Report No. DOT/FAA/CT-82/16 VOLUME 2

JOINT U.S./U.S.S.R. MODE S COMPATIBILITY TEST PROGRAM

Rodney Guishard (U.S.)
Anatoly Bolshev (U.S.S.R.)
et al.

This report was prepared jointly for the U.S./U.S.S.R. Air Traffic Control (05.0402) Subgroup

FINAL REPORT

OCTOBER 1981

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Prepared for

U. S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
TECHNICAL CENTER
Atlantic City Airport, N.J. 08405

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
DOT/FAA/CT-82/16 Volume 2		

4. Title and Subtitle	5. Report Date
JOINT U.S./U.S.S.R. MODE S COMPATIBILITY TEST PROGRAM	October 1981
	6. Performing Organization Code
7. Author(s)	8. Performing Organization Report No.
Rodney Guishard (U.S.) and Anatoly Bolshev (U.S.S.R.)	DOT/FAA/CT-82/16 Vol. 2
9. Performing Organization Name and Address Federal Aviation Administration Technical Center Atlantic City Airport, New Jersey 08405	10. Work Unit No. (TRAIS) 11. Contract or Grant No. 034-241-510
12. Sponsoring Agency Name and Address This report was prepared jointly for the U.S./U.S.S.R. Air Traffic Control (05.0402) Subgroup	13. Type of Report and Period Covered Final Report October 5 through 30, 1981 14. Sponsoring Agency Code

15. Supplementary Notes
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16. Abstract

This document consists of the data collected during the joint tests conducted at the Federal Aviation Administration (FAA) Technical Center to determine the compatibility of a Union of Soviet Socialist Republics (U.S.S.R.) designed transponder with the United States (U.S.) Mode S system. A U.S. transponder was included in these tests for convenient comparison of results. Both bench tests and flight tests were conducted to ascertain compatibility to the U.S. Discrete Address Beacon System (DABS) National Standard of 1978. Radial and orbital flight profiles were used to gather statistical data to draw conclusions about the transponder's performance in conjunction with the Mode S system. Both the methods of conducting these tests and the results obtained are described.

It was concluded that the U.S.S.R. Mode S transponder operated successfully and is compatible with the U.S. Mode S system. Moreover, the test results confirmed that the performance of both the U.S. and the U.S.S.R. transponders were comparable.

A summary of the test results is contained in volume 1.

17. Key Words	18. Distribution Statement
Mode S DABS Transponder	Document is available to the U.S. public through the National Technical Information Service, Springfield, Virginia 22161

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	142	

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INTRODUCTION

This document contains the computerized data reduction results of flight tests conducted to demonstrate the compatibility of the Union of Soviet Socialist Republics (U.S.S.R) Mode S transponder to the United States (U.S.) Mode S system. The results of a U.S. Mode S transponder are included for comparative purposes.

DATA PRESENTATION

Flight plots, samples of the raw data listings used in the surveillance analysis, and plots and histograms of the accuracy analysis data are presented in a chronological order according to date and type of flight. Table 1 lists the order that the data are presented for the Soviet and U.S. transponders.

SURVEILLANCE DATA LISTINGS

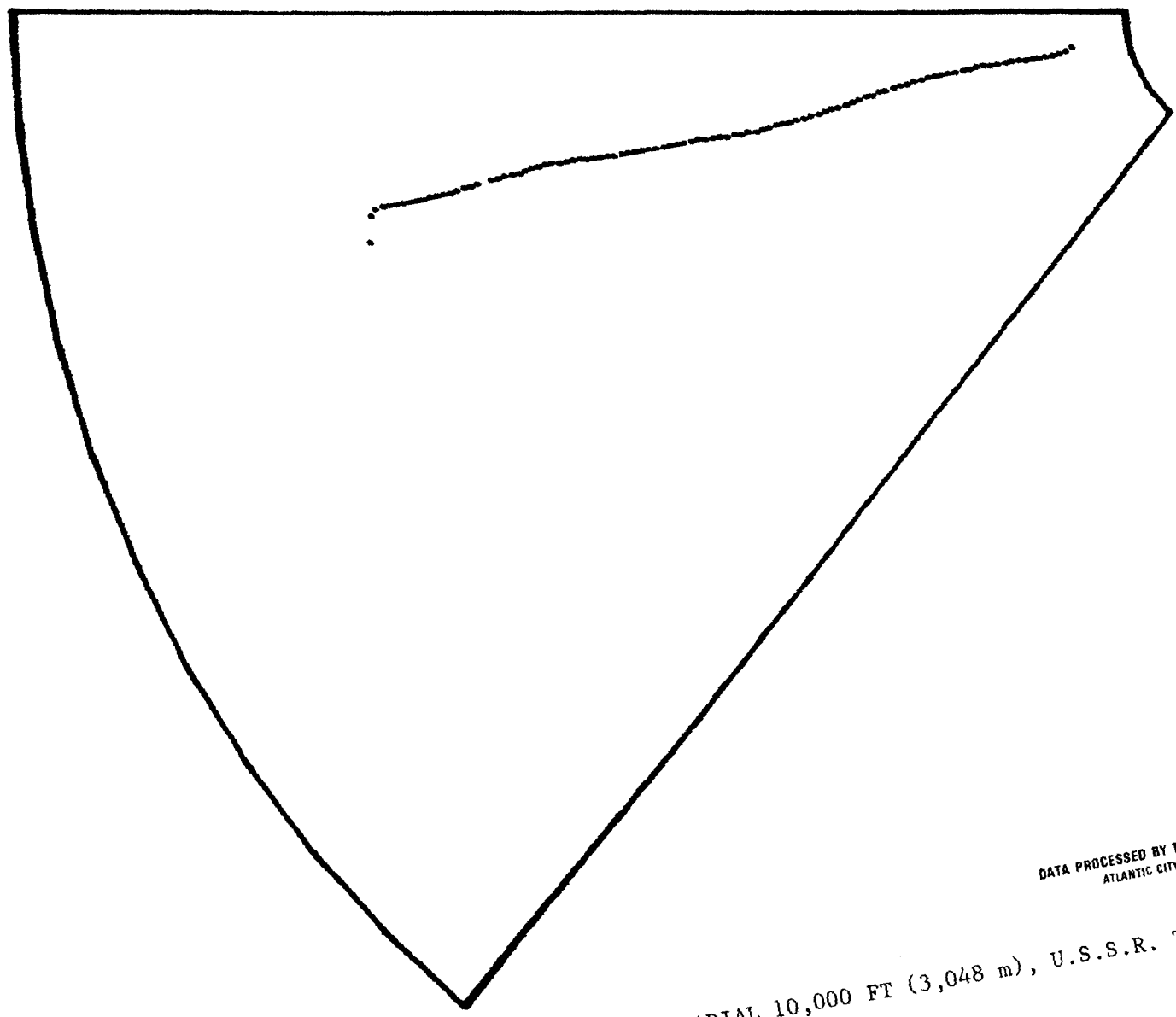
The raw data listings are interpreted from left to right beginning with the letter "D" representing a Mode S reply. The remaining data are listed in the following order: monopulse number, range in nautical miles (Note: This range is the value measured from the start of the Mode S sensor's range window, or earliest predicted range, and, therefore, is not the total range of the target), azimuth in degrees, the last two hexadecimal digits of the target's discrete address, message in hexadecimal, antenna face for optional front/back operation (1 = front, 2 = back), and the time of the reply in hours/minutes/seconds.

FLIGHT TEST DATA

OCTOBER 8, 1981

RADIAL

10,000 FT (3,048 m)



RANGE

005

***

050

AZIMUTH

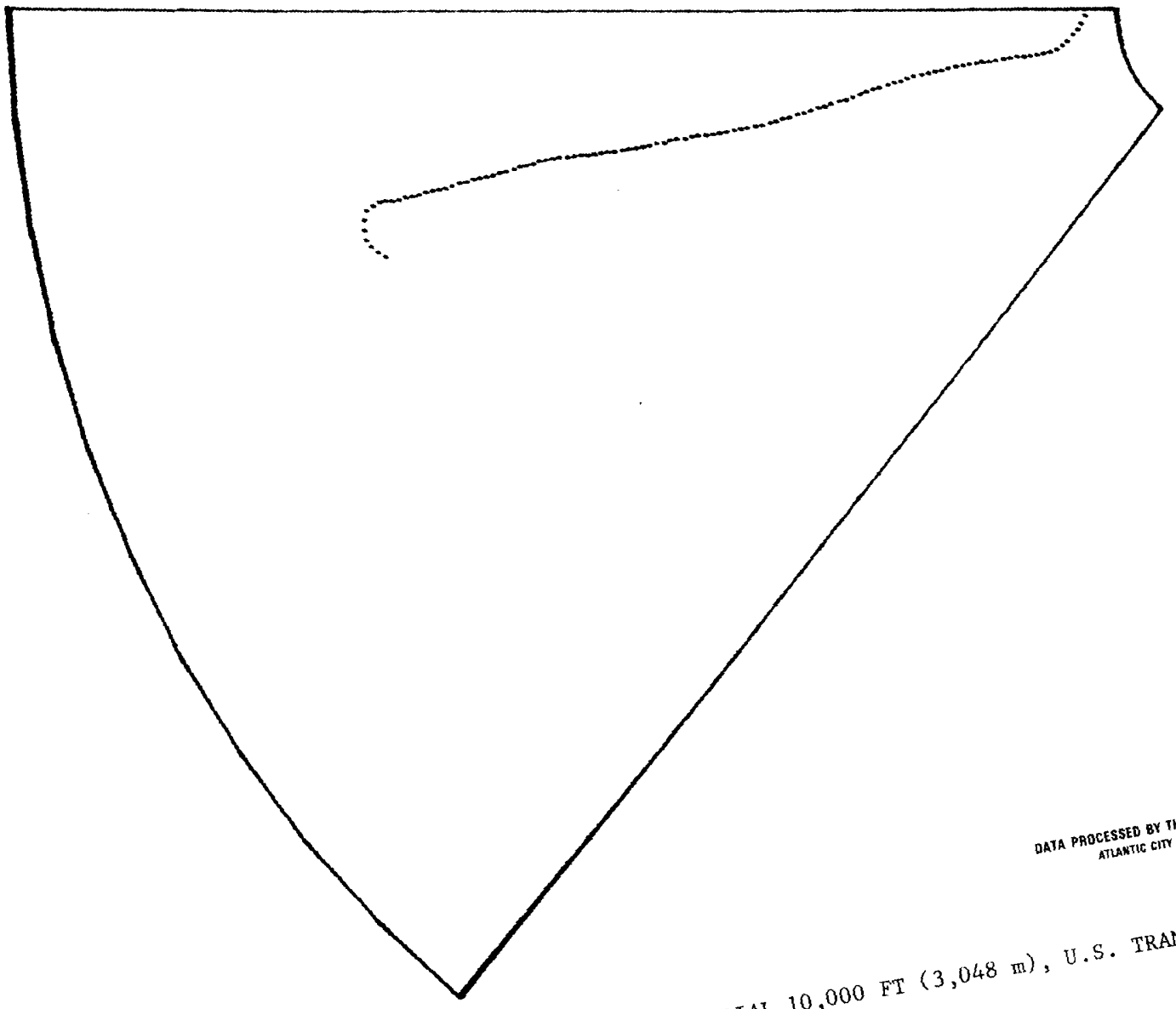
230

***

280

DATA PROCESSED BY THE FAA TECHNICAL CENTER
ATLANTIC CITY AIRPORT, N.J. 08405

OCTOBER 8, 1981, RADIAL 10,000 FT (3,048 m), U.S.S.R. TRANSPONDER



RANGE

005

***

050

AZIMUTH

230

***

280

DATA PROCESSED BY THE FAA TECHNICAL CENTER
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OCTOBER 8, 1981, RADIAL 10,000 FT (3,048 m), U.S. TRANSPONDER

```
  RECORD # 1643  SCAN #  135  FILE #   4
ATC##   RG      AZ     ID/CODE  AL/CF  FW1  FW2   IF#     TIME

 0    8    0.622 265.430      91    MESS=00009AB0  FC=3 A=1  14/32/49.4
 0   39    0.622 265.803      91    MESS=00009AB0  FC=0 A=1  14/32/49.4
SCAN #  1200  ATCRBS TRK =     12    DABS TRK =     4  50.63 14/32/50.6
 0   11    0.617 265.715      91    MESS=00009A90  FC=3 A=1  14/32/54.1
 0   39    0.617 265.913      91    MESS=00009A90  FC=0 A=1  14/32/54.1
SCAN #  1201  ATCRBS TRK =     13    DABS TRK =     4  55.33 14/32/55.5
 0   39    0.597 266.484      91    MESS=00009A90  FC=0 A=1  14/32/58.8
SCAN #  1202  ATCRBS TRK =     11    DABS TRK =     4   0.02 14/33/ 0.0
 0    0    0.617 266.353      91    MESS=00009A90  FC=3 A=1  14/33/ 3.5
 0   35    0.612 266.594      91    MESS=00009A90  FC=0 A=1  14/33/ 3.5
SCAN #  1203  ATCRBS TRK =     12    DABS TRK =     4   4.72 14/33/ 4.8
 0   28    0.622 266.704      91    MESS=00009A90  FC=0 A=1  14/33/ 8.2
SCAN #  1204  ATCRBS TRK =     13    DABS TRK =     4   9.41 14/33/ 9.4
 0    0    0.597 266.836      91    MESS=00009A90  FC=3 A=1  14/33/12.9
 0   29    0.607 267.055      91    MESS=00009A90  FC=0 A=1  14/33/12.9
SCAN #  1205  ATCRBS TRK =     14    DABS TRK =     4  14.10 14/33/14.3
 0   37    0.602 267.385      91    MESS=00009A90  FC=0 A=1  14/33/17.6
SCAN #  1206  ATCRBS TRK =     14    DABS TRK =     4  18.80 14/33/18.9
 0   39    0.612 267.539      91    MESS=00009A90  FC=0 A=1  14/33/22.3
SCAN #  1207  ATCRBS TRK =     14    DABS TRK =     4  23.50 14/33/23.5
 0    0    0.612 267.188      91    MESS=00009A90  FC=3 A=1  14/33/26.9
 0    9    0.612 267.407      91    MESS=00009A90  FC=3 A=1  14/33/26.9
 0   35    0.612 267.583      91    MESS=00009A90  FC=0 A=1  14/33/26.9
SCAN #  1208  ATCRBS TRK =     13    DABS TRK =     4  28.19 14/33/28.2
 0   42    0.612 267.935      91    MESS=00009AB0  FC=0 A=1  14/33/31.6
SCAN #  1209  ATCRBS TRK =     13    DABS TRK =     4  32.88 14/33/33.0
 0   11    0.612 267.385      91    MESS=00009AB0  FC=3 A=1  14/33/36.3
 0    0    0.617 267.561      91    MESS=00009AB0  FC=3 A=1  14/33/36.3
 0   43    0.617 267.979      91    MESS=00009AB0  FC=0 A=1  14/33/36.3
SCAN #  1210  ATCRBS TRK =     13    DABS TRK =     4  37.56 14/33/37.6
 0   34    0.602 267.891      91    MESS=00009A90  FC=0 A=1  14/33/41.0
SCAN #  1211  ATCRBS TRK =     13    DABS TRK =     4  42.25 14/33/42.3
 0    0    0.612 267.627      91    MESS=00009A90  FC=3 A=1  14/33/45.7
 0    0    0.612 267.803      91    MESS=00009A90  FC=3 A=1  14/33/45.7
 0   41    0.612 268.220      91    MESS=00009A90  FC=0 A=1  14/33/45.7
SCAN #  1212  ATCRBS TRK =     13    DABS TRK =     4  46.95 14/33/47.1
 0   33    0.622 268.110      91    MESS=00009A90  FC=0 A=1  14/33/50.4
SCAN #  1213  ATCRBS TRK =     13    DABS TRK =     4  51.63 14/33/51.7
 0    0    0.607 268.000      91    MESS=00009A90  FC=3 A=1  14/33/55.1
 0   28    0.607 268.198      91    MESS=00009A90  FC=0 A=1  14/33/55.1
SCAN #  1214  ATCRBS TRK =     12    DABS TRK =     4  56.32 14/33/56.3
 0   11    0.602 268.198      91    MESS=00009A90  FC=3 A=1  14/33/59.8
 0   31    0.602 268.418      91    MESS=00009A90  FC=0 A=1  14/33/59.8
SCAN #  1215  ATCRBS TRK =     12    DABS TRK =     4   1.02 14/34/ 1.2
 0    0    0.617 268.154      91    MESS=00009A90  FC=3 A=1  14/34/ 4.5
 0   25    0.617 268.352      91    MESS=00009A90  FC=0 A=1  14/34/ 4.5
SCAN #  1216  ATCRBS TRK =     12    DABS TRK =     4   5.71 14/34/ 5.8
 0   30    0.597 268.594      91    MESS=00009AB0  FC=0 A=1  14/34/ 9.2
SCAN #  1217  ATCRBS TRK =     13    DABS TRK =     4  10.41 14/34/10.5
 0   11    0.612 268.154      91    MESS=00009AB0  FC=3 A=1  14/34/13.9
 0   11    0.612 268.352      91    MESS=00009A00  FC=3 A=1  14/34/13.9
```

DATA PROCESSED BY THE FAA TECHNICAL CENTER
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SAMPLE LISTING OF U.S. REPLIES FOR OCTOBER 8, 1981, RADIAL

AZIMUTH DIFF -DEG

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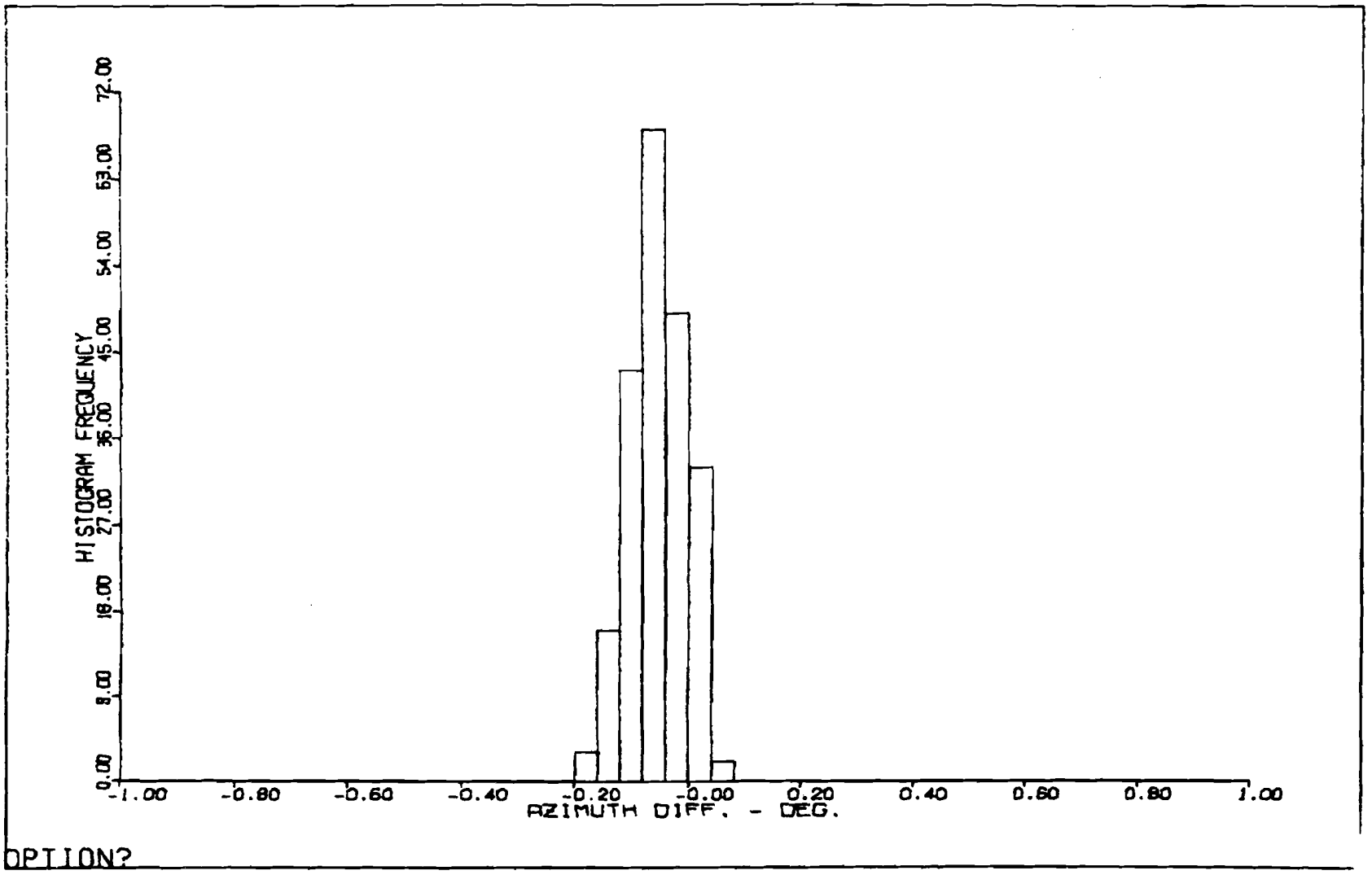
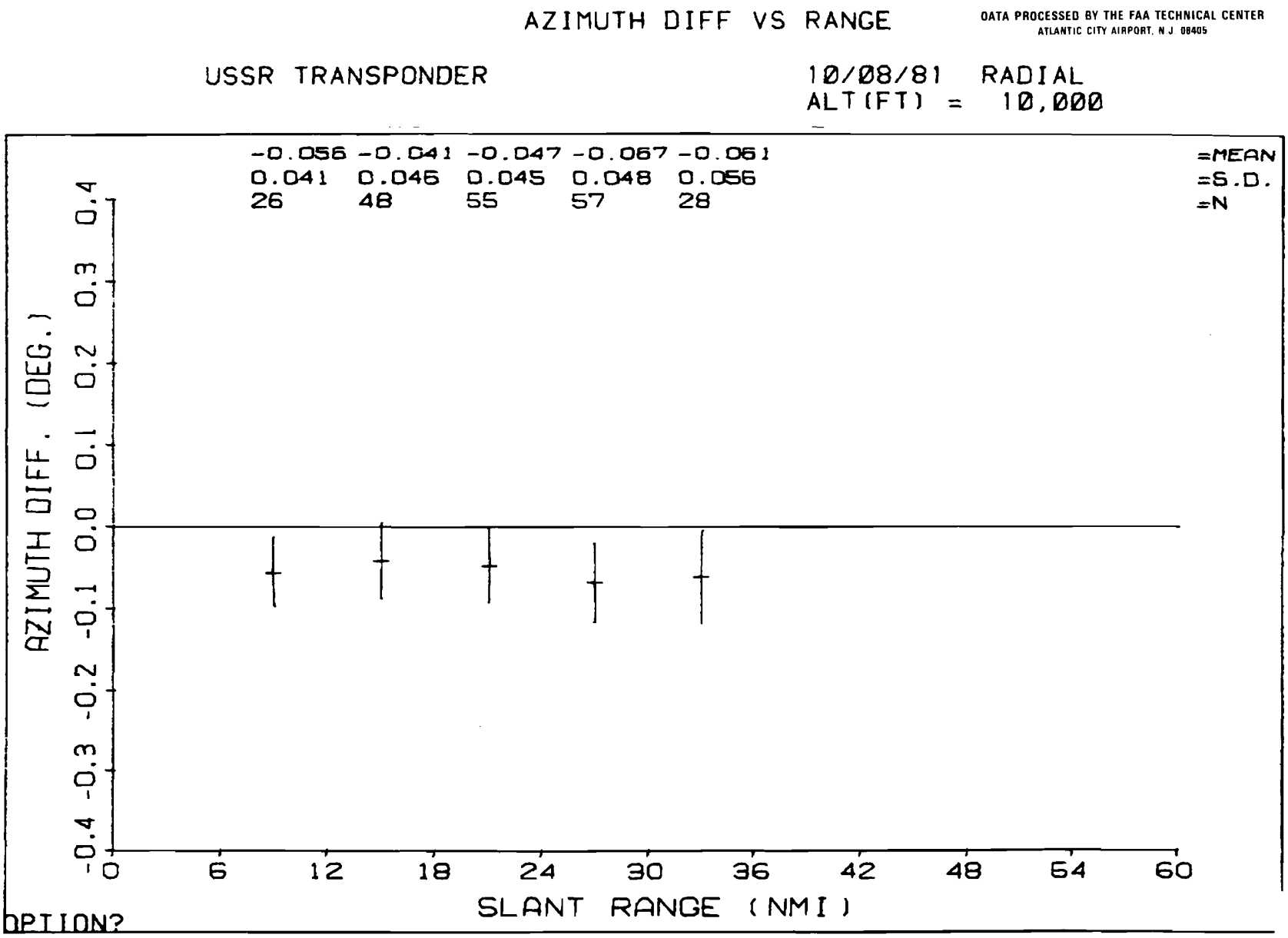
USSR TRANSPONDER
10/08/81 RADIAL
ALT(FT) = 10,000

MEAN = -0.054
STD DEV = 0.048
NO SAMPLES = 214



OPTION?

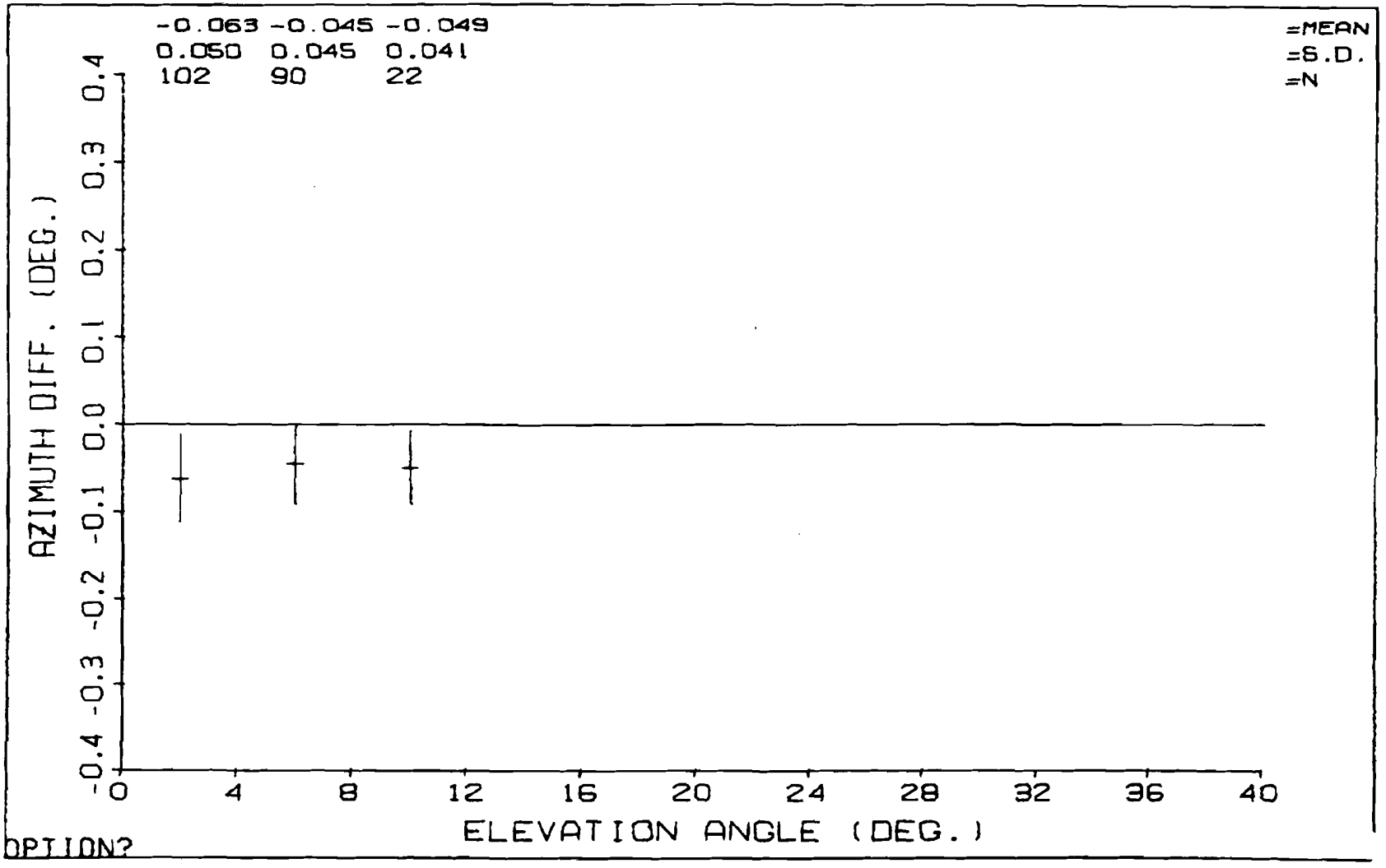

AZIMUTH DIFF VS RANGE
DATA PROCESSED BY THE FAA TECHNICAL CENTER
ATLANTIC CITY AIRPORT, N.J. 08405
USSR TRANSPONDER
10/08/81 RADIAL
ALT(FT) = 10,000
-0.056 -0.041 -0.047 -0.067 -0.061 =MEAN
0.041 0.046 0.045 0.048 0.056 =S.D.
26 48 55 57 28 =N
AZIMUTH DIFF. (DEG.)
0.4 0.3 0.2 0.1 0.0 -0.1 -0.2 -0.3 -0.4
0 6 12 18 24 30 36 42 48 54 60
SLANT RANGE (NMI)
OPTION?

