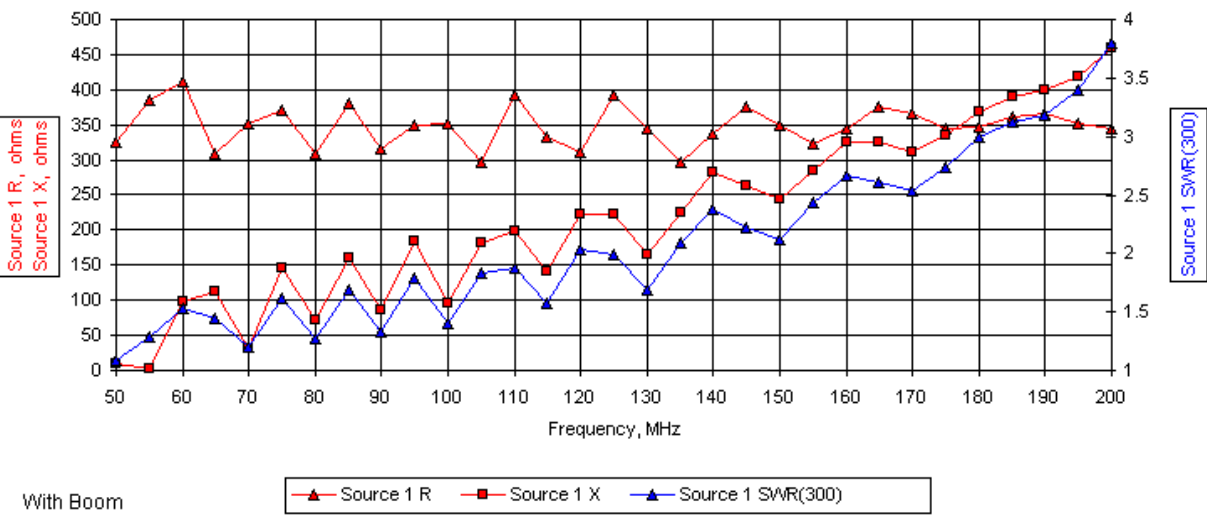
Frequency sweep summary: 50-200 MHz

Category	Minimum	Maximum	Δ	Average
Gain dBi	8.59	9.91	1.32	9.46
Front-Back dB	12.56	19.98	7.42	16.79
E Beamwidth $^\circ$	63.4	72.4	9.0	67.2

20 Elements/Bay, Alpha = 17°, Tau = 0.9, Psi = 20°
Free-Space Forward Gain and 180° Front-to-Back Ratio



20 Elements/Bay, Alpha = 17°, Tau = 0.9, Psi = 20°
Resistance, Reactance, and 300-Ohm SWR

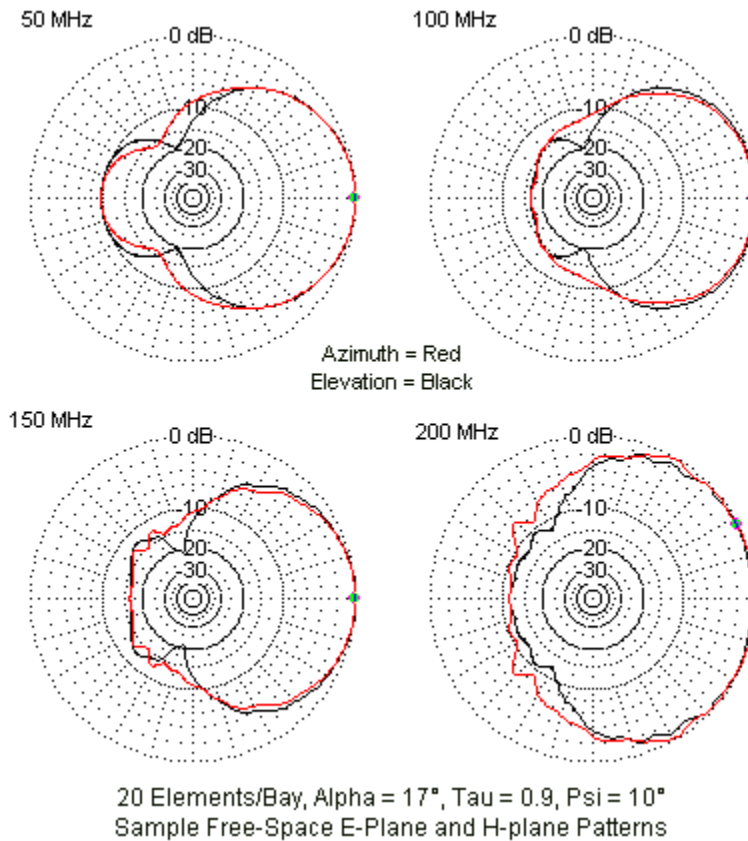


B. Trapezoidal Zig-Zag Arrays without Boom

1. 20 elements/bay, $\alpha = 17^\circ$, $\tau = 0.9$, $\psi = 10^\circ$

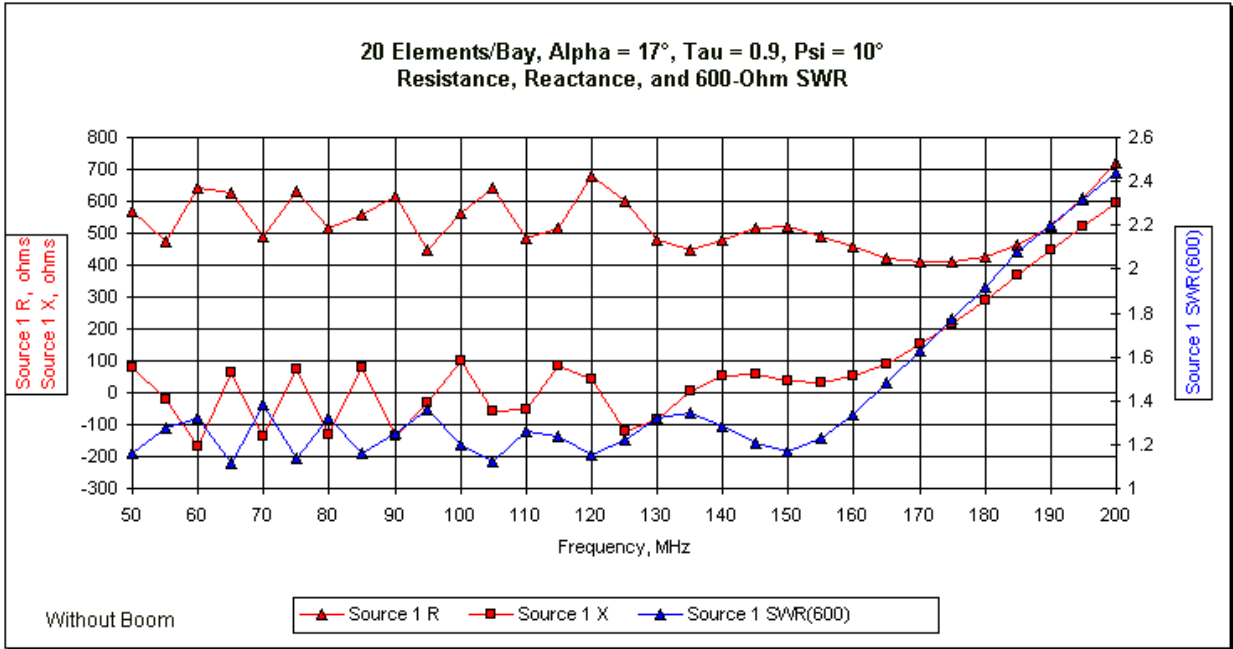
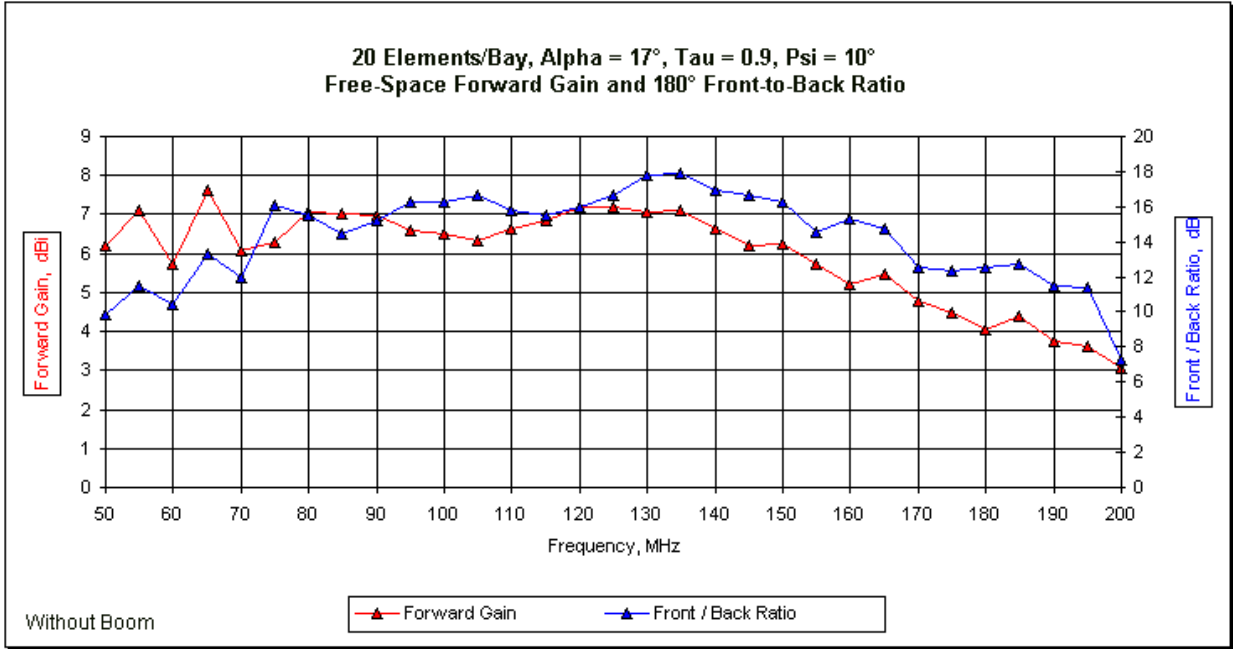
Sample performance values

Frequency MHz	Max. Gain dBi	Front-Back Ratio dB	E BW degrees	H BW degrees	Impedance R +/- jX Ω	600- Ω SWR
50	6.20	9.85	101.1	102.4	566 + j 79	1.16
100	6.49	16.31	95.8	104.6	562 + j 99	1.20
150	6.26	16.26	101.6	110.2	521 + j 37	1.17
200	3.05	7.27	182.0	173.8	723 + j595	2.44



Frequency sweep summary: 50-200 MHz

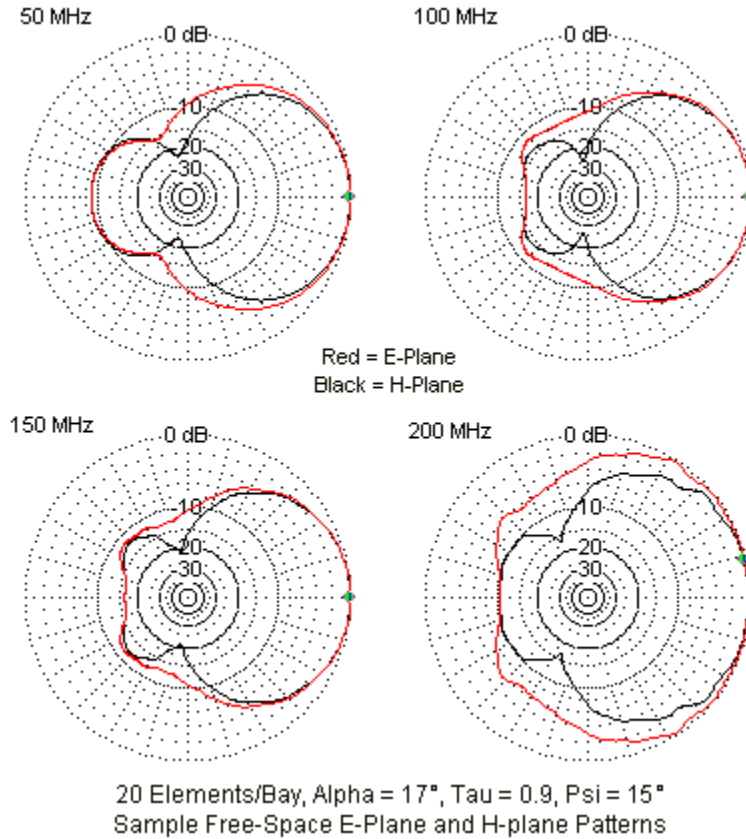
Category	Minimum	Maximum	Δ	Average
Gain dBi	3.05	7.64	4.59	5.97
Front-Back dB	7.27	17.85	10.58	14.26
E Beamwidth $^\circ$	76.8	182.0	105.2	108.1



2. 20 elements/bay, $\alpha = 17^\circ$, $\tau = 0.9$, $\psi = 15^\circ$

Sample performance values

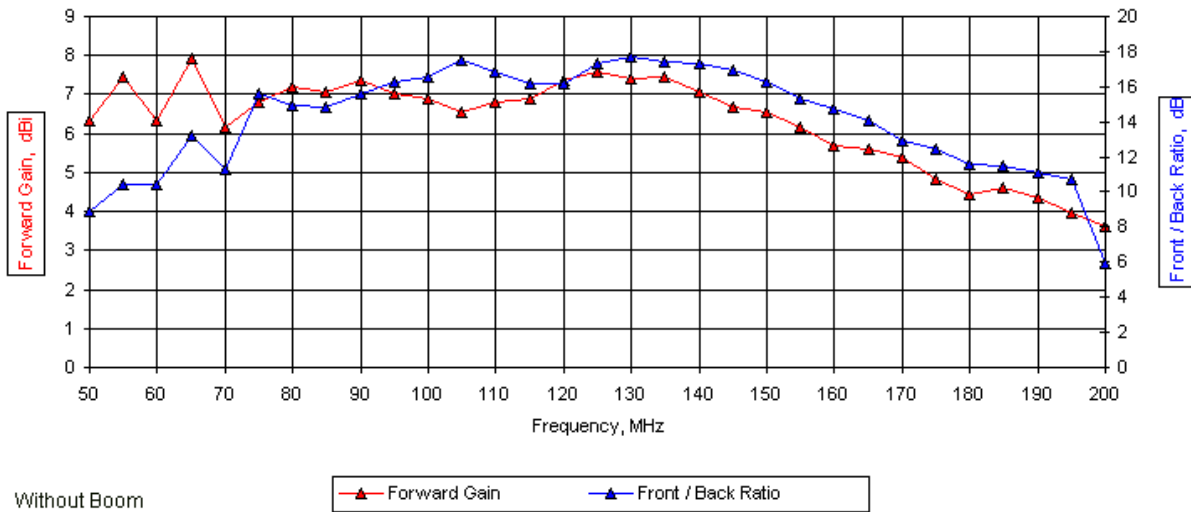
Frequency MHz	Max. Gain dBi	Front-Back Ratio dB	E BW degrees	H BW degrees	Impedance R +/- jX Ω	600- Ω SWR
50	6.34	8.94	107.2	94.6	530 + j 13	1.14
100	6.88	16.55	94.5	90.6	534 + j100	1.24
150	6.56	16.23	99.8	96.8	543 + j 65	1.16
200	3.62	5.95	179.4	129.4	958 + j596	2.43



