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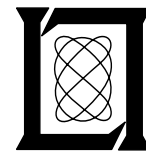
**Project Report
ATC-44**

Model Aircraft L-Band Beacon Antenna Pattern Gain Maps

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24 April 1975

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16. Abstract <p>This document presents L-band antenna patterns for a variety of general aviation and air carrier aircraft; these patterns were based on scale-model measurements. The antenna patterns are described by aircraft-coordinate-referenced elevation vs azimuth gain-contour maps. This method of presentation conveniently displays the effects of aircraft configuration on antenna patterns and allows one to observe the changes in a pattern that result from a change in wheel, flap, or antenna location.</p>			
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TABLE OF CONTENTS

<u>Section</u>		<u>Page</u>
I	Introduction	1
II	Measurement Procedure	1
III	Map Generation and Usage	3
IV	Reading the Maps	3
V	Aircraft Photographs	9 through 37
VI	Aircraft Antenna Maps	38
	A. General Aviation	38
	1. Single Engine	39
	(a) Cessna 150	39
	(b) Piper Cherokee Arrow	47
	(c) Helio U10D	61
	2. Twin Engine	65
	(a) Beechcraft Baron	65
	(b) Beechcraft Baron 99	80
	3. Small Jets	96
	(a) Gates Lear	96
	(b) Grumman Gulfstream	116
	B. Air Carrier	128
	1. Boeing 707	128
	2. Boeing 727	134
	3. Boeing 737	140
	4. Boeing 747	146
	APPENDIX A	152
	REFERENCES	153
	TABLES	
	1. Single Engine Aircraft Patterns	5
	2. Twin Engine Aircraft Patterns	6
	3. Small Jet Aircraft Patterns	7
	4. Air Carrier Patterns	8

Model Aircraft L-Band Beacon Antenna Pattern Gain Maps

I. Introduction

As part of the DABS program, Lincoln Laboratory has formulated and carried out a program that measures aircraft L-band beacon antenna patterns on a variety of scale-model aircraft. These aircraft included single- and twin-engine general aviation types, small business jets and several medium to large air carrier jets. The purpose of this report is to present the gain patterns in a form that is convenient to the reader.

Each of the aircraft models was constructed to allow at least two antenna locations and positions of the landing gear and flaps. Thus, several patterns were obtained for each of the models. As a large data base accumulated the alternates for graphically presenting the L-band beacon antenna, gain data were compared with more than casual interest. The "developed cylinder" plots (gain contours related to airframe referenced elevation vs azimuth coordinates), as used in this report, were selected as a visual, quickly accessed and understood type of gain plot.

II. Measurement Procedure

Eleven model aircraft were measured. Keeping and Sureau [Ref. 1] have documented the results for seven aircraft measured at Lincoln Laboratory. The remaining four aircraft were measured at the Boeing Commercial Airplane Company and documented in Ref. 2. A detailed analysis of some of the gain data has been accomplished by Schlieckert [Ref. 3].

The models constructed were scaled 1/20 to 1/40 the size of the actual aircraft, requiring that the test frequencies be 20x to 40x that of the L-band frequencies employed by the beacon antenna whose patterns were sought, i. e., to 20 to 40 GHz. The higher frequencies were used on only the air carrier models. Vertical polarization was used in most cases (only a few of the air carrier models were measured using horizontal polarization). Measurements of the gain pattern were collected over the entire sphere (4π steradians). Figure 1-1 details the aircraft-oriented coordinate system with the φ azimuthal plane angle measured counterclockwise from the +X direction (right wing); the elevation plane angle θ measured from the +Z axis (vector normal to wings) in a clockwise direction; and the pitch axis, +Y, aligned with the nose of the model.

To obtain gain values over the 4π steradians, the measurement procedure was to begin at $\theta = 1^\circ$, $\varphi = 0^\circ$ for the general aviation models, and $\theta = 0^\circ$ for the air carrier models; then incrementing φ in 2° increments for a total of 180 points for that particular θ value. By repeating this

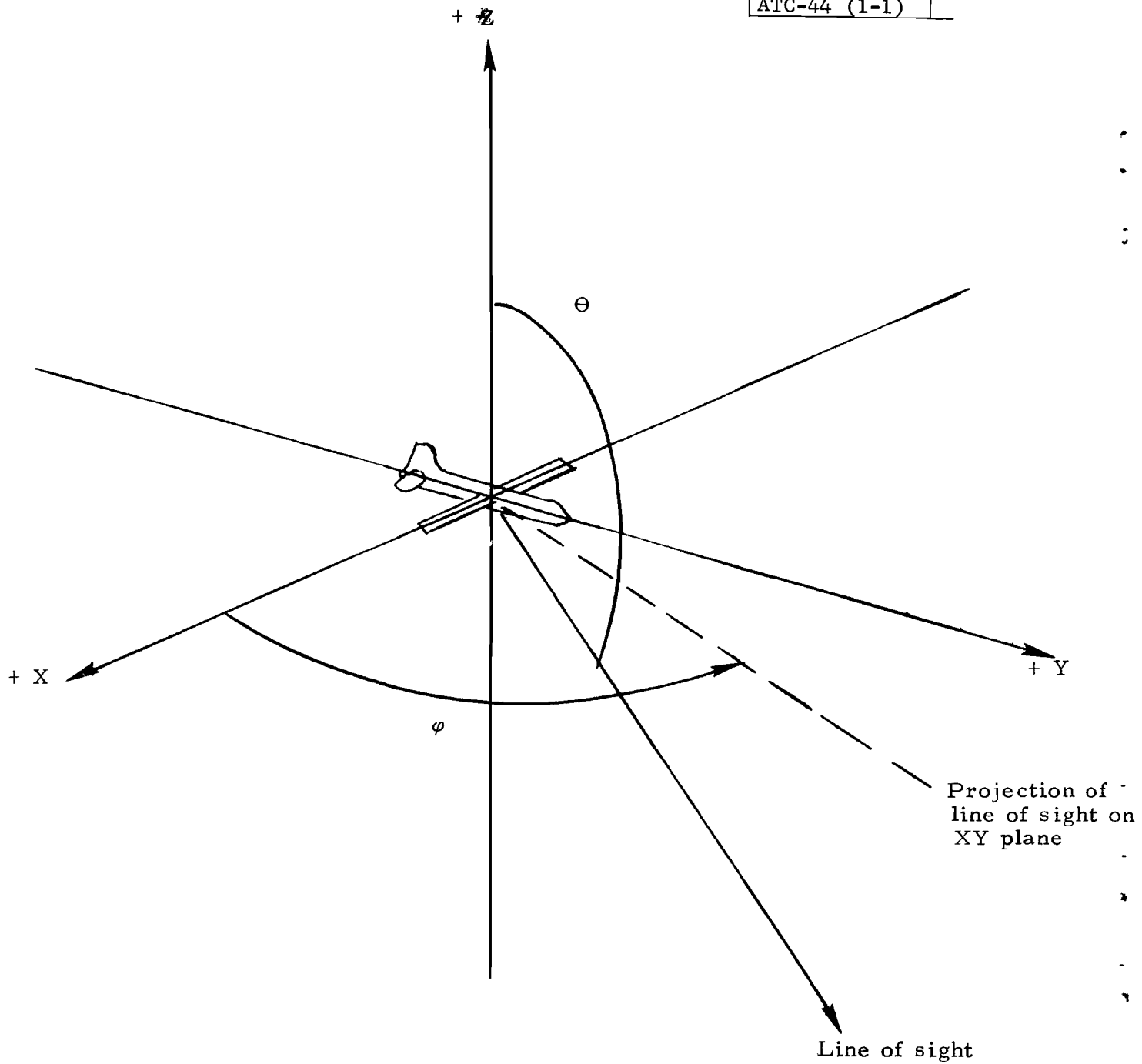


Fig. 1-1. Aircraft coordinate system.

procedure after each 2° increment in θ , a total of 16,200 or 16,380 gain values were generated for each general aviation or air carrier model gain map, respectively. Then the values were normalized to an isotropic antenna (dbi) by integrating over all the values generated [Ref. 1].

III. Map Generation and Usage

Previously, aircraft gain patterns were usually represented by polar plots, with one of the aspect angles held constant as the other was varied. The illustrations provided in this report take that idea a step further by including the 90 or 91 θ planes in one diagram. By assigning a character to a 10-db band and printing out the character at each data point, an L-Band gain "map" was generated. See Figs. 2-1 to 12-6; these maps provide useful information regarding the effects of changes in antenna position for a particular airframe. Another use of the gain maps is to characterize the effects of signal blockage by various parts of the aircraft structure and to indicate pictorially how these effects change if flaps and/or wheel positions are changed. This type of study has been accomplished by Schlieckert [Ref. 3] for typical aircraft. A further use of the L-Band data is the study of improvements resulting from ground and/or air diversity.

Tables 1 through 4 provide an index to the model aircraft pattern "maps." The table entries note for each aircraft type: the antenna positions, the gear and flap conditions, and the polarization used during the model pattern measurements. Antenna positions are pictured (and identified by antenna position number) in top and bottom views of the model aircraft (Figures 1-2 through 1-26).

Since vertically polarized radiation was used throughout the general aviation model aircraft measurements; Tables 1, 2, and 3 do not tabulate polarization. Both vertically and horizontally polarized radiation were used for the air carrier model measurements, and the polarization is identified in Table 4. Note also that the flap condition was always "up" (flaps seated) during the air carrier measurements. Two-numeral codes used during the model measurements to succinctly identify antenna position and gear conditions are explained in Appendix A. (These code numbers appear in the "conditions" block at the top of each map.)

IV. Reading the Maps

To provide a simple example of the way in which the airframe/antenna pattern maps may be used, suppose that it is desired to compare the gain performance of the Cessna 150 top antenna (position 1) with that of the bottom antenna (position 3). Table 1 indicates that Figs. 2-1 and 2-5 should be compared (flaps "up" condition for both cases).

To examine first-order effects, compare the clear areas of each map, i.e., the areas representing gain greater than unity (0 db) for the antenna as

influenced by its surrounding airframe. As might be expected, the top-mounted antenna provides its greatest gain above the aircraft x-y plane (defined by aircraft nose-tail and wingtip-wingtip axes), and the gain of the upper antenna appears to be influenced only slightly by the tail structure (rudder) of the aircraft. It can also be seen that the gain of the top-mounted antenna exceeds 0 dB within and below the x-y plane of the aircraft within only infrequent and narrow azimuthal sectors, primarily on each side of the aircraft tail structure.

Examining Fig. 2-5, it is seen that the gain for the bottom-mounted antenna (position 3) is predominantly below the x-y plane of the aircraft and markedly influenced by the extended nosewheel of the aircraft.

Higher-order effects may then be observed by progressively comparing the areas of the two diagrams denoted by "dots," "slashes," and "percentage" symbols.

TABLE 1

SINGLE ENGINE AIRCRAFT PATTERNS*

<u>AIRCRAFT</u>	<u>ANTENNA</u>	<u>POSITION</u>	<u>GEAR CONDITION</u>		<u>MAP FIGURE NO.</u>
	<u>FIG. NO.</u>	<u>ANT. NO.</u>	<u>WHEELS</u>	<u>FLAPS</u>	
CESSNA 150	1-2	--			
	1-3	1 (T) [†]	DOWN	UP	2-1
	1-3	1 (T)	DOWN	DOWN	2-2
	1-4	2 (B)**	DOWN	UP	2-3
	1-4	2 (B)	DOWN	DOWN	2-4
	1-4	3 (B)	DOWN	UP	2-5
	1-4	3 (B)	DOWN	DOWN	2-6
	1-4	4 (B)	DOWN	UP	2-7
	1-4	4 (B)	DOWN	DOWN	2-8
PIPER CHEROKEE	1-5	--			
	1-6	1 (T)	DOWN	UP	3-1
	1-6	1 (T)	DOWN	DOWN	3-2
	1-6	2 (T)	DOWN	UP	3-3
	1-6	2 (T)	DOWN	DOWN	3-4
	1-6	2 (T)	UP	UP	3-5
	1-6	2 (T)	UP	DOWN	3-6
	1-7	3 (B)	DOWN	UP	3-7
	1-7	3 (B)	DOWN	DOWN	3-8
	1-7	3 (B)	UP	UP	3-9
	1-7	3 (B)	UP	DOWN	3-10
	1-7	4 (B)	DOWN	UP	3-11
	1-7	4 (B)	DOWN	DOWN	3-12
	1-7	4 (B)	UP	UP	3-13
1-7	4 (B)	UP	DOWN	3-14	
HELIO U10D	1-8	--			
	1-10	1 (B)	DOWN	UP	4-1
	1-10	1 (B)	DOWN	DOWN	4-2
	1-10	2 (B)	DOWN	UP	4-3
	1-10	2 (B)	DOWN	DOWN	4-4

* Vertical polarization used for all measurements.

† (T) Top mounted.

** (B) Bottom mounted.

TABLE 2

TWIN ENGINE AIRCRAFT PATTERNS*

<u>AIRCRAFT</u>	<u>ANTENNA</u>	<u>POSITION</u>	<u>GEAR CONDITION</u>		<u>MAP</u>
	<u>FIG. NO.</u>	<u>ANT. NO.</u>	<u>WHEELS</u>	<u>FLAPS</u>	<u>FIG. NO.</u>
BEECH BARON	1-11				
	1-12	1 (T) [†]	DOWN	UP	5-1
	1-12	1 (T)	DOWN	DOWN	5-2
	1-12	1 (T)	UP	UP	5-3
	1-12	1 (T)	UP	DOWN	5-4
	1-12	2 (T)	DOWN	UP	5-5
	1-12	2 (T)	DOWN	DOWN	5-6
	1-12	2 (T)	UP	UP	5-7
	1-12	2 (T)	UP	DOWN	5-8
	1-13	3 (B)**	DOWN	UP	5-9
	1-13	3 (B)	DOWN	DOWN	5-10
	1-13	3 (B)	UP	UP	5-11
	1-13	3 (B)	UP	DOWN	5-12
	1-13	4 (B)	DOWN	DOWN	5-13
	1-13	4 (B)	UP	UP	5-14
	1-13	4 (B)	UP	DOWN	5-15
	BEECH BARON 99	1-14			
1-15		1 (T)	DOWN	UP	6-1
1-15		1 (T)	DOWN	DOWN	6-2
1-15		2 (T)	DOWN	DOWN	6-3
1-15		2 (T)	UP	UP	6-4
1-15		2 (T)	UP	DOWN	6-5
1-16		3 (B)	DOWN	UP	6-6
1-16		3 (B)	DOWN	DOWN	6-7
1-16		3 (B)	UP	UP	6-8
1-16		3 (B)	UP	DOWN	6-9
1-16		4 (B)	DOWN	UP	6-10
1-16		4 (B)	DOWN	DOWN	6-11
1-16		4 (B)	UP	UP	6-12
1-16		4 (B)	UP	DOWN	6-13
1-16		5 (B)	DOWN	DOWN	6-14
1-16		5 (B)	UP	UP	6-15
1-16		5 (B)	UP	DOWN	6-16

* Vertical polarization used for all measurements.

† Top mounted (T).

** Bottom mounted (B).

TABLE 3

SMALL JET AIRCRAFT PATTERNS*

<u>AIRCRAFT</u>	<u>ANTENNA</u> <u>FIG. NO.</u>	<u>POSITION</u> <u>ANT. NO.</u>	<u>GEAR CONDITION</u>		<u>MAP</u> <u>FIG. NO.</u>
			<u>WHEELS</u>	<u>FLAPS</u>	
GATES LEAR JET	1-17				
	1-18	1 (T) [†]	DOWN	UP	7-1
	1-18	1 (T)	DOWN	DOWN	7-2
	1-18	1 (T)	UP	UP	7-3
	1-18	1 (T)	UP	DOWN	7-4
	1-18	2 (T)	DOWN	UP	7-5
	1-18	2 (T)	DOWN	DOWN	7-6
	1-18	2 (T)	UP	UP	7-7
	1-18	2 (T)**	UP	DOWN	7-8
	1-19	3 (B)	DOWN	UP	7-9
	1-19	3 (B)	DOWN	DOWN	7-10
	1-19	3 (B)	UP	UP	7-11
	1-19	3 (B)	UP	DOWN	7-12
	1-19	4 (B)	DOWN	UP	7-13
	1-19	4 (B)	DOWN	DOWN	7-14
	1-19	4 (B)	UP	UP	7-15
	1-19	4 (B)	UP	DOWN	7-16
	1-19	5 (B)	DOWN	UP	7-17
	1-19	5 (B)	DOWN	DOWN	7-18
	1-19	5 (B)	UP	UP	7-19
1-19	5 (B)	UP	DOWN	7-20	
GRUMMAN GULFSTREAM	1-20				
	1-21	1 (T)	DOWN	UP	8-1
	1-21	1 (T)	UP	UP	8-2
	1-21	1 (T)	UP	DOWN	8-3
	1-21	2 (T)	DOWN	UP	8-4
	1-21	2 (T)	UP	UP	8-5
	1-22	3 (B)	DOWN	UP	8-6
	1-22	3 (B)	DOWN	DOWN	8-7
	1-22	3 (B)	UP	UP	8-8
	1-22	3 (B)	UP	DOWN	8-9
	1-22	4 (B)	DOWN	UP	8-10
1-22	4 (B)	UP	UP	8-11	

* Vertical polarization used for all measurements.

† Top mounted (T).

** Bottom mounted (B).

TABLE 4

AIR CARRIER PATTERNS*

<u>AIRCRAFT</u>	<u>ANTENNA POSITION</u>	<u>WHEEL POSITION</u>	<u>POLARI- ZATION</u>	<u>MAP FIG. NO.</u>
BOEING 707 (Fig. 1-23)	TOP	UP	VERT	9-1
	TOP	UP	HORIZ	9-2
	BOTTOM	UP	VERT	9-3
	BOTTOM	UP	HORIZ	9-4
	BOTTOM	DOWN	VERT	9-5
	BOTTOM	DOWN	HORIZ	9-6
BOEING 727 (Fig. 1-24)	TOP	UP	VERT	10-1
	TOP	UP	HORIZ	10-2
	BOTTOM	UP	VERT	10-3
	BOTTOM	UP	HORIZ	10-4
	BOTTOM	DOWN	VERT	10-5
	BOTTOM	DOWN	HORIZ	10-6
BOEING 737 (Fig. 1-25)	TOP	UP	VERT	11-1
	TOP	UP	HORIZ	11-2
	BOTTOM	UP	VERT	11-3
	BOTTOM	UP	HORIZ	11-4
	BOTTOM	DOWN	VERT	11-5
	BOTTOM	DOWN	HORIZ	11-6
BOEING 747 (Fig. 1-26)	TOP	UP	VERT	12-1
	TOP	UP	HORIZ	12-2
	BOTTOM	UP	VERT	12-3
	BOTTOM	UP	HORIZ	12-4
	BOTTOM	DOWN	VERT	12-5
	BOTTOM	DOWN	HORIZ	12-6

* Flaps "up" (seated) always.



Fig. 1-2. Cessna 150, three-quarter view.

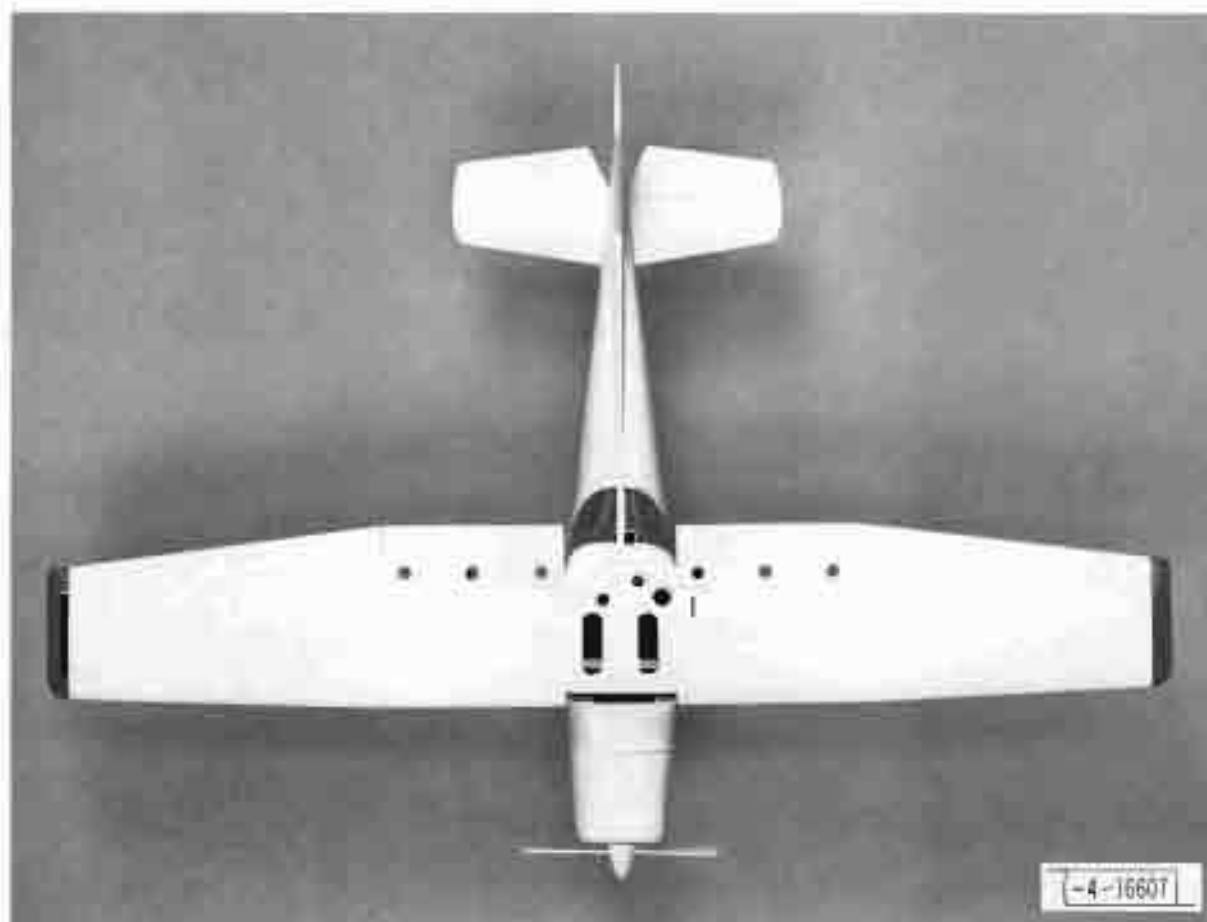


Fig. 1-3. Cessna 150, top view showing antenna position 1.

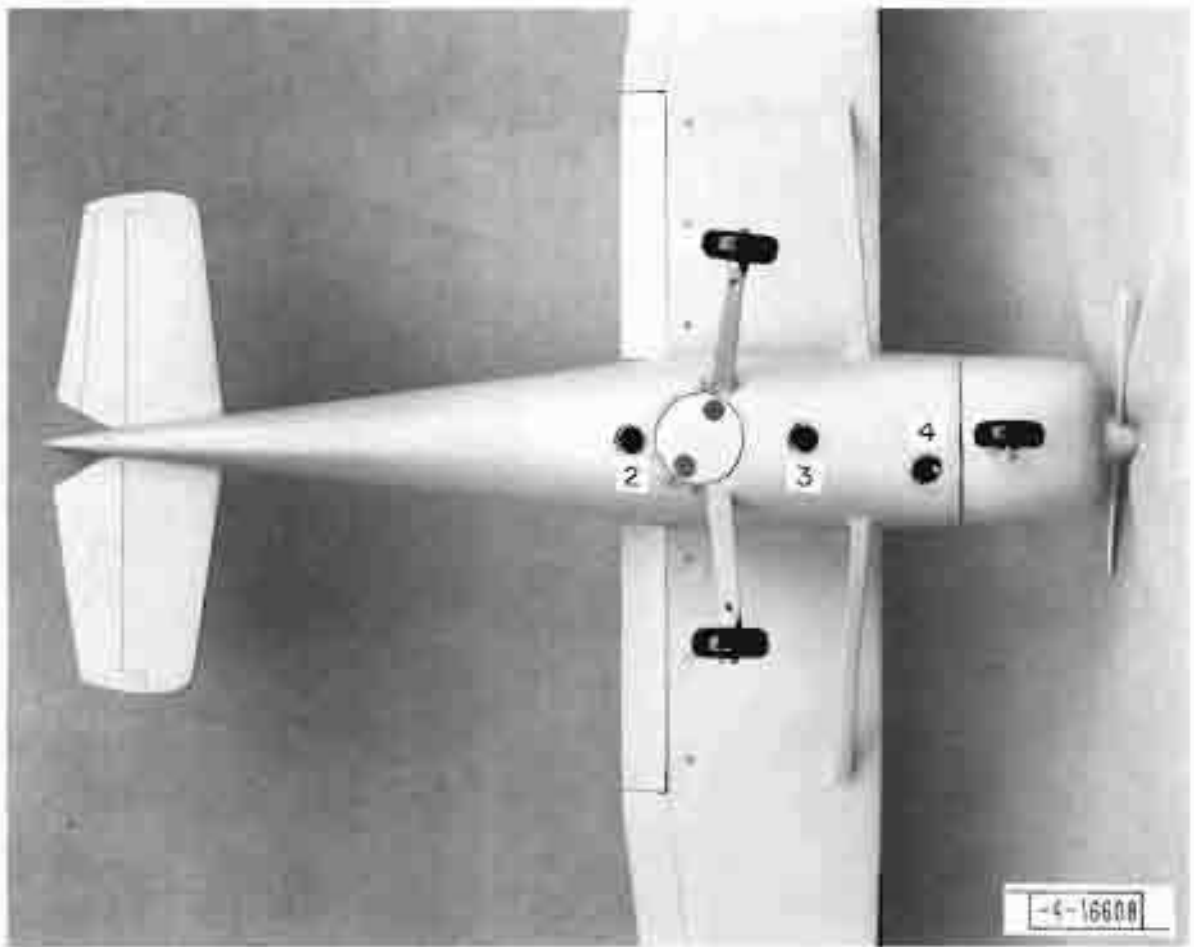


Fig. 1-4. Cessna 150, bottom view showing antenna positions 2, 3 and 4.



Fig. 1-5. Piper Cherokee Arrow, three-quarter view.

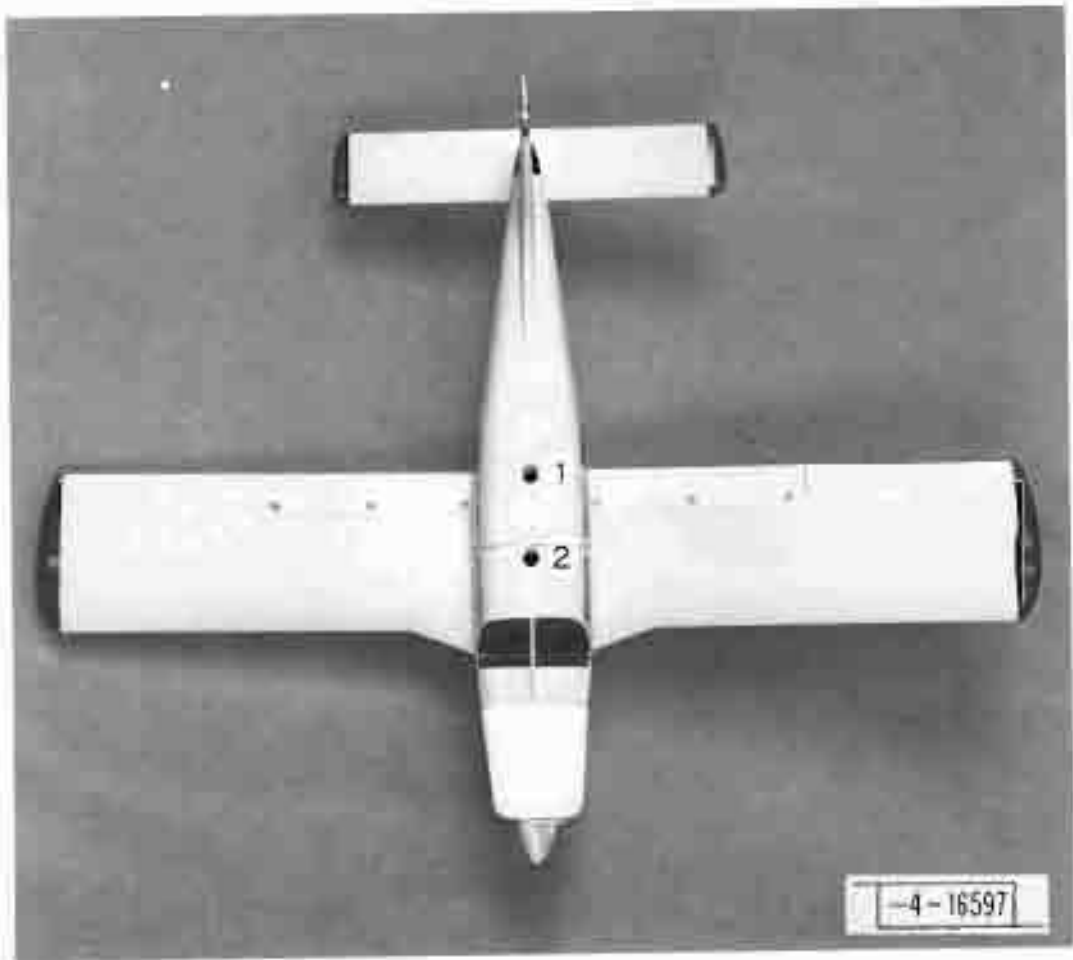


Fig. 1-6. Piper Cherokee Arrow, top view showing antenna positions 1 and 2.

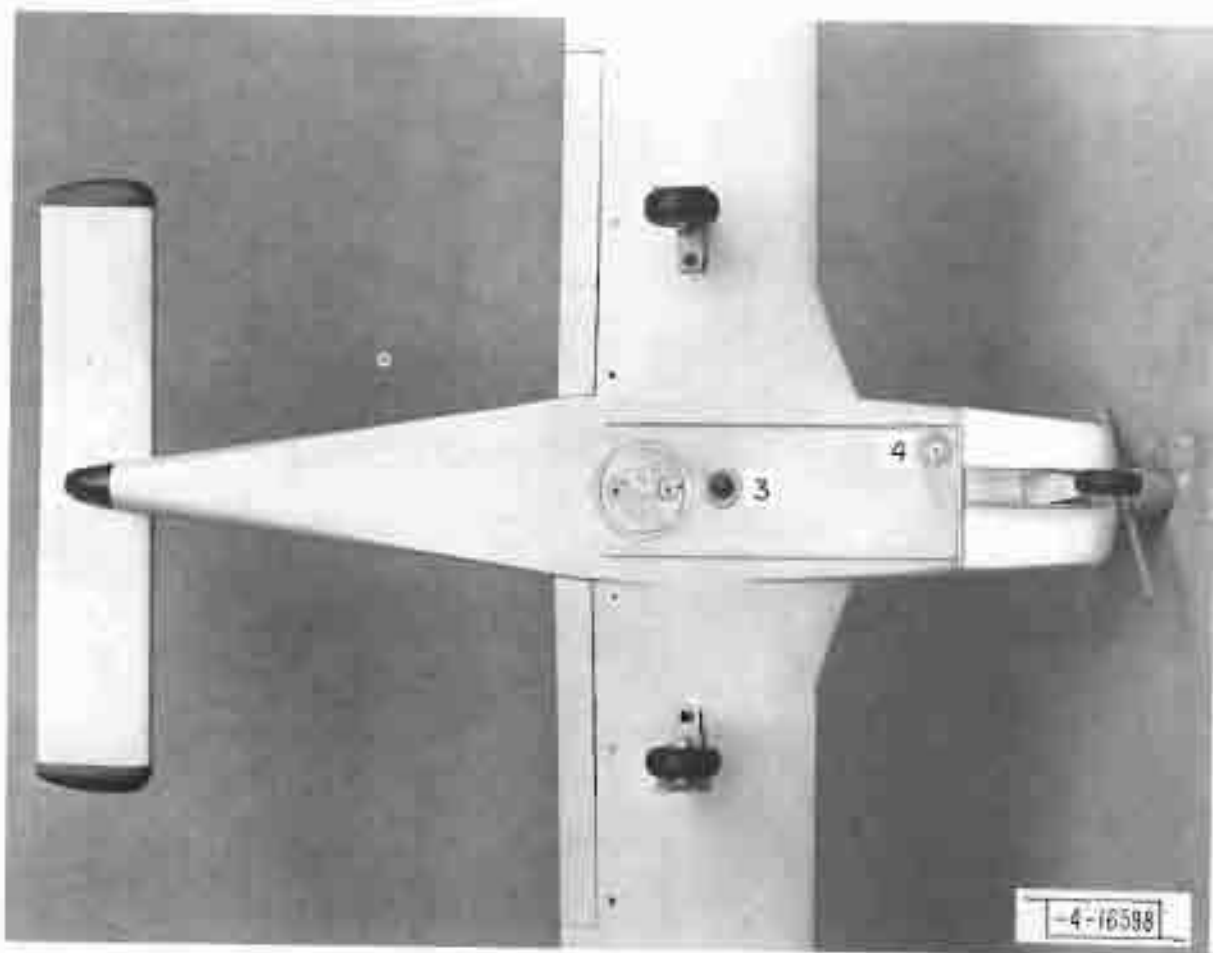


Fig. 1-7. Piper Cherokee Arrow, bottom view showing antenna positions 3 and 4.



Fig. 1-8. Helio U10D, three-quarter view.

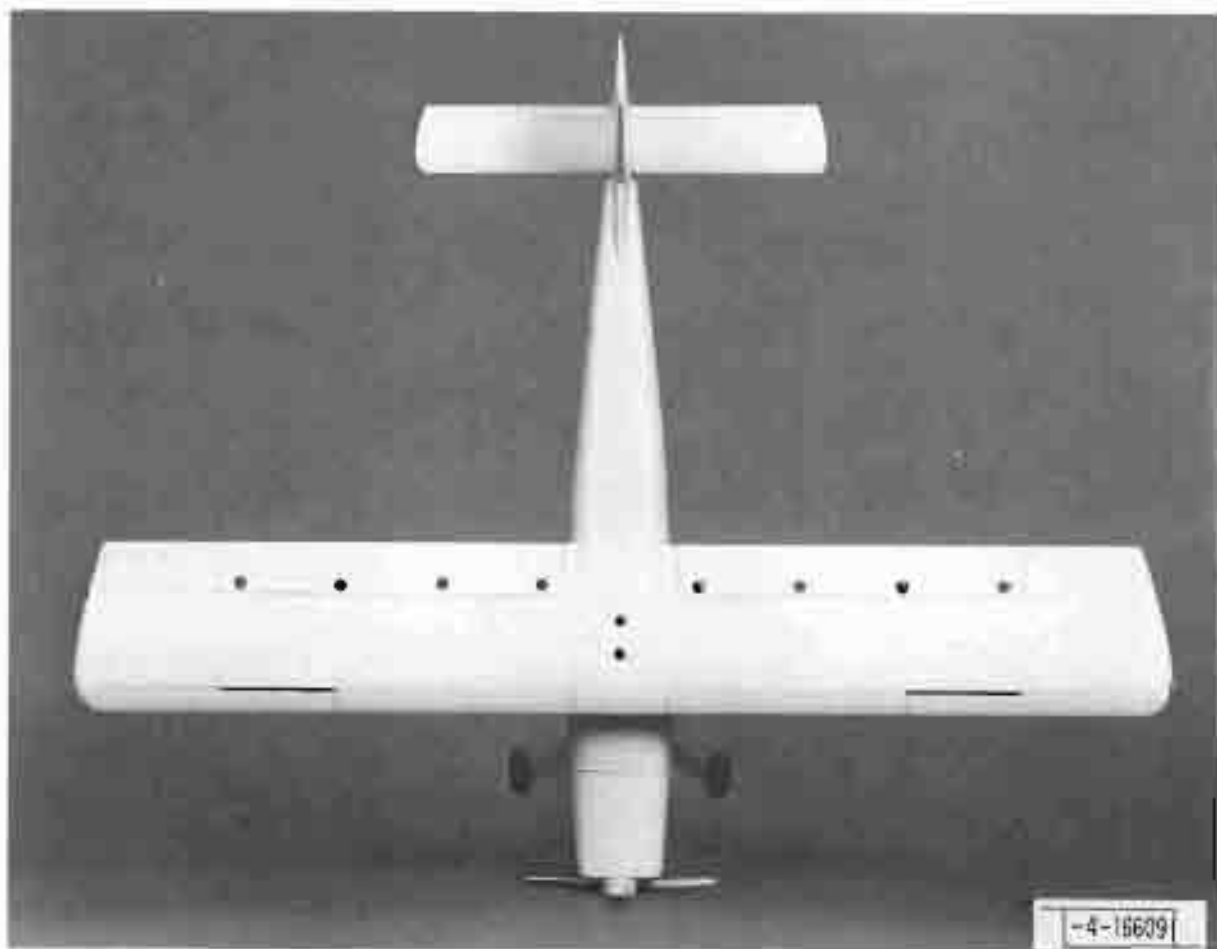


Fig. 1-9. Helio U10D, top view.

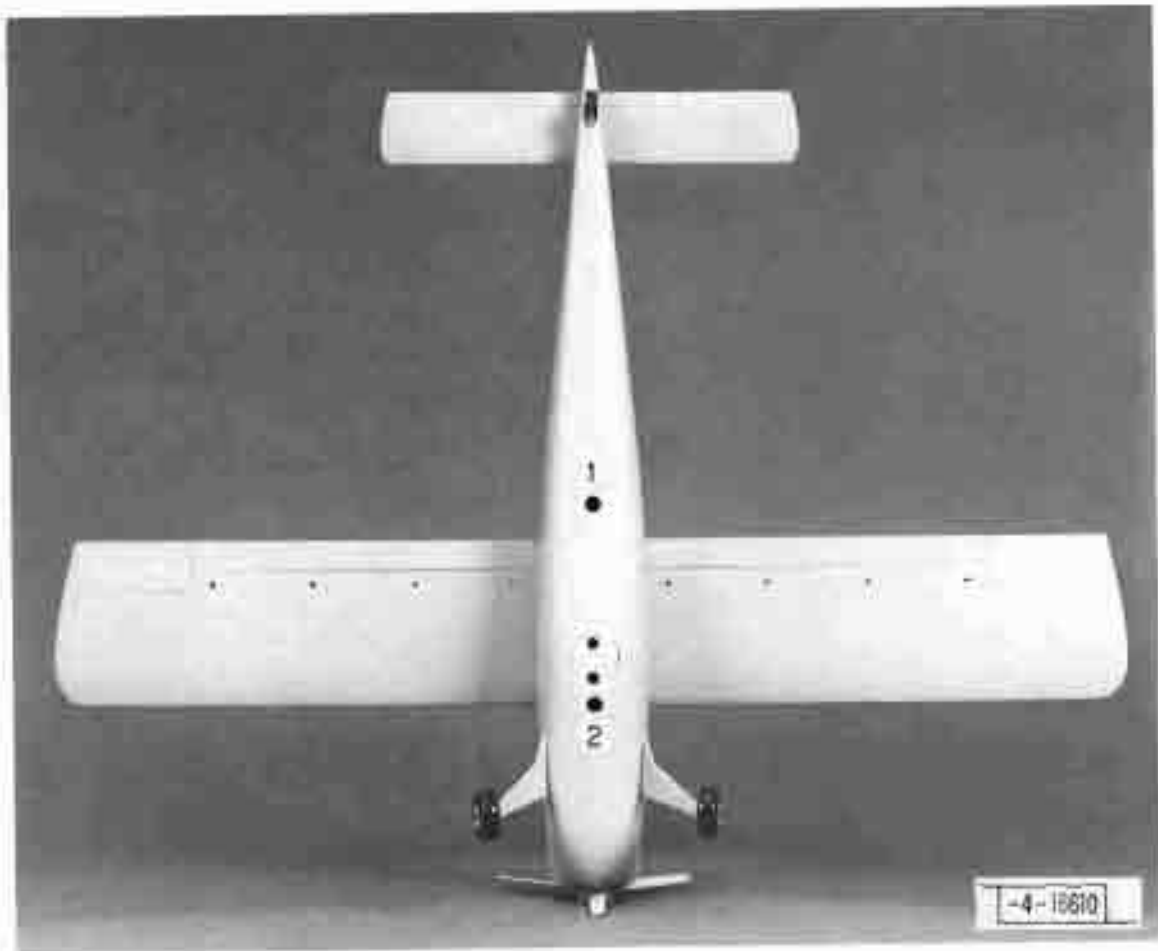


Fig. 1-10. Helio U10D, bottom view showing antenna positions 1 and 2.



Fig. 1-11. Beechcraft Baron, three-quarter view.

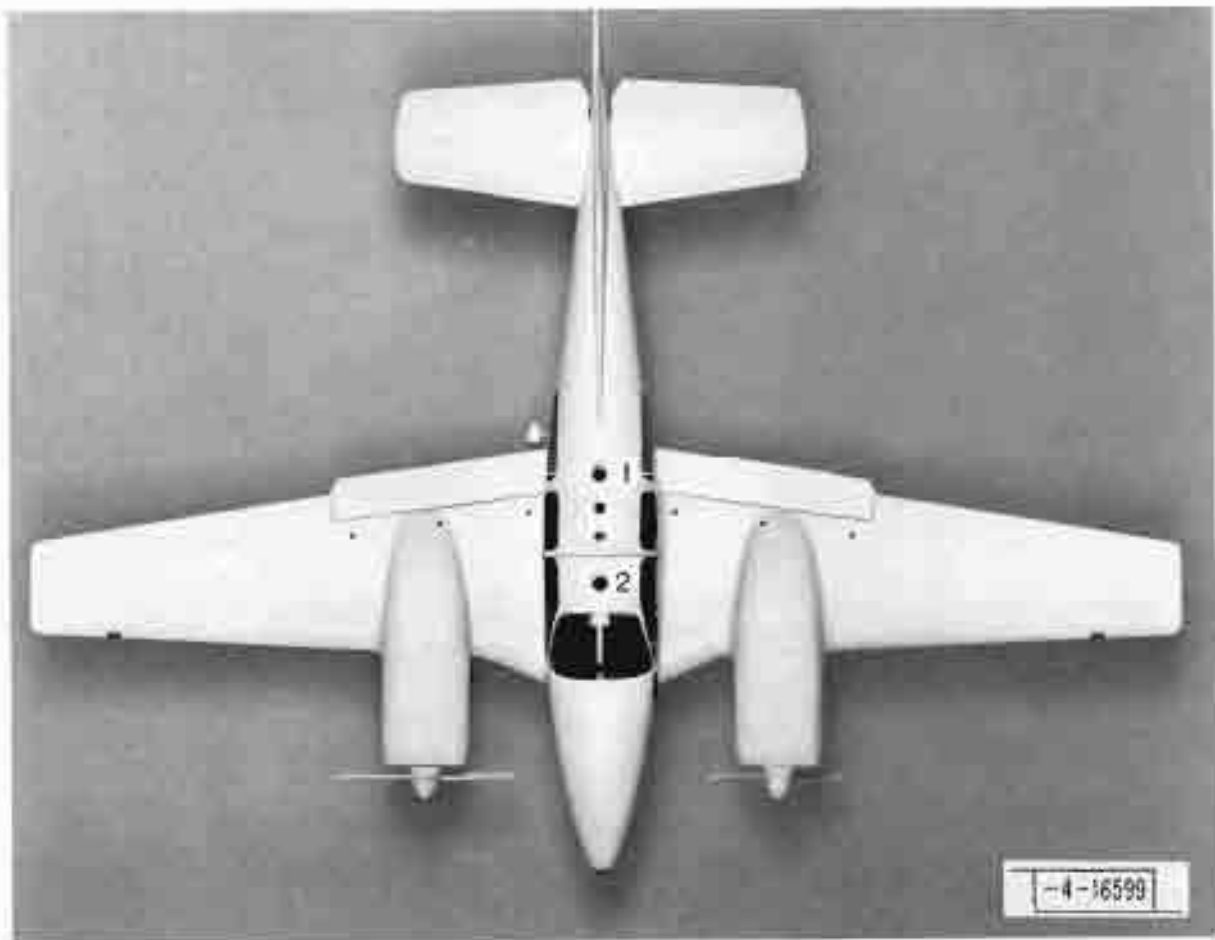


Fig. 1-12. Beechcraft Baron, top view showing antenna positions 1 and 2.

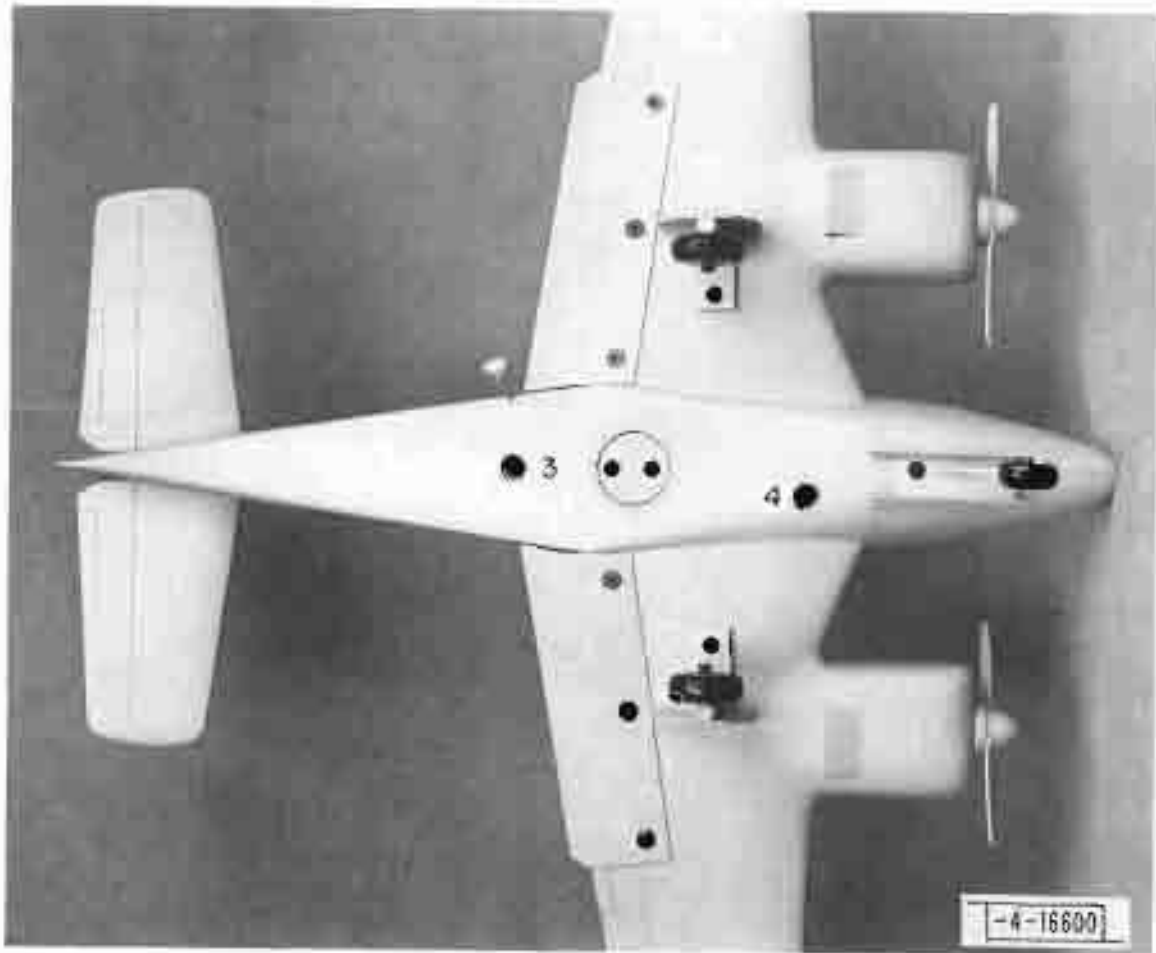


Fig. 1-13. Beechcraft Baron, bottom view showing antenna positions 3 and 4.



Fig. 1-14. Beechcraft B99, three-quarter view.



Fig. 1-15. Beechcraft B99, top view showing antenna positions 1 and 2.

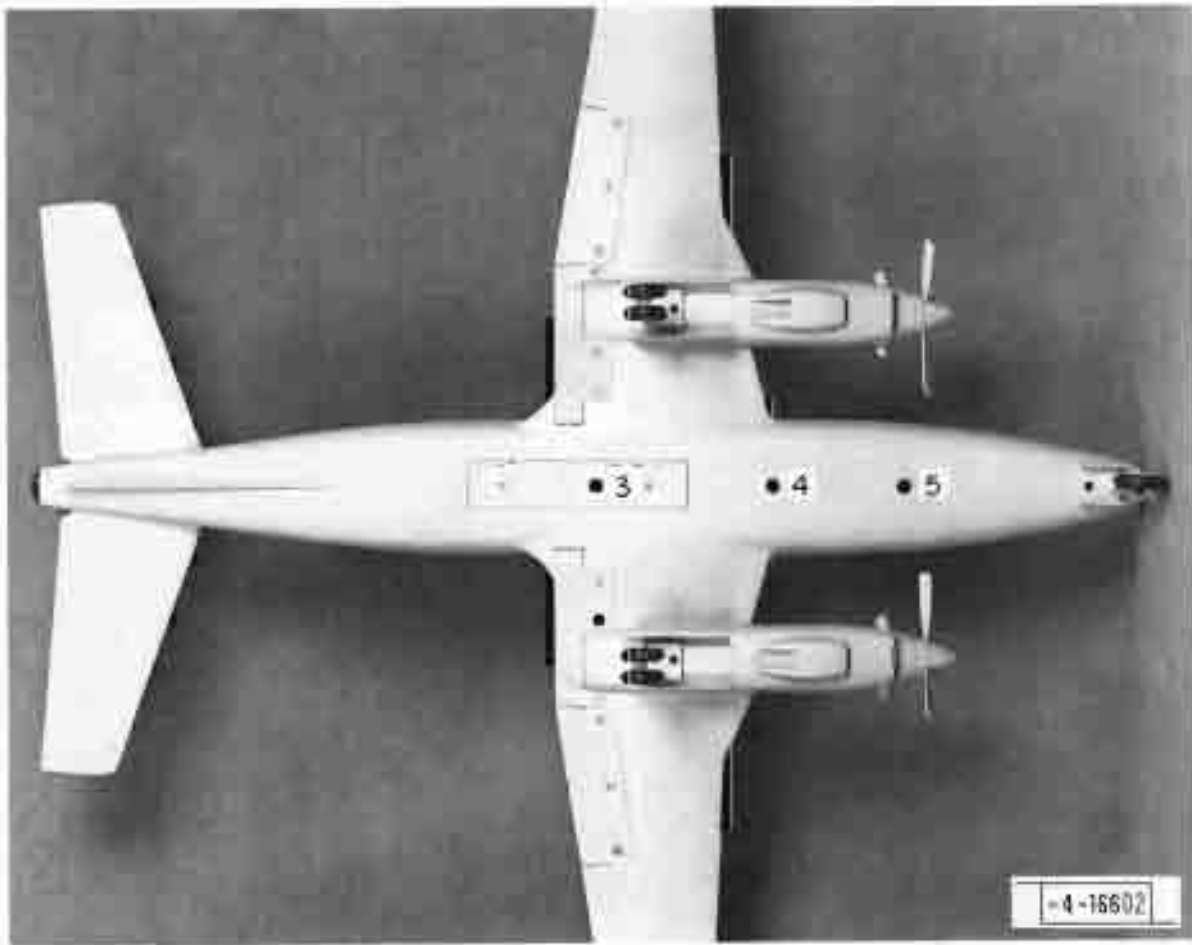


Fig. 1-16. Beechcraft B99, bottom view showing antenna positions 3, 4 and 5.



Fig. 1-17. Gates Lear Jet, three-quarter view.



Fig. I-18. Gates Lear Jet, top view showing antenna positions 1 and 2.

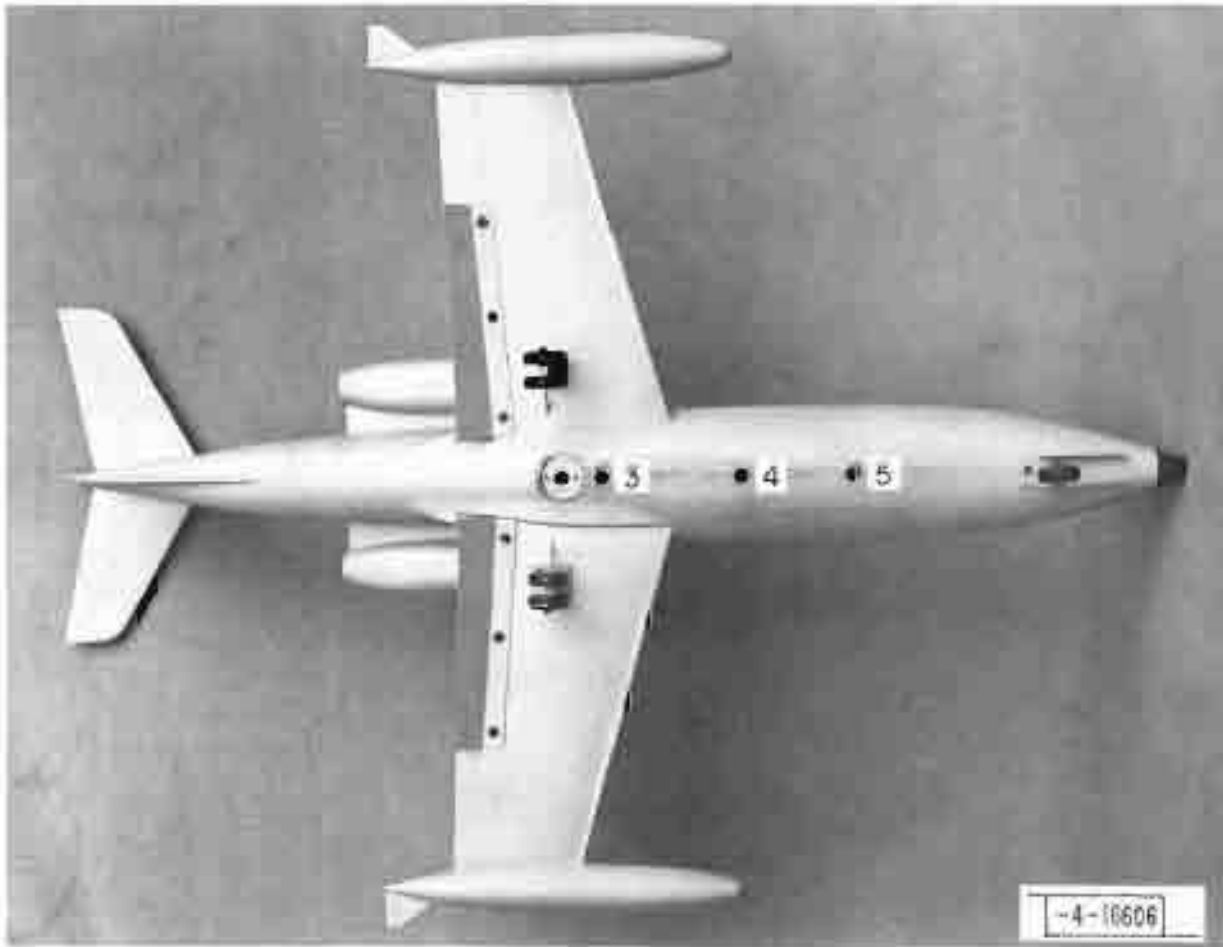


Fig. 1-19. Gates Lear Jet, bottom view showing antenna positions 3, 4 and 5.



Fig. 1-20. Grumman Gulfstream, three-quarter view.



Fig. 1-21. Grumman Gulfstream, top view showing antenna positions 1 and 2.

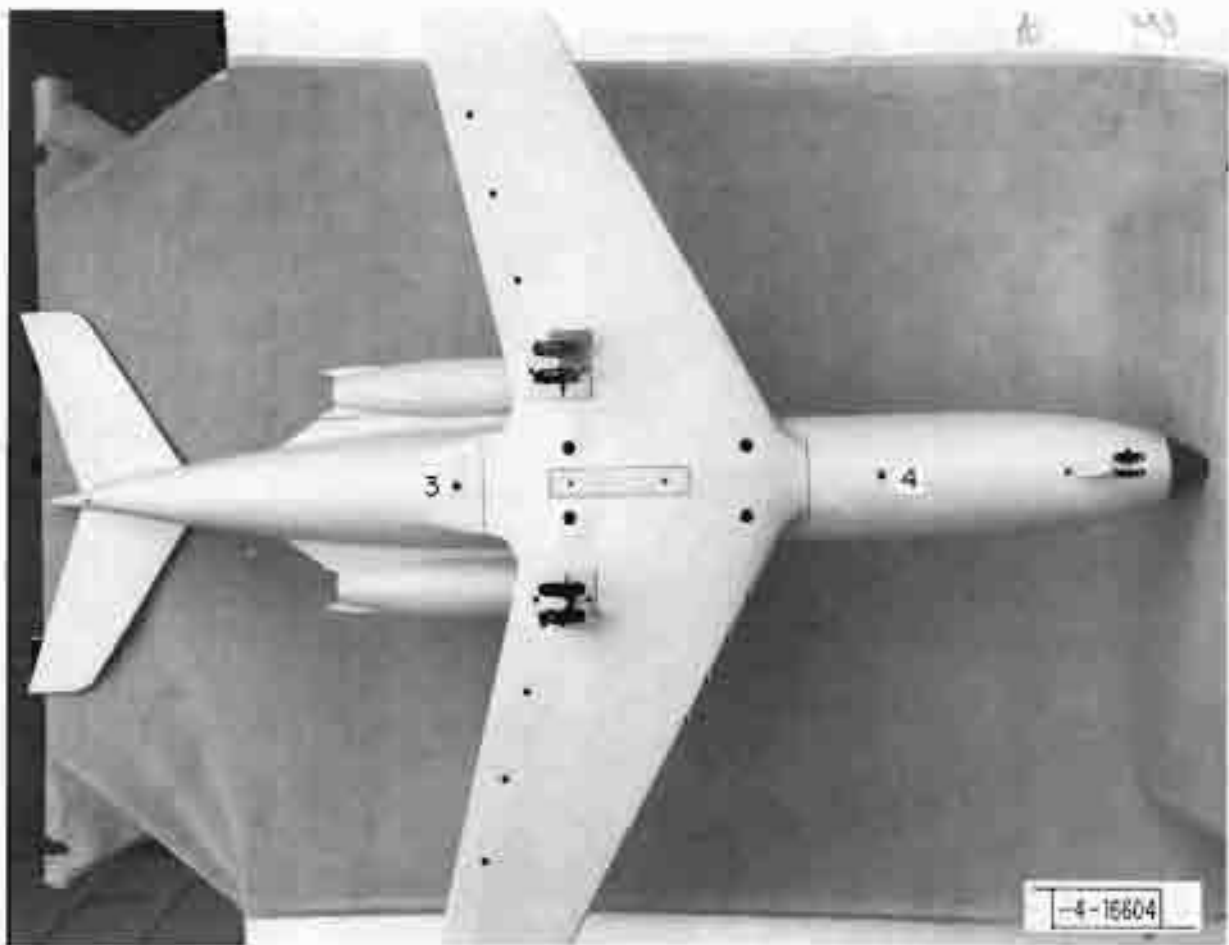


Fig. 1-22. Grumman Gulfstream, bottom view showing antenna positions 3 and 4.

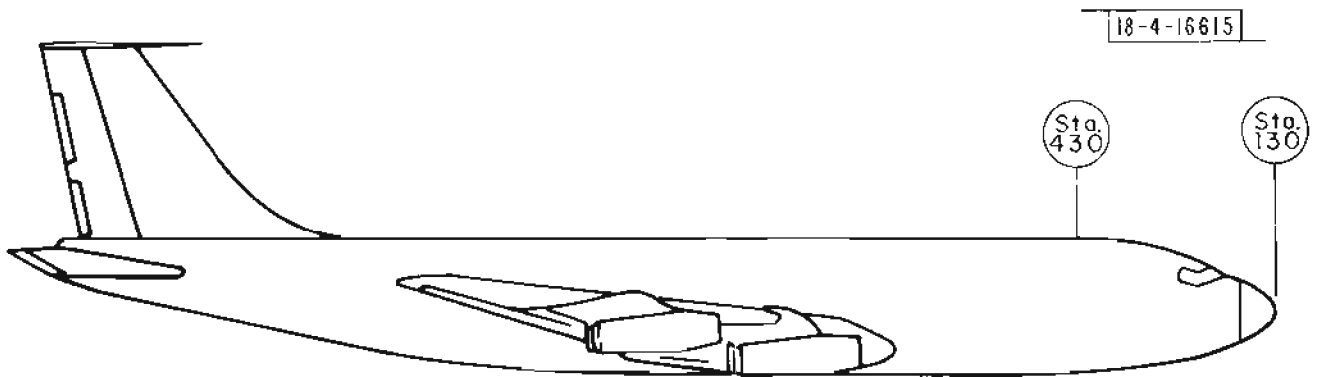


Fig. 1-23(a). Boeing 707, side view showing station position of antennas 1 and 2.