AZIMUTH DIFF VS ELEVATION ANGLE

DATA PROCESSED BY THE FAA TECHNICAL CENTER
ATLANTIC CITY AIRPORT, N.J. 08405

USSR TRANSPONDER

10/08/81 RADIAL
ALT(FT) = 10,000

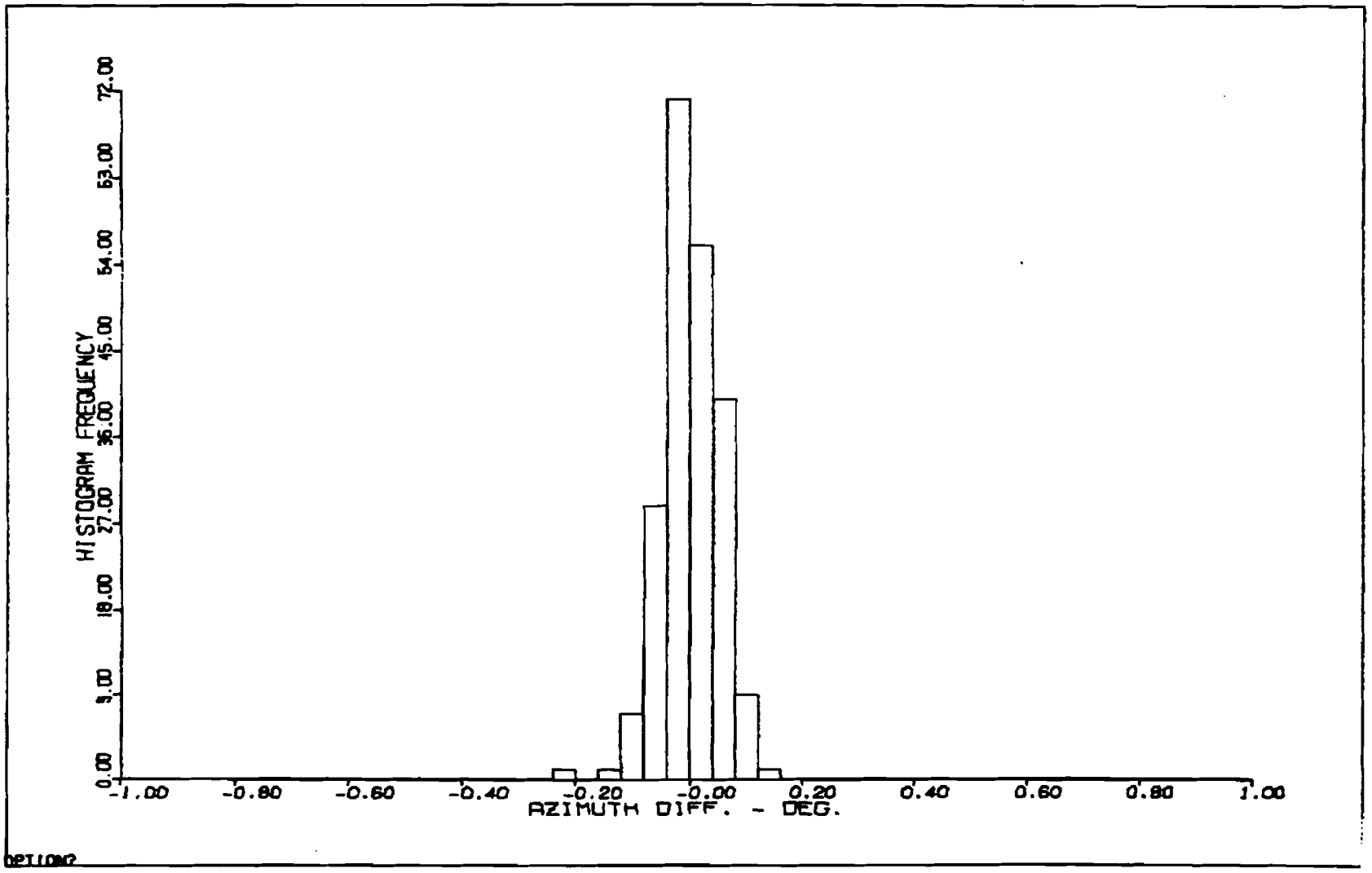


AZIMUTH DIFF. - DEG.

DATA PROCESSED BY THE FAA TECHNICAL CENTER
ATLANTIC CITY AIRPORT, N.J. 08405

USA TRANSPONDER
10/08/81 RADIAL
ALT(FT) = 10000

MEAN = 0.002
STD DEV = 0.050
NO SAMPLES = 215

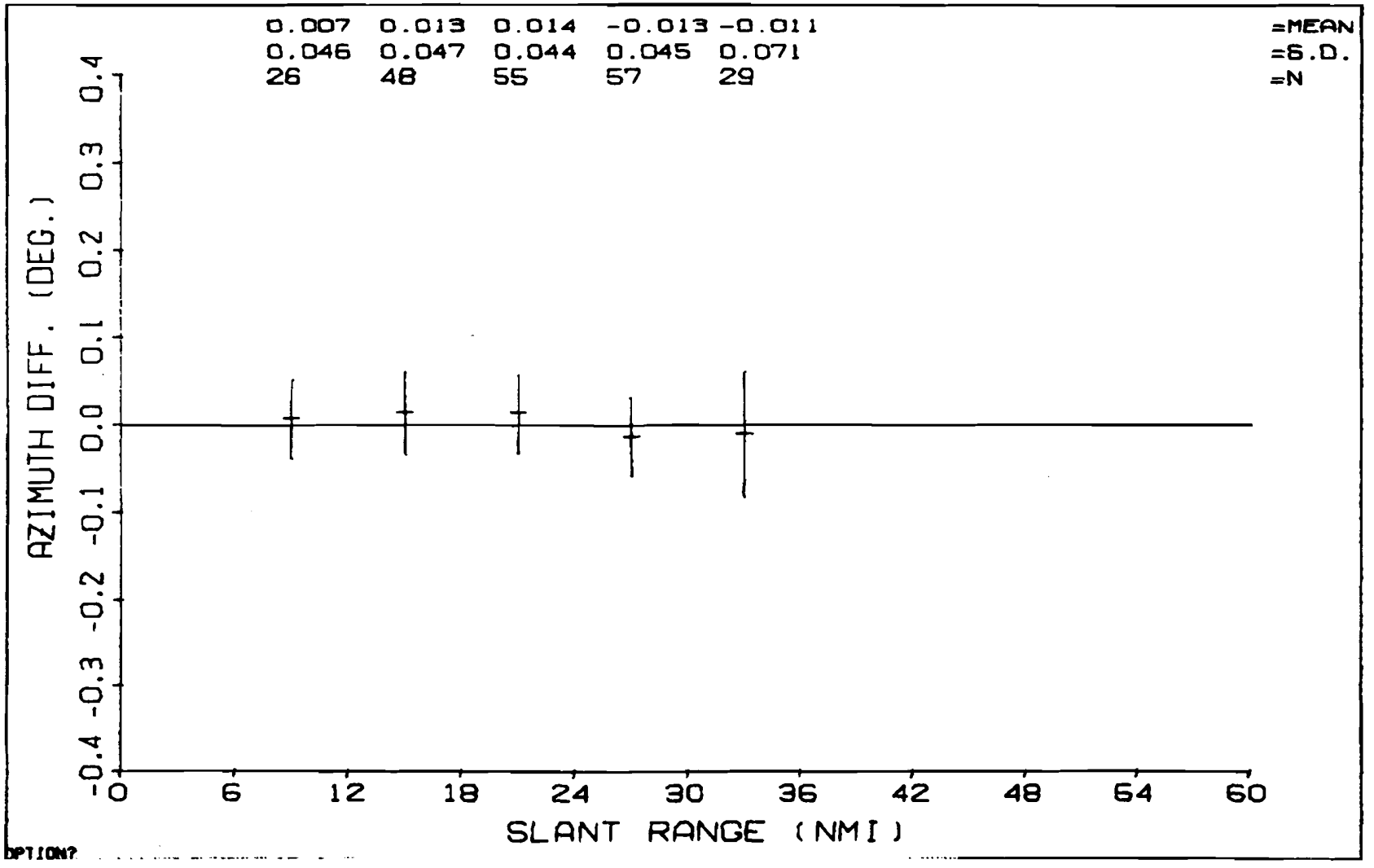


DATA PROCESSED BY THE FAA TECHNICAL CENTER
ATLANTIC CITY AIRPORT, N.J. 08405

AZIMUTH DIFF VS. RANGE

USA TRANSPONDER 10/08/81

ALT(FT): 10,000

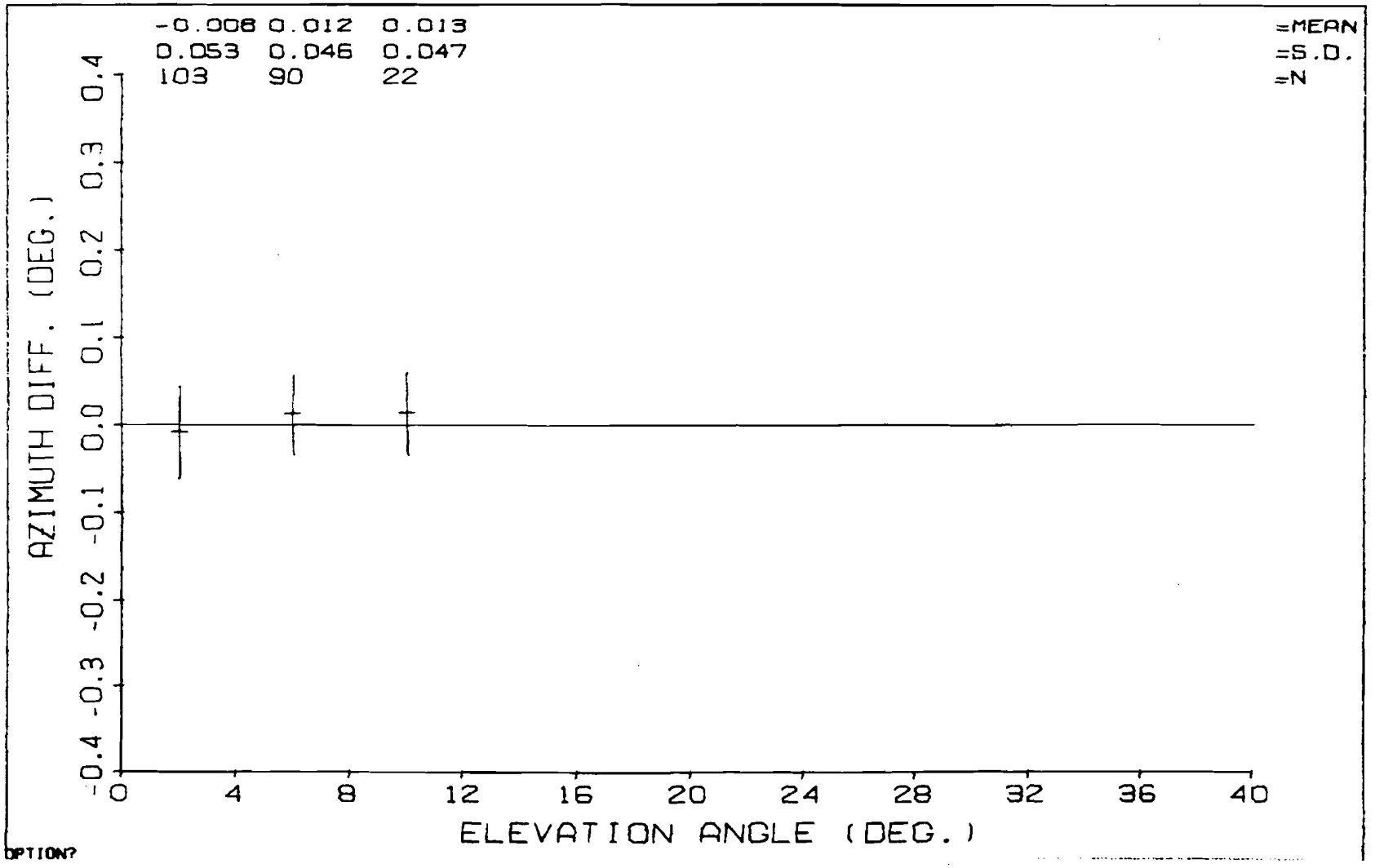


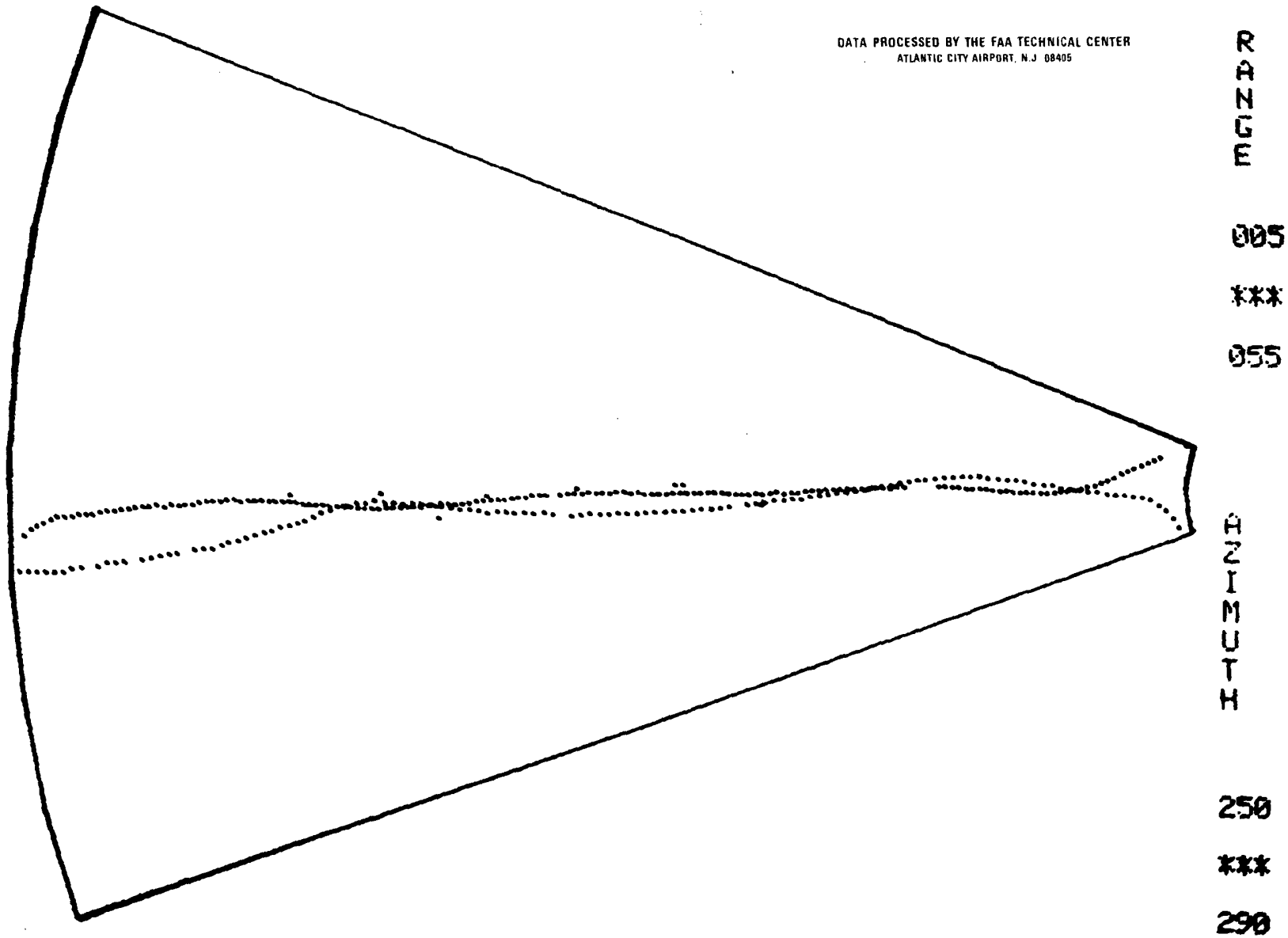
AZIMUTH DIFF VS. ELEVATION ANGLE

DATA PROCESSED BY THE FAA TECHNICAL CENTER
ATLANTIC CITY AIRPORT, N.J. 08405

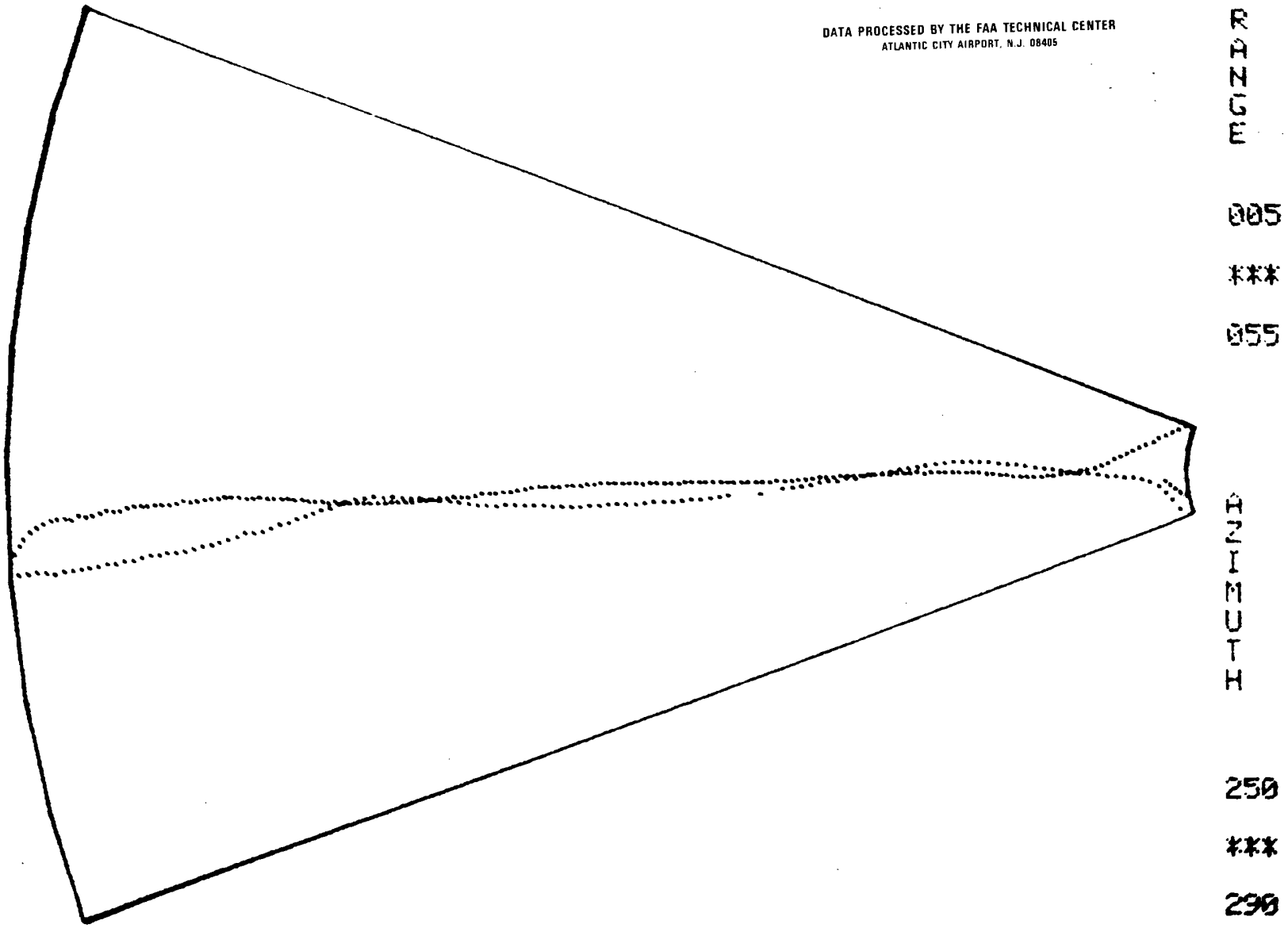
USA TRANSPONDER 10/08/81

ALT(FT): 10,000





OCTOBER 9, 1981, RADIAL 15,000 FT (4,572 m), U.S.S.R. TRANSPONDER



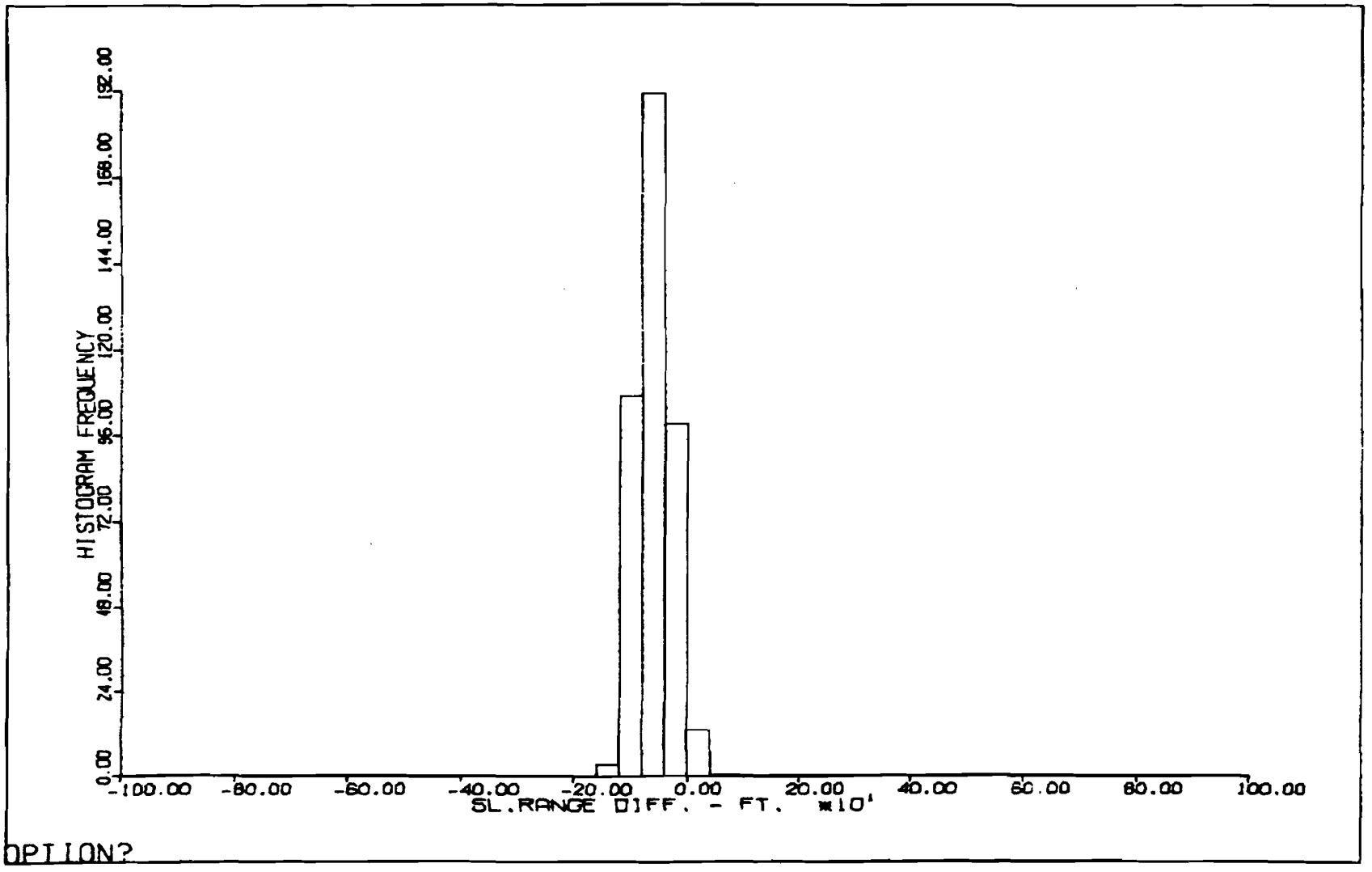
OCTOBER 9, 1981, RADIAL 15,000 FT (4,572 m), U.S. TRANSPONDER

DATA PROCESSED BY THE FAA TECHNICAL CENTER
ATLANTIC CITY AIRPORT, N.J. 08405

SLANT RANGE DIFF - FT

USSR TRANSPONDER
10/09/81 RADIAL
ALT(FT) = 15,000

MEAN = -58.62
STD DEV = 31.18
NO SAMPLES = 413



OPTION?

RANGE DIFF VS ELEVATION ANGLE

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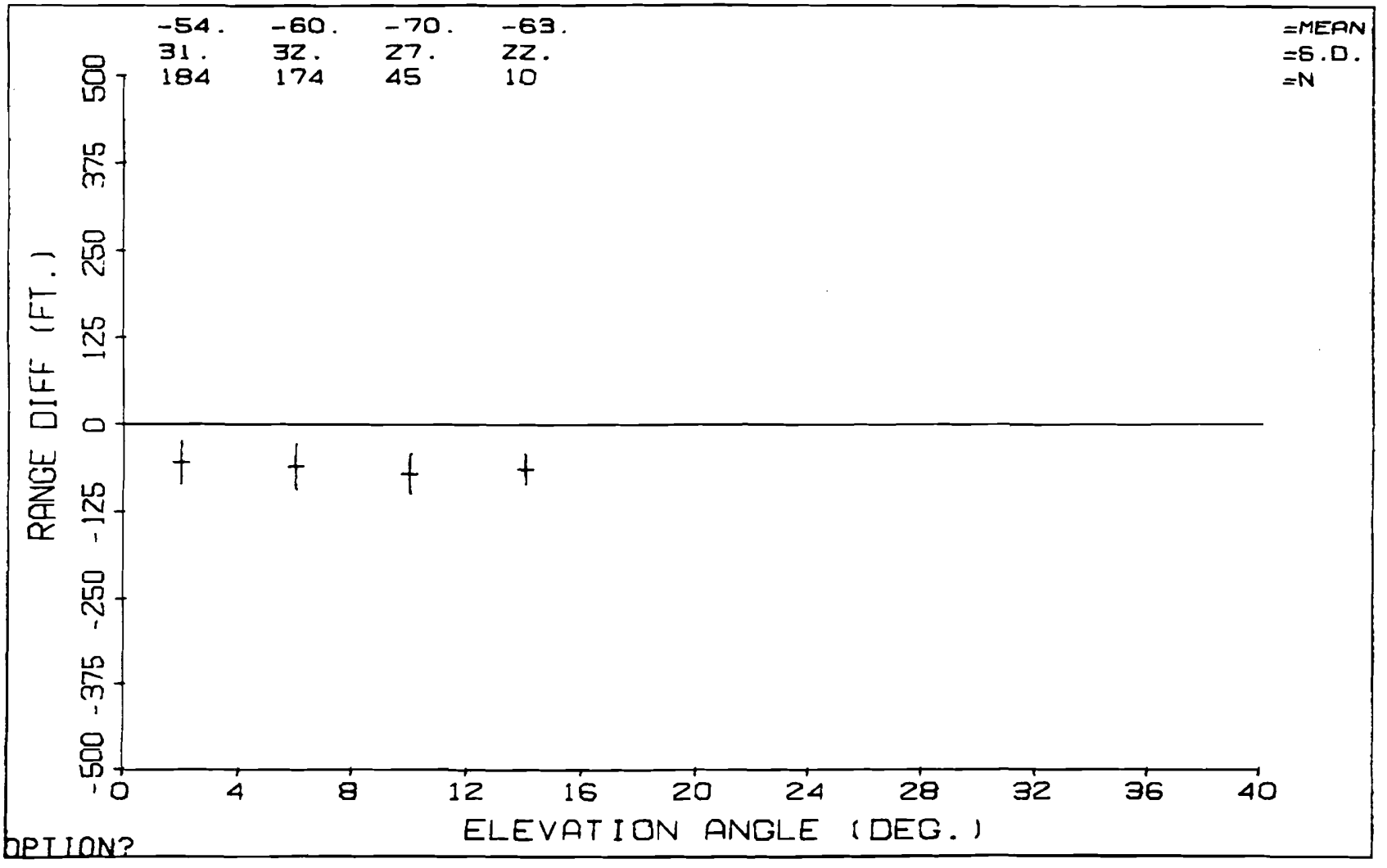
USSR TRANSPONDER

10/09/81 RADIAL
ALT(FT) = 15,000

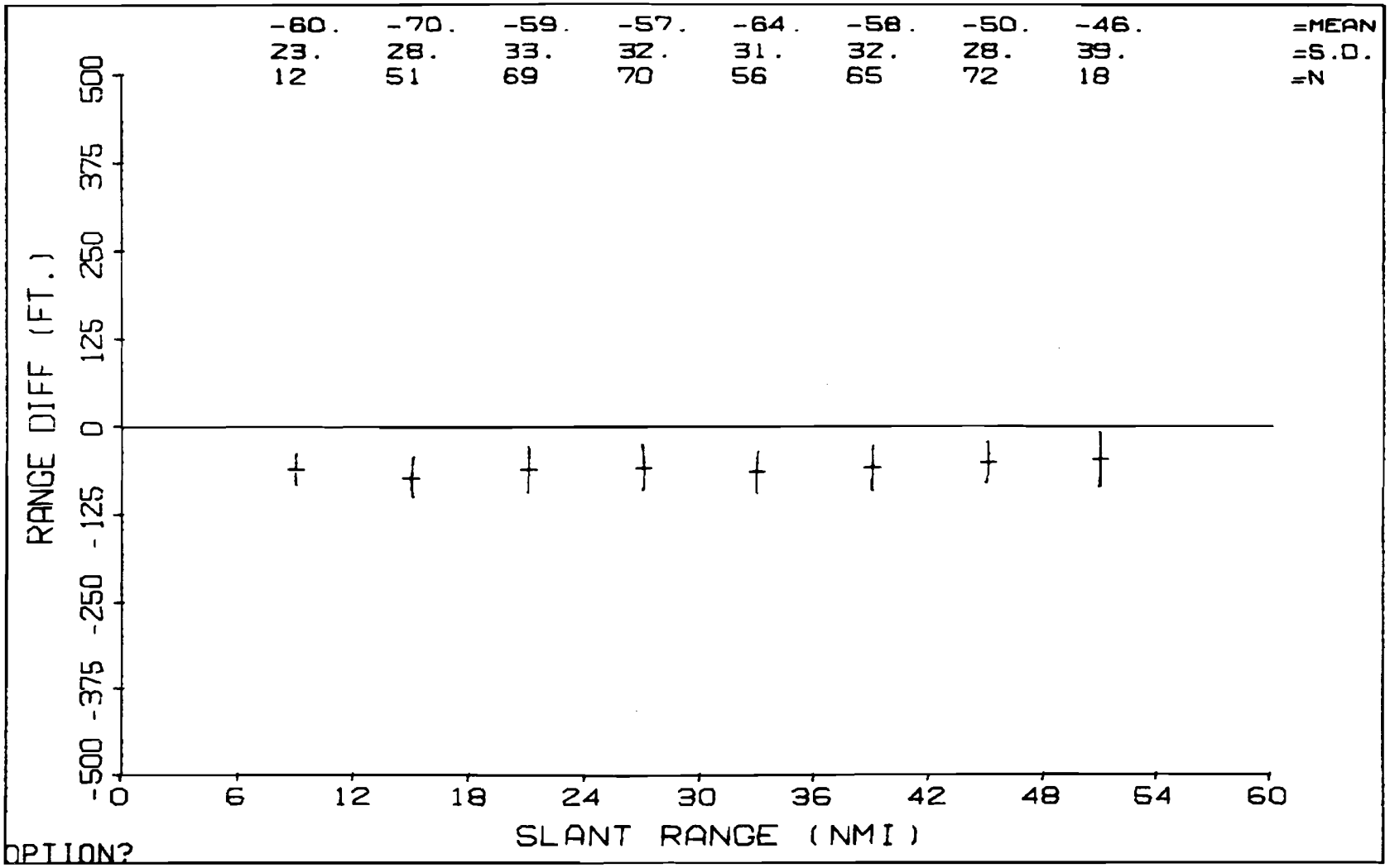


RANGE DIFF VS RANGE

DATA PROCESSED BY THE FAA TECHNICAL CENTER
ATLANTIC CITY AIRPORT, N.J. 08405

USSR TRANSPONDER

10/09/81 RADIAL
ALT(FT) = 15,000

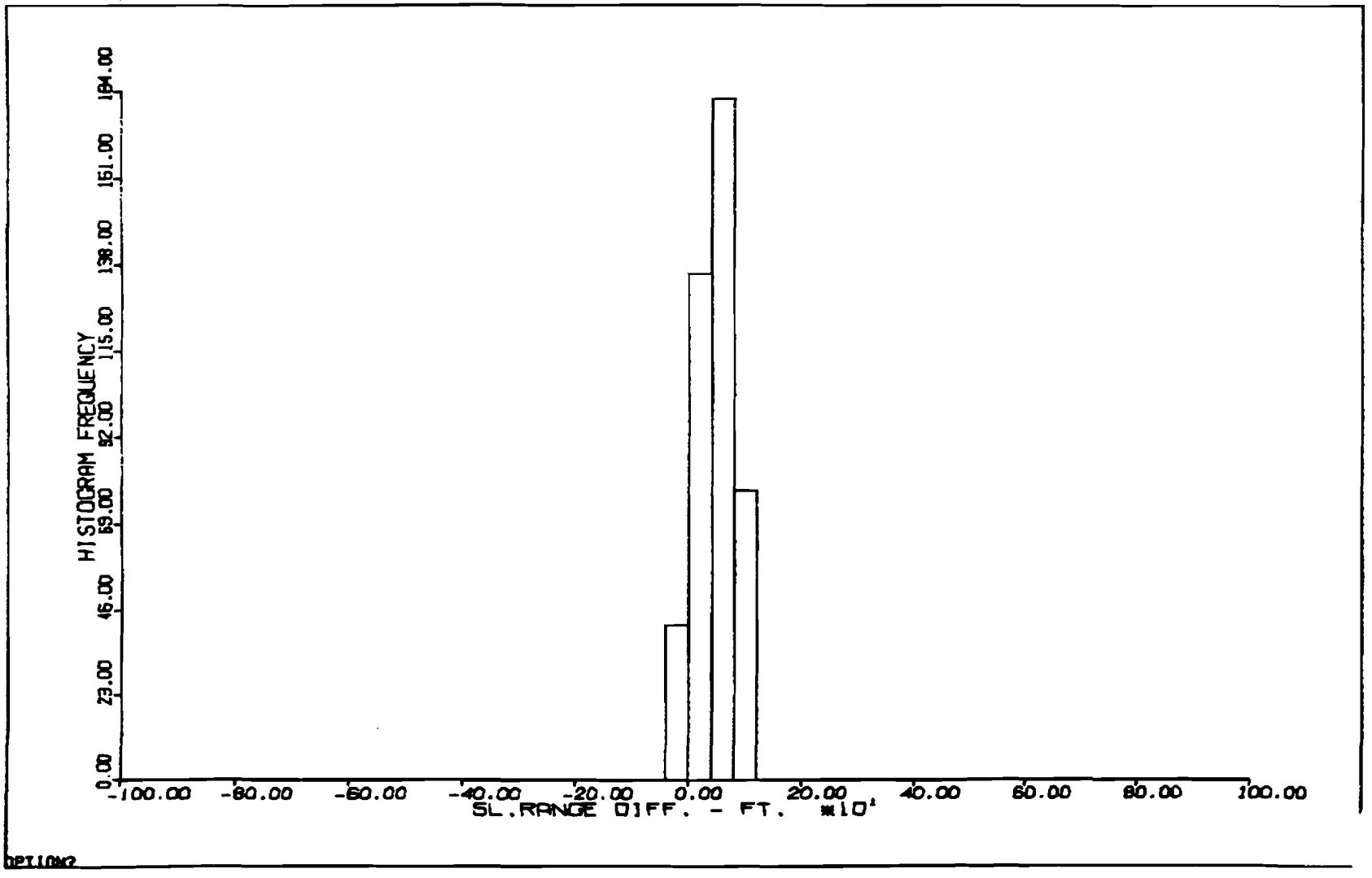


SLANT RANGE DIFF. - FT.