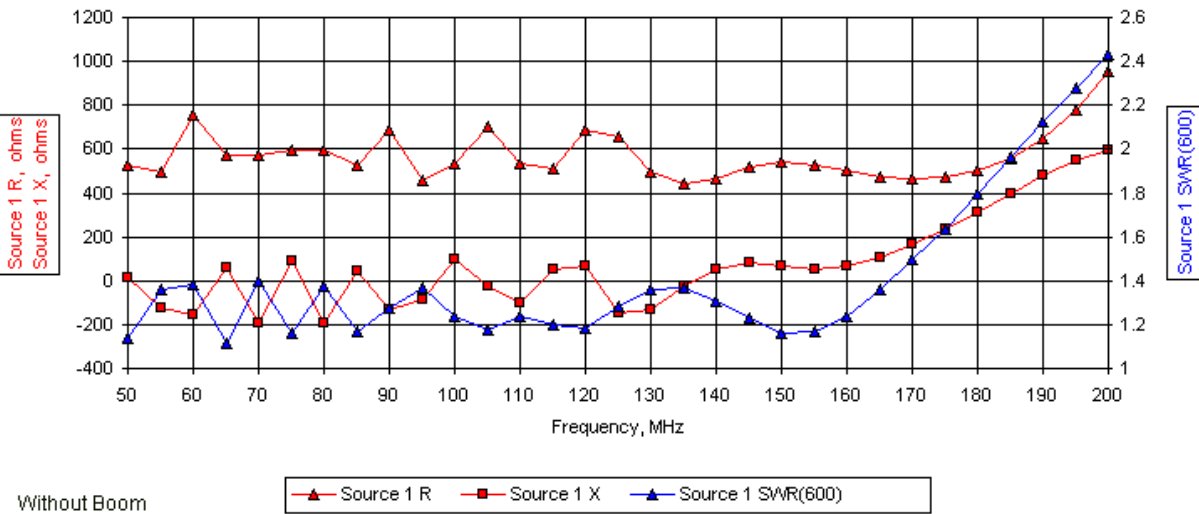
Frequency sweep summary: 50-200 MHz

Category	Minimum	Maximum	Δ	Average
Gain dBi	3.62	7.93	4.31	6.31
Front-Back dB	5.95	17.75	11.80	14.14
E Beamwidth $^\circ$	76.6	179.4	102.8	108.6

20 Elements/Bay, Alpha = 17°, Tau = 0.9, Psi = 15°
Free-Space Forward Gain and 180° Front-to-Back Ratio



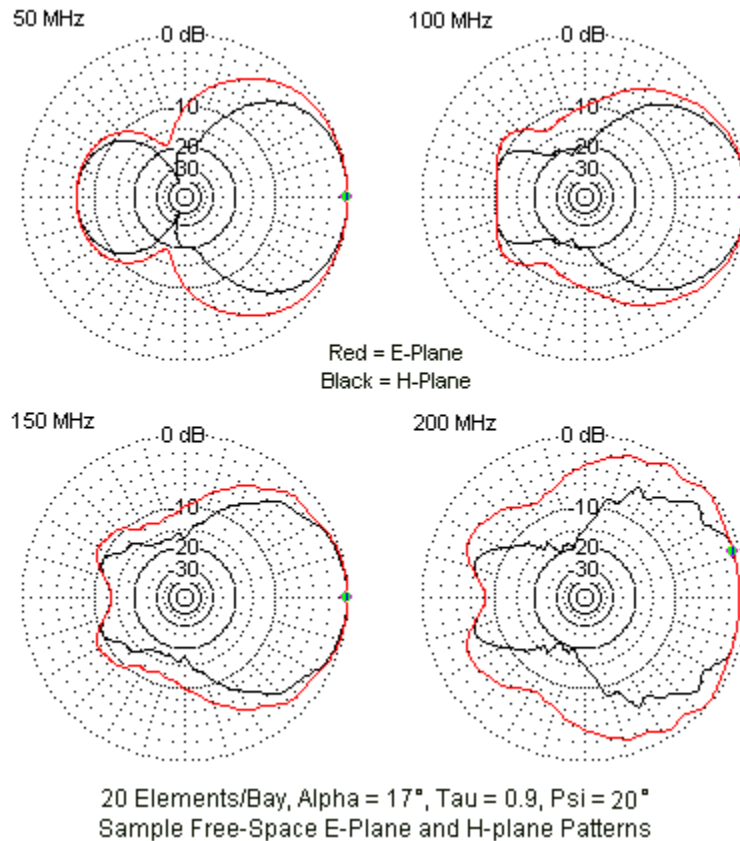
20 Elements/Bay, Alpha = 17°, Tau = 0.9, Psi = 15°
Resistance, Reactance, and 600-Ohm SWR



3. 20 elements/bay, $\alpha = 17^\circ$, $\tau = 0.9$, $\psi = 20^\circ$

Sample performance values

Frequency MHz	Max. Gain dBi	Front-Back Ratio dB	E BW degrees	H BW degrees	Impedance R +/- jX Ω	600- Ω SWR
50	6.20	6.97	120.0	86.6	559 + j 1	1.07
100	7.02	10.51	96.2	76.6	550 + j121	1.26
150	6.63	13.57	103.7	86.2	594 + j 87	1.16
200	4.48	4.68	170.0	93.6	1378 + j345	2.47

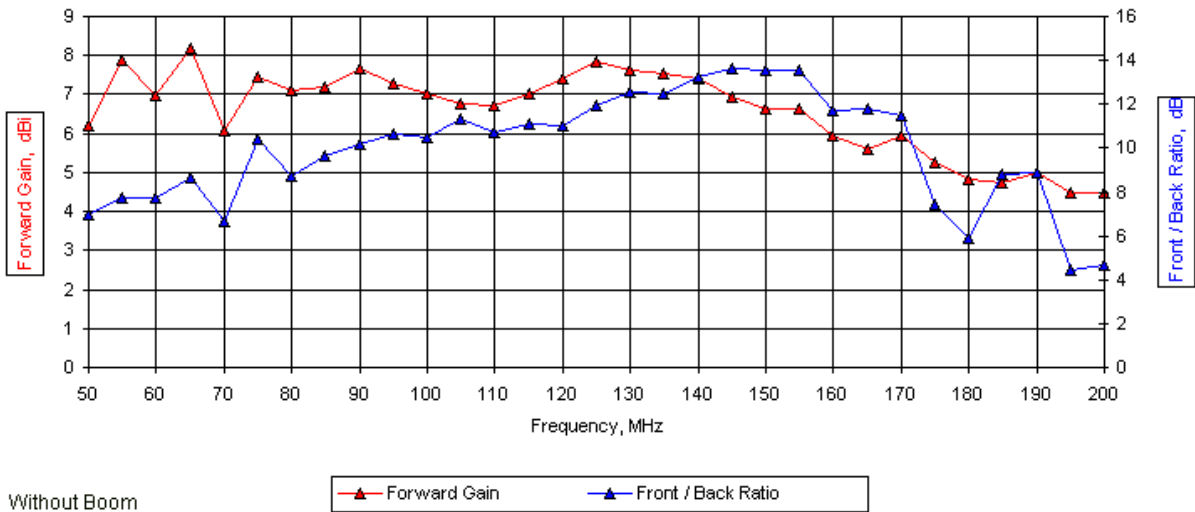


Frequency sweep summary: 50-200 MHz

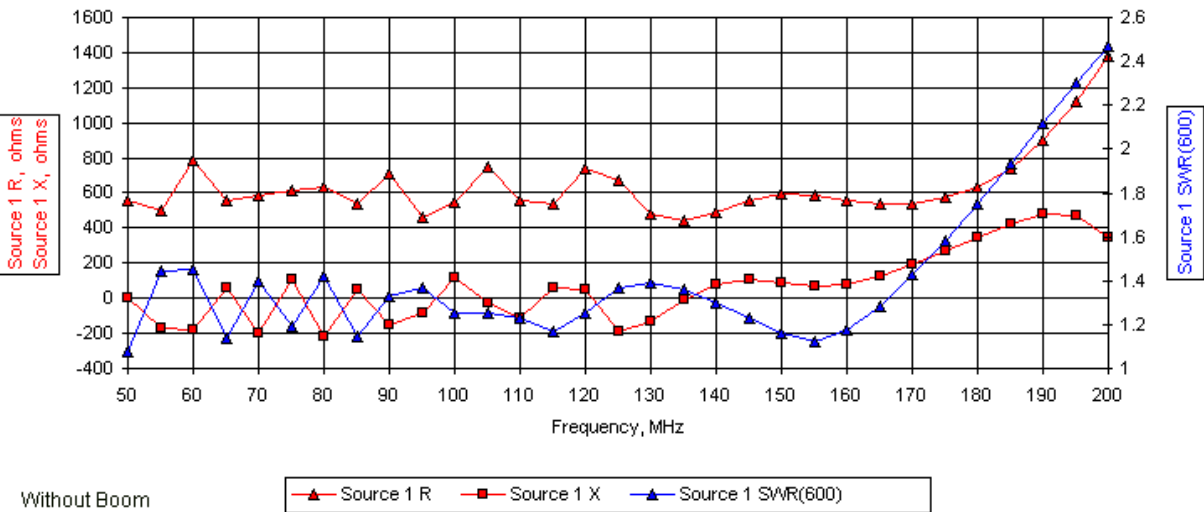
Category	Minimum	Maximum	Δ	Average
Gain dBi	4.48	8.20	3.72*	6.57
Front-Back dB	4.46	13.60	9.14	9.94
E Beamwidth $^\circ$	73.6	170.0	96.4*	109.7

*Least variation across the passband of the group.

20 Elements/Bay, Alpha = 17°, Tau = 0.9, Psi = 20°
Free-Space Forward Gain and 180° Front-to-Back Ratio



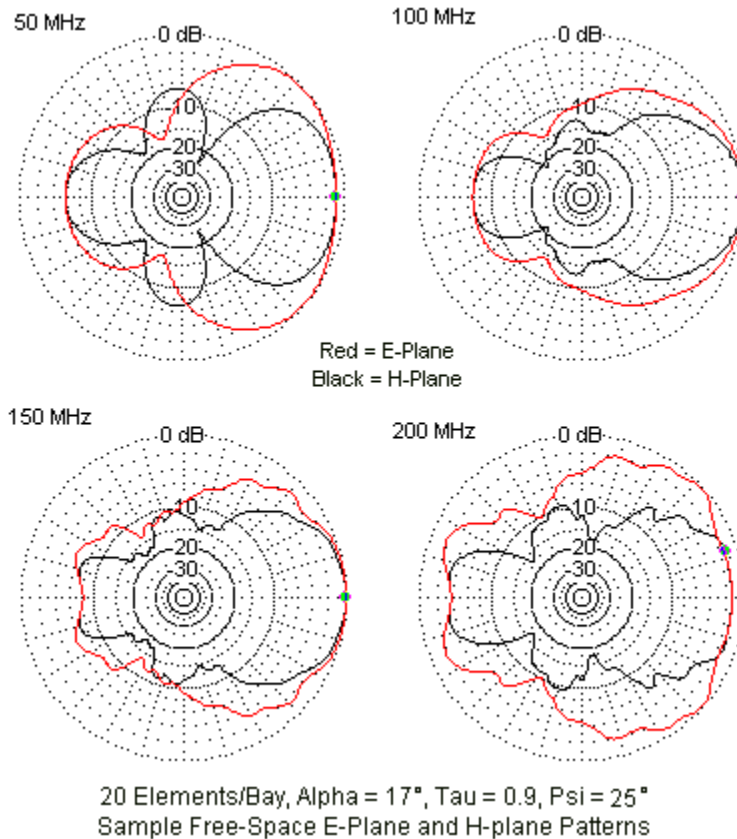
20 Elements/Bay, Alpha = 17°, Tau = 0.9, Psi = 20°
Resistance, Reactance, and 600-Ohm SWR



4. 20 elements/bay, $\alpha = 17^\circ$, $\tau = 0.9$, $\psi = 25^\circ$

Sample performance values

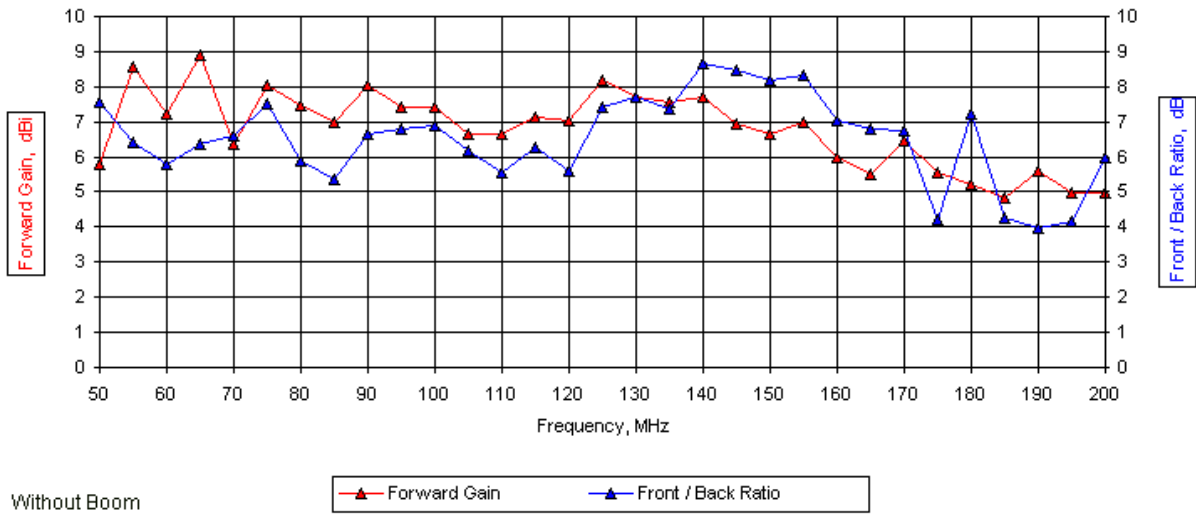
Frequency MHz	Max. Gain dBi	Front-Back Ratio dB	E BW degrees	H BW degrees	Impedance R +/- jX Ω	600- Ω SWR
50	5.81	7.58	143.2	84.8	692 - j 57	1.18
100	7.43	6.87	89.2	61.8	590 + j139	1.26
150	6.67	8.20	108.8	69.4	645 + j 97	1.19
200	5.00	5.99	165.0	79.8	1325 - j327	2.37



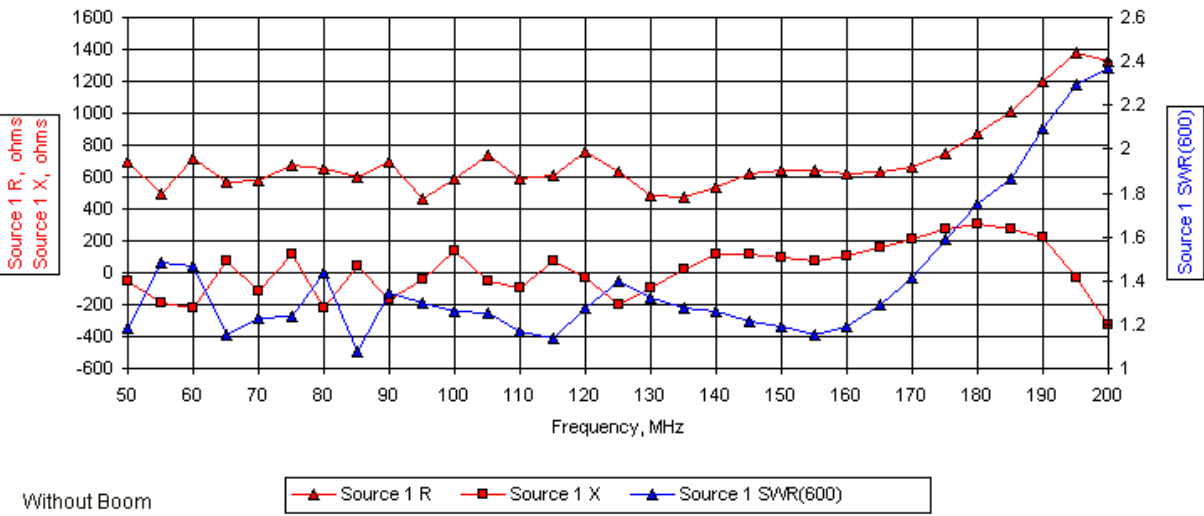
Frequency sweep summary: 50-200 MHz

Category	Minimum	Maximum	Δ	Average
Gain dBi	4.84	8.89	4.05	6.79
Front-Back dB	3.97	8.68	4.71	6.52
E Beamwidth $^\circ$	65.4	173.4	108.0	111.6