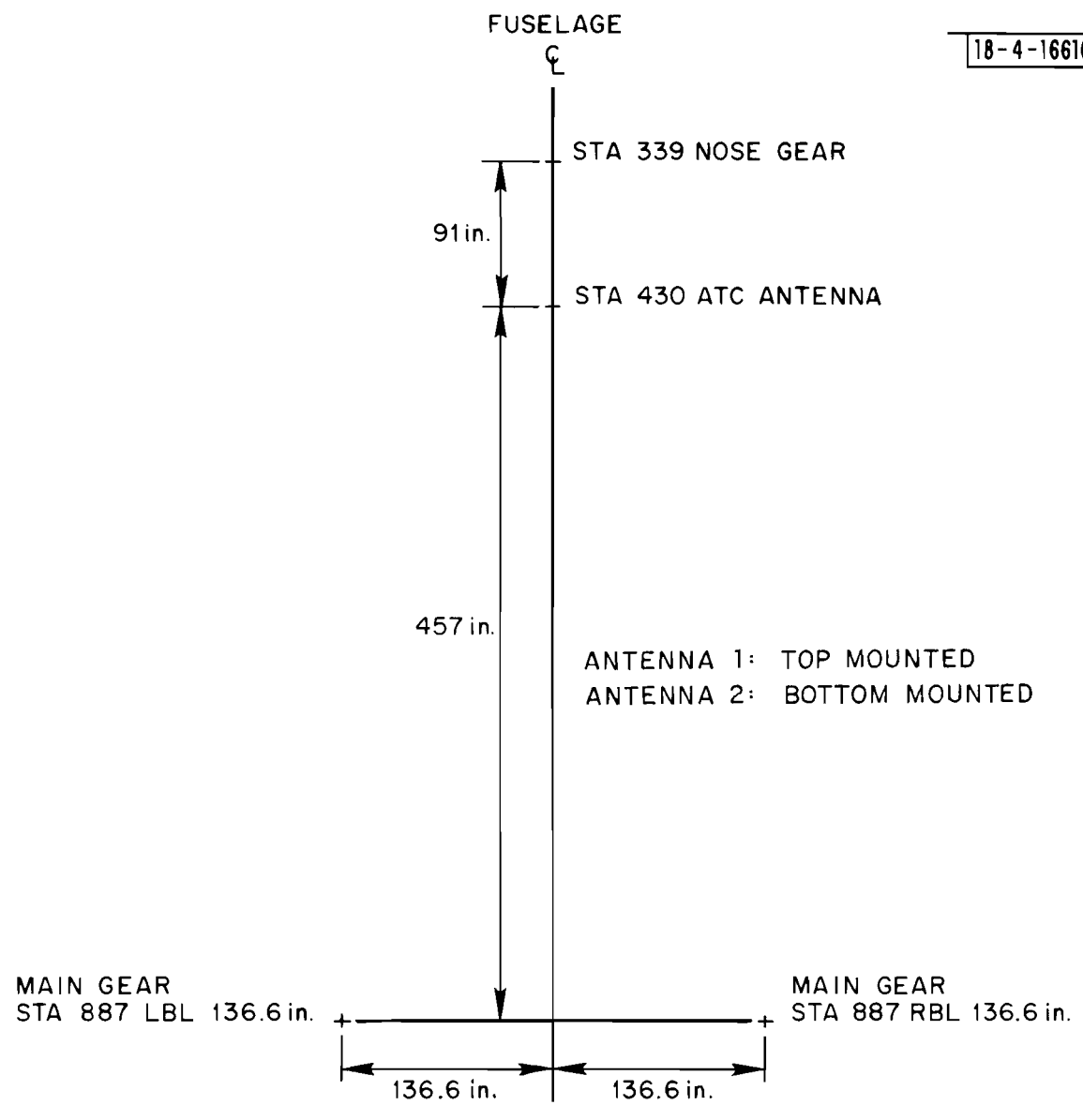


Fig. 1-23(b). Boeing 707, relative positions of landing gear to antenna station.

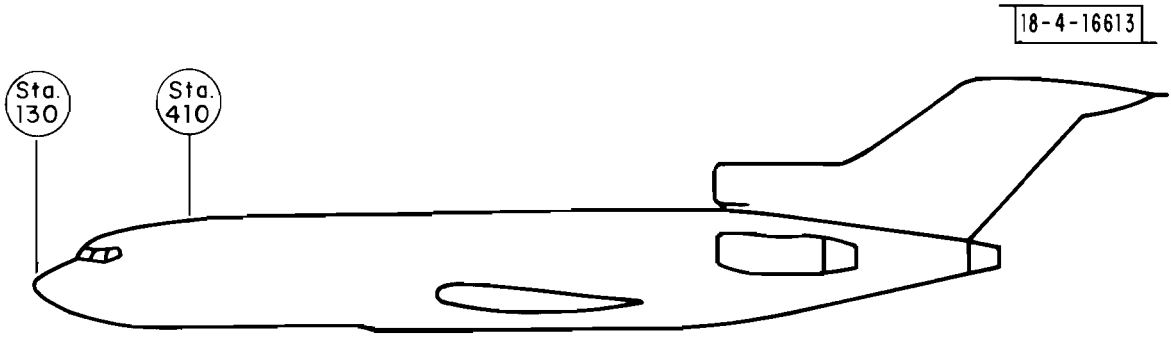


Fig. 1-24(a). Boeing 727, side view showing station position of antennas 1 and 2.

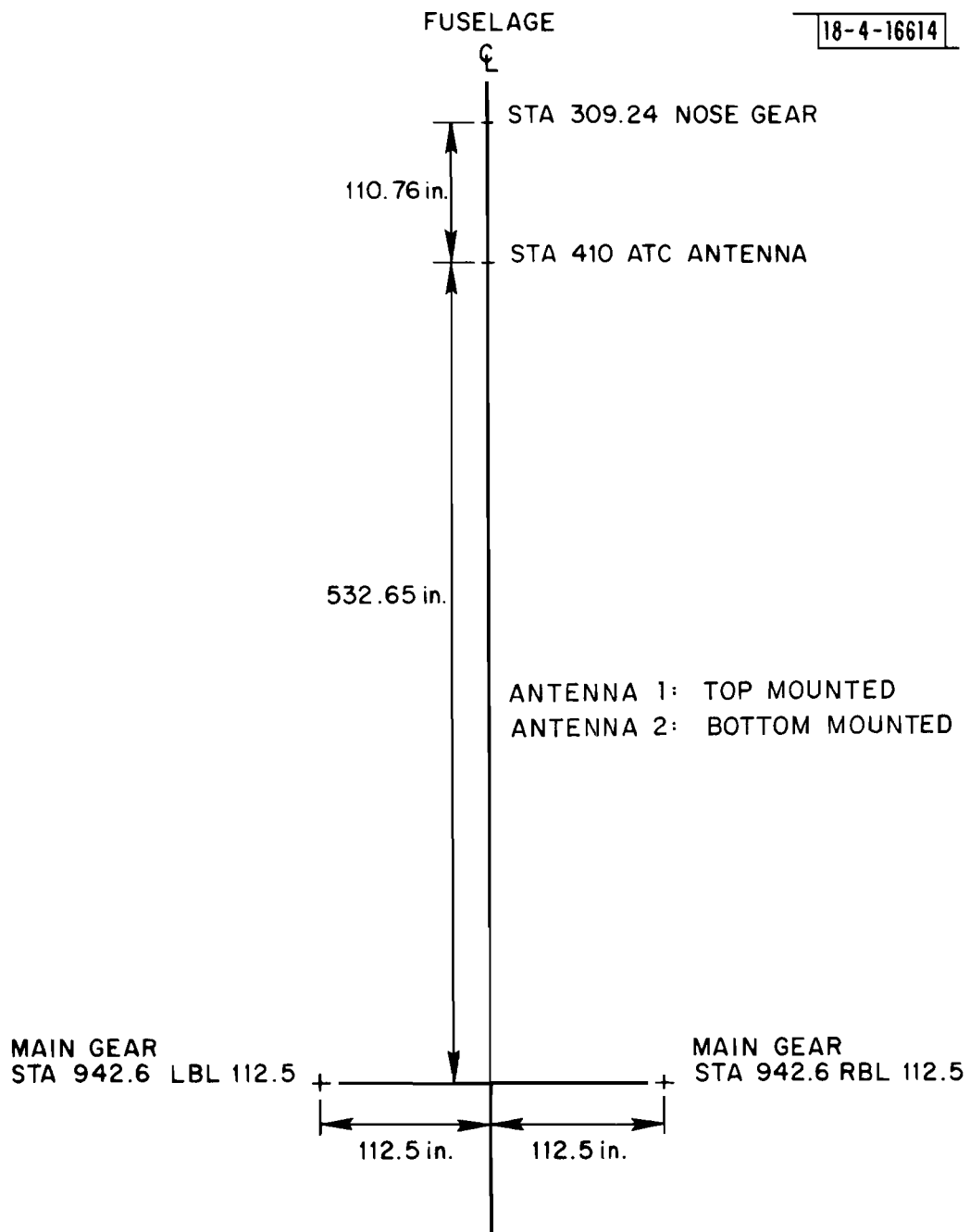


Fig. 1-24(b). Boeing 727, relative positions of landing gear to antenna station.

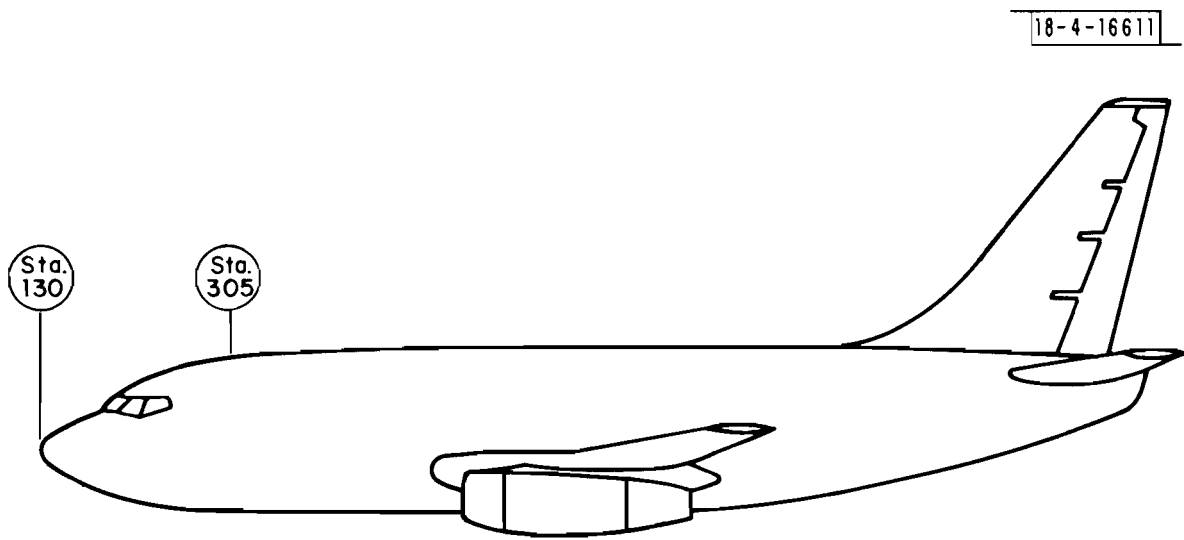


Fig. 1-25(a). Boeing 737, side view showing station position of antennas 1 and 2.

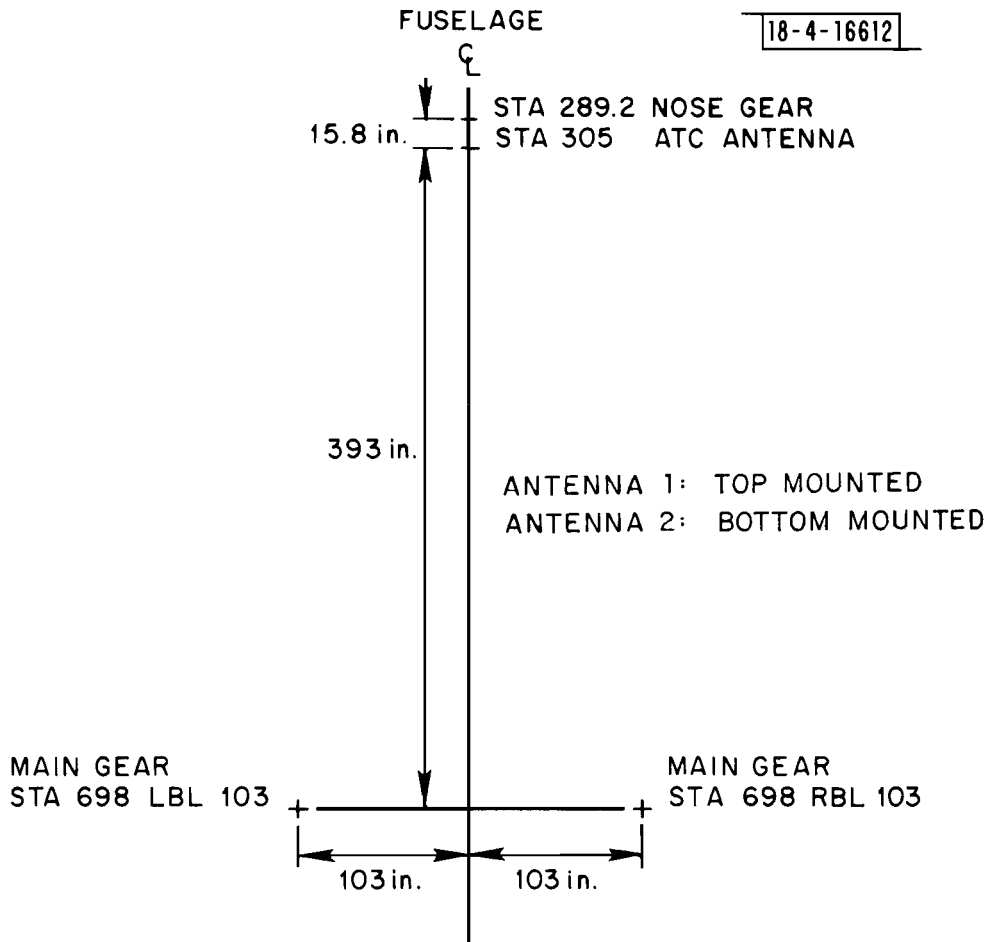


Fig. 1-25(b). Boeing 737, relative position of landing gear to antenna station.

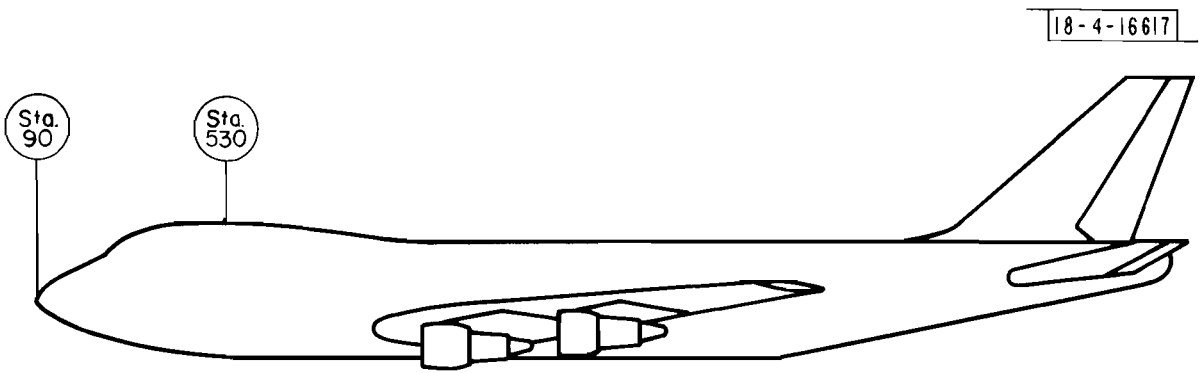


Fig. 1-26(a). Boeing 747, side view showing station position of antennas 1 and 2.

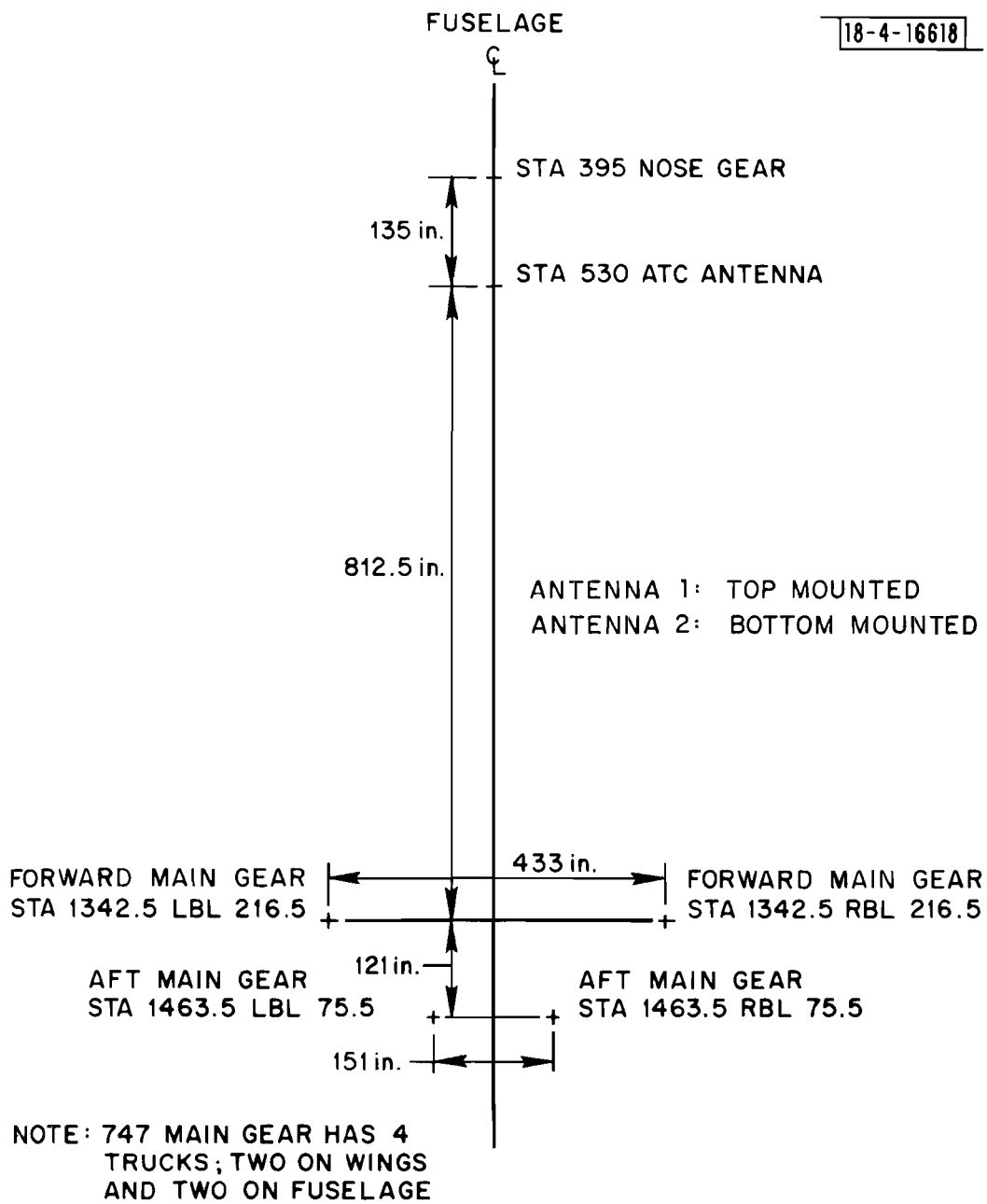


Fig. 1-26(b). Boeing 747, relative positions of landing gear to antenna station.

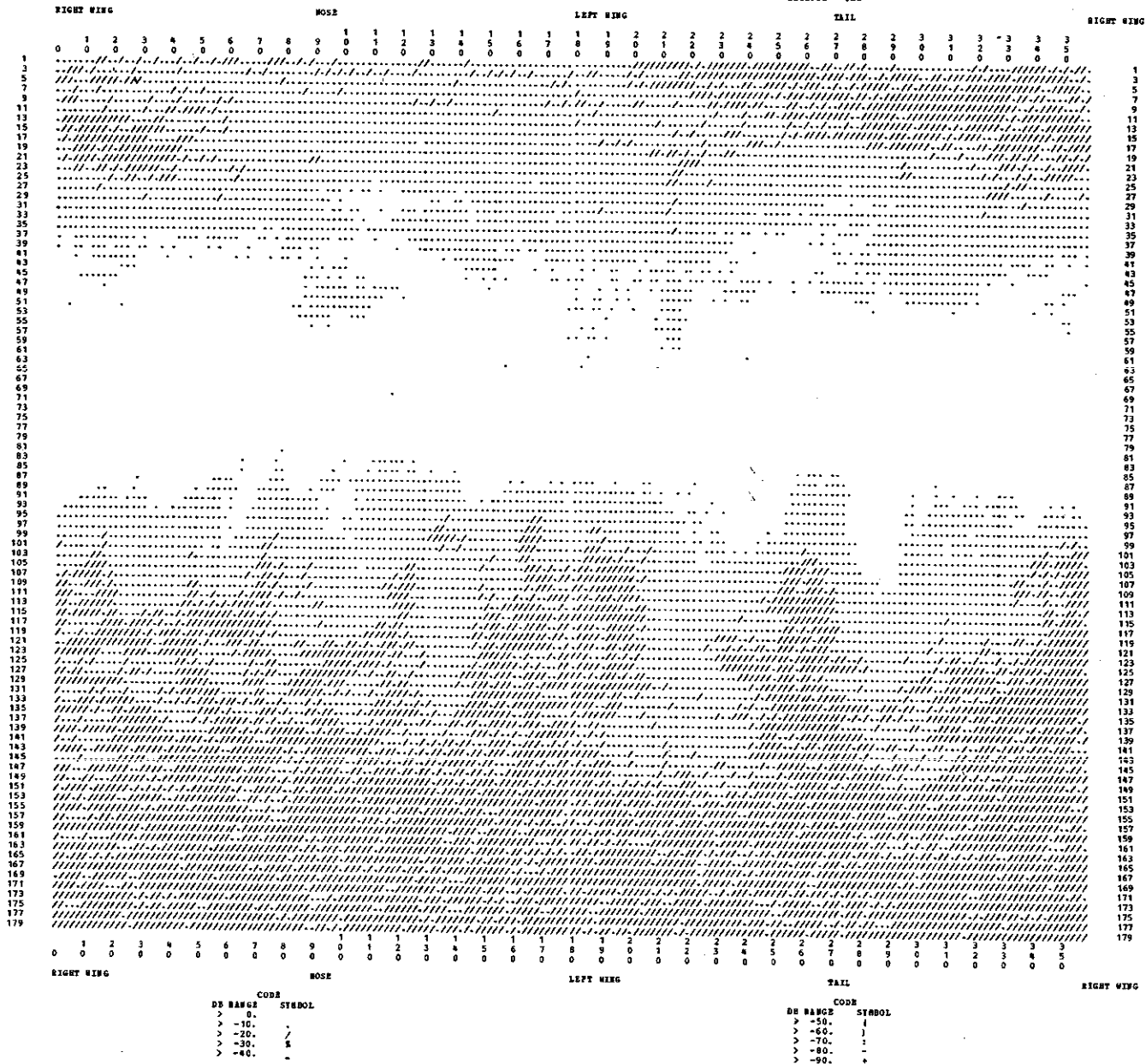
VI. Aircraft Antenna Maps

GENERAL AVIATION

1. Single Engine
 - (a) Cessna 150
 - (b) Piper Cherokee Arrow
 - (c) Helio U10D
2. Twin Engine
 - (a) Beechcraft Baron
 - (b) Beechcraft Baron 99
3. Small Jets
 - (a) Gates Lear
 - (b) Grumman Gulfstream

AIRCRAFT TYPE = C150, CESSNA 150
 CONDITIONS = 11 WHEELS DOWN, FLAPS UP, TOP HOISTED ANTENNA, VERTICAL POLARIZATION
 AZIMUTH - PHI

AIRCRAFT TYPE = C150, CESSNA 150
 CONDITIONS = 11 WHEELS DOWN, FLAPS UP, TOP HOISTED ANTENNA, VERTICAL POLARIZATION
 AZIMUTH - PHI



39

Fig. 2-1. Cessna 150; antenna position 1 (T); wheels down, flaps up.

AIRCRAFT TYPE - C150, CESSNA 150
 CONDITIONS - 21 WHEELS DOWN, FLAPS DOWN, TOP HOISTED ANTENNA, VERTICAL POLARIZATION
 AZIMUTH - PHI

AIRCRAFT TYPE - C150, CESSNA 150
 CONDITIONS - 21 WHEELS DOWN, FLAPS DOWN, TOP HOISTED ANTENNA, VERTICAL POLARIZATION
 AZIMUTH - PHI

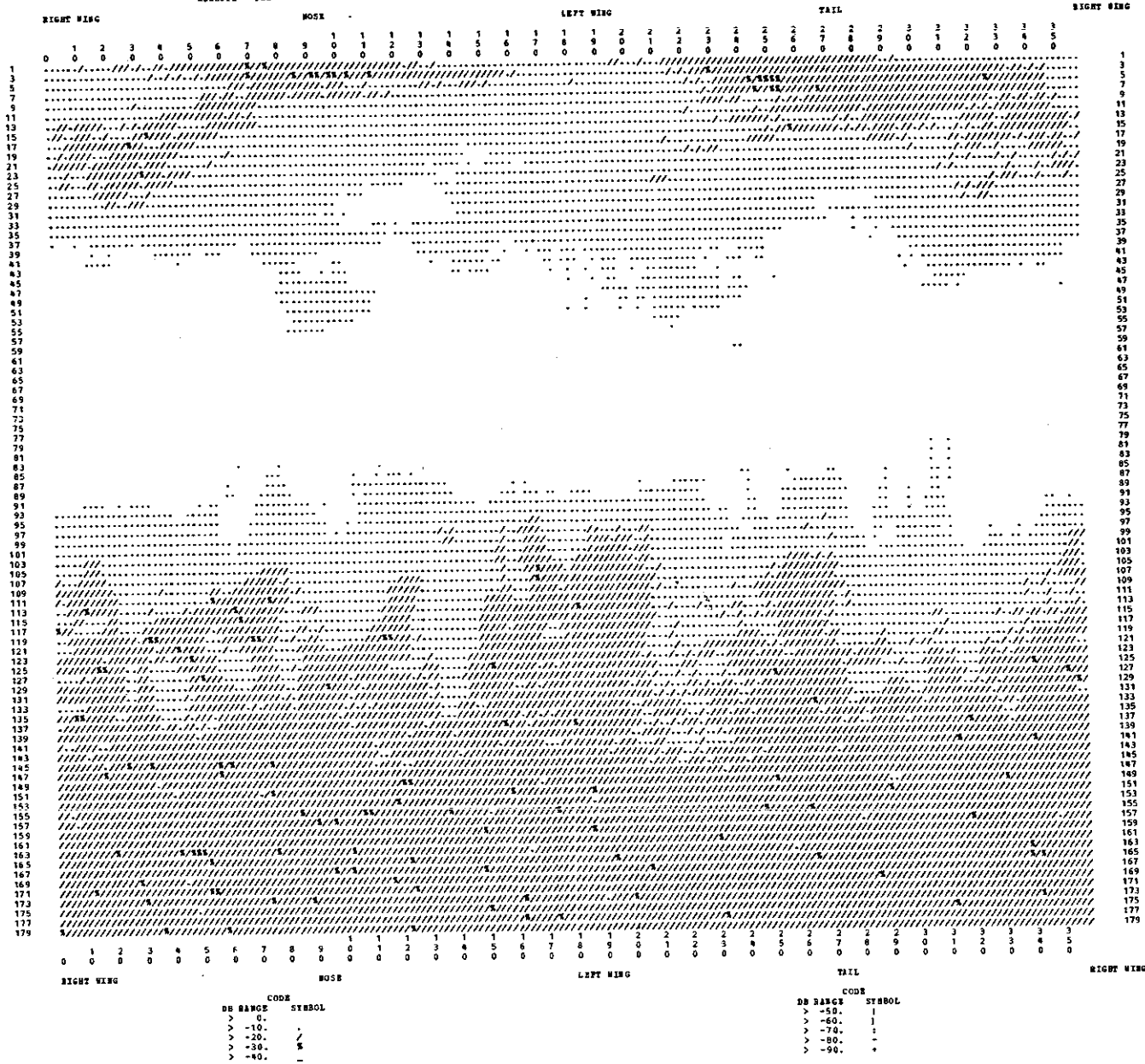


Fig. 2-2. Cessna 150; antenna position 1(T); wheels down, flaps down.

AIRCRAFT TYPE - C150, CESSNA 150
 CONDITIONS - 12 WHEELS DOWN, FLAPS UP, BOTTOM MOUNTED ANTENNA, VERTICAL POLARIZATION

AIRCRAFT TYPE - C150, CESSNA 150
 CONDITIONS - 12 WHEELS DOWN, FLAPS UP, BOTTOM MOUNTED ANTENNA, VERTICAL POLARIZATION

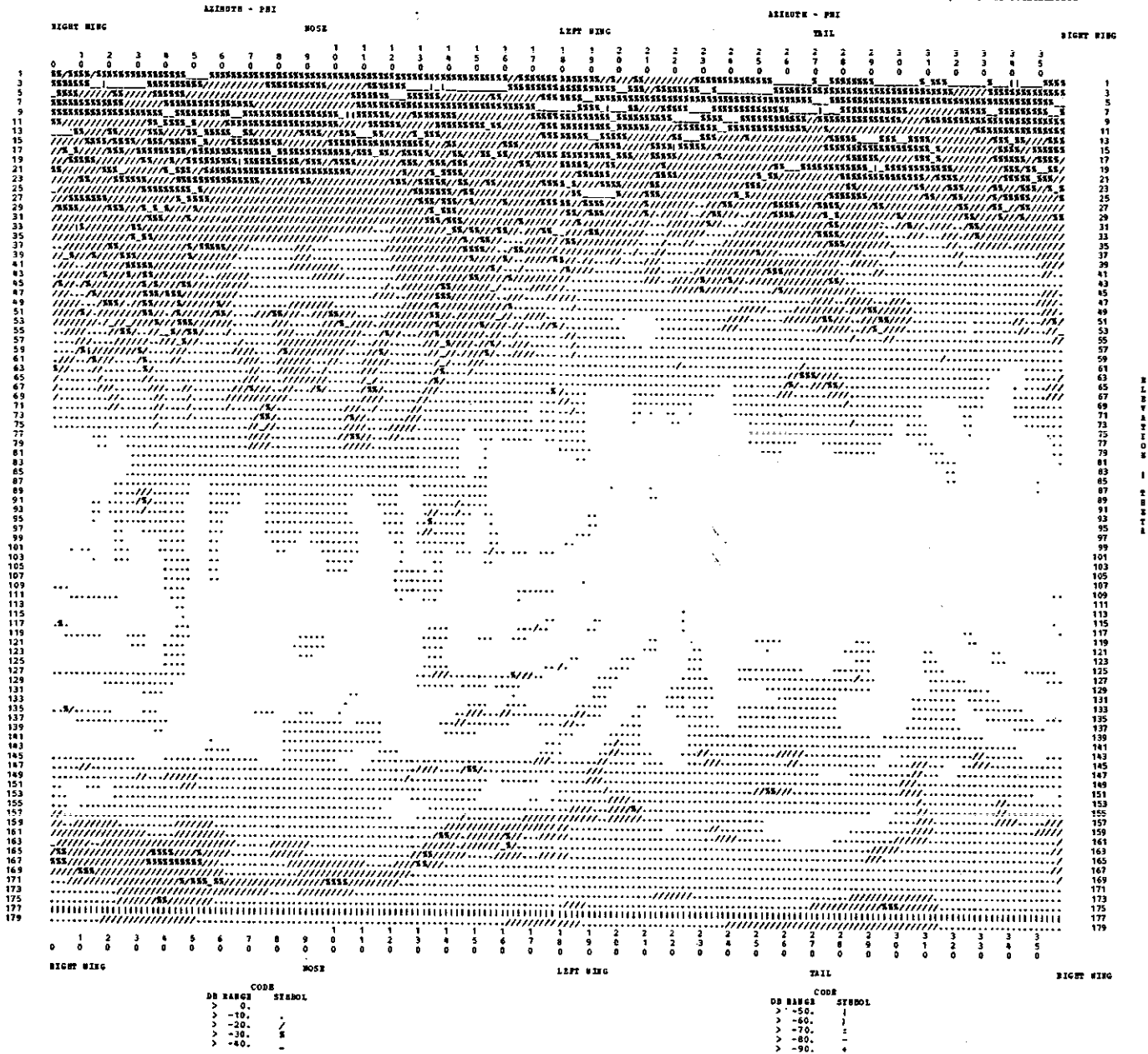
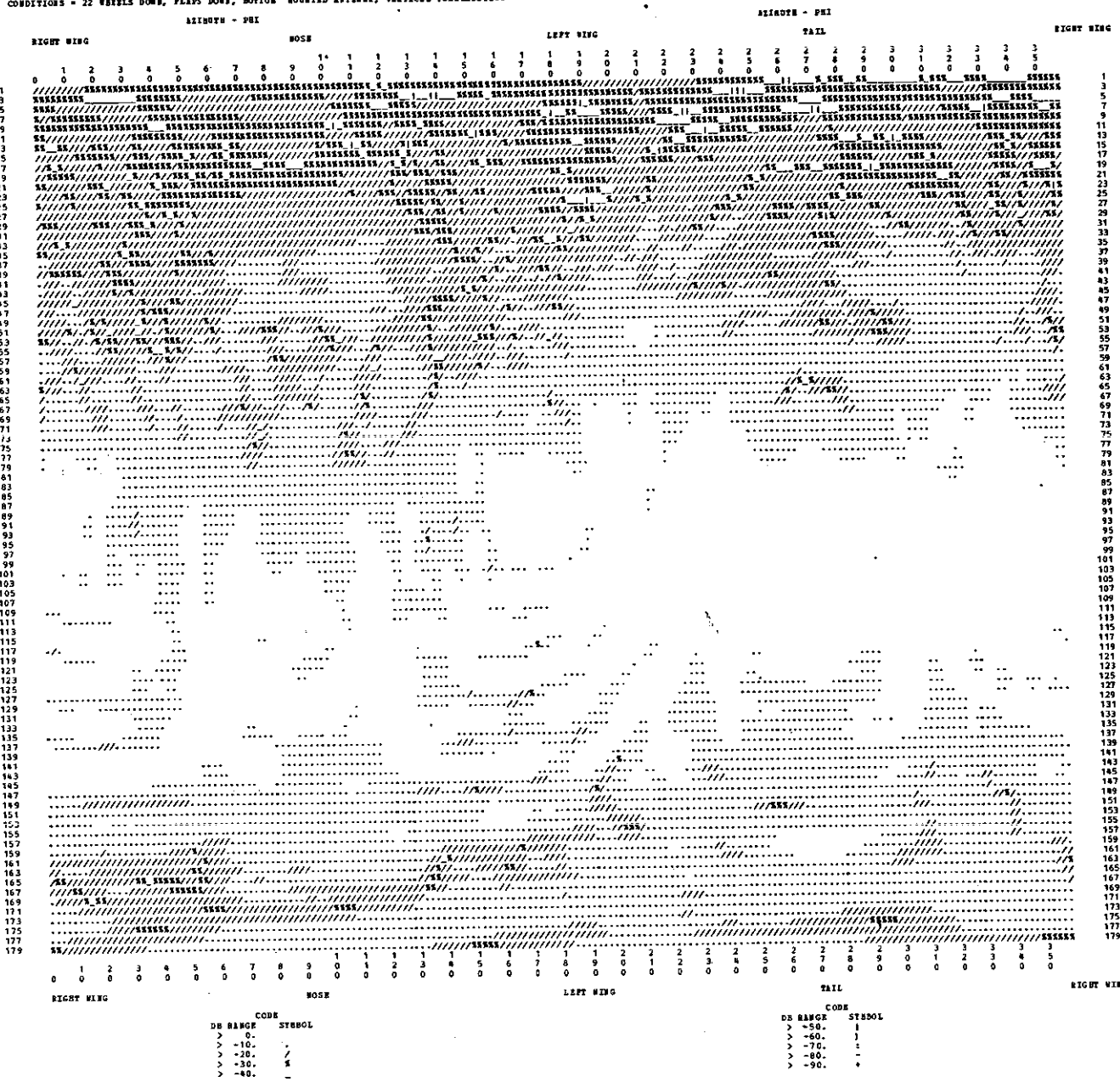


Fig. 2-3. Cessna 150; antenna position 2 (B); wheels down, flaps up.

AIRCRAFT TYPE = C150 , CESSNA 150
 CONDITIONS = 22 WHEELS DOWN, FLAPS DOWN, BOTTOM MOUNTED ANTENNA, VERTICAL POLARIZATION

AIRCRAFT TYPE = C150 , CESSNA 150
 CONDITIONS = 22 WHEELS DOWN, FLAPS DOWN, BOTTOM MOUNTED ANTENNA, VERTICAL POLARIZATION

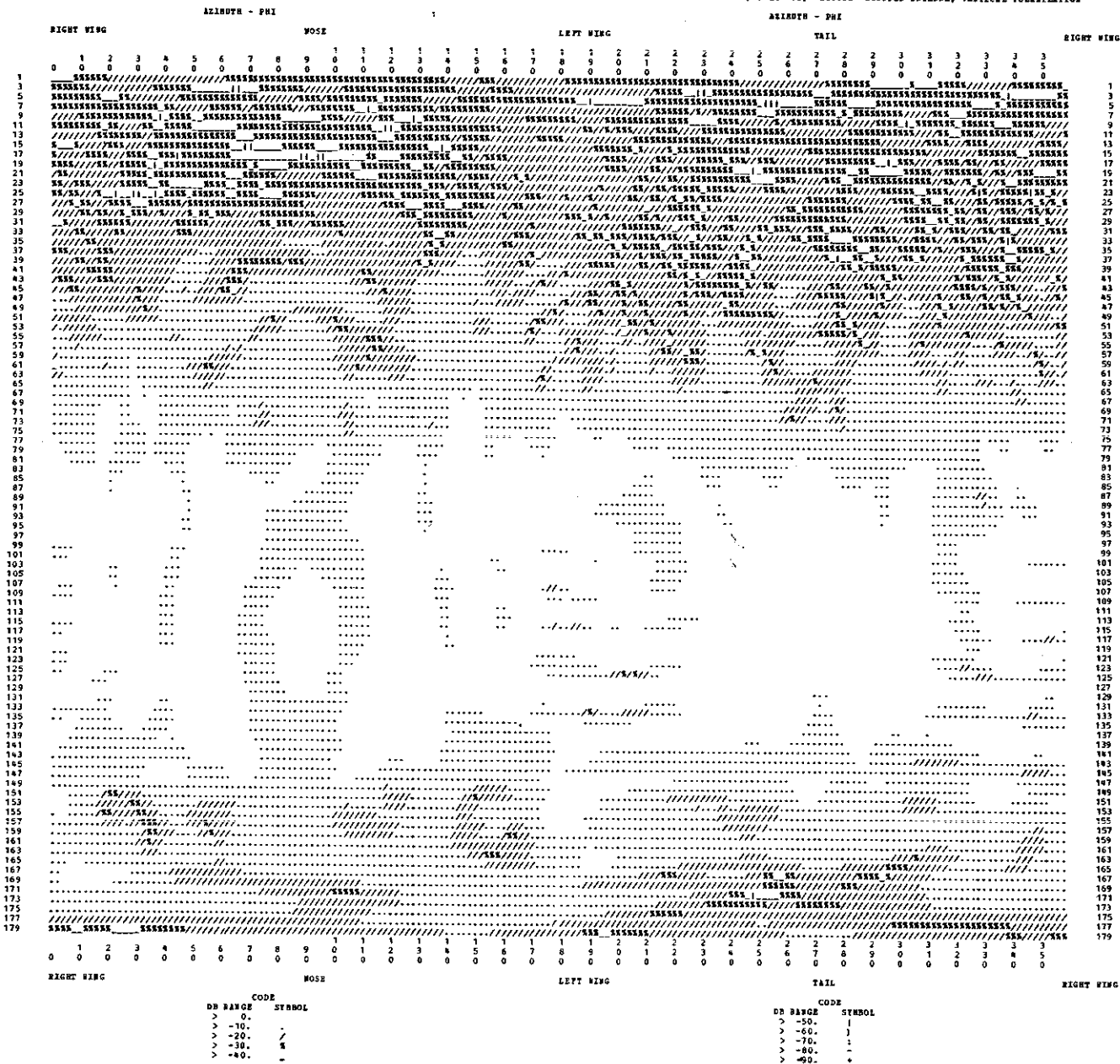


42

Fig. 2-4. Cessna 150; antenna position 2 (B); wheels down, flaps down.

CONDITIONS = 13 WHEELS DOWN, FLAPS UP, BOTTOM MOUNTED ANTENNA, VERTICAL POLARIZATION

CONDITIONS = 13 WHEELS DOWN, FLAPS UP, BOTTOM MOUNTED ANTENNA, VERTICAL POLARIZATION



43

Fig. 2-5. Cessna 150; antenna position 3 (B); wheels down, flaps up.

AIRCRAFT TYPE - C150, CESSNA 150
 CONDITIONS - 23 WHEELS DOWN, FLAPS DOWN, BOTTOM MOUNTED ANTENNA, VERTICAL POLARIZATION

AIRCRAFT TYPE - C150, CESSNA 150
 CONDITIONS - 23 WHEELS DOWN, FLAPS DOWN, BOTTOM MOUNTED ANTENNA, VERTICAL POLARIZATION

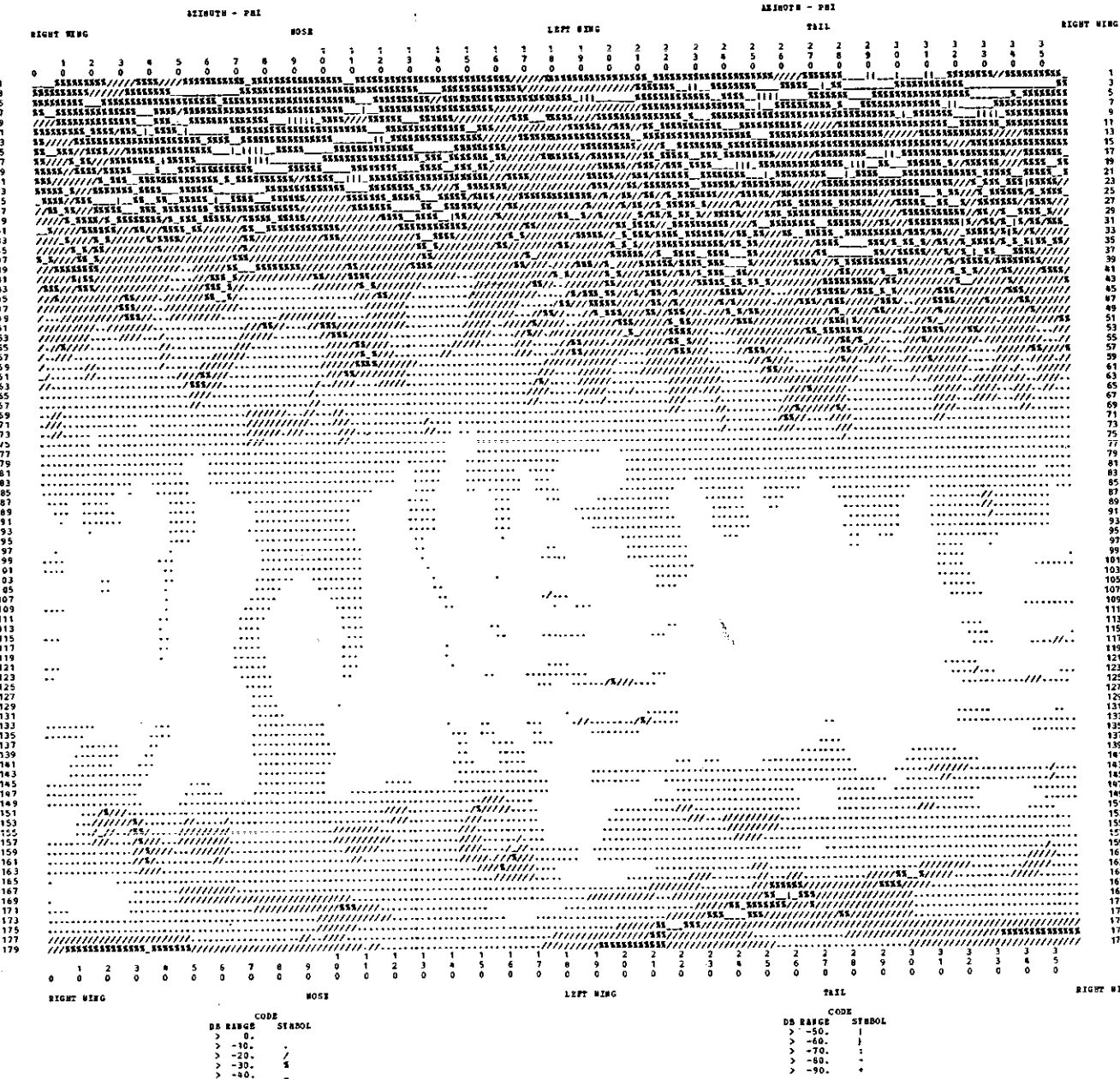


Fig. 2-6. Cessna 150; antenna position 3 (B); wheels down, flaps down.

AIRCRAFT TYPE = C150, CESSNA 150
 CONDITIONS = 14 WHEELS DOWN, FLAPS UP, ROTOR MOUNTED ANTENNA, VERTICAL POLARIZATION

AIRCRAFT TYPE = C150, CESSNA 150
 CONDITIONS = 14 WHEELS DOWN, FLAPS UP, ROTOR MOUNTED ANTENNA, VERTICAL POLARIZATION

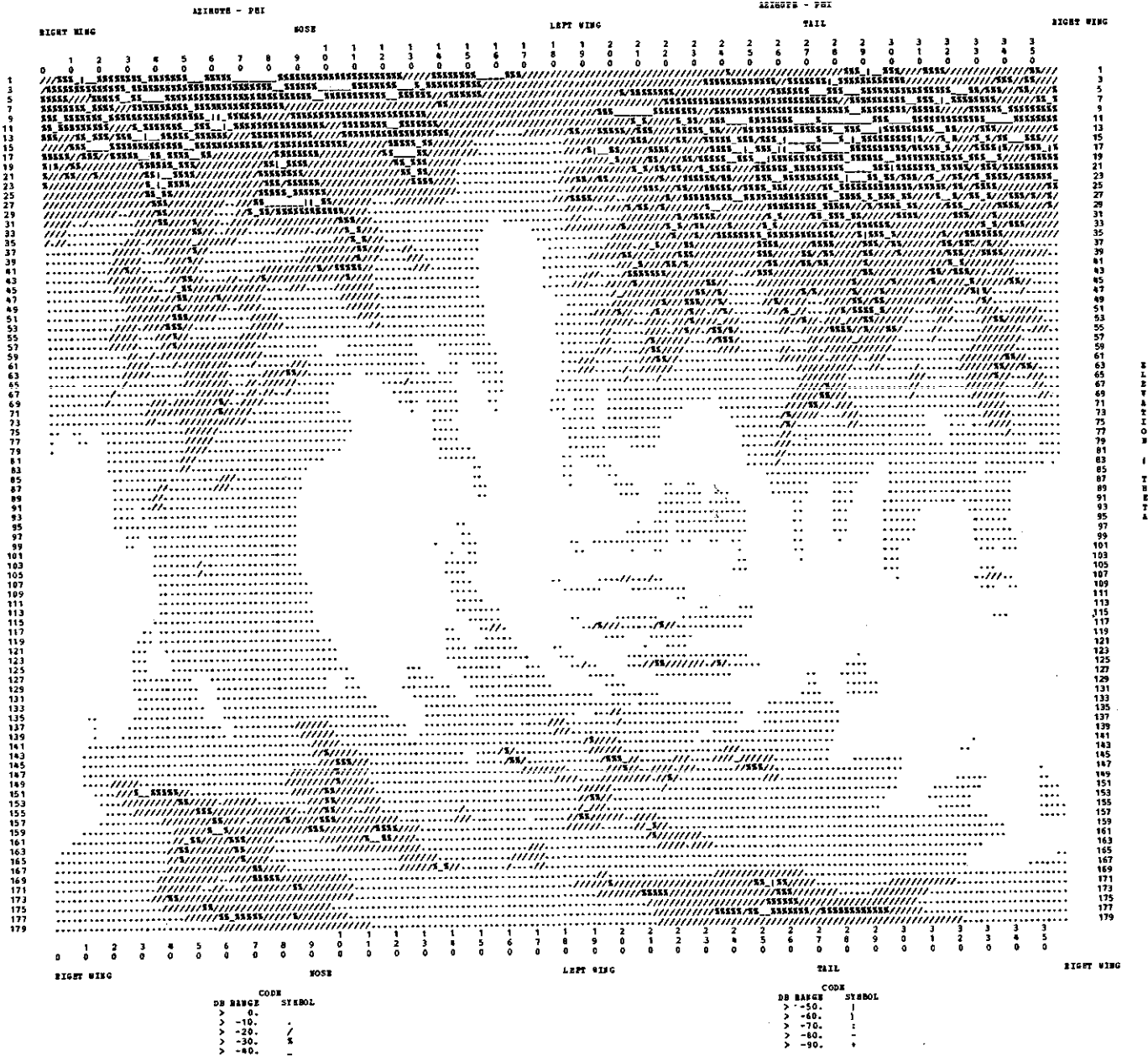
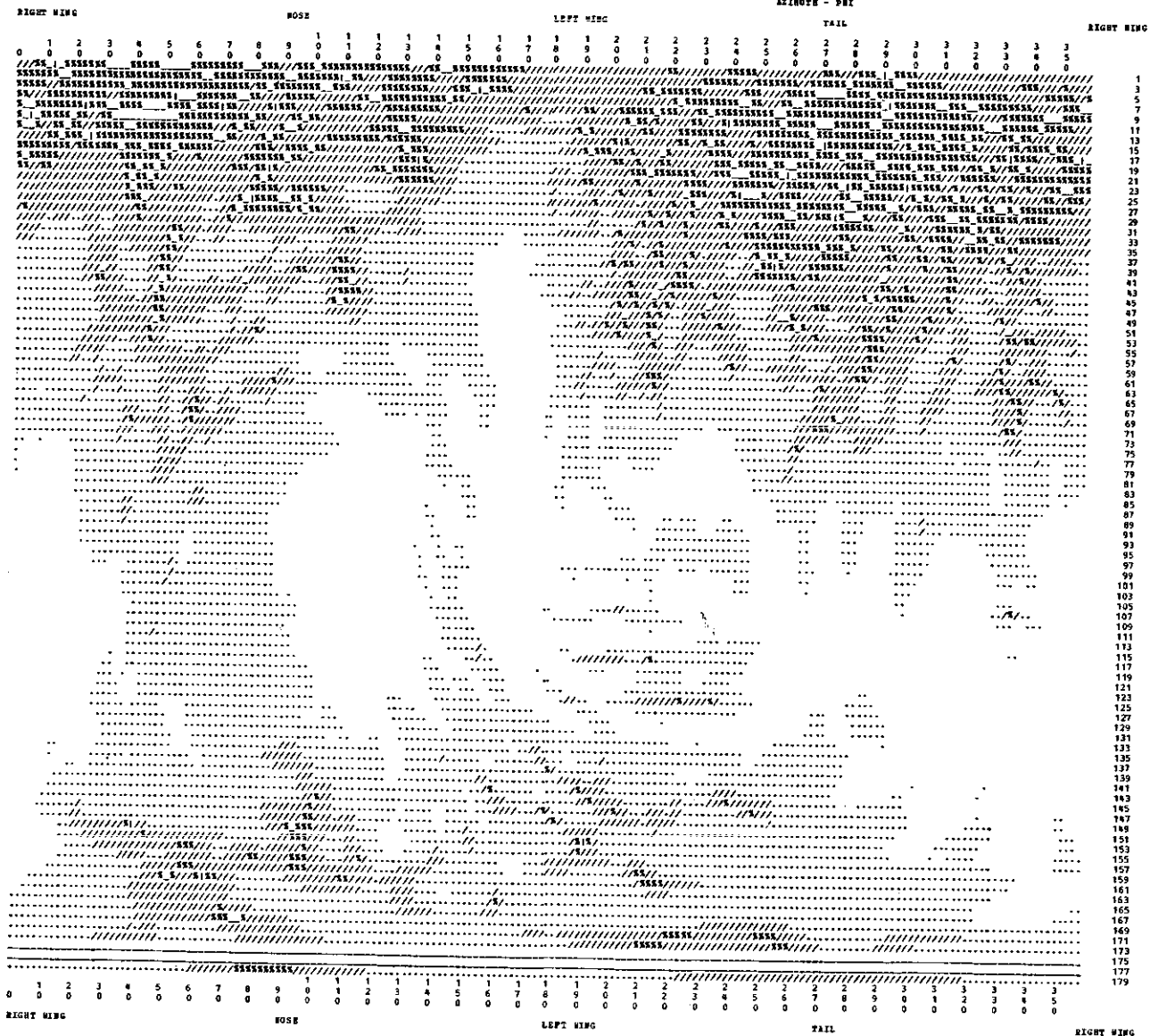


Fig. 2-7. Cessna 150; antenna position 4 (B); wheels down, flaps up.

AIRCRAFT TYPE = C150, CESSNA 150
 CONDITIONS = 24 WHEELS DOWN, FLAPS DOWN, BOTTOM MOUNTED ANTENNA, VERTICAL POLARIZATION
 AIRROUTE - PHI

AIRCRAFT TYPE = C150, CESSNA 150
 CONDITIONS = 24 WHEELS DOWN, FLAPS DOWN, BOTTOM MOUNTED ANTENNA, VERTICAL POLARIZATION
 AIRROUTE - PHI



DB RANGE	CODE	SYMBOL	DB RANGE	CODE	SYMBOL
> -10.	0	.	> -50.	1	.
> -20.	1	.	> -60.	2	.
> -30.	2	.	> -70.	3	.
> -40.	3	.	> -80.	4	.
			> -90.	5	.

Fig. 2-8. Cessna 150; antenna position 4 (B); wheels down, flaps down.

46

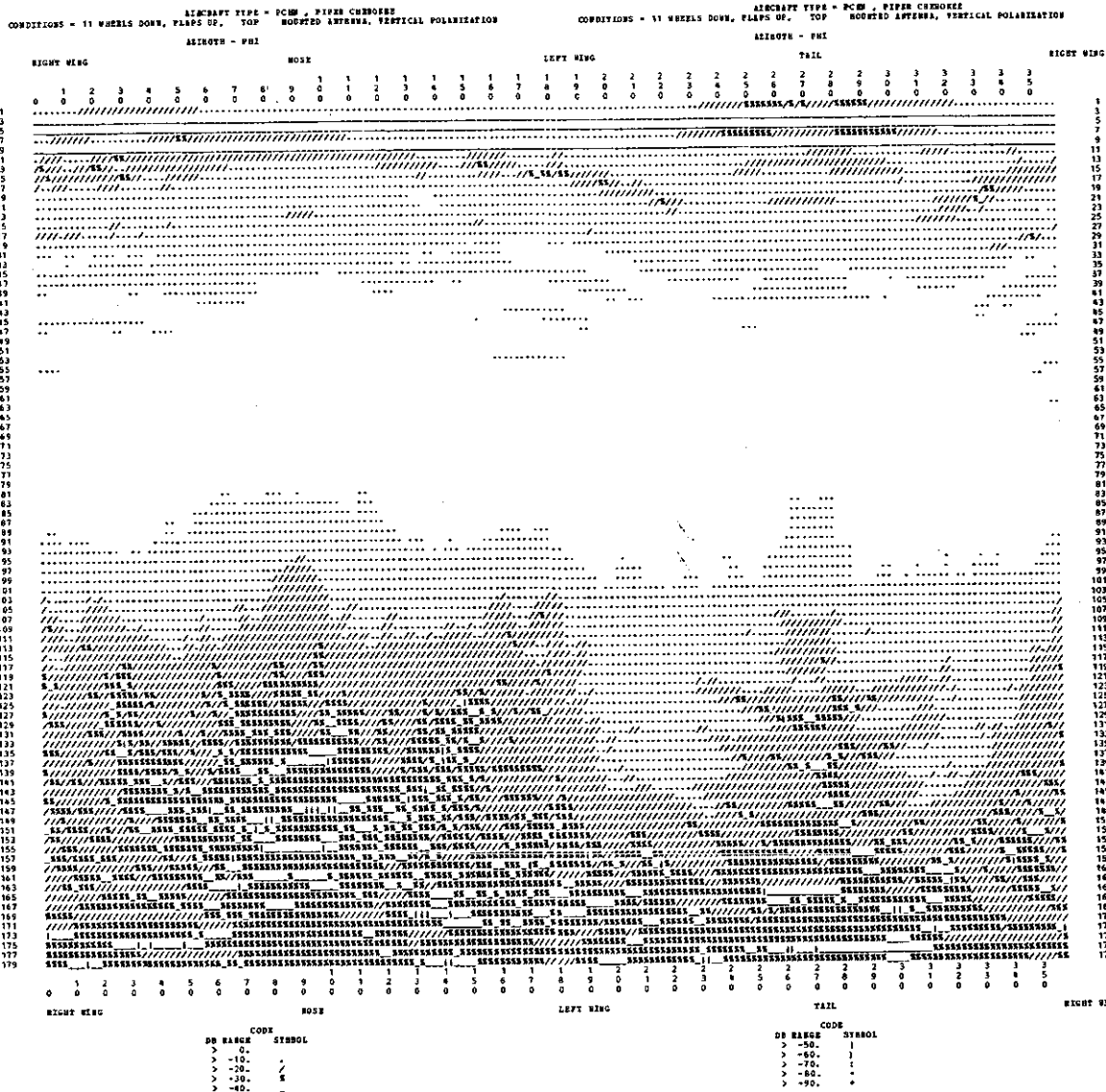


Fig. 3-1. Piper Cherokee Arrow; antenna position 1 (T); wheels down, flaps up.

AIRCRAFT TYPE = PCMB - PIPER CHEROKEE
 CONDITIONS = 12 WHEELS DOWN, FLAPS UP, TOP ROOSTED ANTENNA, VERTICAL POLARIZATION
 AIRCRAFT TYPE = PCMB - PIPER CHEROKEE
 CONDITIONS = 12 WHEELS DOWN, FLAPS UP, TOP ROOSTED ANTENNA, VERTICAL POLARIZATION

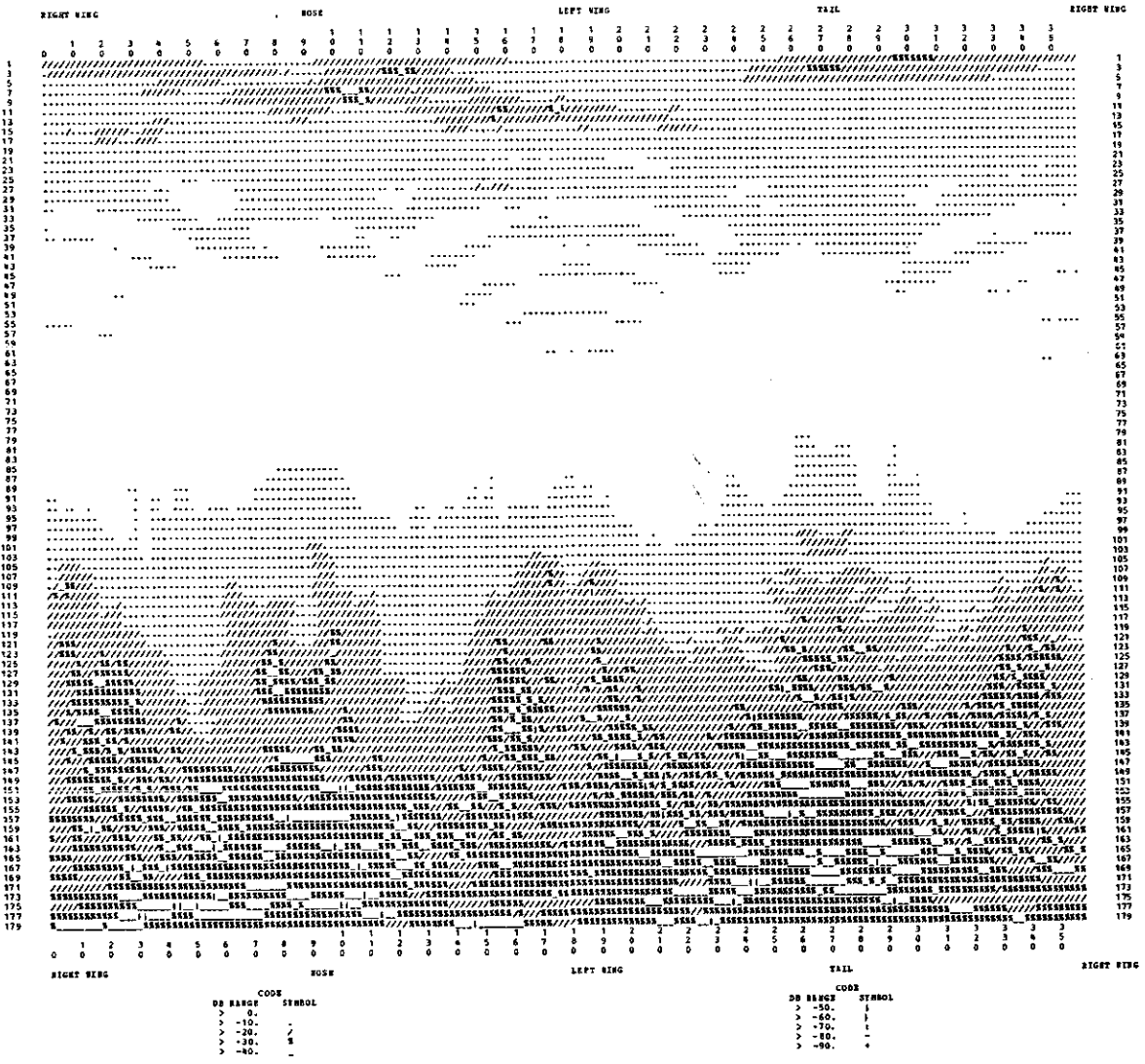


Fig. 3-3. Piper Cherokee Arrow; antenna position 2 (T); wheels down, flaps up.