DATA PROCESSED BY THE FAA TECHNICAL CENTER
ATLANTIC CITY AIRPORT, N.J. 08405

USA TRANSPONDER
10/09/81 RADIAL FLIGHT
ALT(FT) = 15000

MEAN = 46.527
STD DEV = 32.717
NO SAMPLES = 437

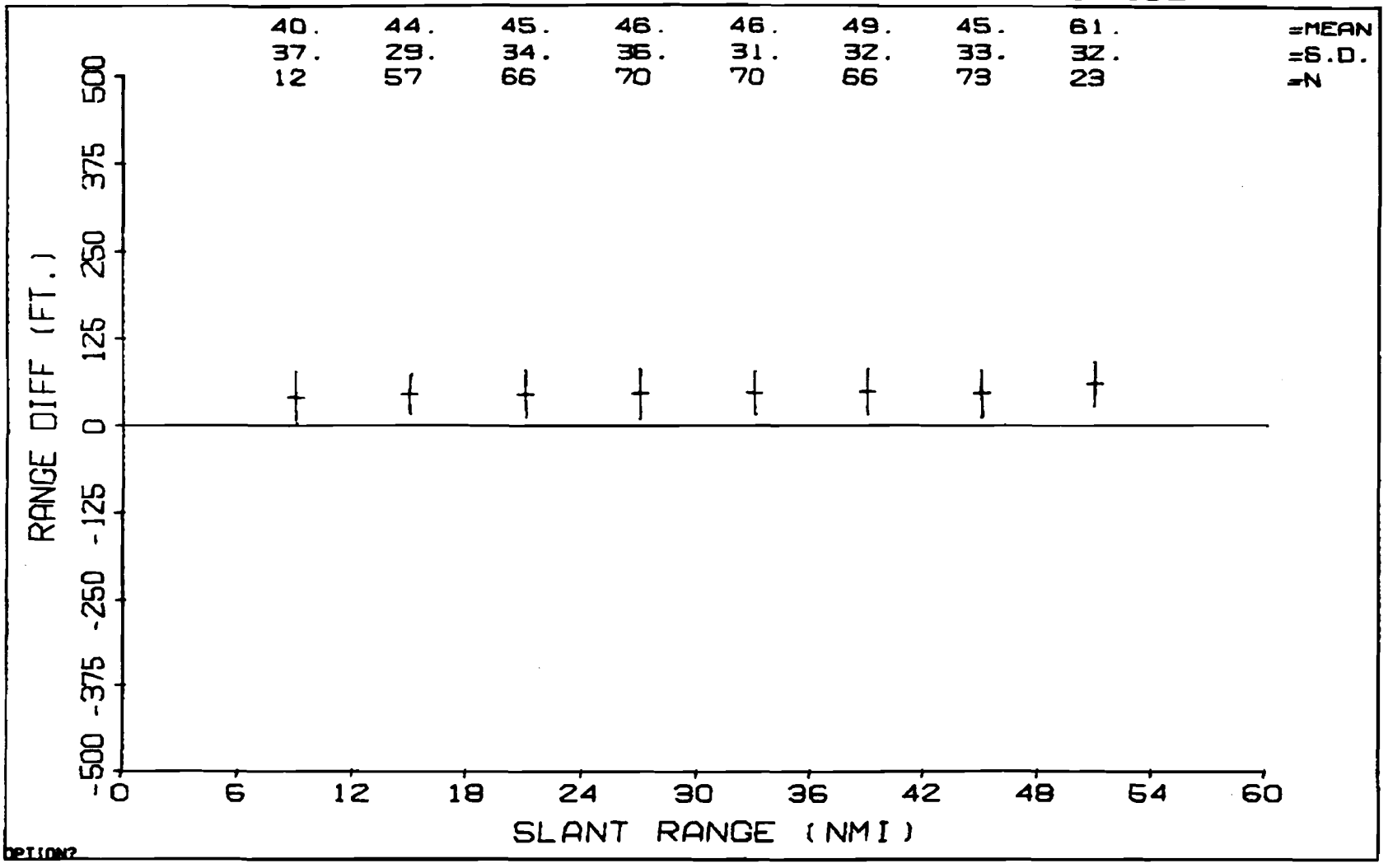


RANGE DIFF VS. RANGE

DATA PROCESSED BY THE FAA TECHNICAL CENTER
ATLANTIC CITY AIRPORT, N.J. 08405

USA TRANSPONDER 10/09/81

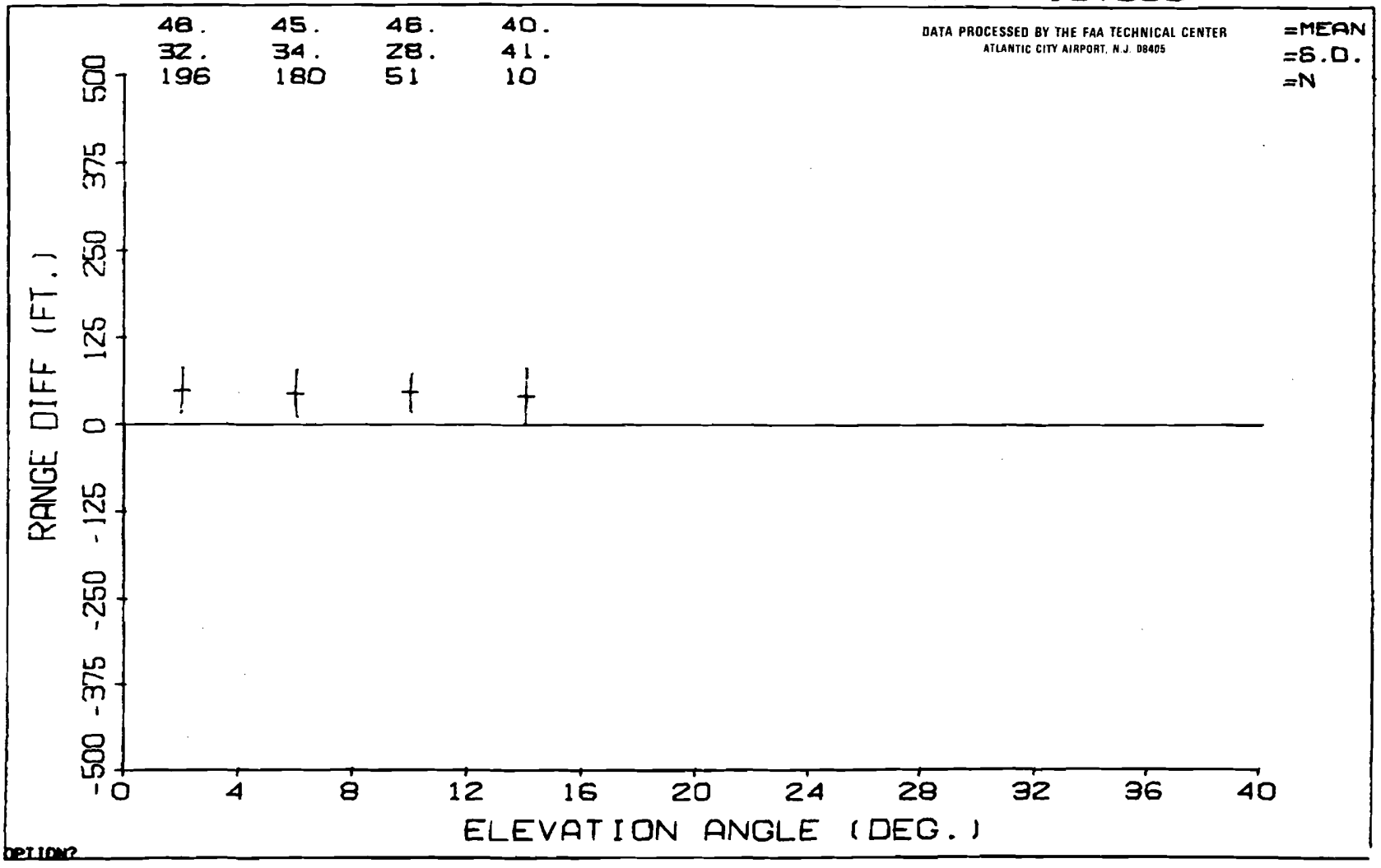
ALT(FT): 15,000



RANGE DIFF VS. ELEVATION ANGLE

USA TRANSPONDER 10/09/81

ALT(FT): 15,000

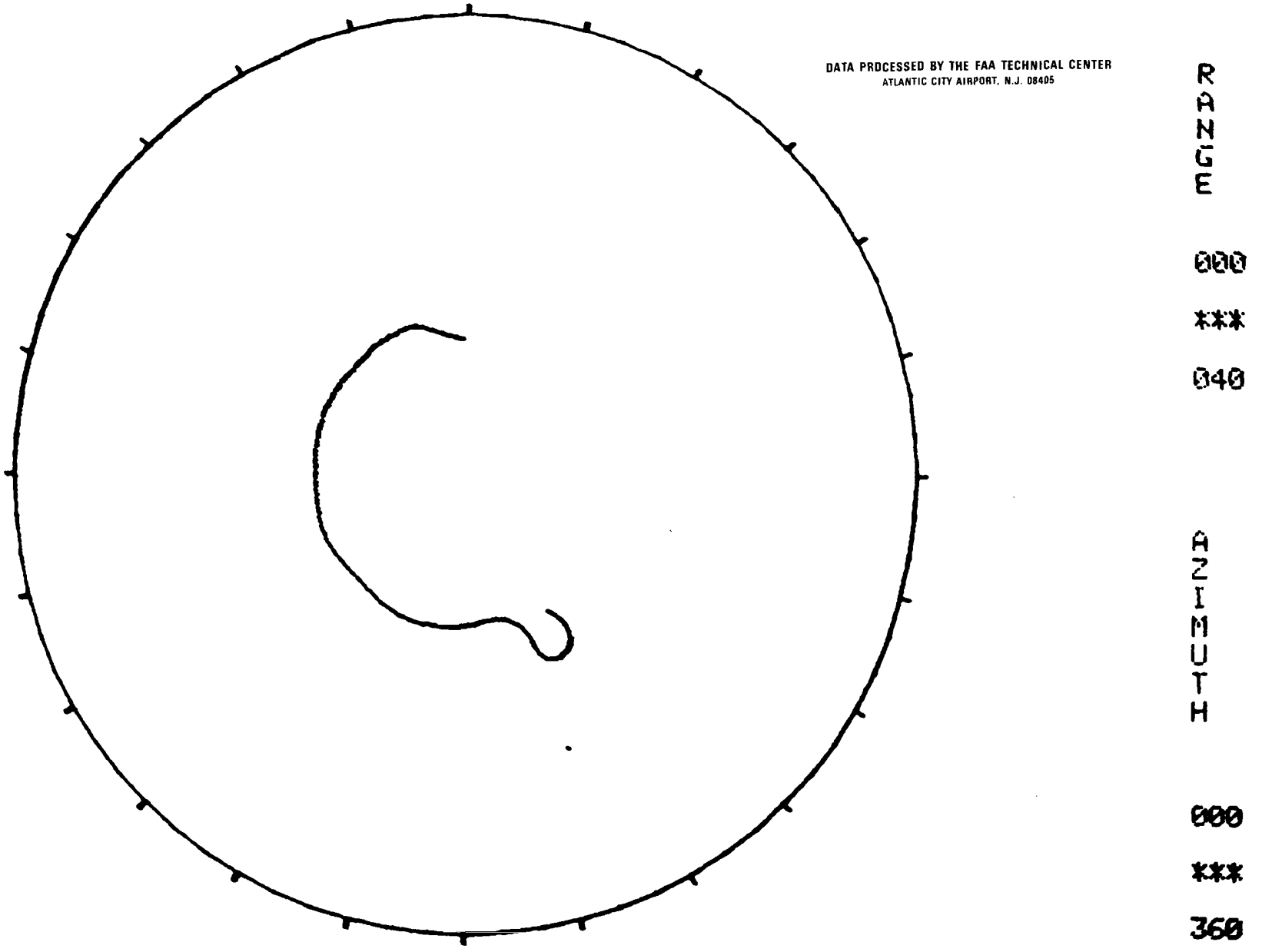


FLIGHT TEST DATA

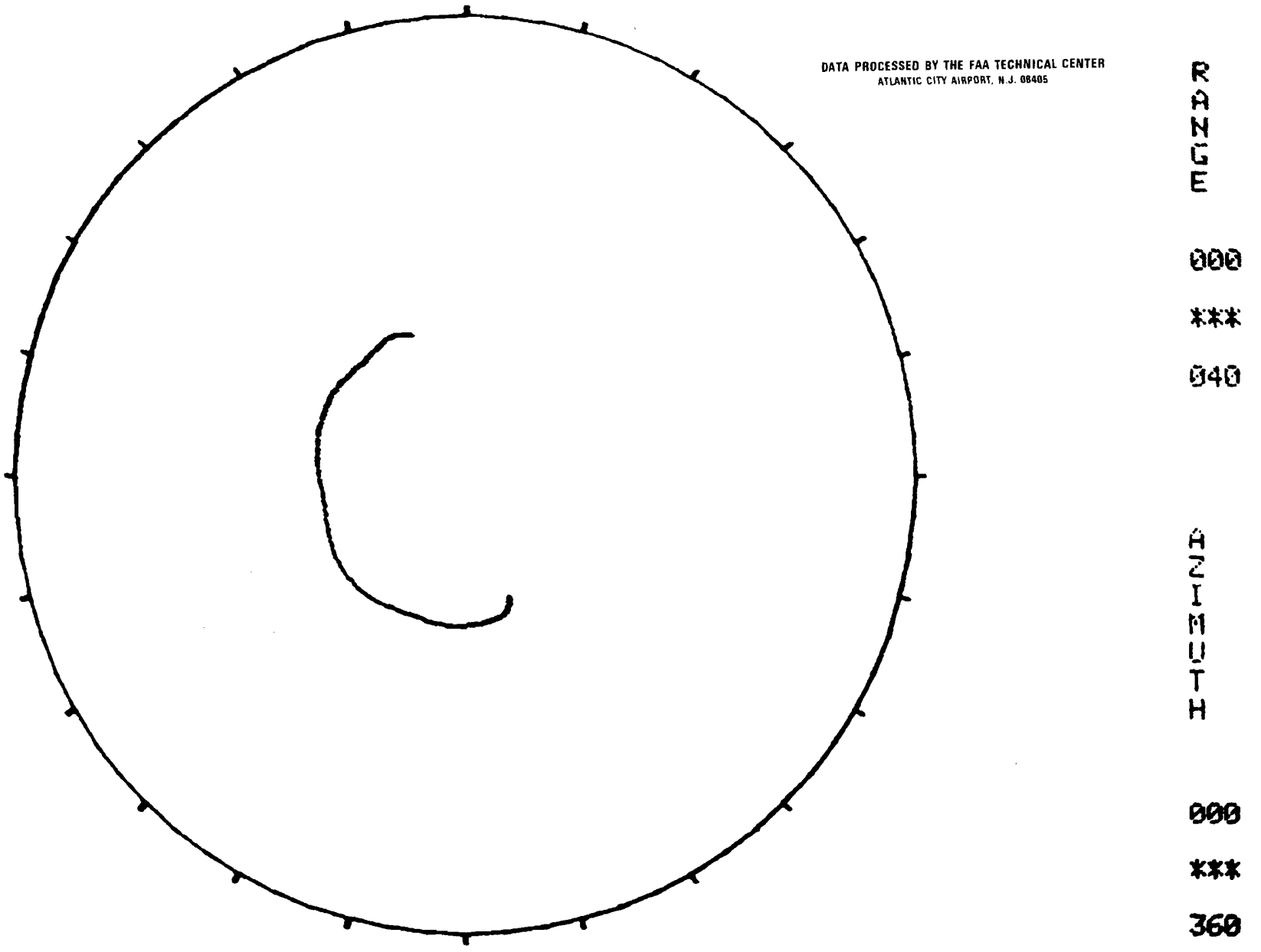
OCTOBER 9, 1981

ORBITAL

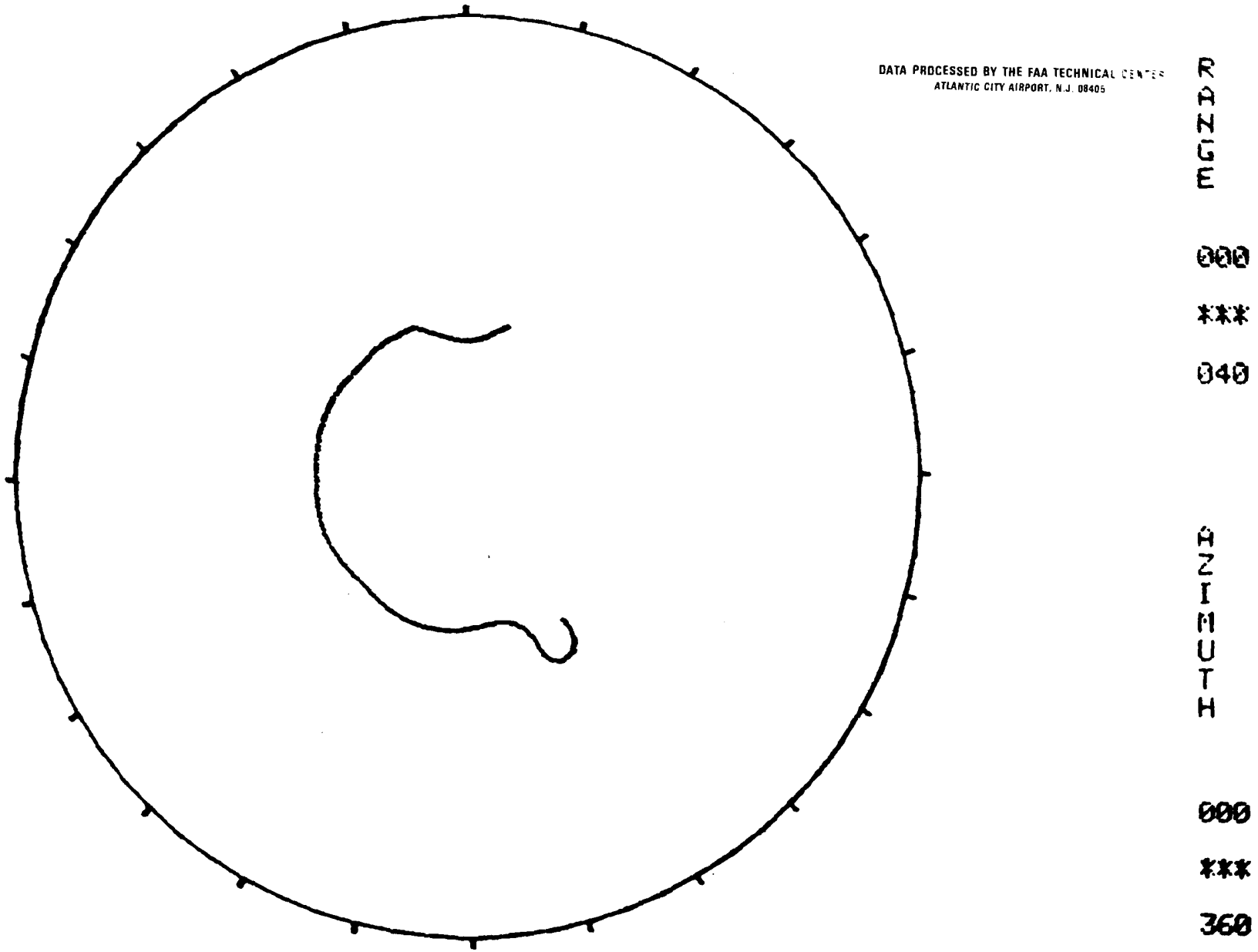
12,000 FT (3,658 m)



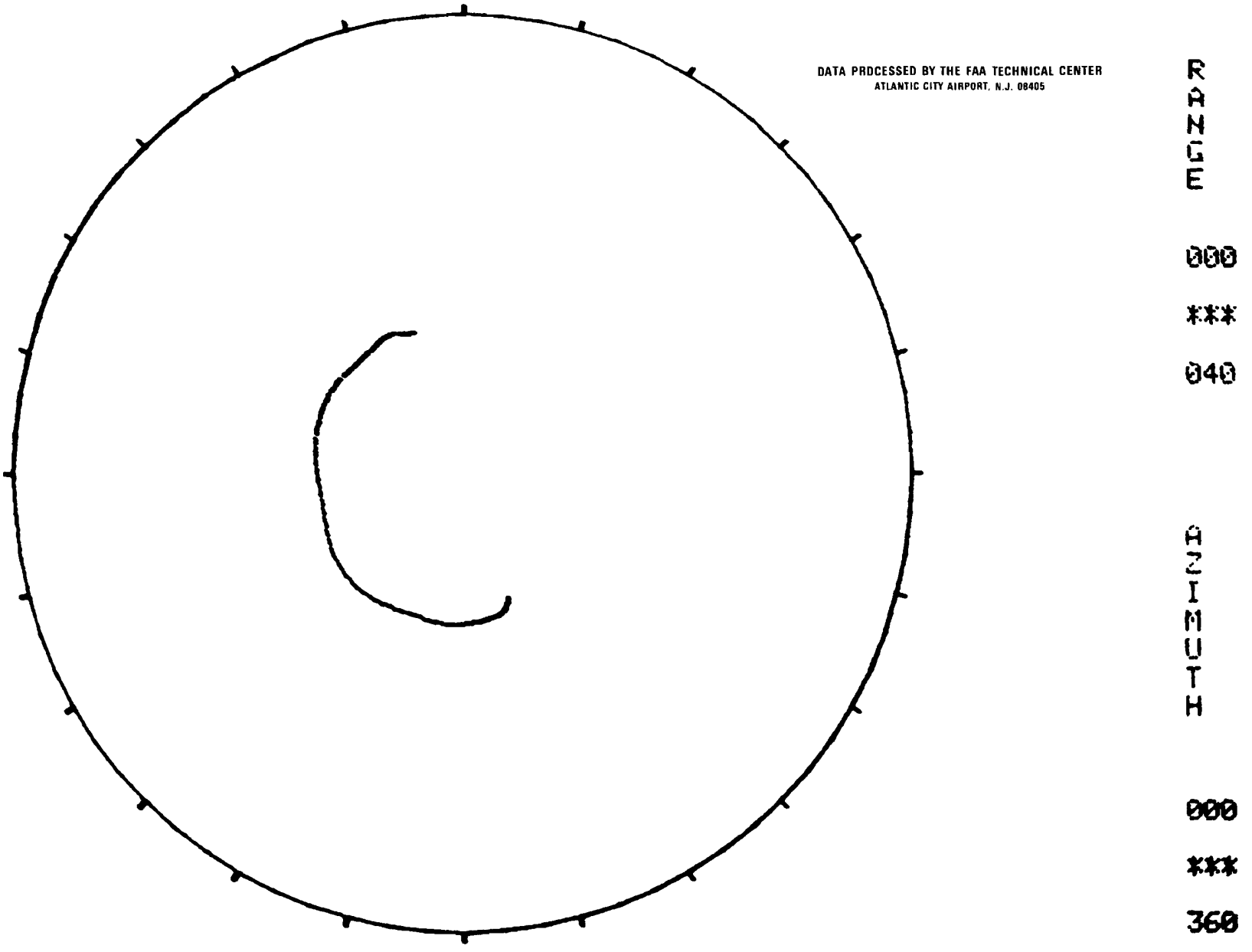
OCTOBER 9, 1981, ORBITAL 12,000 FT (3,658 m), U.S.S.R. TRANSPONDER



OCTOBER 9, 1981, ORBITAL 12,000 FT (3,658 m), U.S.S.R. TRANSPONDER



OCTOBER 9, 1981, ORBITAL 12,000 FT (3,658 m), U.S. TRANSPONDER



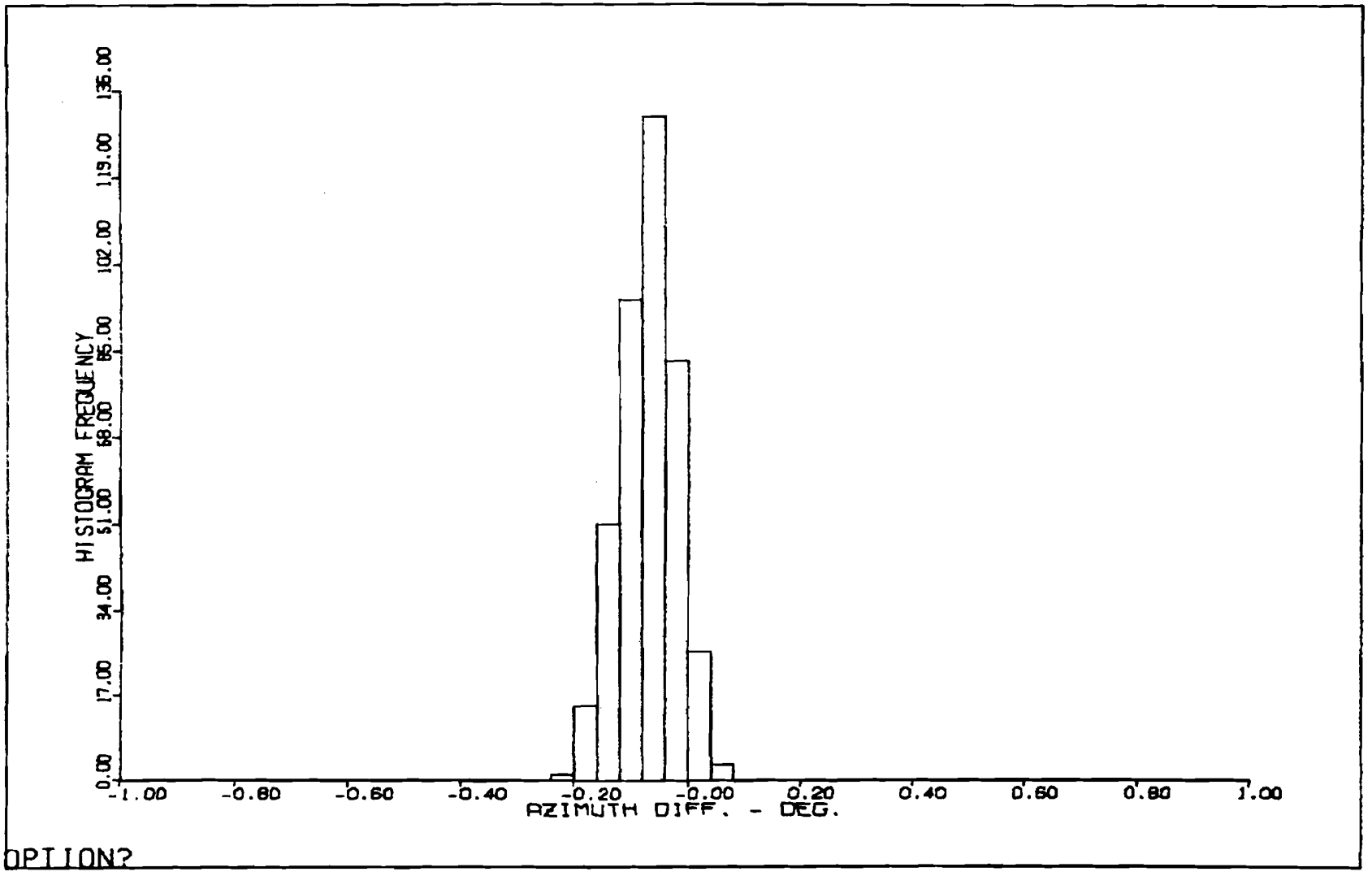
OCTOBER 9, 1981, ORBITAL 12,000 FT (3,658 m), U.S. TRANSPONDER

AZIMUTH DIFF - DEG

DATA PROCESSED BY THE FAA TECHNICAL CENTER
ATLANTIC CITY AIRPORT, N.J. 08405

USSR TRANSPONDER
10/09/81 ORBITAL
ALT(FT) = 12,000

MEAN = -0.07
STD DEV = 0.05
NO SAMPLES = 405



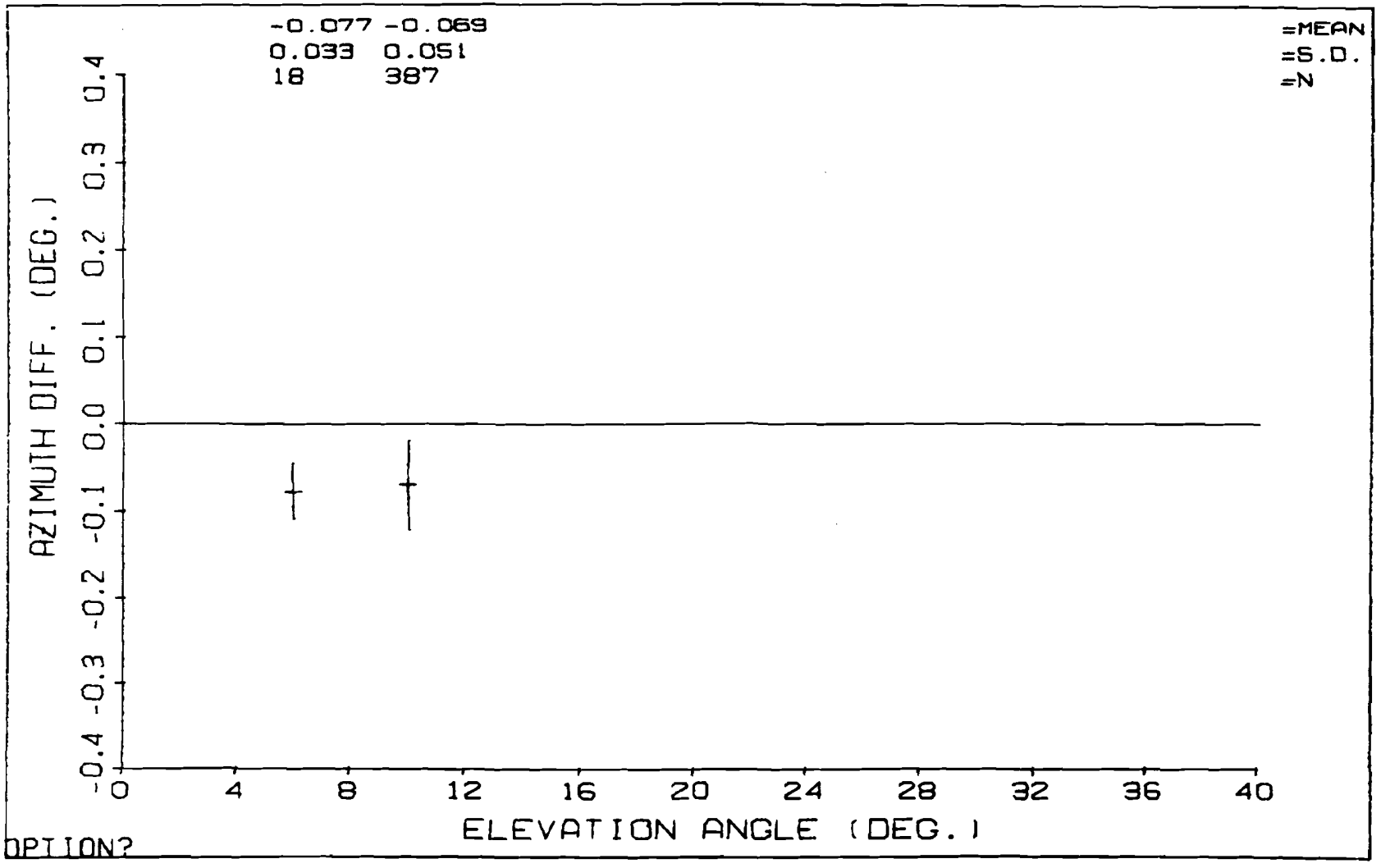
OPTION?