20 Elements/Bay, Alpha = 17°, Tau = 0.9, Psi = 25°
Free-Space Forward Gain and 180° Front-to-Back Ratio



20 Elements/Bay, Alpha = 17°, Tau = 0.9, Psi = 25°
Resistance, Reactance, and 600-Ohm SWR



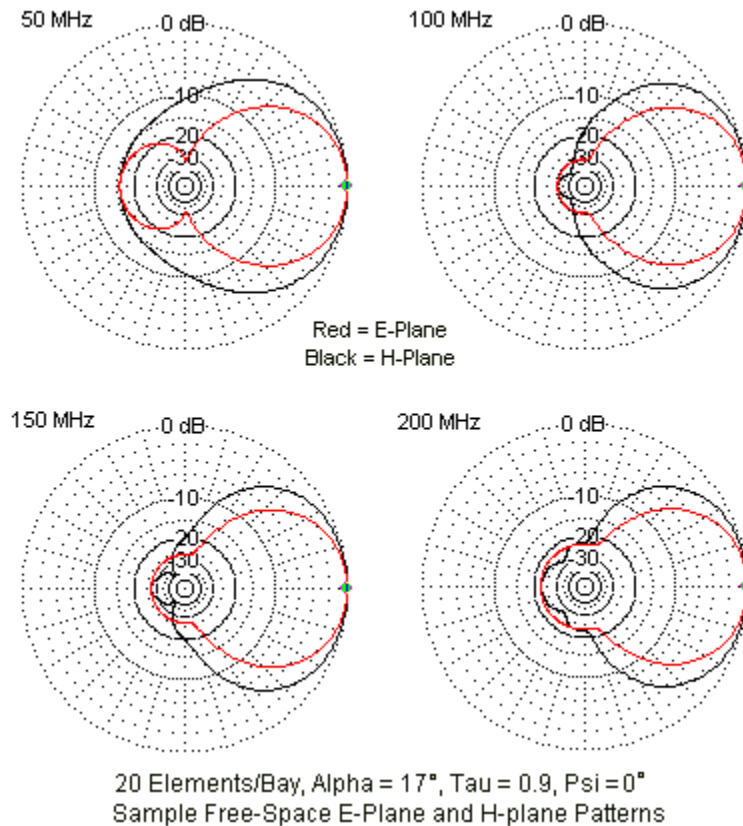
X (Saw-Tooth) Zig-Zag Log-Periodic Arrays

A. X Arrays with Boom

1. 20 elements/bay, $\alpha = 17^\circ$, $\tau = 0.9$, $\psi = 0^\circ$ (flat array, 4" separation between bays)

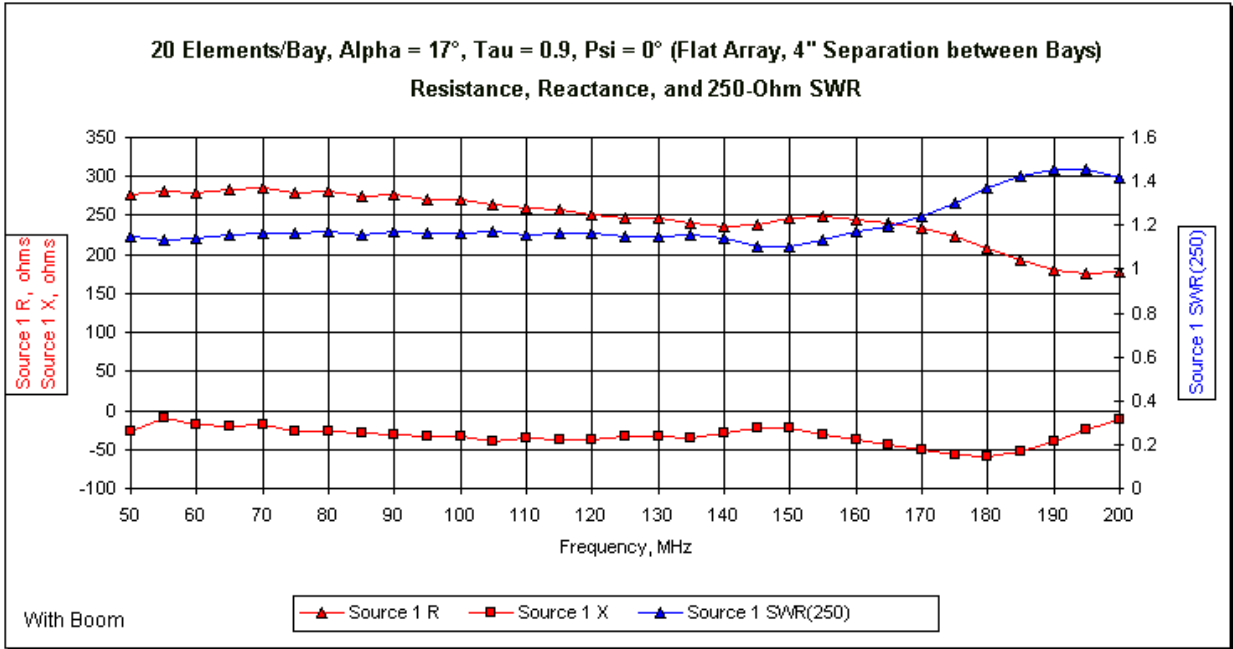
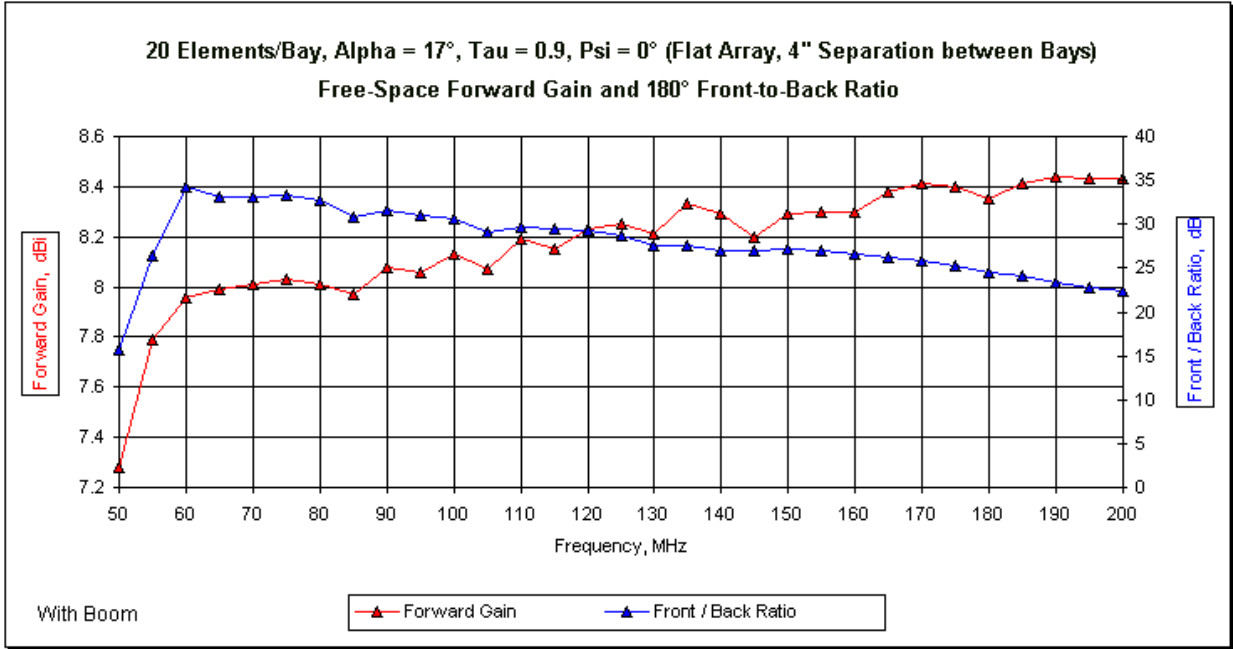
Sample performance values

Frequency MHz	Max. Gain dBi	Front-Back Ratio dB	E BW degrees	H BW degrees	Impedance R +/- jX Ω	250- Ω SWR
50	7.28	15.70	64.2	99.2	276 - j 26	1.15
100	8.13	30.62	64.6	95.6	270 - j 33	1.16
150	8.29	27.14	64.2	94.6	246 - j 23	1.10
200	8.43	22.34	63.0	91.8	178 - j 12	1.41



Frequency sweep summary: 50-200 MHz

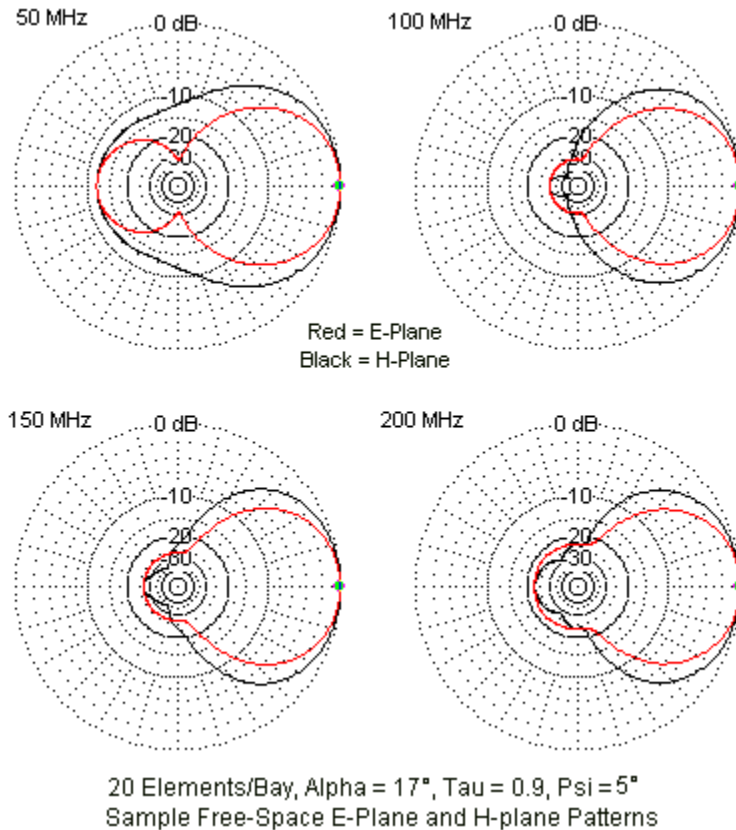
Category	Minimum	Maximum	Δ	Average
Gain dBi	7.28	8.44	1.16	8.17
Front-Back dB	15.70	34.21	18.51	27.84
E Beamwidth °	63.0	65.5	2.5	64.3



2. 20 elements/bay, $\alpha = 17^\circ$, $\tau = 0.9$, $\psi = 5^\circ$

Sample performance values

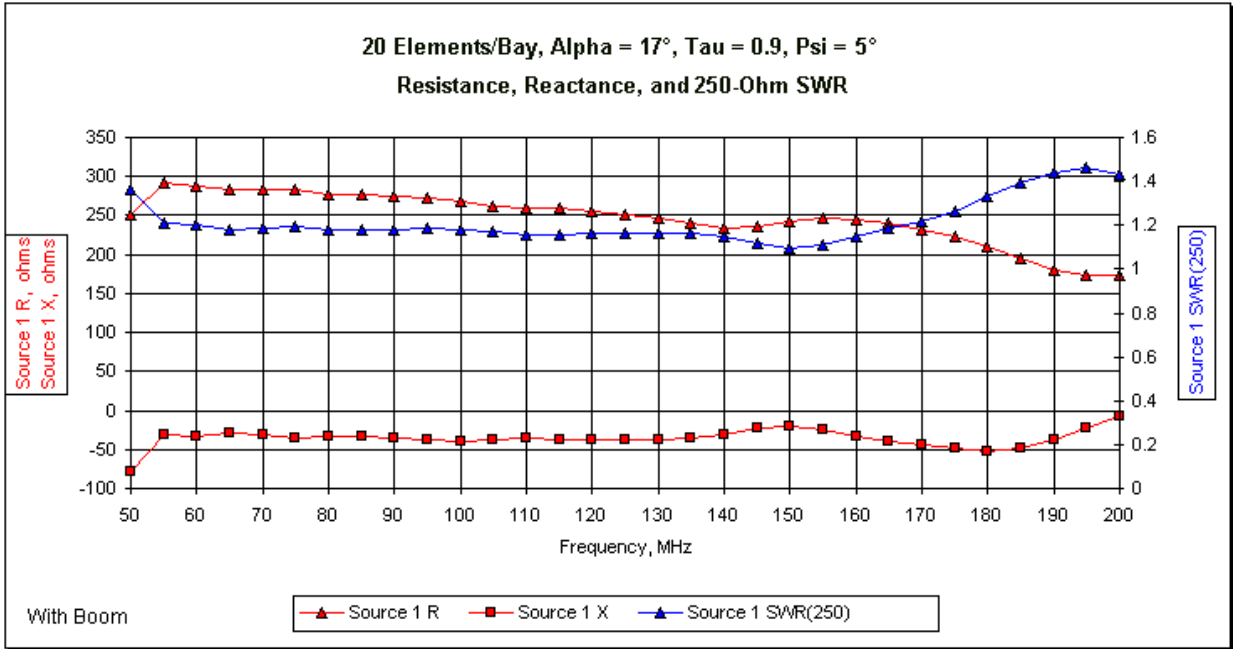
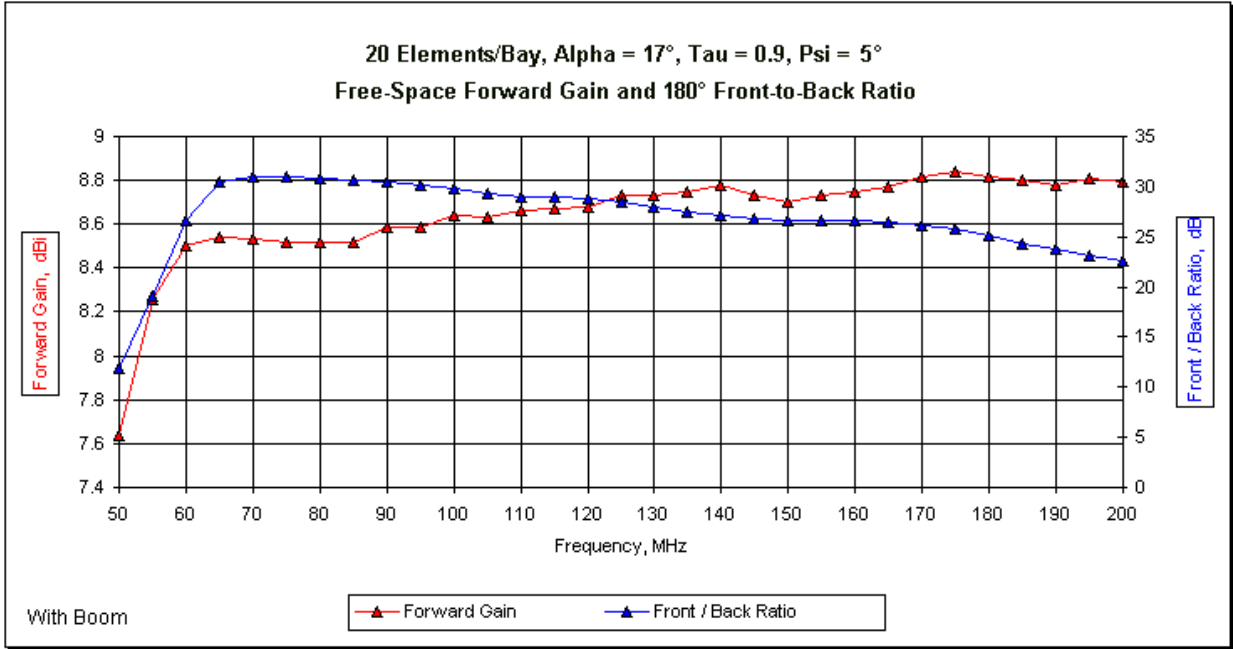
Frequency MHz	Max. Gain dBi	Front-Back Ratio dB	E BW degrees	H BW degrees	Impedance R +/- jX Ω	250- Ω SWR
50	7.64	11.96	63.5	90.2	252 - j 78	1.36
100	8.64	29.77	63.8	88.0	267 - j 39	1.18
150	8.70	26.57	64.0	88.8	241 - j 20	1.09
200	8.79	22.60	62.4	86.8	175 - j 7	1.44



Frequency sweep summary: 50-200 MHz

Category	Minimum	Maximum	Δ	Average
Gain dBi	7.64	8.84	1.20	8.64
Front-Back dB	11.96	30.93	18.97	26.87
E Beamwidth $^\circ$	62.4	64.6	2.2*	63.5

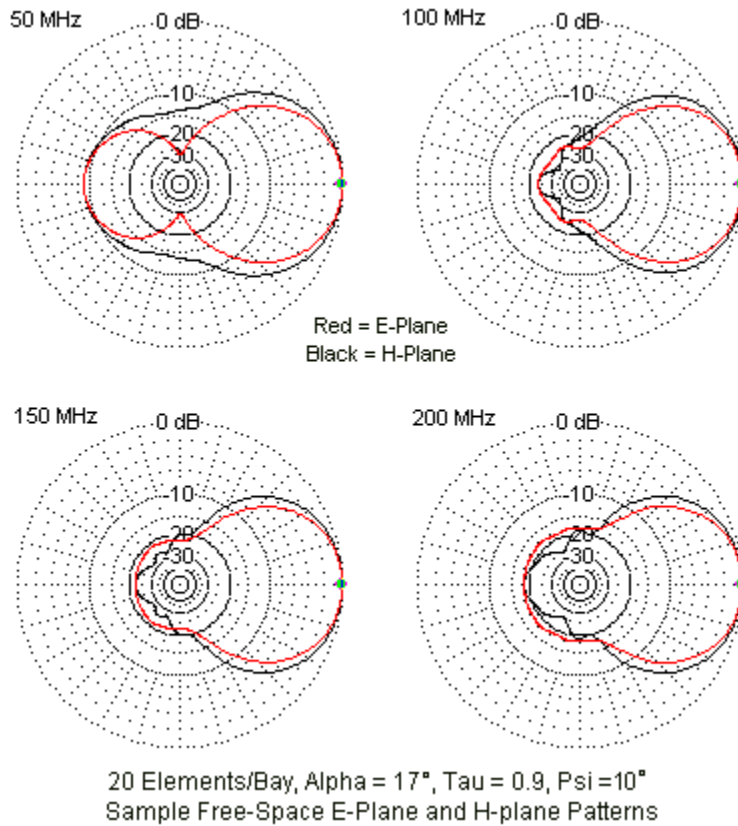
*Least variation across the passband of the group.