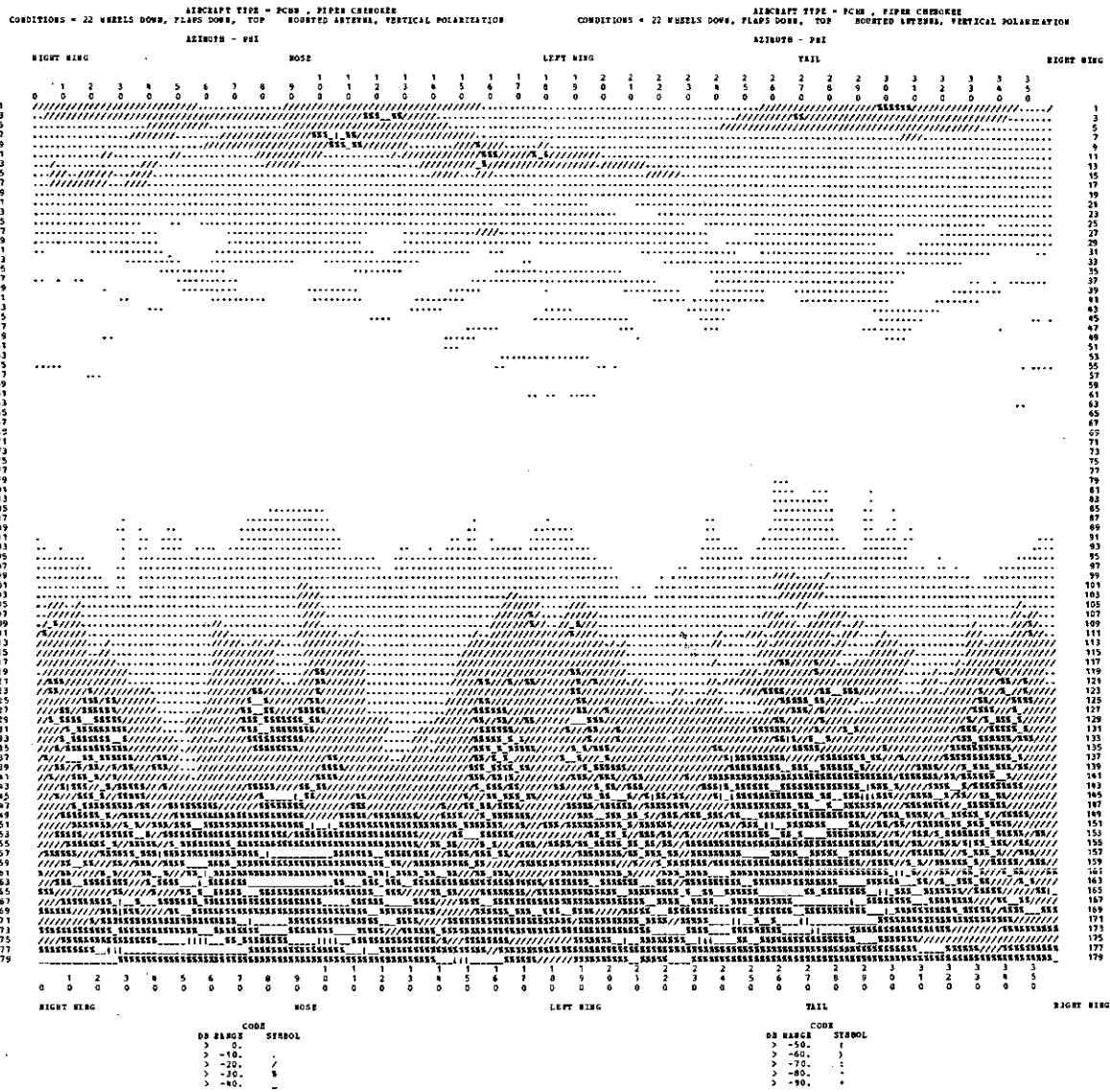


Fig. 3-4. Piper Cherokee Arrow; antenna position 2 (T); wheels down, flaps down.

CONDITIONS = 42 WHEELS UP, FLAPS DOWN, TOP MOUNTED ANTENNA, VERTICAL POLARIZATION

CONDITIONS = 42 WHEELS UP, FLAPS DOWN, TOP MOUNTED ANTENNA, VERTICAL POLARIZATION

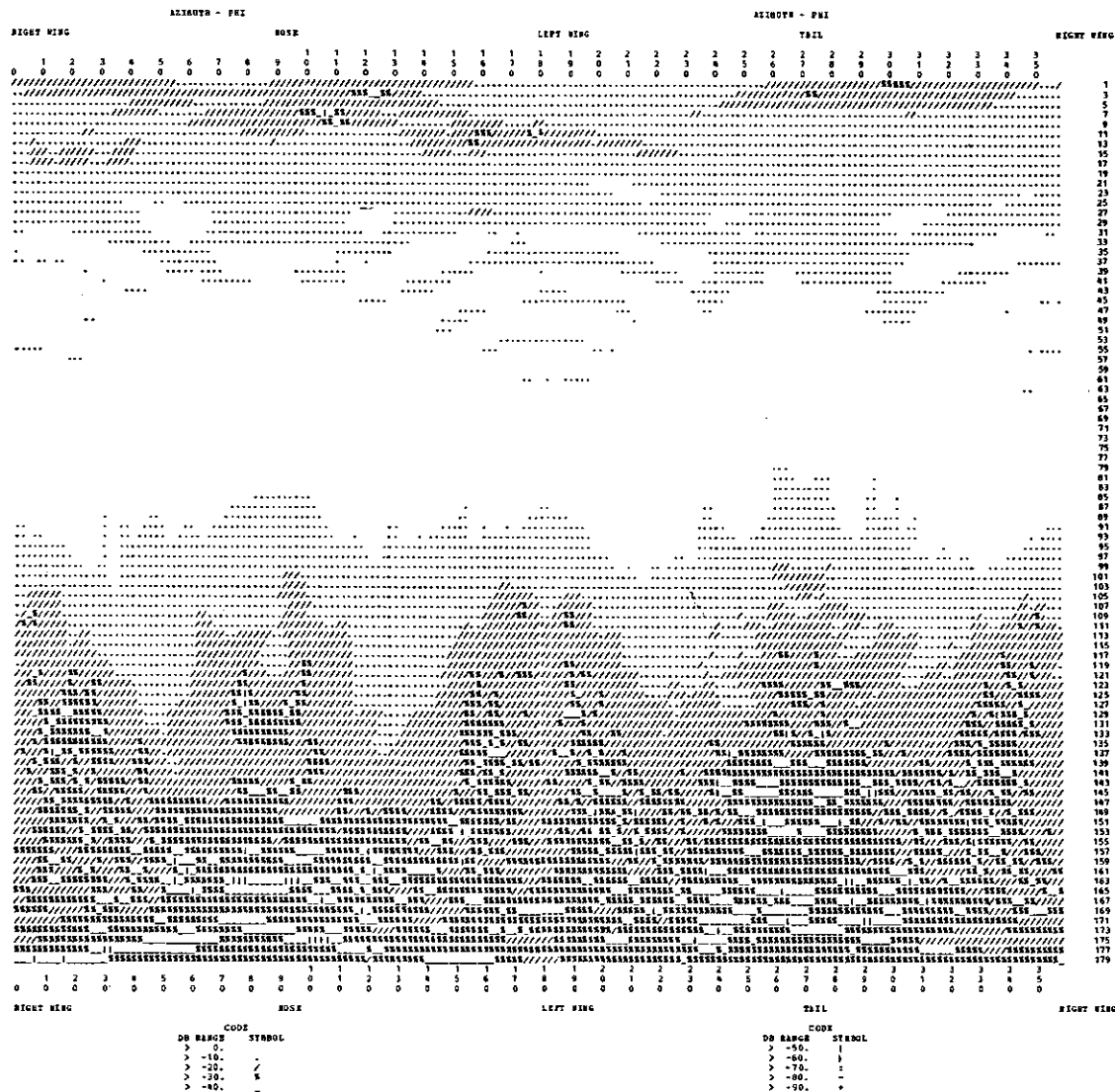


Fig. 3-6. Piper Cherokee Arrow; antenna position 2 (T); wheels up, flaps down.

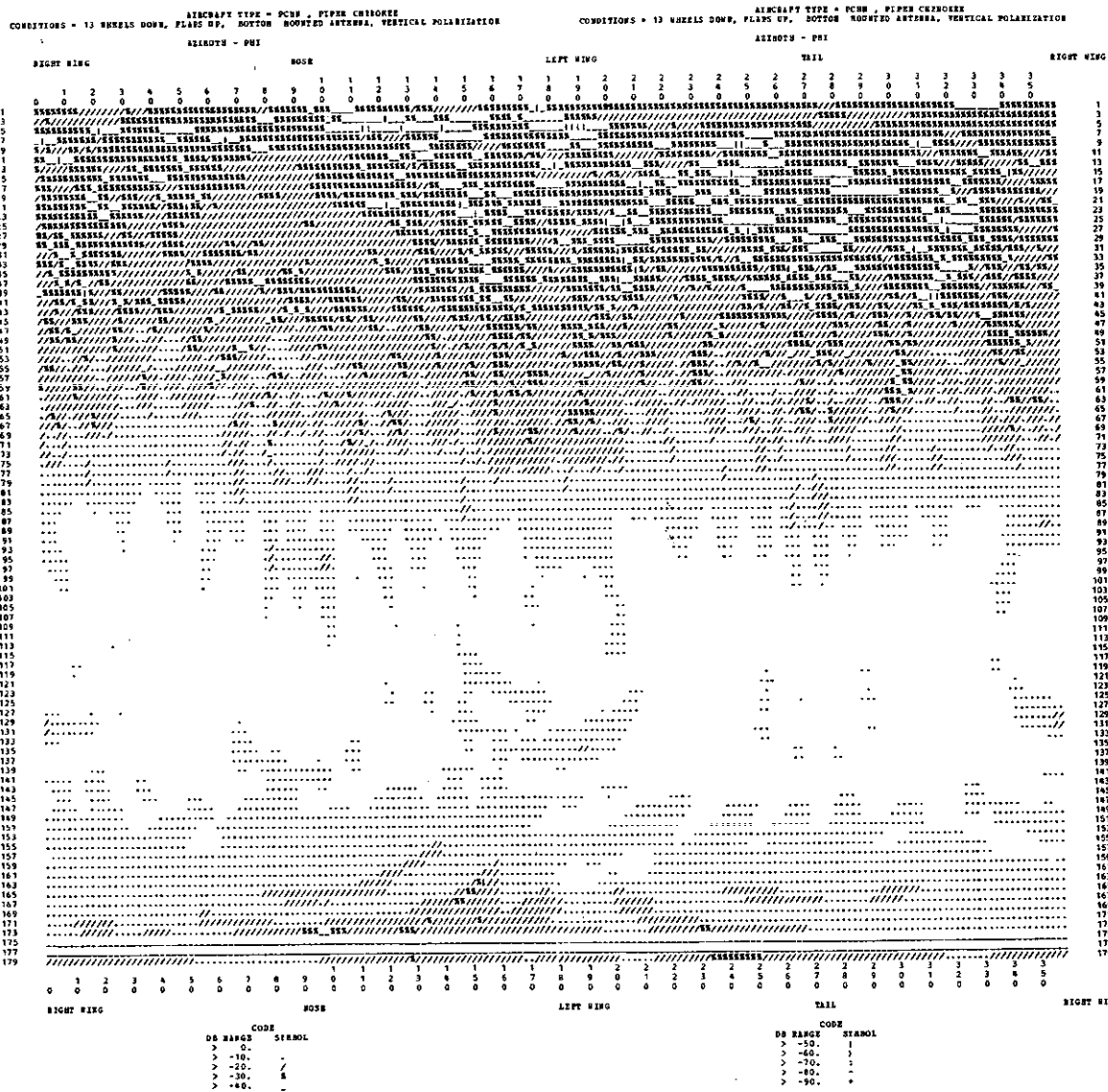


Fig. 3-7. Piper Cherokee Arrow; antenna position 3 (B); wheels down, flaps up.

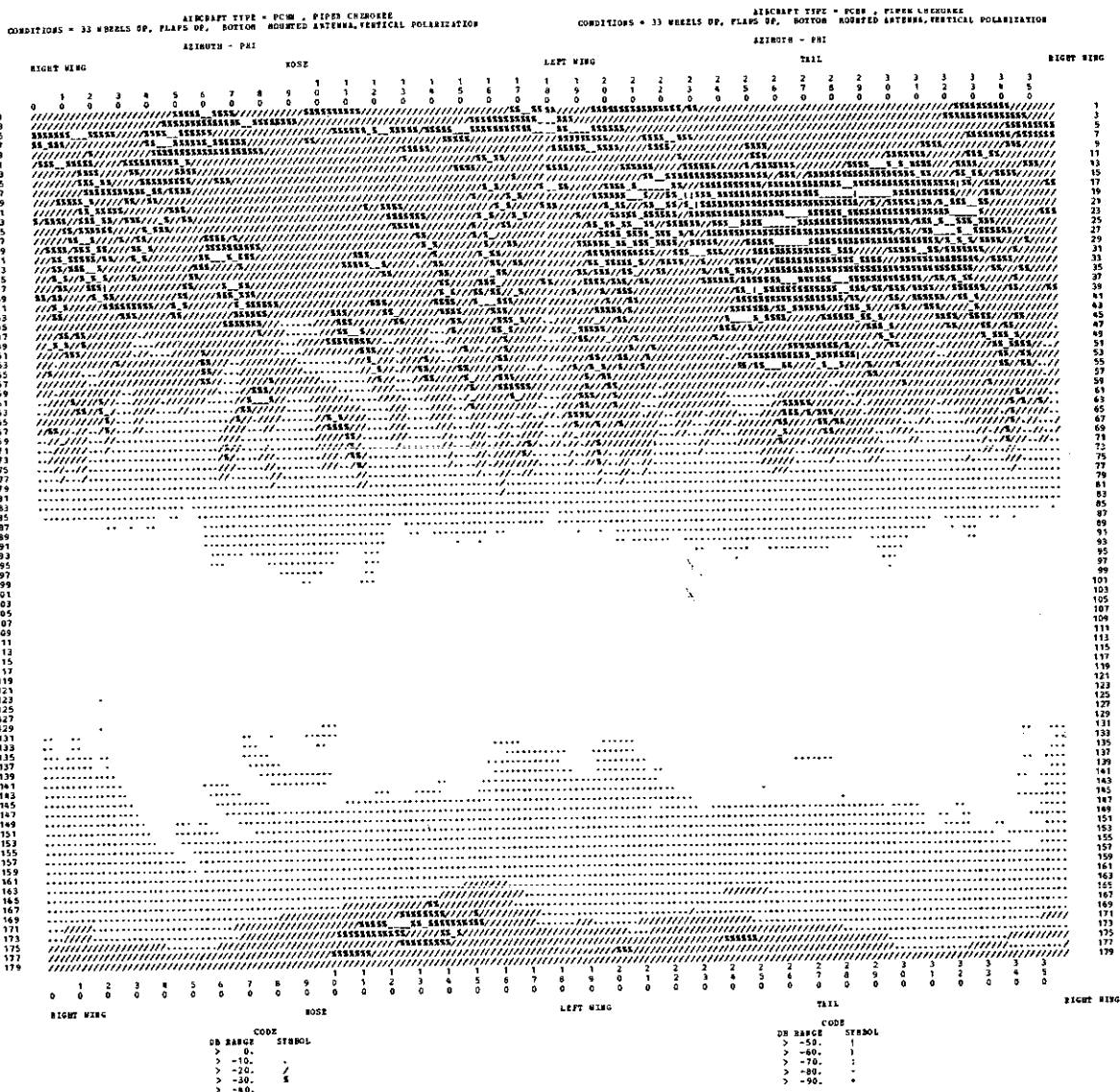


Fig. 3-9. Piper Cherokee Arrow; antenna position 3 (B); wheels up, flaps up.

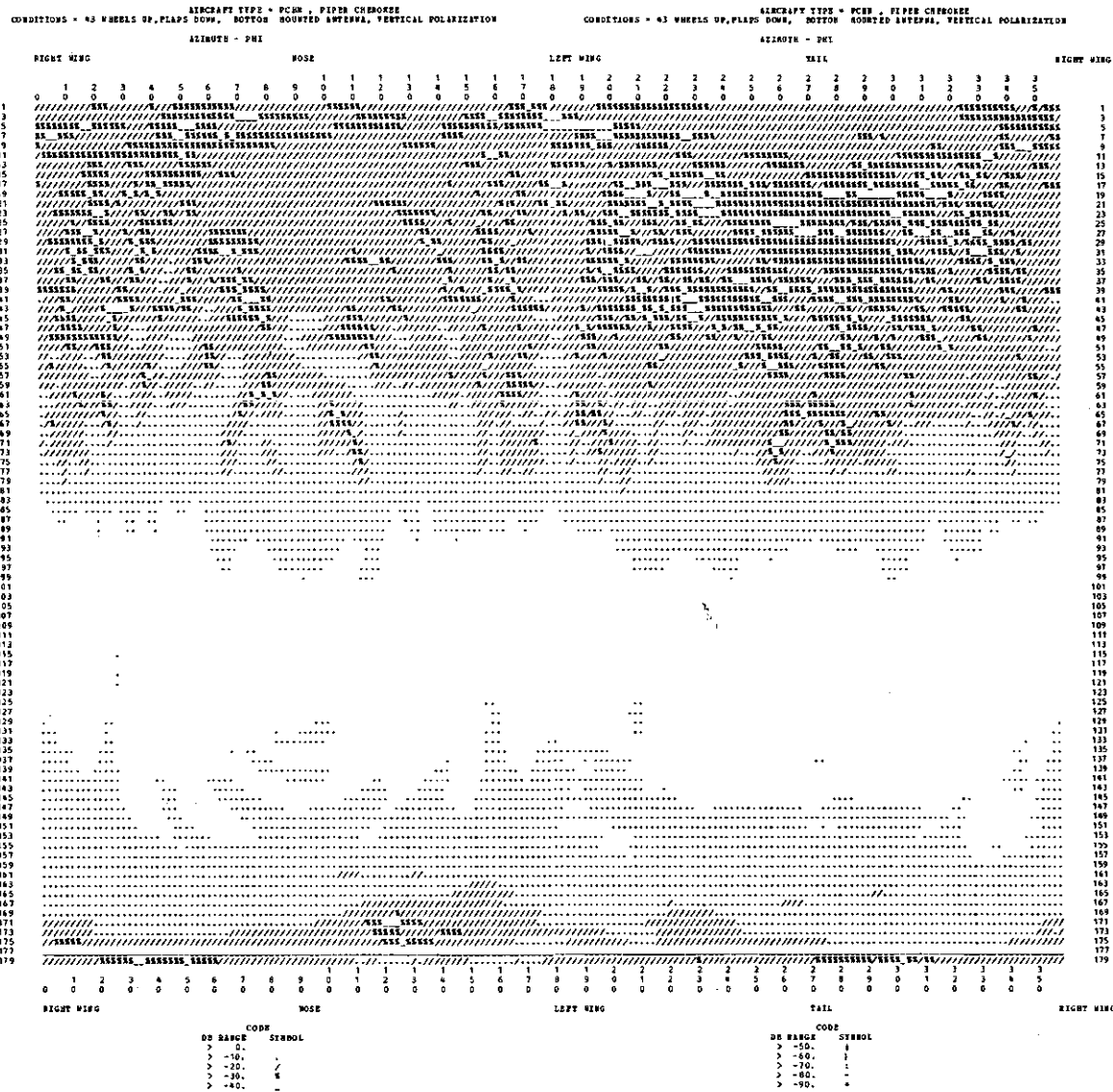


Fig. 3-10. Piper Cherokee Arrow; antenna position 3 (B); wheels up, flaps down.

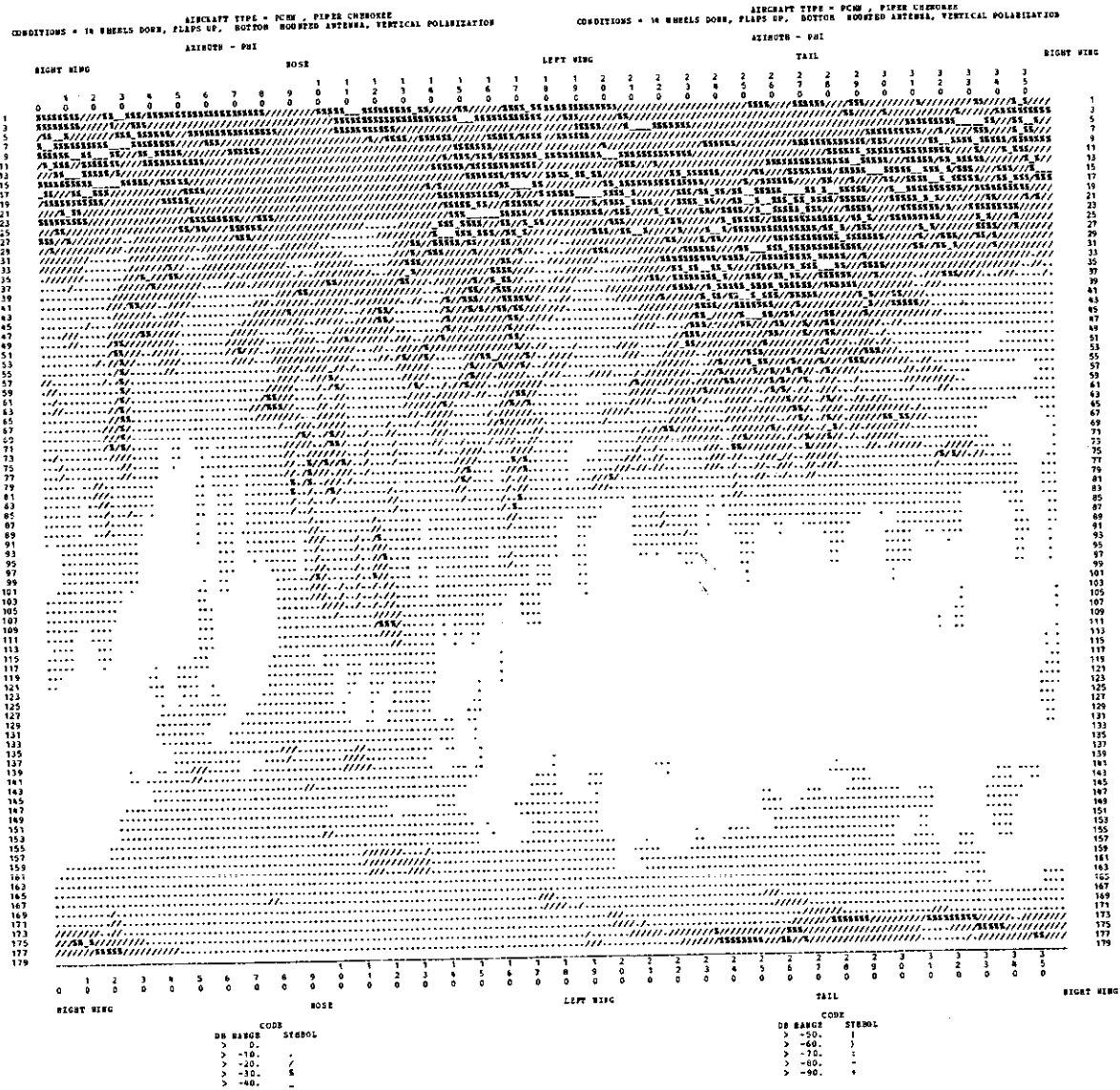
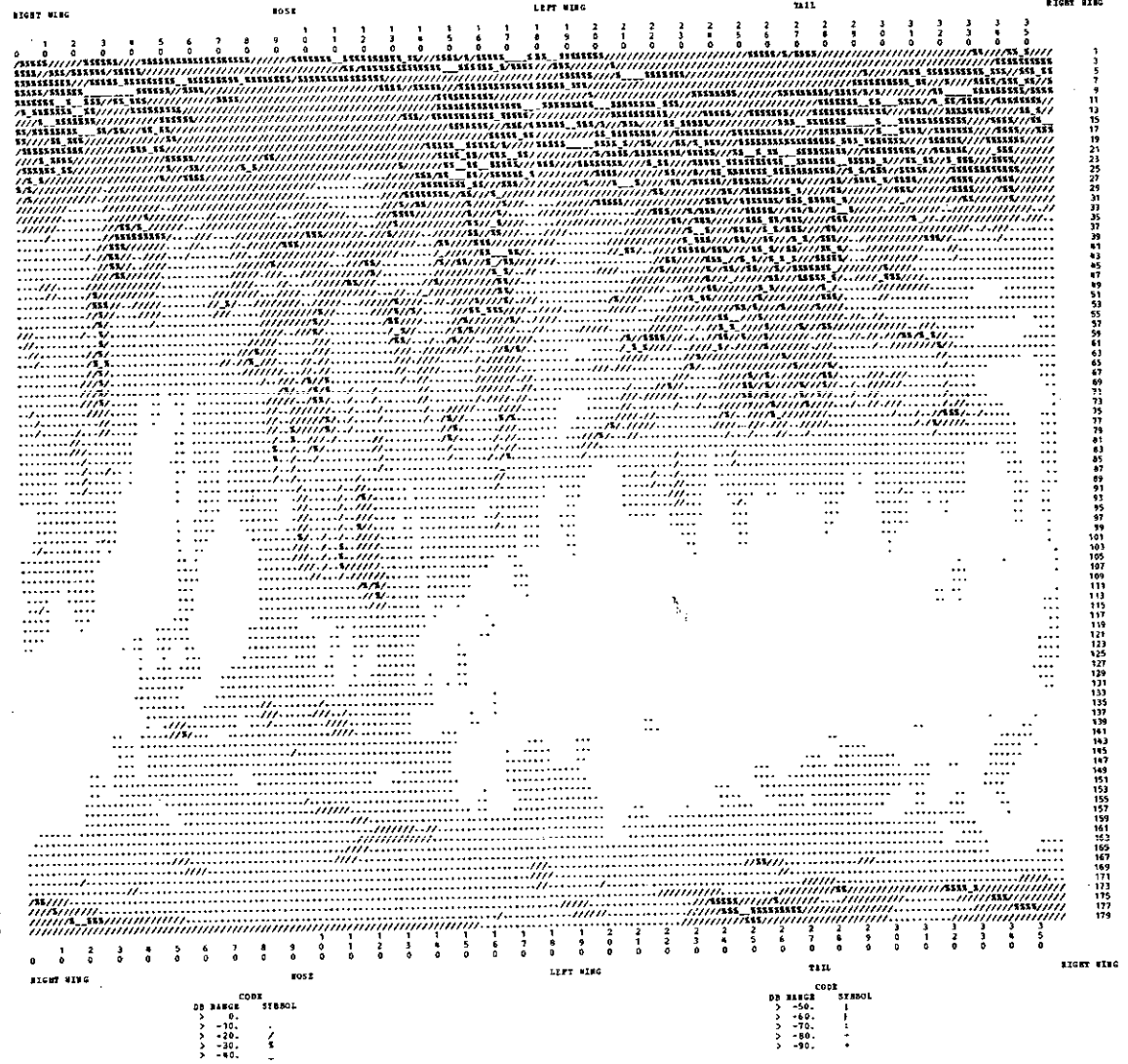


Fig. 3-11. Piper Cherokee Arrow; antenna position 4 (B); wheels down, flaps up.

CONDITIONS * 24 WHEELS DOWN, FLAPS DOWN, BOTTOM MOUNTED ANTENNA, VERTICAL POLARIZATION
 AIRCRAFT TYPE * PC12 , PIPER CHEROKEE
 AZIMUTH - 091

CONDITIONS * 24 WHEELS DOWN, FLAPS DOWN, BOTTOM MOUNTED ANTENNA, VERTICAL POLARIZATION
 AIRCRAFT TYPE * PC12 , PIPER CHEROKEE
 AIRCRAFT - 091

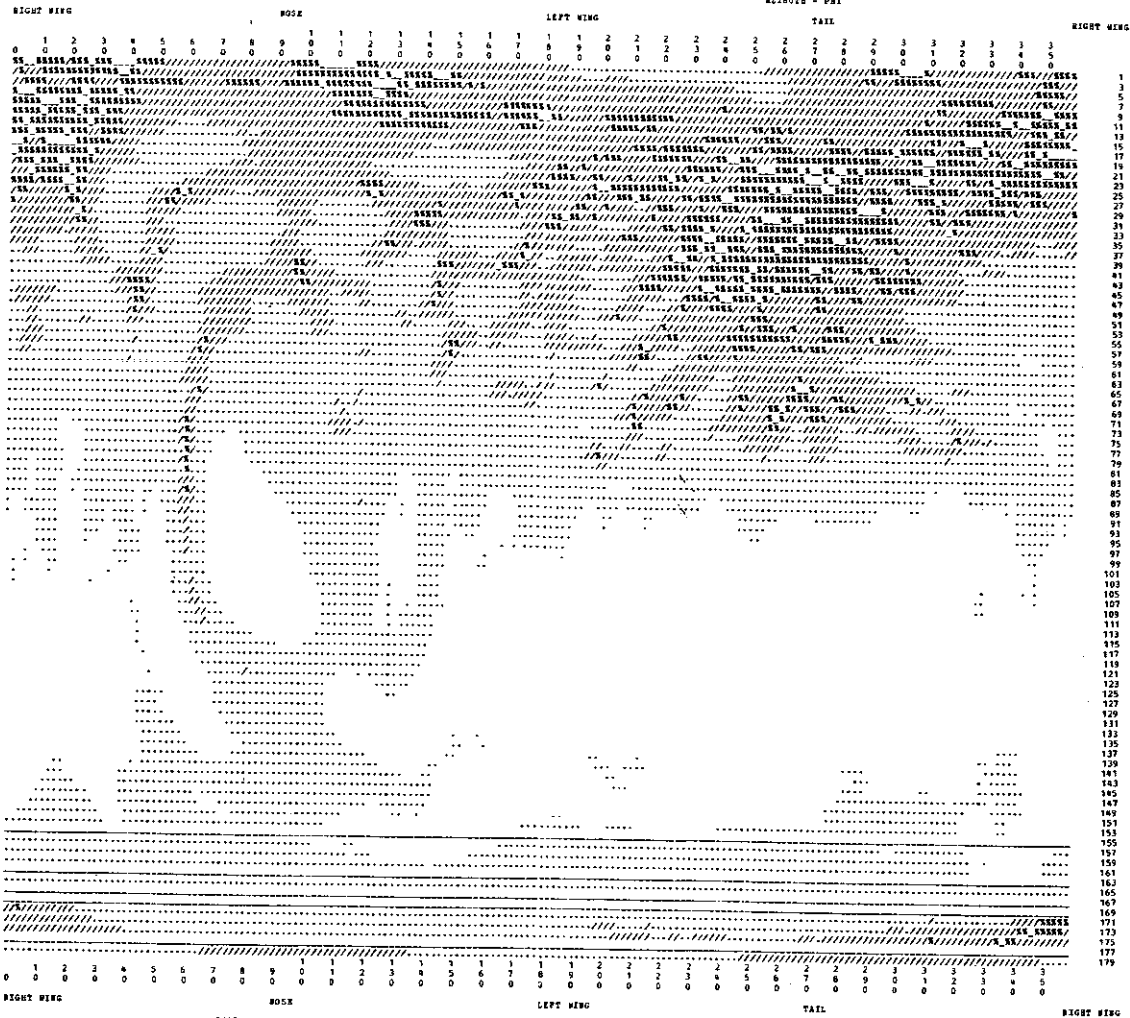


58

Fig. 3-12. Piper Cherokee Arrow; antenna position 4 (B); wheels down, flaps down.

CONDITIONS = 30 WHEELS UP, FLAPS UP, ROTOR HOISTED ANTENNA, VERTICAL POLARIZATION
 AIRCRAFT TYPE = PCHW, PIPER CHEROKEE
 AZIMUTH - PHI

CONDITIONS = 30 WHEELS UP, FLAPS UP, ROTOR HOISTED ANTENNA, VERTICAL POLARIZATION
 AIRCRAFT TYPE = PCHW, PIPER CHEROKEE
 AZIMUTH - PHI



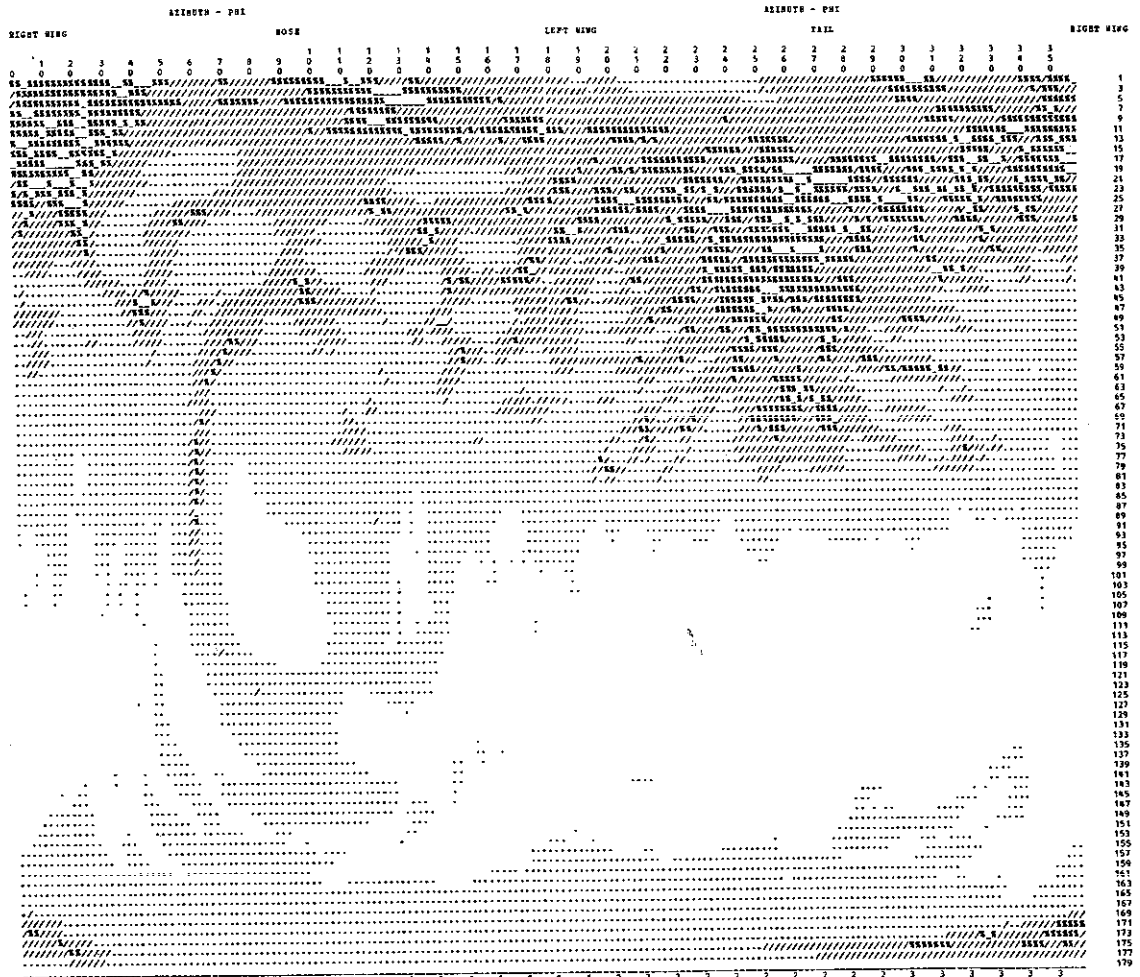
RIGHT WING	NOSE	LEFT WING	TAIL	RIGHT WING
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

DB RANGE	SYMBOL	DB RANGE	SYMBOL
> 0.	.	> -50.	j
> -10.	/	> -60.	l
> -20.	^	> -70.	o
> -30.	~	> -80.	q
> -40.	z	> -90.	r

Fig. 3-13. Piper Cherokee Arrow; antenna position 4 (B); wheels up, flaps up.

AIRCRAFT TYPE - PCW , PIPER CHEROKEE
 CONDITIONS - AN WHEELS UP, FLAPS DOWN, OUTTOP DOWNED ANTENNA, VERTICAL POLARIZATION

AIRCRAFT TYPE - PCW , PIPER CHEROKEE
 CONDITIONS - AN WHEELS UP, FLAPS DOWN, BOTTOM DOWNED ANTENNA, VERTICAL POLARIZATION

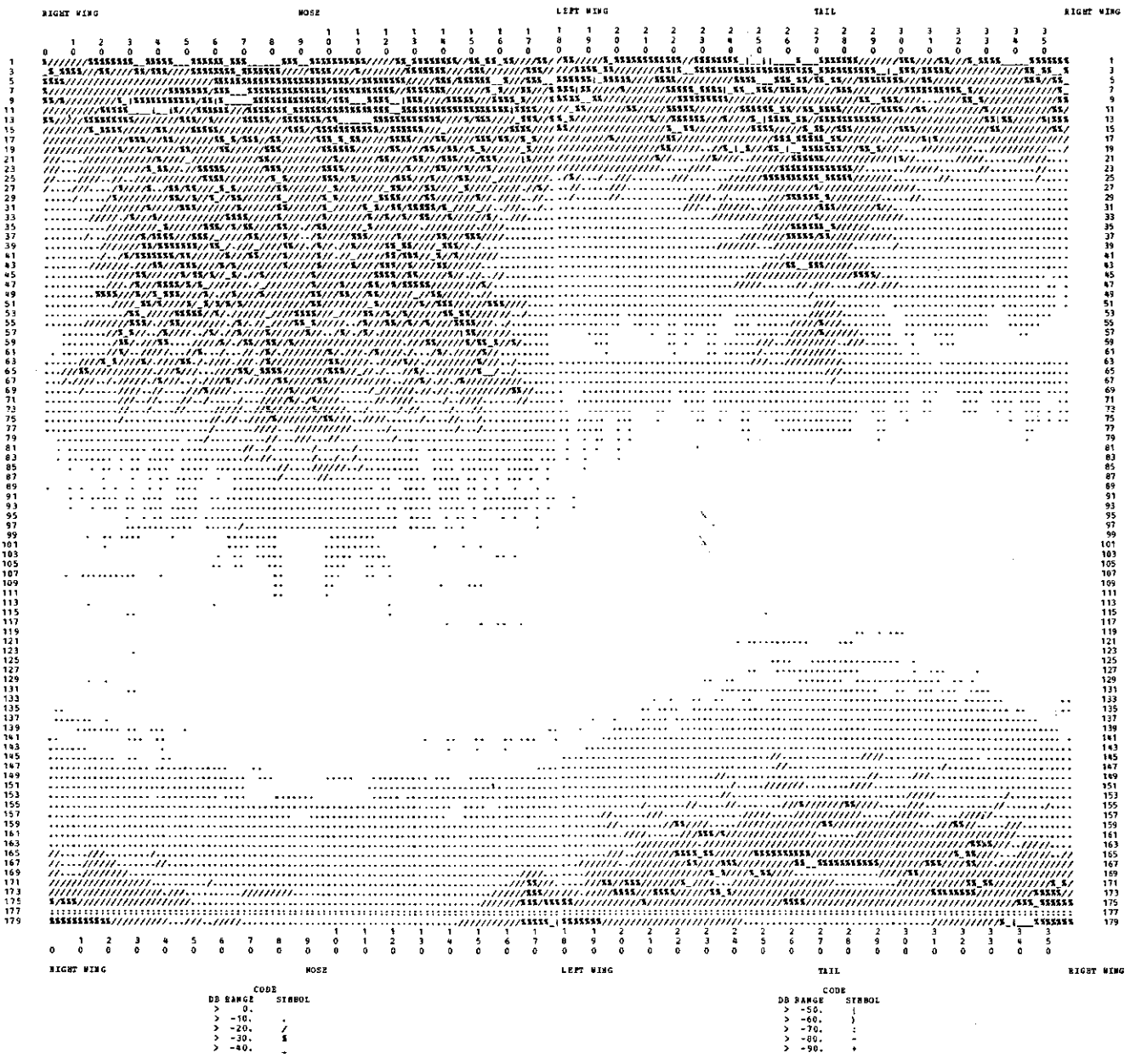


RIGHT WING	CODE	SYMBOL	RIGHT WING	CODE	SYMBOL
> 0.		.	> -50.		.
> -10.		.	> -60.		.
> -20.		.	> -70.		.
> -30.		.	> -80.		.
> -40.		.	> -90.		.

Fig. 3-14. Piper Cherokee Arrow; antenna position 4 (B); wheels up, flaps down.

AIRCRAFT TYPE = HELI , HELIO (U10D)
 CONDITIONS = 11 WHEELS DOWN, FLAPS UP, BOTTOM HOISTED ANTENNA, VERTICAL POLARIZATION
 AZIMUTH - PHI

AIRCRAFT TYPE = HELI , HELIO (U10D)
 CONDITIONS = 11 WHEELS DOWN, FLAPS UP, BOTTOM HOISTED ANTENNA, VERTICAL POLARIZATION
 AZIMUTH - PHI



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Fig. 4-1. Helio U10D; antenna position 1 (B); wheels down, flaps up.

CONDITIONS = 21 WHEELS DOWN, FLAPS DOWN, ROTON ADJUSTED ANTENNA, VERTICAL POLARIZATION
 AIRCRAFT TYPE = HELI, HELIO (U10D)
 AZIMUTH - PHI

CONDITIONS = 21 WHEELS DOWN, FLAPS DOWN, ROTON SQUARED ANTENNA, VERTICAL POLARIZATION
 AIRCRAFT TYPE = HELI, HELIO (U10D)
 AZIMUTH - PHI

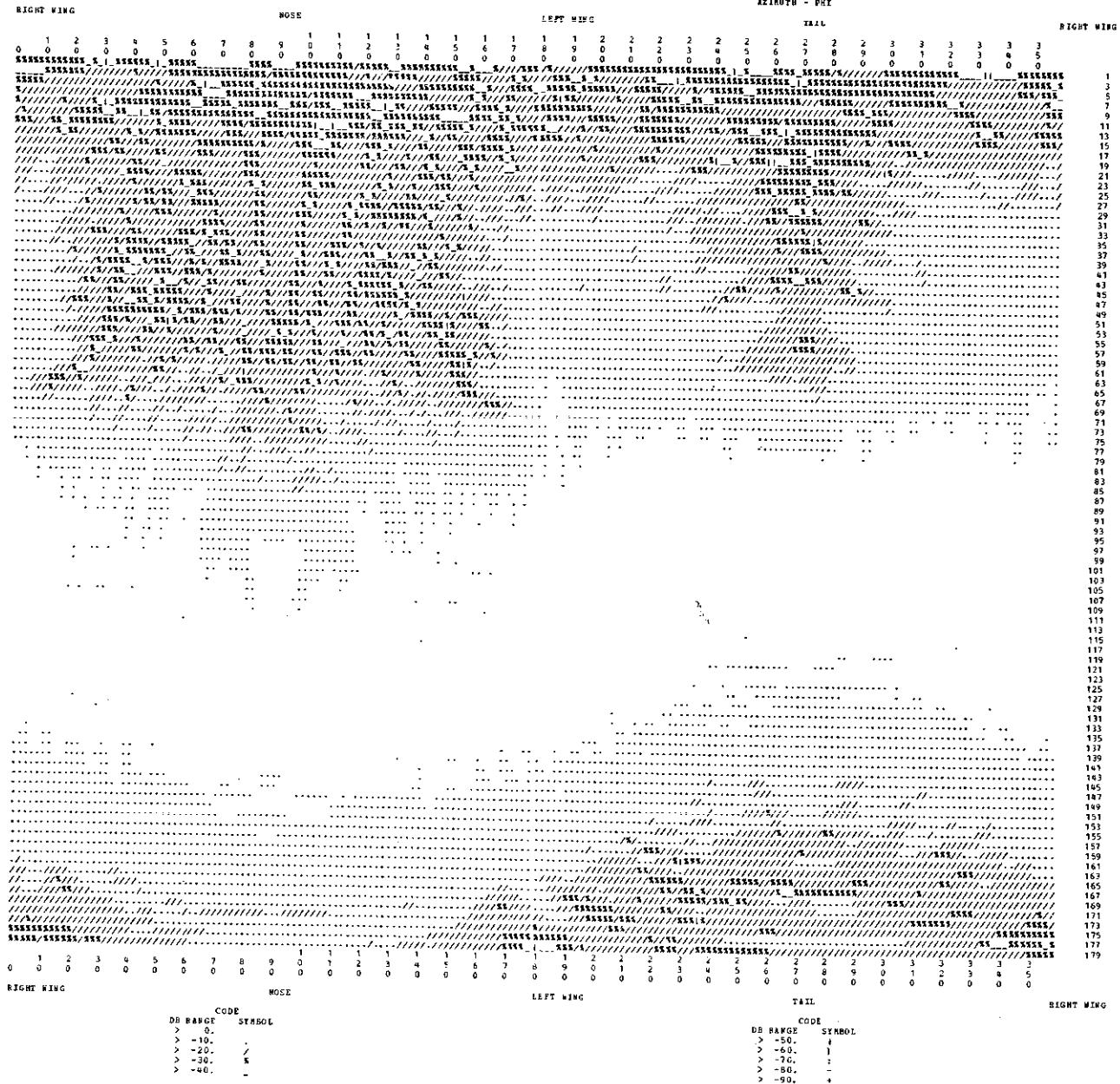


Fig. 4-2. Helio U10D; antenna position 1 (B); wheels down, flaps down.

C45-1212

AIRCRAFT TYPE = HELI, HELIO U10D
 CONDITIONS = 22 WHEELS DOWN, FLAPS DOWN, BOTTOM MOUNTED ANTENNA, VERTICAL POLARIZATION

AIRCRAFT TYPE = HELI, HELIO U10D
 CONDITIONS = 22 WHEELS DOWN, FLAPS DOWN, BOTTOM MOUNTED ANTENNA, VERTICAL POLARIZATION

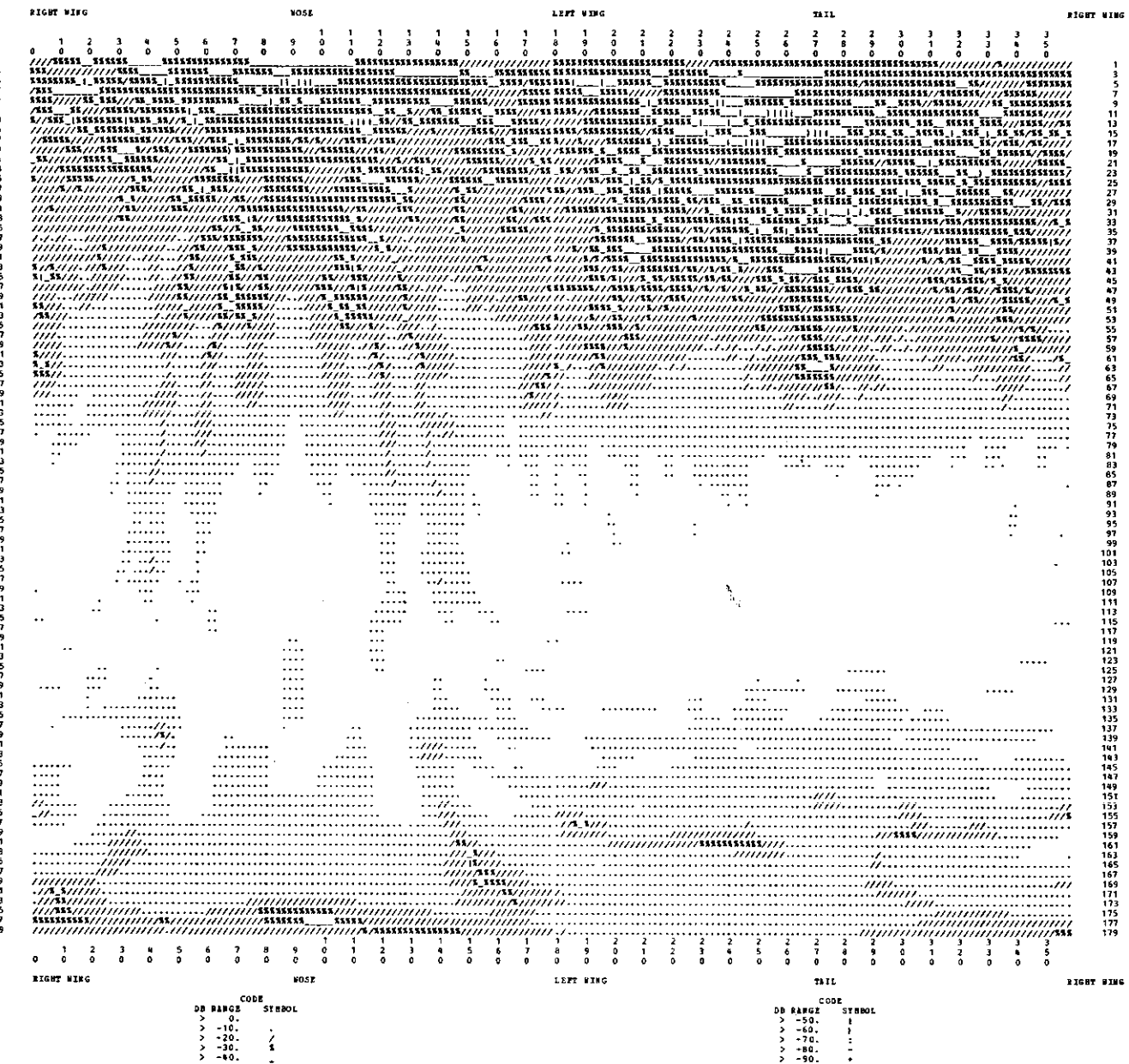


Fig. 4-4. Helio U10D; antenna position 2 (B); wheels down, flaps down.

AIRCRAFT TYPE = BEAC, BEECH BARON
 CONDITIONS = 11 WHEELS DOWN, FLAPS UP, TOP HOISTED ANTENNA, VERTICAL POLARIZATION
 AIRLINER - PHL

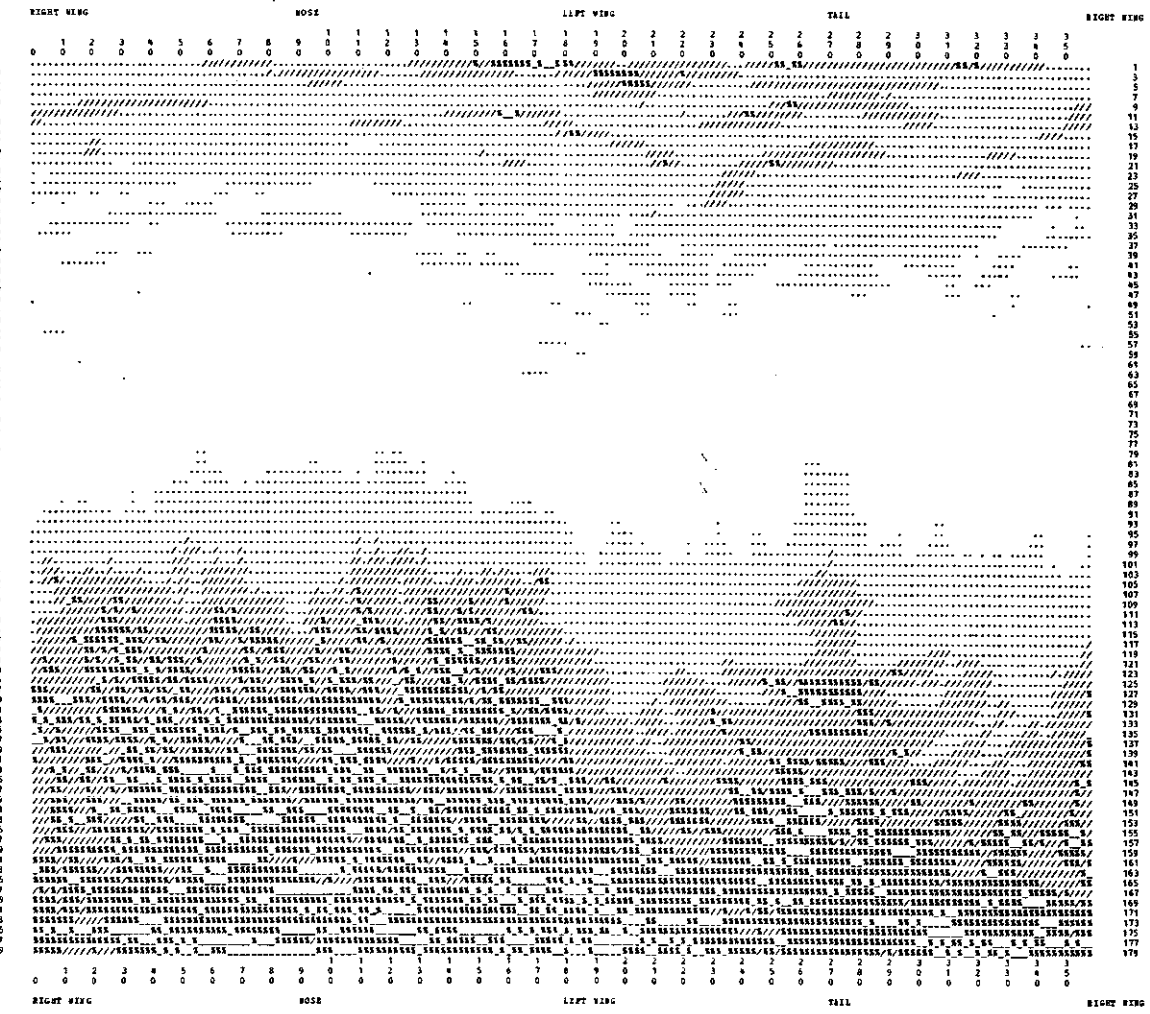


Fig. 5-1. Beechcraft Baron; antenna position 1 (T); wheels down, flaps up.

65

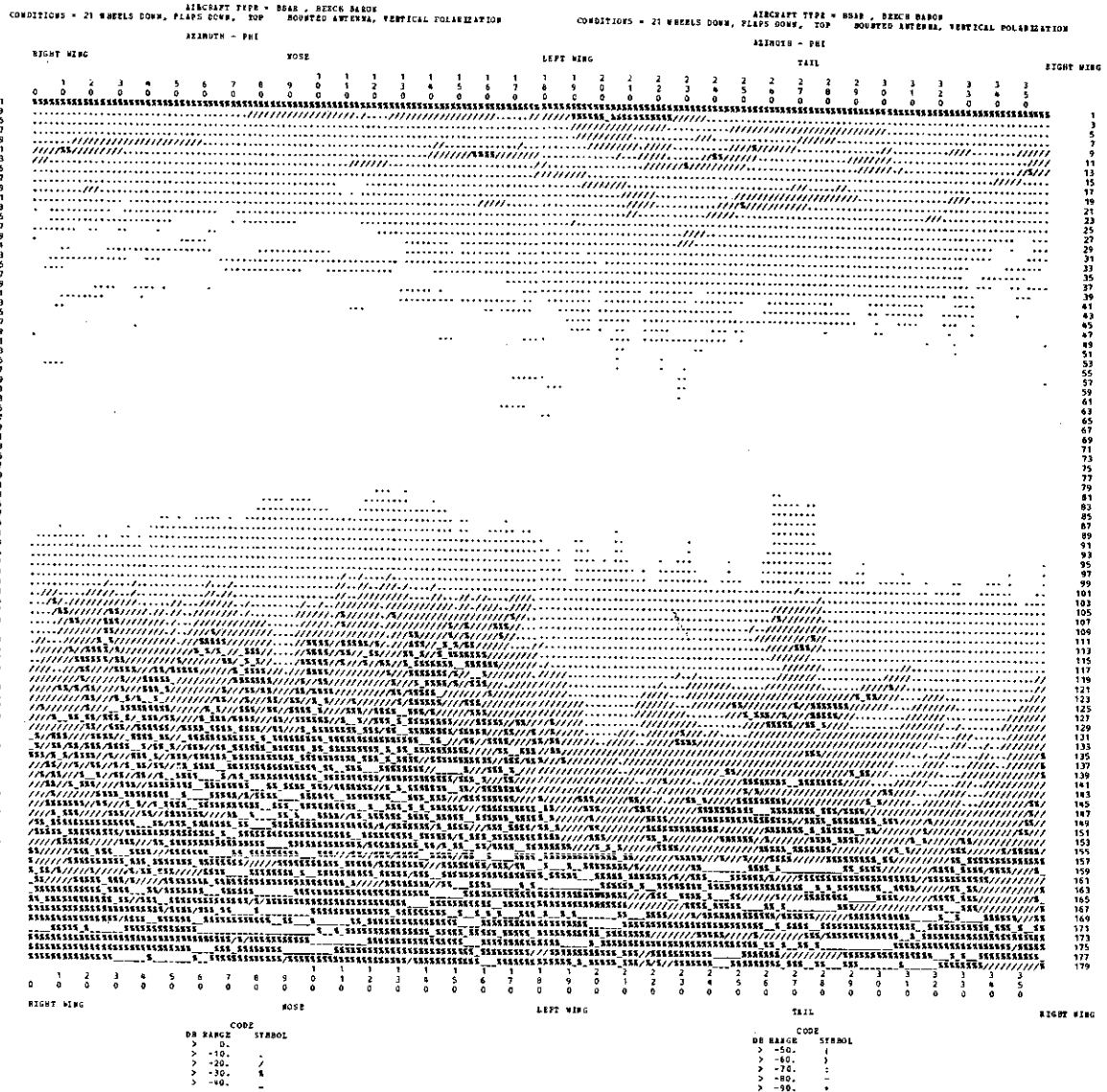


Fig. 5-2. Beechcraft Baron; antenna position 1 (T); wheels down, flaps down.

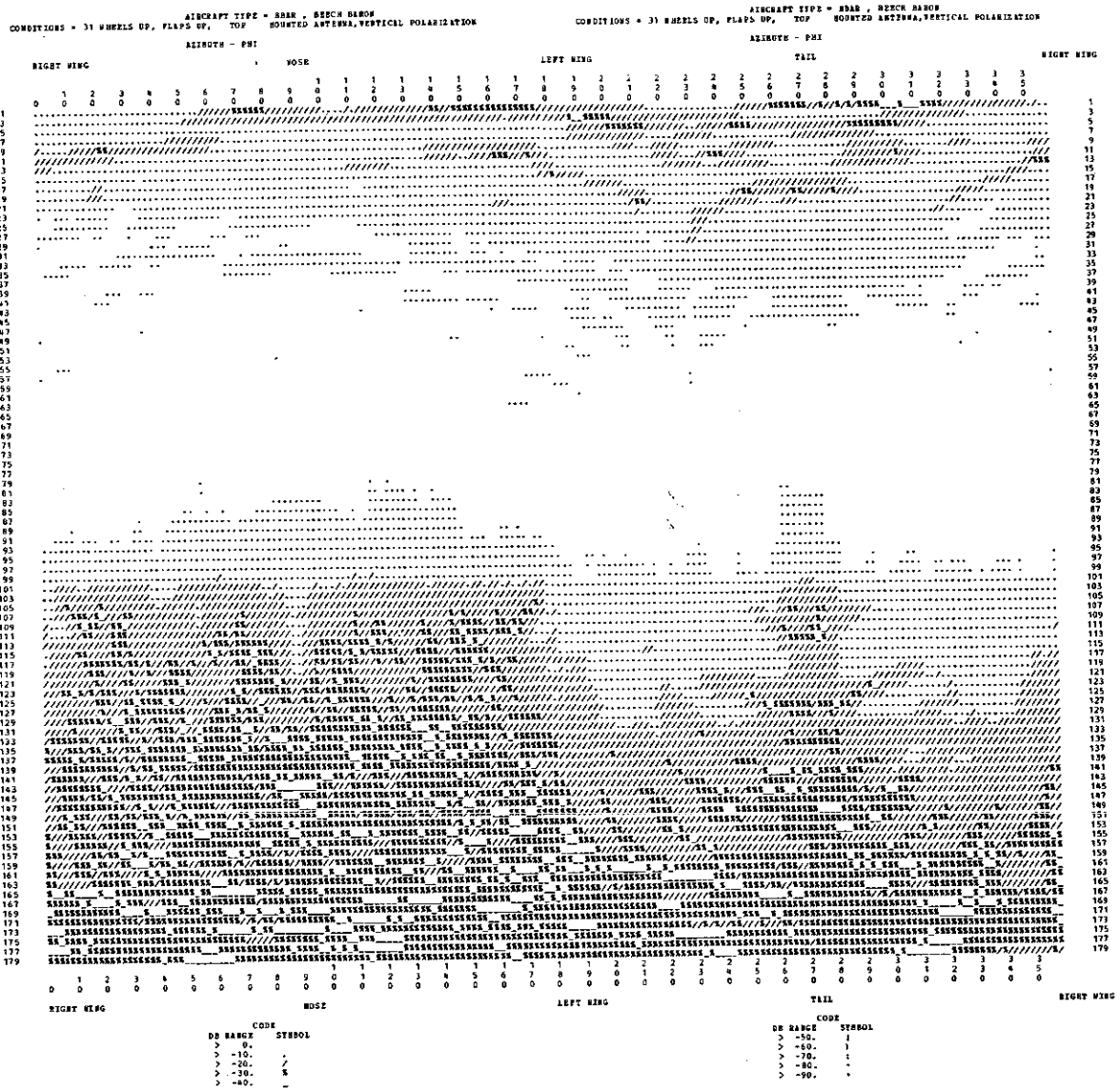


Fig. 5-3. Beechcraft Baron; antenna position 1 (T); wheels down, flaps up.