AZIMUTH DIFF VS ELEVATION ANGLE

DATA PROCESSED BY THE FAA TECHNICAL CENTER
ATLANTIC CITY AIRPORT, N.J. 08405

USSR TRANSPONDER

10/09/81 ORBITAL
ALT(FT) = 12,000



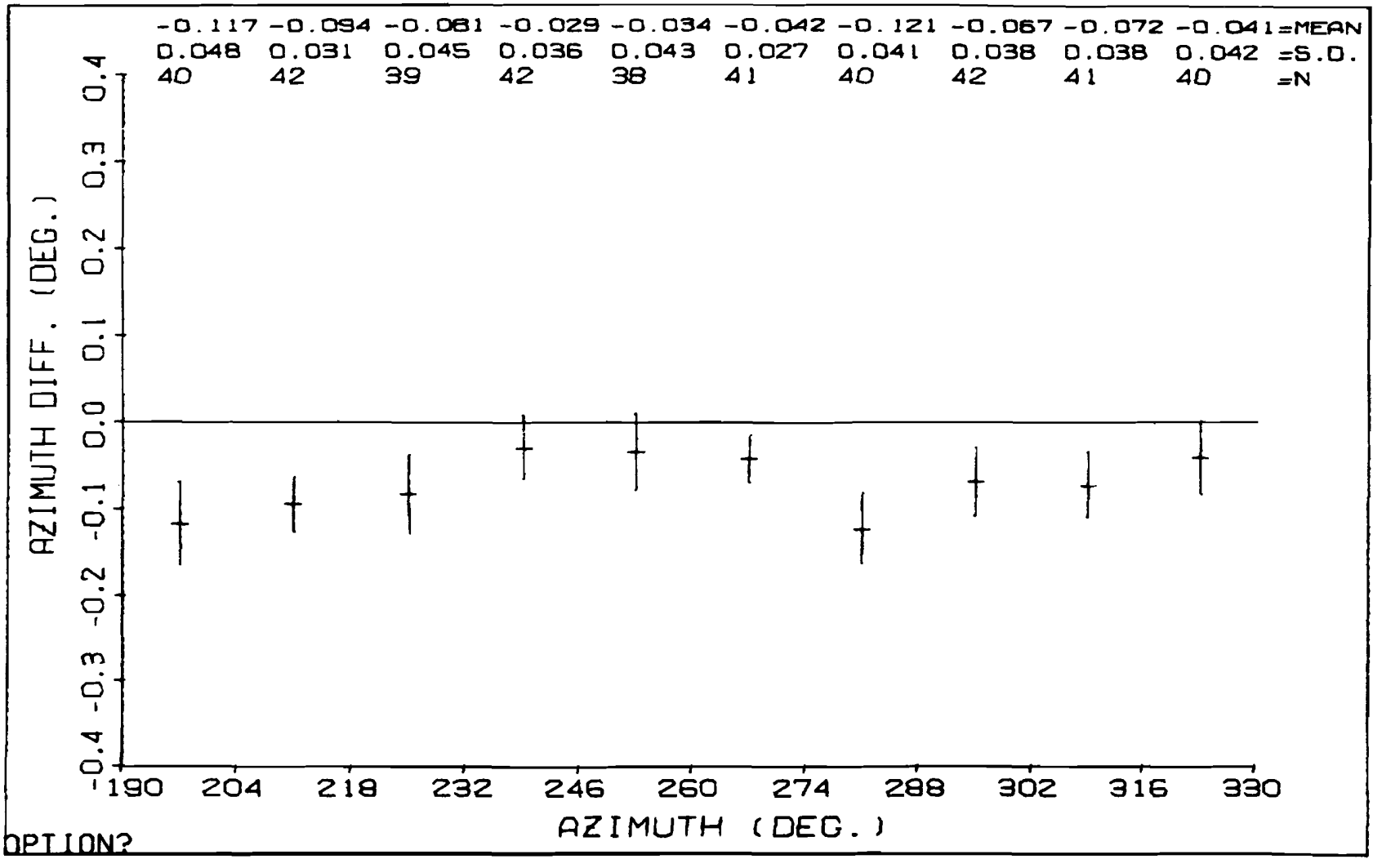
OPTION?

AZIMUTH DIFF VS AZIMUTH

DATA PROCESSED BY THE FAA TECHNICAL CENTER
ATLANTIC CITY AIRPORT, N.J. 08405

USSR TRANSPONDER

10/09/81 ORBITAL
ALT(FT) = 12,000



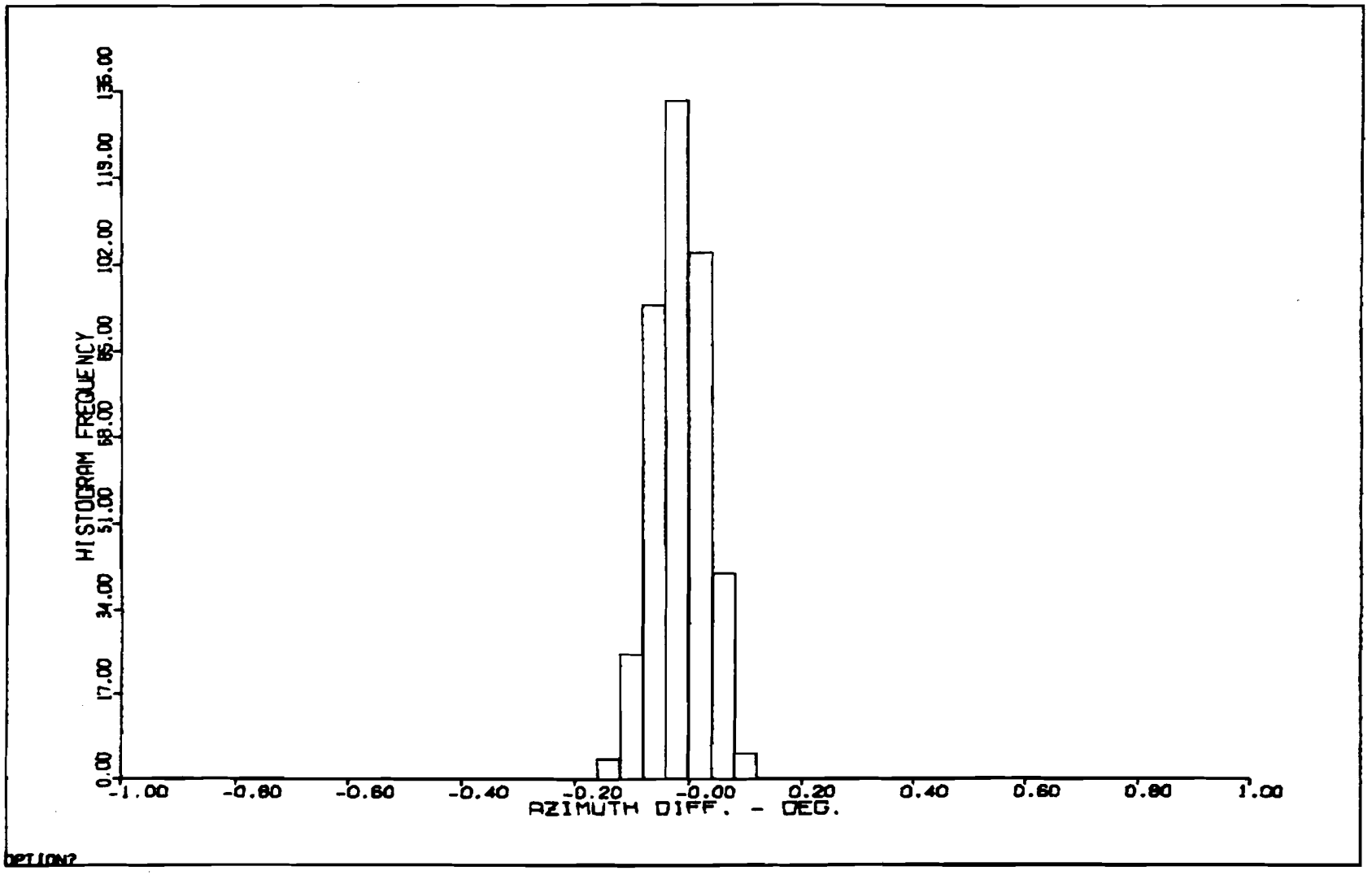
OPTION?

AZIMUTH DIFF. - DEG.