3. 20 elements/bay, $\alpha = 17^\circ$, $\tau = 0.9$, $\psi = 10^\circ$

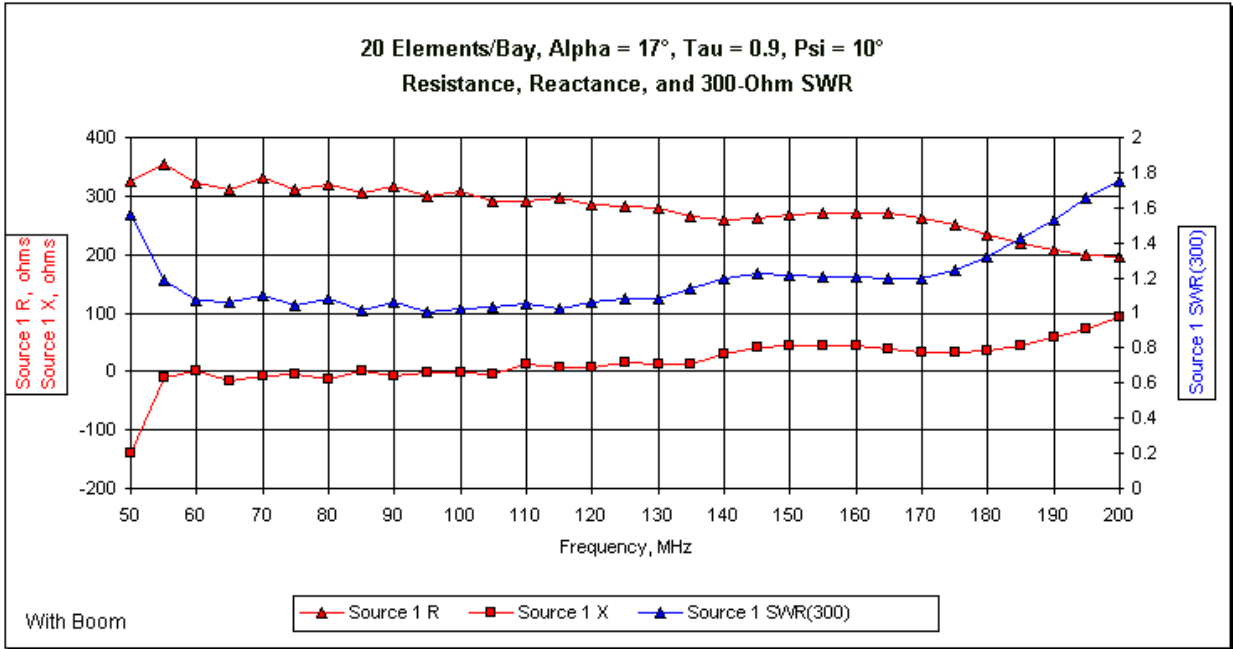
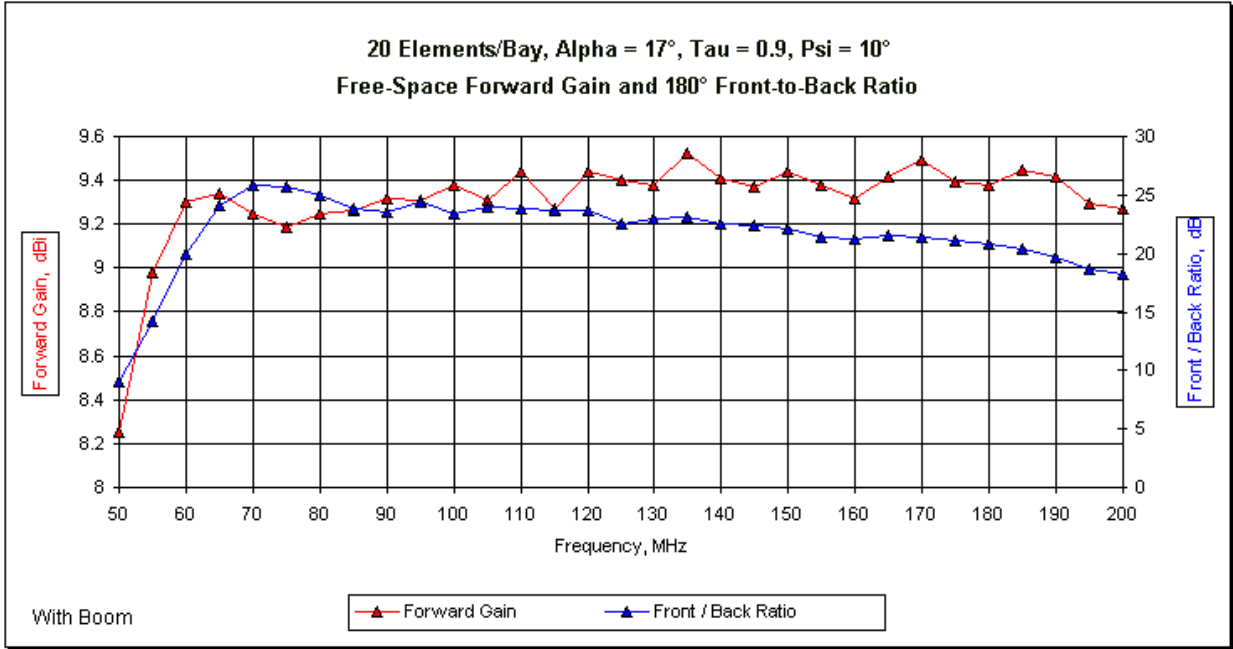
Sample performance values

Frequency MHz	Max. Gain dBi	Front-Back Ratio dB	E BW degrees	H BW degrees	Impedance R +/- jX Ω	300- Ω SWR
50	8.25	9.06	62.8	77.0	324 - j138	1.56
100	9.38	23.42	64.0	76.3	307 - j 1	1.02
150	9.44	22.14	63.4	75.6	268 +j 44	1.21
200	9.27	18.23	63.0	75.8	197 + j 93	1.75



Frequency sweep summary: 50-200 MHz

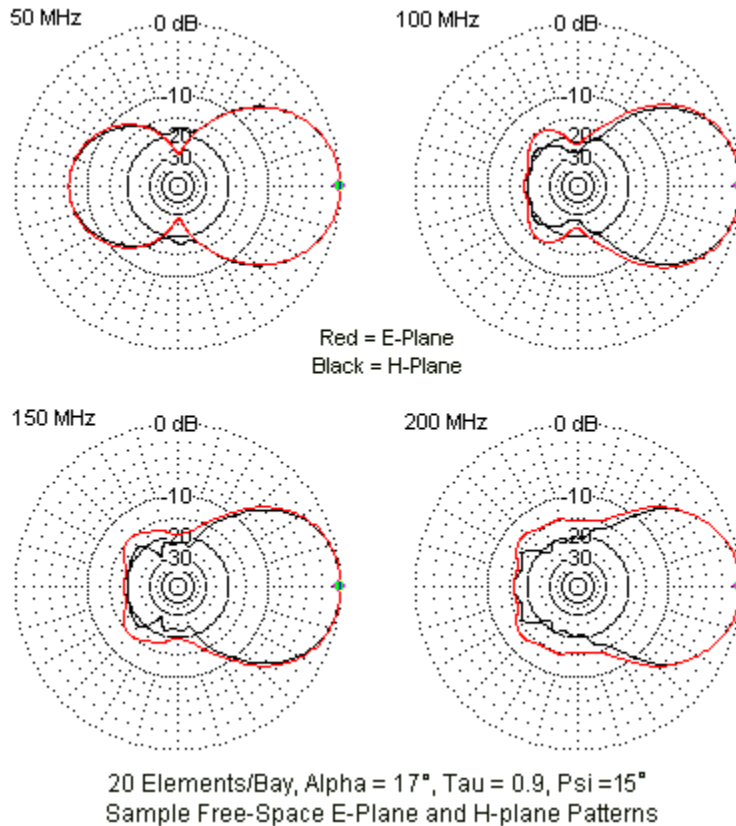
Category	Minimum	Maximum	Δ	Average
Gain dBi	8.25	9.52	1.27	9.31
Front-Back dB	9.06	25.85	17.69	21.75
E Beamwidth $^\circ$	62.6	65.4	2.8	63.8



4. 20 elements/bay, $\alpha = 17^\circ$, $\tau = 0.9$, $\psi = 15^\circ$

Sample performance values

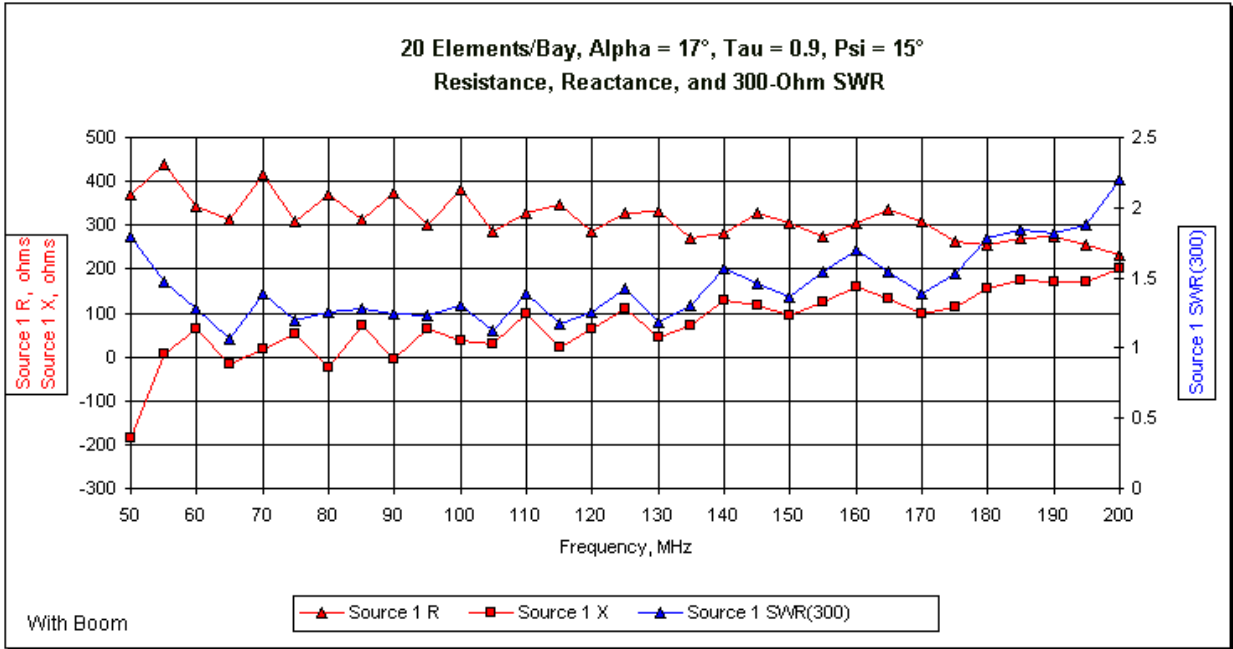
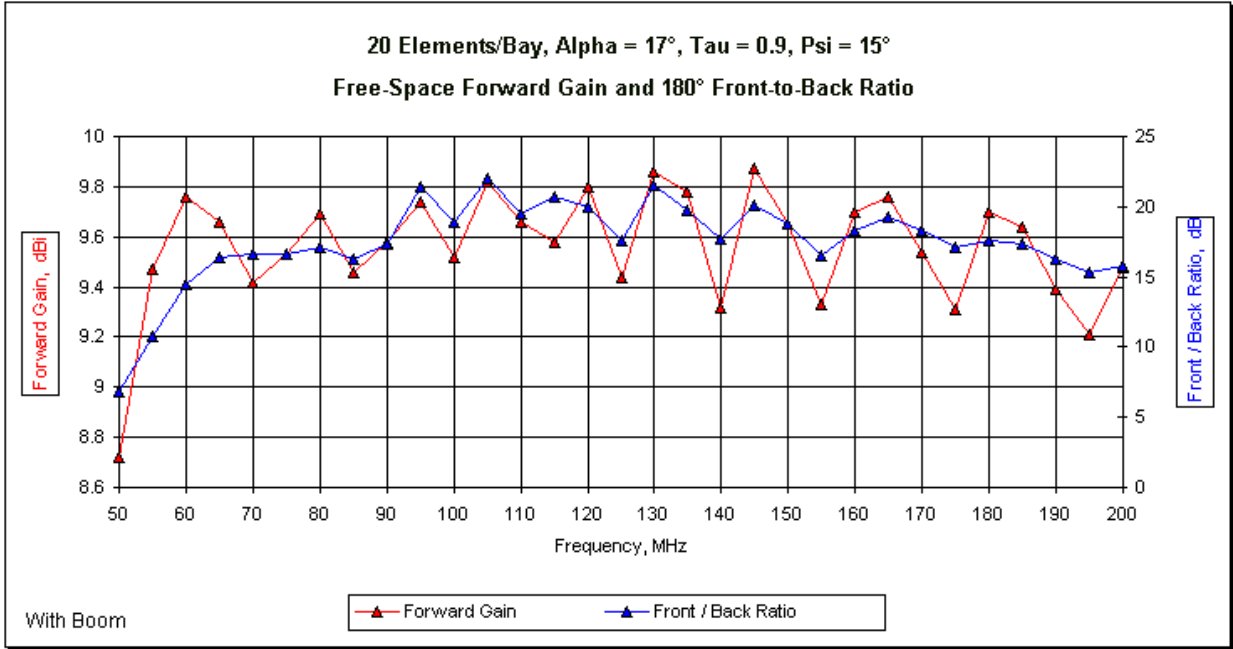
Frequency MHz	Max. Gain dBi	Front-Back Ratio dB	E BW degrees	H BW degrees	Impedance R +/- jX Ω	300- Ω SWR
50	8.72	6.87	63.0	63.1	368 - j185	1.79
100	9.52	18.88	68.0	64.6	381 + j 38	1.30
150	9.65	18.81	65.8	63.2	303 + j 94	1.36
200	9.48	15.81	62.4	62.0	230 + j202	2.21



Frequency sweep summary: 50-200 MHz

Category	Minimum	Maximum	Δ	Average
Gain dBi	8.72	9.87	1.15*	9.56
Front-Back dB	6.87	22.01	15.14	17.49
E Beamwidth $^\circ$	62.1	69.8	7.7	65.5

*Least variation across the passband of the group.