AIRCRAFT TYPE = B24A, BEECH BARON
 CONDITIONS = 41 WHEELS UP, FLAPS DOWN, TOP SCANNED ANTENNA, VERTICAL POLARIZATION

AIRCRAFT TYPE = B24A, BEECH BARON
 CONDITIONS = 41 WHEELS UP, FLAPS DOWN, TOP SCANNED ANTENNA, VERTICAL POLARIZATION

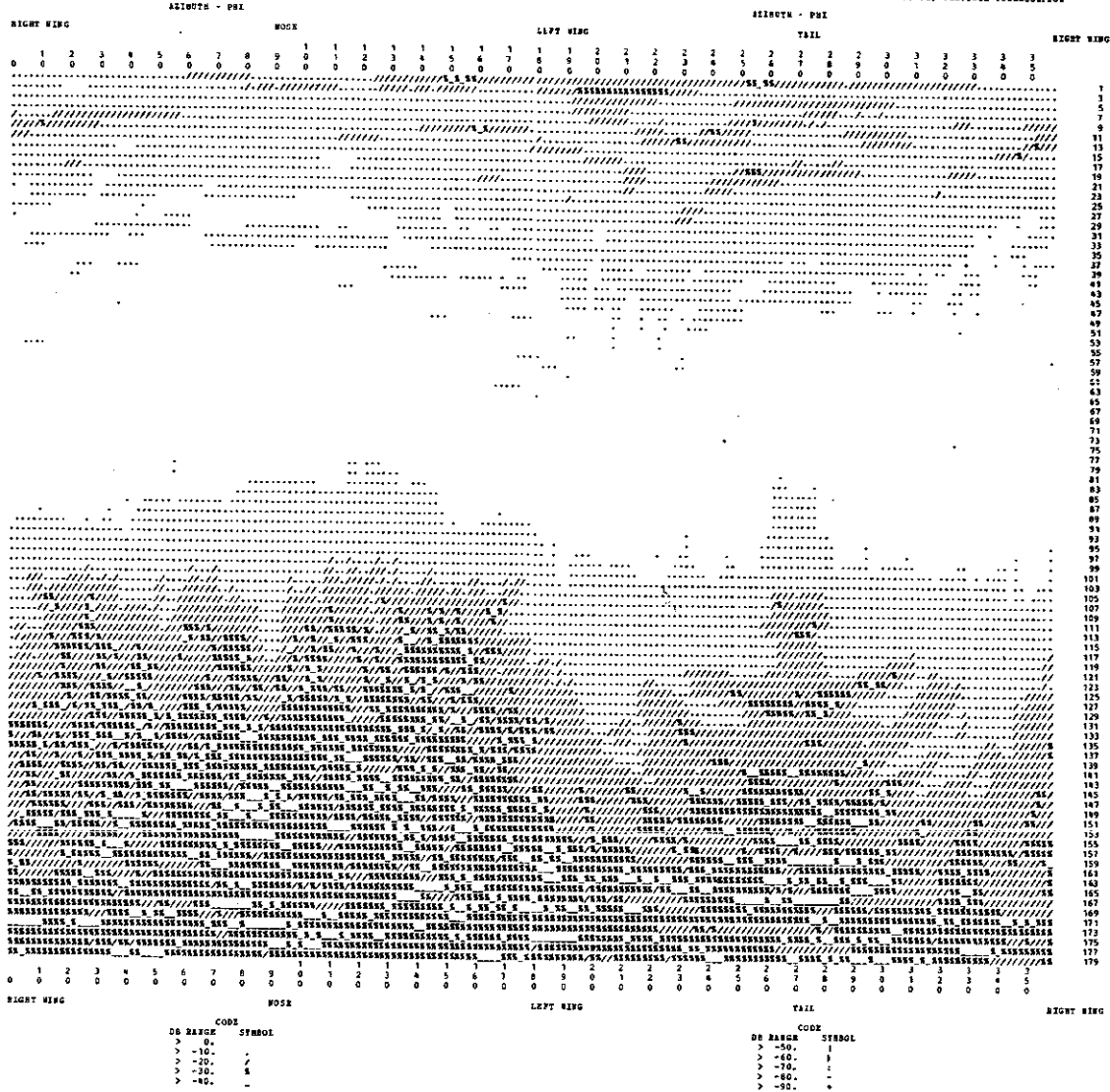
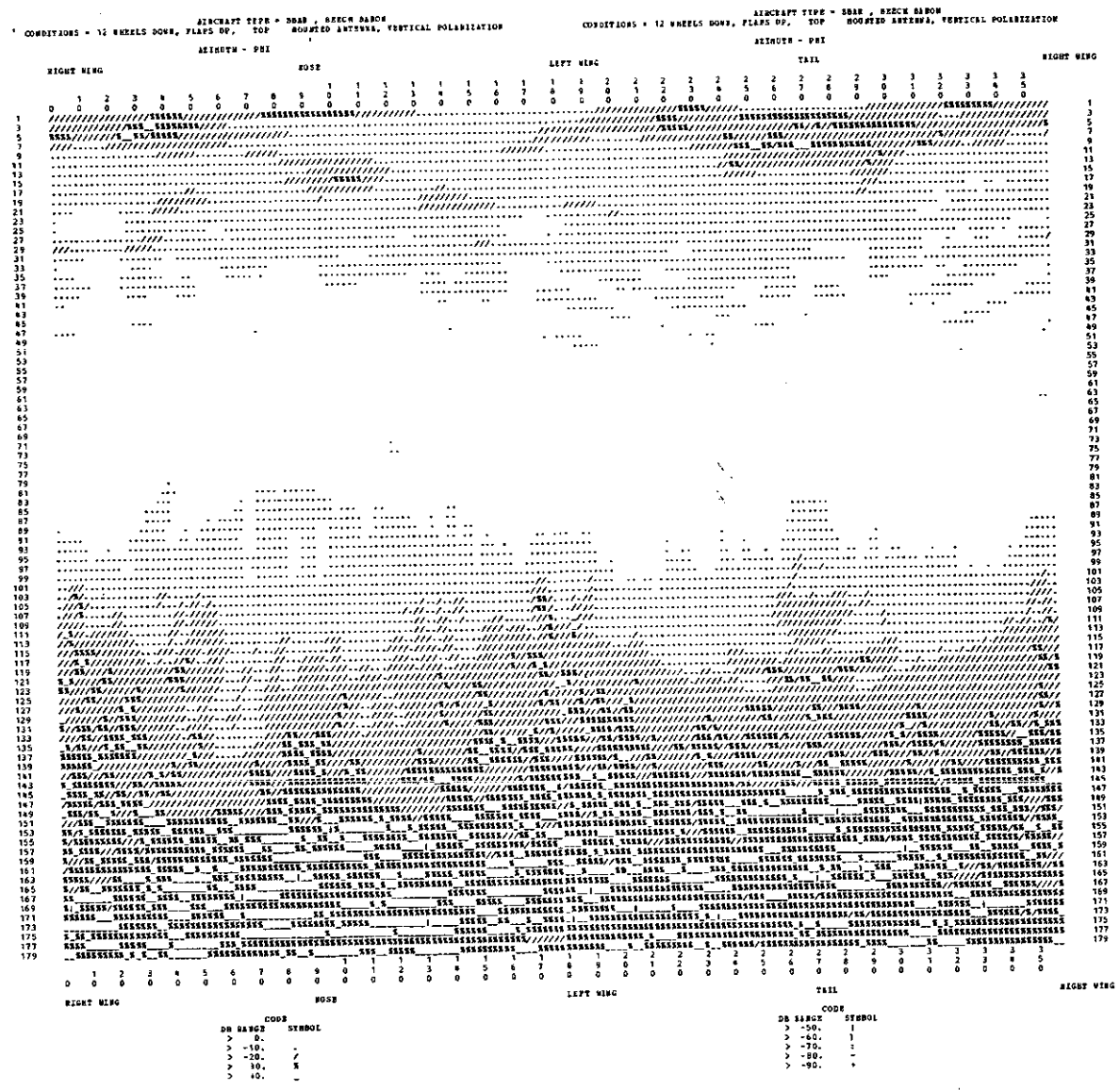
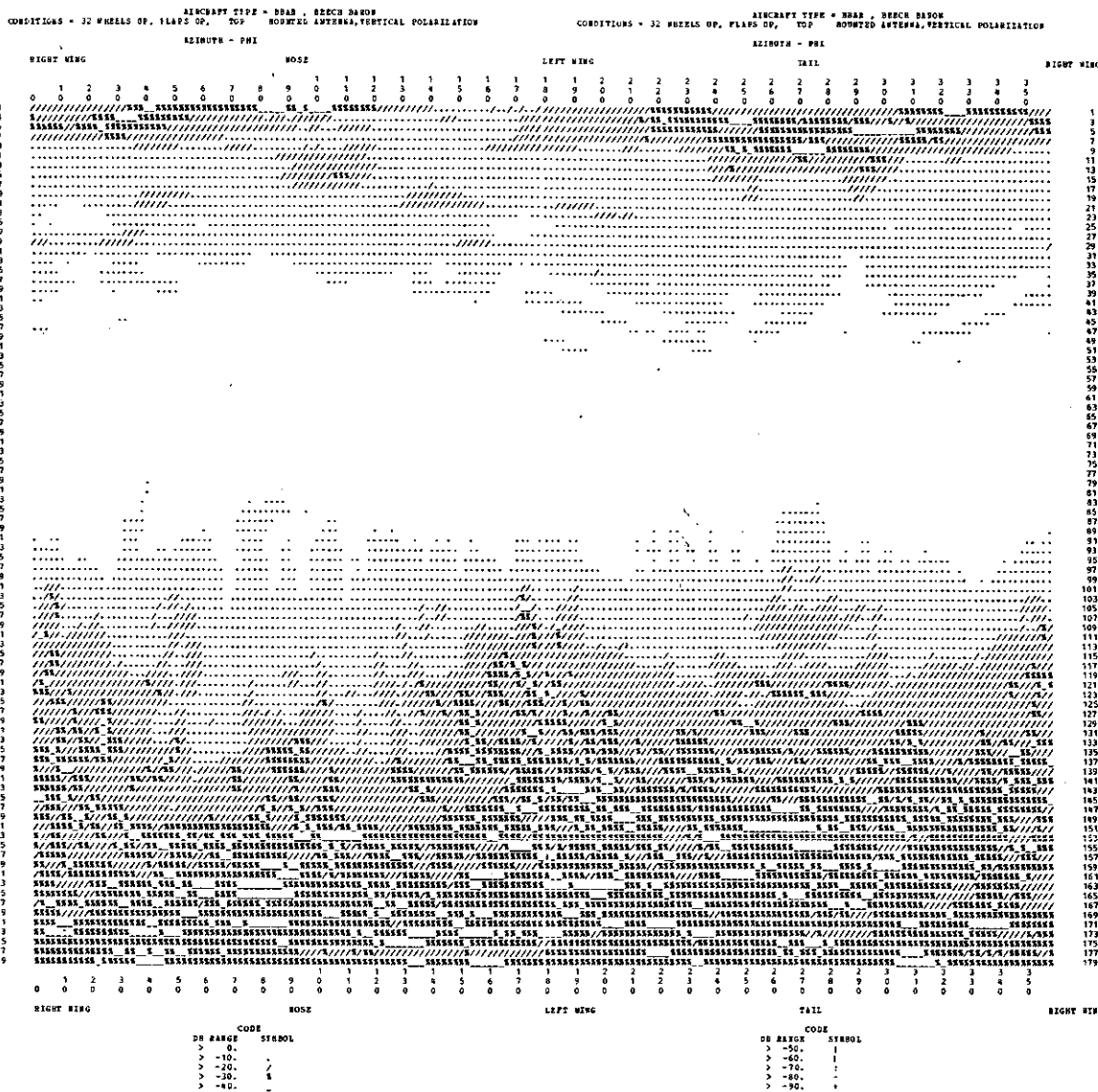


Fig. 5-4. Beechcraft Baron; antenna position 1 (T); wheels up, flaps down.



69

Fig. 5-5. Beechcraft Baron; antenna position 2 (T); wheels down, flaps up.



71

Fig. 5-7. Beechcraft Baron; antenna position 2 (T); wheels up, flaps up.

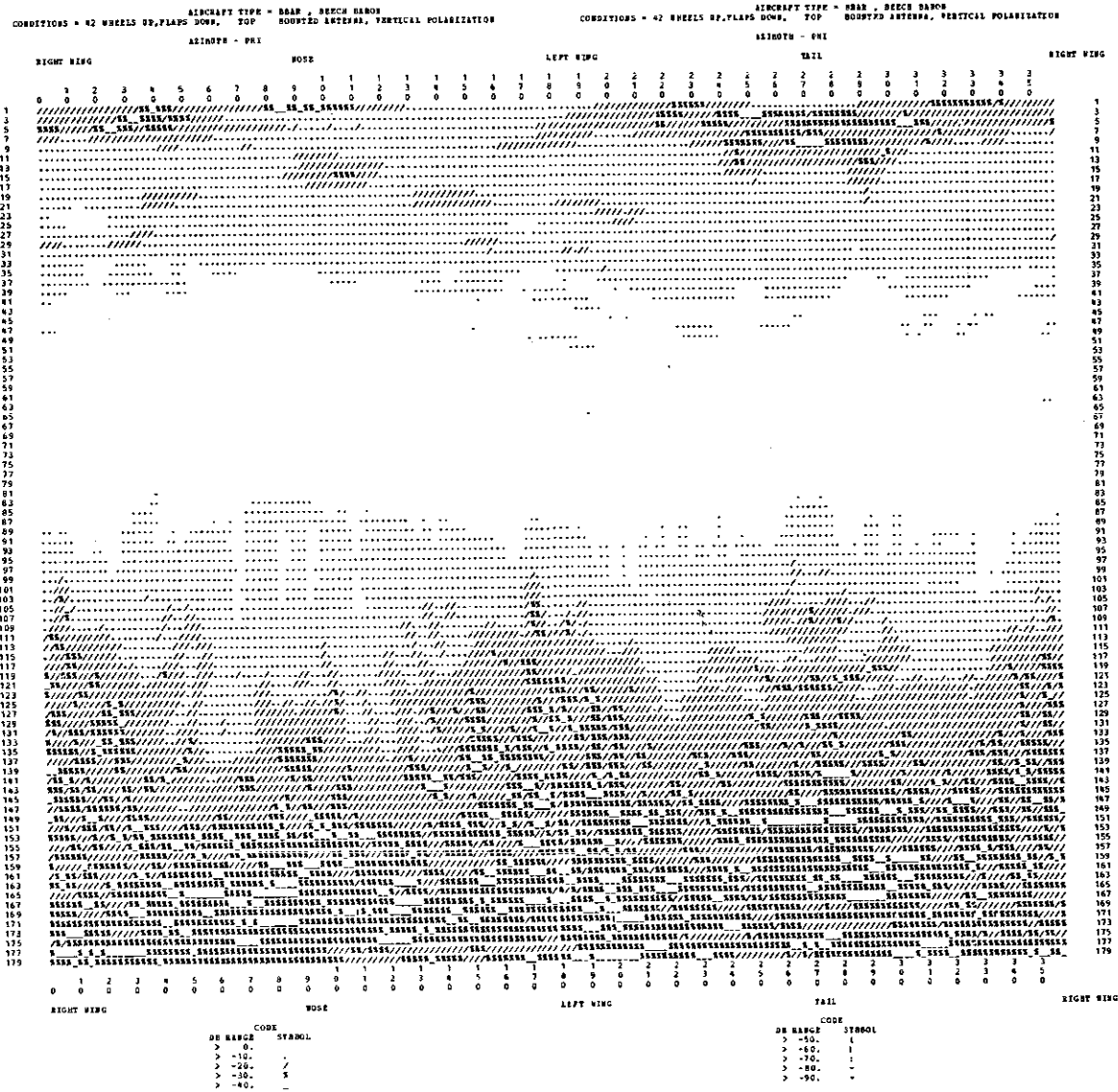
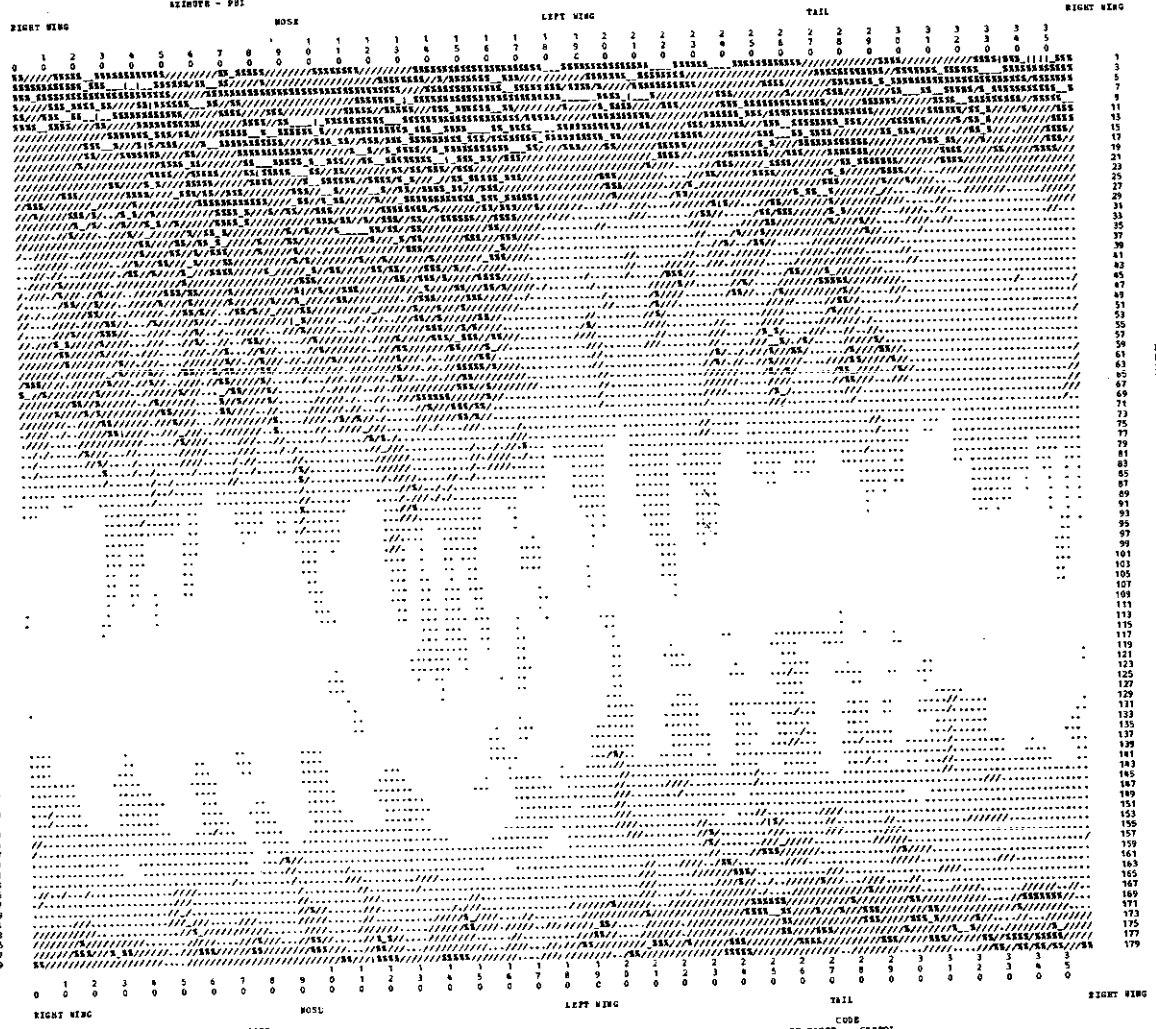


Fig. 5-8. Beechcraft Baron; antenna position 2 (T); wheels up, flaps down.

ALSCRAFT TYPE = BARON BEECH BARON
 CONDITIONS = 13 WHEELS DOWN, FLAPS UP, BOTTOM HOODED ANTENNA, VERTICAL POLARIZATION
 AZIMUTH - PHI

ALSCRAFT TYPE = BARON BEECH BARON
 CONDITIONS = 13 WHEELS DOWN, FLAPS UP, BOTTOM HOODED ANTENNA, VERTICAL POLARIZATION
 AZIMUTH - PHI



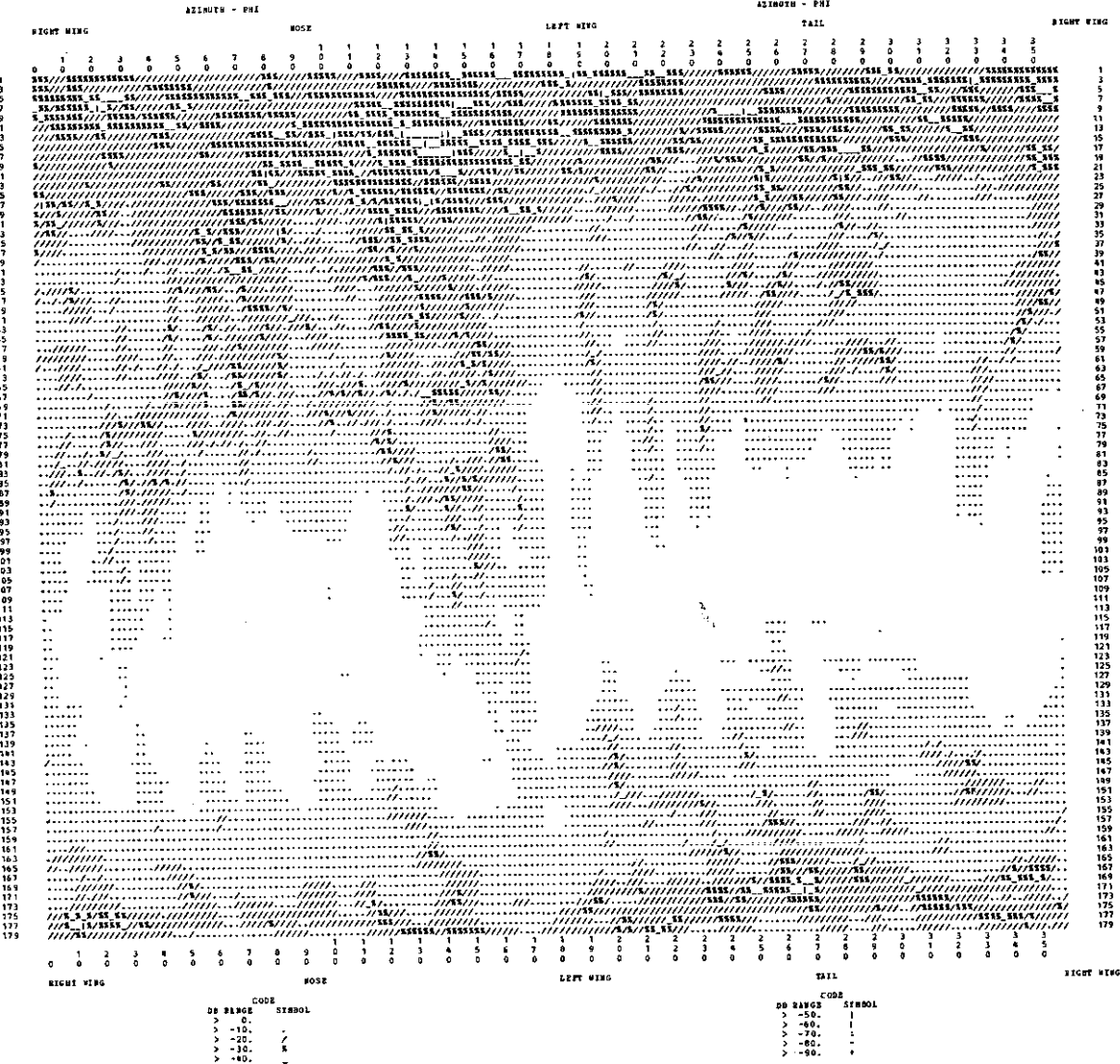
CODES		CODES	
DB RANGE	SYMBOL	DB RANGE	SYMBOL
> 0.	.	> -50.	1
> -10.	1	> -60.	3
> -20.	2	> -70.	5
> -30.	3	> -80.	7
> -40.	5	> -90.	9

73

Fig. 5-9. Beechcraft Baron; antenna position 3 (B); wheels down, flaps up.

CONDITIONS - 23 WHEELS DOWN, FLAPS DOWN, BOTTOM MOUNTED ANTENNA, VERTICAL POLARIZATION

CONDITIONS - 23 WHEELS DOWN, FLAPS DOWN, BOTTOM MOUNTED ANTENNA, VERTICAL POLARIZATION



74

Fig. 5-10. Beechcraft Baron; antenna position 3 (B); wheels down, flaps down.

AIRCRAFT TYPE = BARON, BEECH BARON
 CONDITIONS = 33 WHEELS UP, FLAPS UP, BOTTOM MOUNTED ANTENNA, VERTICAL POLARIZATION

AIRCRAFT TYPE = BARON, BEECH BARON
 CONDITIONS = 33 WHEELS UP, FLAPS UP, BOTTOM MOUNTED ANTENNA, VERTICAL POLARIZATION

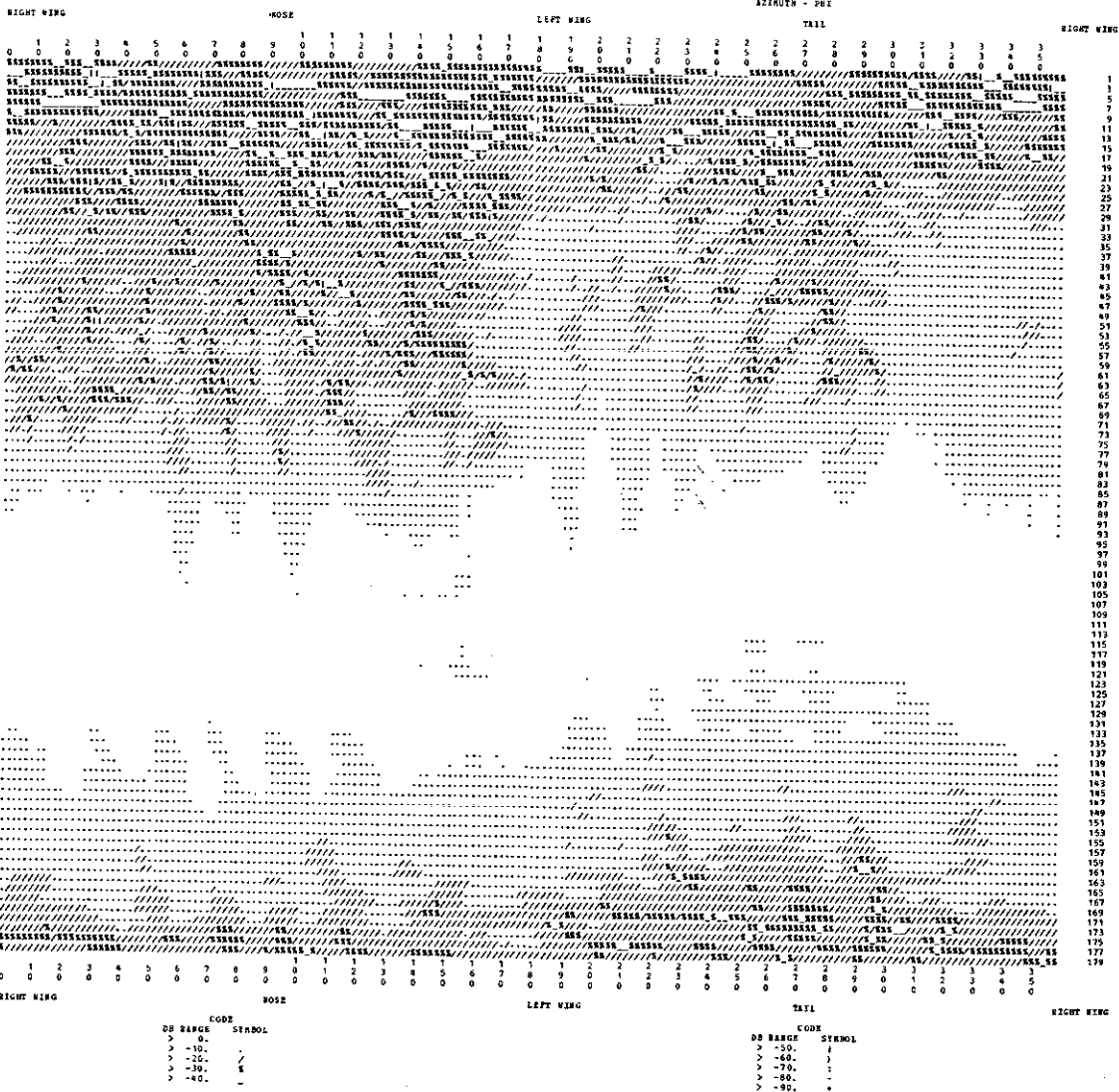


Fig. 5-11. Beechcraft Baron; antenna position 3 (B); wheels up, flaps up.

AIRCRAFT TYPE = BARON, BEECH BARON
 CONDITIONS = 43 WHEELS UP, FLAPS DOWN, ROTTOR HOUSTED ANTENNA, VERTICAL POLARIZATION

AIRCRAFT TYPE = BARON, BEECH BARON
 CONDITIONS = 43 WHEELS UP, FLAPS DOWN, ROTTOR HOUSTED ANTENNA, VERTICAL POLARIZATION

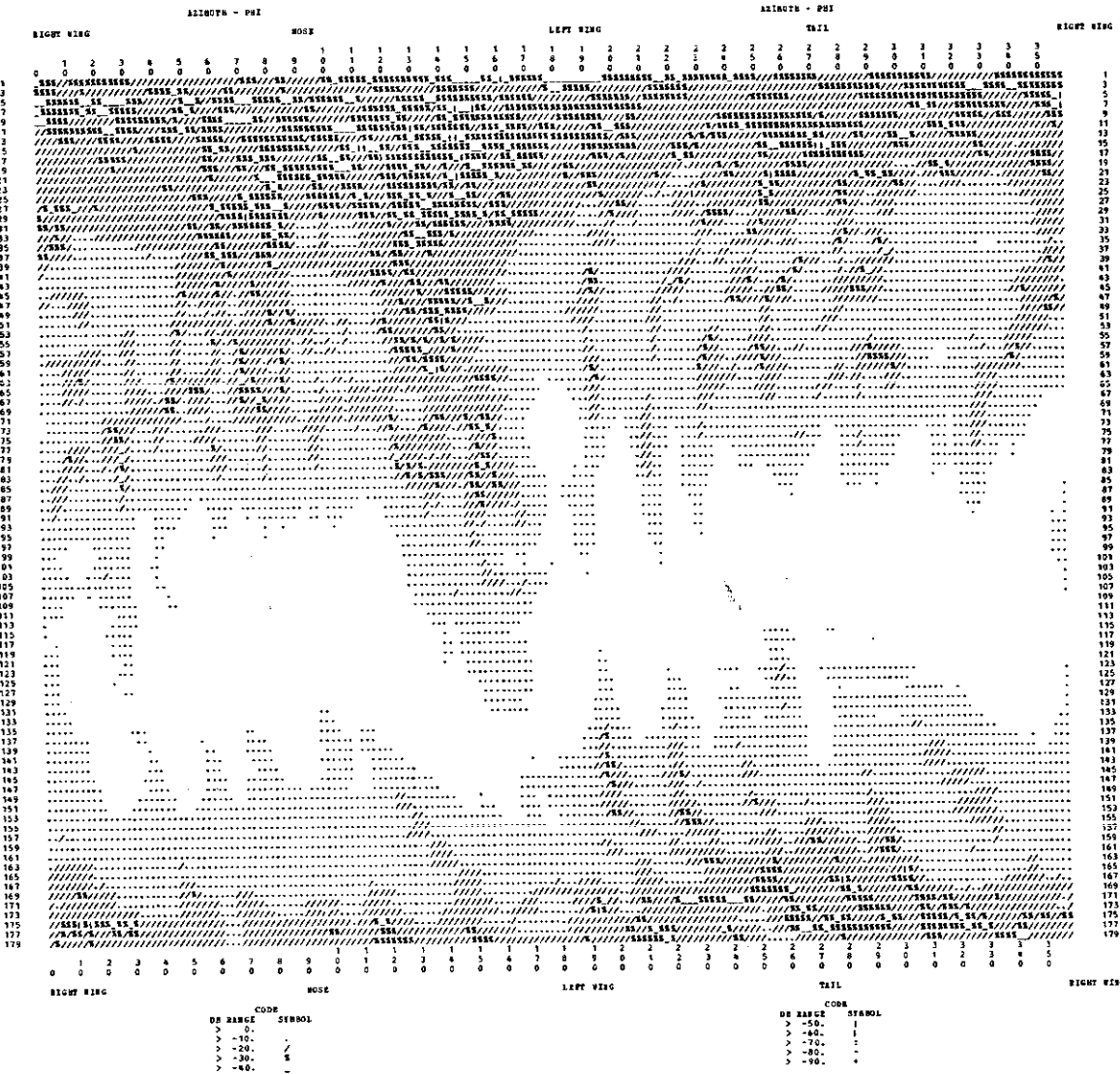


Fig. 5-12. Beechcraft Baron; antenna position 3 (B); wheels up, flaps down.

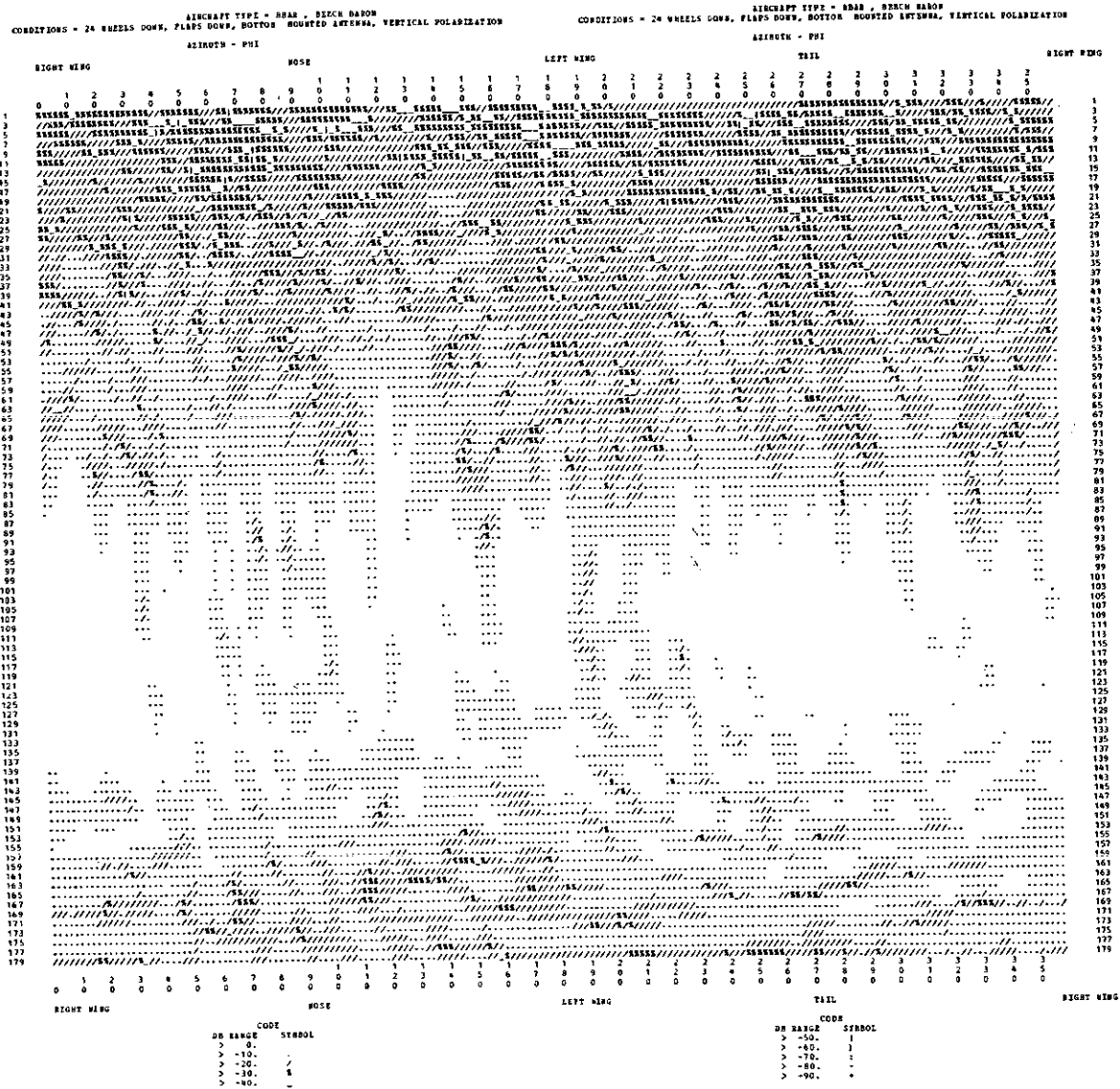
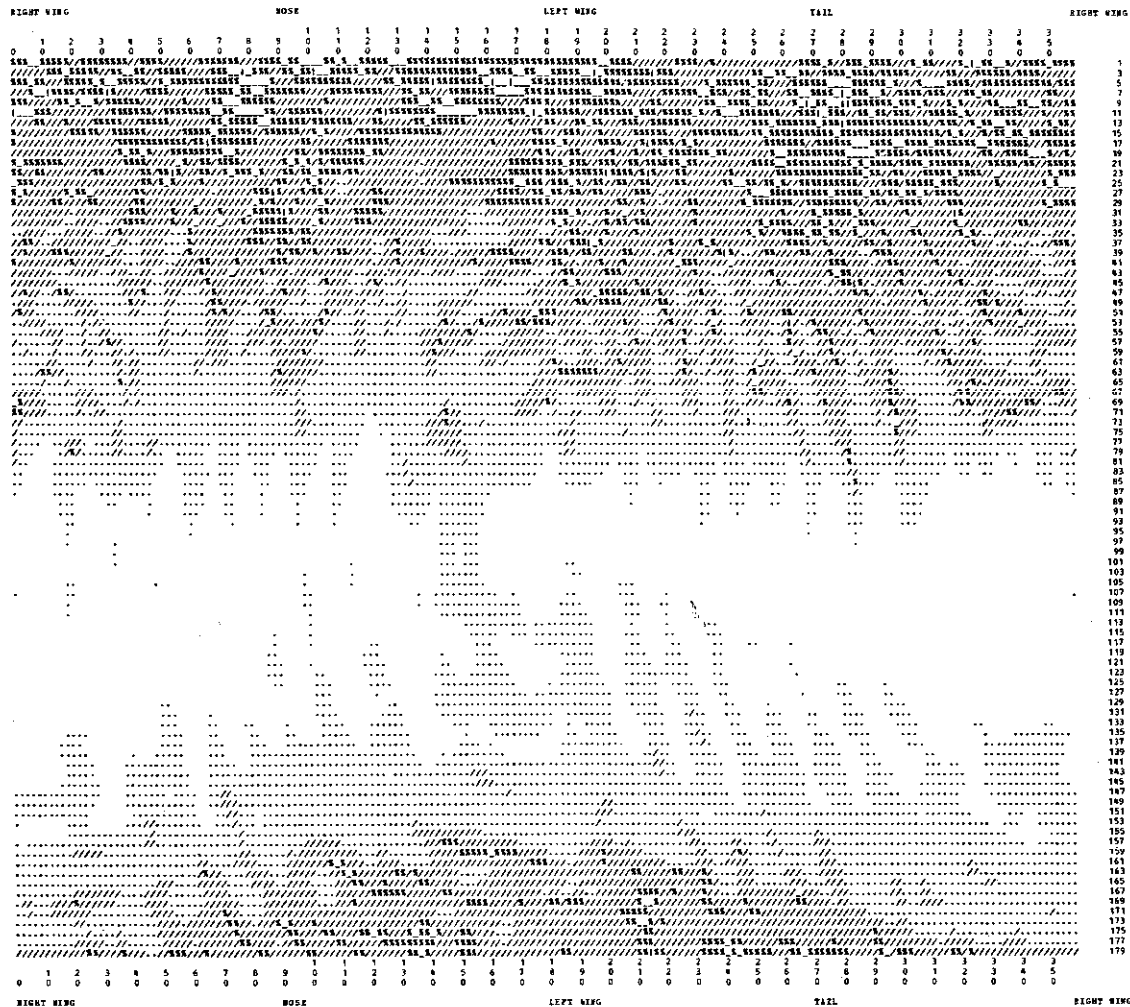


Fig. 5-13. Beechcraft Baron; antenna position 4 (B); wheels down, flaps down.

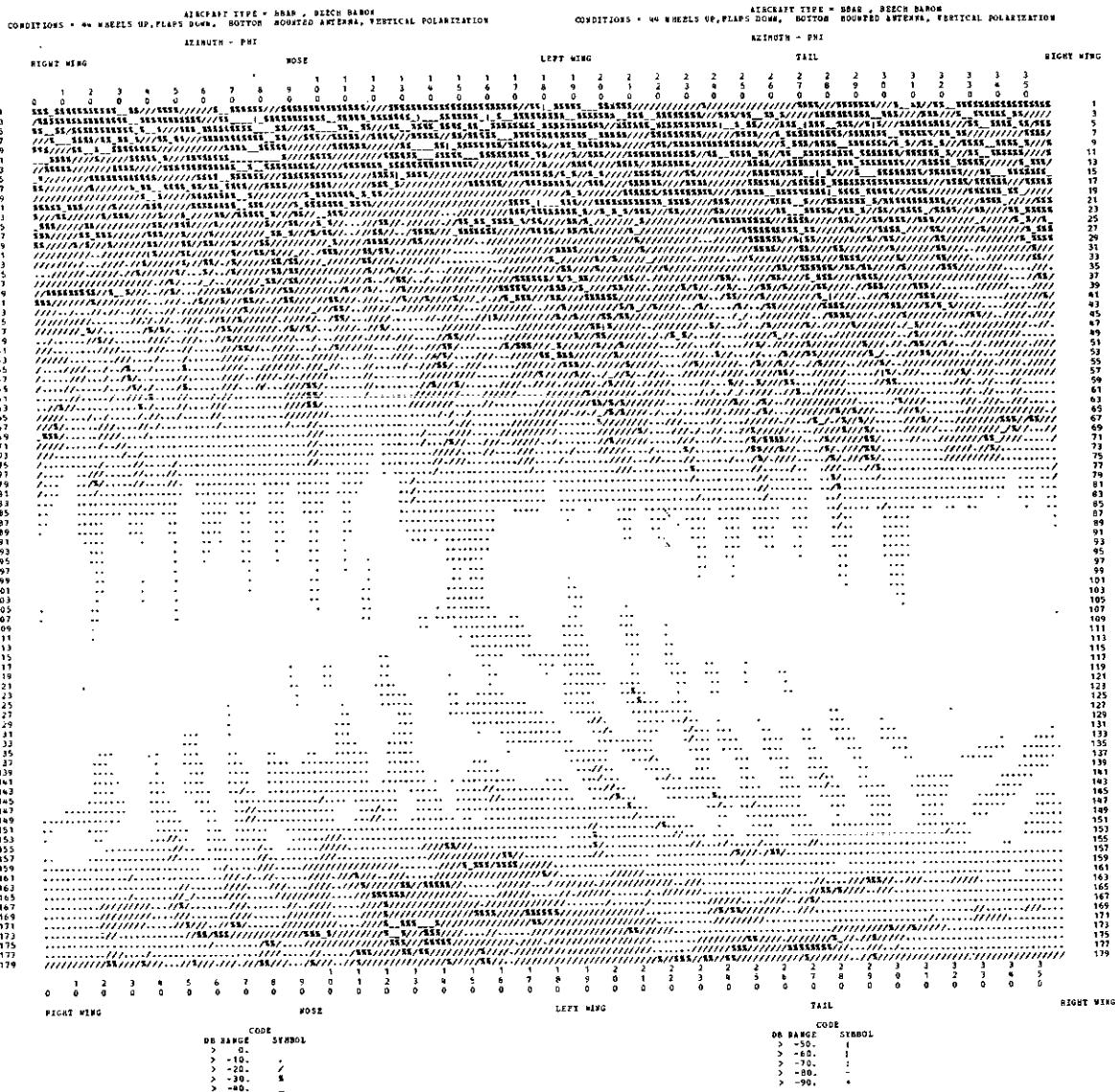
AIRCRAFT TYPE = BARON - BEECH BARON
 CONDITIONS = 36 WHEELS UP, FLAPS UP, BOTTOM MOUNTED ANTENNA, VERTICAL POLARIZATION
 AZIMUTH - PHI

AIRCRAFT TYPE = BARON - BEECH BARON
 CONDITIONS = 36 WHEELS UP, FLAPS UP, BOTTOM MOUNTED ANTENNA, VERTICAL POLARIZATION
 AZIMUTH - PHI



Nose		Left Wing		Tail		Right Wing	
1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4
5	5	5	5	5	5	5	5
6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8

Fig. 5-14. Beechcraft Baron; antenna position 4 (B); wheels up, flaps up.



79

Fig. 5-15. Beechcraft Baron; antenna position 4 (B); wheels up, flaps down.

80

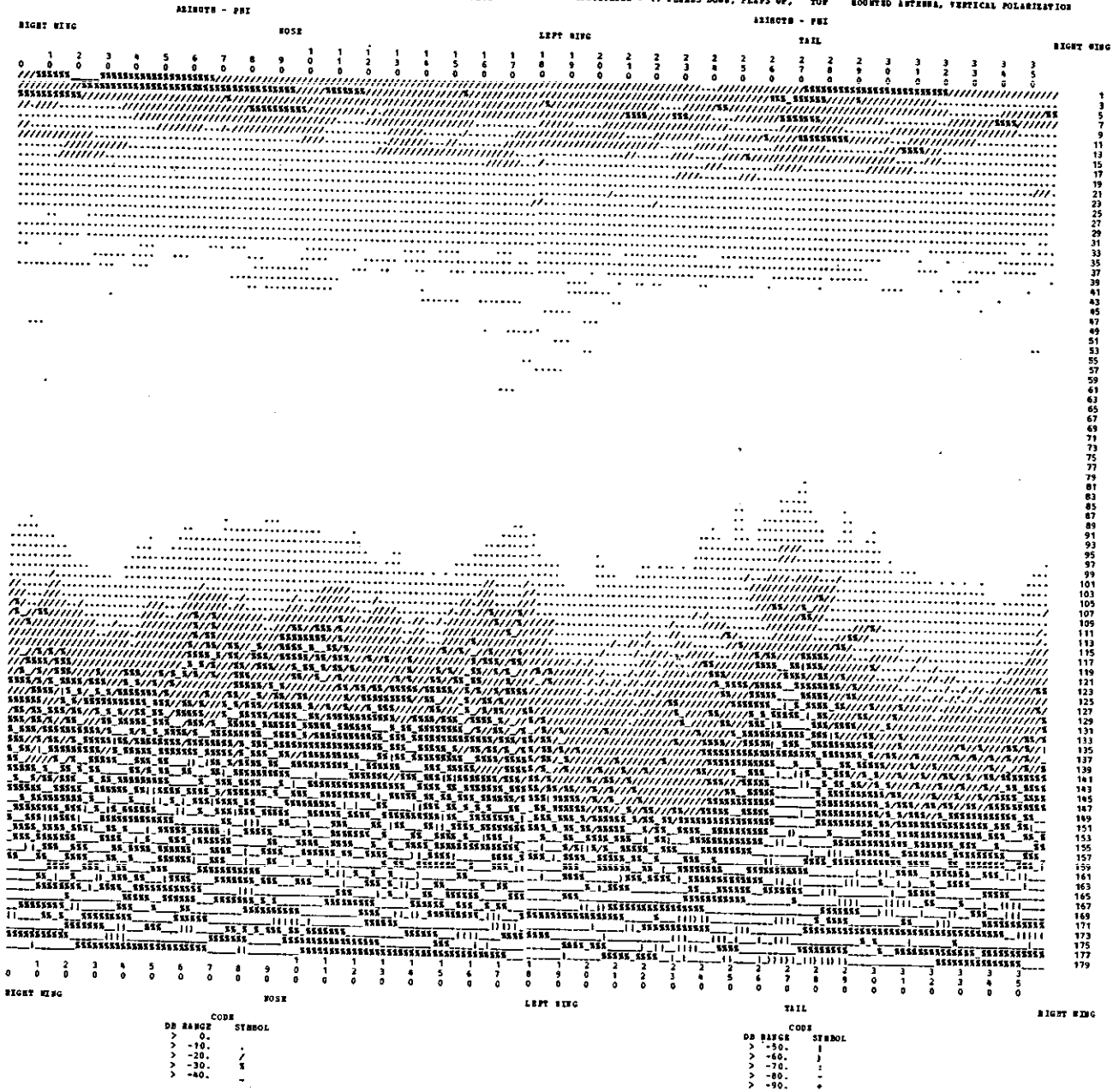
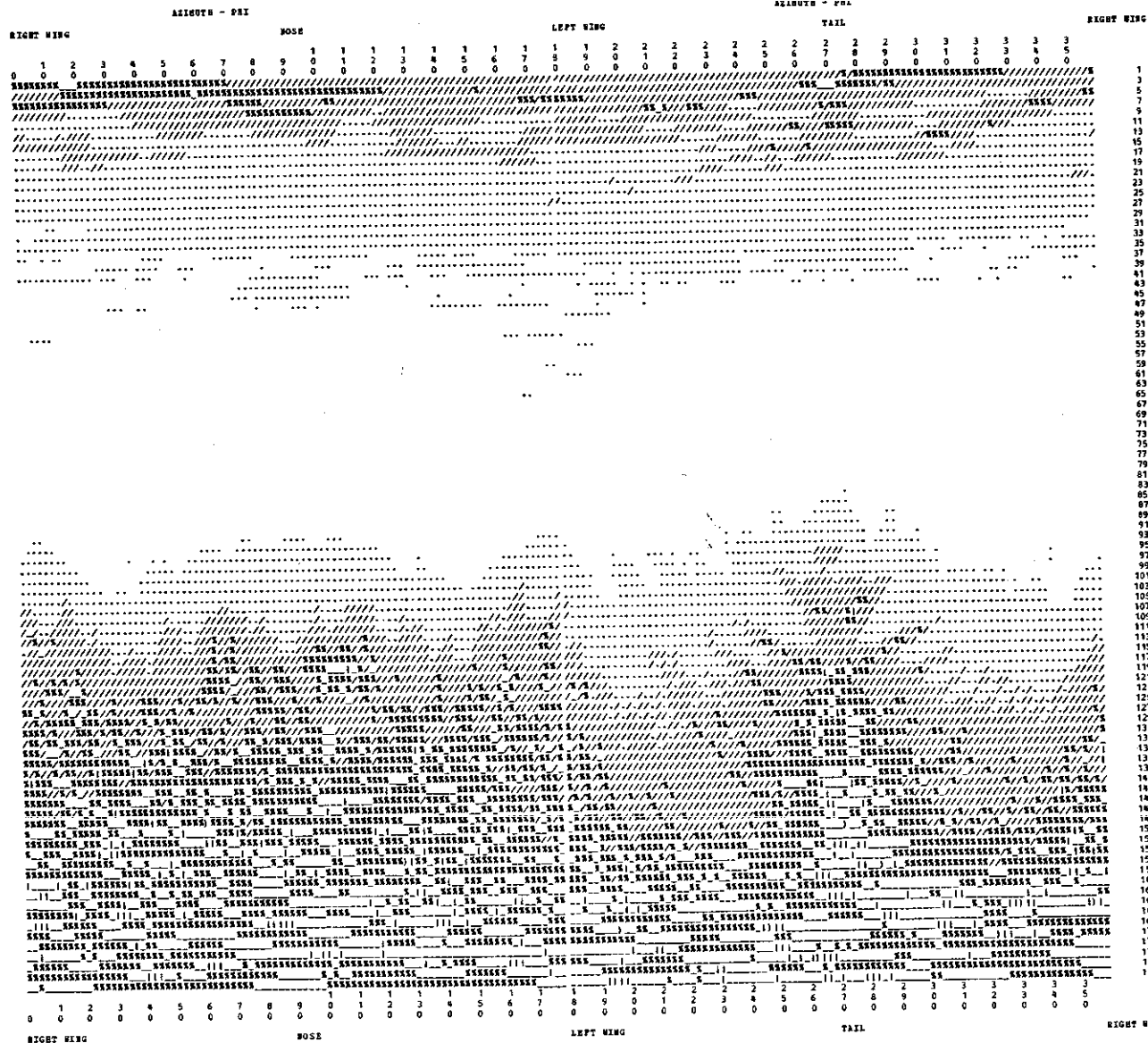


Fig. 6-1. Beechcraft Baron 99; antenna position 1 (T); wheels down, flaps up.

AIRCRAFT TYPE = B899 , SERCH 899
 CONDITIONS = 21 WHEELS DOWN, FLAPS DOWN, TOP MOUNTED ANTENNA, VERTICAL POLARIZATION
 AIRCRAFT TYPE = B899 , SERCH 899
 CONDITIONS = 21 WHEELS DOWN, FLAPS DOWN, TOP MOUNTED ANTENNA, VERTICAL POLARIZATION



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Fig. 6-2. Beechcraft Baron 99; antenna position 1 (T); wheels down, flaps down.

AIRCRAFT TYPE = B599 , BEECH 99
 CONDITIONS = 22 WHEELS DOWN, FLAPS DOWN, TOP ROUINDED ANTENNA, VERTICAL POLARIZATION

AIRCRAFT TYPE = B599 , BEECH 99
 CONDITIONS = 22 WHEELS DOWN, FLAPS DOWN, TOP ROUINDED ANTENNA, VERTICAL POLARIZATION

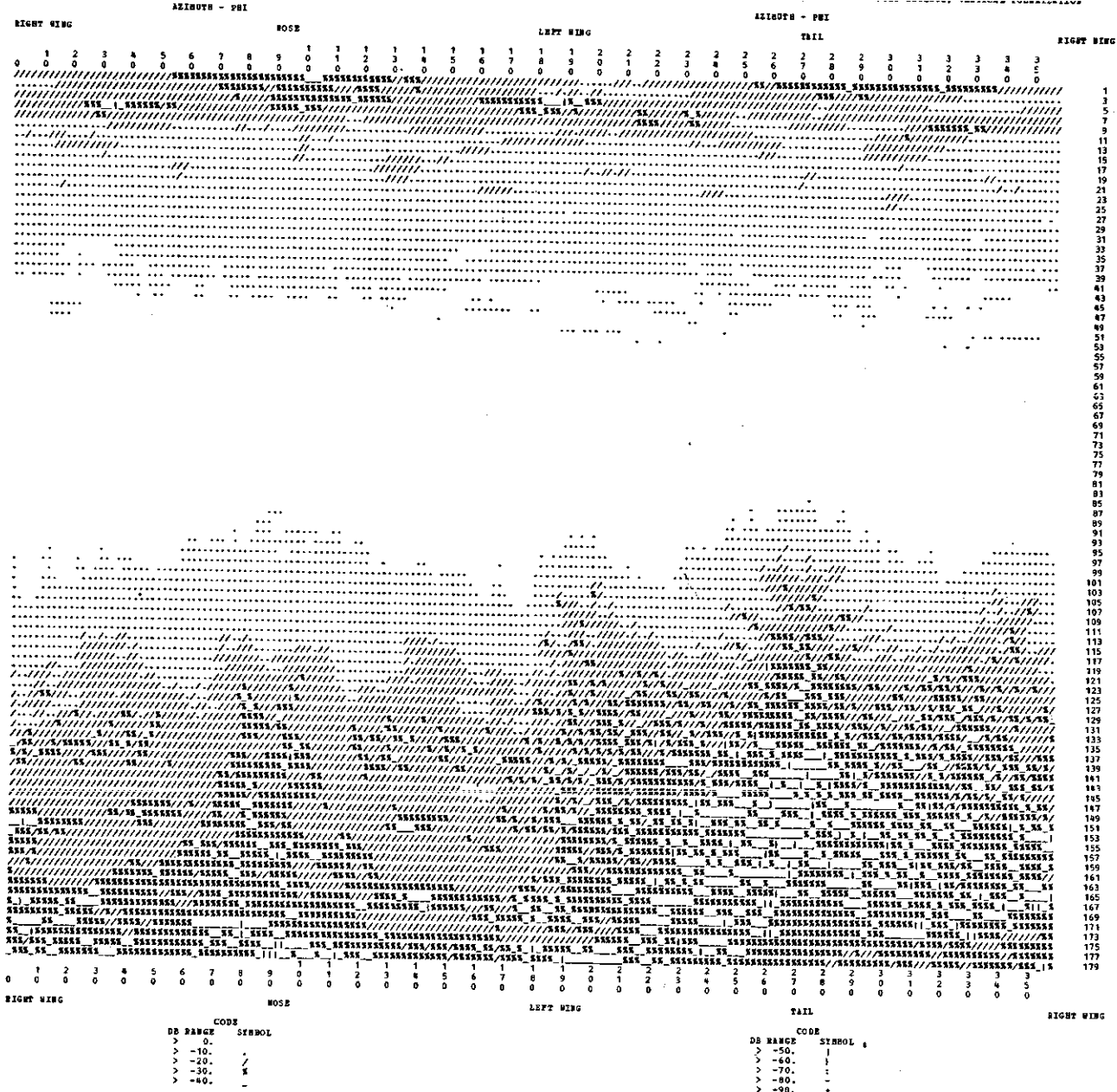
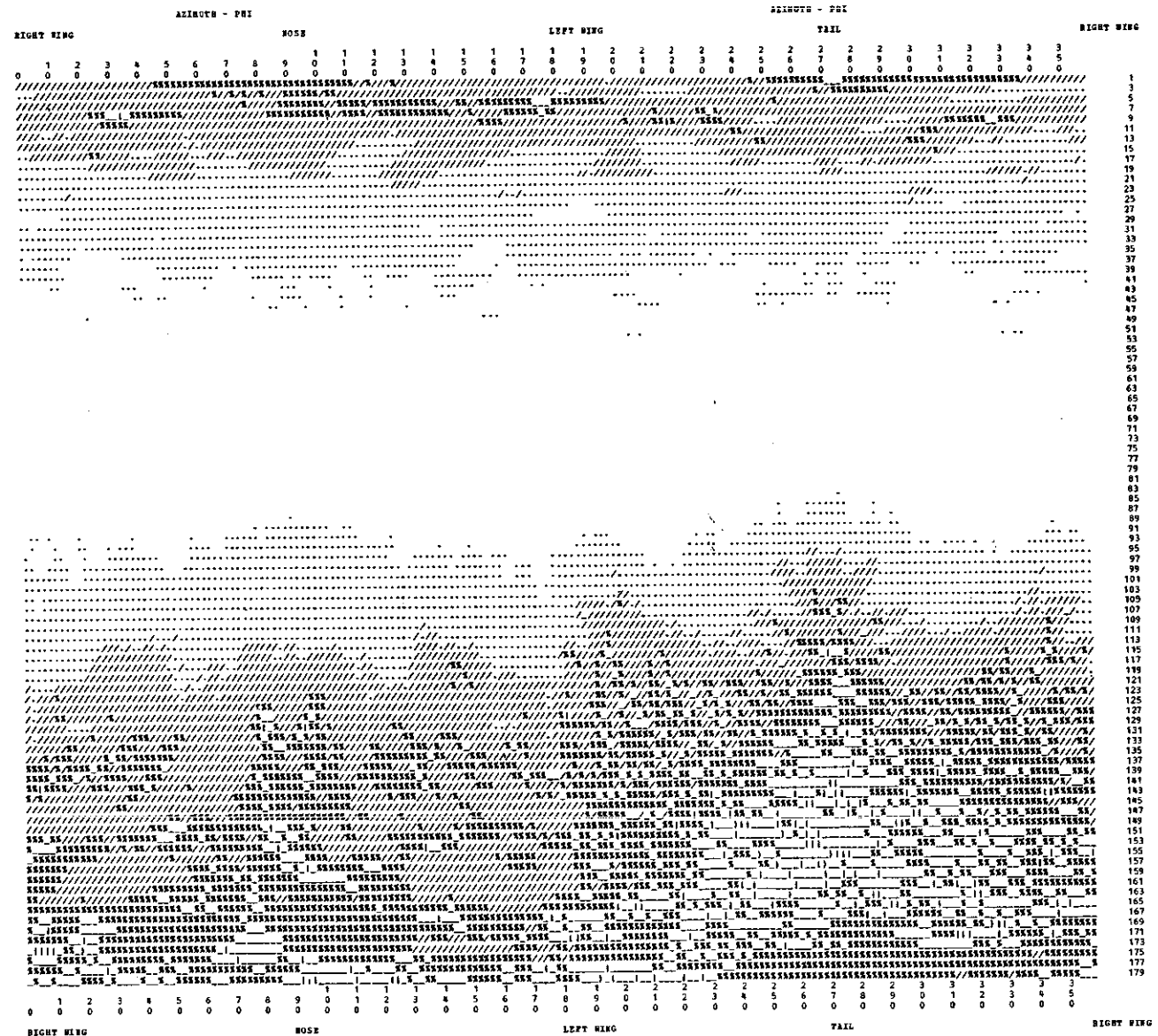


Fig. 6-3. Beechcraft Baron 99; antenna position 2 (T); wheels down, flaps down.