DATA PROCESSED BY THE FAA TECHNICAL CENTER
ATLANTIC CITY AIRPORT, N.J. 08405

USA TRANSPONDER
10/09/81 ORBITAL FLIGHT
ALT(FT) = 12000

MEAN = -0.017
STD DEV = 0.044
NO SAMPLES = 407

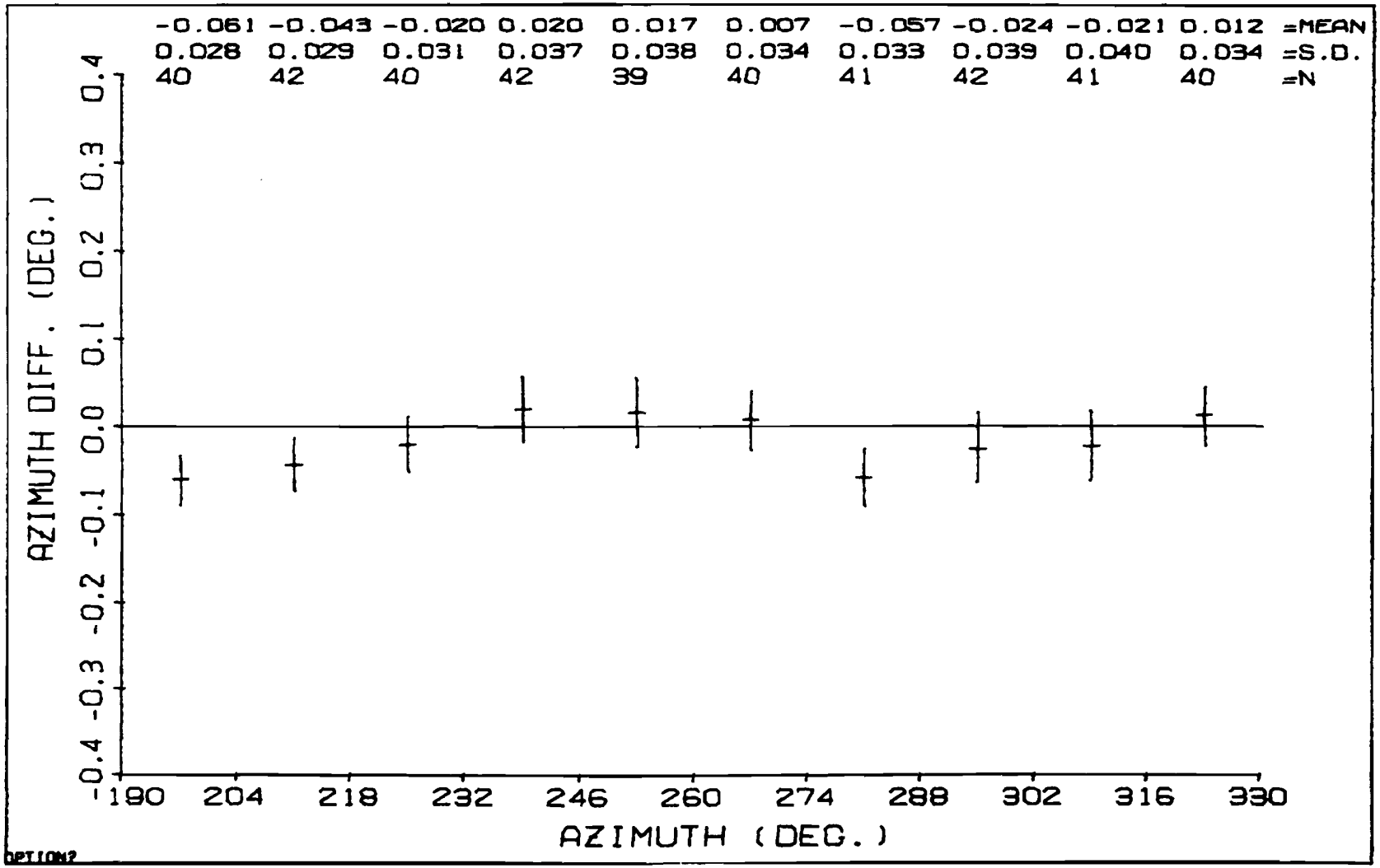


AZIMUTH DIFF VS. AZIMUTH

DATA PROCESSED BY THE FAA TECHNICAL CENTER
ATLANTIC CITY AIRPORT, N.J. 08405

USA TRANSPONDER 10/09/81

ALT(FT): 12,000

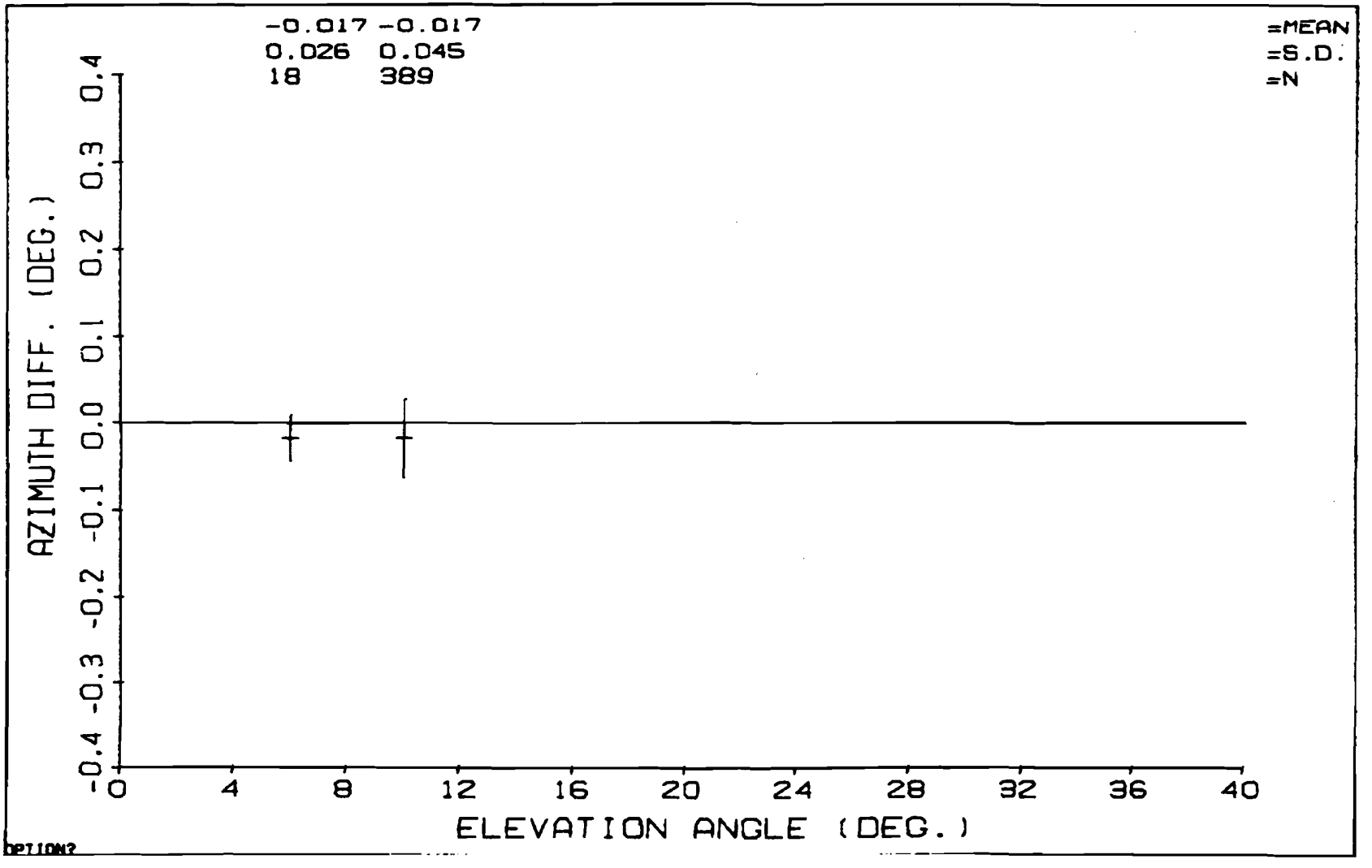


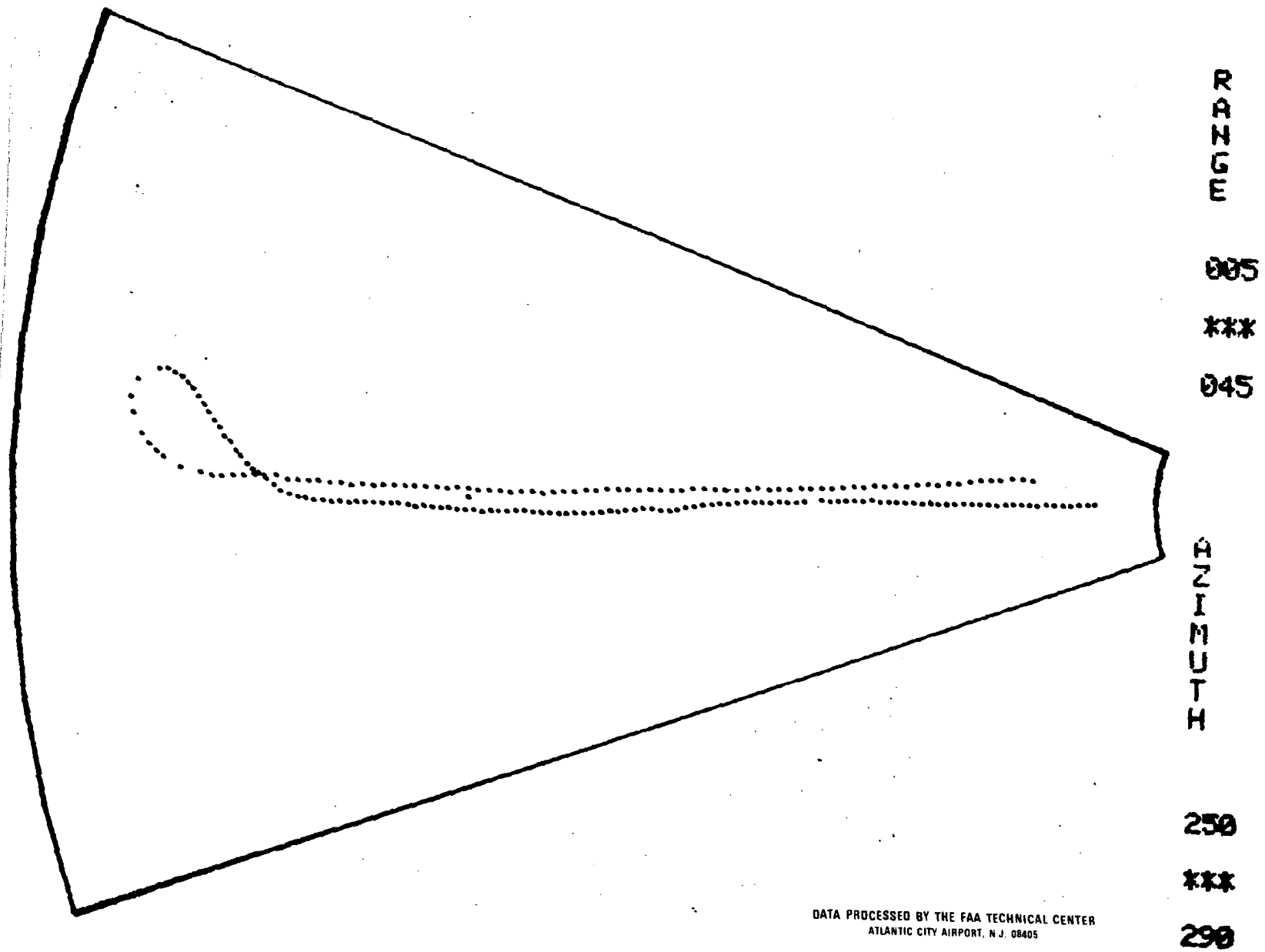
AZIMUTH DIFF VS. ELEVATION ANGLE

DATA PROCESSED BY THE FAA TECHNICAL CENTER
ATLANTIC CITY AIRPORT, N.J. 08405

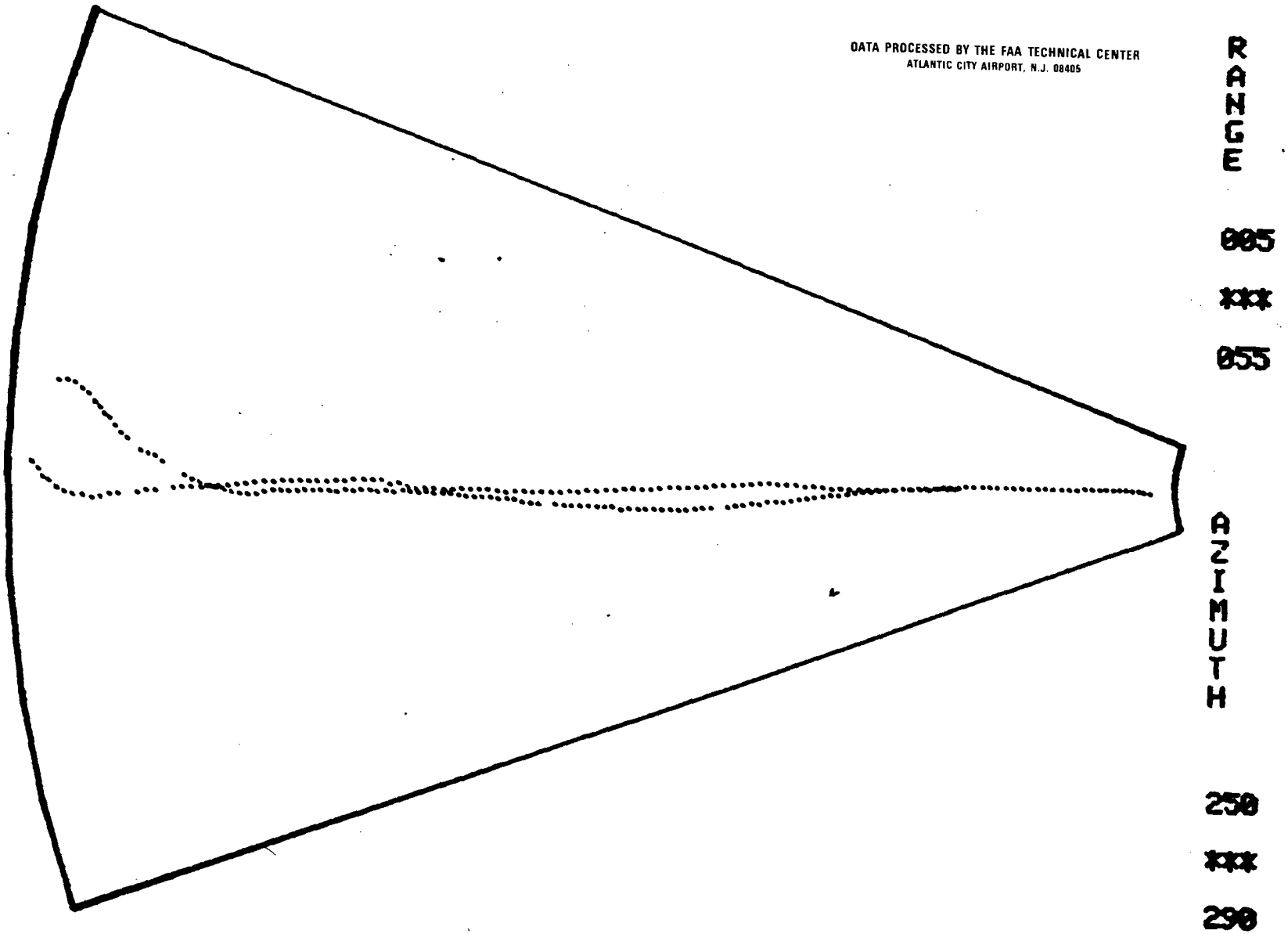
USA TRANSPONDER 10/09/81

ALT(FT): 12,000

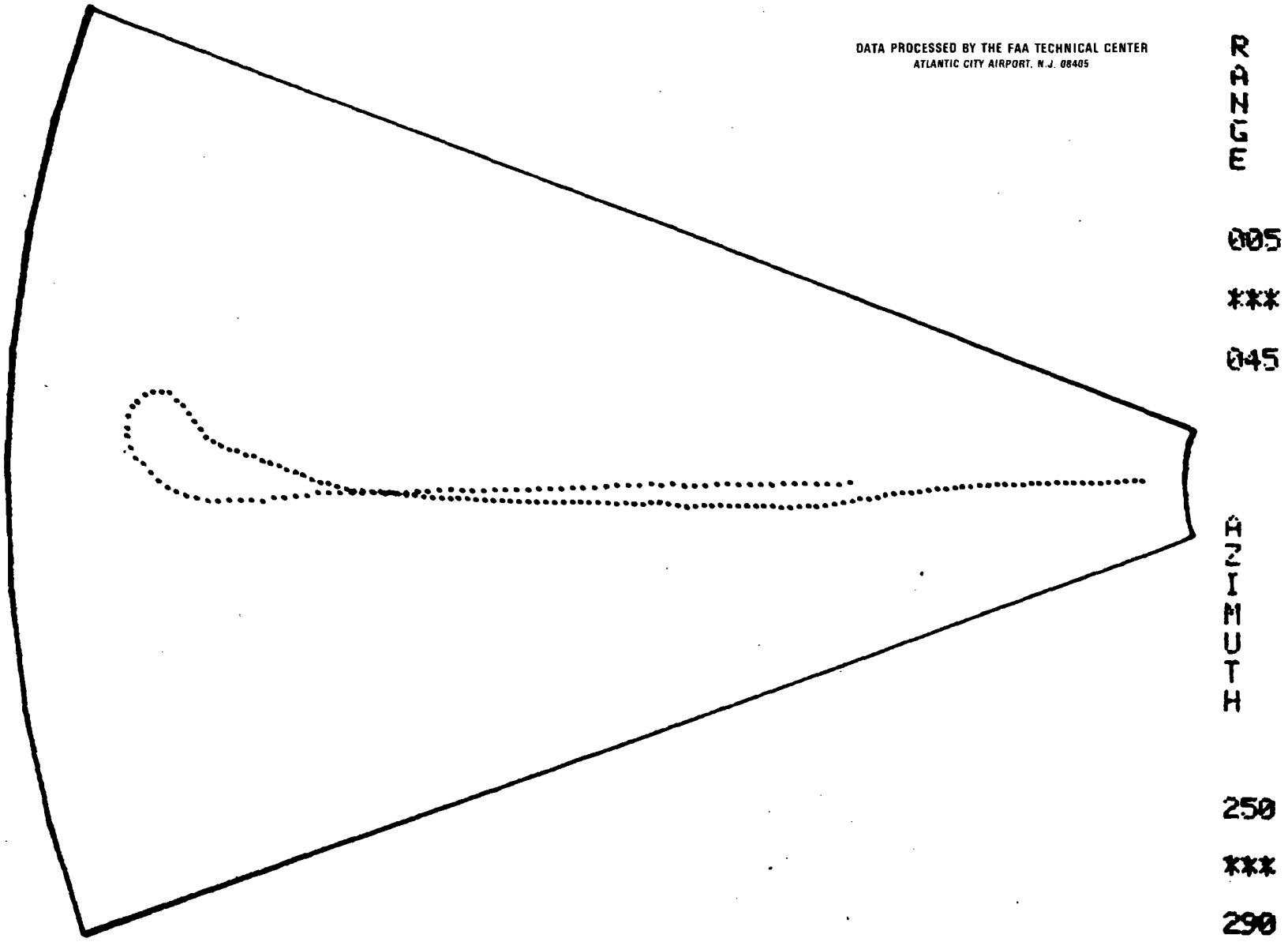




OCTOBER 13, 1981, RADIAL 10,000 FT (3,048 m), U.S.S.R. TRANSPONDER



OCTOBER 13, 1981, RADIAL 15,000 FT (4,572 m), U.S.S.R.TRANSPONDER



OCTOBER 13, 1981, RADIAL 10,000 FT (3,048 m), U.S. TRANSPONDER

```
D   29   0.617 271.824      01   MESS=00001AA2  FC=0 A=1   14/15/58.7
SCAN #  579  ATCRBS TRK =   60   DABS TRK =     5  59.88 14/16/ 0.0
D    0  20.370 271.780      01   MESS=1954EFFC  FC=1 A=1   14/16/ 3.4
D   42   0.607 272.351      01   MESS=00001AA2  FC=0 A=1   14/16/ 3.4
SCAN #  580  ATCRBS TRK =   60   DABS TRK =     5   4.57 14/16/ 4.8
D   41   0.612 272.329      01   MESS=00001AA2  FC=0 A=1   14/16/ 8.1
SCAN #  581  ATCRBS TRK =   59   DABS TRK =     5   9.26 14/16/ 9.3
D   31   0.612 271.912      01   MESS=00001AA2  FC=0 A=1   14/16/12.8
SCAN #  582  ATCRBS TRK =   58   DABS TRK =     5  13.95 14/16/14.1
D    0   0.622 271.362      01   MESS=00001AA2  FC=3 A=1   14/16/17.4
D   30   0.617 271.560      01   MESS=00001AA2  FC=0 A=1   14/16/17.4
SCAN #  583  ATCRBS TRK =   57   DABS TRK =     5  18.63 14/16/18.8
D   29   0.602 271.274      01   MESS=00001AA2  FC=0 A=1   14/16/22.1
SCAN #  584  ATCRBS TRK =   57   DABS TRK =     5  23.32 14/16/23.3
D    0   0.612 270.769      01   MESS=00001AA2  FC=3 A=1   14/16/26.8
D   28   0.612 270.967      01   MESS=00001AA2  FC=0 A=1   14/16/26.8
SCAN #  585  ATCRBS TRK =   57   DABS TRK =     5  28.01 14/16/28.0
D   37   0.617 270.879      01   MESS=00001AA2  FC=0 A=1   14/16/31.5
SCAN #  586  ATCRBS TRK =   58   DABS TRK =     5  32.70 14/16/32.7
D   30   0.597 270.439      01   MESS=00001AA2  FC=0 A=1   14/16/36.2
SCAN #  587  ATCRBS TRK =   59   DABS TRK =     5  37.38 14/16/37.4
D    0   0.612 269.912      01   MESS=00001AA2  FC=3 A=1   14/16/40.9
D   28   0.612 270.110      01   MESS=00001AA2  FC=0 A=1   14/16/40.9
SCAN #  588  ATCRBS TRK =   61   DABS TRK =     5  42.07 14/16/42.1
D   33   0.617 269.934      01   MESS=00001AA2  FC=0 A=1   14/16/45.6
SCAN #  589  ATCRBS TRK =   62   DABS TRK =     5  46.75 14/16/46.9
D   28   0.597 269.692      01   MESS=00001AA2  FC=0 A=1   14/16/50.3
SCAN #  590  ATCRBS TRK =   62   DABS TRK =     5  51.44 14/16/51.6
D   33   0.617 269.626      01   MESS=00001AA2  FC=0 A=1   14/16/54.9
SCAN #  591  ATCRBS TRK =   61   DABS TRK =     5  56.17 14/16/56.1
D    0   0.602 269.143      01   MESS=00001AA2  FC=3 A=1   14/16/59.6
D   27   0.607 269.341      01   MESS=00001AA2  FC=0 A=1   14/16/59.6
SCAN #  592  ATCRBS TRK =   59   DABS TRK =     5   0.80 14/17/ 0.9
D   43   0.602 269.583      01   MESS=00001AA2  FC=0 A=1   14/17/ 4.3
SCAN #  593  ATCRBS TRK =   58   DABS TRK =     5   5.49 14/17/ 5.6
D   24   0.617 269.055      01   MESS=00001AA2  FC=0 A=1   14/17/ 8.9
D   48   0.617 269.604      01   MESS=00001AA2  FC=0 A=1   14/17/ 9.0
SCAN #  594  ATCRBS TRK =   58   DABS TRK =     5  10.17 14/17/10.3
D   30   0.607 269.165      01   MESS=00001AA2  FC=0 A=1   14/17/13.6
SCAN #  595  ATCRBS TRK =   59   DABS TRK =     5  14.86 14/17/15.0
D   29   0.602 268.945      01   MESS=00001AA2  FC=0 A=1   14/17/18.3
SCAN #  596  ATCRBS TRK =   59   DABS TRK =     5  19.55 14/17/19.6
D    0   0.622 268.550      01   MESS=00001AA2  FC=3 A=1   14/17/23.0
D   26   0.622 268.792      01   MESS=00001AA2  FC=0 A=1   14/17/23.0
SCAN #  597  ATCRBS TRK =   59   DABS TRK =     5  24.23 14/17/24.3
D   32   0.612 268.341      01   MESS=00001AA2  FC=0 A=1   14/17/27.7
SCAN #  598  ATCRBS TRK =   59   DABS TRK =     5  28.91 14/17/29.1
D   25   0.607 268.539      01   MESS=00001AA2  FC=0 A=1   14/17/32.4
SCAN #  599  ATCRBS TRK =   59   DABS TRK =     5  33.59 14/17/33.8
D   39   0.607 268.847      01   MESS=00001AA2  FC=0 A=1   14/17/37.1
SCAN #  600  ATCRBS TRK =   58   DABS TRK =     5  38.28 14/17/38.3
```

DATA PROCESSED BY THE FAA TECHNICAL CENTER
ATLANTIC CITY AIRPORT, N.J. 08405

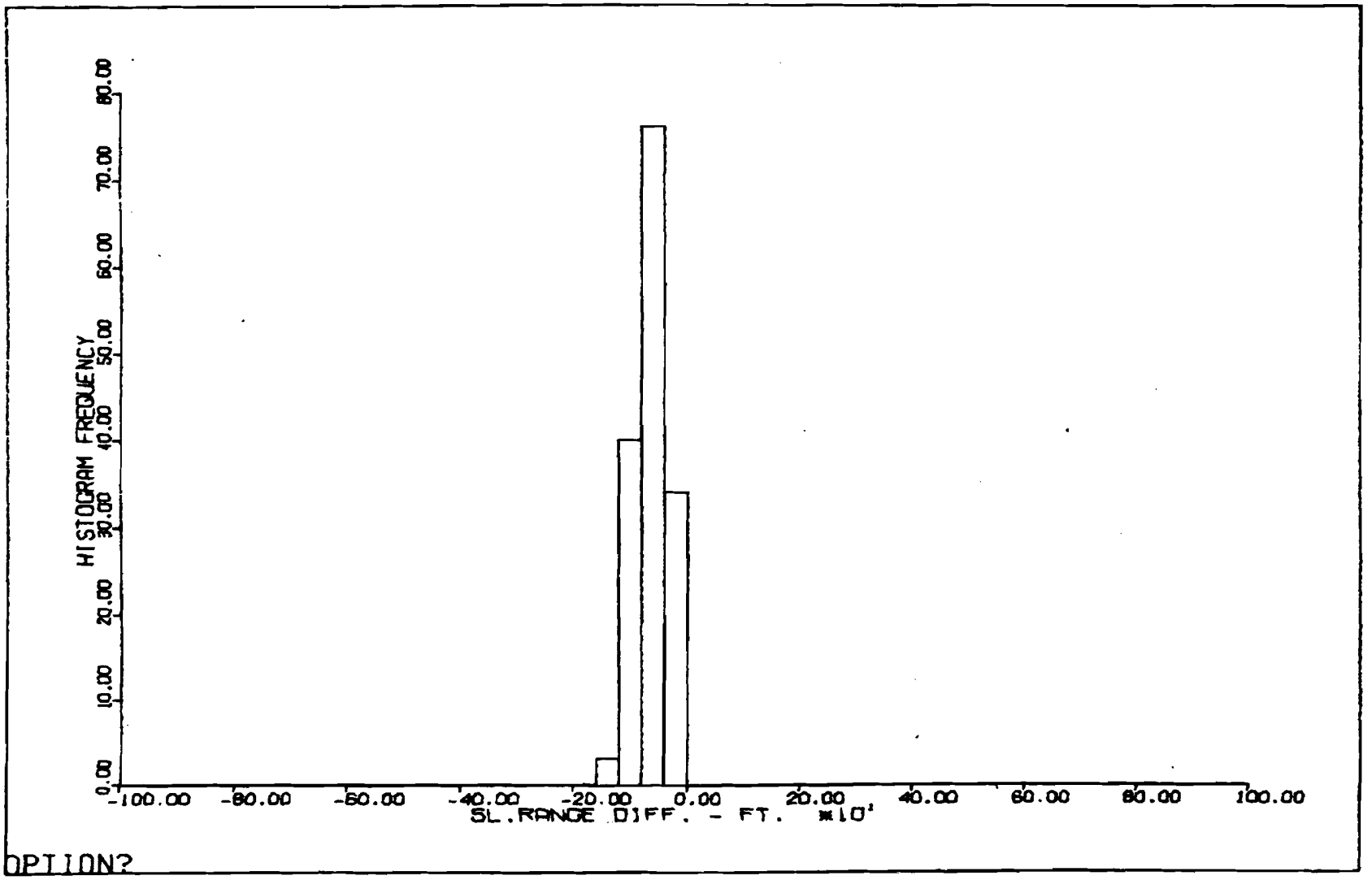
SAMPLE LISTING OF SOVIET REPLIES FOR OCTOBER 13, 1981, RADIAL

SLANT RANGE DIFF - FT

DATA PROCESSED BY THE FAA TECHNICAL CENTER
ATLANTIC CITY AIRPORT, N.J. 08405

USSR TRANSPONDER
10/13/81 RADIAL
ALT(FT) = 10,000

MEAN = -62.06
STD DEV = 29.58
NO SAMPLES = 153



OPTION?

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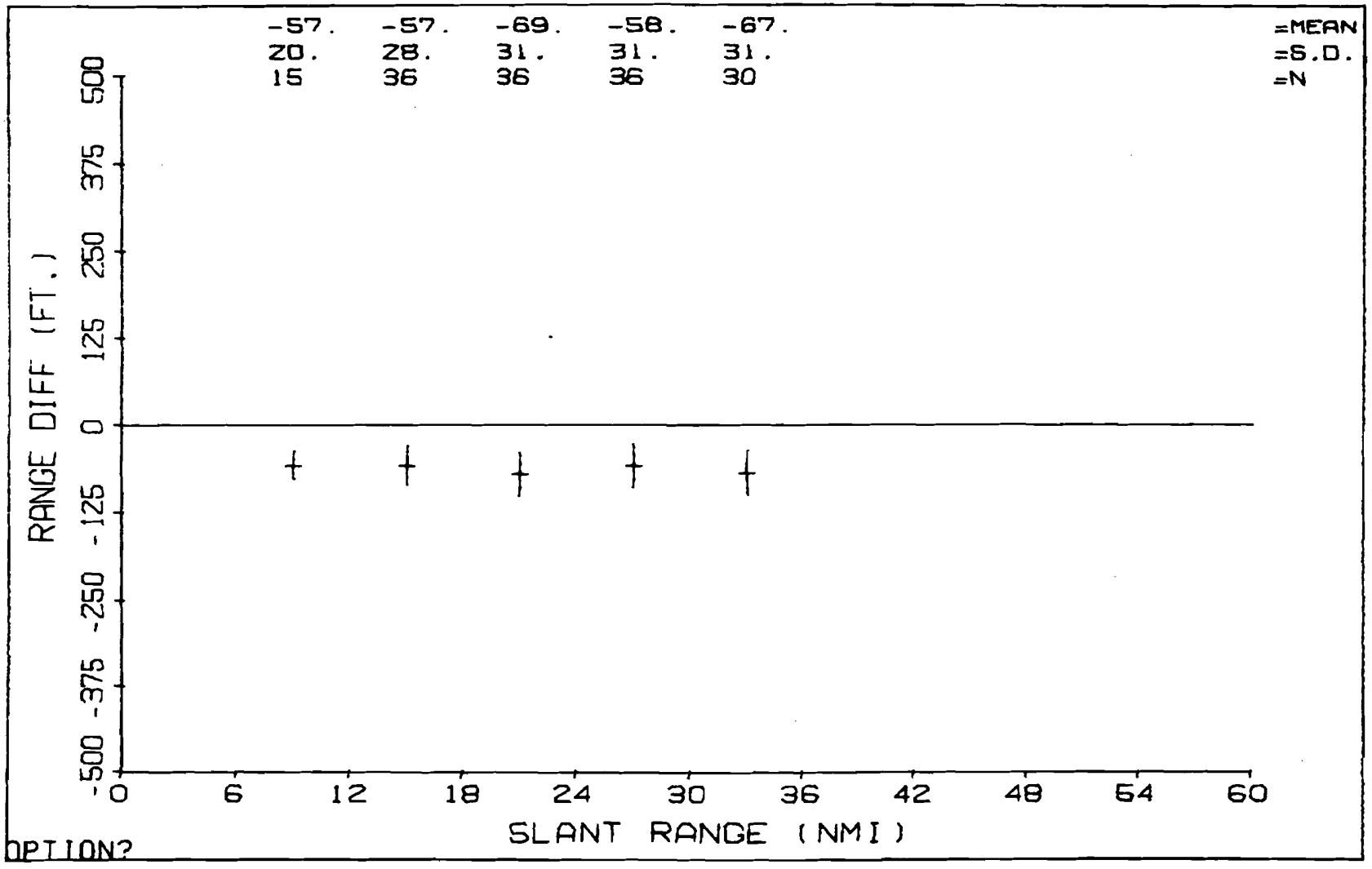
ATLANTIC CITY AIRPORT, N.J. 08405

RANGE DIFF VS RANGE

USSR TRANSPONDER

10/13/81 RADIAL
ALT(FT) = 10,000

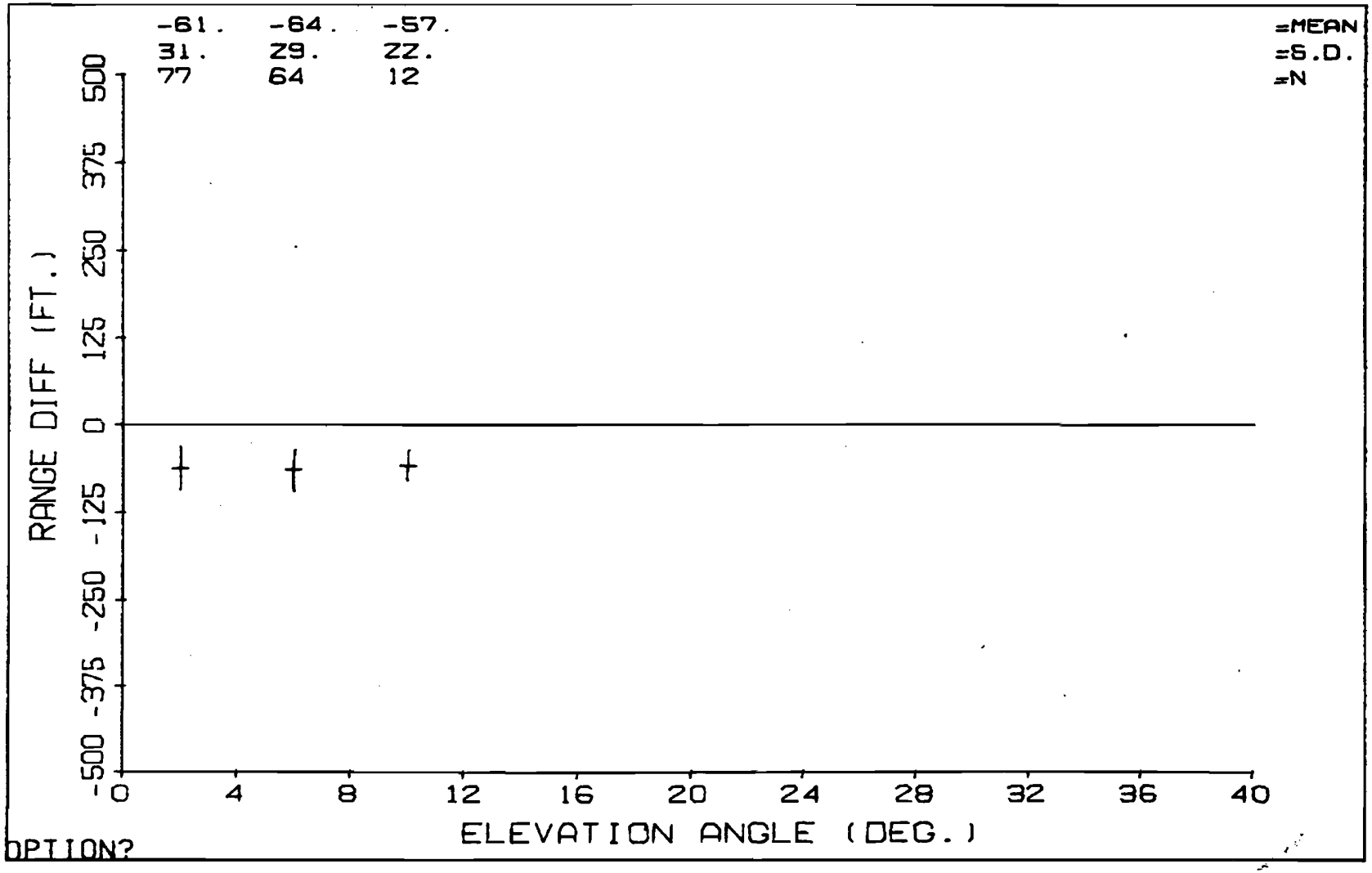


DATA PROCESSED BY THE FAA TECHNICAL CENTER
ATLANTIC CITY AIRPORT, N.J. 08405

RANGE DIFF VS ELEVATION ANGLE

USSR TRANSPONDER

10/13/81 RADIAL
ALT(FT) = 10,000

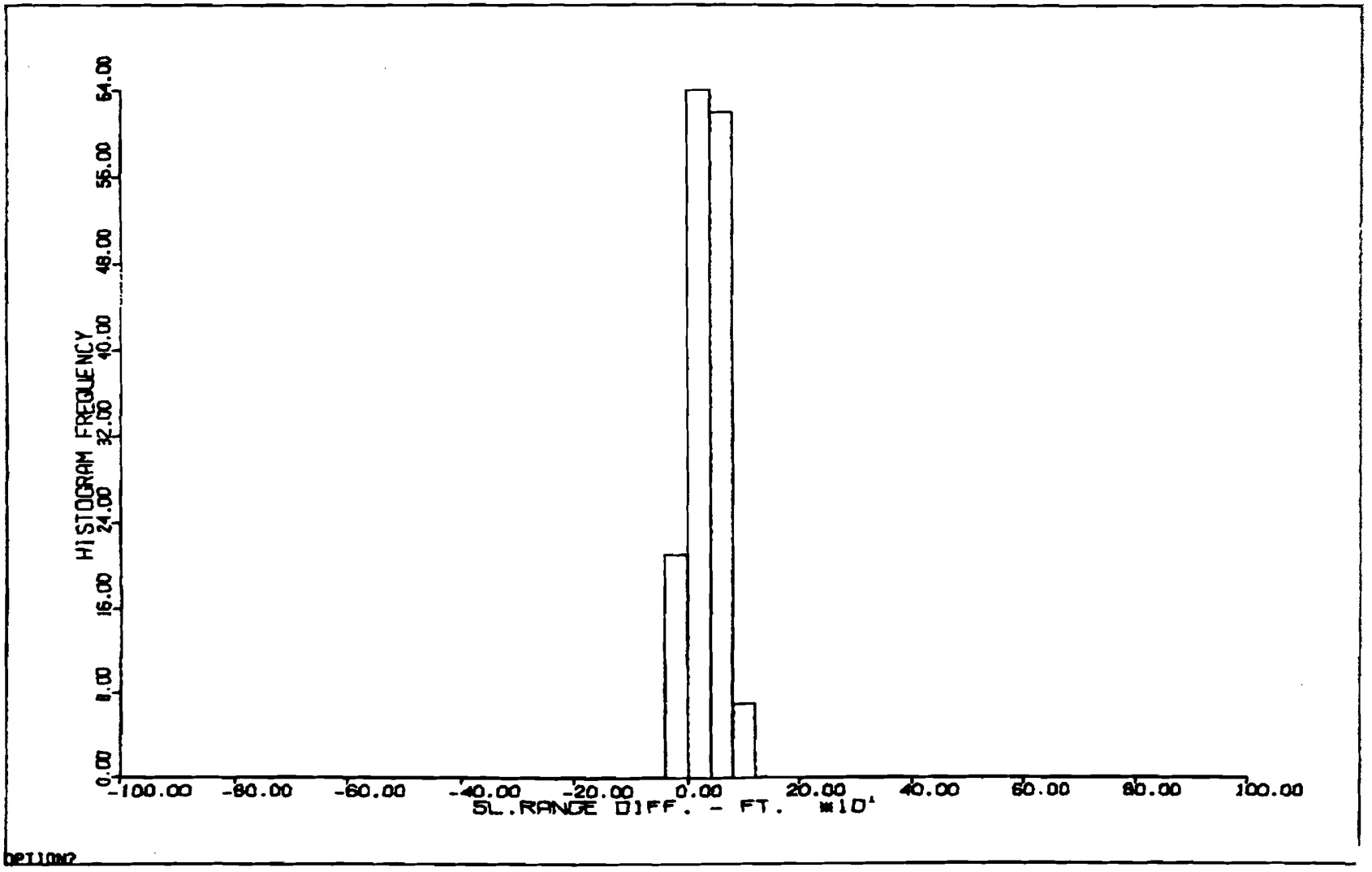


SLANT RANGE DIFF. - FT.