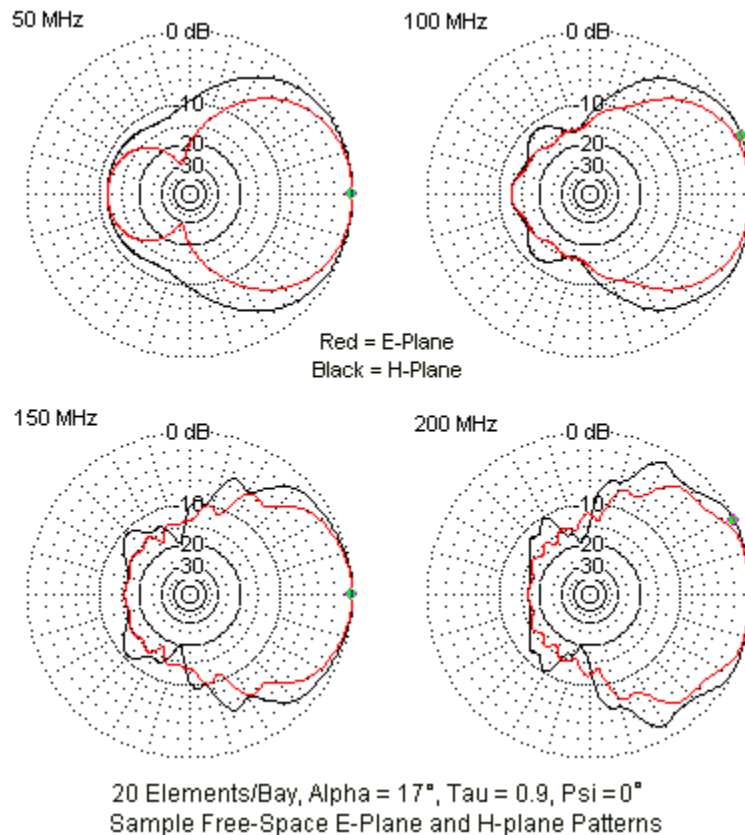


B. X Arrays without Boom

1. 20 elements/bay, $\alpha = 17^\circ$, $\tau = 0.9$, $\psi = 0^\circ$ (flat array, 4" separation between bays)

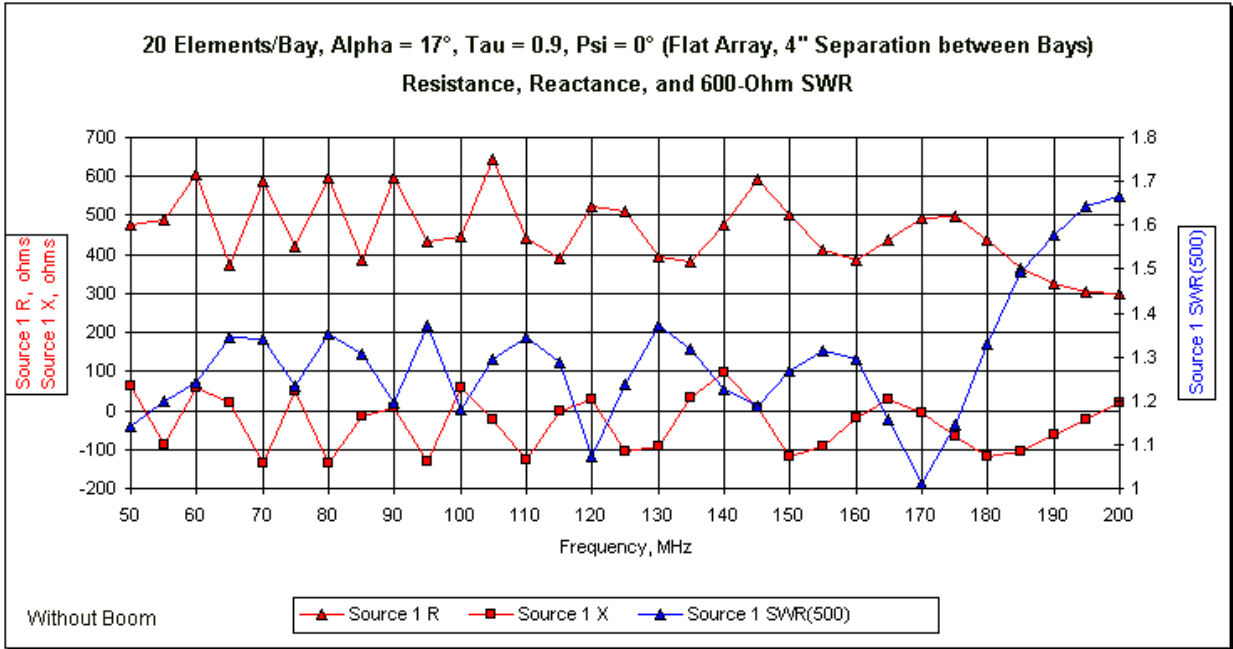
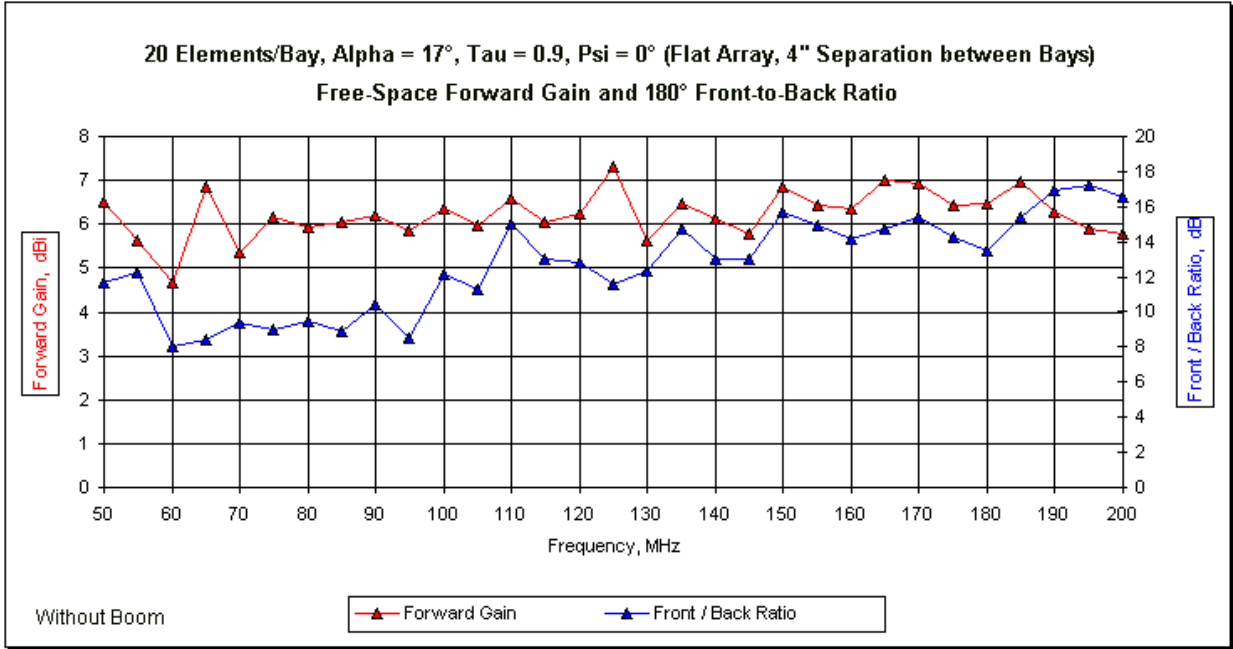
Sample performance values

Frequency MHz	Max. Gain dBi	Front-Back Ratio dB	E BW degrees	H BW degrees	Impedance R +/- jX Ω	600- Ω SWR	500- Ω SWR
50	6.51	11.66	84.6	117.4	477 + j 61	1.29	1.14
100	6.34	12.15	87.4	115.2	446 + j 57	1.37	1.18
150	6.86	15.69	79.6	103.4	504 - j119	1.32	1.27
200	5.79	16.53	107.2	134.0	301 + j 18	2.00	1.67



Frequency sweep summary: 50-200 MHz

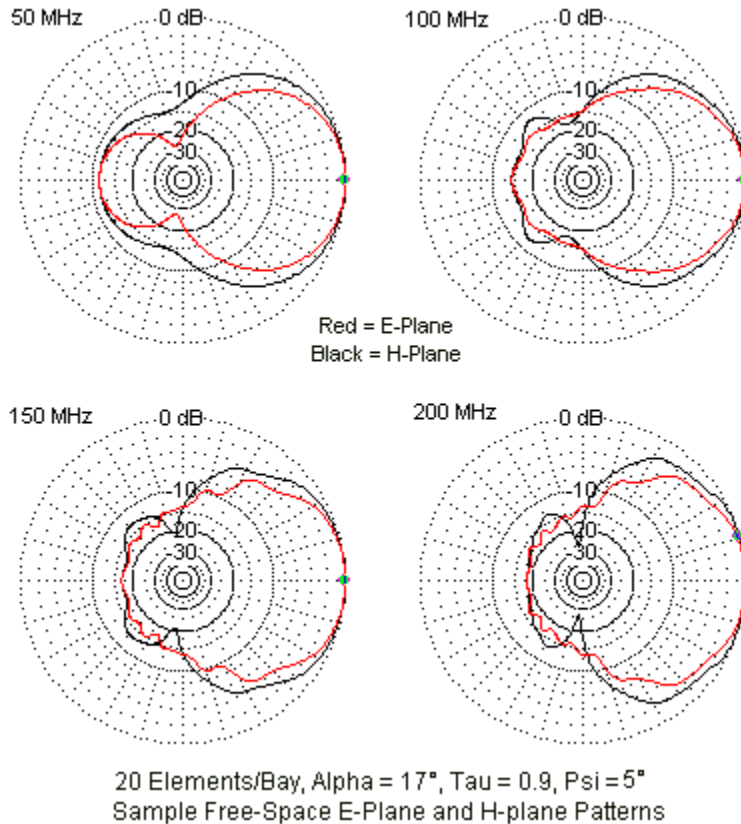
Category	Minimum	Maximum	Δ	Average
Gain dBi	4.67	7.32	2.65	6.23
Front-Back dB	8.04	17.18	9.14	12.70
E Beamwidth $^\circ$	74.2	116.4	42.2	91.0



2. 20 elements/bay, $\alpha = 17^\circ$, $\tau = 0.9$, $\psi = 5^\circ$

Sample performance values

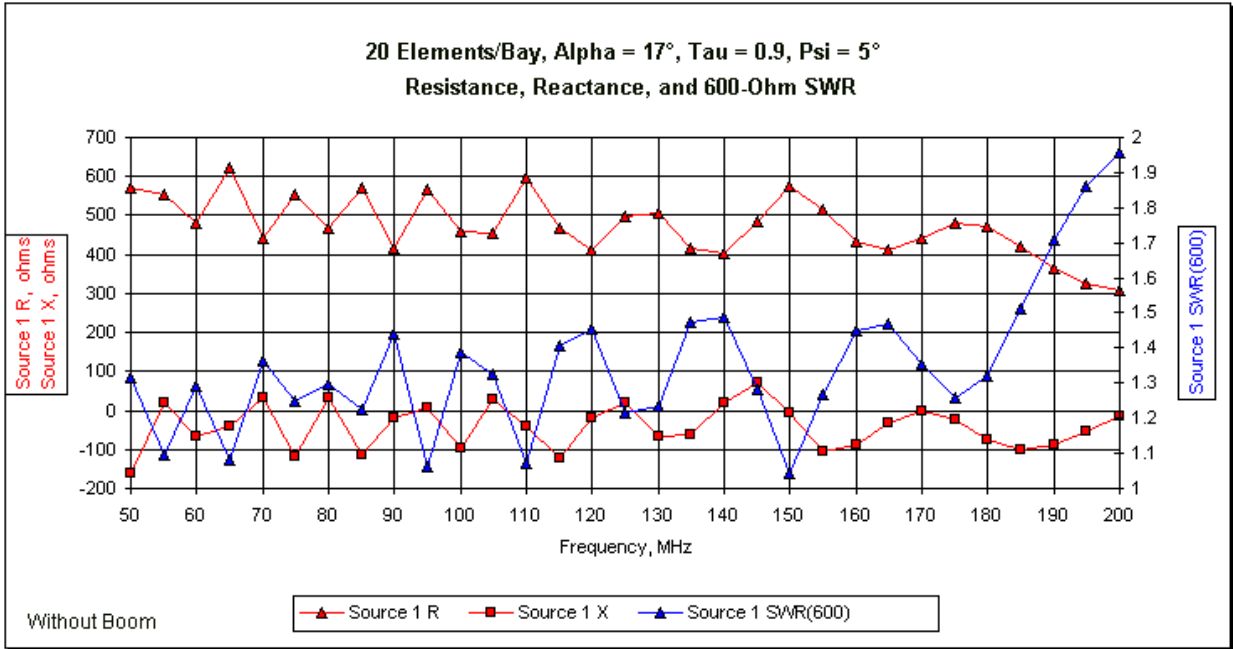
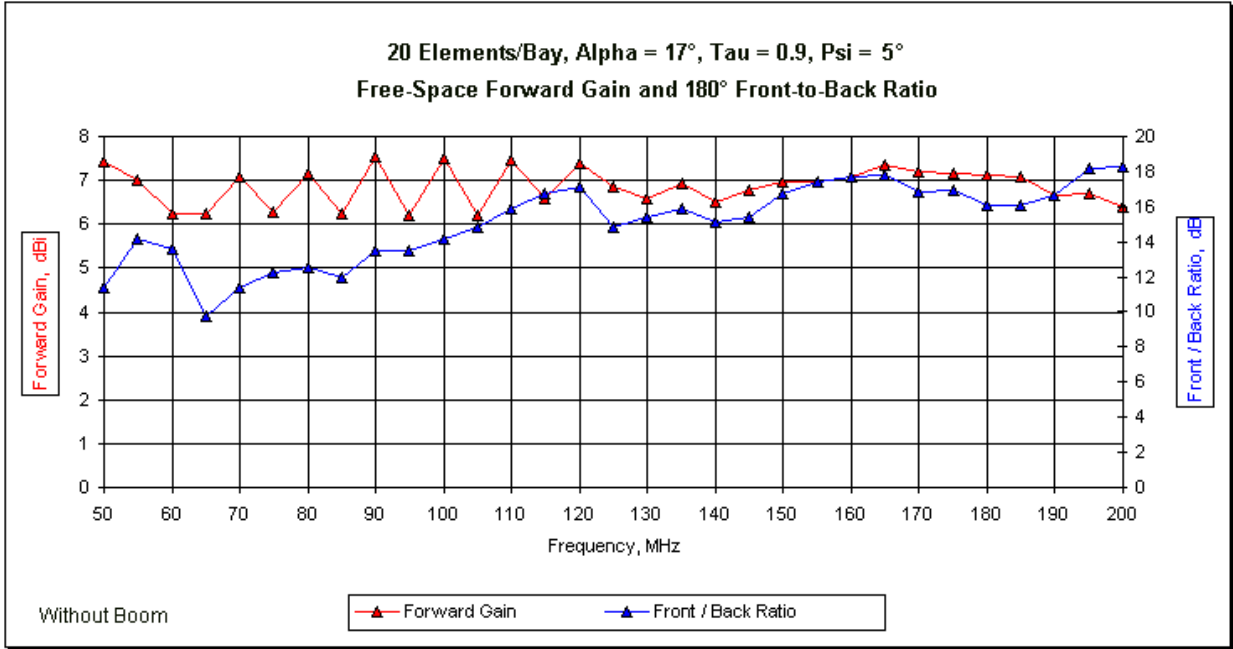
Frequency MHz	Max. Gain dBi	Front-Back Ratio dB	E BW degrees	H BW degrees	Impedance R +/- jX Ω	600- Ω SWR
50	7.42	11.42	76.4	99.0	573 - j160	1.32
100	7.50	14.18	73.2	93.4	458 - j 98	1.39
150	6.95	16.78	77.2	98.8	577 - j 6	1.04
200	6.35	18.14	100.4	124.8	307 - j 15	1.96



Frequency sweep summary: 50-200 MHz

Category	Minimum	Maximum	Δ	Average
Gain dBi	6.19	7.53	1.34*	6.87
Front-Back dB	9.79	18.26	8.47	15.10
E Beamwidth $^\circ$	87.2	124.8	37.6	107.9

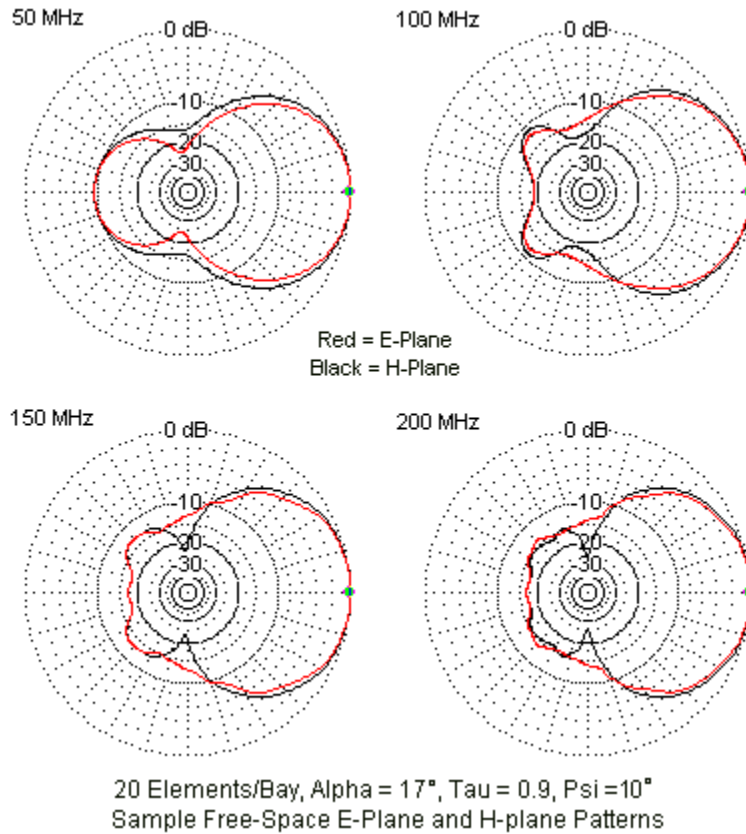
*Least variation across the passband of the group.