CONDITIONS = 32 WHEELS UP, FLAPS UP, TOP MOUNTED ANTENNA, VERTICAL POLARIZATION

CONDITIONS = 32 WHEELS UP, FLAPS UP, TOP MOUNTED ANTENNA, VERTICAL POLARIZATION



DP RANGE	CODE	SYMBOL	DP RANGE	CODE	SYMBOL
> 0.			> -60.		
> -10.			> -70.		
> -20.			> -80.		
> -30.			> -90.		
> -40.					

Fig. 6-4. Beechcraft Baron 99; antenna position 2 (T); wheels up, flaps up.

83

E L E V A T I O N

T H E T A

AIRCRAFT TYPE = B999 . BEECH 99
 CONDITIONS = 42 WHEELS UP, FLAPS DOWN, TOP MOUNTED ANTENNA, VERTICAL POLARIZATION
 AZIMUTH - PHI

AIRCRAFT TYPE = B999 . BEECH 99
 CONDITIONS = 42 WHEELS UP, FLAPS DOWN, TOP MOUNTED ANTENNA, VERTICAL POLARIZATION
 AZIMUTH - PHI

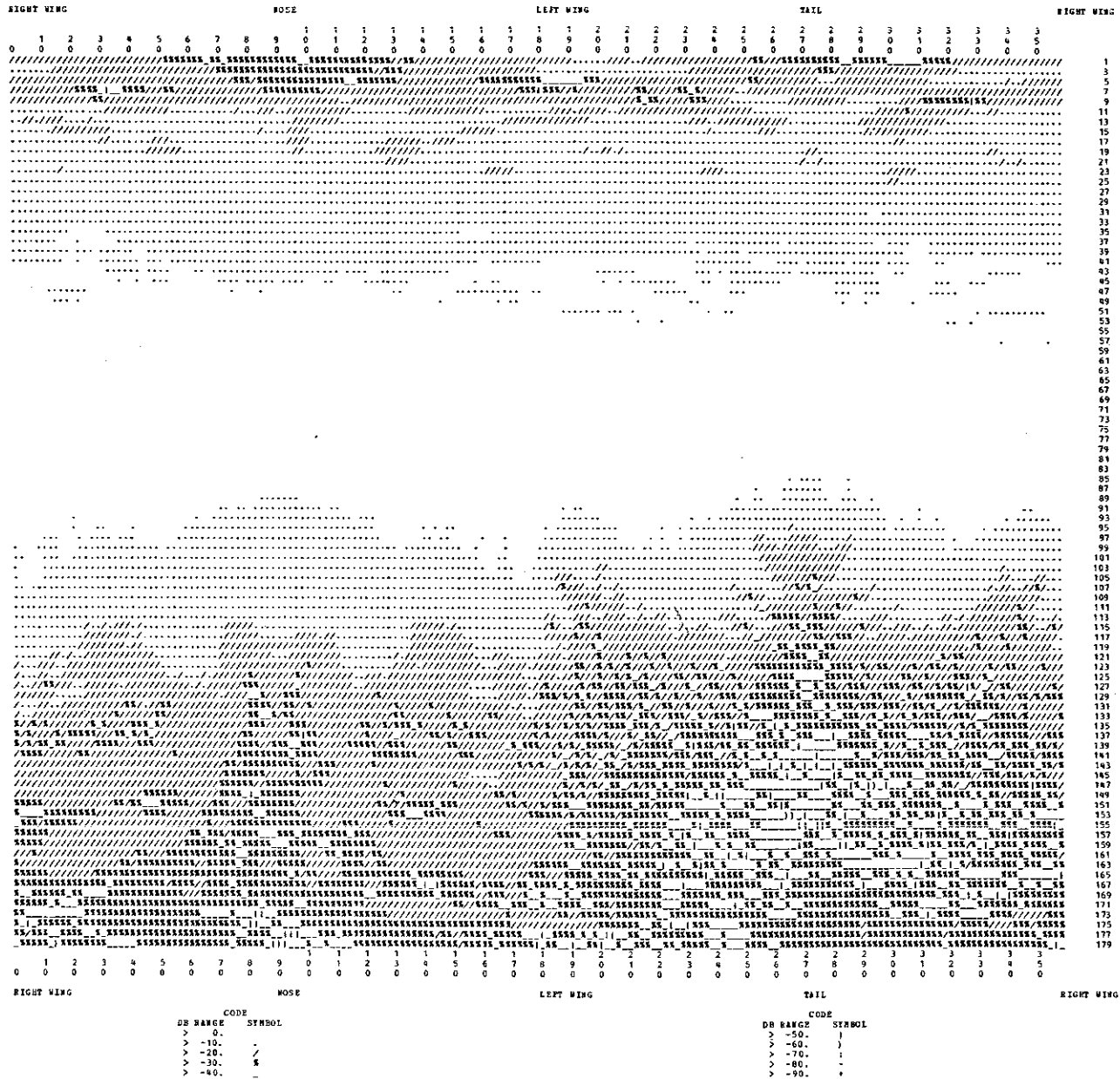


Fig. 6-5. Beechcraft Baron 99; antenna position 2 (T); wheels up, flaps down.

E L E V A T I O N

CONDITIONS = 13 WHEELS DOWN, FLAPS UP, ROTOR HOISTED ANTENNA, VERTICAL POLARIZATION
 AIRCRAFT TYPE = B999, BECH 999

CONDITIONS = 13 WHEELS DOWN, FLAPS UP, ROTOR SCOUTED ANTENNA, VERTICAL POLARIZATION
 AIRCRAFT TYPE = B999, BECH 999

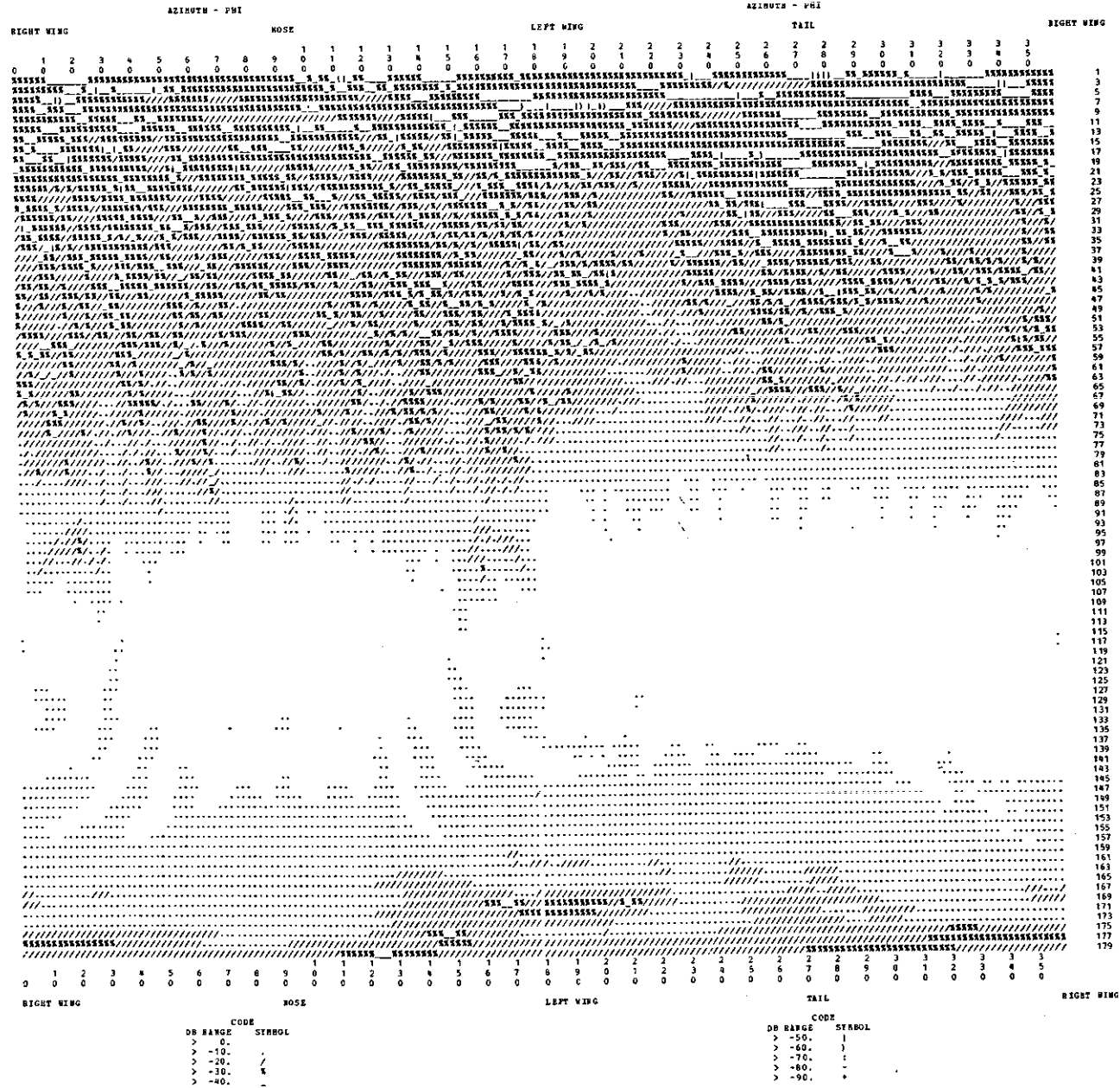


Fig. 6-6. Beechcraft Baron 99; antenna position 3 (B); wheels down, flaps up.

AIRCRAFT TYPE = B99 , BEECH 99
CONDITIONS = 33 WHEELS UP, FLAPS UP, BOTTOM HOUSTED ANTENNA, VERTICAL POLARIZATION

AIRCRAFT TYPE = B99 , BEECH 99
CONDITIONS = 33 WHEELS UP, FLAPS UP, BOTTOM HOUSTED ANTENNA, VERTICAL POLARIZATION
AZIMUTH - PHI

87

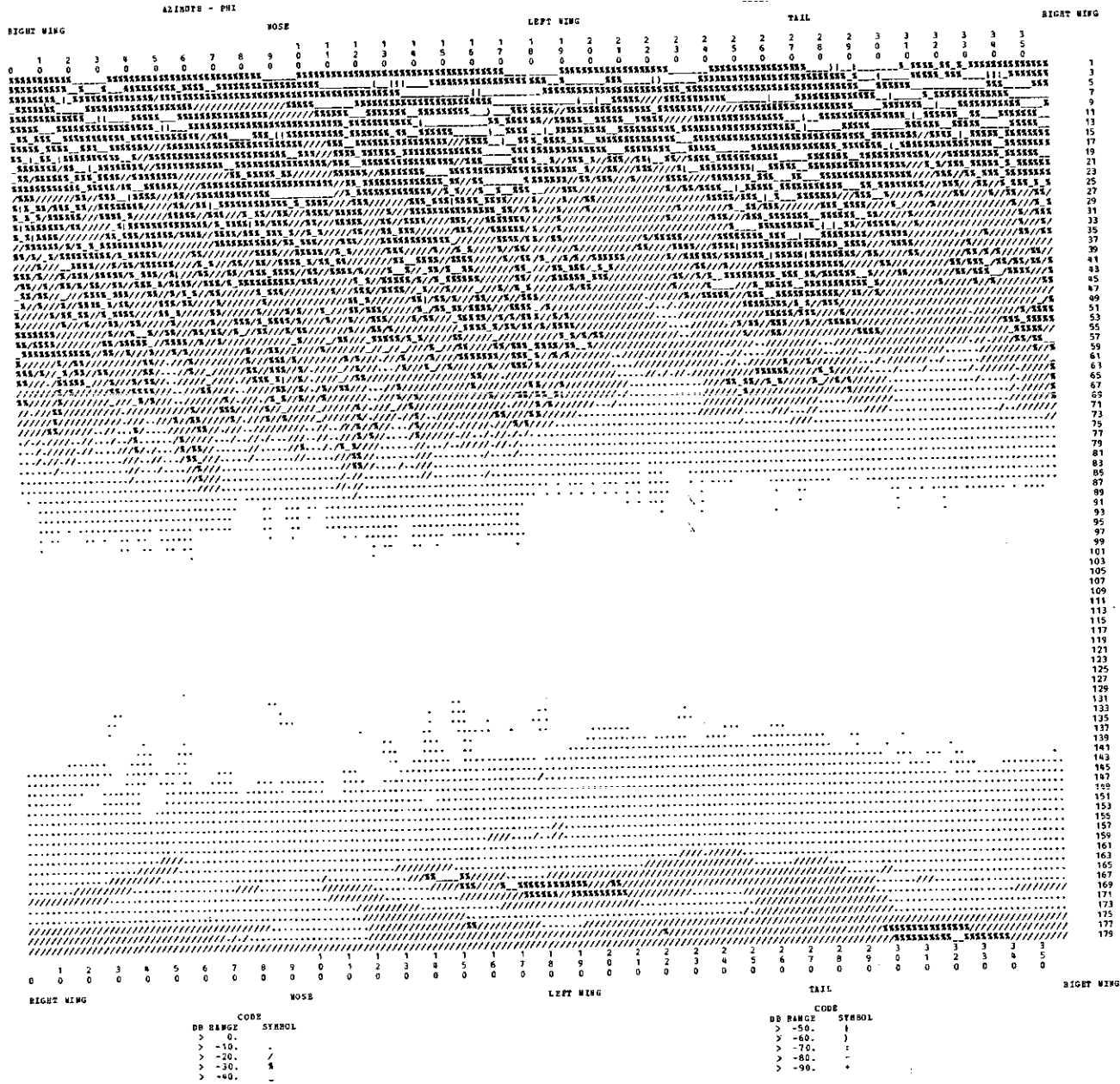


Fig. 6-8. Beechcraft Baron 99; antenna position 3 (B); wheels up, flaps up.

CONDITIONS = 43 WHEELS UP, FLAPS DOWN, BOTTOM MOUNTED ANTENNA, VERTICAL POLARIZATION
 AIRCRAFT TYPE = B699, BEECH 899
 AZIMUTH - PHI

CONDITIONS = 43 WHEELS UP, FLAPS DOWN, BOTTOM MOUNTED ANTENNA, VERTICAL POLARIZATION
 AIRCRAFT TYPE = B699, BEECH 899
 AZIMUTH - PHI

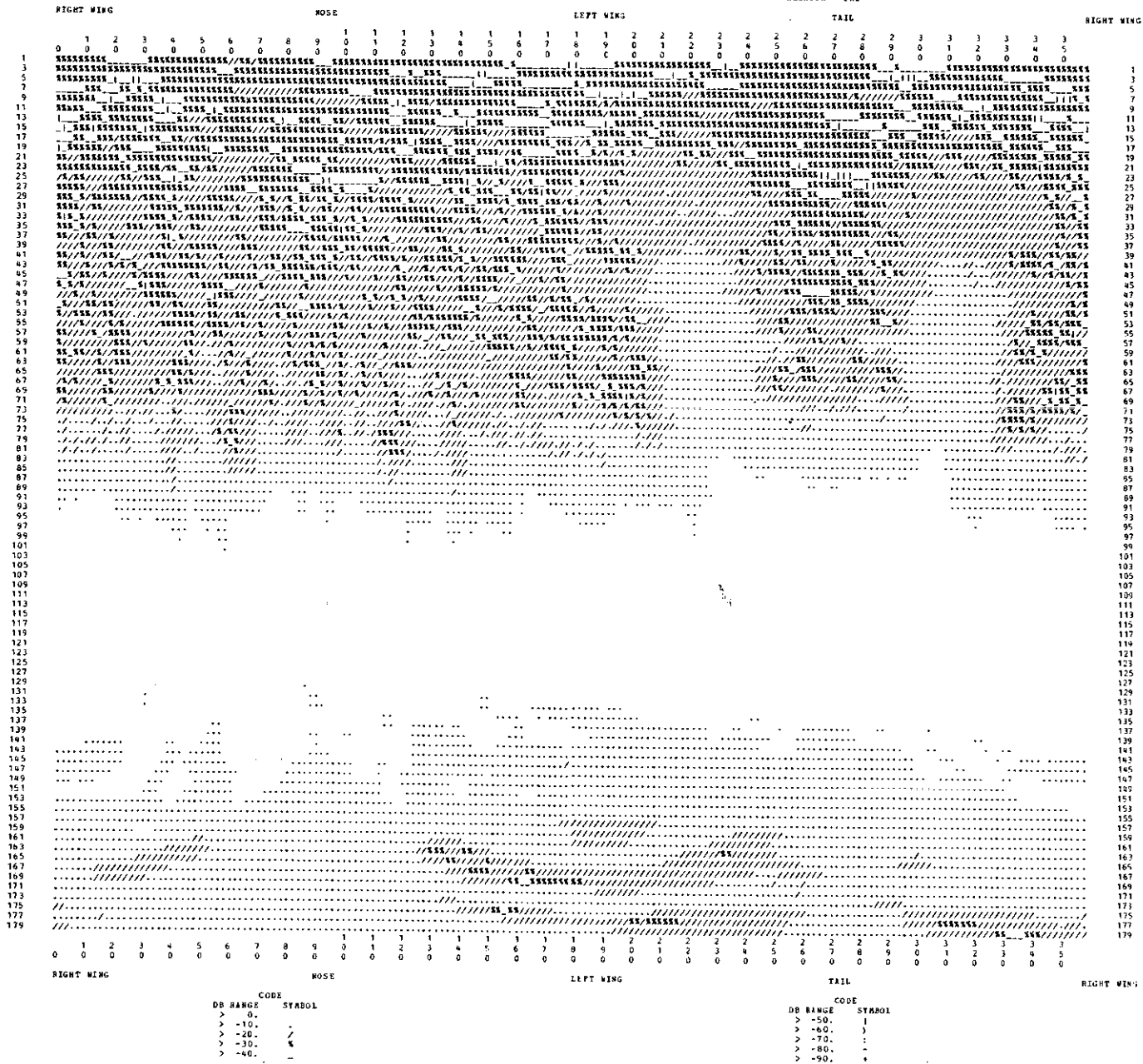


Fig. 6-9. Beechcraft Baron 99; antenna position 3 (B); wheels up, flaps down.

06

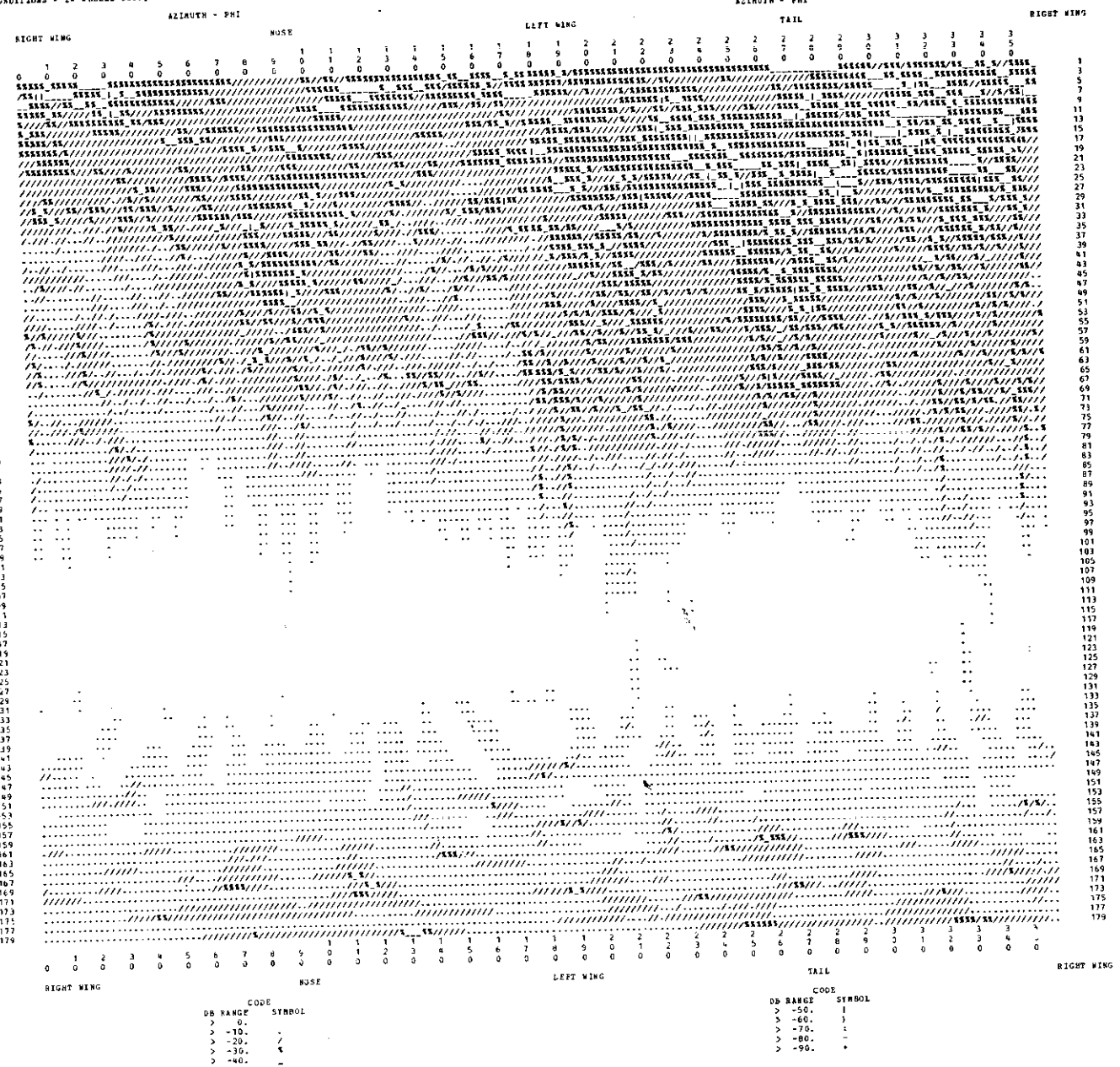
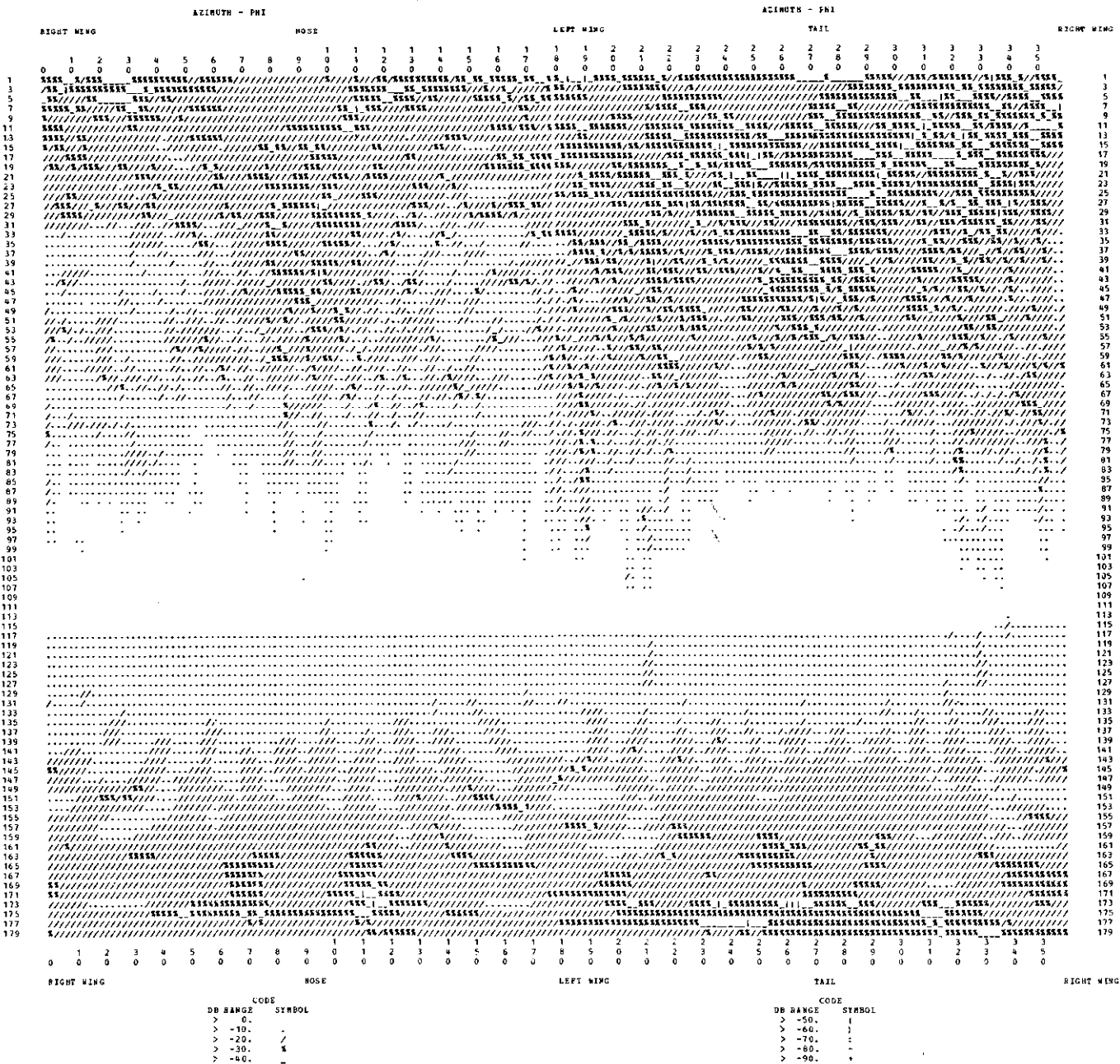


Fig. 6-11. Beechcraft Baron 99; antenna position 4 (B); wheels down, flaps down.

ALCRAFT TYPE = B859 , BECH 899
 CONDITIONS = 14 WHEELS DOWN, FLAPS UP, BOTTOM MOUNTED ANTENNA, VERTICAL POLARIZATION

ALCRAFT TYPE = B859 , BECH 899
 CONDITIONS = 14 WHEELS DOWN, FLAPS UP, BOTTOM MOUNTED ANTENNA, VERTICAL POLARIZATION



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Fig. 6-10. Beechcraft Baron 99; antenna position 4 (B); wheels down, flaps up.

AIRCRAFT TYPE = 8899, BEECH 899
 CONDITIONS = 34 WHEELS UP, FLAPS UP, BOTTOM MOUNTED ANTENNA, VERTICAL POLARIZATION

AIRCRAFT TYPE = 8899, BEECH 899
 CONDITIONS = 34 WHEELS UP, FLAPS UP, BOTTOM MOUNTED ANTENNA, VERTICAL POLARIZATION

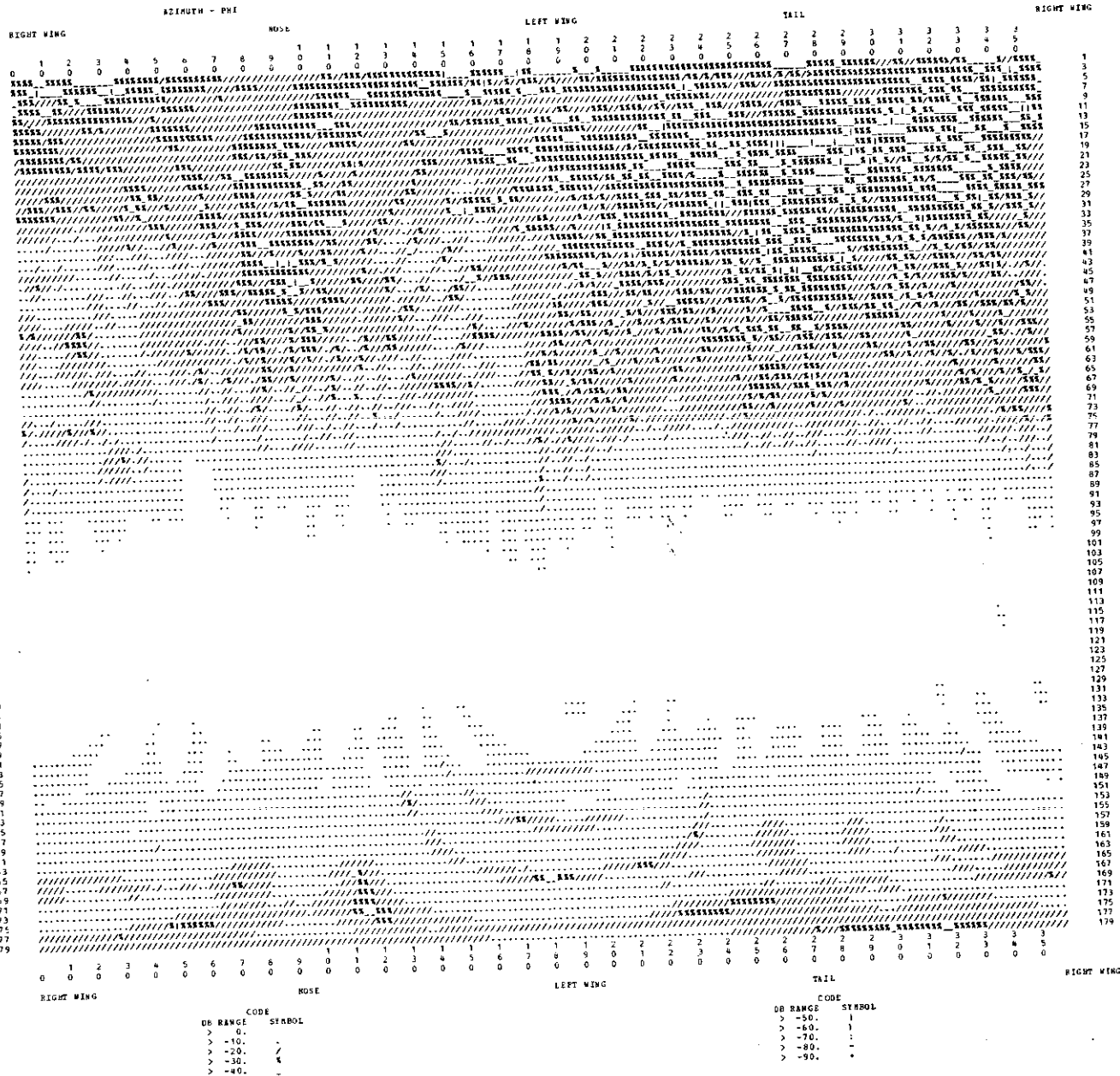


Fig. 6-12. Beechcraft Baron 99; antenna position 4 (B); wheels up, flaps up.

AIRCRAFT TYPE = B99 , BECH B99
CONDITIONS = WHEELS UP, FLAPS DOWN, ROTOR HOISTED ANTENNA, VERTICAL POLARIZATION

AIRCRAFT TYPE = B99 , BECH B99
CONDITIONS = WHEELS UP, FLAPS DOWN, ROTOR HOISTED ANTENNA, VERTICAL POLARIZATION

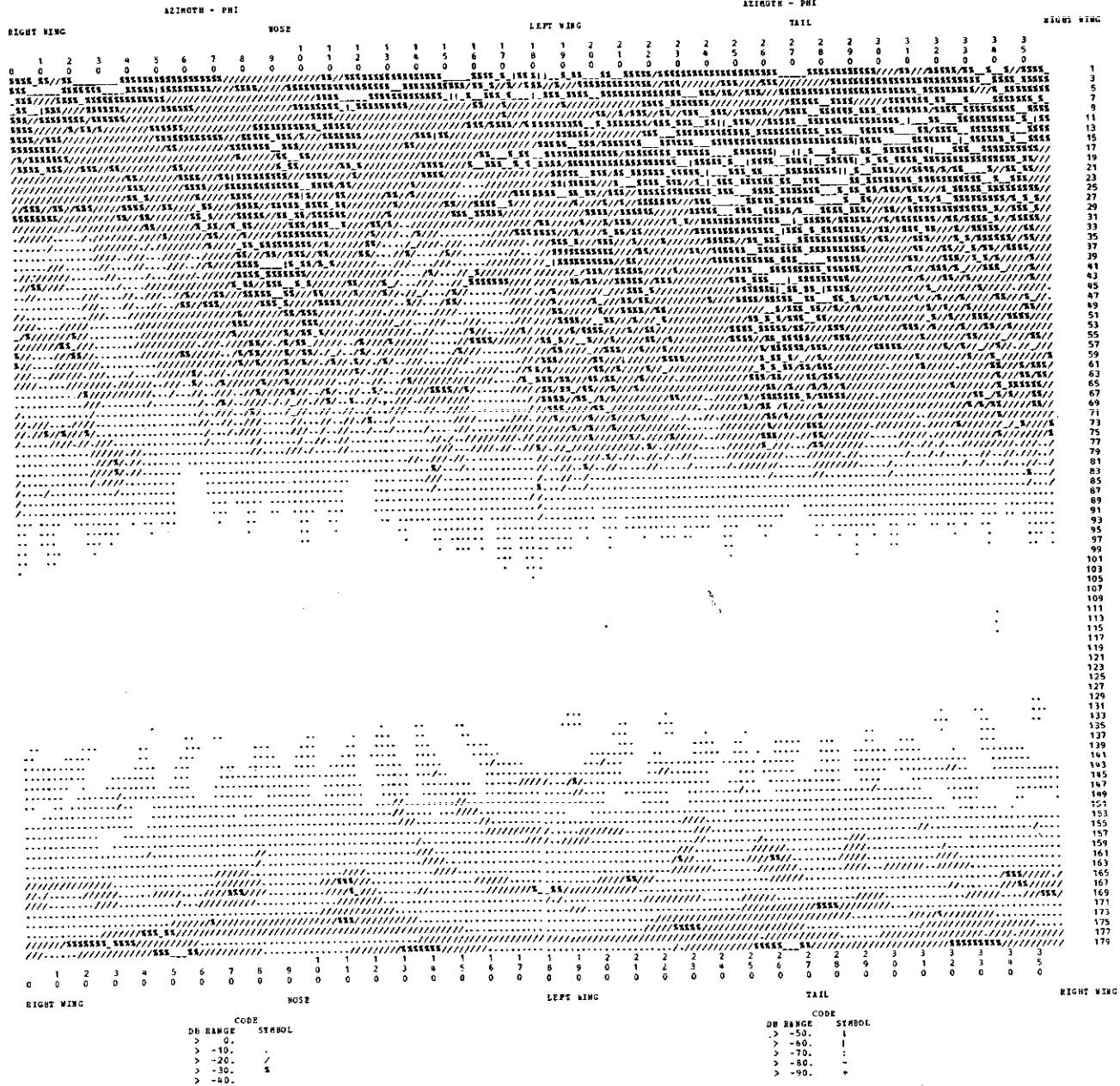
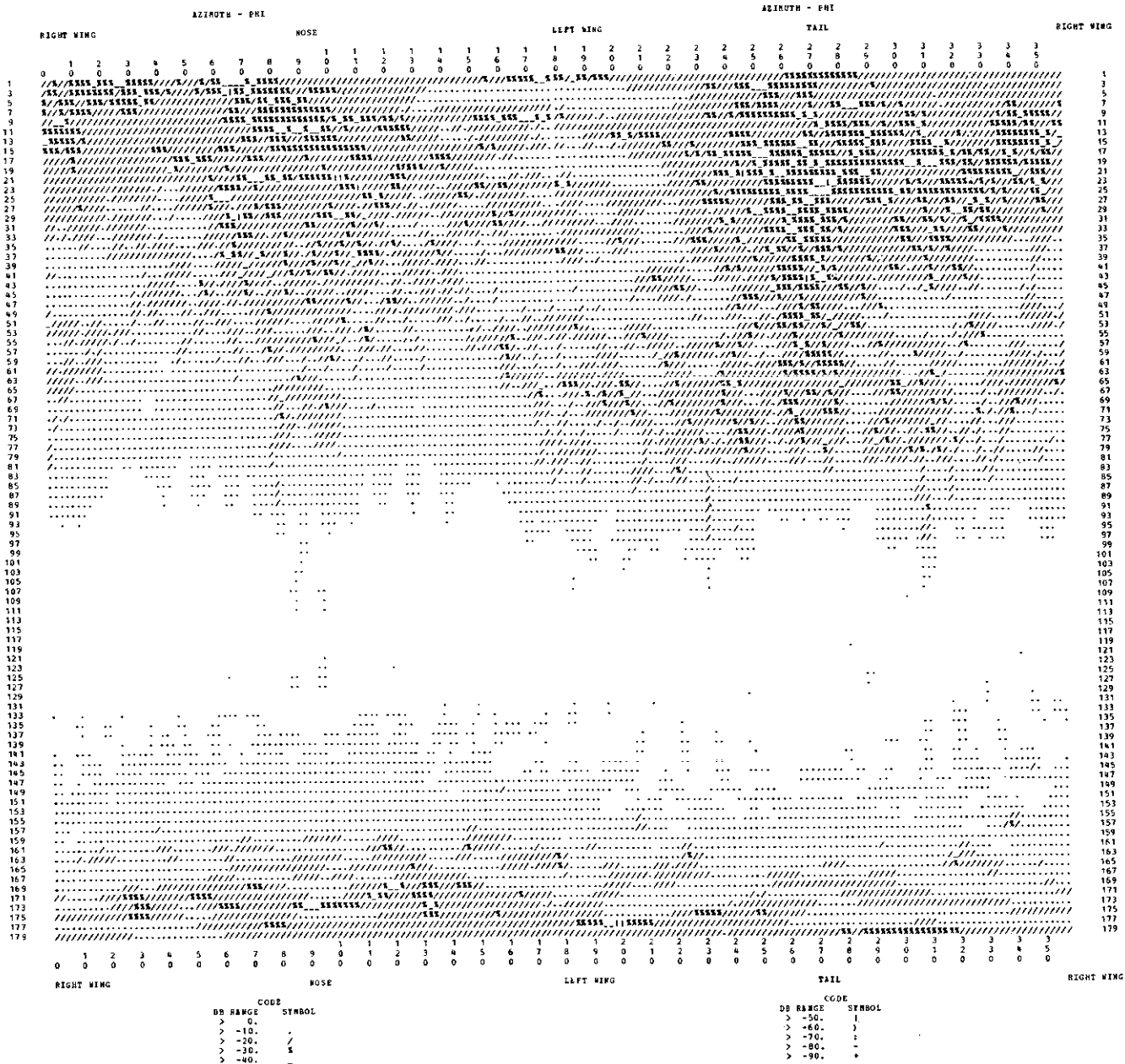


Fig. 6-13. Beechcraft Baron 99; antenna position 4 (B); wheels up, flaps down.

AIRCRAFT TYPE - B699 - BEECH 899
 CONDITIONS - 25 WHEELS DOWN, FLAPS DOWN, BOTTOM MOUNTED ANTENNA, VERTICAL POLARIZATION

AIRCRAFT TYPE - B699 - BEECH 899
 CONDITIONS - 25 WHEELS DOWN, FLAPS DOWN, BOTTOM MOUNTED ANTENNA, VERTICAL POLARIZATION



93

Fig. 6-14. Beechcraft Baron 99; antenna position 5 (B); wheels down, flaps down.

AIRCRAFT TYPE = 8099 , BEECH 899
 CONDITIONS = 35 WHEELS UP, FLAPS UP, BOTTOM MOUNTED ANTENNA, VERTICAL POLARIZATION

AIRCRAFT TYPE = 8099 , BEECH 899
 CONDITIONS = 35 WHEELS UP, FLAPS UP, BOTTOM MOUNTED ANTENNA, VERTICAL POLARIZATION

94

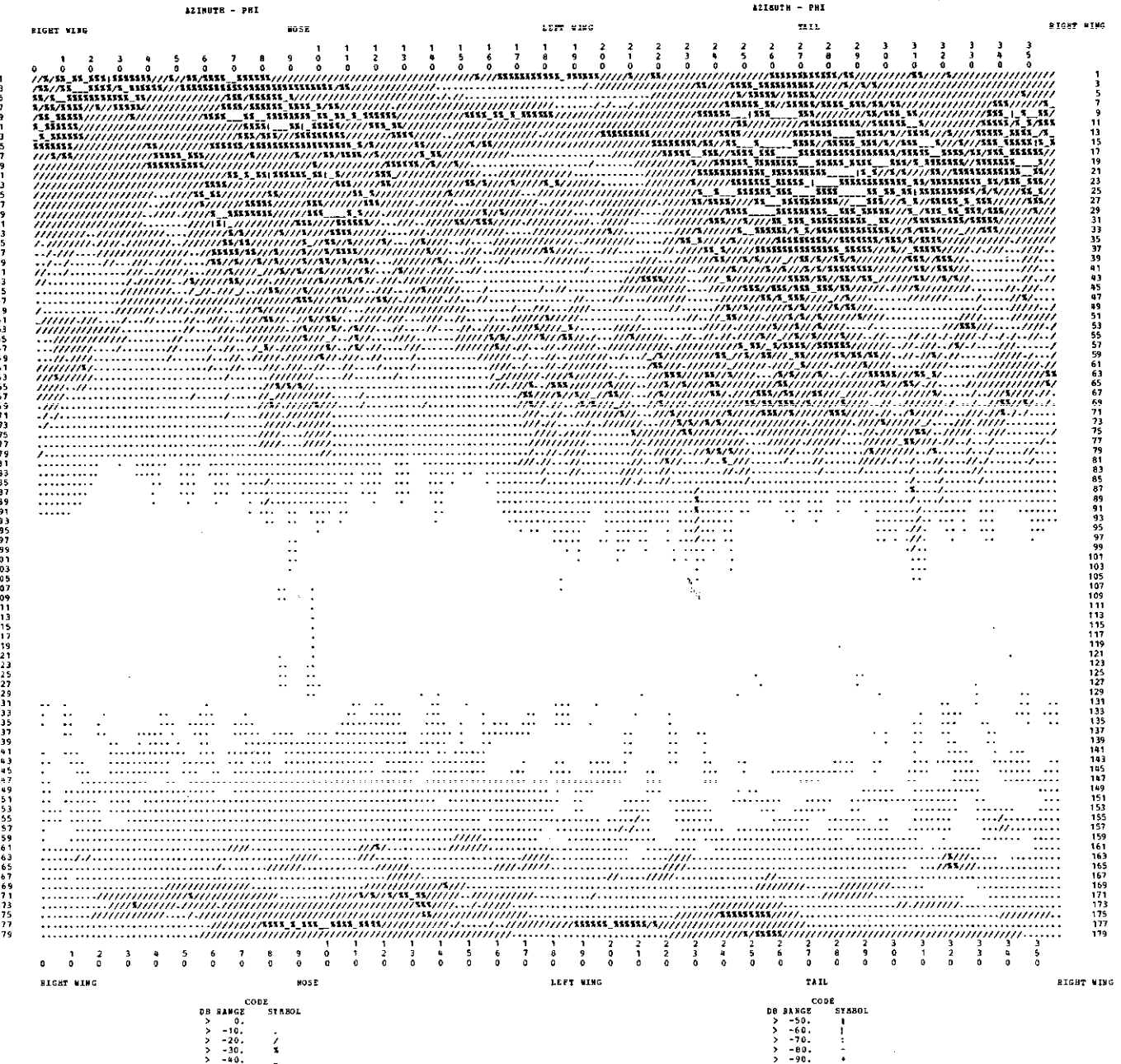


Fig. 6-15. Beechcraft Baron 99; antenna position 5 (B); wheels up, flaps up.

AIRCRAFT TYPE = B99 , BEECH B99
 CONDITIONS = 45 WHEELS UP, FLAPS DOWN, BOTTOM MOUNTED ANTENNA, VERTICAL POLARIZATION
 AZIMUTH - PHI

AIRCRAFT TYPE = B99 , BEECH B99
 CONDITIONS = 45 WHEELS UP, FLAPS DOWN, BOTTOM MOUNTED ANTENNA, VERTICAL POLARIZATION
 AZIMUTH - PHI

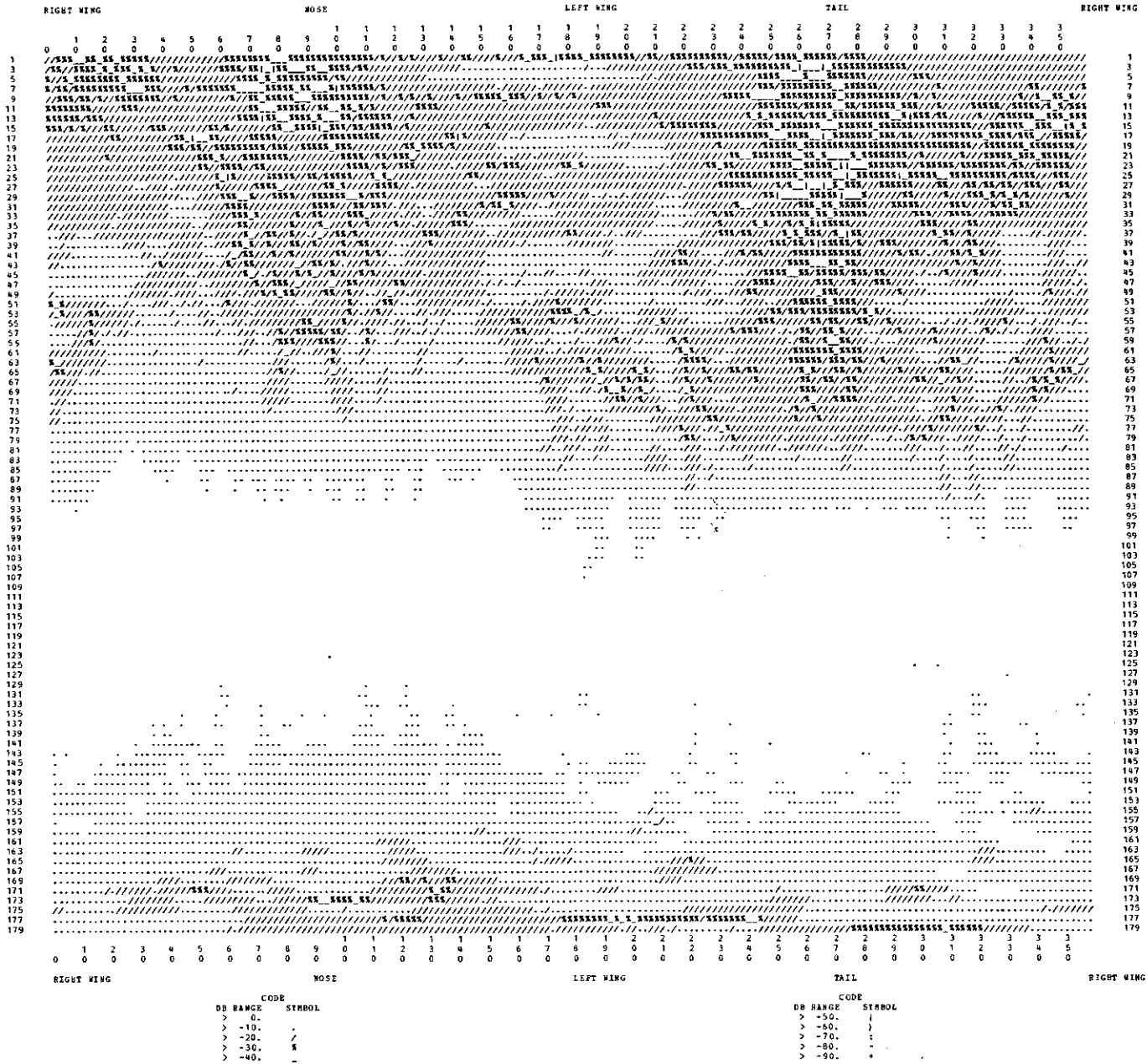


Fig. 6-16. Beechcraft Baron 99; antenna position 5 (B); wheels up, flaps down.

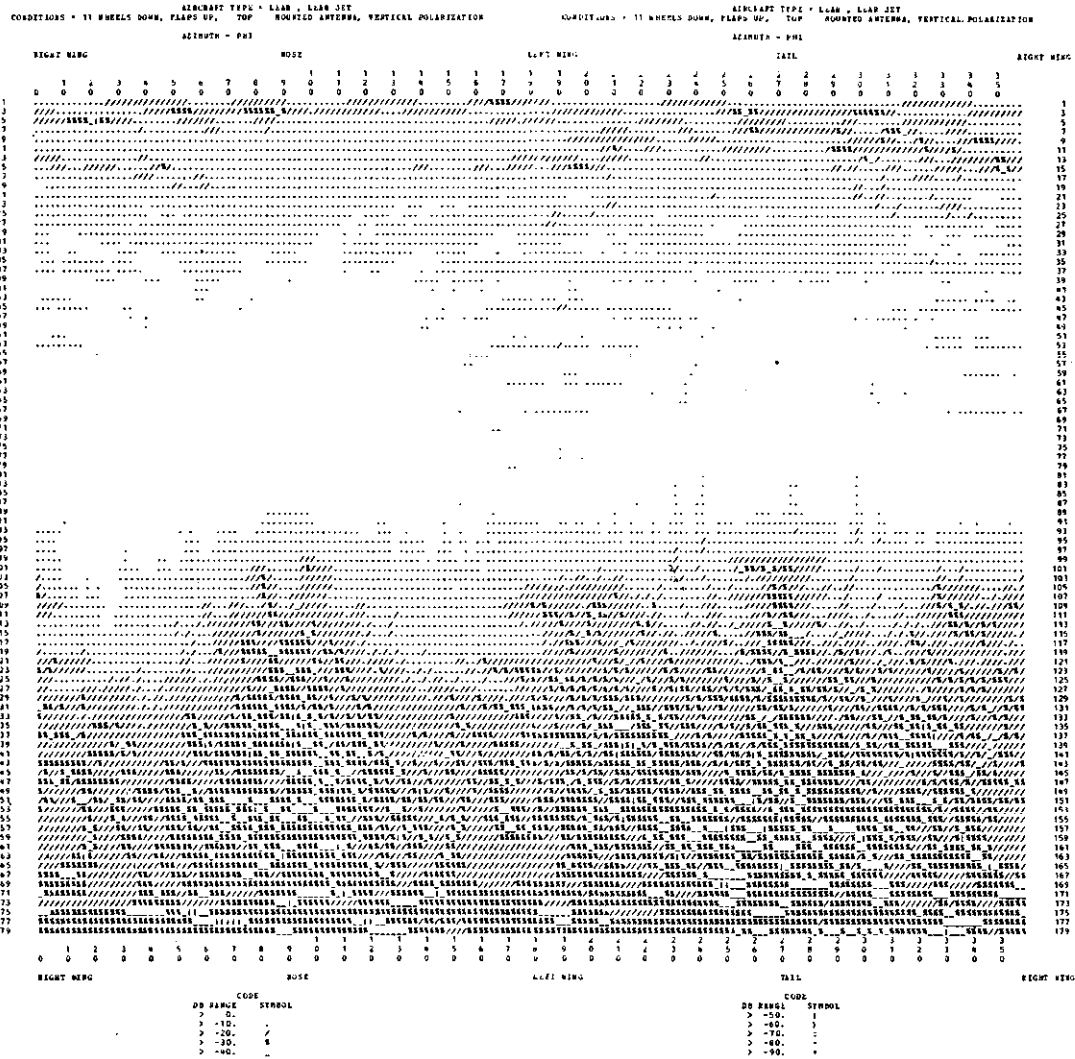
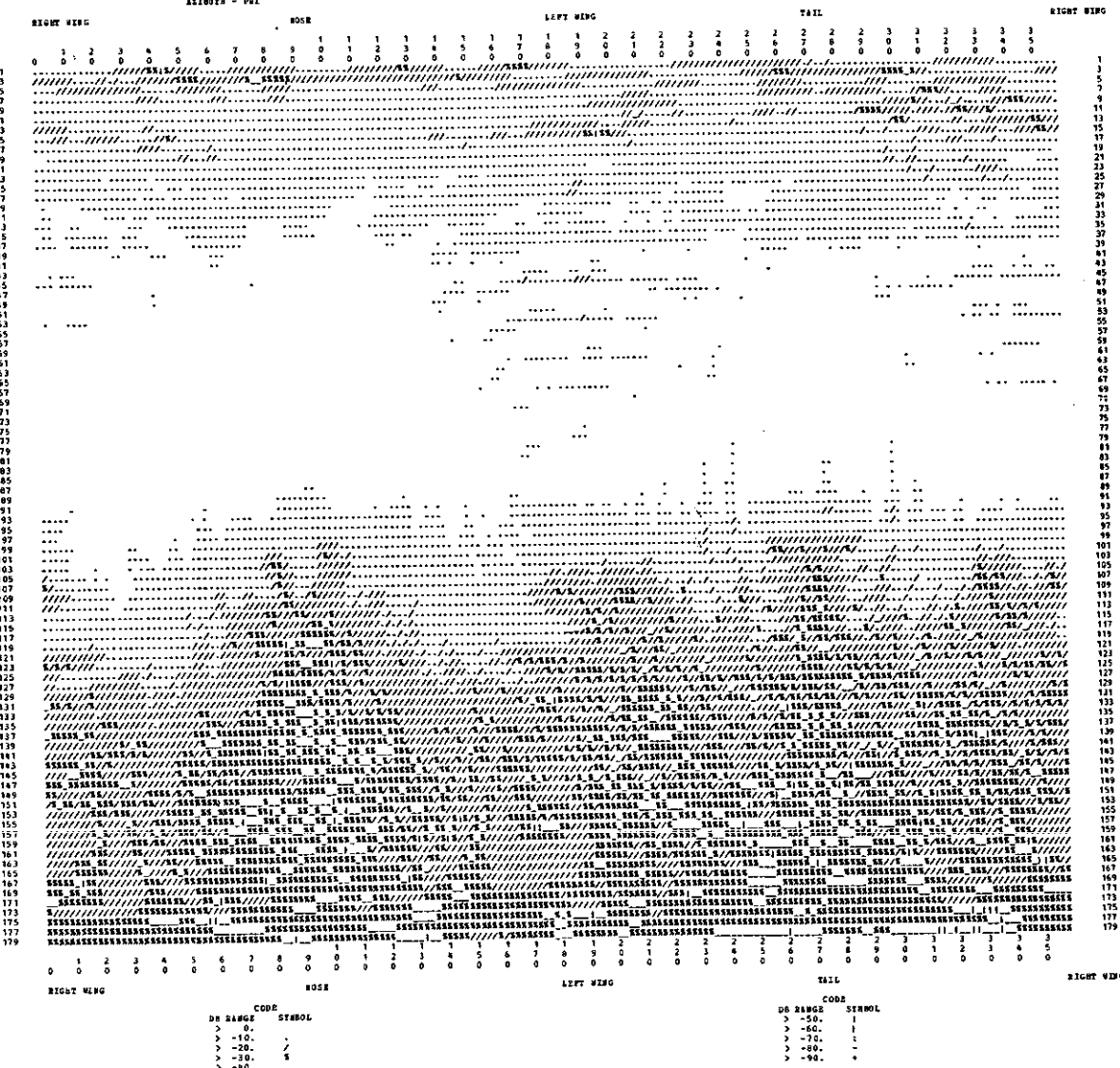


Fig. 7-1. Gates Lear jet; antenna position 1 (T); wheels down, flaps up.

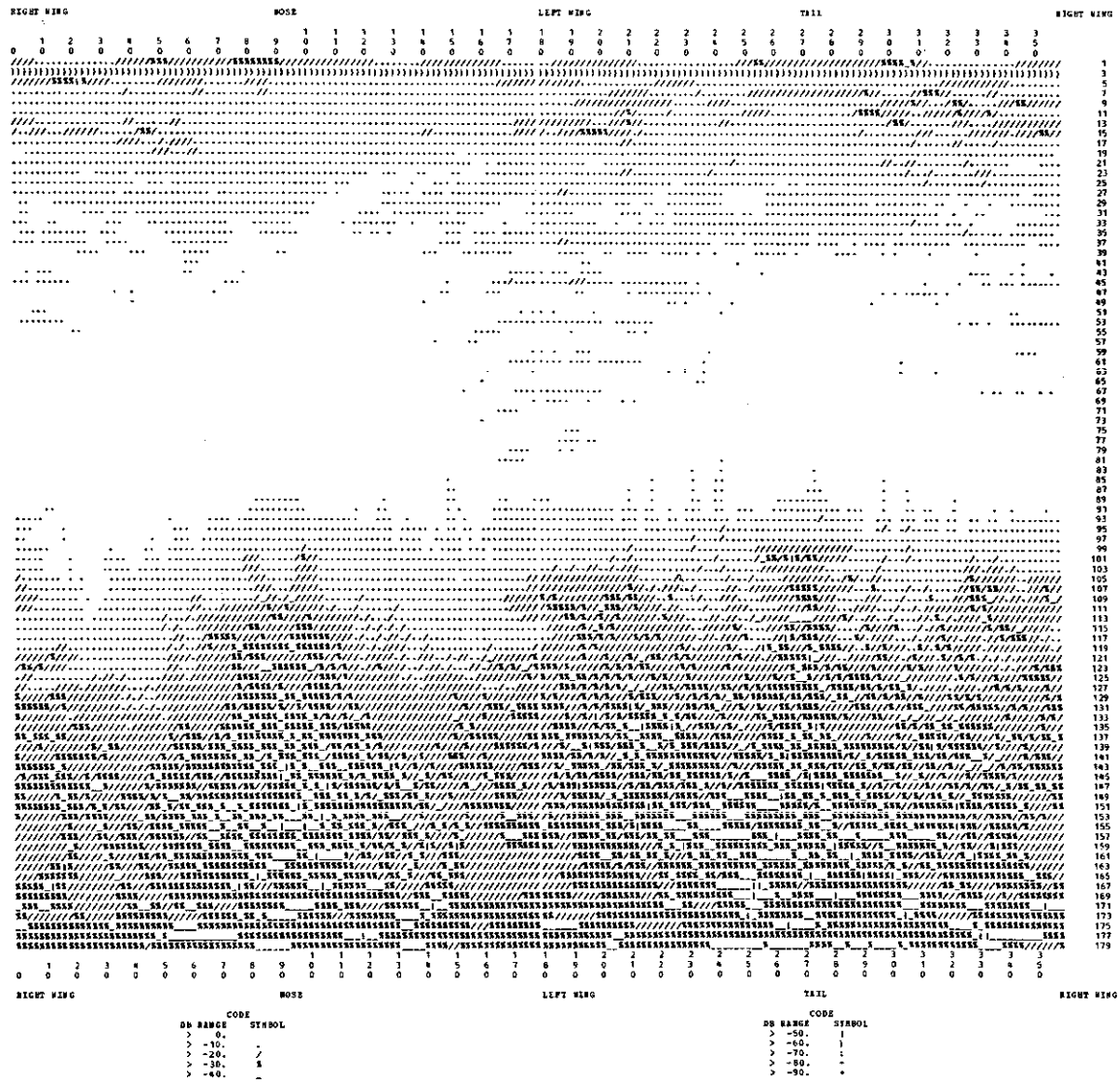
AIRCRAFT TYPE = LEAR, LEAR JET
 CONDITIONS = 21 WHEELS DOWN, FLAPS DOWN, TOP ROOSTED EXTEND, VERTICAL POLARIZATION
 AIRCRAFT TYPE = LEAR, LEAR JET
 CONDITIONS = 21 WHEELS DOWN, FLAPS DOWN, TOP ROOSTED EXTEND, VERTICAL POLARIZATION
 AIRCRAFT - FBI



97

Fig. 7-2. Gates Lear jet; antenna position 1 (T); wheels down, flaps down.