DATA PROCESSED BY THE FAA TECHNICAL CENTER
ATLANTIC CITY AIRPORT, N.J. 08405

USA TRANSPONDER
10/13/81 RADIAL
ALT(FT) = 10000

MEAN = 34.973
STD DEV = 28.110
NO SAMPLES = 154

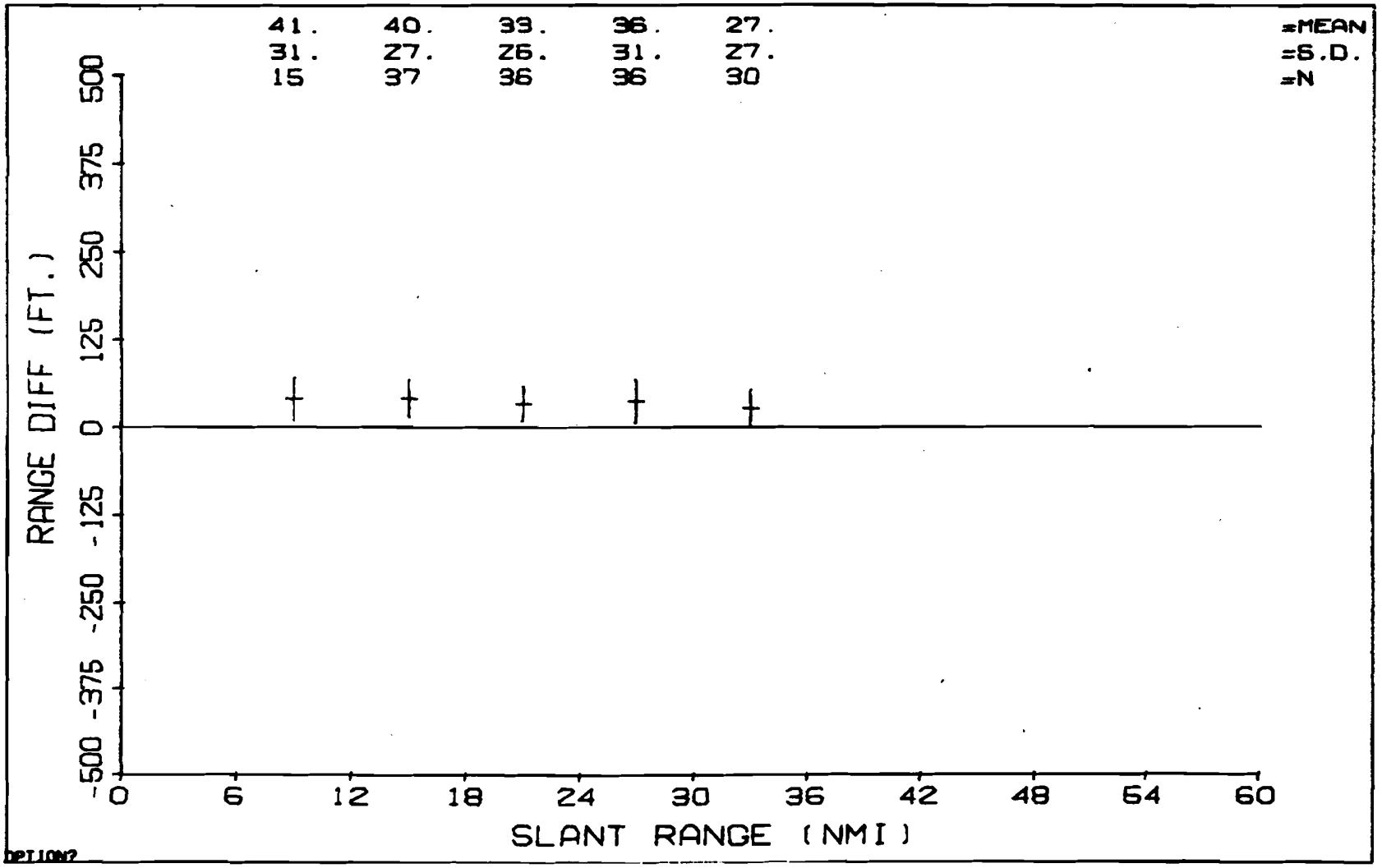


RANGE DIFF VS. RANGE

DATA PROCESSED BY THE FAA TECHNICAL CENTER
ATLANTIC CITY AIRPORT, N.J. 08405

USA TRANSPONDER 10/13/81

ALT(FT): 10,000

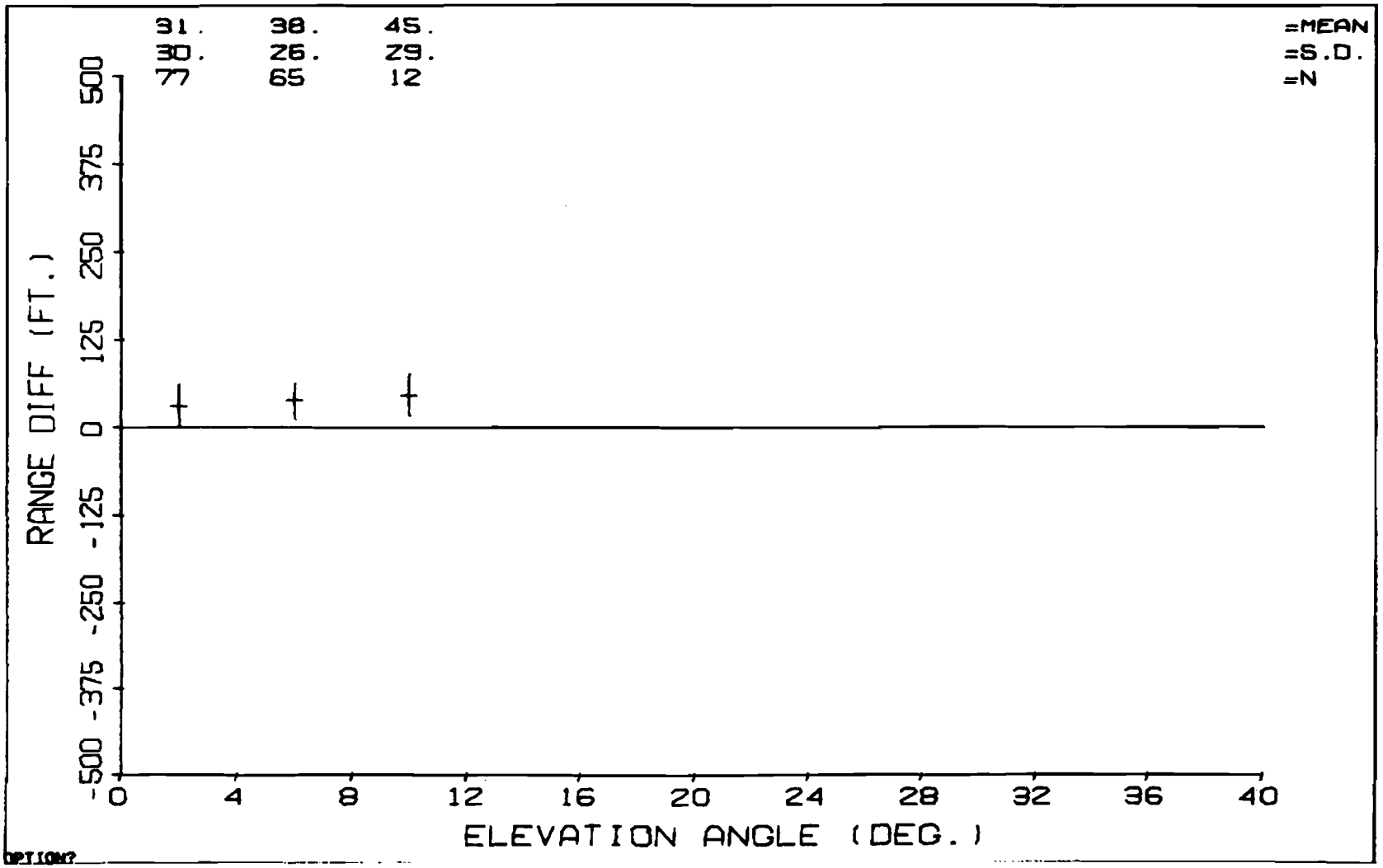


RANGE DIFF VS. ELEVATION ANGLE

DATA PROCESSED BY THE FAA TECHNICAL CENTER
ATLANTIC CITY AIRPORT, N.J. 08405

USA TRANSPONDER 10/13/81

ALT(FT): 10,000

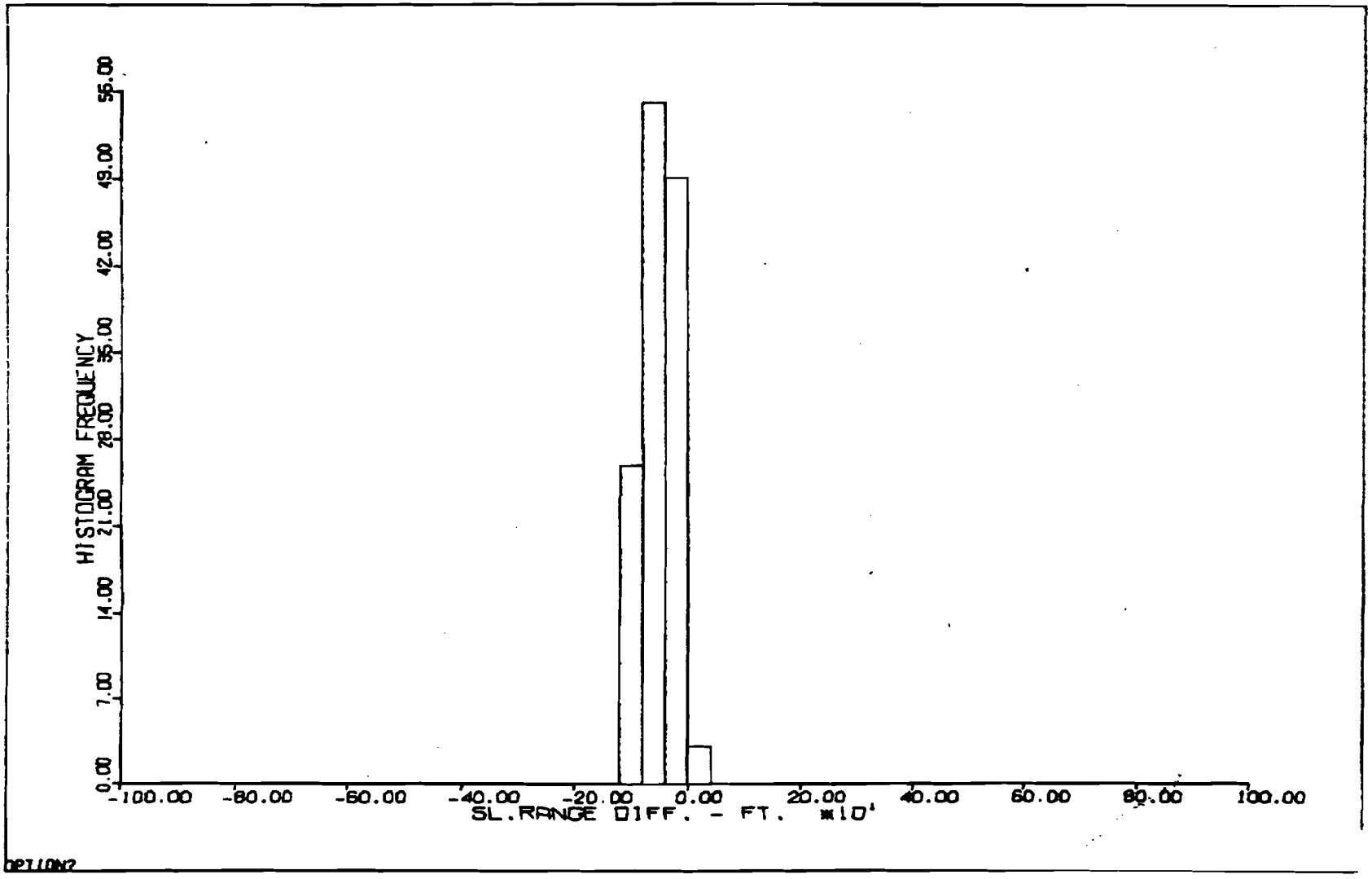


RANGE DIFF - FT

DATA PROCESSED BY THE FAA TECHNICAL CENTER
ATLANTIC CITY AIRPORT, N.J. 08405

USSR TRANSPONDER
10/13/81 RADIAL
ALT(FT) = 10,000

MEAN = -53.05
STD DEV = 29.78
NO SAMPLES = 133

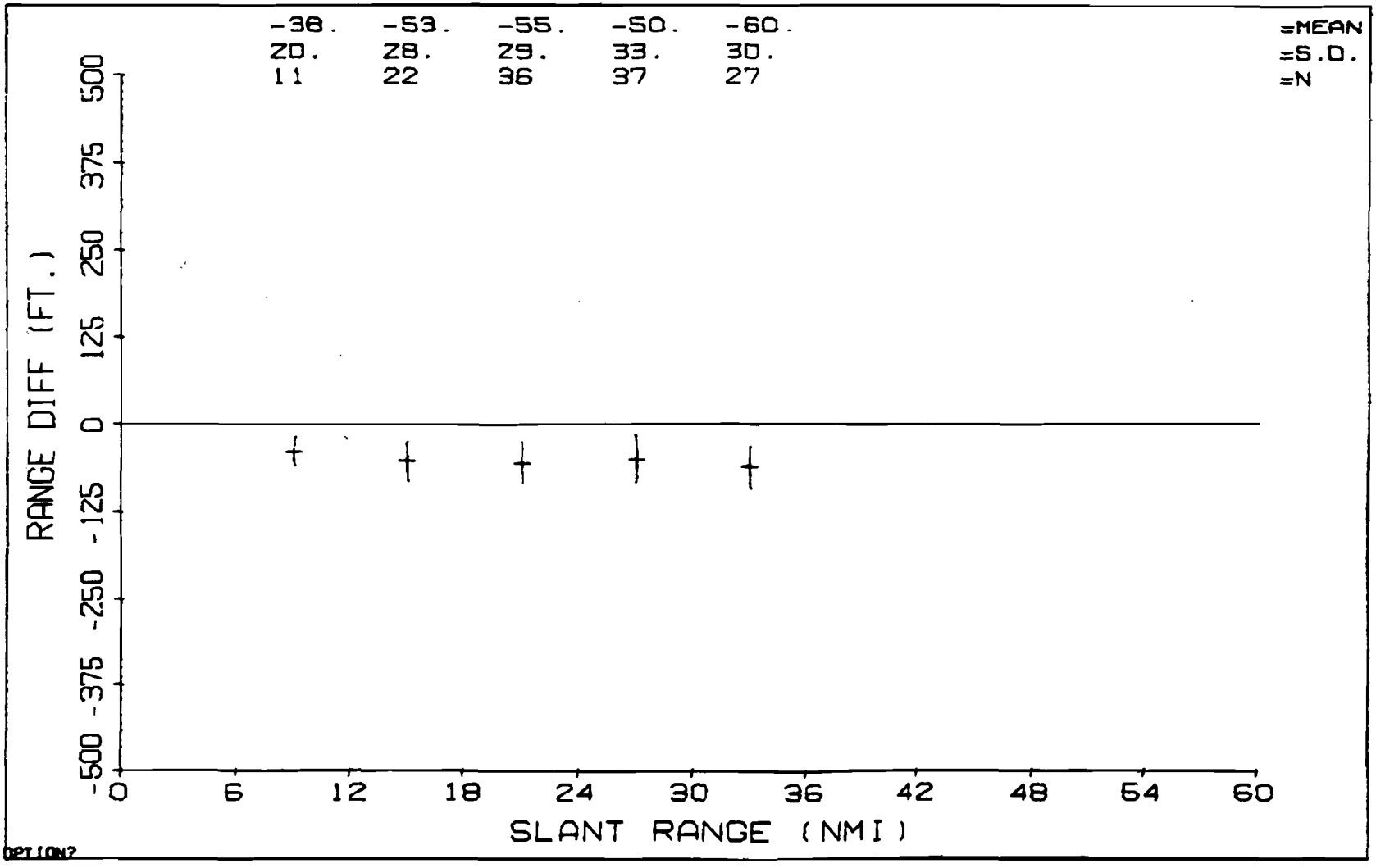


RANGE DIFF VS RANGE

DATA PROCESSED BY THE FAA TECHNICAL CENTER
ATLANTIC CITY AIRPORT, N.J. 08405

USSR TRANSPONDER

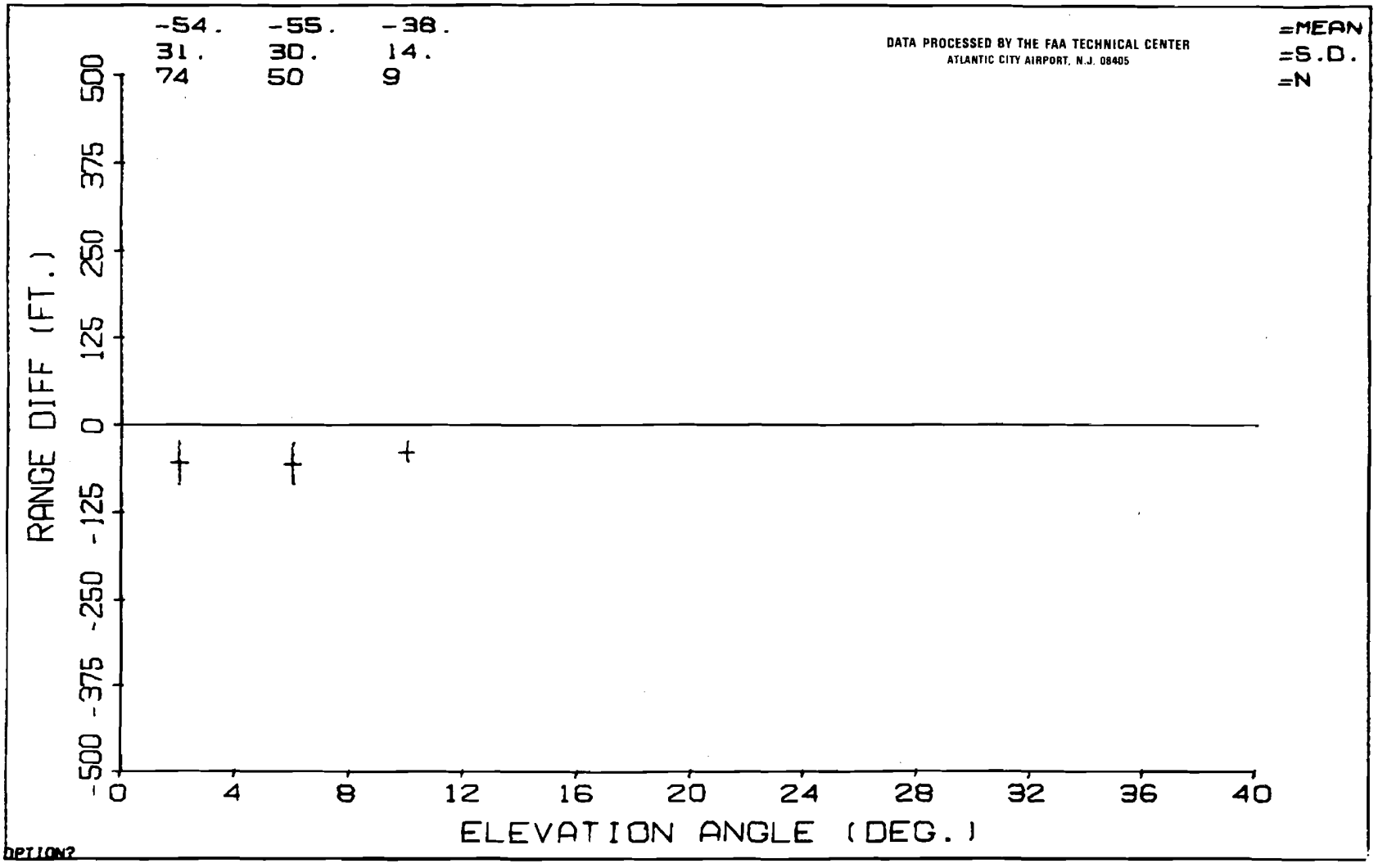
10/13/81 RADIAL
ALT(FT) = 10,000



RANGE DIFF VS ELEVATION ANGLE

USSR TRANSPONDER

10/13/81 RADIAL
ALT(FT) = 10,000

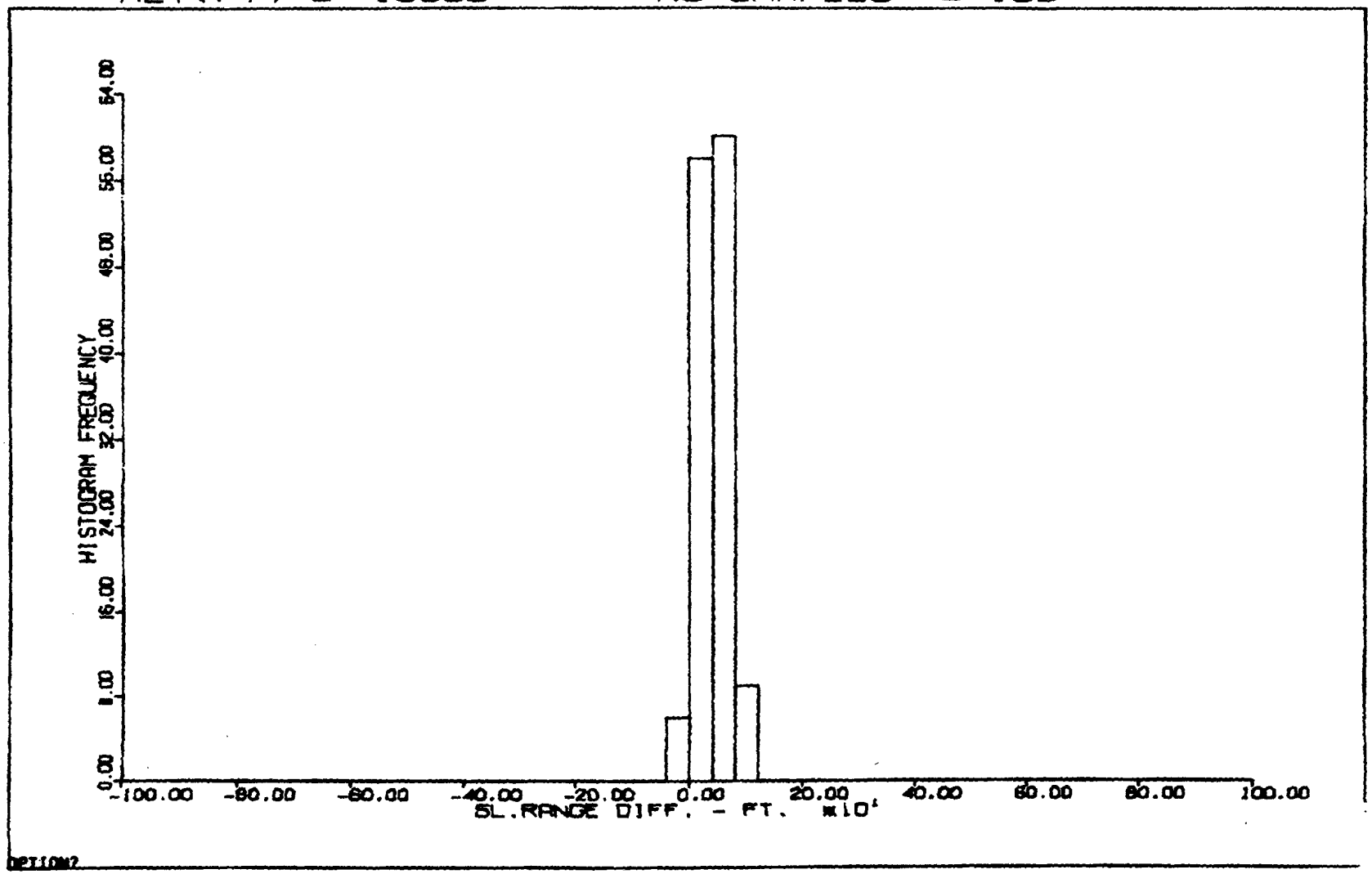


SLANT RANGE DIFF. - FT.