3. 20 elements/bay, $\alpha = 17^\circ$, $\tau = 0.9$, $\psi = 10^\circ$

Sample performance values

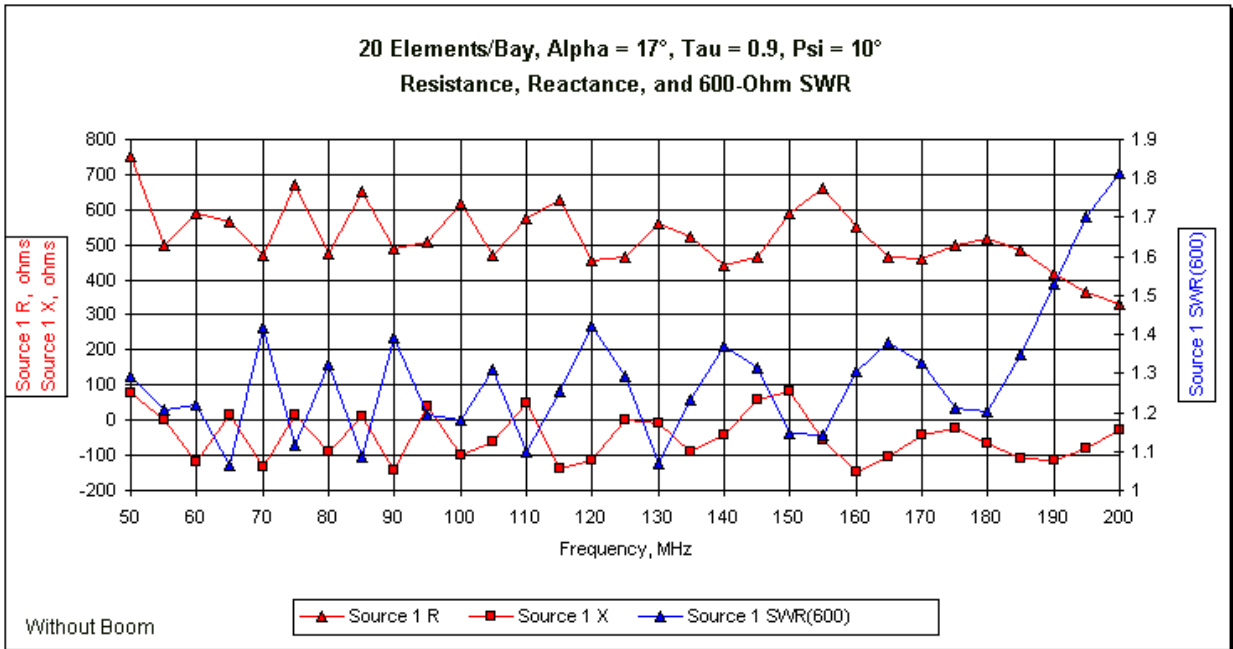
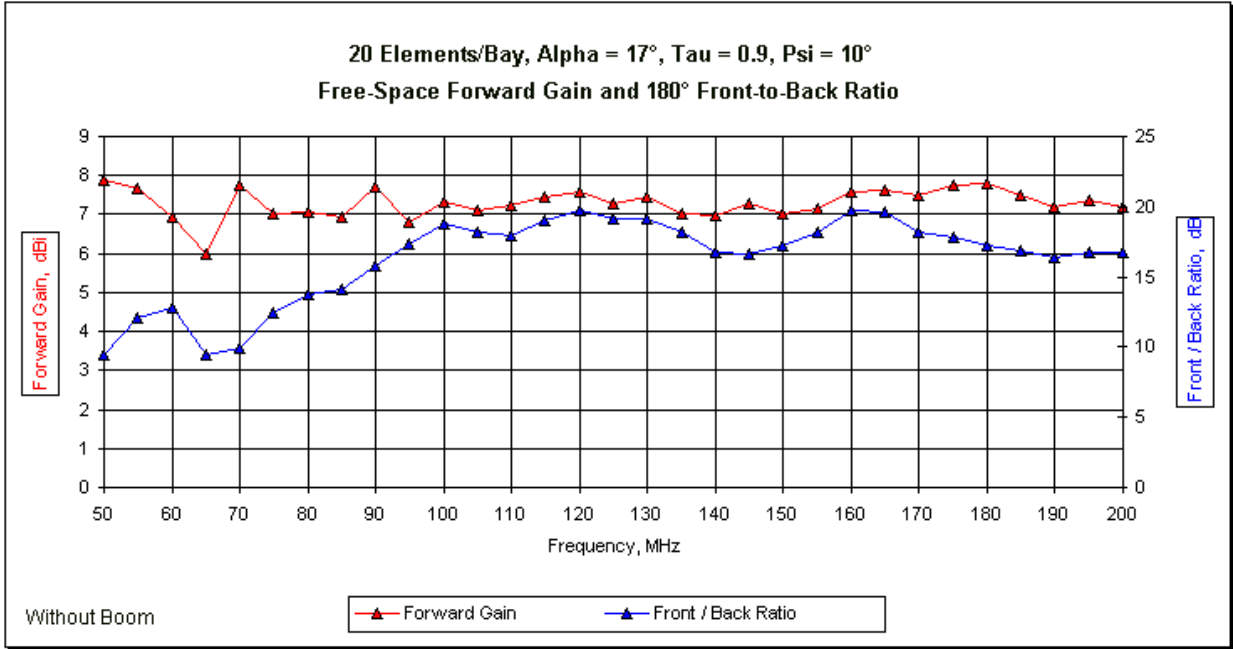
Frequency MHz	Max. Gain dBi	Front-Back Ratio dB	E BW degrees	H BW degrees	Impedance R +/- jX Ω	600- Ω SWR
50	7.90	9.46	74.2	83.8	754 + j 78	1.29
100	7.32	18.82	82.4	91.4	619 - j 99	1.18
150	7.04	17.72	83.4	95.6	592 + j 82	1.15
200	7.21	16.69	90.2	96.6	332 - j 30	1.81



Frequency sweep summary: 50-200 MHz

Category	Minimum	Maximum	Δ	Average
Gain dBi	6.00	7.90	1.90	7.30
Front-Back dB	9.44	19.78	10.34	16.31
E Beamwidth $^\circ$	73.0	107.6	34.6*	84.0

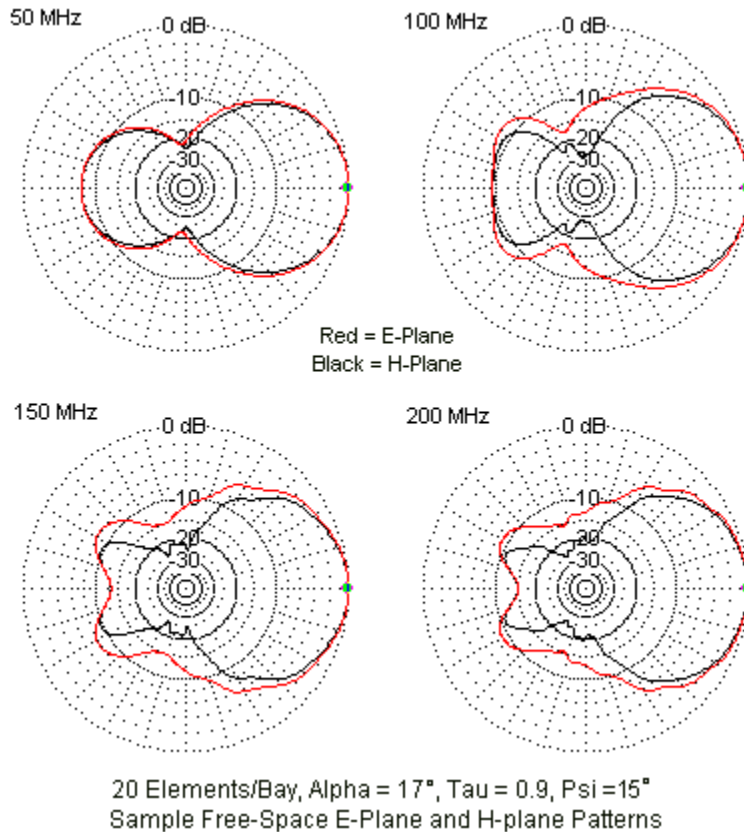
*Least variation across the passband of the group.



4. 20 elements/bay, $\alpha = 17^\circ$, $\tau = 0.9$, $\psi = 15^\circ$

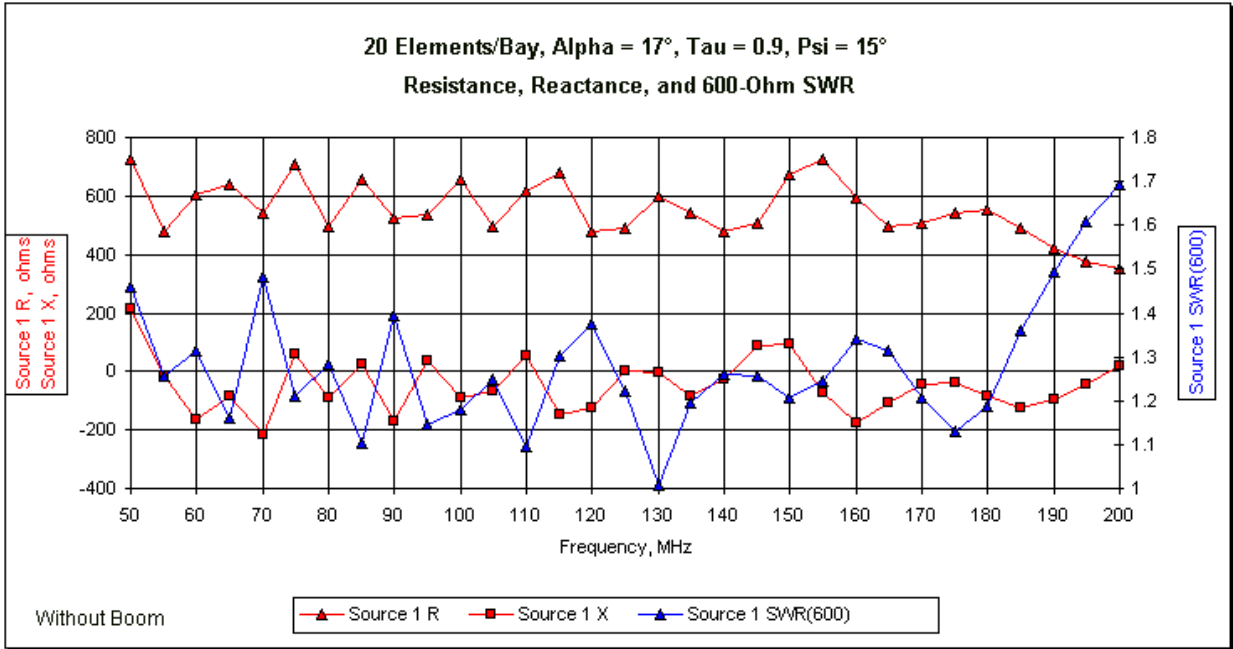
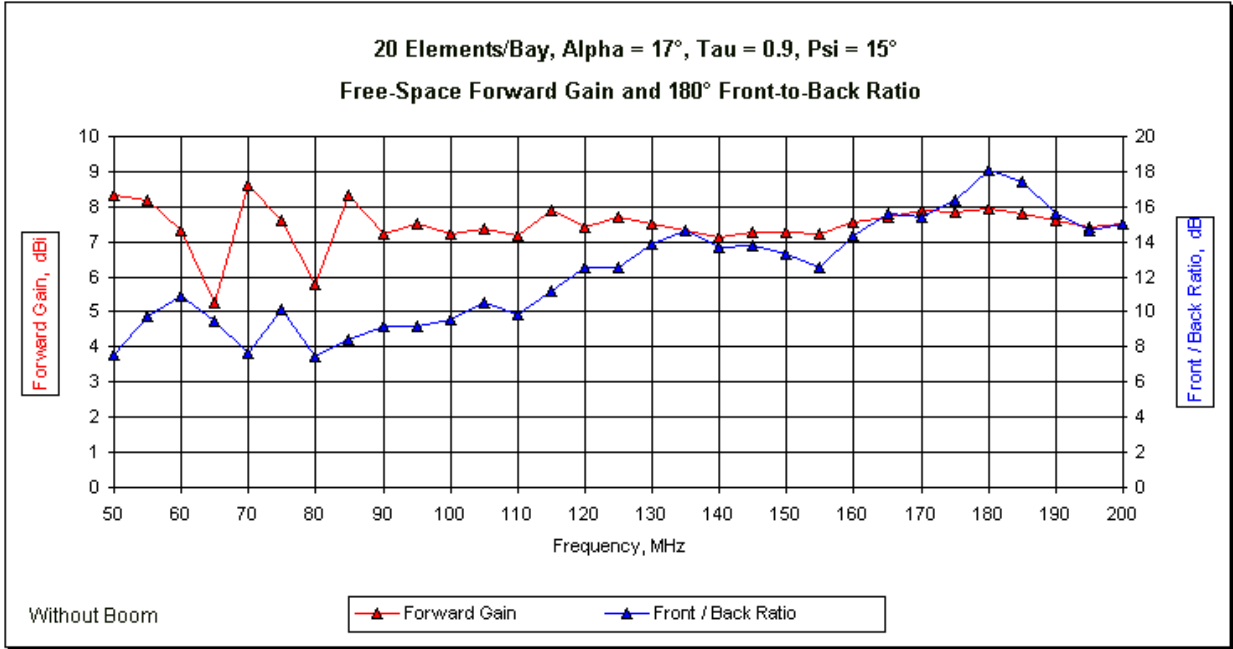
Sample performance values

Frequency MHz	Max. Gain dBi	Front-Back Ratio dB	E BW degrees	H BW degrees	Impedance R +/- jX Ω	600- Ω SWR
50	8.34	7.53	73.4	69.0	726 + j 217	1.46
100	7.23	9.58	88.4	79.0	658 - j 87	1.18
150	7.27	13.34	89.6	79.6	672 + j 94	1.21
200	7.50	15.01	91.0	79.8	355 + j 20	1.69