1 AIRCRAFT TYPE - LEAR, LEAR JET
CONDITIONS - 31 WHEELS UP, FLAPS UP, TOP BOWTIED ANTENNA, VERTICAL POLARIZATION
AZIMUTH - PHI
AIRCRAFT TYPE - LEAR, LEAR JET
CONDITIONS - 31 WHEELS UP, FLAPS UP, TOP BOWTIED ANTENNA, VERTICAL POLARIZATION
AZIMUTH - PHI

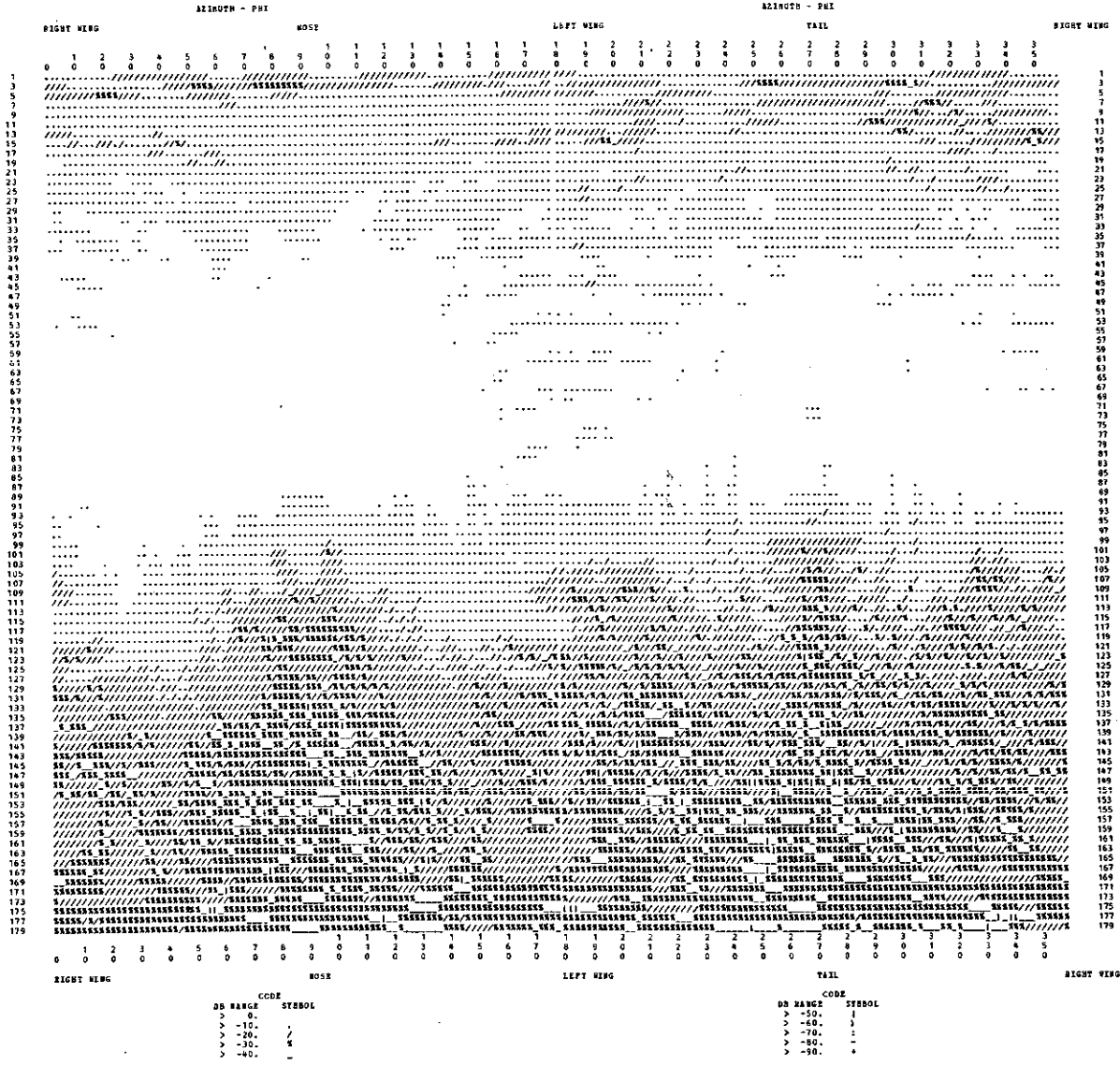


98

Fig. 7-3. Gates Lear jet; antenna position 1 (T); wheels up, flaps up.

AIRCRAFT TYPE = LEAR, LEAR JET
 CONDITIONS = AT WHEELS UP, FLAPS DOWN, TOP MOUNTED ANTENNA, VERTICAL POLARIZATION

AIRCRAFT TYPE = LEAR, LEAR JET
 CONDITIONS = AT WHEELS UP, FLAPS DOWN, TOP MOUNTED ANTENNA, VERTICAL POLARIZATION



66

Fig. 7-4. Gates Lear jet; antenna position 1 (T); wheels up, flaps down.

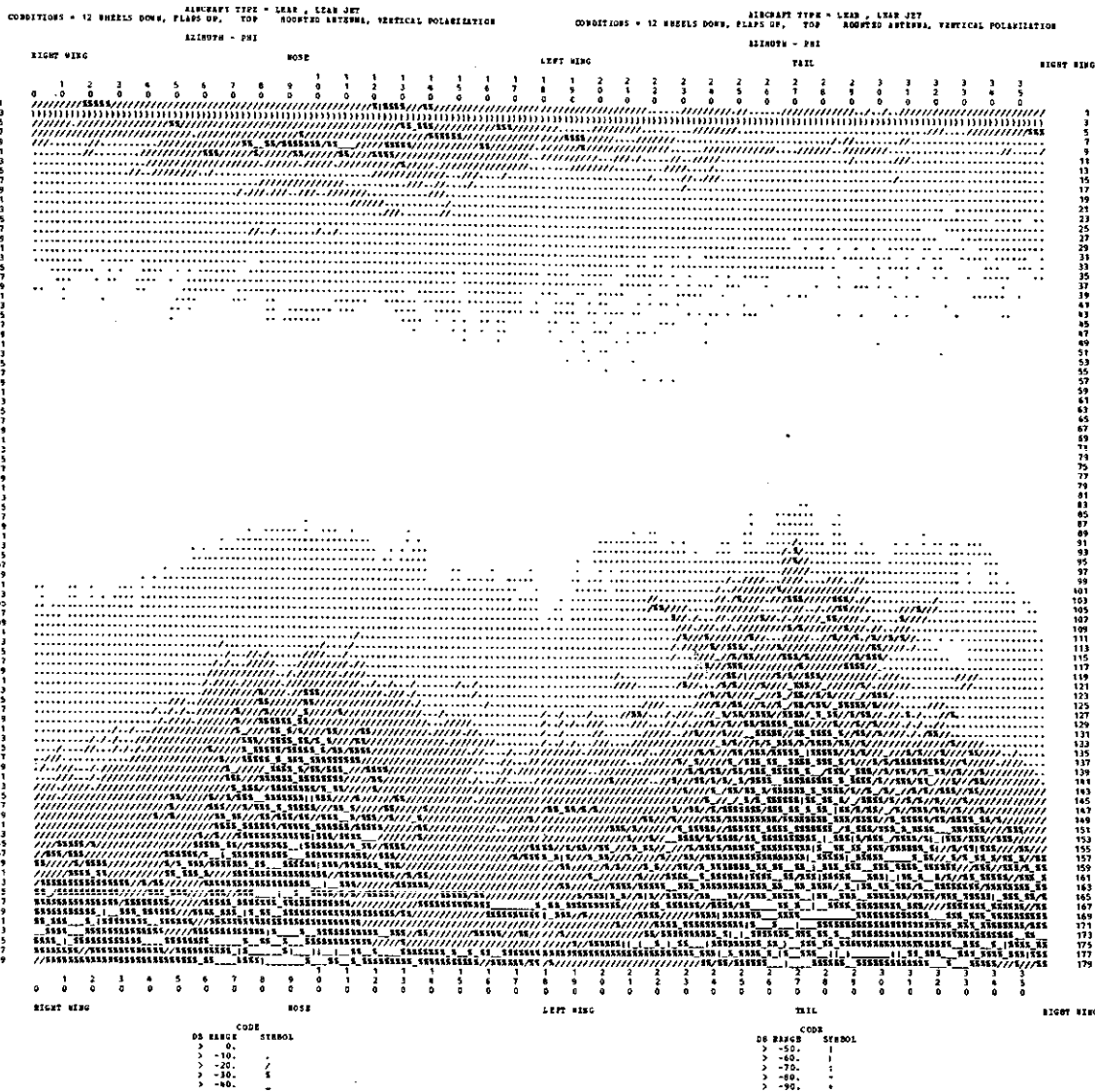


Fig. 7-5. Gates Lear jet; antenna position 2 (T); wheels down, flaps up.

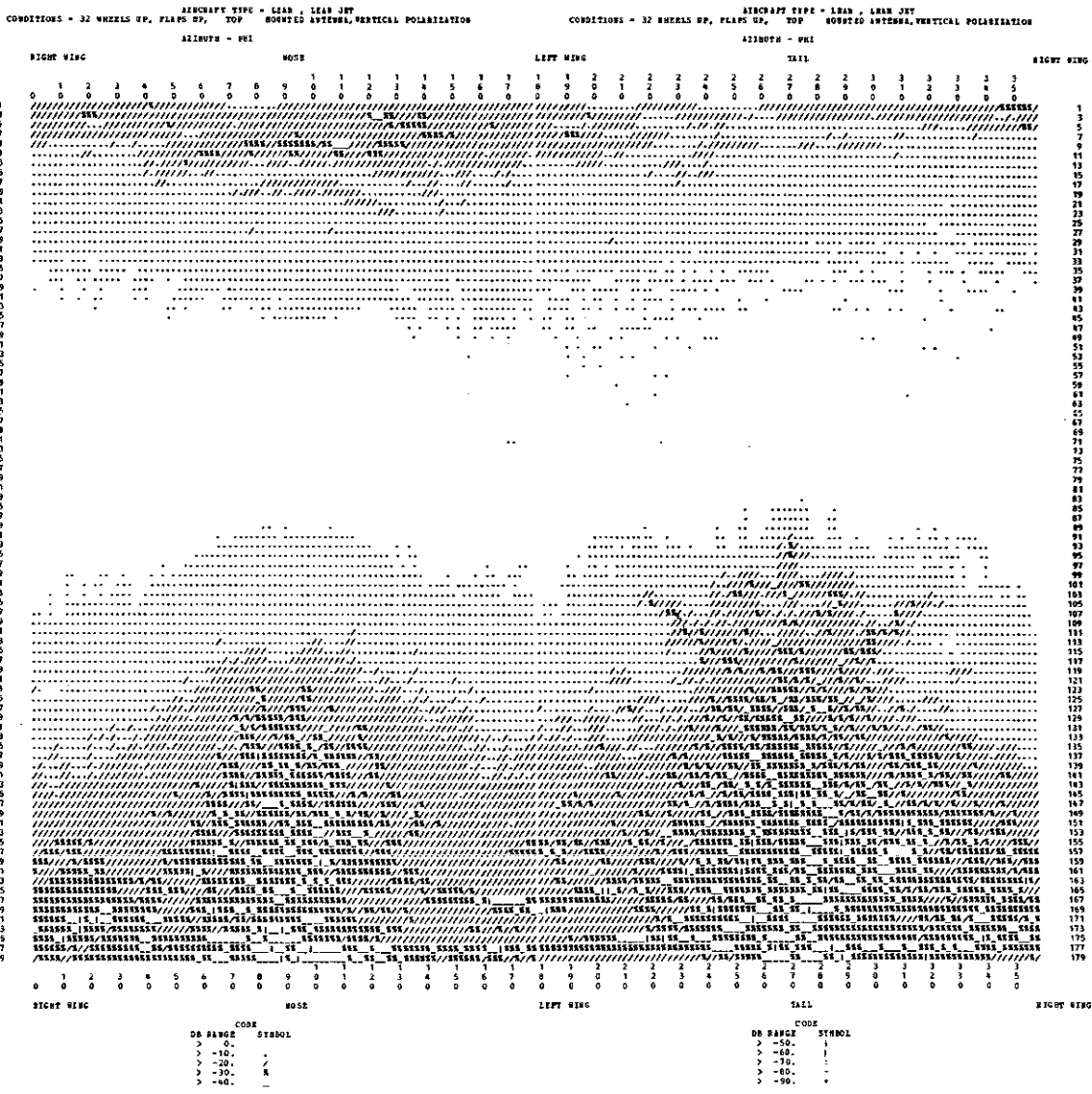


Fig. 7-7. Gates Lear jet; antenna position 2 (T); wheels up, flaps up.

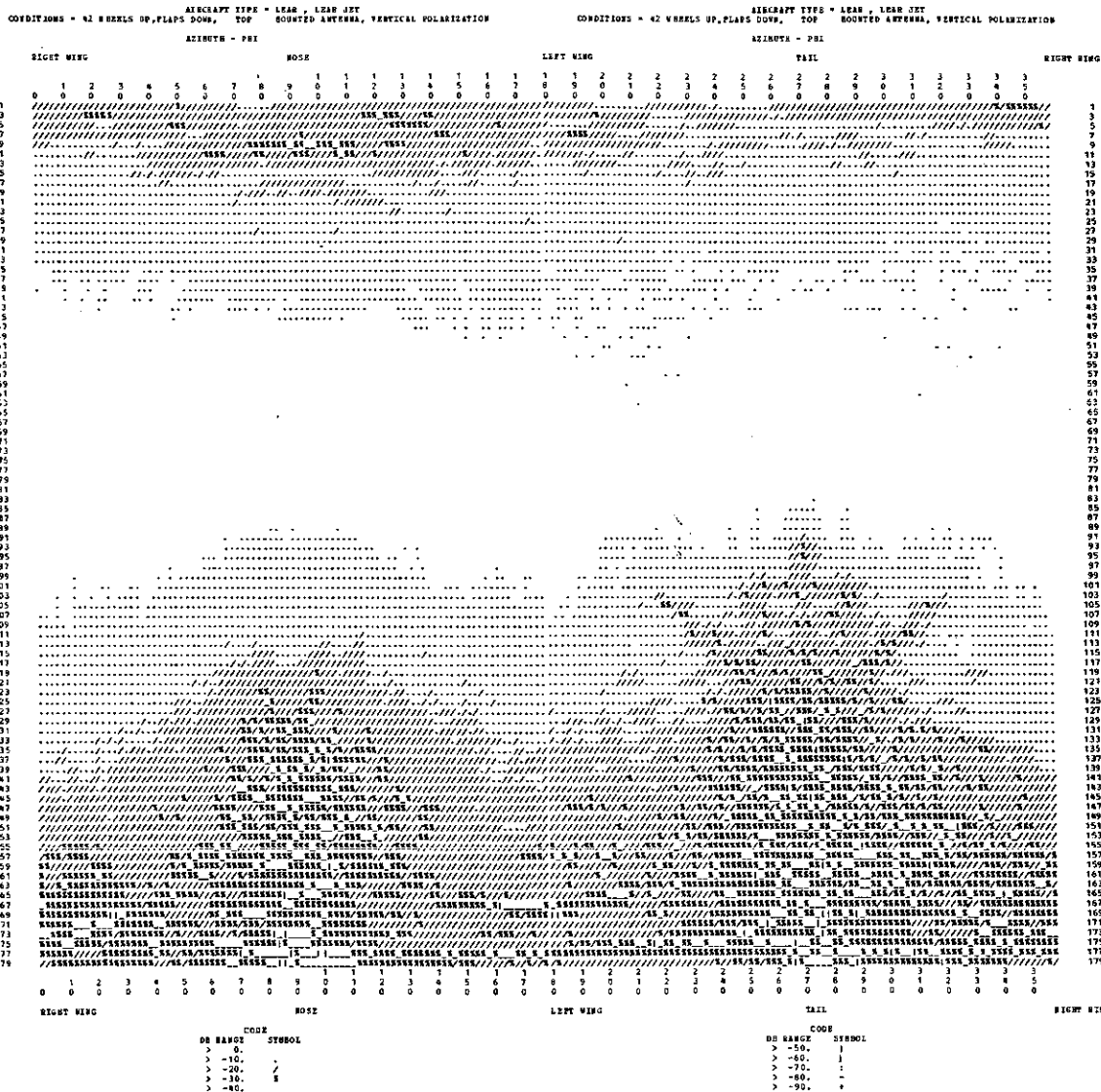
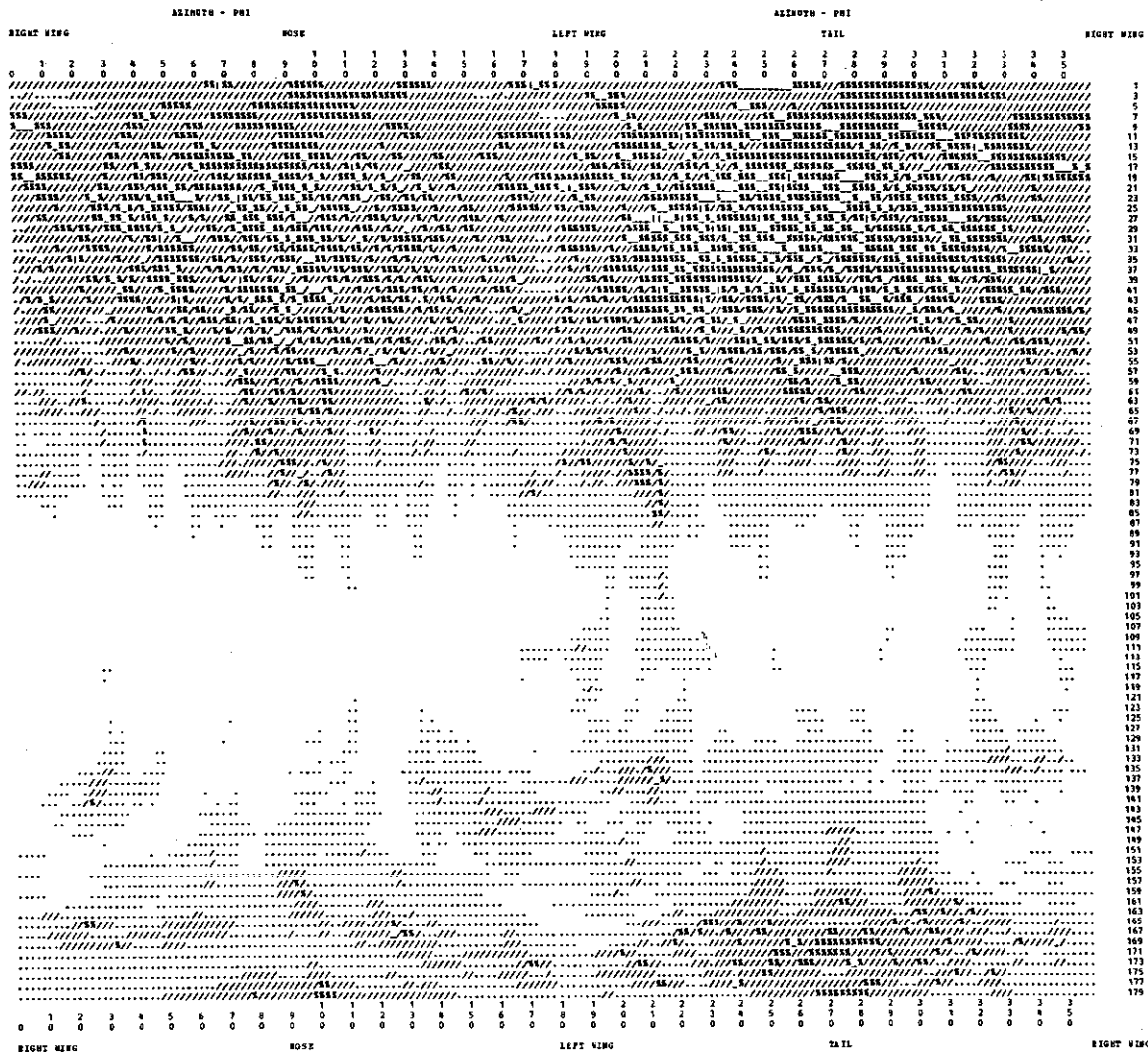


Fig. 7-8. Gates Lear jet; antenna position 2 (T); wheels down, flaps down.

AIRCRAFT TYPE - LEAR, LEAR JET
 CONDITIONS - 13 WHEELS DOWN, FLAPS UP, BOTTOM MOUNTED ANTENNA, VERTICAL POLARIZATION

AIRCRAFT TYPE - LEAR, LEAR JET
 CONDITIONS - 11 WHEELS DOWN, FLAPS UP, BOTTOM MOUNTED ANTENNA, VERTICAL POLARIZATION



CODE
 DB RANGE SYMBOL
 > 0. -
 > -10. -
 > -20. -
 > -30. -
 > -40. -

CODE
 DB RANGE SYMBOL
 > -50. -
 > -60. -
 > -70. -
 > -80. -
 > -90. -

Fig. 7-9. Gates Lear jet; antenna position 3 (B); wheels down, flaps up.

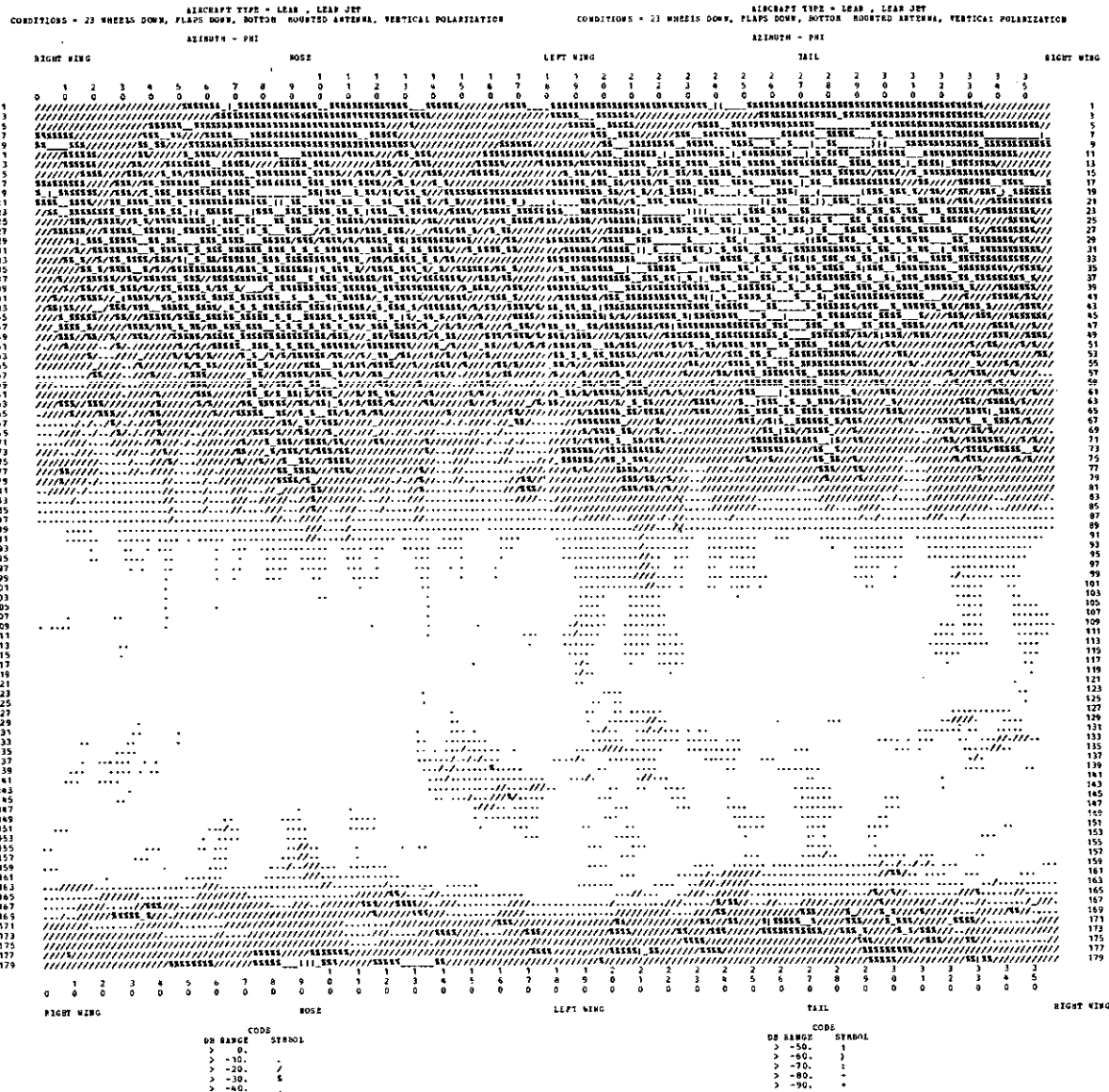


Fig. 7-10. Gates Lear jet; antenna position 3 (B); wheels down, flaps down.

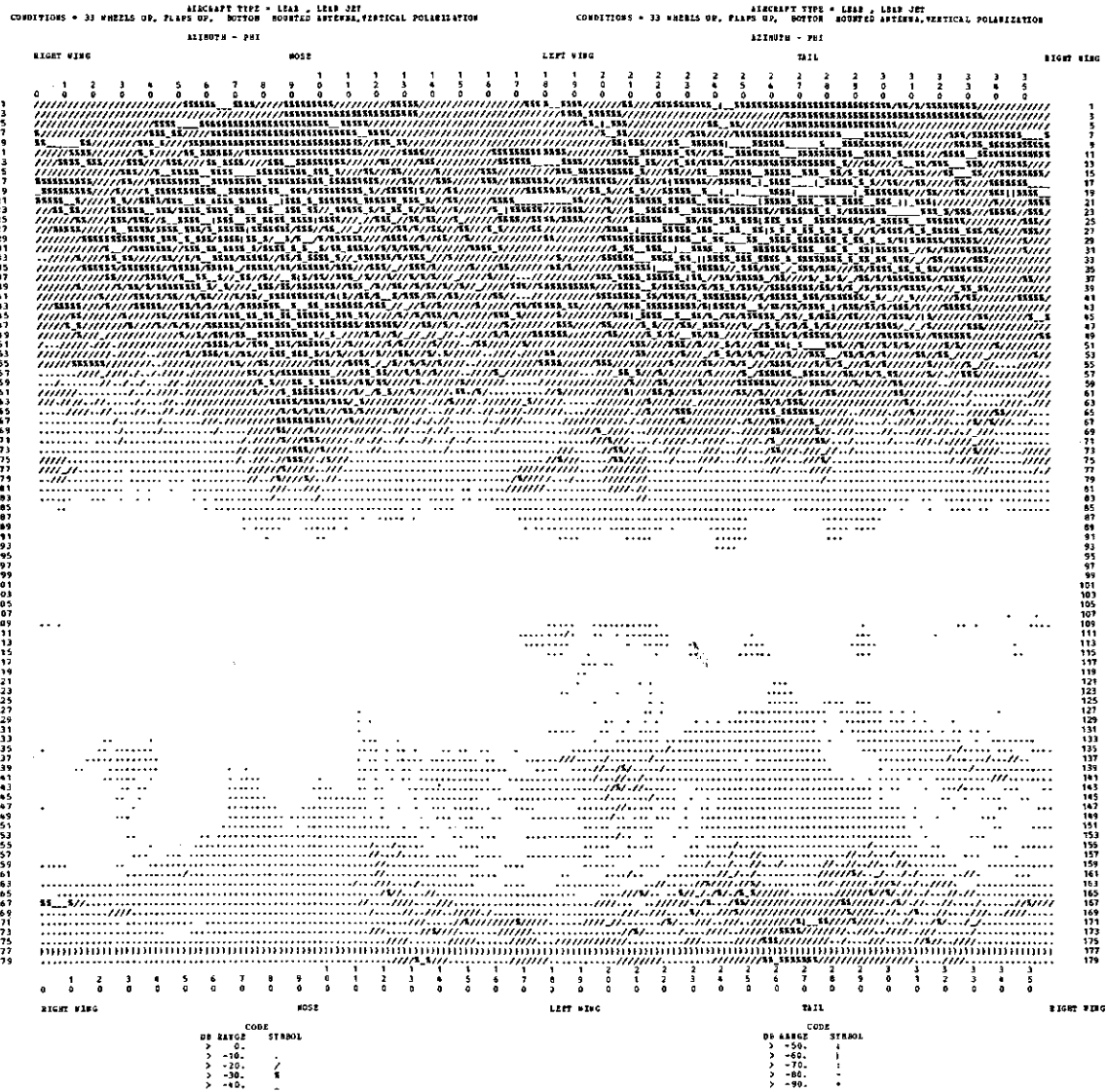


Fig. 7-11. Gates Lear jet; antenna position 3 (B); wheels up, flaps up.

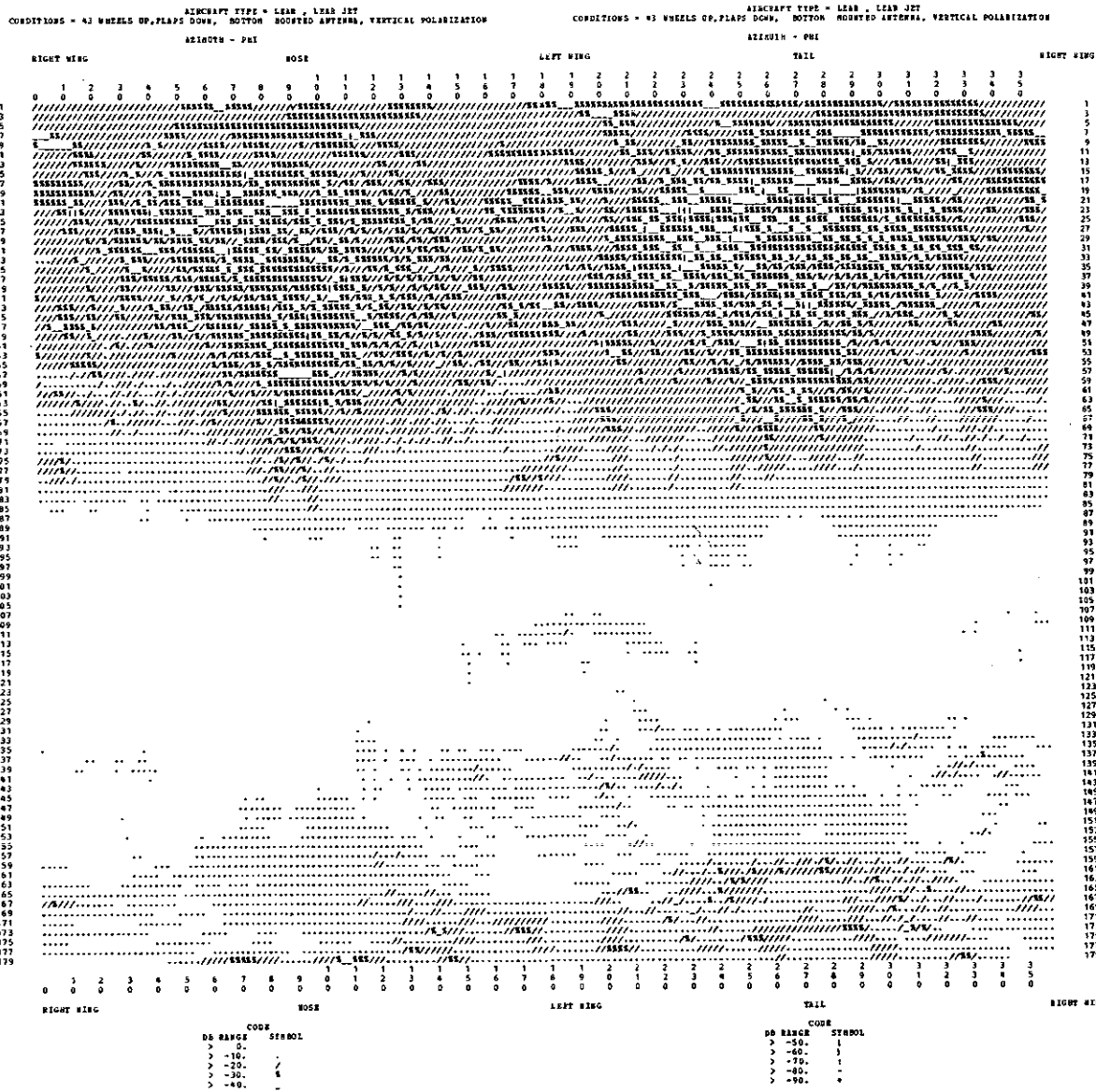


Fig. 7-12. Gates Lear jet; antenna position 3 (B); wheels up, flaps down.

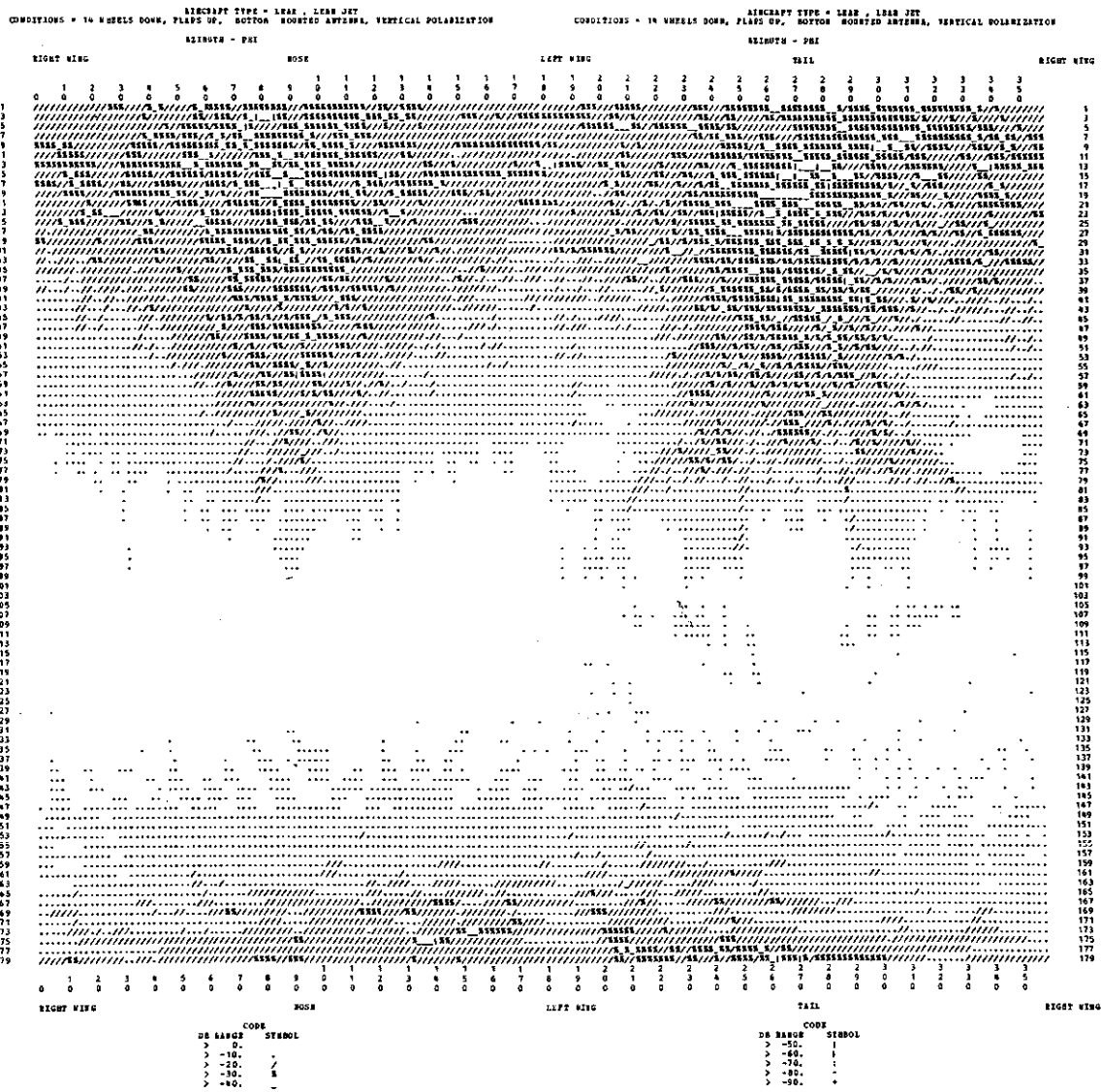
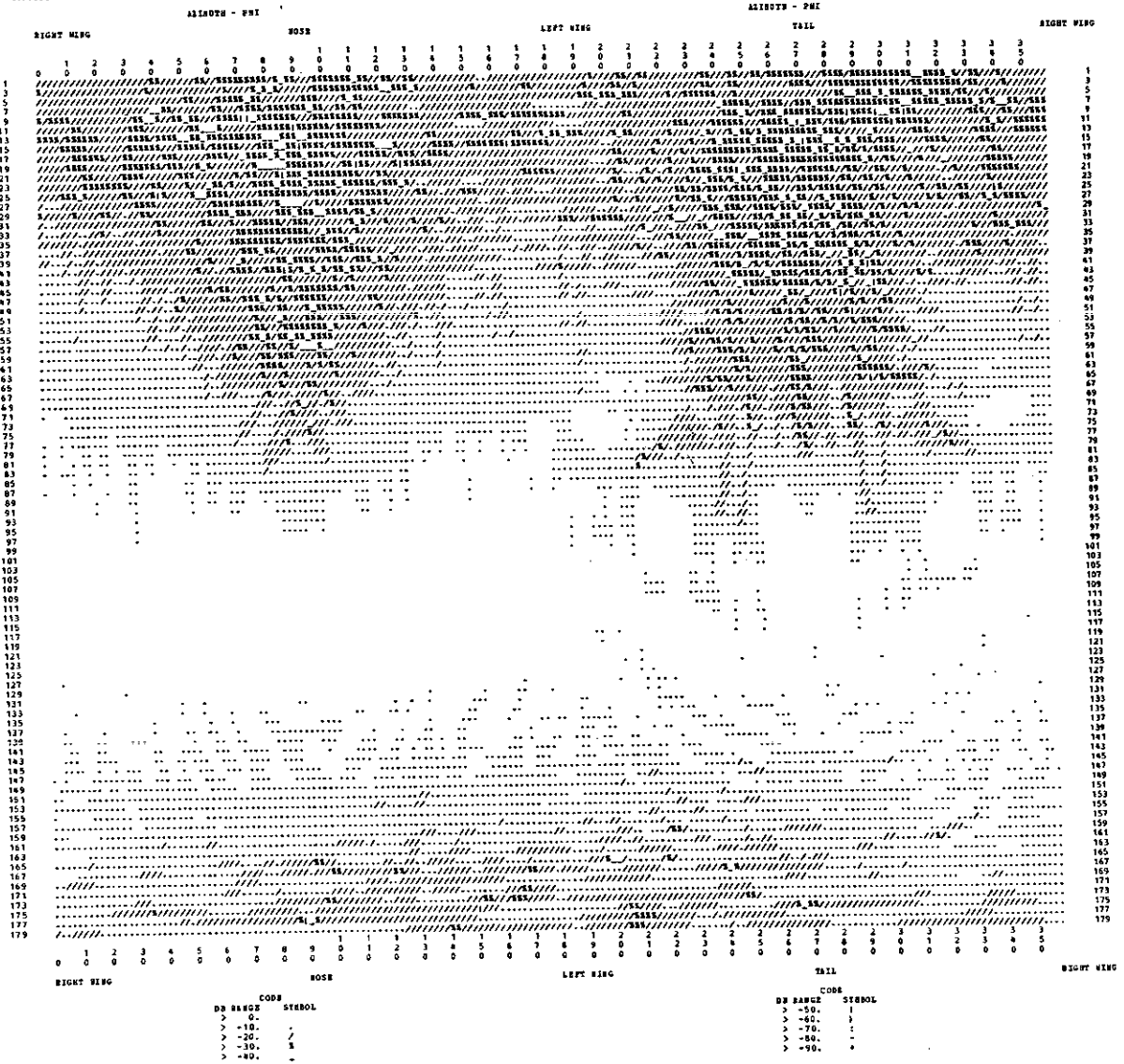


Fig. 7-13. Gates Lear jet; antenna position 4 (B); wheels down, flaps up.

CONDITIONS - 24 WHEELS DOWN, FLAPS DOWN, ROTOR HOISTED ANTENNA, VERTICAL POLARIZATION
 AIRCRAFT TYPE - LEAR, LEAR JET
 AIRCRAFT TYPE - LEAR, LEAR JET

CONDITIONS - 24 WHEELS DOWN, FLAPS DOWN, ROTOR HOISTED ANTENNA, VERTICAL POLARIZATION
 AIRCRAFT TYPE - LEAR, LEAR JET
 AIRCRAFT TYPE - LEAR, LEAR JET



109

Fig. 7-14. Gates Lear jet; antenna position 4 (B); wheels down, flaps down.

AIRCRAFT TYPE = LEAR JET
 CONDITIONS = 34 WHEELS UP, FLAPS UP, BOTTOM MOUNTED ANTENNA, VERTICAL POLARIZATION
 ALTITUDE - P81

AIRCRAFT TYPE = LEAR JET
 CONDITIONS = 34 WHEELS UP, FLAPS UP, BOTTOM MOUNTED ANTENNA, VERTICAL POLARIZATION
 ALTITUDE - P81

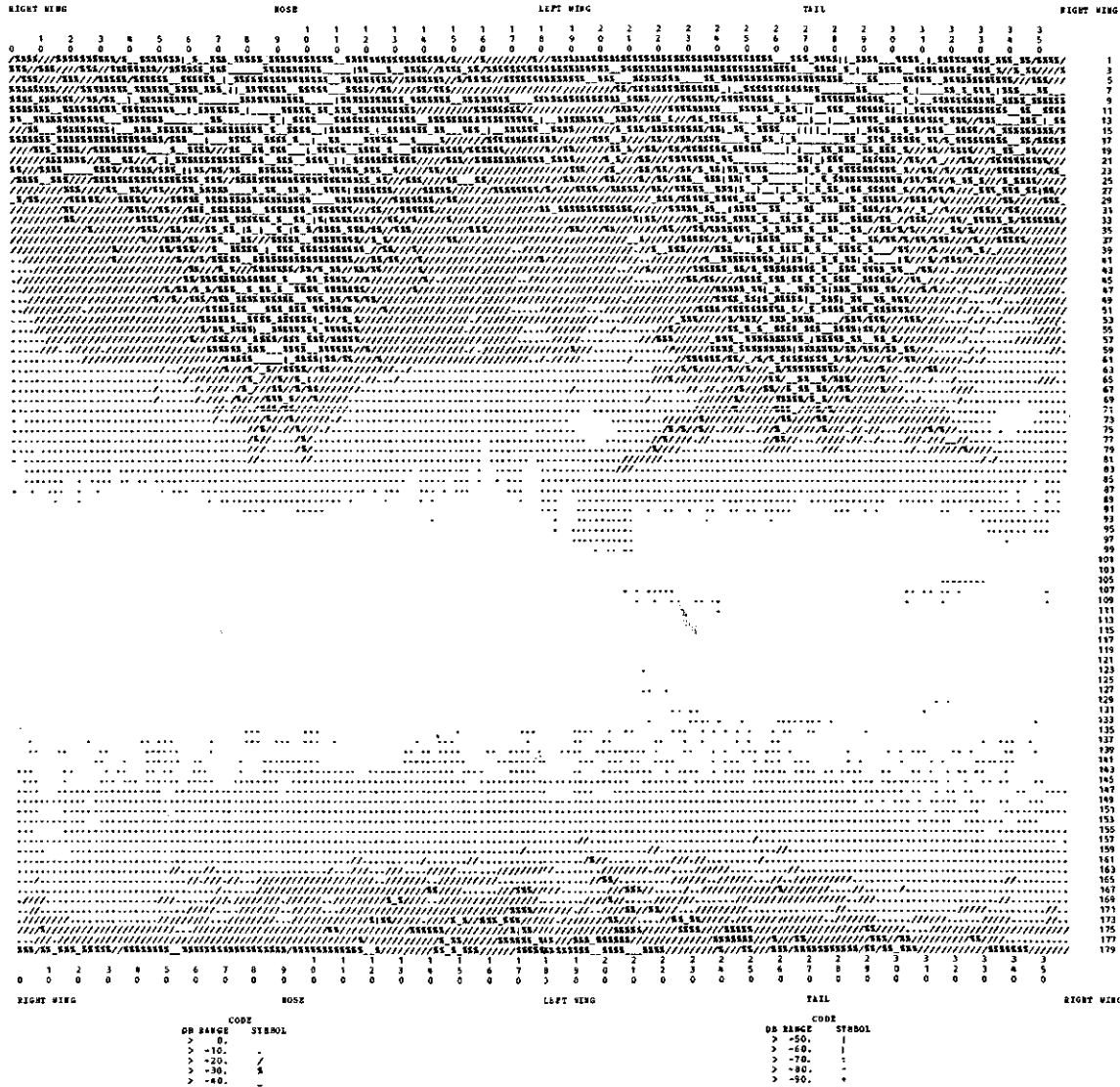
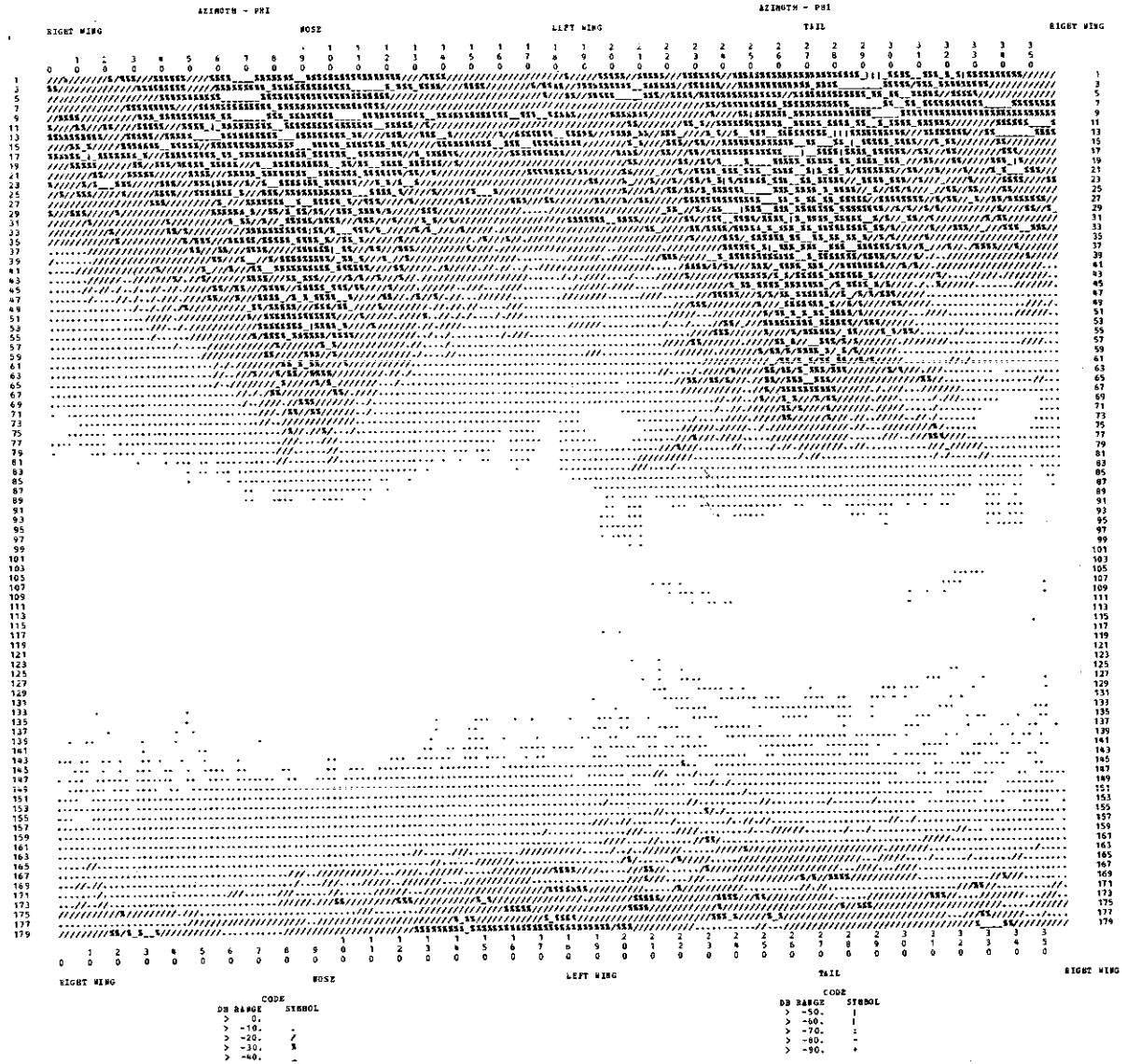


Fig. 7-15. Gates Lear jet; antenna position 4 (B); wheels up, flaps up.

CONDITIONS = 40 WHEELS UP, FLAPS DOWN, ROTOR MOUNTED ANTENNA, VERTICAL POLARIZATION

CONDITIONS = 40 WHEELS UP, FLAPS DOWN, ROTOR MOUNTED ANTENNA, VERTICAL POLARIZATION

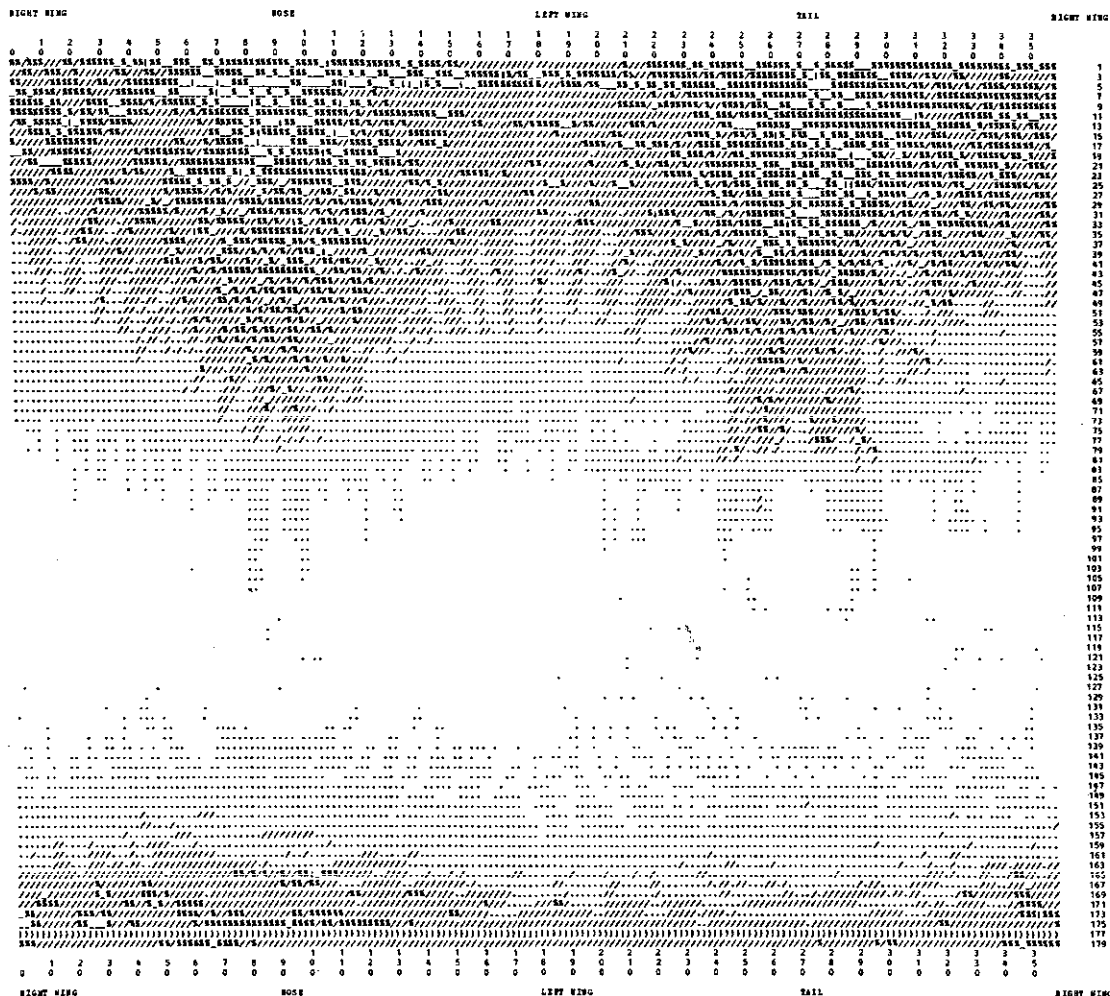


III

Fig. 7-16. Gates Lear jet; antenna position 4 (B); wheels up, flaps down.

AIRCRAFT TYPE - LEAR, LEAR JET
 CONDITIONS - 15 WHEELS DOWN, FLAPS UP, BOTTOM MOUNTED ANTENNA, VERTICAL POLARIZATION
 AIRCRAFT TYPE - LEAR, LEAR JET
 CONDITIONS - 15 WHEELS DOWN, FLAPS UP, BOTTOM MOUNTED ANTENNA, VERTICAL POLARIZATION

AIRCRAFT TYPE - LEAR, LEAR JET
 CONDITIONS - 15 WHEELS DOWN, FLAPS UP, BOTTOM MOUNTED ANTENNA, VERTICAL POLARIZATION



RIGHT WING	NOSE	LEFT WING	TAIL	RIGHT WING
CODE DB RANGE SYMBOL > 0. > -10. > -20. > -30. > -40.		CODE DB RANGE SYMBOL > -50. 1 > -60. 1 > -70. 1 > -80. 1 > -90. 1		

Fig. 7-17. Gates Lear jet; antenna position 5 (B); wheels down, flaps up.

CONDITIONS = 25 WHEELS DOWN, FLAPS DOWN, MOTOR HOISTED ANTENNA, VERTICAL POLARIZATION

CONDITIONS = 25 WHEELS DOWN, FLAPS DOWN, MOTOR HOISTED ANTENNA, VERTICAL POLARIZATION

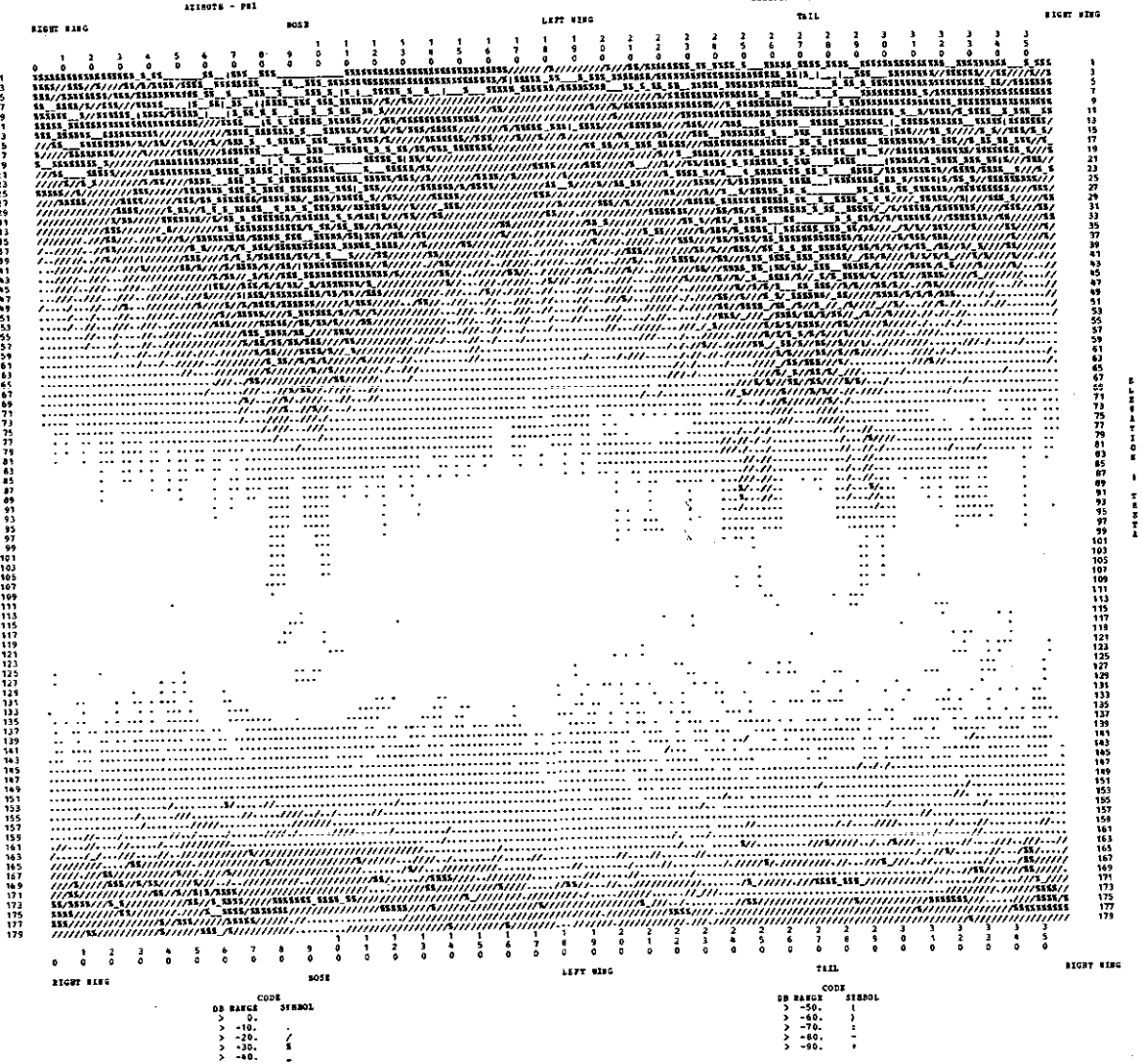


Fig. 7-18. Gates Lear jet; antenna position 5 (B); wheels down, flaps down.

CONDITIONS = 35 WHEELS UP, FLAPS UP, AIRCRAFT TYPE = LEAR, LEAR JET
 AIRCRAFT TYPE = LEAR, LEAR JET
 CONDITIONS = 35 WHEELS UP, FLAPS UP, AIRCRAFT TYPE = LEAR, LEAR JET

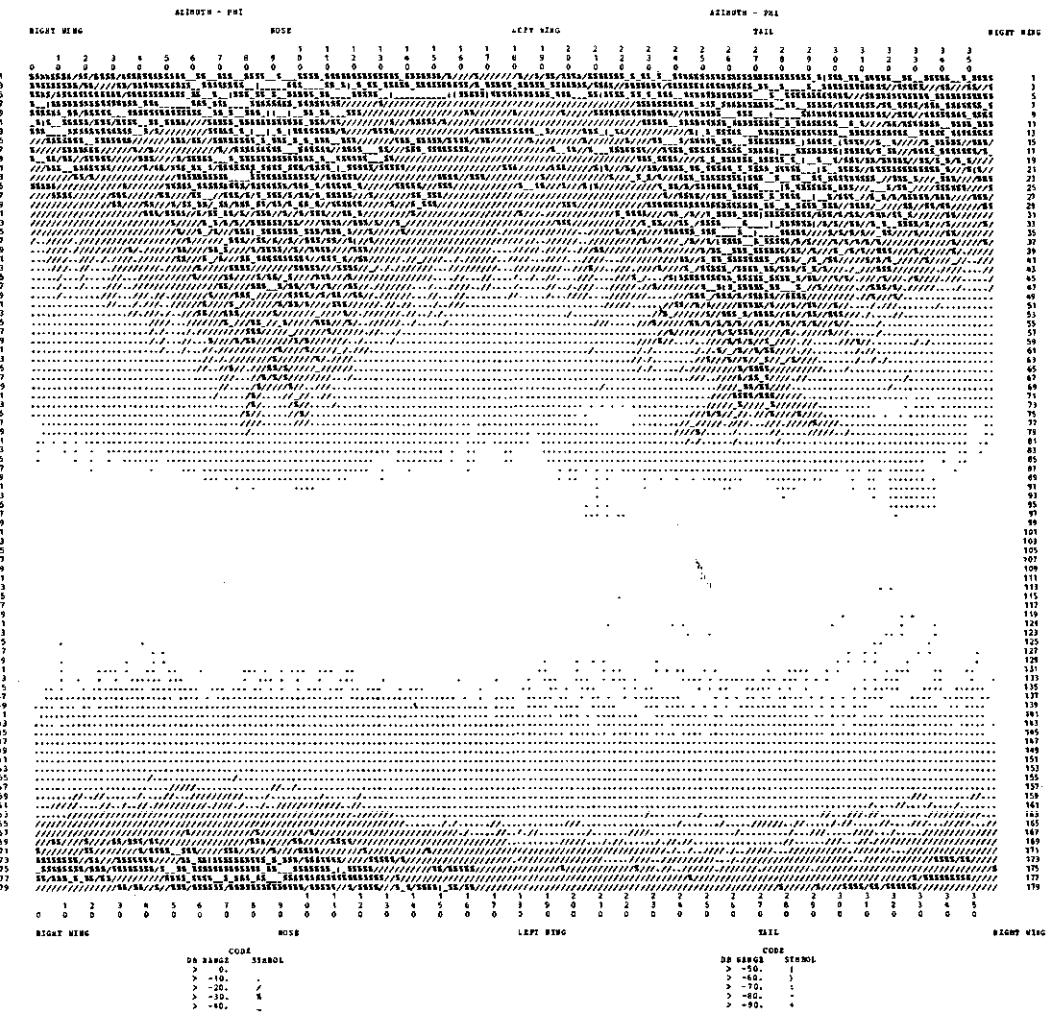


Fig. 7-19. Gates Lear jet; antenna position 5 (B); wheels up, flaps up.