DATA PROCESSED BY THE FAA TECHNICAL CENTER
ATLANTIC CITY AIRPORT, N.J. 08405

USA TRANSPONDER
10/13/81 RADIAL
ALT(FT) = 10000

MEAN = 43.337
STD DEV = 24.382
NO SAMPLES = 133

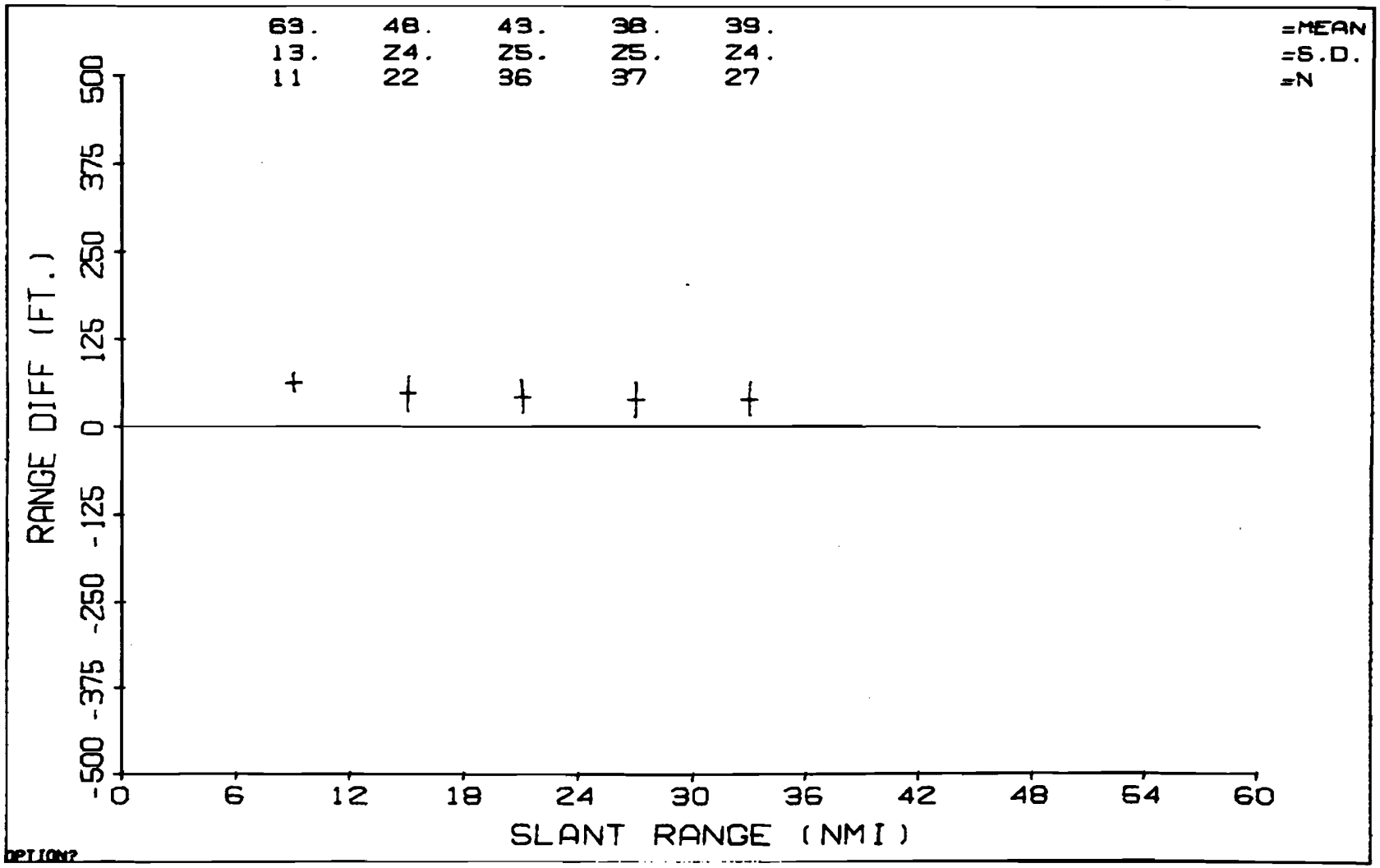


RANGE DIFF VS. RANGE

DATA PROCESSED BY THE FAA TECHNICAL CENTER
ATLANTIC CITY AIRPORT, N.J. 08405

USA TRANSPONDER 10/13/81

ALT(FT): 10,000

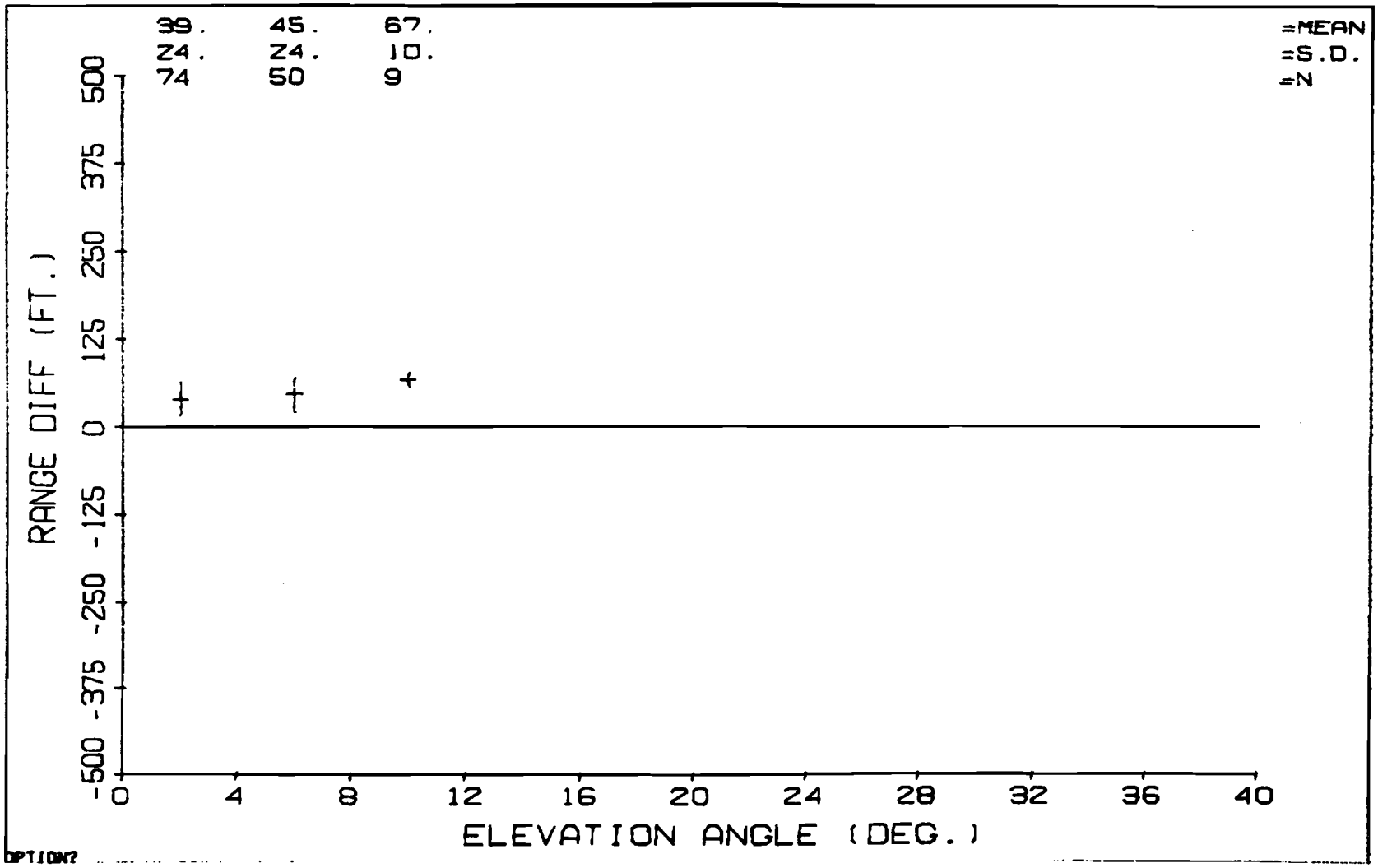


RANGE DIFF VS. ELEVATION ANGLE

DATA PROCESSED BY THE FAA TECHN CAL CENTER
ATLANTIC CITY AIRPORT, N J 08405

USA TRANSPONDER 10/13/81

ALT(FT): 10,000

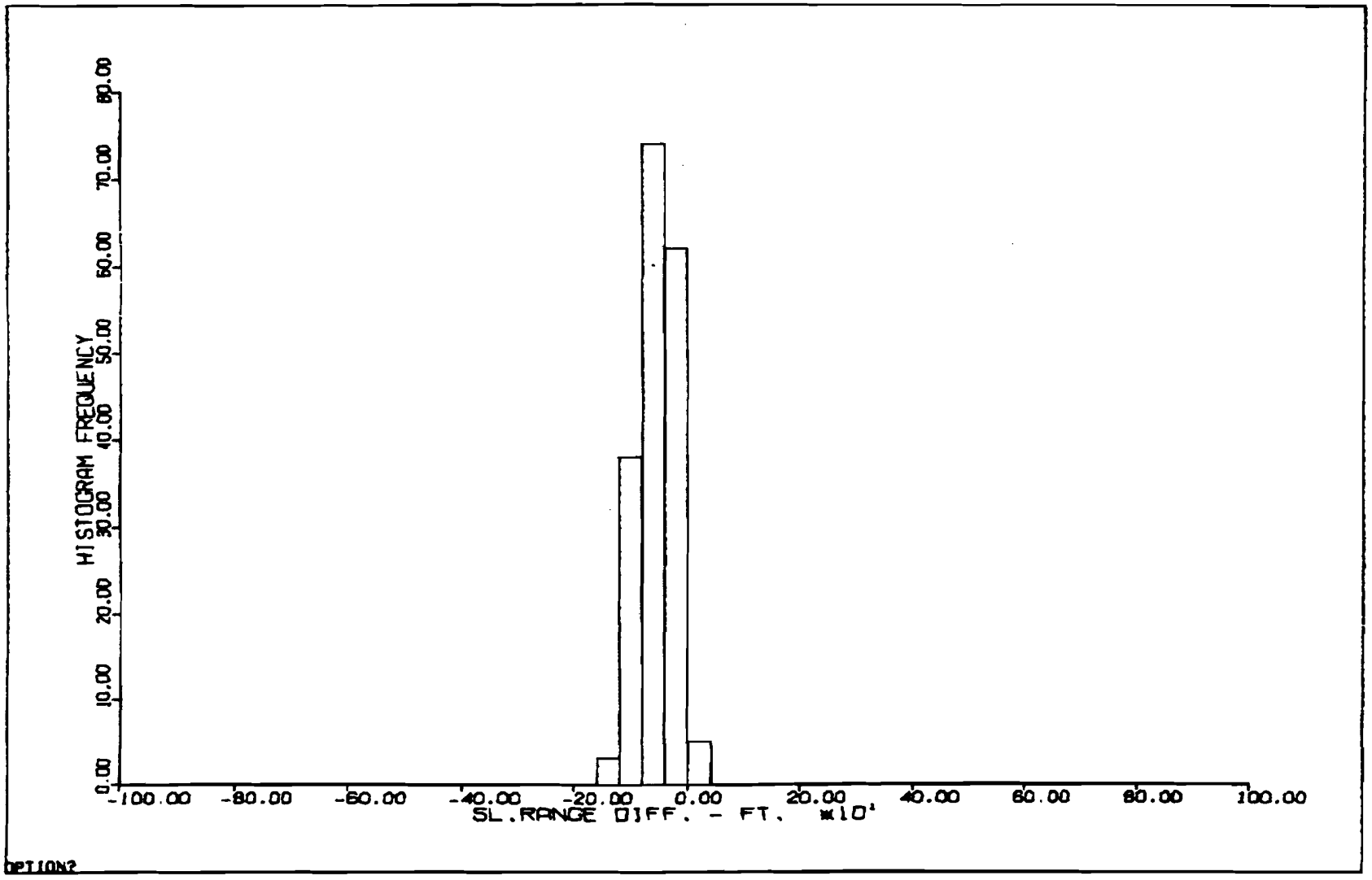


SLANT RANGE DIFF - FT

DATA PROCESSED BY THE FAA TECHNICAL CENTER
ATLANTIC CITY AIRPORT, N.J. 08405

USSR TRANSPONDER
10/13/81 RADIAL
ALT(FT) = 15,000

MEAN = -53.70
STD DEV = 32.43
NO SAMPLES = 182

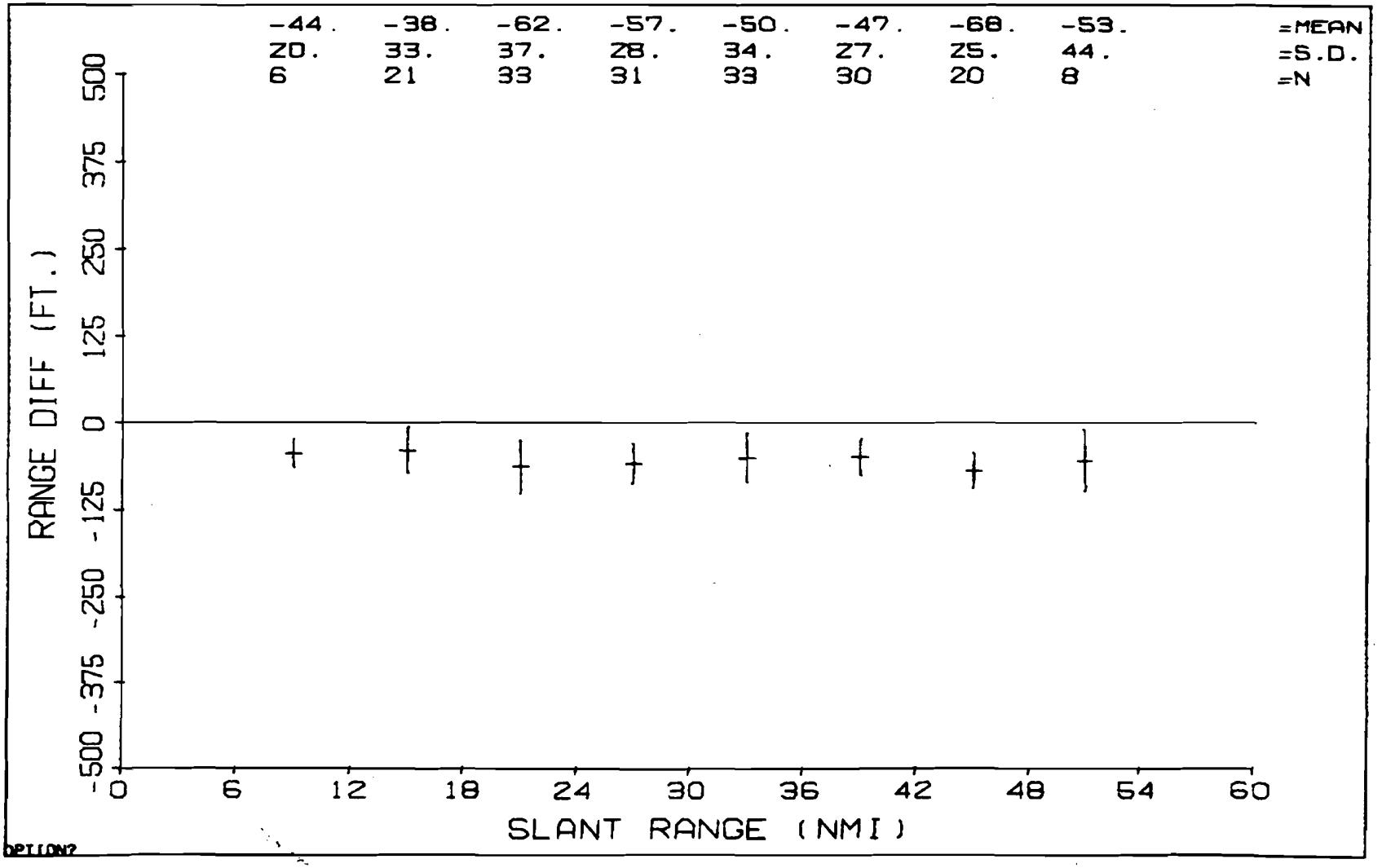


RANGE DIFF VS RANGE

DATA PROCESSED BY THE FAA TECHNICAL CENTER
ATLANTIC CITY AIRPORT, N.J. 08405

USSR TRANSPONDER

10/13/81 RADIAL
ALT(FT) = 15,000

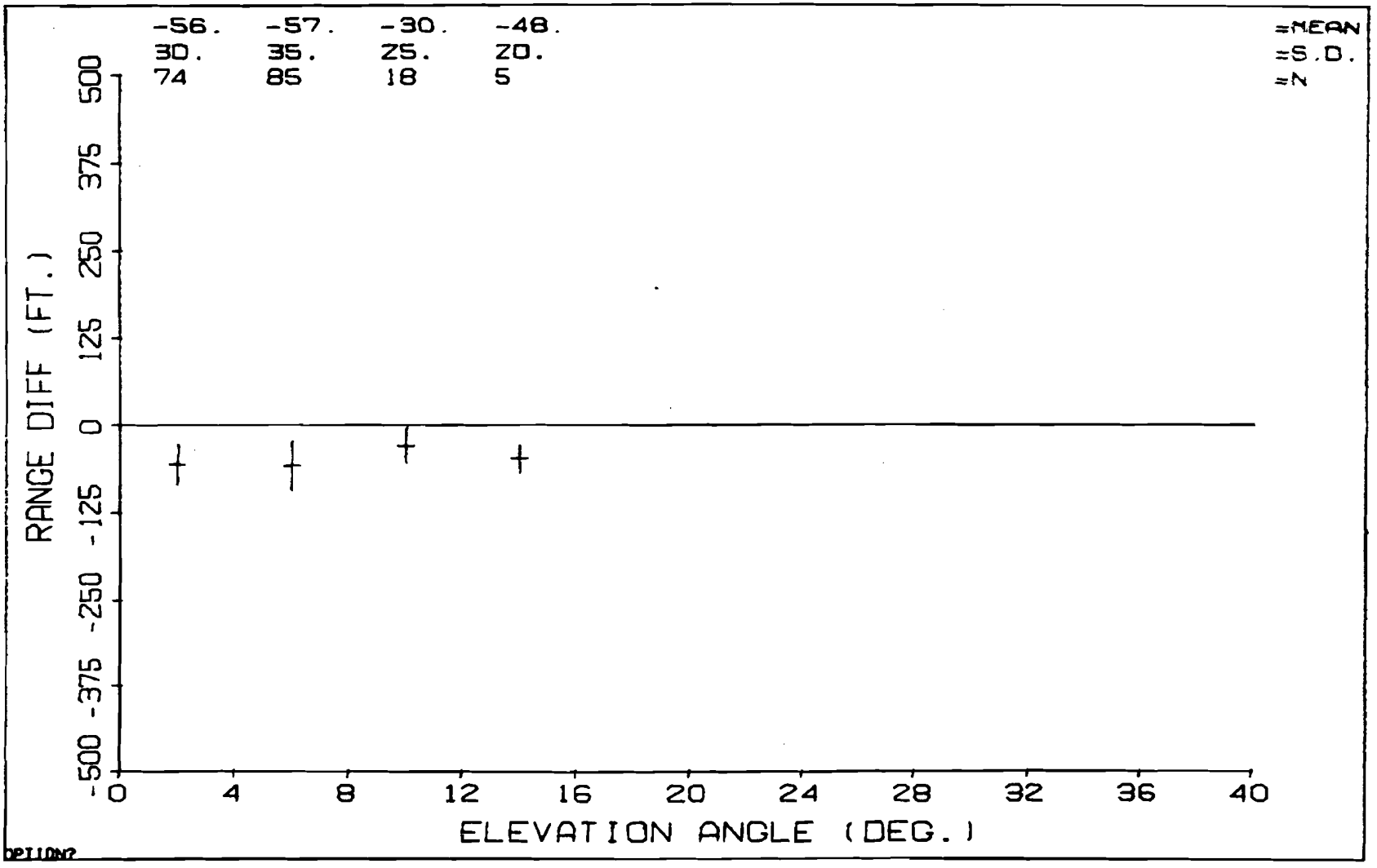


RANGE DIFF VS ELEVATION ANGLE

DATA PROCESSED BY THE FAA TECHNICAL CENTER
ATLANTIC CITY AIRPORT, N.J. 08405

USSR TRANSPONDER

10/13/81 RADIAL
ALT(FT) = 15,000

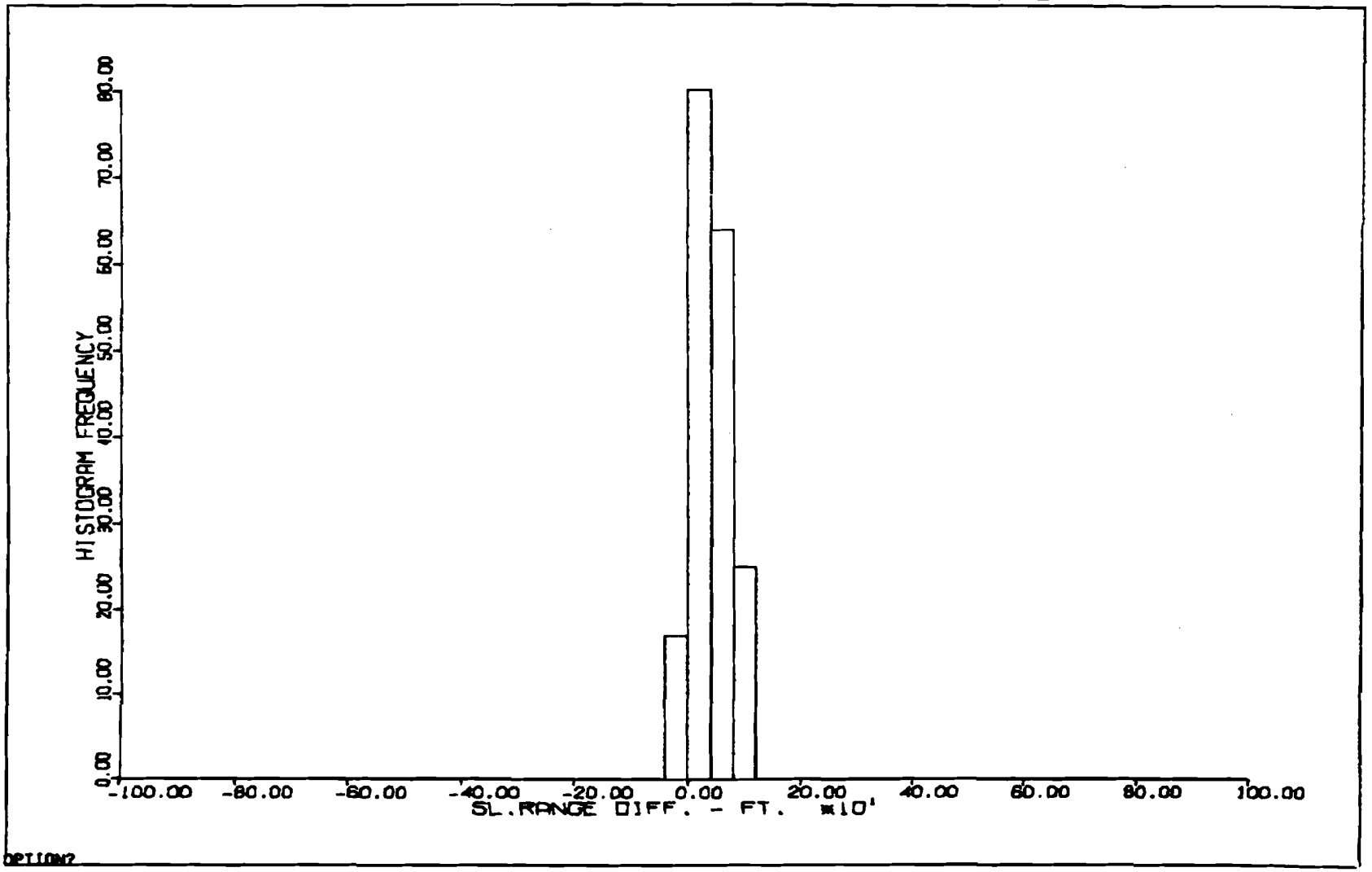


SLANT RANGE DIFF. - FT.

DATA PROCESSED BY THE FAA TECHNICAL CENTER
ATLANTIC CITY AIRPORT, N.J. 08405

USA TRANSPONDER
10/13/81 RADIAL
ALT(FT) = 15000

MEAN = 41.481
STD DEV = 31.741
NO SAMPLES = 186



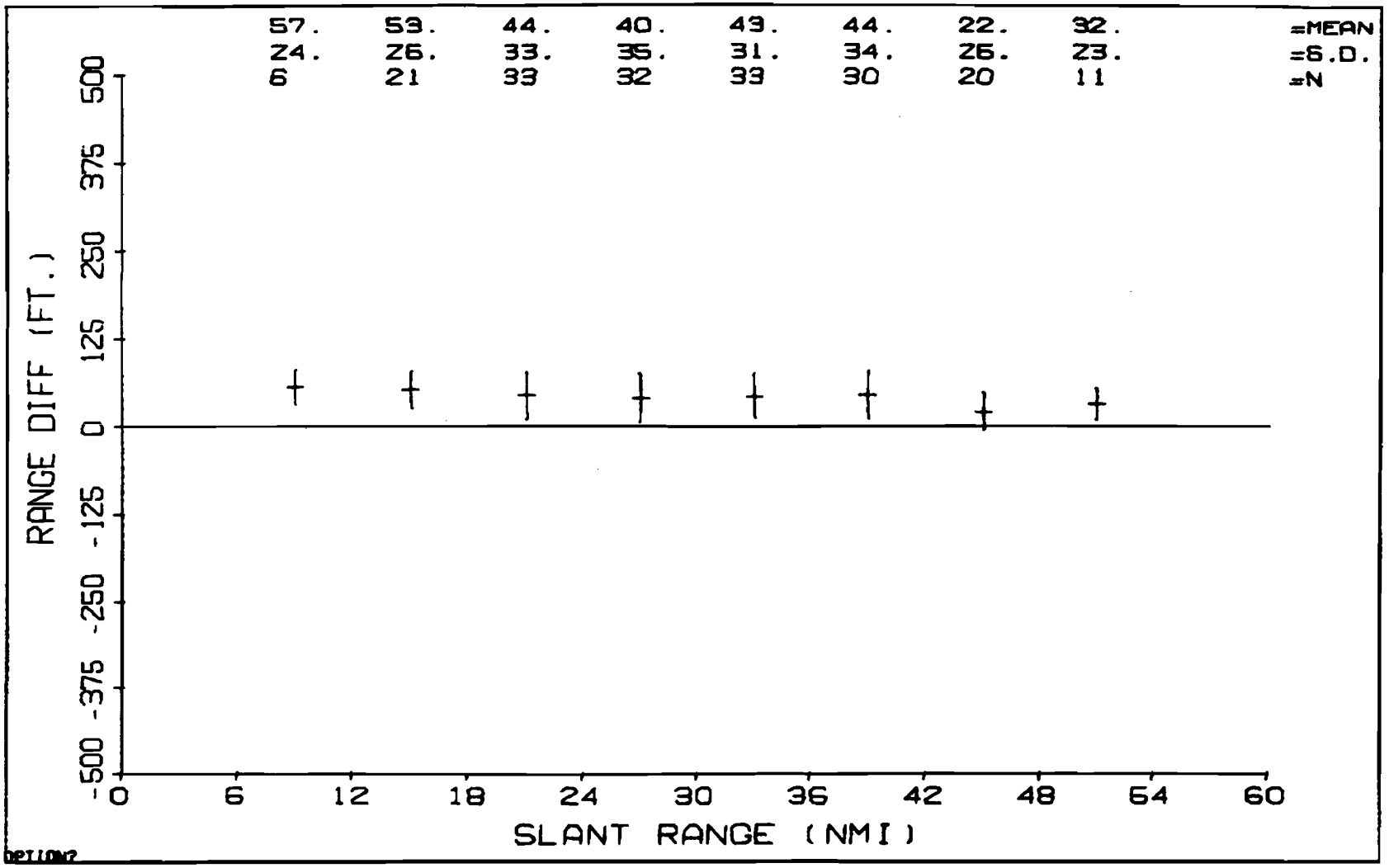
RANGE DIFF VS. RANGE

DATA PROCESSED BY THE FAA TECHNICAL CENTER
ATLANTIC CITY AIRPORT, N.J. 08405

USA TRANSPONDER 10/13/81

ALT(FT): 15,000

57.	53.	44.	40.	43.	44.	22.	32.	=MEAN
24.	26.	33.	35.	31.	34.	26.	23.	=S.D.
6	21	33	32	33	30	20	11	=N

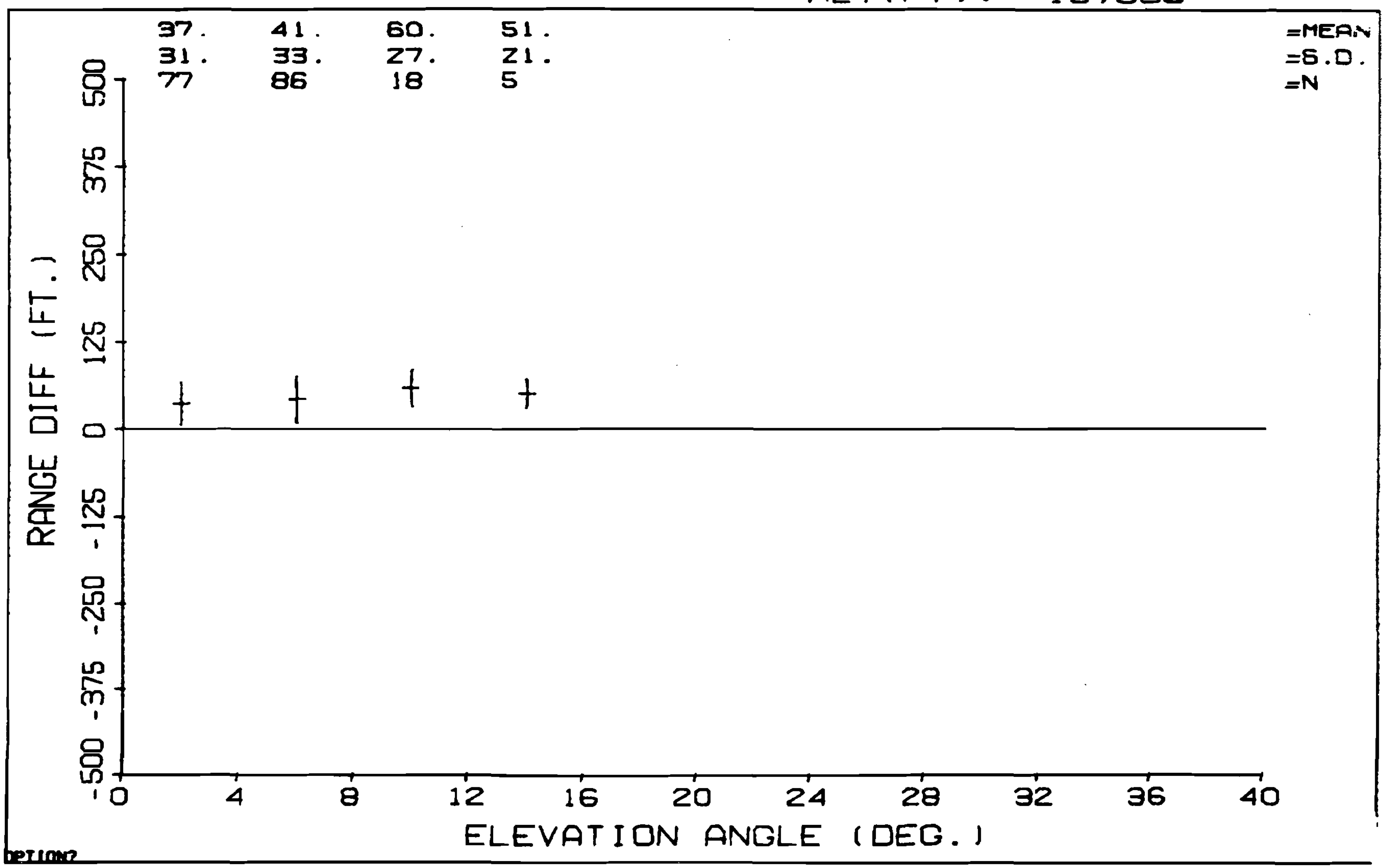


RANGE DIFF VS. ELEVATION ANGLE

DATA PROCESSED BY THE FAA TECHNICAL CENTER
ATLANTIC CITY AIRPORT, N.J. 08405

USA TRANSPONDER 10/13/81

ALT(FT): 15,000

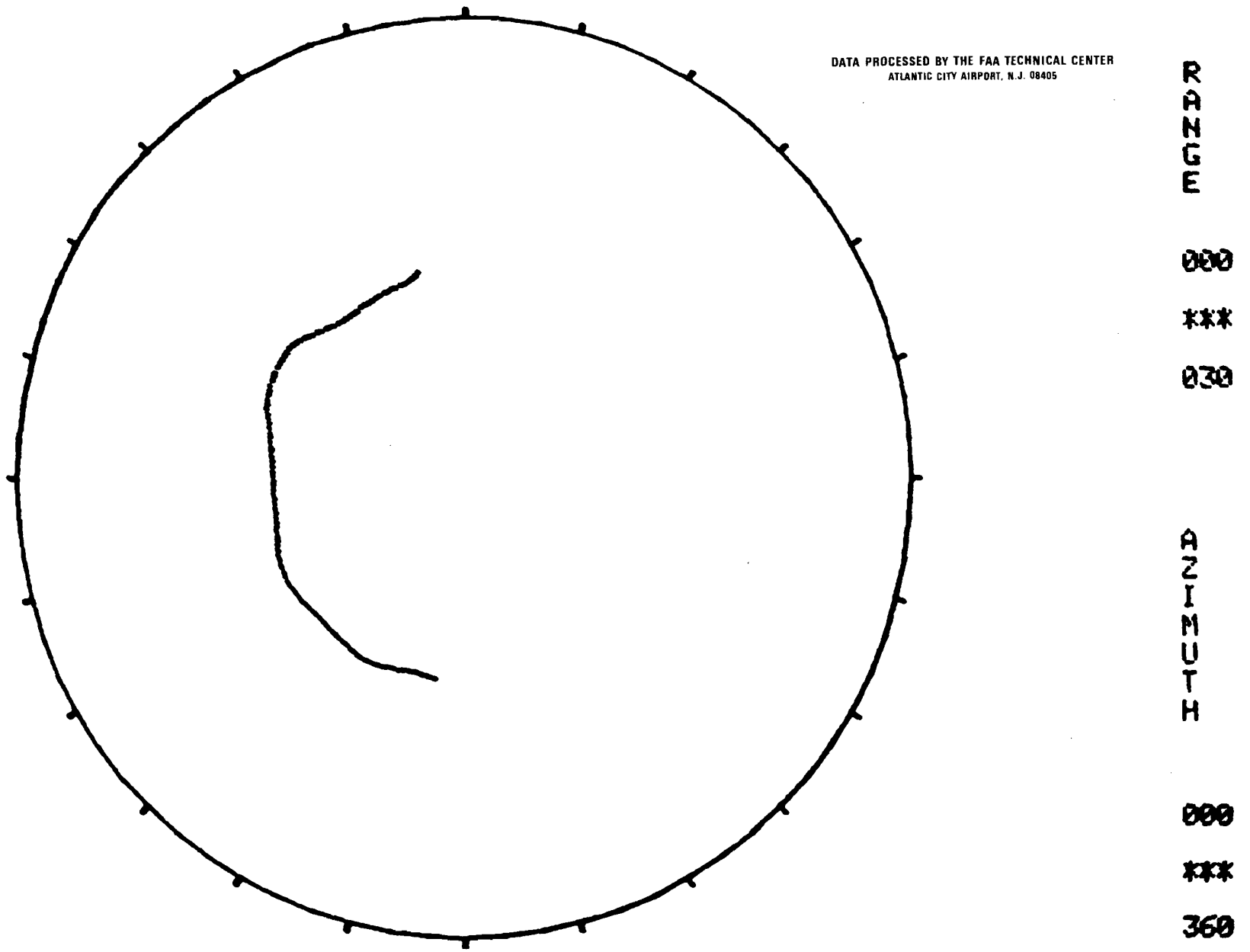


FLIGHT TEST DATA

OCTOBER 14, 1981

ORBITAL

6,000 FT (1,829 m)



OCTOBER 14, 1981, ORBITAL 6,000 FT (1,829 m), U.S.S.R. TRANSPONDER

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[illegible] #  558  SCAN #   30  FILE #   4
[illegible]   RG      AZ     ID/CODE  AL/CF  FW1  FW2    IF#     TIME