Frequency sweep summary: 50-200 MHz

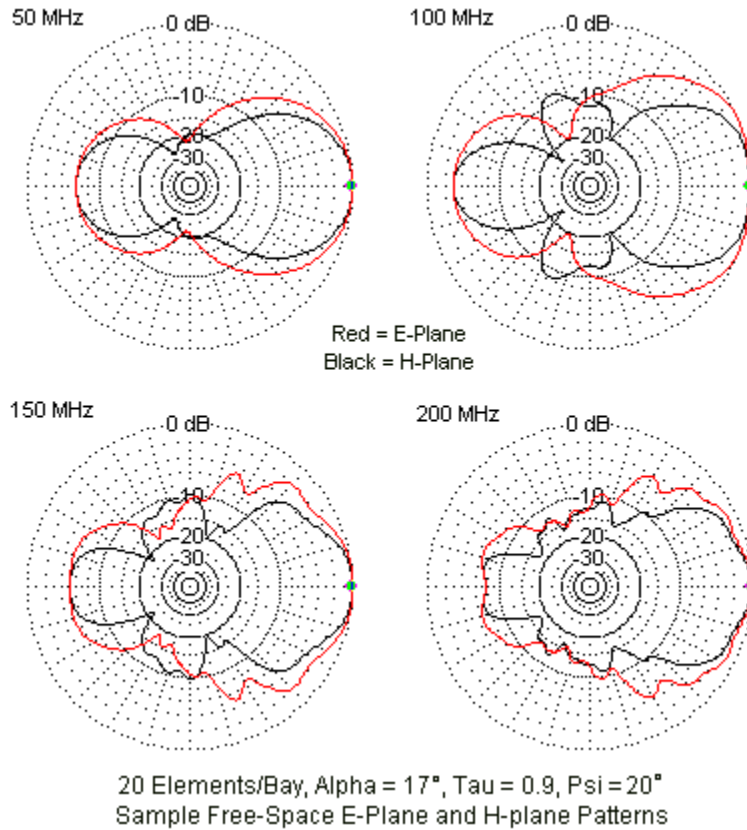
Category	Minimum	Maximum	Δ	Average
Gain dBi	5.27	8.62	3.35	7.49
Front-Back dB	7.51	18.06	10.55	12.26
E Beamwidth $^\circ$	65.6	134.2	68.6	86.5



5. 20 elements/bay, $\alpha = 17^\circ$, $\tau = 0.9$, $\psi = 20^\circ$

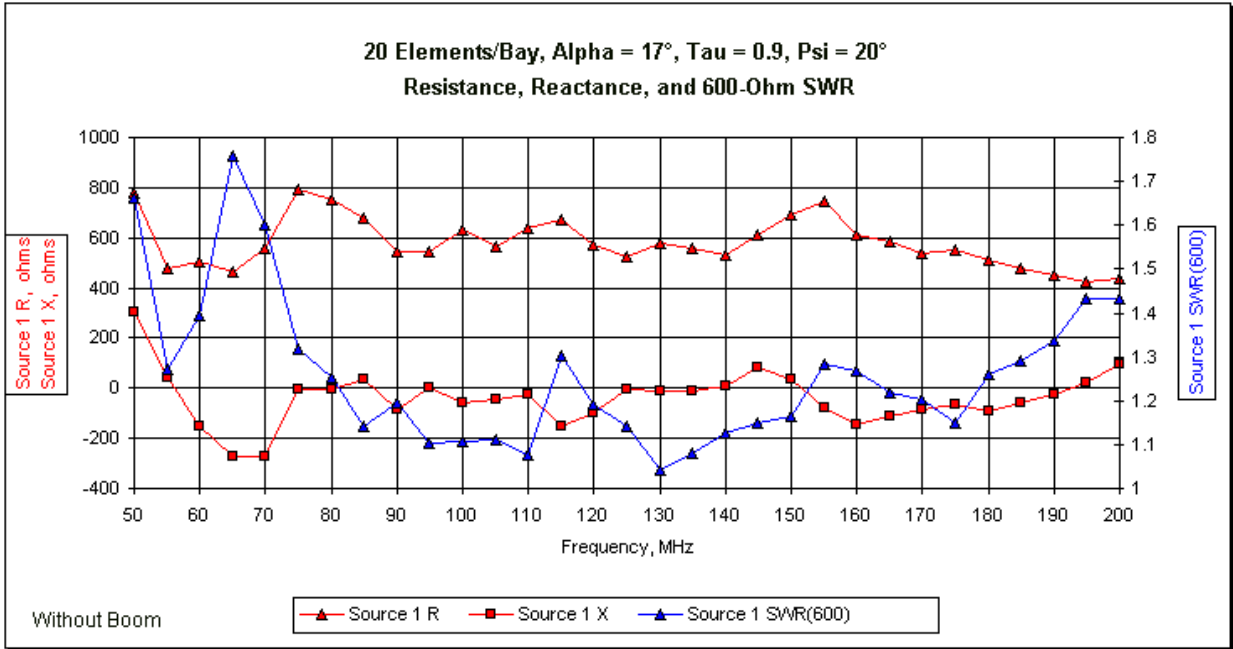
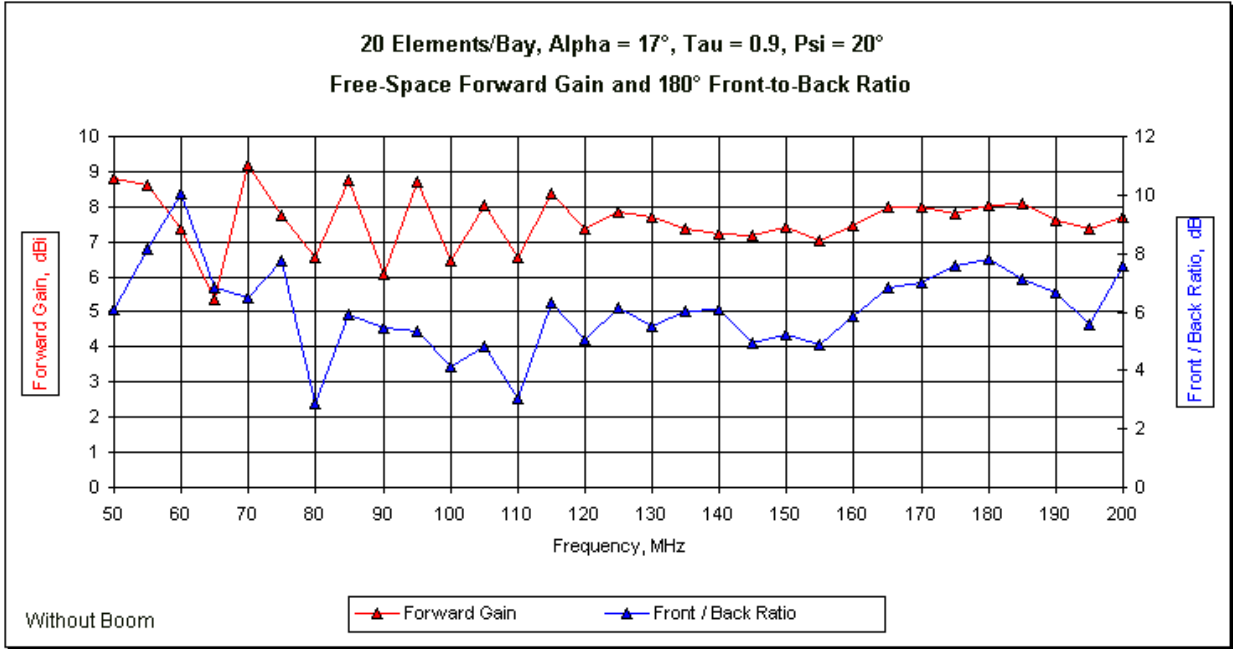
Sample performance values

Frequency MHz	Max. Gain dBi	Front-Back Ratio dB	E BW degrees	H BW degrees	Impedance R +/- jX Ω	600- Ω SWR
50	8.79	6.11	73.8	56.8	776 + j 302	1.66
100	6.48	4.12	106.8	71.2	629 - j 56	1.11
150	7.44	5.23	98.8	55.2	693 + j 33	1.16
200	7.71	7.60	92.0	68.0	440 + j 95	1.43



Frequency sweep summary: 50-200 MHz

Category	Minimum	Maximum	Δ	Average
Gain dBi	5.38	9.21	3.83	7.61
Front-Back dB	2.85	10.04	7.19	6.10
E Beamwidth $^\circ$	45.6	158.2	112.6	88.8

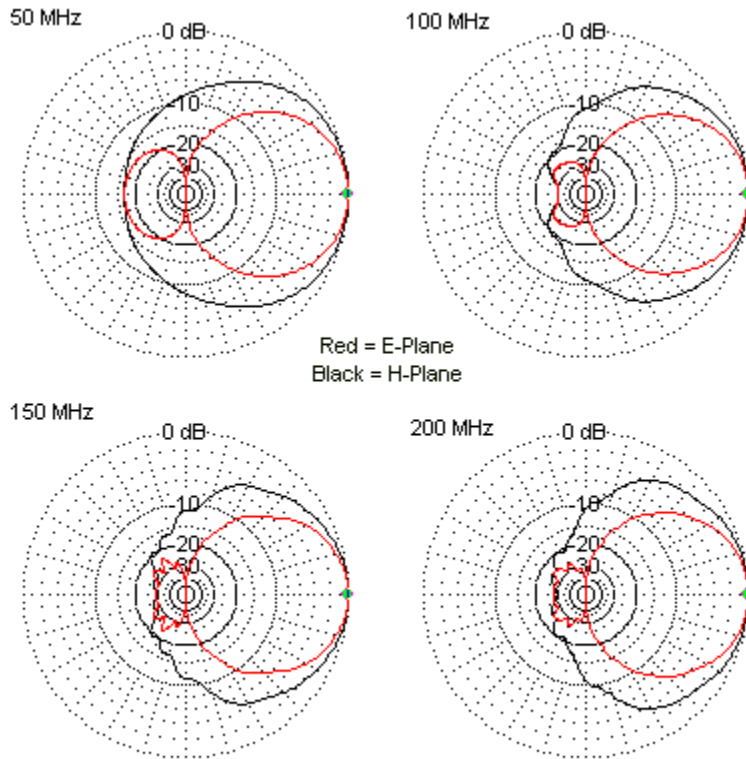


Log-Periodic Dipole Arrays

1. 20 elements, $\alpha' = 17^\circ$, $\tau = 0.9$, $\sigma = 0.167$, single bay

Sample performance values

Frequency MHz	Max. Gain dBi	Front-Back Ratio dB	E BW degrees	H BW degrees	Impedance R +/- jX Ω	200- Ω SWR
50	7.33	16.71	67.0	107.8	209 - j 5	1.05
100	8.19	30.77	63.0	94.6	196 - j 30	1.16
150	8.30	29.16	62.6	93.2	180 - j 19	1.16
200	7.88	28.38	63.7	109.4	182 - j 11	1.29

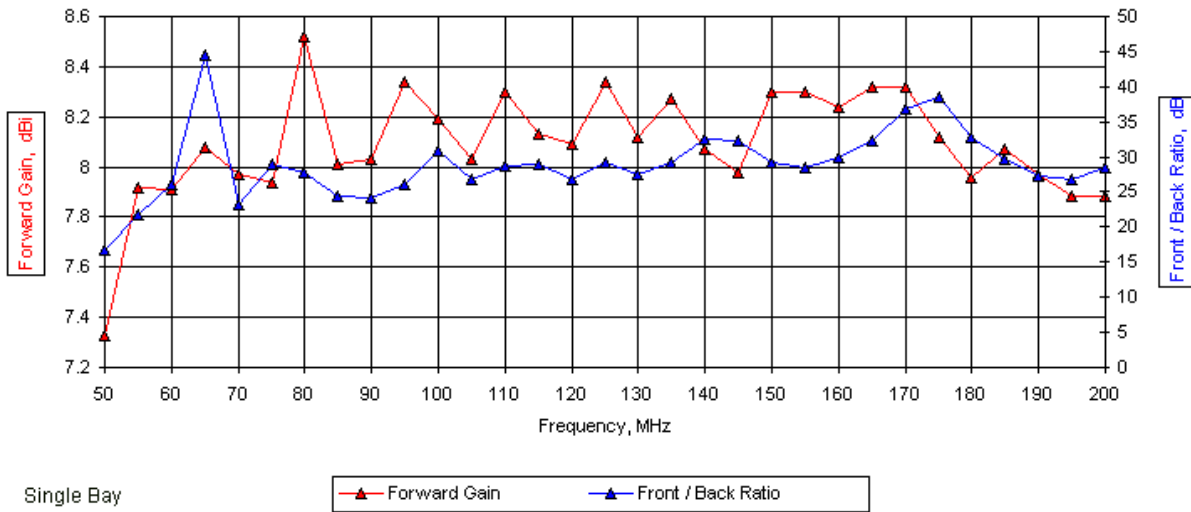


20-Element LPDA, $\alpha' = 17^\circ$, $\tau = 0.9$, $\sigma = 0.167$
Sample Free-Space E-Plane and H-Plane Patterns

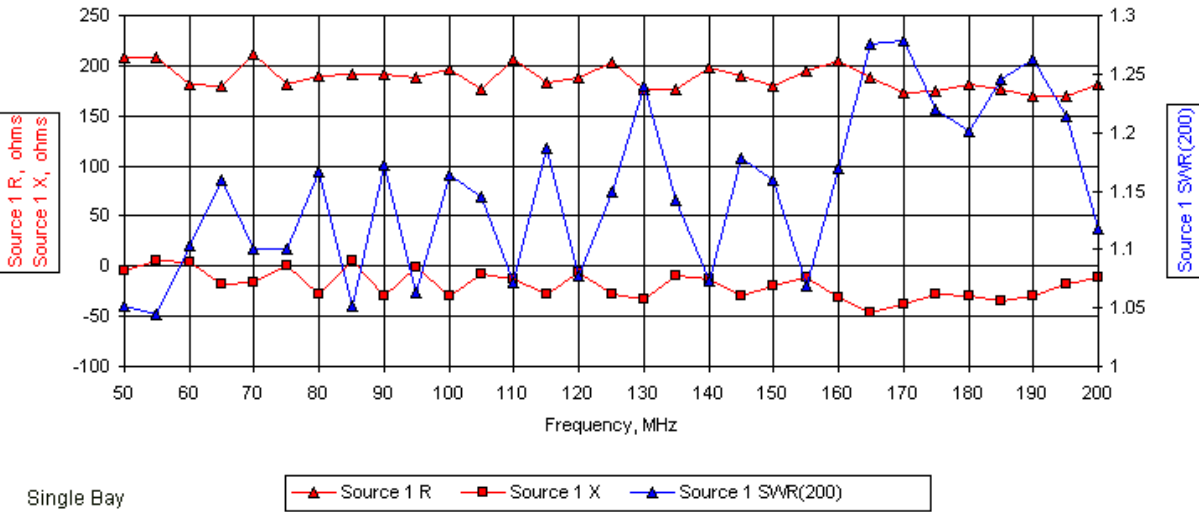
Frequency sweep summary: 50-200 MHz

Category	Minimum	Maximum	Δ	Average
Gain dBi	7.33	8.52	1.19	8.09
Front-Back dB	16.71	44.56	27.85	28.93
E Beamwidth $^\circ$	60.8	66.4	5.6	63.7
H Beamwidth $^\circ$	83.8	109.4	25.6	99.8

20-Element LPDA, Alpha' = 17°, Tau = 0.9, Sigma = 0.167
Free-Space Forward Gain and 180° Front-to-Back Ratio



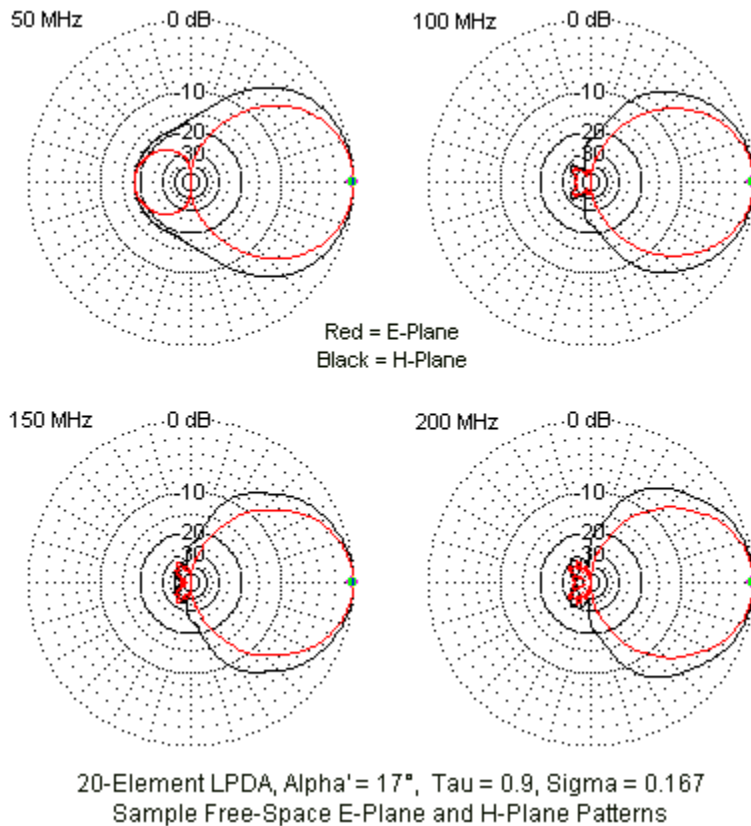
20-Element LPDA, Alpha' = 17°, Tau = 0.9, Sigma = 0.167
Resistance, Reactance, and 200-Ohm SWR