115

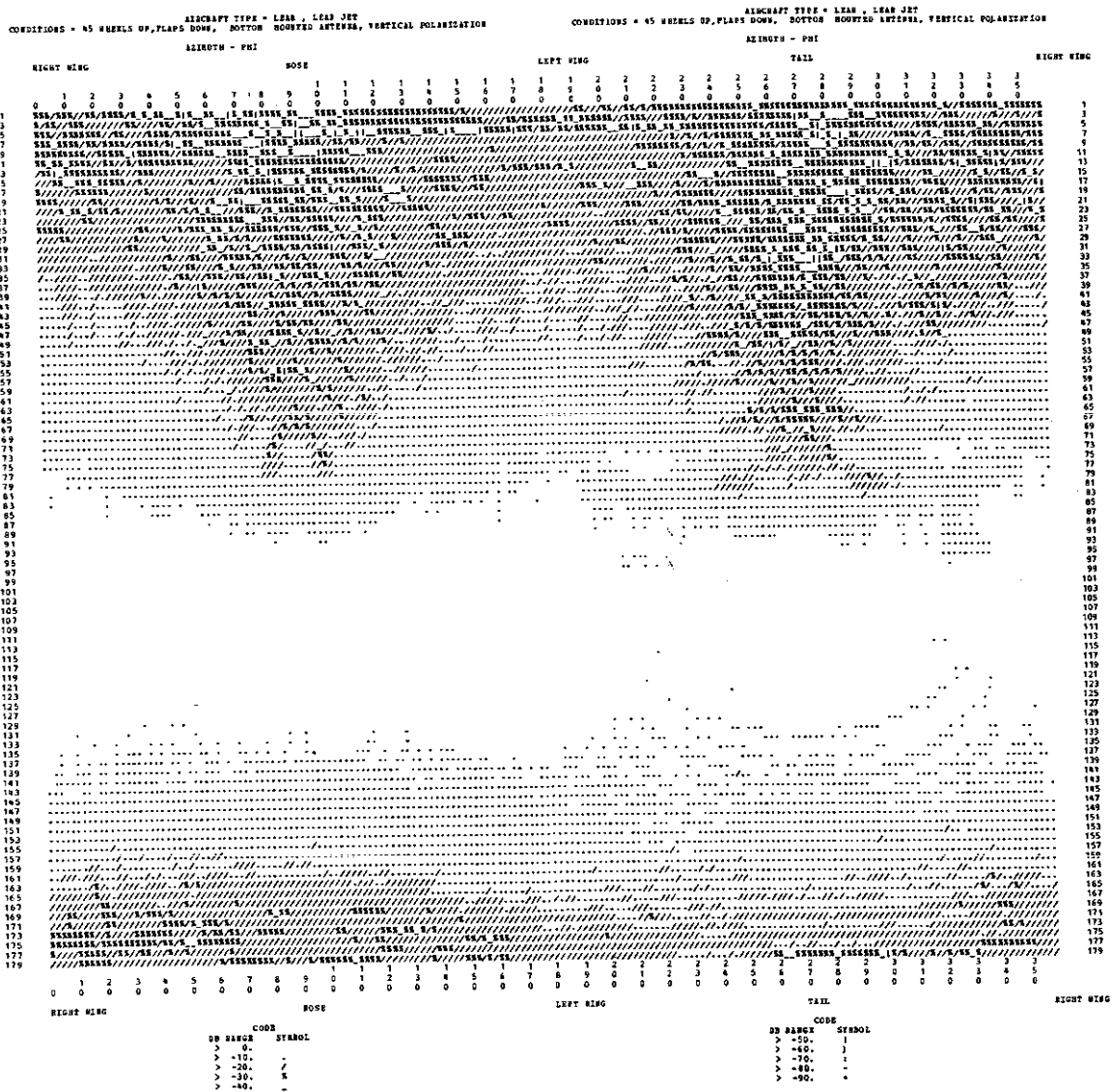


Fig. 7-20. Gates Lear jet; antenna position 5 (B); wheels up, flaps down.

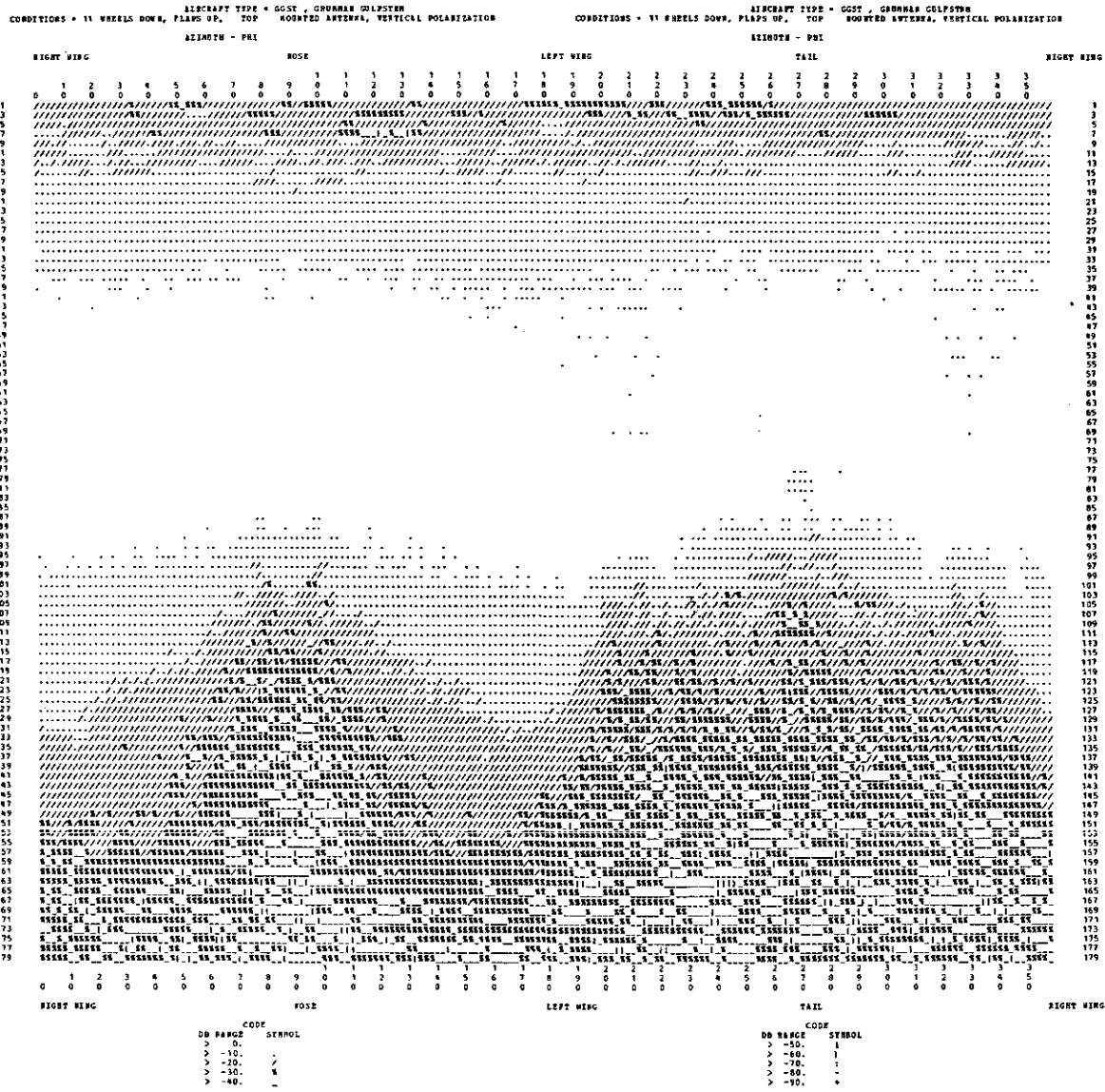
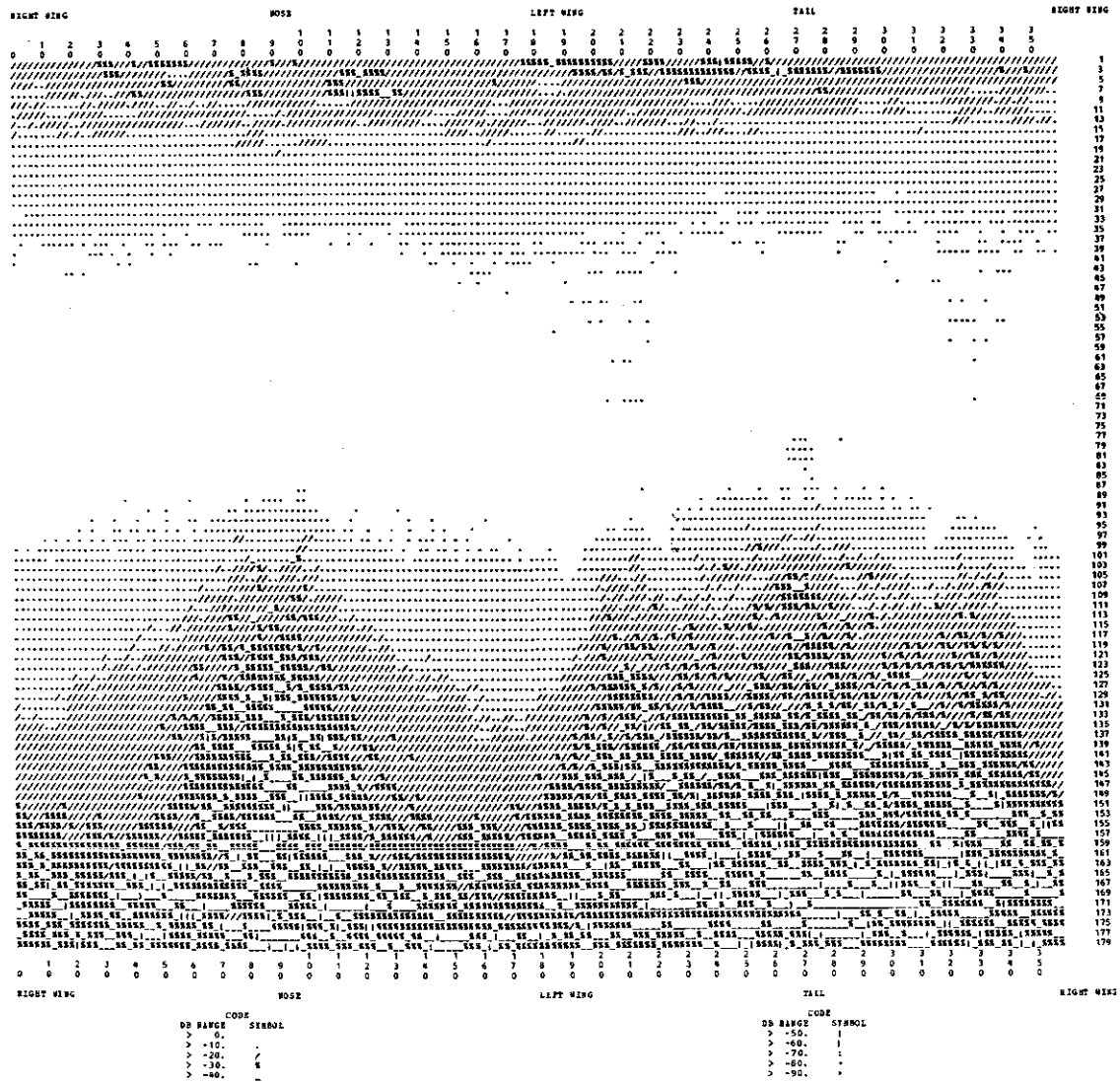


Fig. 8-1. Grumman Gulfstream; antenna position 1 (T); wheels down, flaps up.

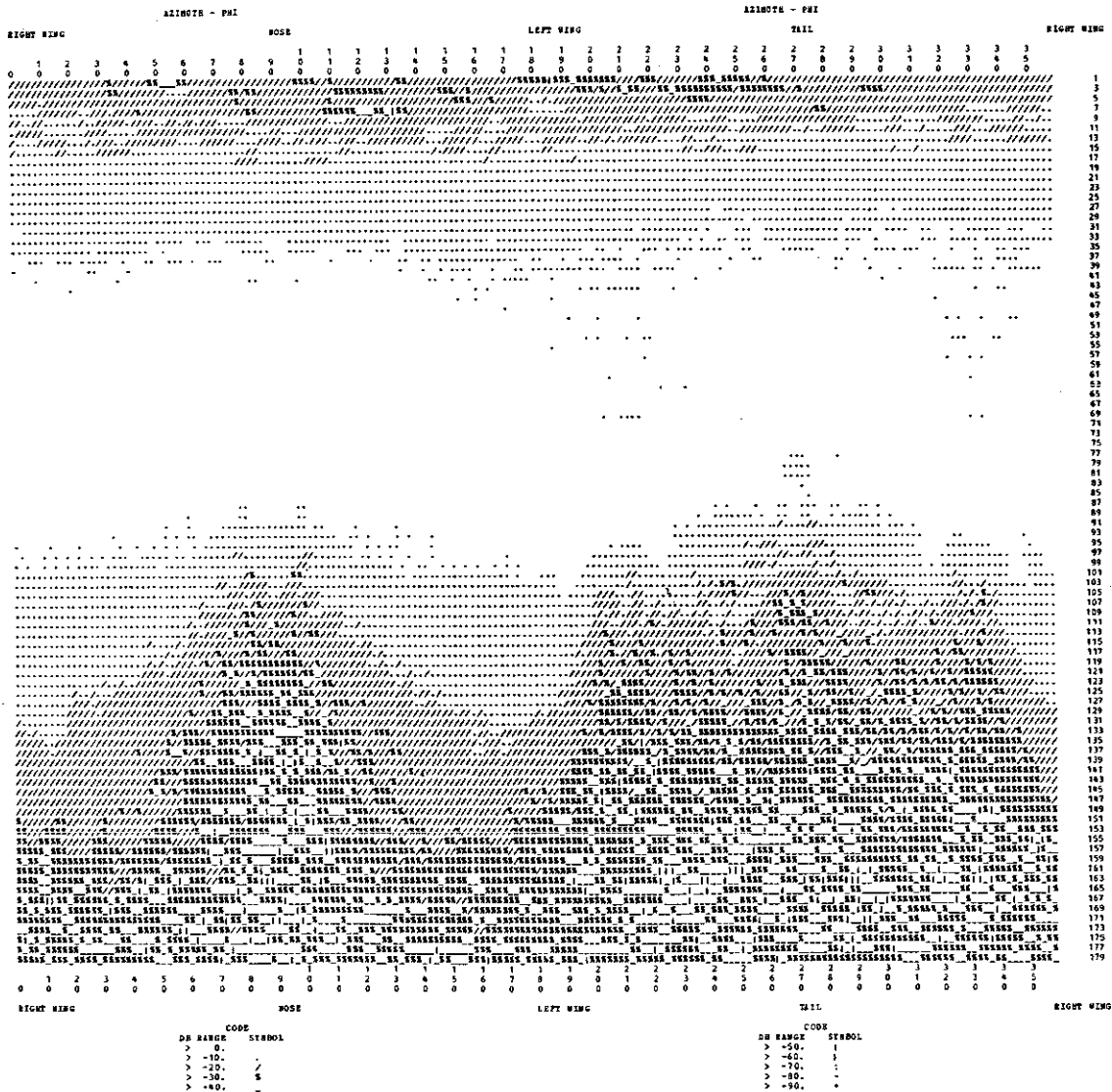
AIRCRAFT TYPE - G65T, GRUMMAN GULFSTREAM
 CONDITIONS - 31 WHEELS UP, FLAPS UP, TOP MOUNTED ANTENNA, VERTICAL POLARIZATION
 AIRCRAFT TYPE - G65T, GRUMMAN GULFSTREAM
 CONDITIONS - 31 WHEELS UP, FLAPS UP, TOP MOUNTED ANTENNA, VERTICAL POLARIZATION
 AIRCRAFT TYPE - G65T, GRUMMAN GULFSTREAM
 CONDITIONS - 31 WHEELS UP, FLAPS UP, TOP MOUNTED ANTENNA, VERTICAL POLARIZATION



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Fig. 8-2. Grumman Gulfstream; antenna position 1 (T); wheels up, flaps up.

AIRCRAFT TYPE = G6ST, GRUMMAN GULFSTREAM AIRCRAFT TYPE = G6ST, GRUMMAN GULFSTREAM
 CONDITIONS = 41 WHEELS UP, FLAPS DOWN, TOP HOODED ANTENNA, VERTICAL POLARIZATION CONDITIONS = 41 WHEELS UP, FLAPS DOWN, TOP HOODED ANTENNA, VERTICAL POLARIZATION



118

Fig. 8-3. Grumman Gulfstream; antenna position 1 (T); wheels up, flaps down.

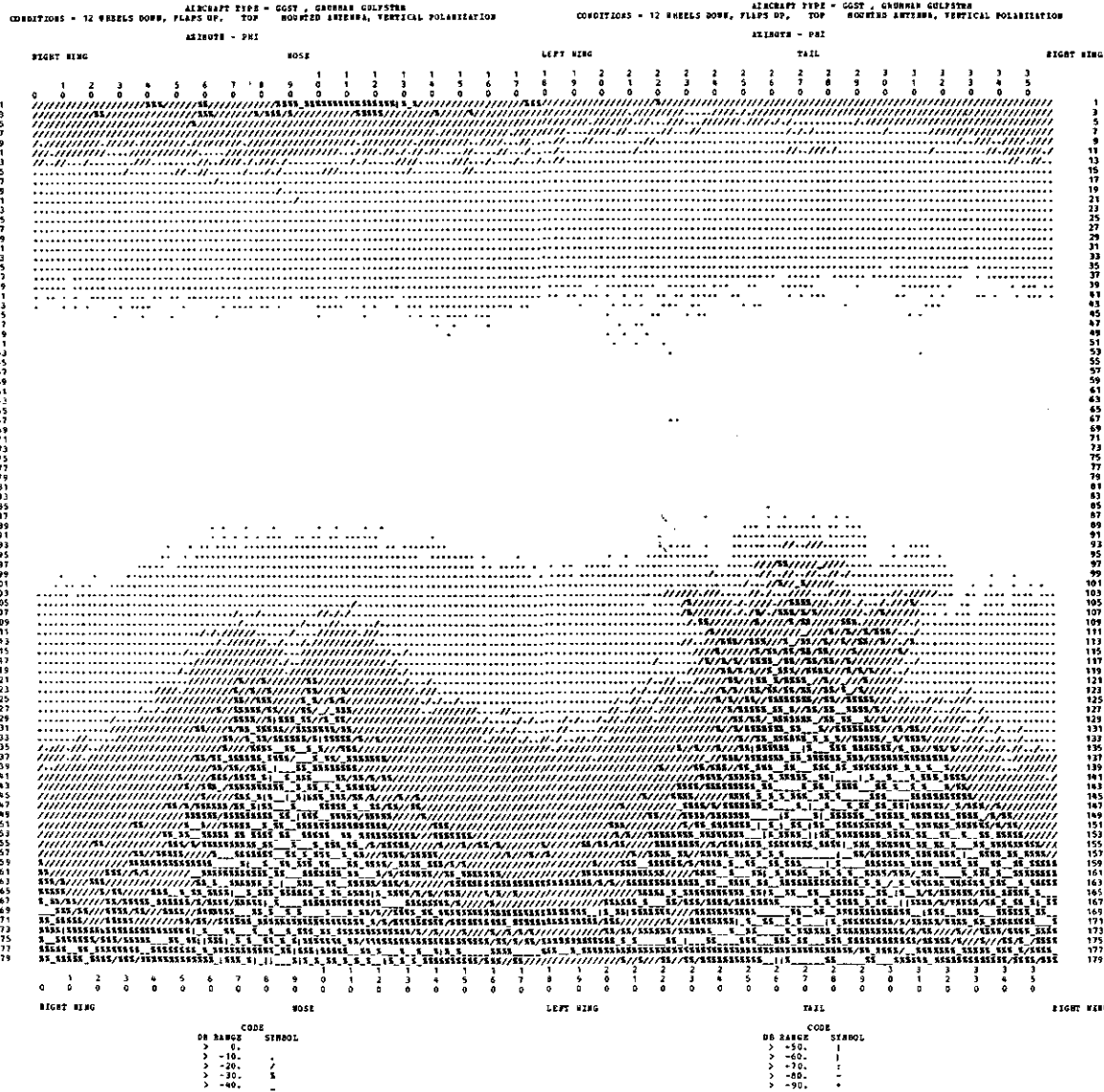
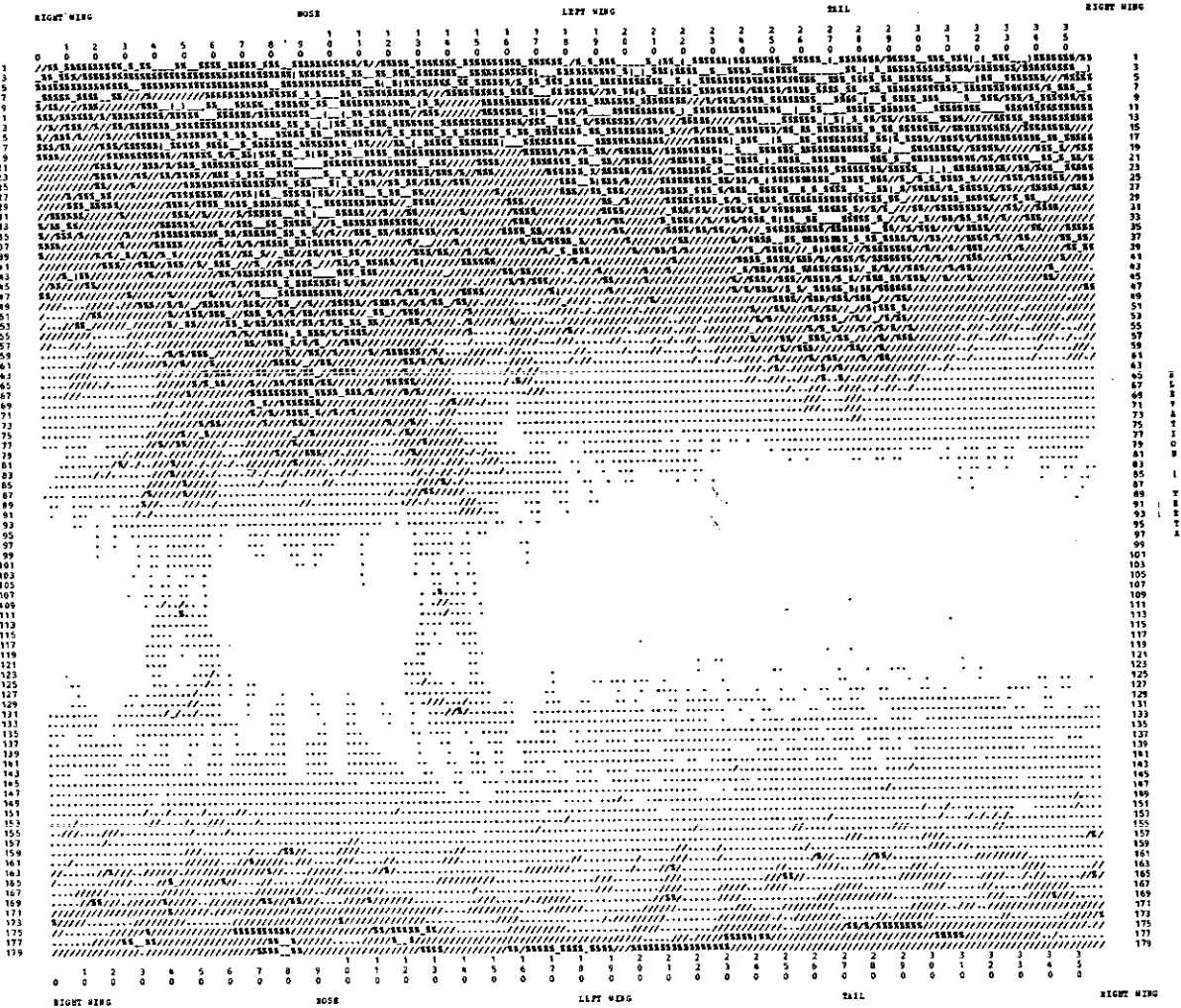


Fig. 8-4. Grumman Gulfstream; antenna position 2 (T); wheels down, flaps up.

AIRCRAFT TYPE - GUST, GRUMMAN GULFSTREAM
 CONDITIONS - 13 WHEELS DOWN, FLAPS UP, BOTTOM SCOTTED ANTENNA, VERTICAL POLARIZATION
 AIRCRAFT - FBI

AIRCRAFT TYPE - GUST, GRUMMAN GULFSTREAM
 CONDITIONS - 13 WHEELS DOWN, FLAPS UP, BOTTOM SCOTTED ANTENNA, VERTICAL POLARIZATION
 AIRCRAFT - FBI



RIGHT WING	NOSE	LEFT WING	TAIL	RIGHT WING
CODE DB RANGE SYMBOL > 0. - > -10. - > -20. - > -30. - > -40. -		CODE DB RANGE SYMBOL > -50. - > -60. - > -70. - > -80. - > -90. -		

Fig. 8-6. Grumman Gulfstream; antenna position 3 (B); wheels down, flaps up.

AIRCRAFT TYPE = C-47, GRUMMAN GULFSTREAM
CONDITIONS = 23 WHEELS DOWN, FLAPS DOWN, MOTOR HOUSED ANTENNA, VERTICAL POLARIZATION

AIRCRAFT TYPE = C-47, GRUMMAN GULFSTREAM
CONDITIONS = 23 WHEELS DOWN, FLAPS DOWN, MOTOR HOUSED ANTENNA, VERTICAL POLARIZATION

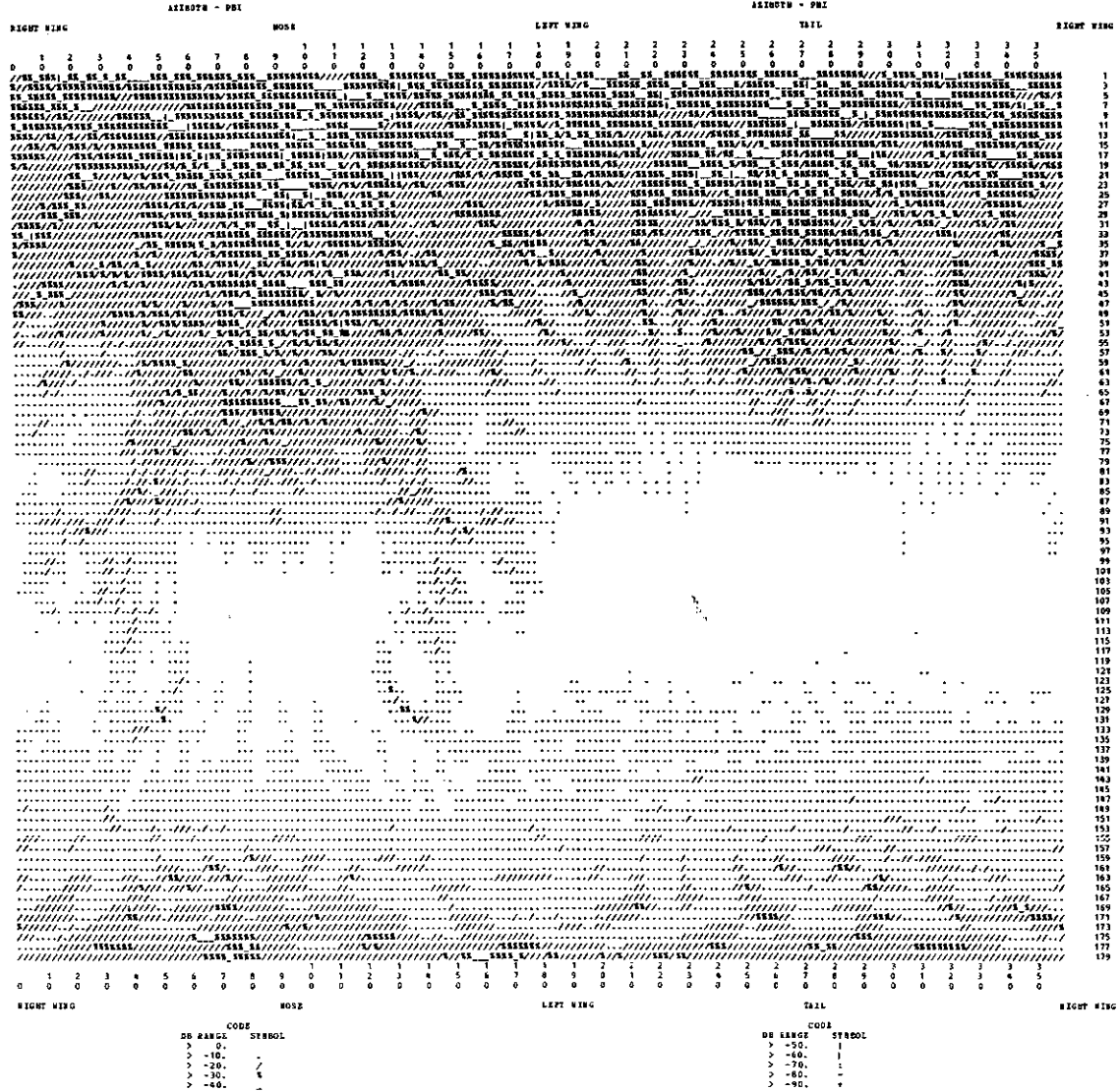


Fig. 8-7. Grumman Gulfstream; antenna position 3 (B); wheels down, flaps down.

AIRCRAFT TYPE - GUST, GRUMMAN GULFSTREAM
 CONDITIONS - 33 WHEELS UP, FLAPS UP, BOOMER MOUNTED ANTENNA, VERTICAL POLARIZATION

AIRCRAFT TYPE - GUST, GRUMMAN GULFSTREAM
 CONDITIONS - 33 WHEELS UP, FLAPS UP, BOOMER MOUNTED ANTENNA, VERTICAL POLARIZATION

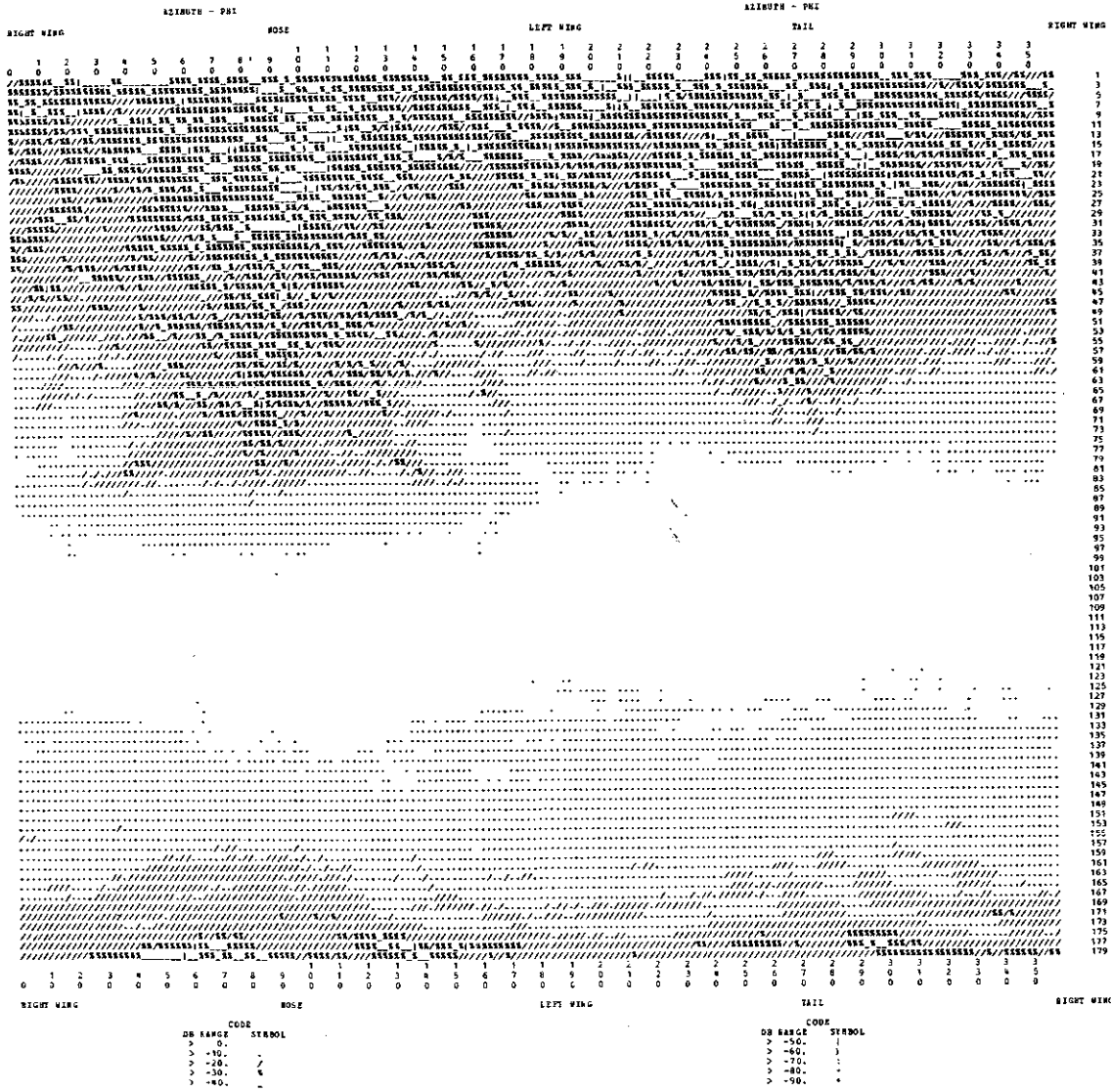


Fig. 8-8. Grumman Gulfstream; antenna position 3 (B); wheels up, flaps up.

AIRCRAFT TYPE = G052 : GRUMMAN GULFSTREAM
 CONDITIONS = 43 WHEELS UP, FLAPS DOWN, BOTTOM MOUNTED ANTENNA, VERTICAL POLARIZATION
 AIRLINE = PHX

AIRCRAFT TYPE = G052 : GRUMMAN GULFSTREAM
 CONDITIONS = 43 WHEELS UP, FLAPS DOWN, BOTTOM MOUNTED ANTENNA, VERTICAL POLARIZATION
 AIRLINE = PHX

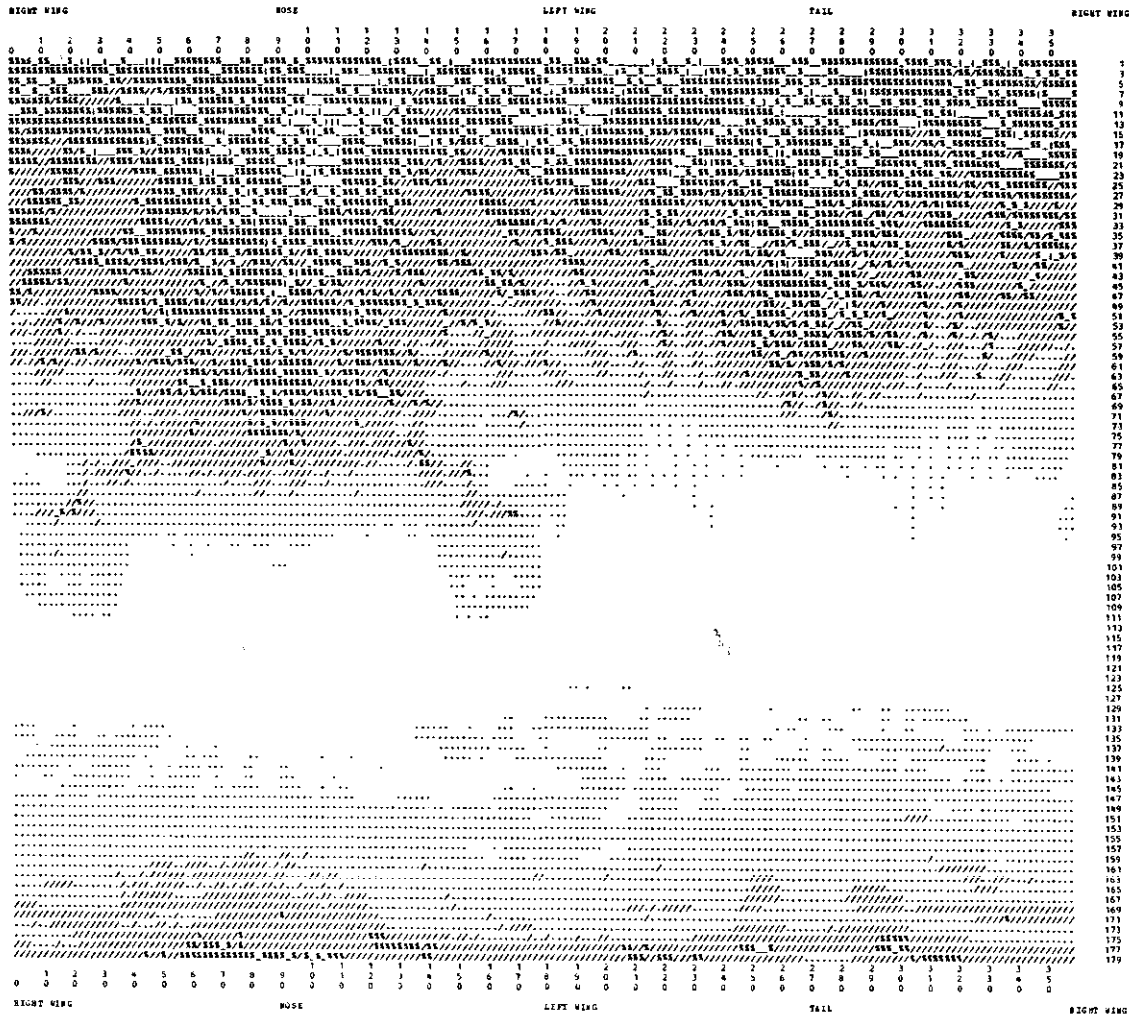


Fig. 8-9. Grumman Gulfstream; antenna position 3 (B); wheels up, flaps down.

CONDITIONS - 14 WHEELS DOWN, FLAPS UP, ROTOR HOISTED ANTENNA, VERTICAL POLARIZATION

CONDITIONS - 14 WHEELS DOWN, FLAPS UP, ROTOR HOISTED ANTENNA, VERTICAL POLARIZATION

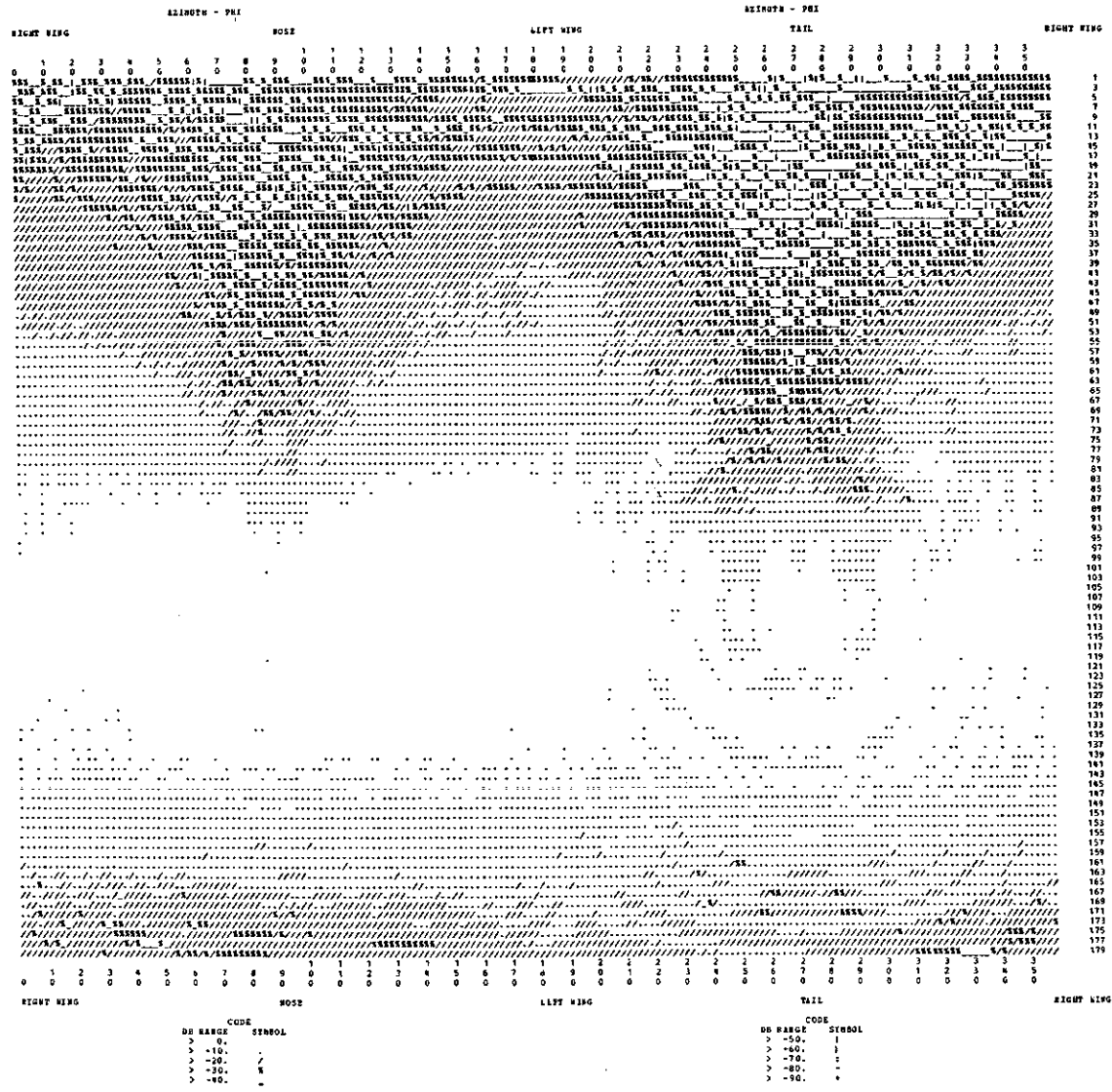


Fig. 8-10. Grumman Gulfstream; antenna position 4 (B); wheels down, flaps up.

AIRCRAFT TYPE - G06T, GRUMMAN GULFSTREAM
CONDITIONS - 34 WHEELS UP, FLAPS UP, BOTTOM MOUNTED ANTENNA, VERTICAL POLARIZATION
ALIGNMENT - FBI

AIRCRAFT TYPE - G06T, GRUMMAN GULFSTREAM
CONDITIONS - 34 WHEELS UP, FLAPS UP, BOTTOM MOUNTED ANTENNA, VERTICAL POLARIZATION
ALIGNMENT - FBI

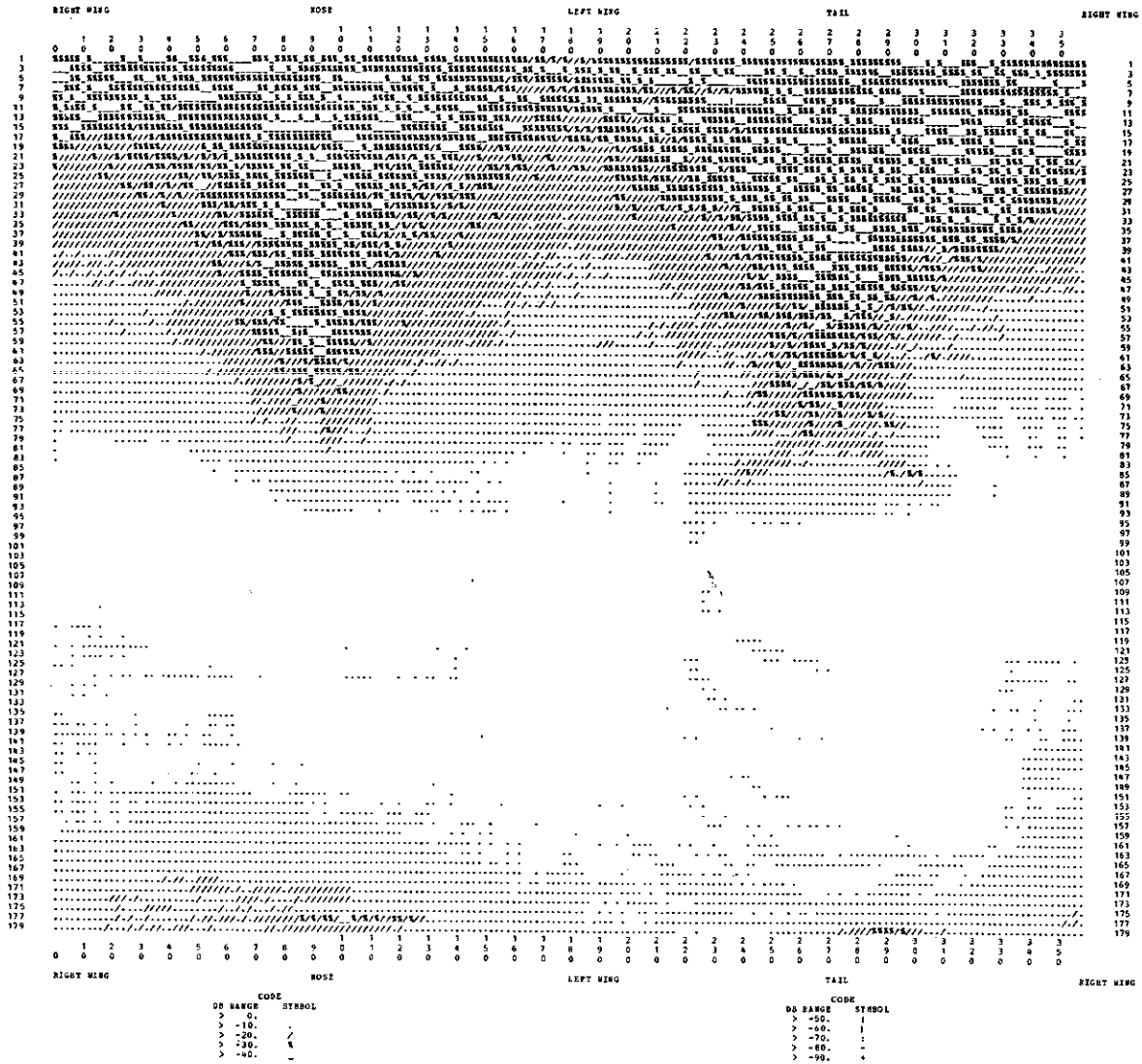


Fig. 8-11. Grumman Gulfstream; antenna position 4 (B); wheels up, flaps up.

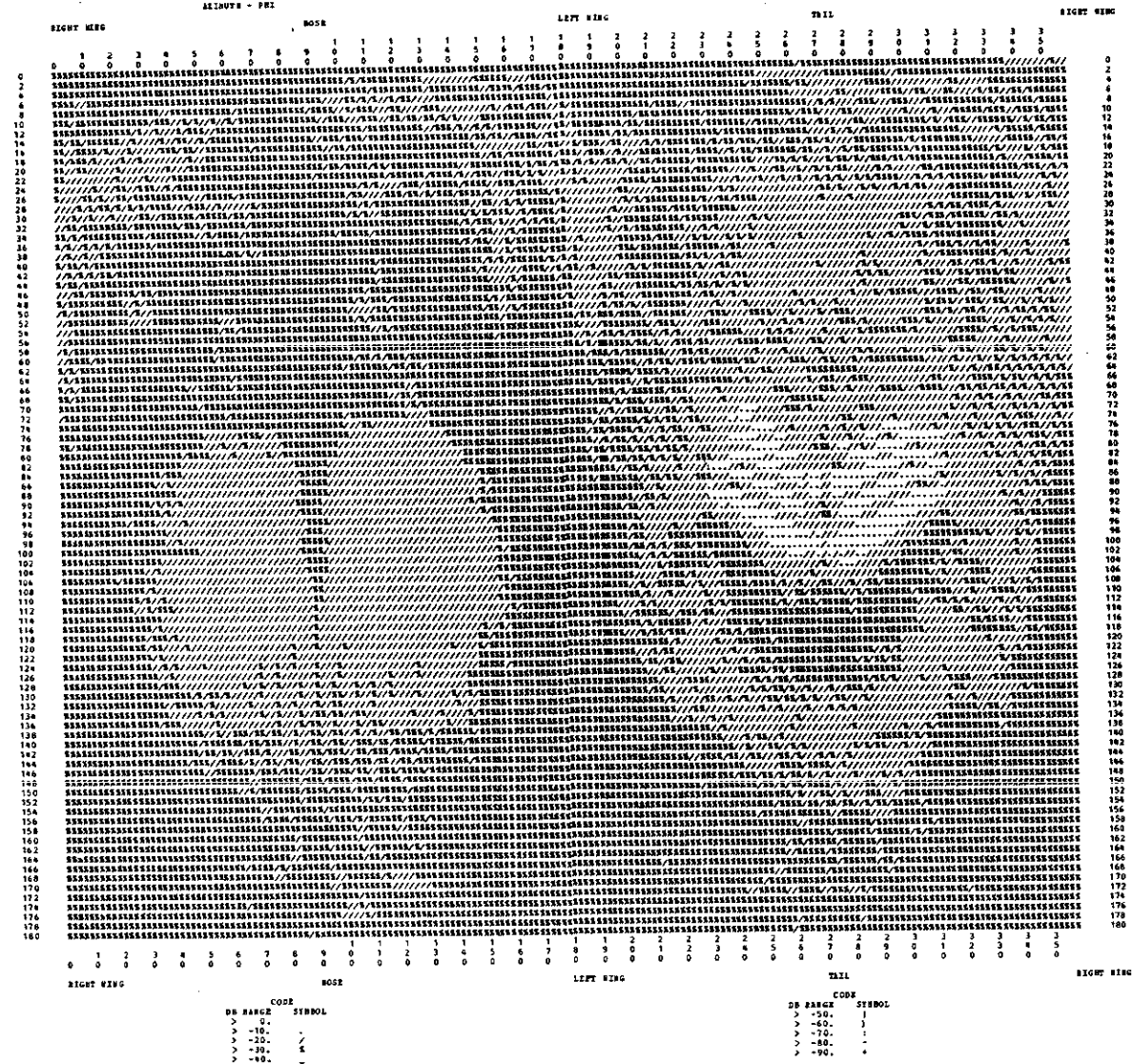
AIR CARRIER*

1. Boeing 707
2. Boeing 727
3. Boeing 737
4. Boeing 747

*All positions measured with flaps up.

CONDITIONS - 12, WHEELS UP, FLAPS UP, TOP MOUNTED ANTENNA, HORIZONTAL POLARIZATION

CONDITIONS - 12, WHEELS UP, FLAPS UP, TOP MOUNTED ANTENNA, HORIZONTAL POLARIZATION



129

Fig. 9-2. Boeing 707; antenna position 1 (T); wheels up; horizontal polarization.

AIRCRAFT TYPE = B707, BOEING 707
 CONDITIONS = 22, WHEELS UP, FLAPS UP, ROTATED ANTENNA, HORIZONTAL POLARIZATION
 AIRCRAFT TYPE = B707, BOEING 707
 CONDITIONS = 22, WHEELS UP, FLAPS UP, ROTATED ANTENNA, HORIZONTAL POLARIZATION

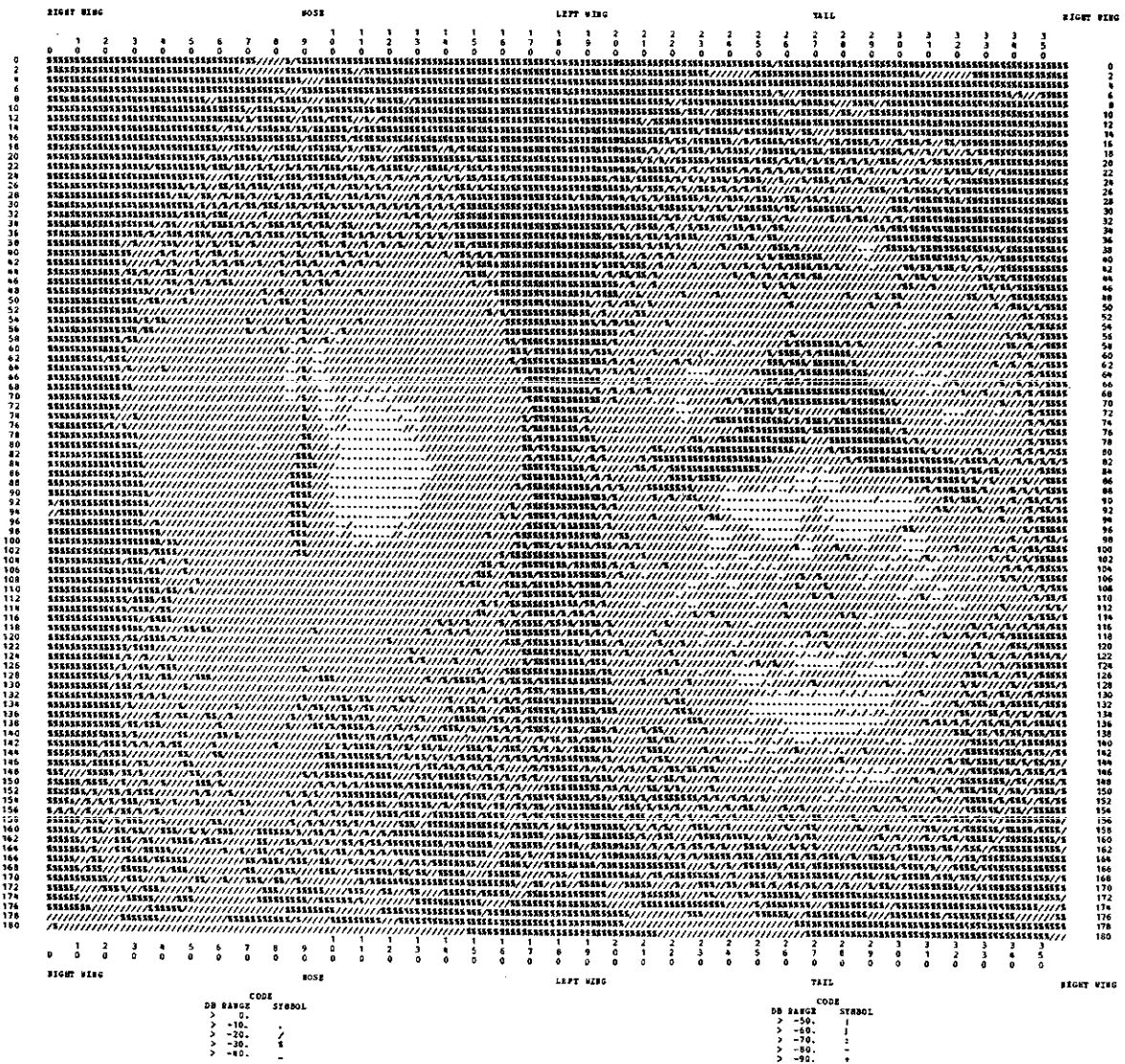
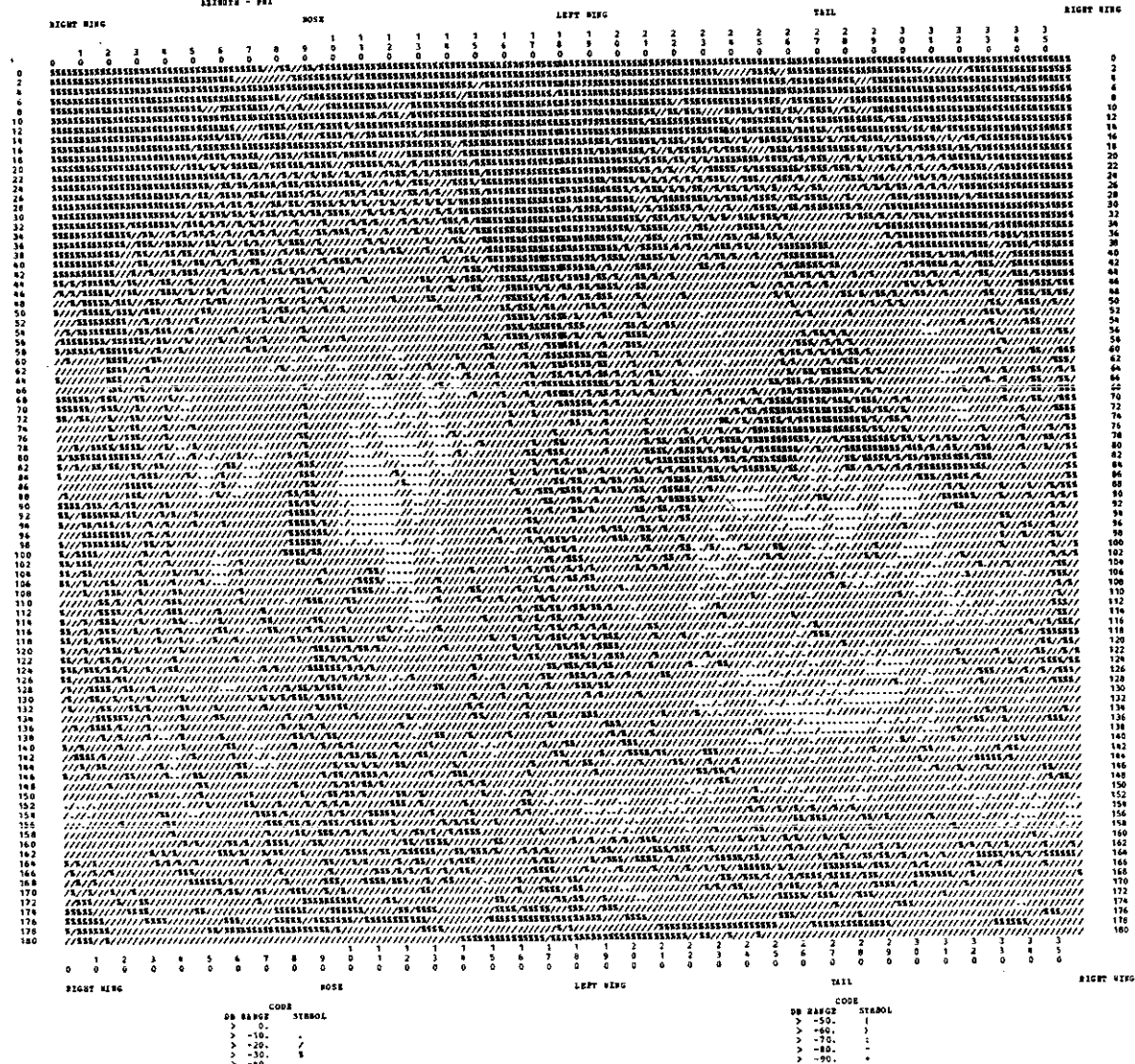


Fig. 9-4. Boeing 707; antenna position 2 (B); wheels up; horizontal polarization.

AIRCRAFT TYPE - B707, BOEING 707
 CONDITIONS = 24, WHEELS DOWN, FLAPS UP, ROTOR MOUNTED ANTENNA, HORIZONTAL POLARIZATION
 AIRSOUTH - FBI

AIRCRAFT TYPE - B707, BOEING 707
 CONDITIONS = 24, WHEELS DOWN, FLAPS UP, ROTOR MOUNTED ANTENNA, HORIZONTAL POLARIZATION
 AIRSOUTH - FBI



133

Fig. 9-6. Boeing 707; antenna position 2 (B); wheels down; horizontal polarization.

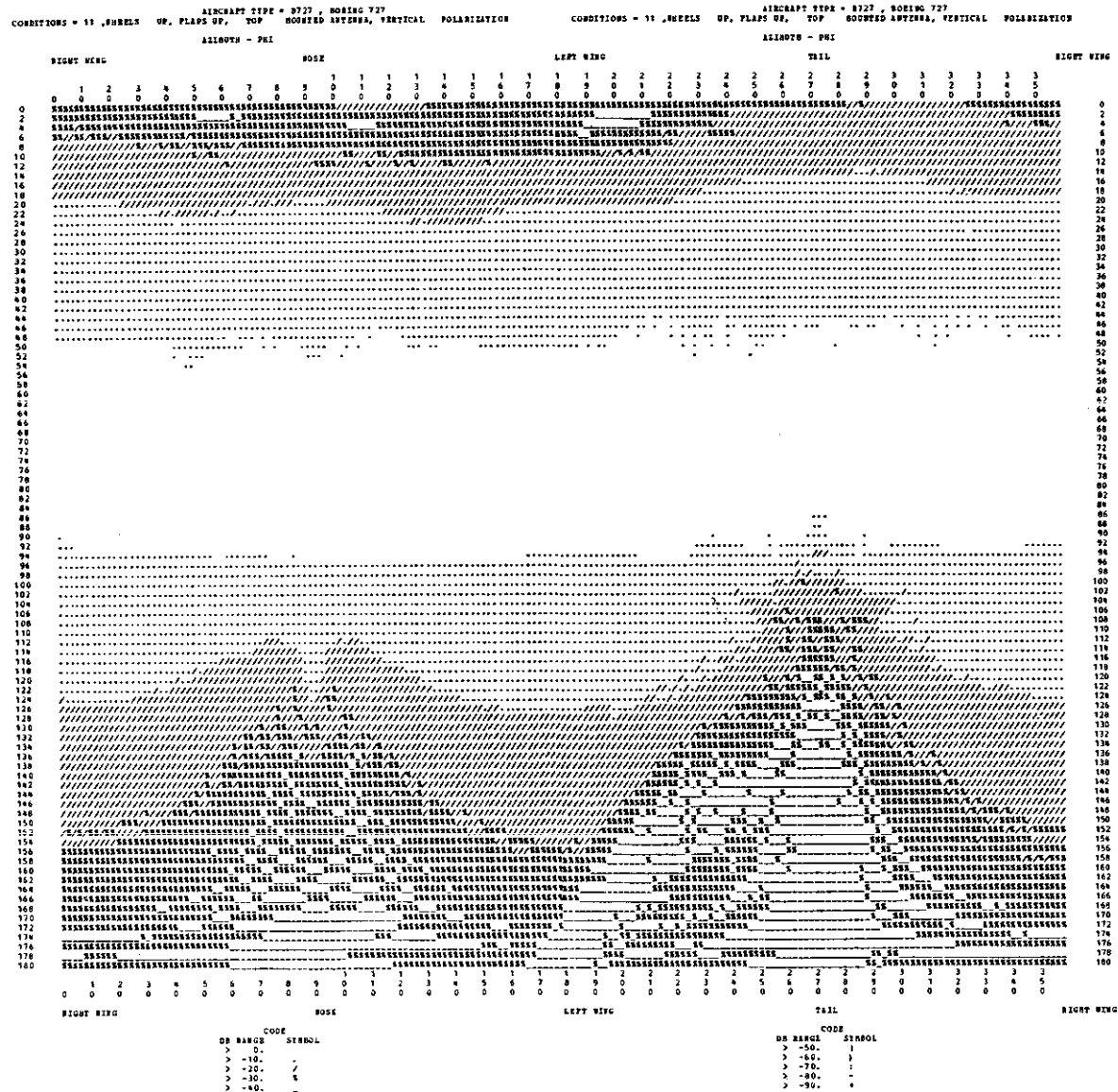
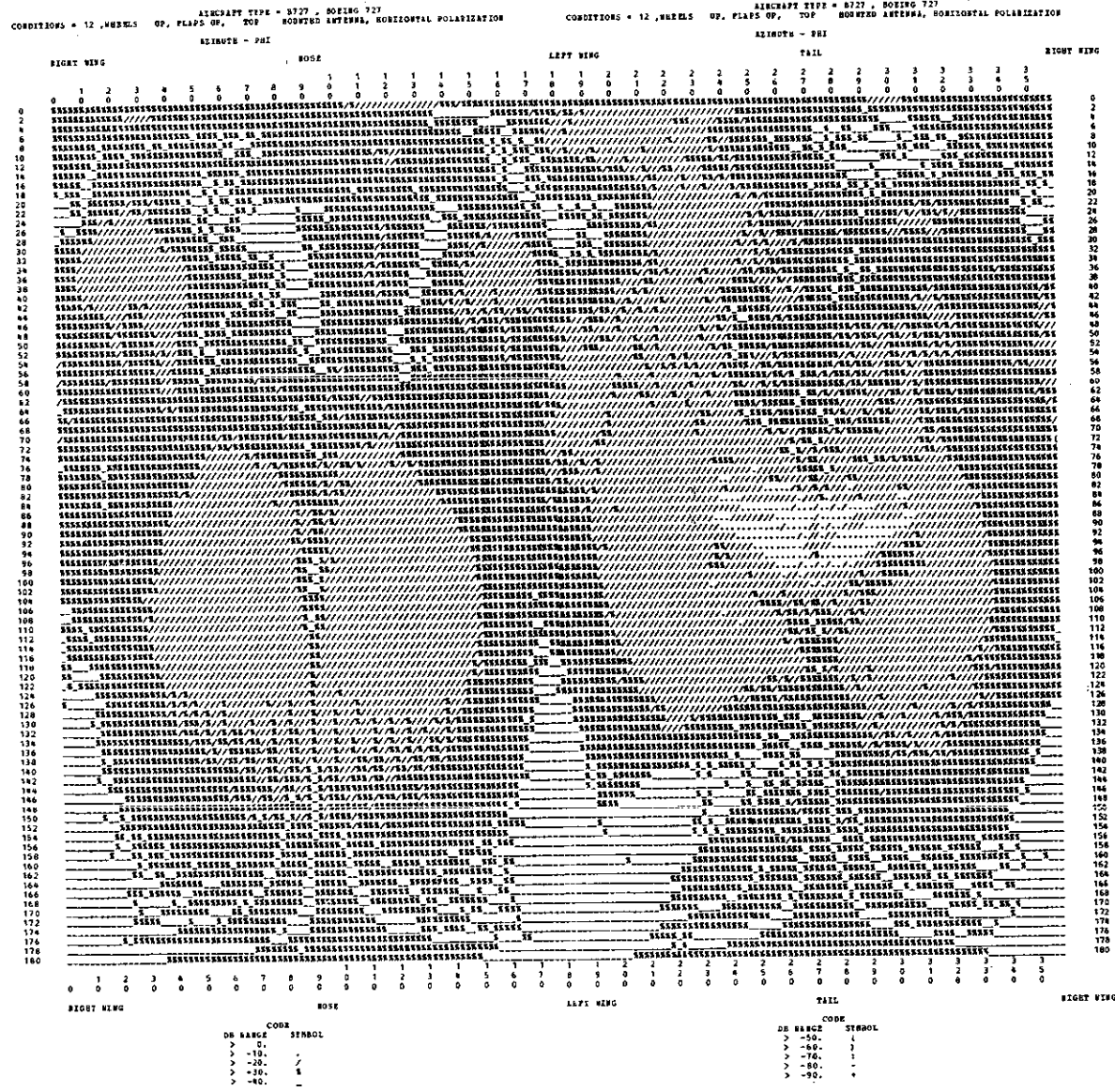


Fig. 10-1. Antenna position 1 (T); wheels up; vertical polarization.



135

Fig. 10-2. Boeing 727; antenna position 1 (T); wheels up; horizontal polarization.

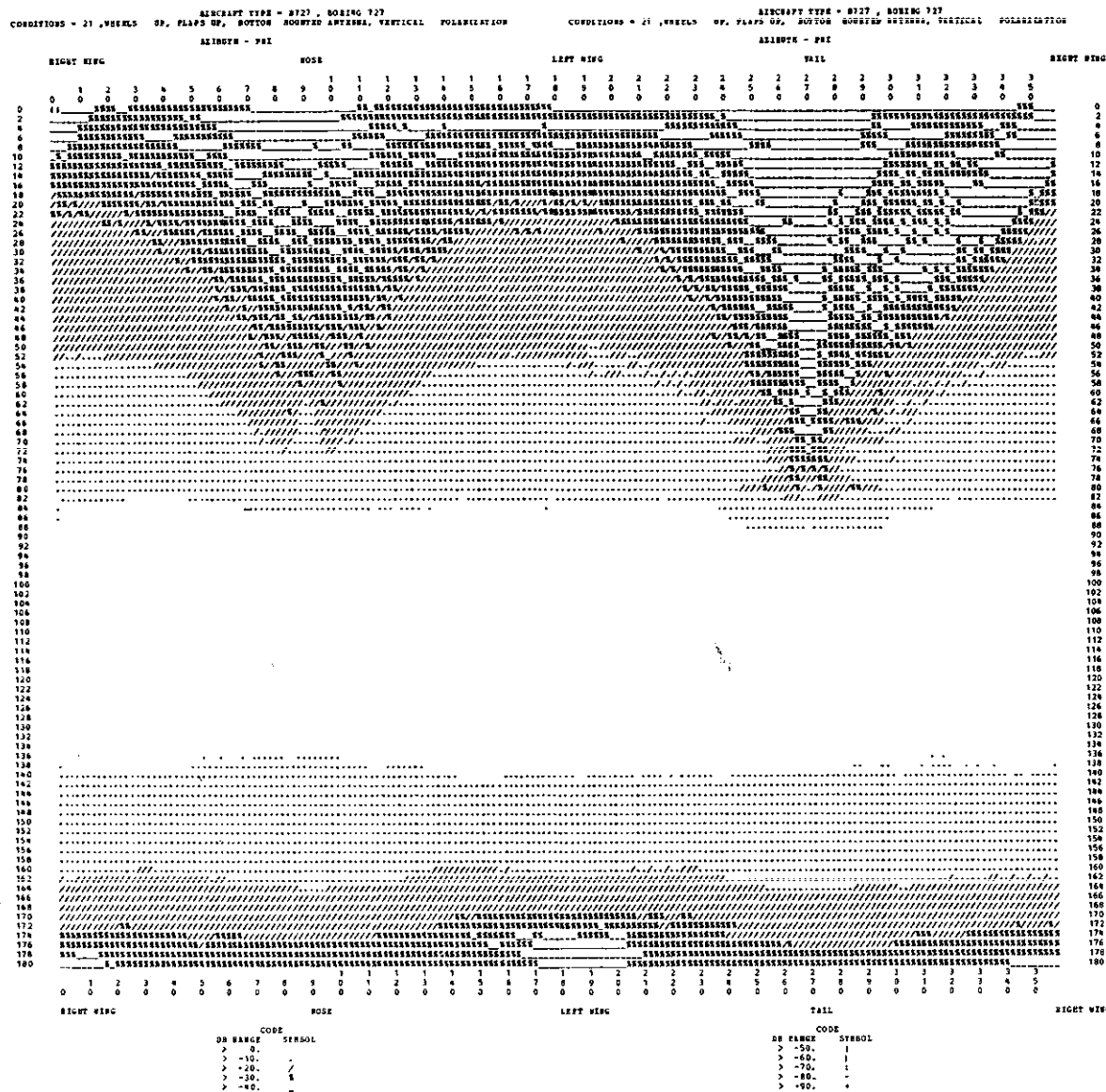


Fig. 10-3. Boeing 727; antenna position 2 (B); wheels up; vertical polarization.

AIRCRAFT TYPE = B727, MODEL 727
 CONDITIONS = 22, WHEELS UP, FLAPS UP, BOTTOM MOUNTED ANTENNA, HORIZONTAL POLARIZATION
 AIRCRAFT TYPE = B727, MODEL 727
 CONDITIONS = 22, WHEELS UP, FLAPS UP, BOTTOM MOUNTED ANTENNA, HORIZONTAL POLARIZATION
 AIRCRAFT - FBI

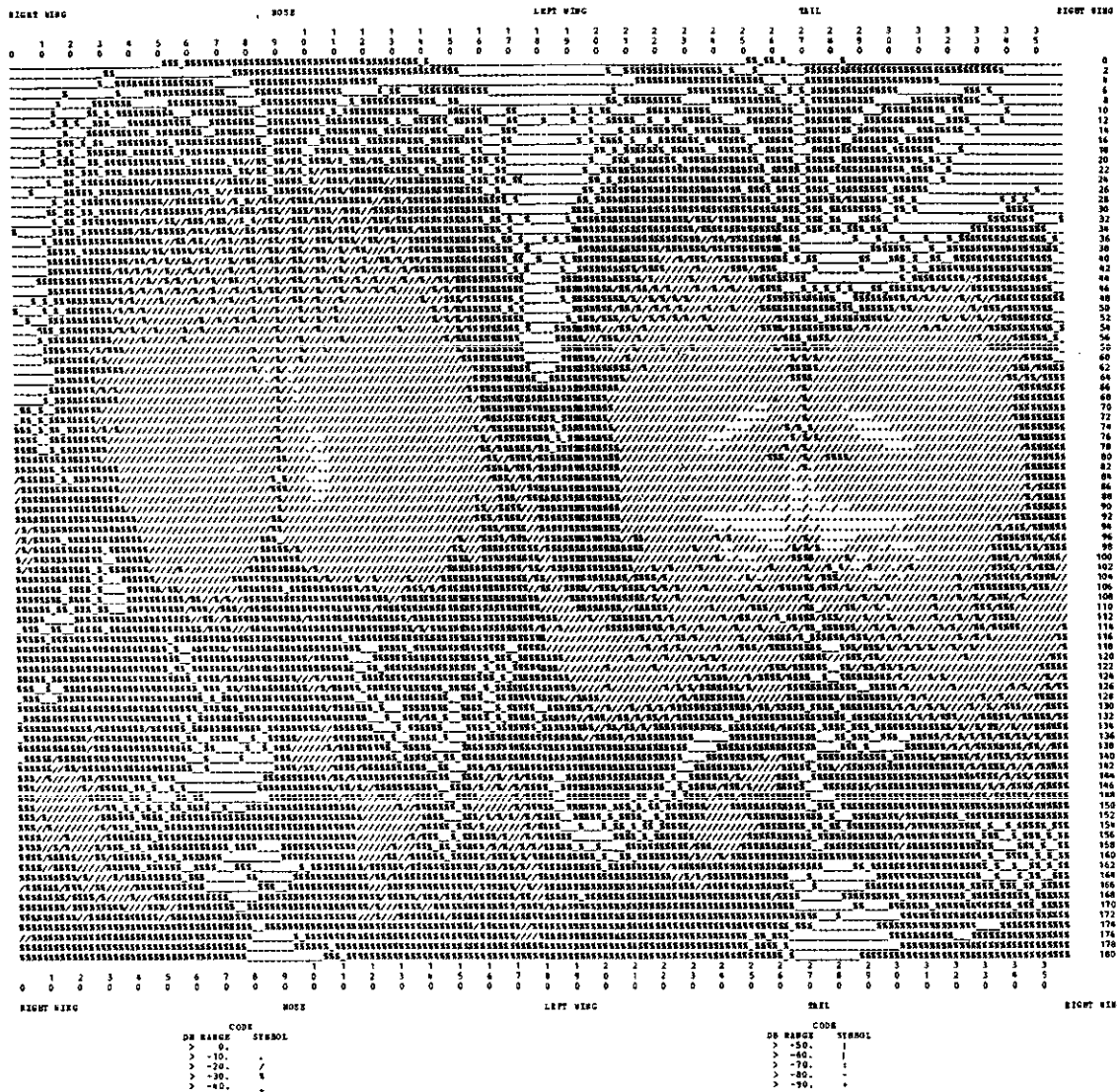


Fig. 10-4. Boeing 727; antenna position 2 (B); wheels up; horizontal polarization.

CONDITIONS - 24, WHEELS DOWN, FLAPS UP, ROTOR ROTATED ANTENNA, HORIZONTAL POLARIZATION

CONDITIONS - 24, WHEELS DOWN, FLAPS UP, ROTOR ROTATED ANTENNA, HORIZONTAL POLARIZATION

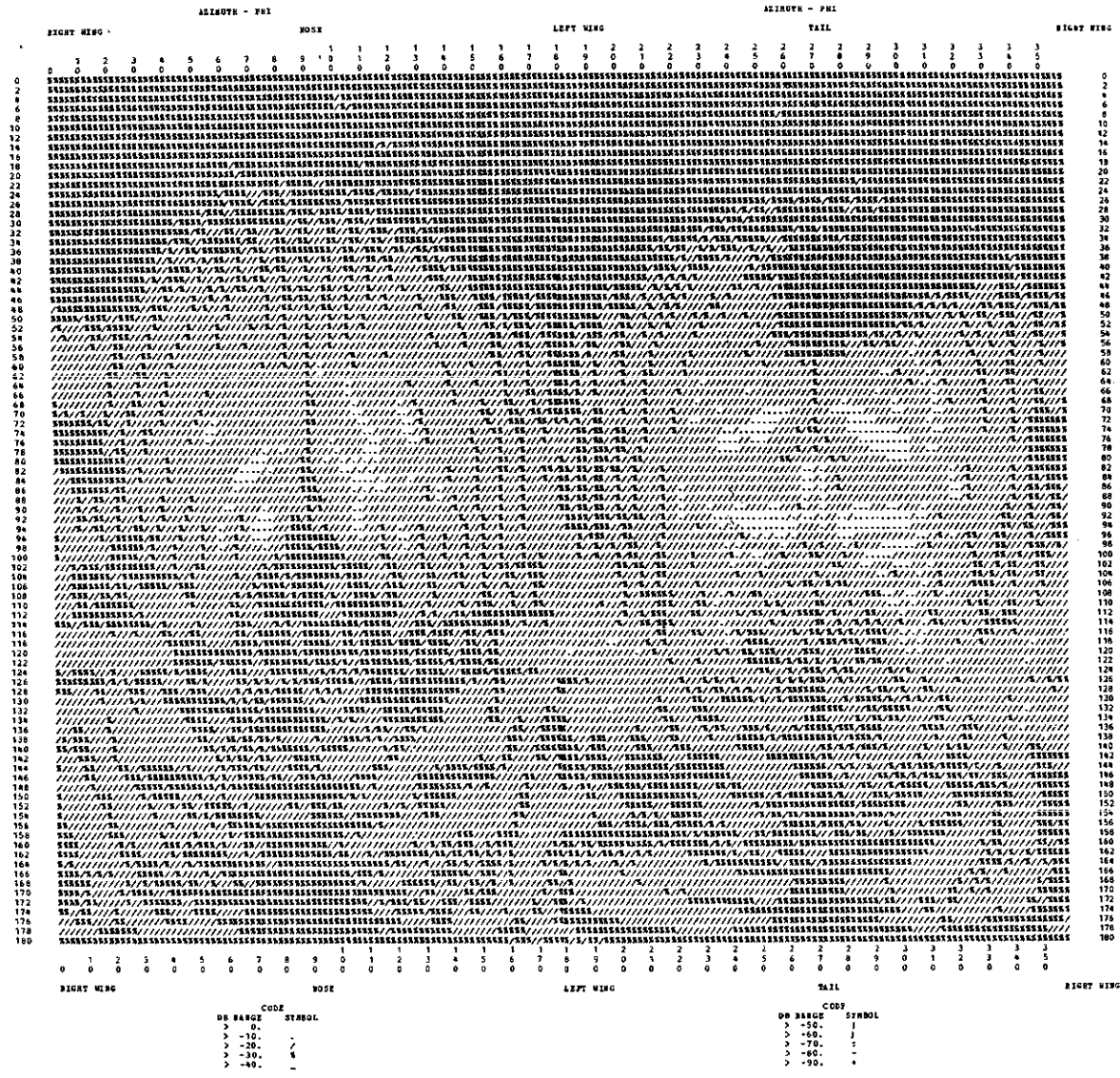


Fig. 10-6. Boeing 727; antenna position 2 (B); wheels down; horizontal polarization.

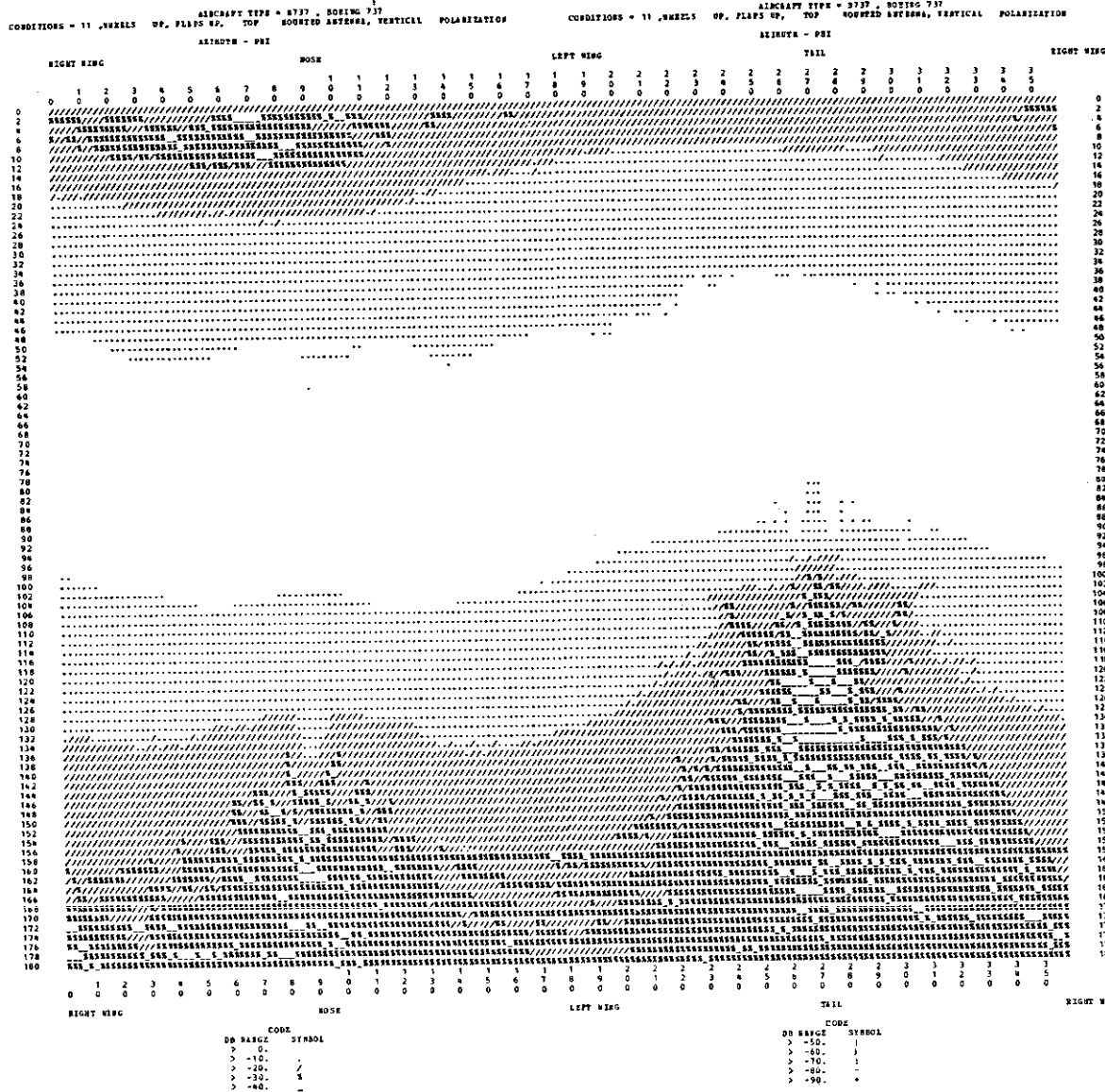


Fig. 11-1. Boeing 737; antenna position 1 (T); wheels up; vertical polarization.

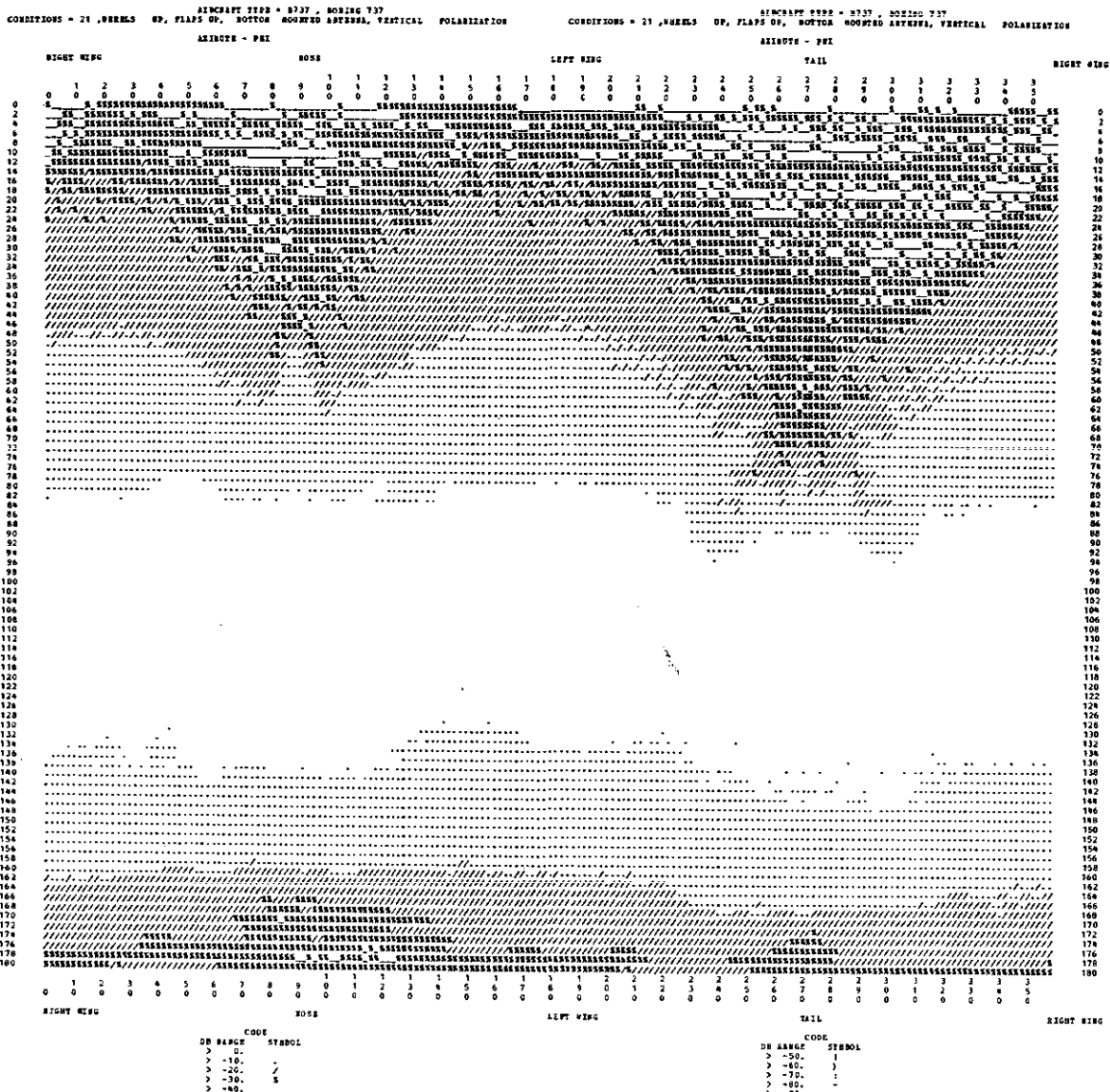
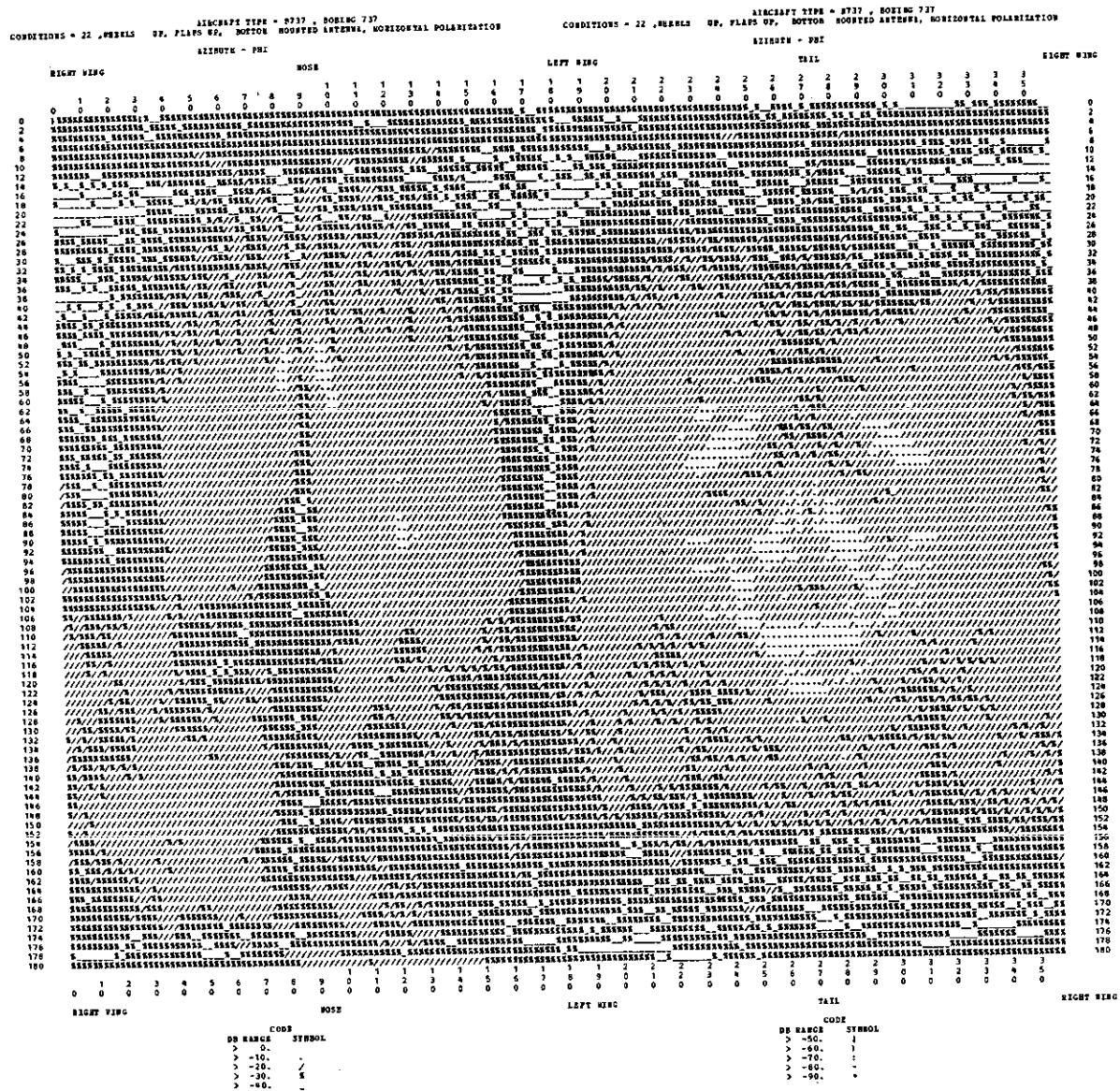


Fig. 11-3. Boeing 737; antenna position 2 (B); wheels up; vertical polarization.



143

Fig. 11-4. Antenna position 2 (B); wheels up; horizontal polarization.

AIRCRAFT TYPE - B737, BOEING 737
 CONDITIONS - 23, WHEELS DOWN, FLAPS UP, BOTTOM HOISTED ANTENNA, VERTICAL POLARIZATION
 AIRBURN - PRI

AIRCRAFT TYPE - B737, BOEING 737
 CONDITIONS - 23, WHEELS DOWN, FLAPS UP, BOTTOM HOISTED ANTENNA, VERTICAL POLARIZATION
 AIRBURN - PRI

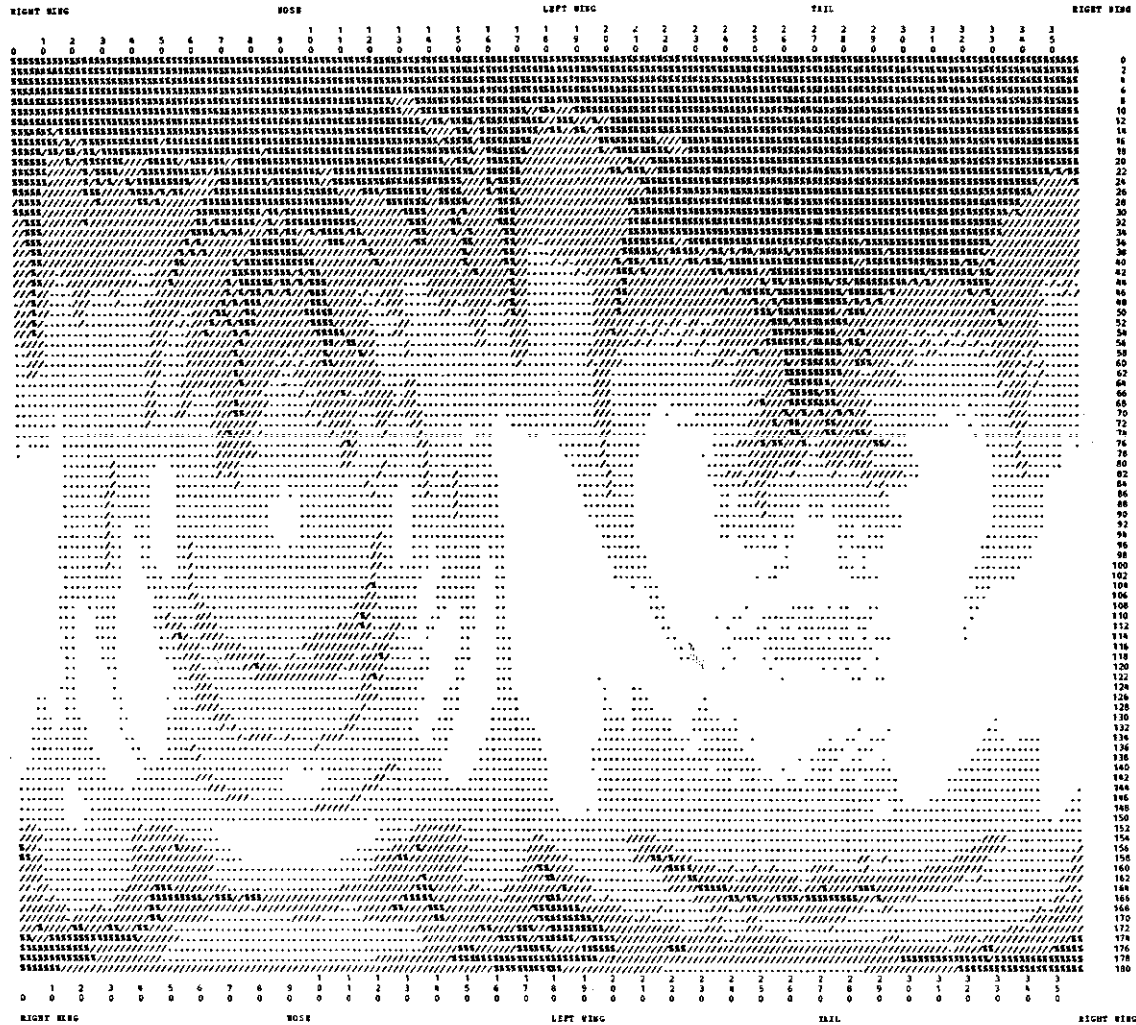


Fig. 11-5. Boeing 737; antenna position 2 (B); wheels down; vertical polarization.

AIRCRAFT TYPE = B737 , BOEING 737
 CONDITIONS = 24 ,WHEELS DOWN, FLAPS UP, BOTTOM MOUNTED ANTENNA, HORIZONTAL POLARIZATION

AIRCRAFT TYPE = B737 , BOEING 737
 CONDITIONS = 24 ,WHEELS DOWN, FLAPS UP, BOTTOM MOUNTED ANTENNA, HORIZONTAL POLARIZATION

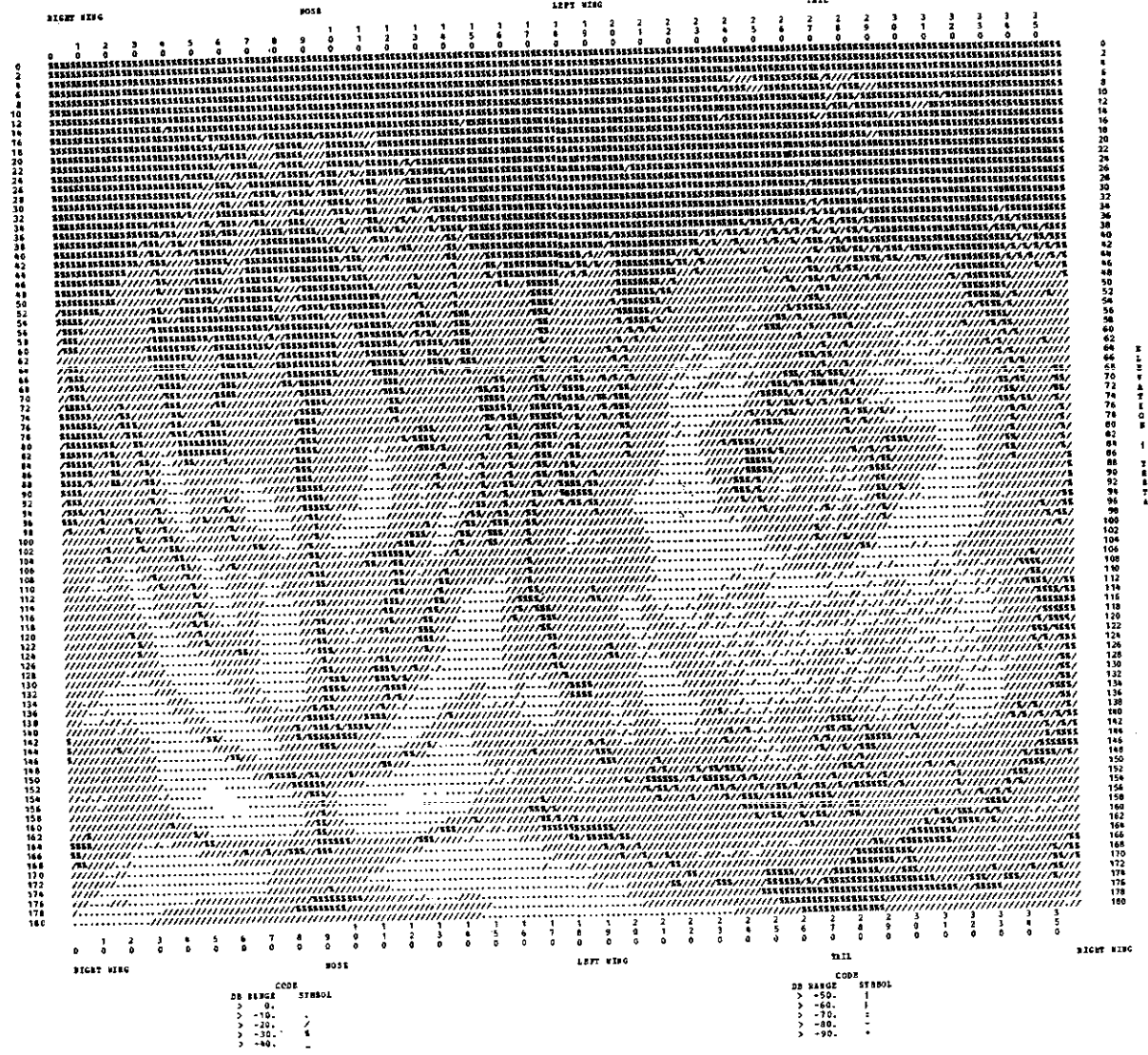


Fig. 11-6. Boeing 737; antenna position 2 (B); wheels down; horizontal polarization.

CONDITIONS = 11, WHEELS UP, FLAPS UP, TOP ROOPIED ANTENNA, VERTICAL POLARIZATION AIRCRAFT TYPE = B747, BOEING 747
 CONDITIONS = 11, WHEELS UP, FLAPS UP, TOP ROOPIED ANTENNA, VERTICAL POLARIZATION AIRCRAFT TYPE = B747, BOEING 747

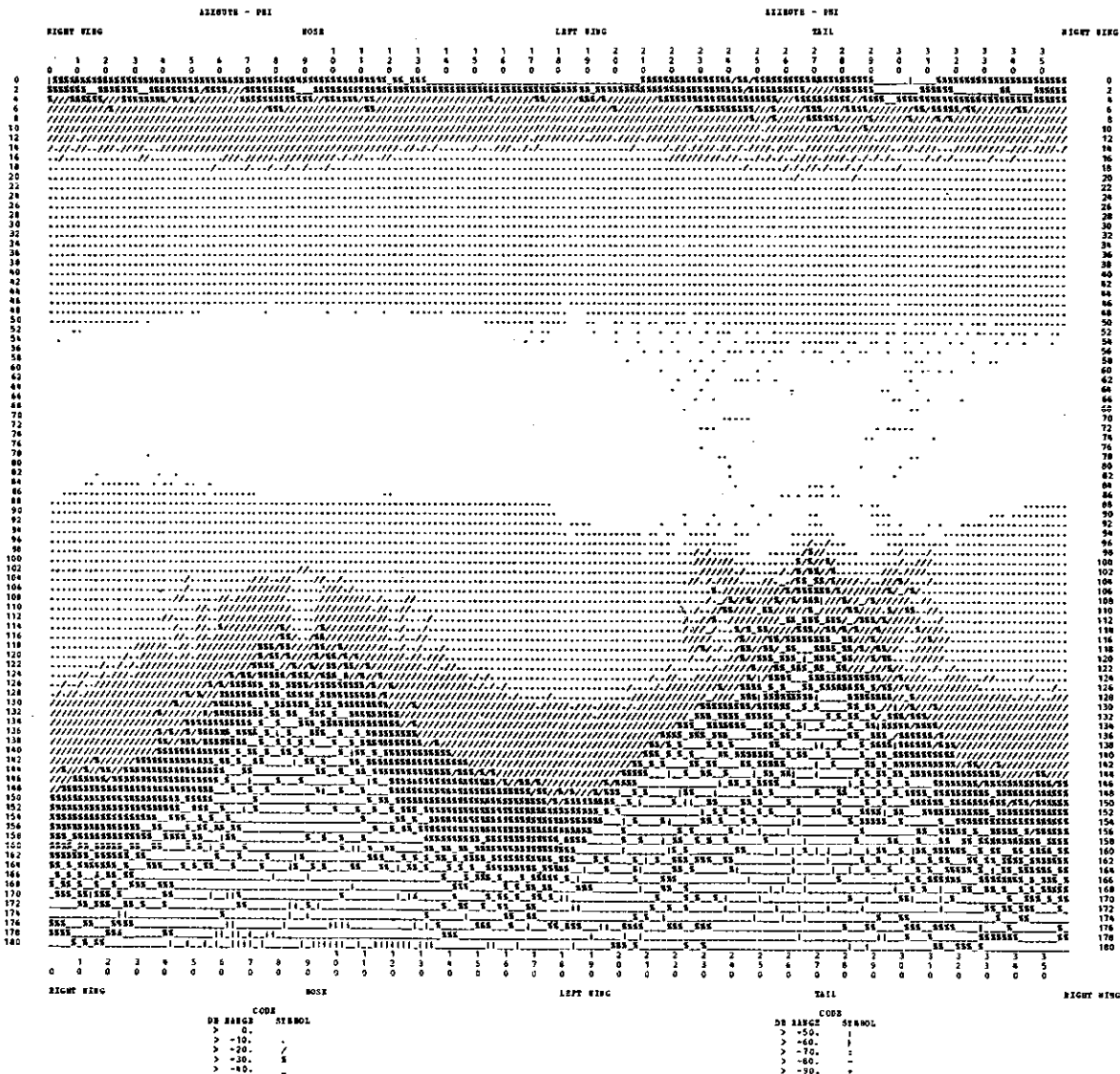


Fig. 12-1. Boeing 747; antenna position 1 (T); wheels up; vertical polarization.

AIRCRAFT TYPE - B747, BOEING 747 AIRCRAFT TYPE - B747, BOEING 747
CONDITIONS - 12 WHEELS UP, FLAPS UP, HORIZONTAL POLARIZATION CONDITIONS - 12 WHEELS UP, FLAPS UP, HORIZONTAL POLARIZATION
ALBANY - FBI AIRPORT - FBI

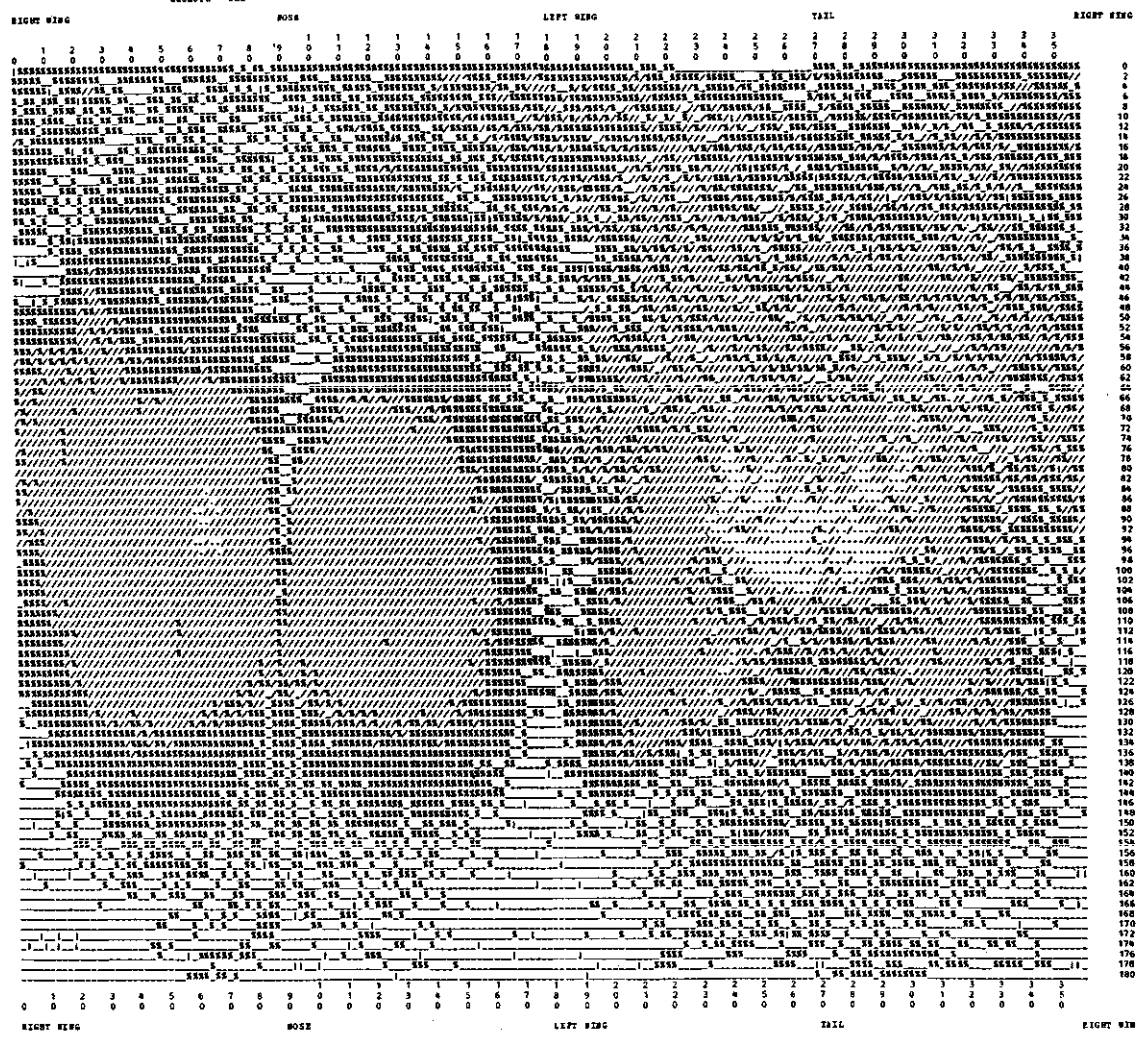


Fig. 12-2. Boeing 747; antenna position 1 (T); wheels up; horizontal polarization.

147

BIROPAFT TYPE = B747, BORING 747
 CONDITIONS = 22, WHEELS UP, FLAPS UP, ROTARY INTERNAL, HORIZONTAL POLARIZATION
 AIRCRAFT TYPE = B747, BORING 747
 CONDITIONS = 22, WHEELS UP, FLAPS UP, ROTARY INTERNAL, HORIZONTAL POLARIZATION

AIRCRAFT TYPE = B747, BORING 747
 CONDITIONS = 22, WHEELS UP, FLAPS UP, ROTARY INTERNAL, HORIZONTAL POLARIZATION

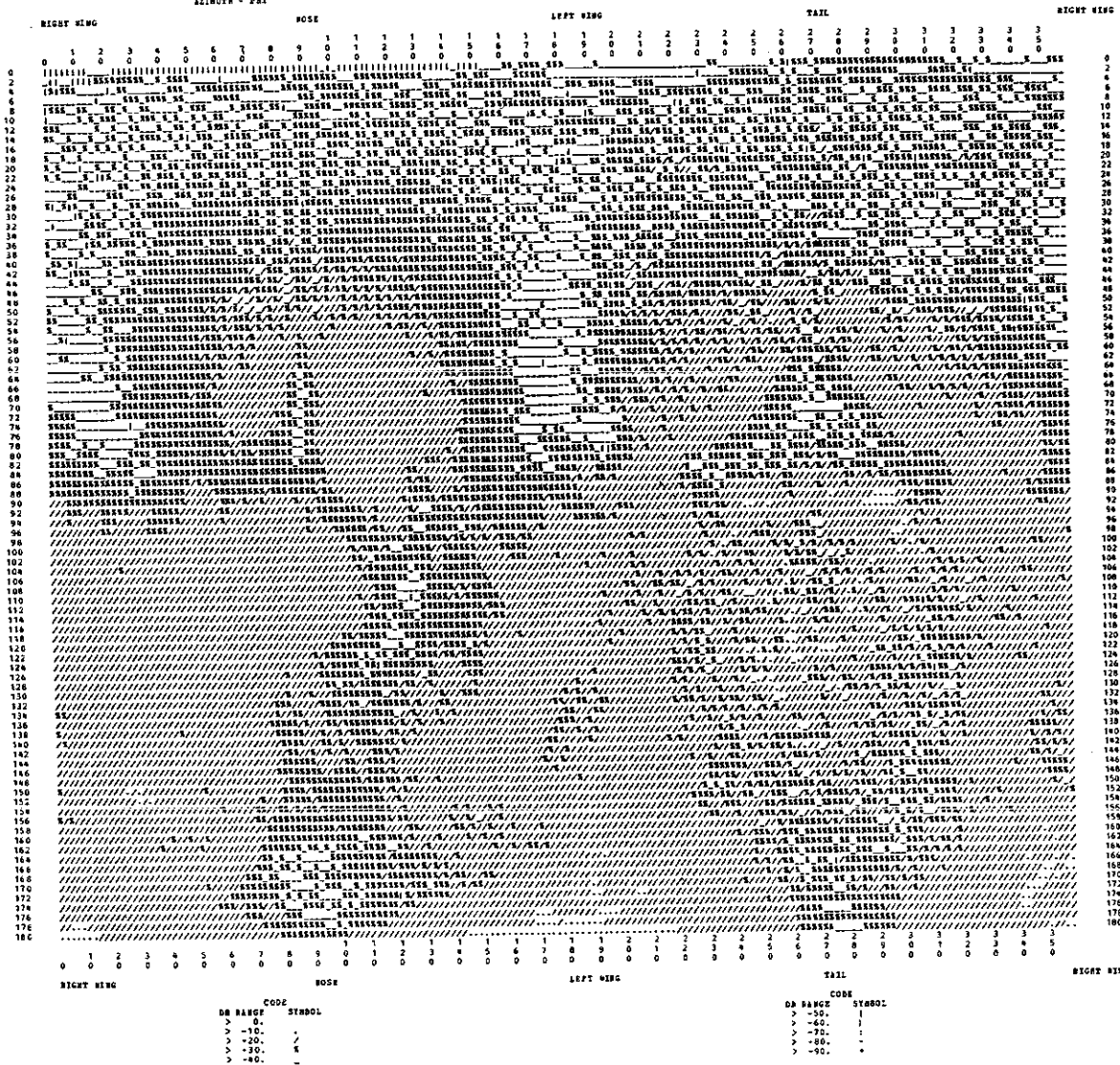


Fig. 12-4. Boeing 747; antenna position 2 (B); wheels up; horizontal polarization.

CONDITIONS = 23, WHEELS DOWN, FLAPS UP, ROTOR MOUNTED ANTENNA, VERTICAL POLARIZATION
 AIRCRAFT TYPE = B747, BOEING 747
 ALIQUOT - FBI

CONDITIONS = 23, WHEELS DOWN, FLAPS UP, ROTOR MOUNTED ANTENNA, VERTICAL POLARIZATION
 AIRCRAFT TYPE = B747, BOEING 747
 ALIQUOT - FBI

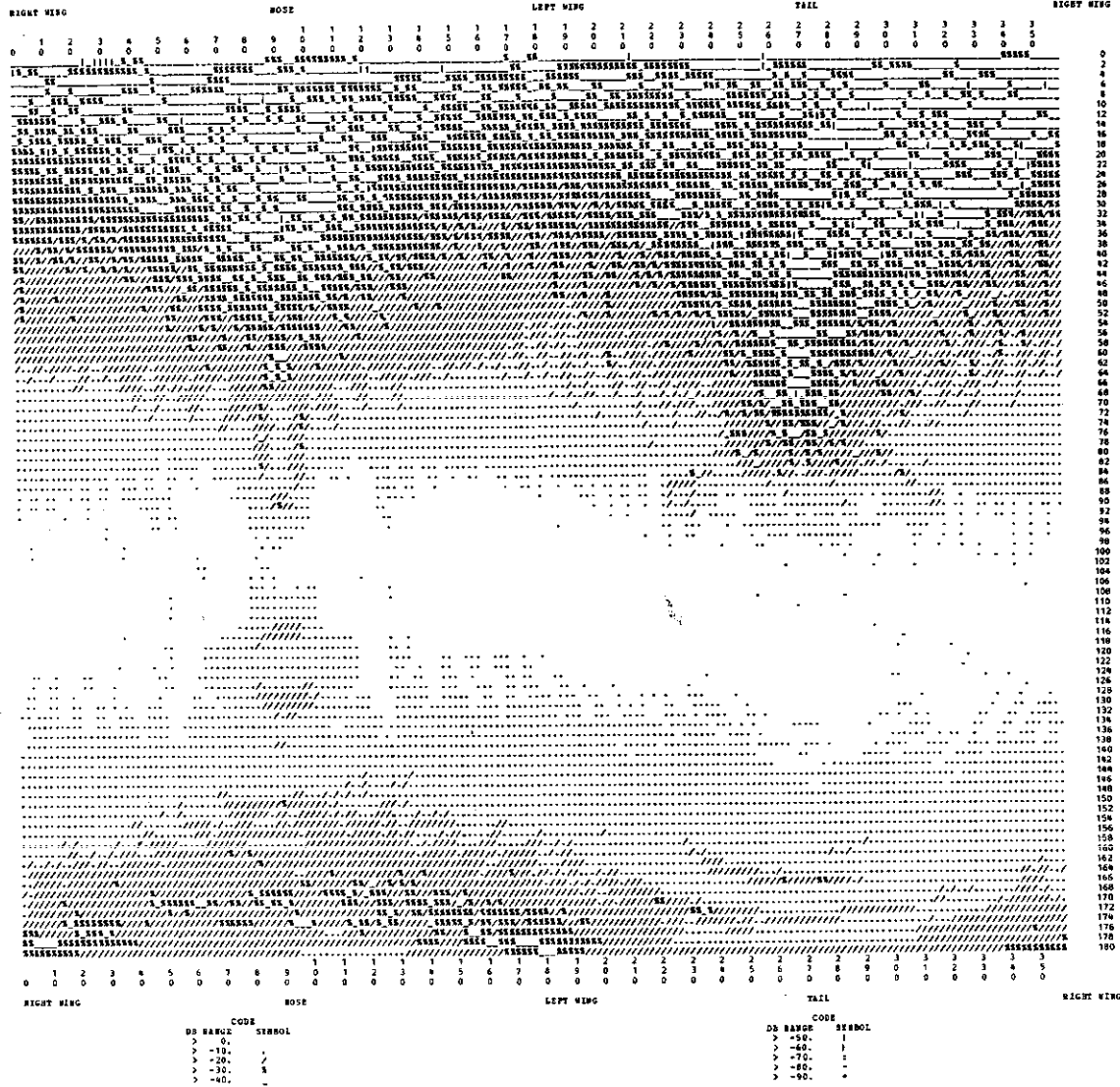


Fig. 12-5. Boeing 747; antenna position 2 (B); wheels down; vertical polarization.

CONDITIONS - 24, WHEELS DOWN, FLAPS UP, BOTTOM MOUNTED ANTENNA, HORIZONTAL POLARIZATION
 AIRCRAFT TYPE - B747, BOEING 747
 AIRCRAFT TYPE - B747, BOEING 747
 AIRCRAFT TYPE - B747, BOEING 747
 AIRCRAFT TYPE - B747, BOEING 747

CONDITIONS - 24, WHEELS DOWN, FLAPS UP, BOTTOM MOUNTED ANTENNA, HORIZONTAL POLARIZATION
 AIRCRAFT TYPE - B747, BOEING 747
 AIRCRAFT TYPE - B747, BOEING 747
 AIRCRAFT TYPE - B747, BOEING 747
 AIRCRAFT TYPE - B747, BOEING 747

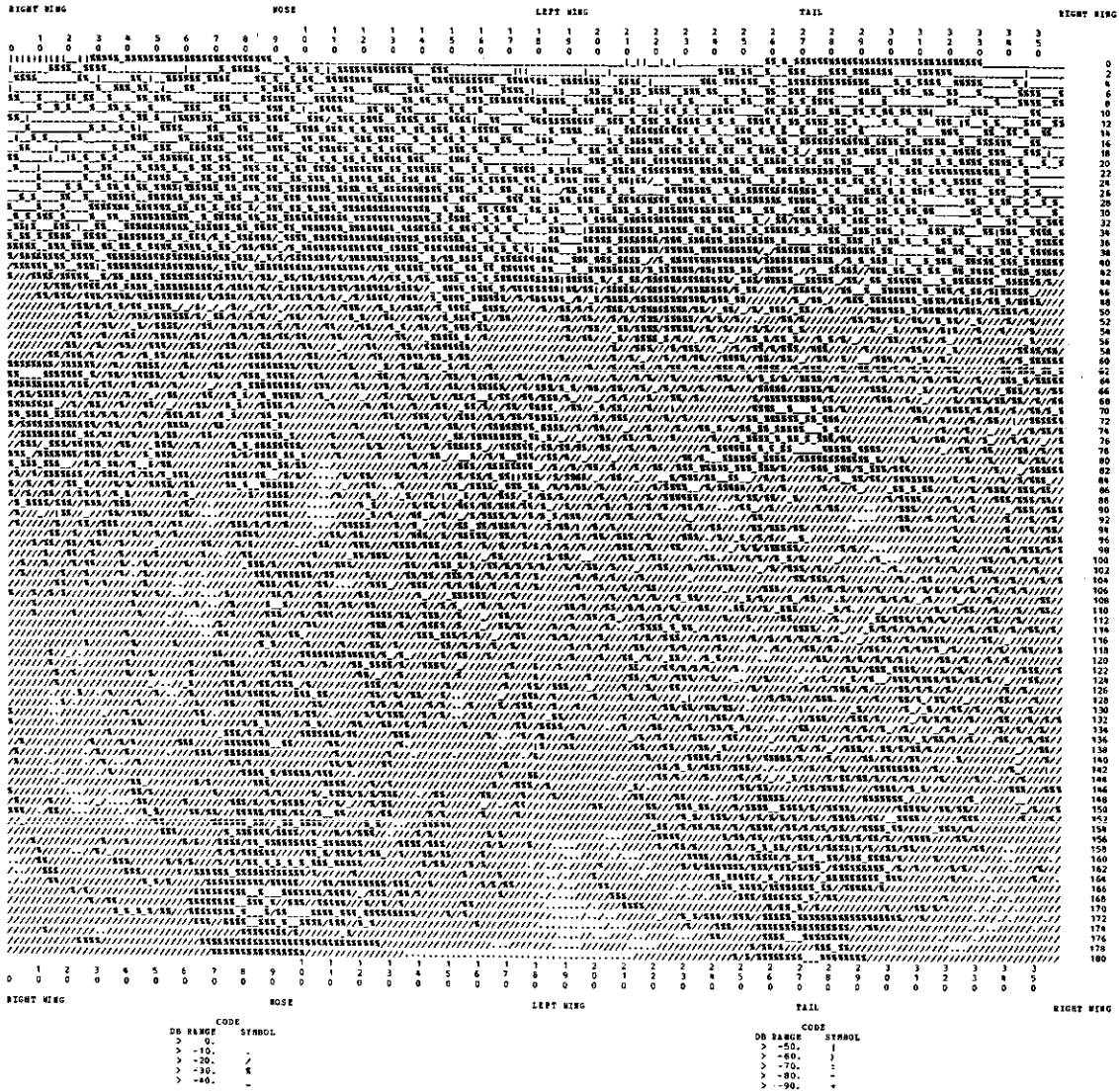


Fig. 12-6. Boeing 747; antenna position 2 (B); wheels down; horizontal polarization.

APPENDIX A

ANTENNA POSITION AND GEAR CONDITION CODING

1. General Aviation and Small Jet Models Only

Numerals of the two-numeral code, IJ, have the following meanings:

- I denotes gear condition:
1. Wheels down, flaps up
 2. Wheels down, flaps down
 3. Wheels up, flaps up
 4. Wheels up, flaps down.

J denotes antenna position as designated by numerals on Figs. 1-3 through 1-22.

2. Air Carrier Models Only

Numerals of the two-numeral code, MN, have the following meanings:

M denotes antenna position as designated on Figs. 1-23 through 1-26.

N denotes wheel condition (flaps always up), and polarization used:

1. Wheels up, vertical polarization
2. Wheels up, horizontal polarization
3. Wheels down, vertical polarization
4. Wheels down, horizontal polarization.

REFERENCES

1. Keeping, K. J. and Sureau, J. C., "Scale Model Measurements of Aircraft L-Band Beacon Antenna," Lincoln Laboratory, M. I. T., Project Report ATC-47, FAA-RD-75-23 (4 March 1975).
2. "ATC Antenna Patterns on Boeing Aircraft," Boeing Co. (June 1974).
3. Schlieckert, G. J., "An Analysis of Aircraft L-Band Beacon Antenna Patterns," Lincoln Laboratory, M. I. T., Project Report ATC-37, FAA-RD-74-144 (15 January 1975).