2. 20 elements, $\alpha' = 17^\circ$, $\tau = 0.9$, $\sigma = 0.167$, double bay, $\psi = 5^\circ$

Sample performance values

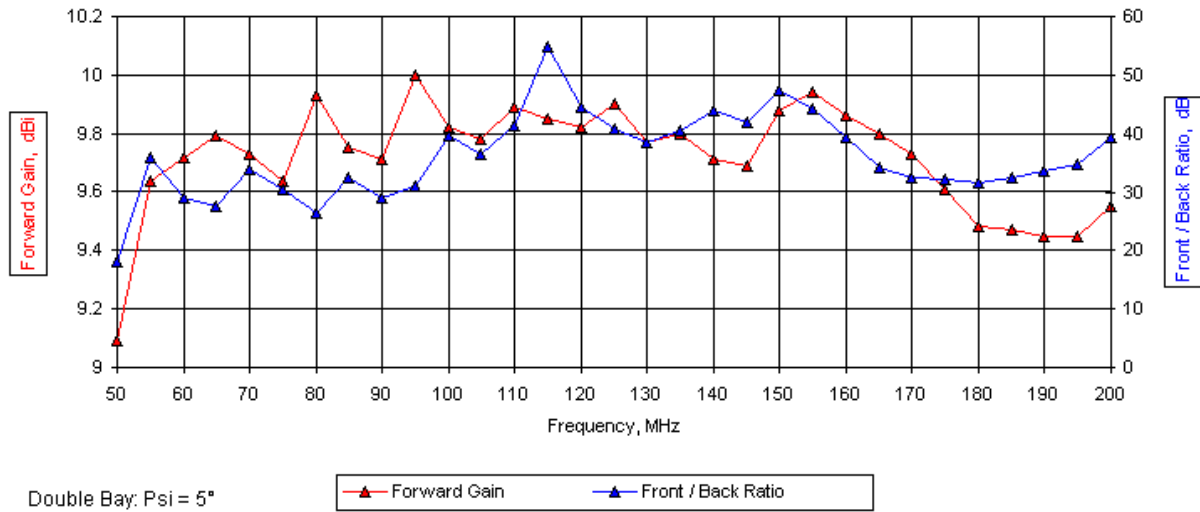
Frequency MHz	Max. Gain dBi	Front-Back Ratio dB	E BW degrees	H BW degrees	Impedance R +/- jX Ω	100- Ω SWR
50	9.09	18.10	61.4	83.2	94 - j 7	1.10
100	9.82	39.75	57.0	74.4	94 - j 9	1.12
150	9.88	47.35	57.0	74.2	97 - j 11	1.12
200	9.55	39.30	57.5	75.2	100 - j 11	1.11



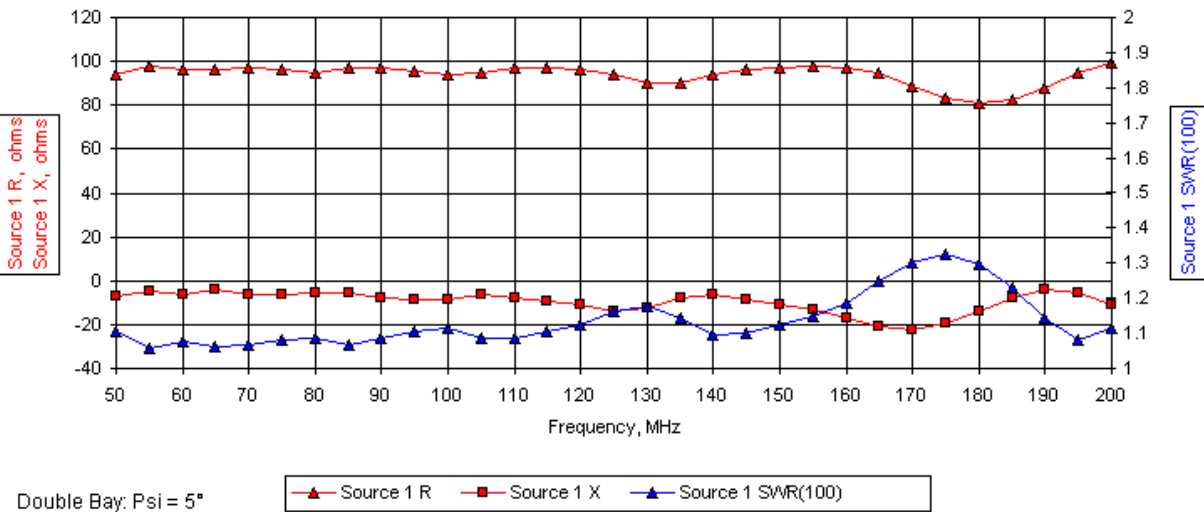
Frequency sweep summary: 50-200 MHz

Category	Minimum	Maximum	Δ	Average
Gain dBi	9.09	10.00	0.91	9.72
Front-Back dB	18.10	54.74	36.64	36.02
E Beamwidth $^\circ$	55.4	61.4	6.0	57.6

20-Element LPDA, Alpha' = 17°, Tau = 0.9, Sigma = 0.167
Free-Space Forward Gain and 180° Front-to-Back Ratio



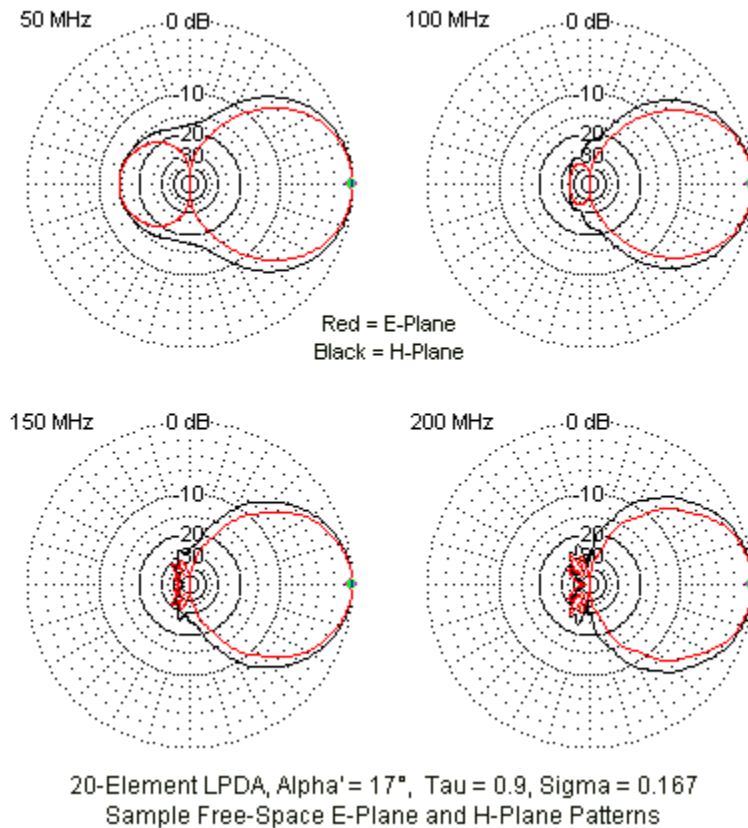
20-Element LPDA, Alpha' = 17°, Tau = 0.9, Sigma = 0.167
Resistance, Reactance, and 100-Ohm SWR



3. 20 elements, $\alpha' = 17^\circ$, $\tau = 0.9$, $\sigma = 0.167$, double bay, $\psi = 10^\circ$

Sample performance values

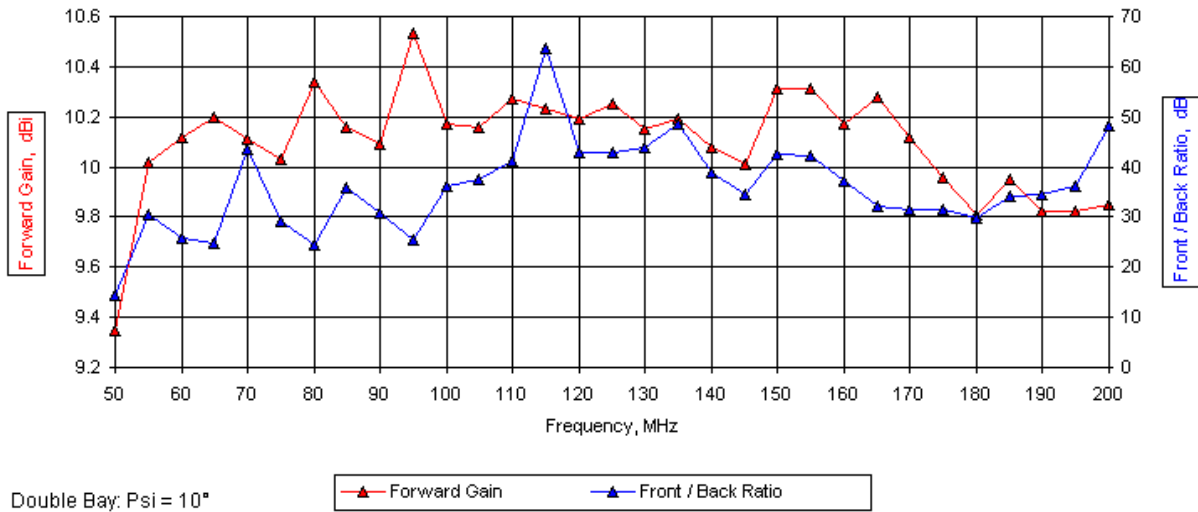
Frequency MHz	Max. Gain dBi	Front-Back Ratio dB	E BW degrees	H BW degrees	Impedance R +/- jX Ω	100- Ω SWR
50	9.35	14.28	61.0	73.2	89 - j 2	1.13
100	10.17	36.27	57.8	68.4	93 - j 8	1.11
150	10.31	42.41	57.4	66.4	98 - j 12	1.14
200	9.85	48.23	57.8	69.2	99 - j 12	1.13



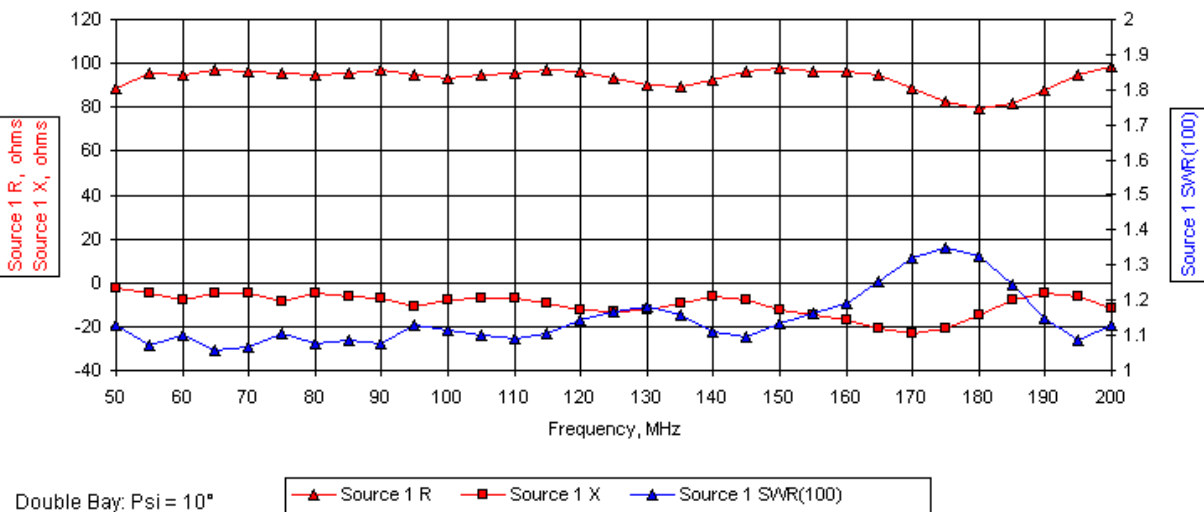
Frequency sweep summary: 50-200 MHz

Category	Minimum	Maximum	Δ	Average
Gain dBi	9.35	10.79	1.18	10.00
Front-Back dB	14.28	63.75	49.47	35.93
E Beamwidth $^\circ$	54.0	61.0	7.0	57.8

20-Element LPDA, Alpha' = 17°, Tau = 0.9, Sigma = 0.167
Free-Space Forward Gain and 180° Front-to-Back Ratio



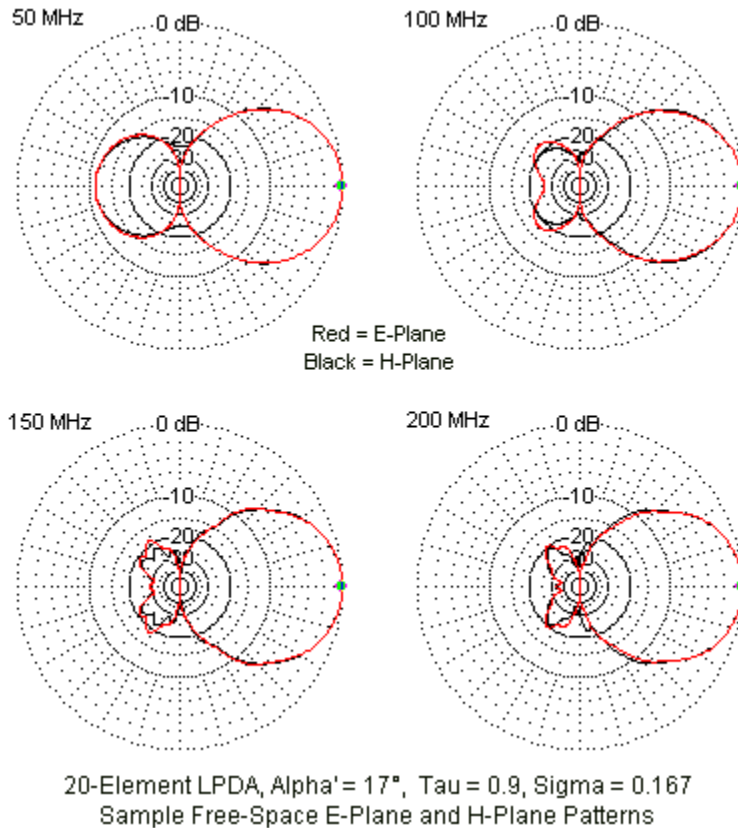
20-Element LPDA, Alpha' = 17°, Tau = 0.9, Sigma = 0.167
Resistance, Reactance, and 100-Ohm SWR



4. 20 elements, $\alpha' = 17^\circ$, $\tau = 0.9$, $\sigma = 0.167$, double bay, $\psi = 15^\circ$

Sample performance values

Frequency MHz	Max. Gain dBi	Front-Back Ratio dB	E BW degrees	H BW degrees	Impedance R +/- jX Ω	100- Ω SWR
50	9.70	11.19	61.6	61.7	88 + j 9	1.18
100	10.40	26.23	57.2	59.0	96 - j 2	1.04
150	10.20	29.51	60.6	62.0	101 - j 17	1.19
200	10.34	33.26	61.0	60.0	96 - j 17	1.19



Frequency sweep summary: 50-200 MHz

Category	Minimum	Maximum	Δ	Average
Gain dBi	9.70	10.79	1.09	10.39
Front-Back dB	11.19	42.10	30.91	28.27
E Beamwidth $^\circ$	54.4	62.8	8.4	58.8