[illegible]   [illegible] [illegible]   01   MESS=00000002  FC=0 A=1   15/ 7/18.3
SCAN #   526  ATCRBS TRK =   93   DABS TRK =     3  19.02 15/ 7/19.2
D   [illegible]   0.607 299.136      01   MESS=00000002  FC=0 A=1   15/ 7/22.9
SCAN #   527  ATCRBS TRK =   93   DABS TRK =     3  23.70 15/ 7/23.8
D   [illegible]   0.597 297.949      01   MESS=00000002  FC=0 A=1   15/ 7/27.6
SCAN #   528  ATCRBS TRK =   91   DABS TRK =     3  28.39 15/ 7/28.5
D   [illegible]   0.602 296.411      01   MESS=00000002  FC=3 A=1   15/ 7/32.2
[illegible]   [illegible] [illegible]   01   MESS=00000002  FC=0 A=1   15/ 7/32.[illegible]
SCAN #   529  ATCRBS TRK =   89   DABS TRK =     3  33.08 15/ 7/33.2
D   [illegible]   0.597 295.027      01   MESS=00000002  FC=3 A=1   15/ 7/36.9
D   [illegible]   0.597 295.225      01   MESS=00000002  FC=0 A=1   15/ 7/36.9
SCAN #   530  ATCRBS TRK =   88   DABS TRK =     3  37.76 15/ 7/37.9
D   [illegible]   0.602 294.214      01   MESS=00000002  FC=0 A=1   15/ 7/41.6
SCAN #   531  ATCRBS TRK =   89   DABS TRK =     3  42.45 15/ 7/42.6
[illegible]   0.617 [illegible]   01   MESS=00000002  FC=[illegible] A=1   15/ 7/46.[illegible]
[illegible]   532  ATCRBS TRK =   89   DABS TRK =     3  4[illegible].1[illegible] 15/ 7/4[illegible]
D   [illegible]   0.592 291.270      01   MESS=00000002  FC=0 A=1   15/ 7/50.9
SCAN #   533  ATCRBS TRK =   90   DABS TRK =     3  51.80 15/ 7/52.0
D   [illegible]   0.617 289.929      01   MESS=00000002  FC=0 A=1   15/ 7/55.6
SCAN #   534  ATCRBS TRK =   90   DABS TRK =     3  56.49 15/ 7/56.7
D   33   0.587 288.611      01   MESS=00000002  FC=0 A=1   15/ 8/ 0.2
SCAN #   535  ATCRBS TRK =   90   DABS TRK =     3   1.16 15/ 8/ 1.4
D   [illegible]   0.602 287.2[illegible]   01   MESS=00000002  FC=0 A=1   15/ 8/ 4.9
SCAN #   536  ATCRBS TRK =   88   DABS TRK =     3   5.85 15/ 8/ 5.9
D   28   0.617 285.974      01   MESS=00000002  FC=0 A=1   15/ 8/ 9.6
SCAN #   537  ATCRBS TRK =   88   DABS TRK =     3  10.54 15/ 8/10.5
D   5[illegible]   0.592 285.139      01   MESS=00000002  FC=0 A=1   15/ 8/14.2
SCAN #   538  ATCRBS TRK =   87   DABS TRK =     3  15.21 15/ 8/15.4
D   33   0.607 283.381      01   MESS=00000002  FC=0 A=1   15/ 8/18.9
SCAN #   539  ATCRBS TRK =   [illegible]   DABS TRK =     3  1[illegible].90 15/ 8/20.1
[illegible]   0.602 281.4[illegible]   01   MESS=00000002  FC=3 A=1   15/ 8/23.6
D    0   0.597 281.689      01   MESS=00000002  FC=3 A=1   15/ 8/23.6
D   33   0.602 282.063      01   MESS=00000002  FC=0 A=1   15/ 8/23.6
SCAN #   540  ATCRBS TRK =   88   DABS TRK =     3  24.58 15/ 8/24.7
D   42   0.597 281.052      01   MESS=00000002  FC=0 A=1   15/ 8/28.2
SCAN #   541  ATCRBS TRK =   87   DABS TRK =     3  29.25 15/ 8/29.4
D   30   0.607 279.360      01   MESS=00000002  FC=0 A=1   15/ 8/32.9
SCAN #   542  ATCRBS TRK =   90   DABS TRK [illegible]   3  33.94 15/ 8/34.1
D    0   0.597 277.537      01   MESS=00000002  FC=3 A=1   15/ 8/37.5
D    0   0.597 277.734      01   MESS=00000002  FC=3 A=1   15/ 8/37.5
D   20   0.597 277.932      01   MESS=00000002  FC=0 A=1   15/ 8/37.5
SCAN #   543  ATCRBS TRK =   86   DABS TRK =     3  38.61 15/ 8/38.8
D    0   0.597 276.548      01   MESS=00000002  FC=3 A=1   15/ 8/42.2
D   29   0.597 276.746      01   MESS=00000002  FC=0 A=1   15/ 8/42.2
SCAN #   544  ATCRBS TRK =   89   DABS TRK =     3  4[illegible].29 15/ 8/43.3
[illegible]   0.607 2[illegible].515   01   MESS=00000002  FC=0 A=1   15/ 8/46.8
SCAN #   545  ATCRBS TRK =   89   DABS TRK =     3  4[illegible].97 15/ 8/48.2
[illegible]   0.602 2[illegible].867   01   MESS=00000002  FC=3 A=1   15/ 8/51.5
[illegible]   0.597 2[illegible].087   01   MESS=00000002  FC=0 A=1   15/ 8/51.5
SCAN #   546  ATCRBS TRK =   90   DABS TRK =     3  5[illegible].65 15/ 8/52.8
[illegible]   0.617 272.681      01   MESS=00000002  FC=3 A=1   15/ 8/56.2
```

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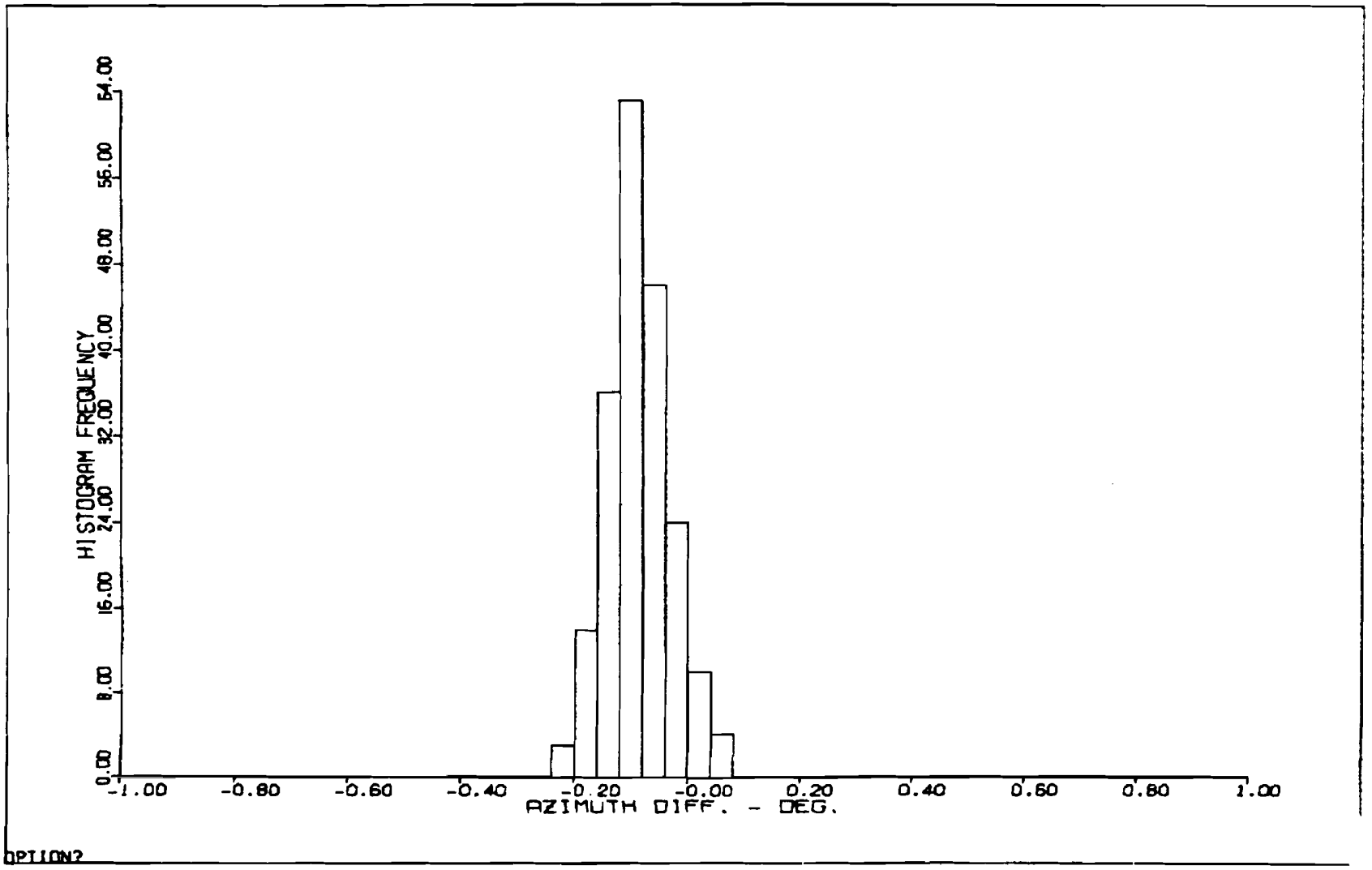
SAMPLE LISTING OF SOVIET REPLIES FOR OCTOBER 14, 1981, ORBITAL

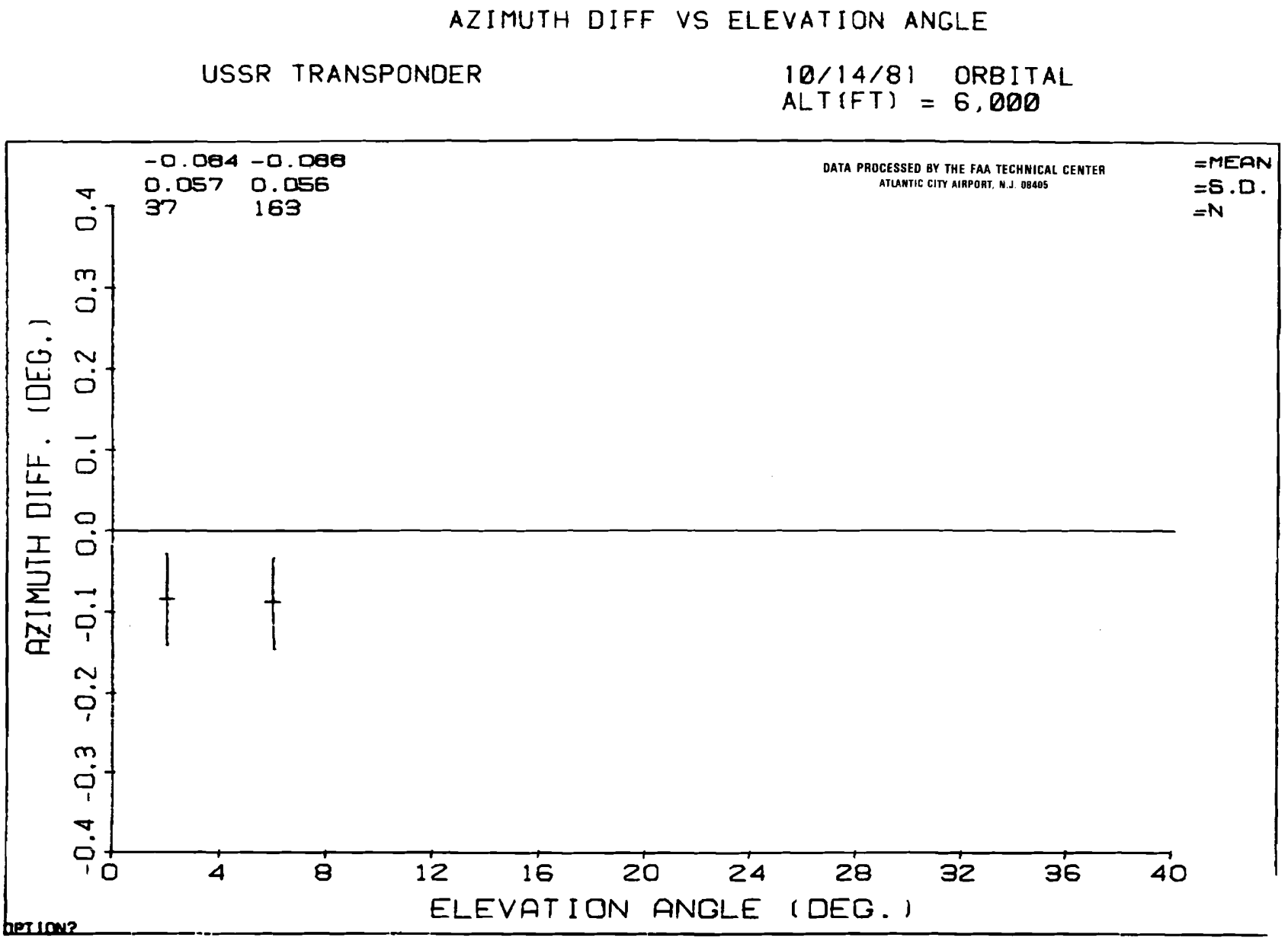
AZIMUTH DIFF - DEG

DATA PROCESSED BY THE FAA TECHNICAL CENTER
ATLANTIC CITY AIRPORT, N.J. 08405

USSR TRANSPONDER
10/14/81 ORBITAL
ALT(FT) = 6,000

MEAN = -0.087
STD DEV = 0.056
NO SAMPLES = 200



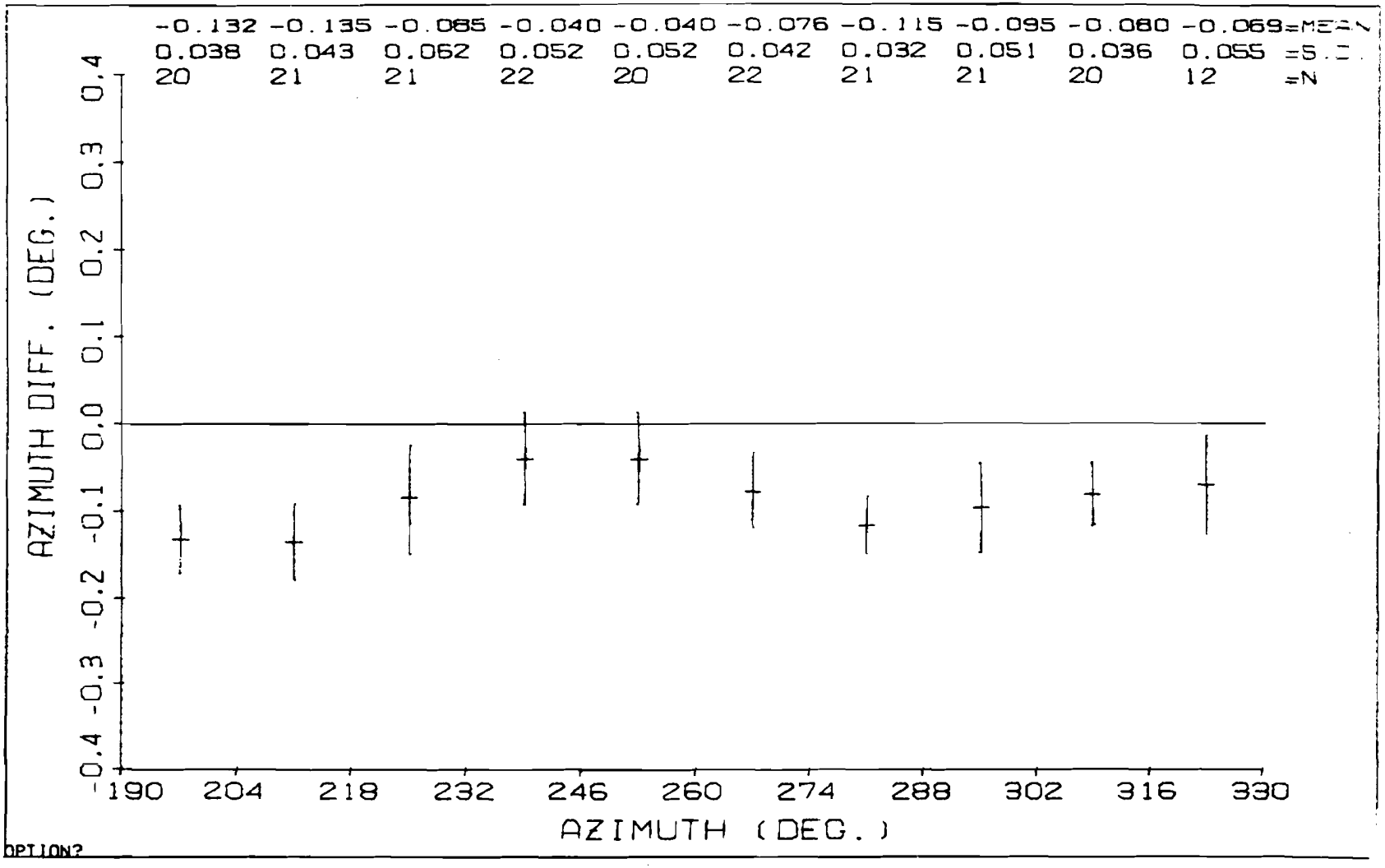

AZIMUTH DIFF VS ELEVATION ANGLE
USSR TRANSPONDER
10/14/81 ORBITAL
ALT(FT) = 6,000
-0.084 -0.088
0.057 0.056
37 163
DATA PROCESSED BY THE FAA TECHNICAL CENTER
ATLANTIC CITY AIRPORT, N.J. 08405
=MEAN
=S.D.
=N
AZIMUTH DIFF. (DEG.)
-0.4 -0.3 -0.2 -0.1 0.0 0.1 0.2 0.3 0.4
0 4 8 12 16 20 24 28 32 36 40
ELEVATION ANGLE (DEG.)
OPTION?

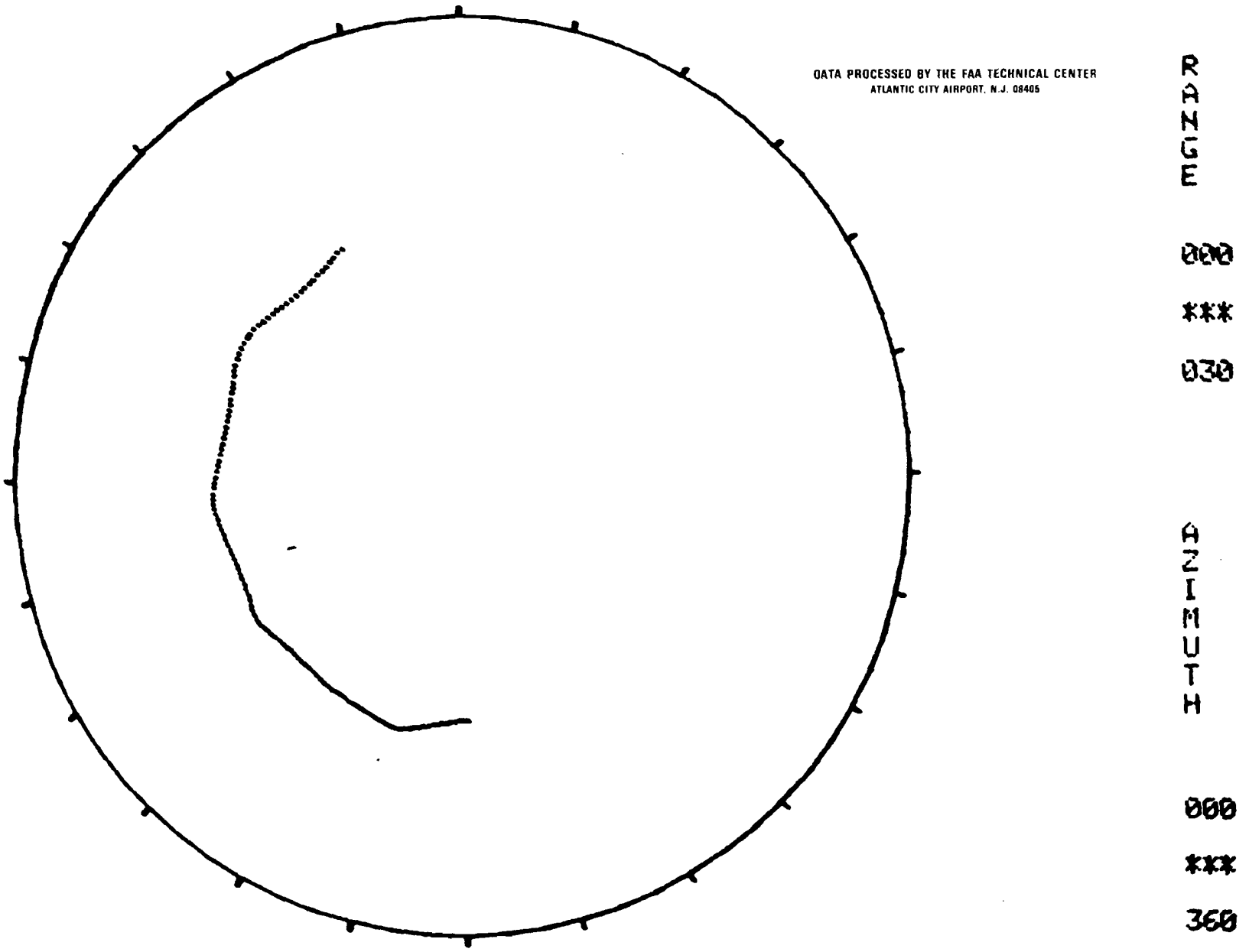
AZIMUTH DIFF VS AZIMUTH

DATA PROCESSED BY THE FAA TECHNICAL CENTER
ATLANTIC CITY AIRPORT, N.J. 08405

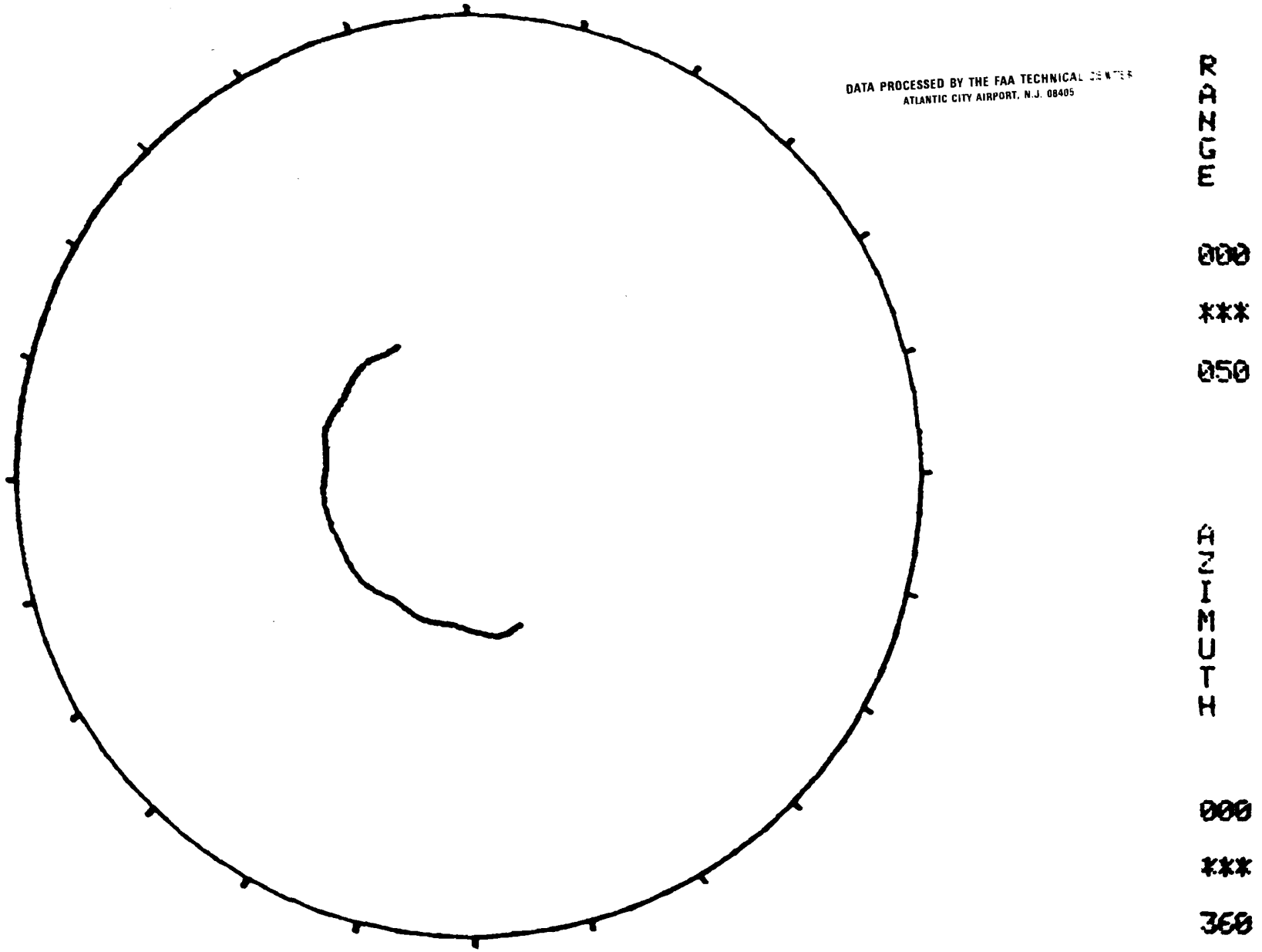
USSR TRANSPONDER

10/14/81 ORBITAL
ALT(FT) = 6,000

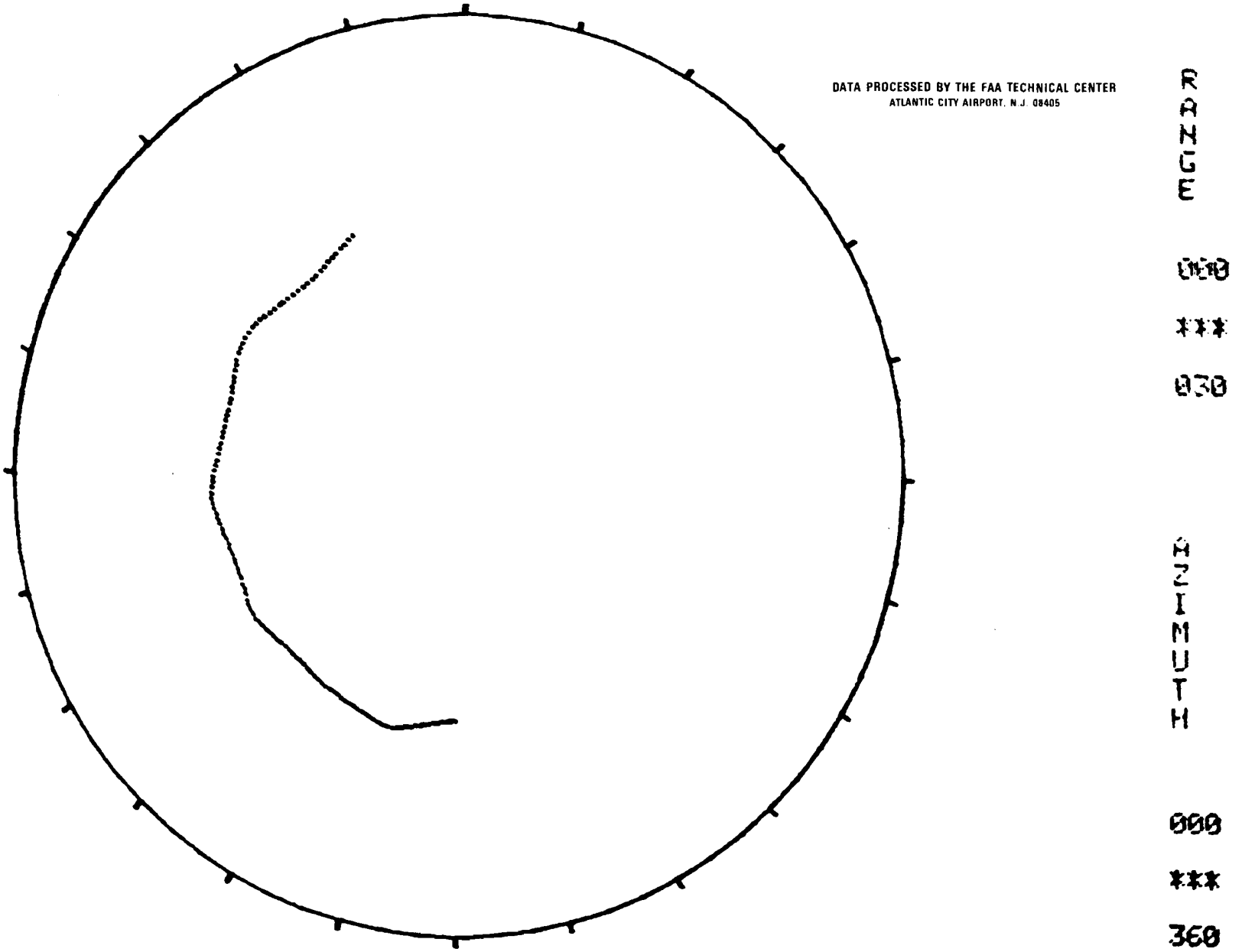




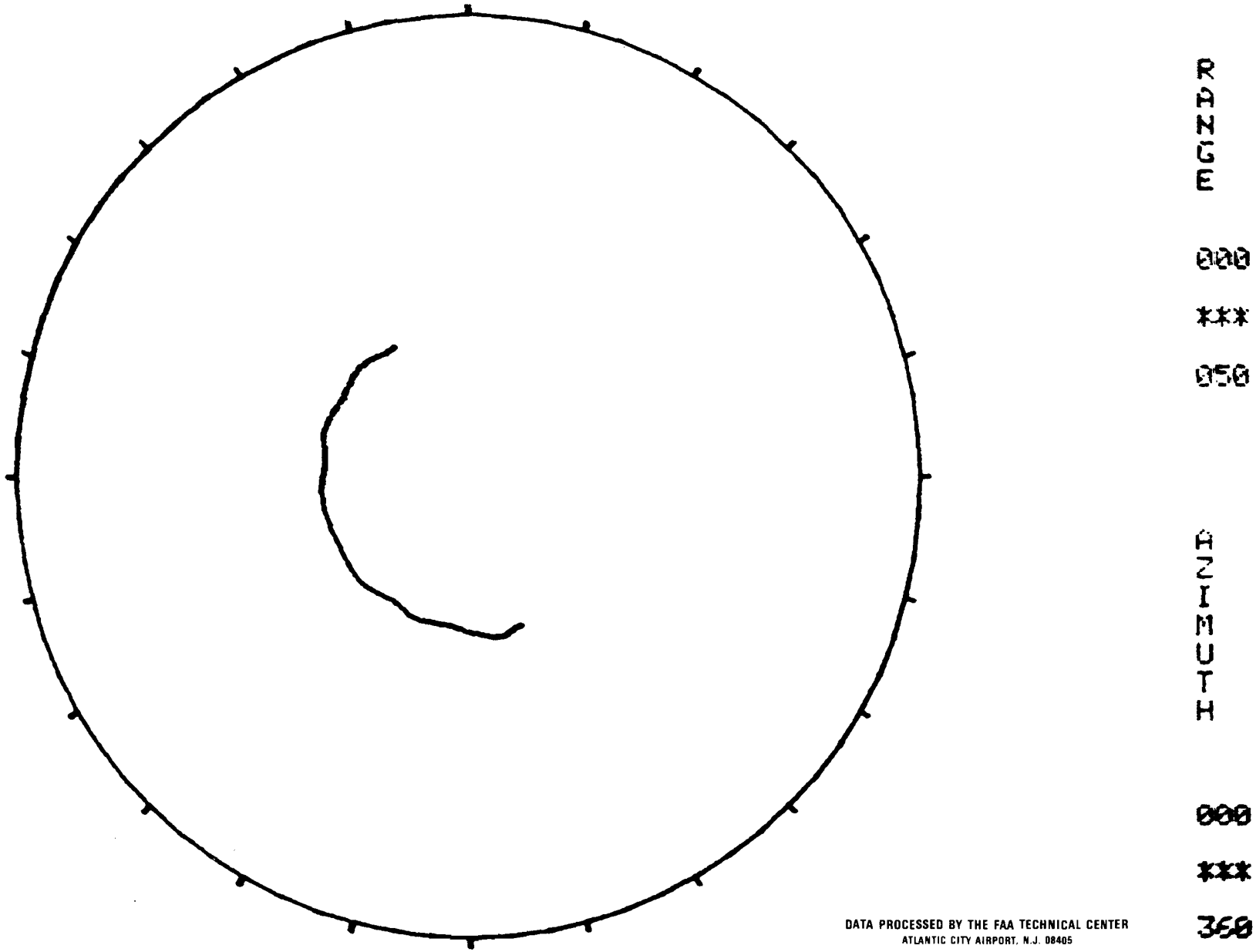
OCTOBER 16, 1981, ORBITAL 12,500 FT (3,810 m), U.S.S.R. TRANSPONDER



OCTOBER 16, 1981, ORBITAL 12,500 FT (3,810 m), U.S.S.R. TRANSPONDER



OCTOBER 1981, ORBITAL 12, 500 FT (3,810 m), U.S. TRANSPONDER



OCTOBER 16, 1981, ORBITAL 12,500 FT (3,810 m), U.S. TRANSPONDER

```
   RECORD # 3032  SCAN #  180  FILE #   4
ATC##   RG      AZ     ID/CODE  AL/CF  FW1  FW2   IF#     TIME

D    33    0.577 329.370      CA    MESS=00000BA2  FC=0 A=1   14/42/43.1
SCAN # 1443  ATCRBS TRK =   87   DABS TRK =     4  43.53 14/42/43.6
D    29    0.587 327.986      CA    MESS=00000BA2  FC=0 A=1   14/42/47.8
SCAN # 1444  ATCRBS TRK =   88   DABS TRK =     4  48.21 14/42/48.3
D     4    0.582 326.646      CA    MESS=00000BA2  FC=2 A=1   14/42/52.4
D    27    0.582 326.843      CA    MESS=00000BA2  FC=0 A=1   14/42/52.4
SCAN # 1445  ATCRBS TRK =   88   DABS TRK =     4  52.90 14/42/53.1
D    31    0.607 326.272      CA    MESS=00000BA2  FC=0 A=1   14/42/57.1
SCAN # 1446  ATCRBS TRK =   87   DABS TRK =     4  57.59 14/42/57.7
D    41    0.592 324.756      CA    MESS=00000BA2  FC=0 A=1   14/43/ 1.8
SCAN # 1447  ATCRBS TRK =   88   DABS TRK =     4   2.27 14/43/ 2.4
D    39    0.617 323.525      CA    MESS=00000BA2  FC=0 A=1   14/43/ 6.4
SCAN # 1448  ATCRBS TRK =   88   DABS TRK =     4   6.95 14/43/ 7.0
D    39    0.617 322.273      CA    MESS=00000BA2  FC=0 A=1   14/43/11.1
SCAN # 1449  ATCRBS TRK =   88   DABS TRK =     4  11.63 14/43/11.8
D    40    0.622 320.999      CA    MESS=00000BA2  FC=0 A=1   14/43/15.8
SCAN # 1450  ATCRBS TRK =   88   DABS TRK =     4  16.30 14/43/16.4
D    15    0.622 319.417      CA    MESS=00000BA2  FC=3 A=1   14/43/20.4
D    35    0.627 319.658      CA    MESS=00000BA2  FC=0 A=1   14/43/20.4
SCAN # 1451  ATCRBS TRK =   86   DABS TRK =     4  20.99 14/43/21.2
D    20    0.622 318.142      CA    MESS=00000BA2  FC=3 A=1   14/43/25.1
D    35    0.622 318.384      CA    MESS=00000BA2  FC=0 A=1   14/43/25.1
SCAN # 1452  ATCRBS TRK =   87   DABS TRK =     4  25.67 14/43/25.7
D    30    0.647 317.065      CA    MESS=00000BA2  FC=0 A=1   14/43/29.8
SCAN # 1453  ATCRBS TRK =   89   DABS TRK =     4  30.36 14/43/30.5
D    34    0.642 315.923      CA    MESS=00000BA2  FC=0 A=1   14/43/34.4
SCAN # 1454  ATCRBS TRK =   89   DABS TRK =     4  35.05 14/43/35.2
D     0    0.642 314.297      CA    MESS=00000BA2  FC=3 A=1   14/43/39.1
D    29    0.642 314.539      CA    MESS=00000BA2  FC=0 A=1   14/43/39.1
SCAN # 1455  ATCRBS TRK =   91   DABS TRK =     4  39.73 14/43/39.9
D     0    0.632 312.979      CA    MESS=00000BA2  FC=3 A=1   14/43/43.7
D     0    0.632 313.220      CA    MESS=00000BA2  FC=3 A=1   14/43/43.7
D    36    0.632 313.550      CA    MESS=00000BA2  FC=0 A=1   14/43/43.8
SCAN # 1456  ATCRBS TRK =   94   DABS TRK =     4  44.42 14/43/44.5
D    29    0.622 312.144      CA    MESS=00000BA2  FC=0 A=1   14/43/48.4
SCAN # 1457  ATCRBS TRK =   95   DABS TRK =     4  49.10 14/43/49.3
D     4    0.612 310.737      CA    MESS=00000BAA  FC=2 A=1   14/43/53.1
D    28    0.612 310.957      CA    MESS=00000BA2  FC=0 A=1   14/43/53.1
SCAN # 1458  ATCRBS TRK =   94   DABS TRK =     4  53.80 14/43/53.8
D     4    0.612 309.661      CA    MESS=00040BE0  FC=2 A=1   14/43/57.8
D    31    0.612 309.880      CA    MESS=00000BA2  FC=0 A=1   14/43/57.8
SCAN # 1459  ATCRBS TRK =   96   DABS TRK =     4  58.48 14/43/58.6
D    34    0.602 308.782      CA    MESS=00000BA2  FC=0 A=1   14/44/ 2.5
SCAN # 1460  ATCRBS TRK =   91   DABS TRK =     4   3.16 14/44/ 3.3
D     0    0.602 307.244      CA    MESS=00000BA2  FC=3 A=1   14/44/ 7.1
D    28    0.597 307.465      CA    MESS=00000BA2  FC=0 A=1   14/44/ 7.1
SCAN # 1461  ATCRBS TRK =   92   DABS TRK =     4   7.85 14/44/ 7.9
D    32    0.587 306.321      CA    MESS=00000BA2  FC=0 A=1   14/44/11.8
SCAN # 1462  ATCRBS TRK =   91   DABS TRK =     4  12.54 14/44/12.6
D     0    0.582 304.651      CA    MESS=00000BA2  FC=3 A=1   14/44/16.5
D    29    0.582 304.893      CA    MESS=00000BA2  FC=0 A=1   14/44/16.5
```

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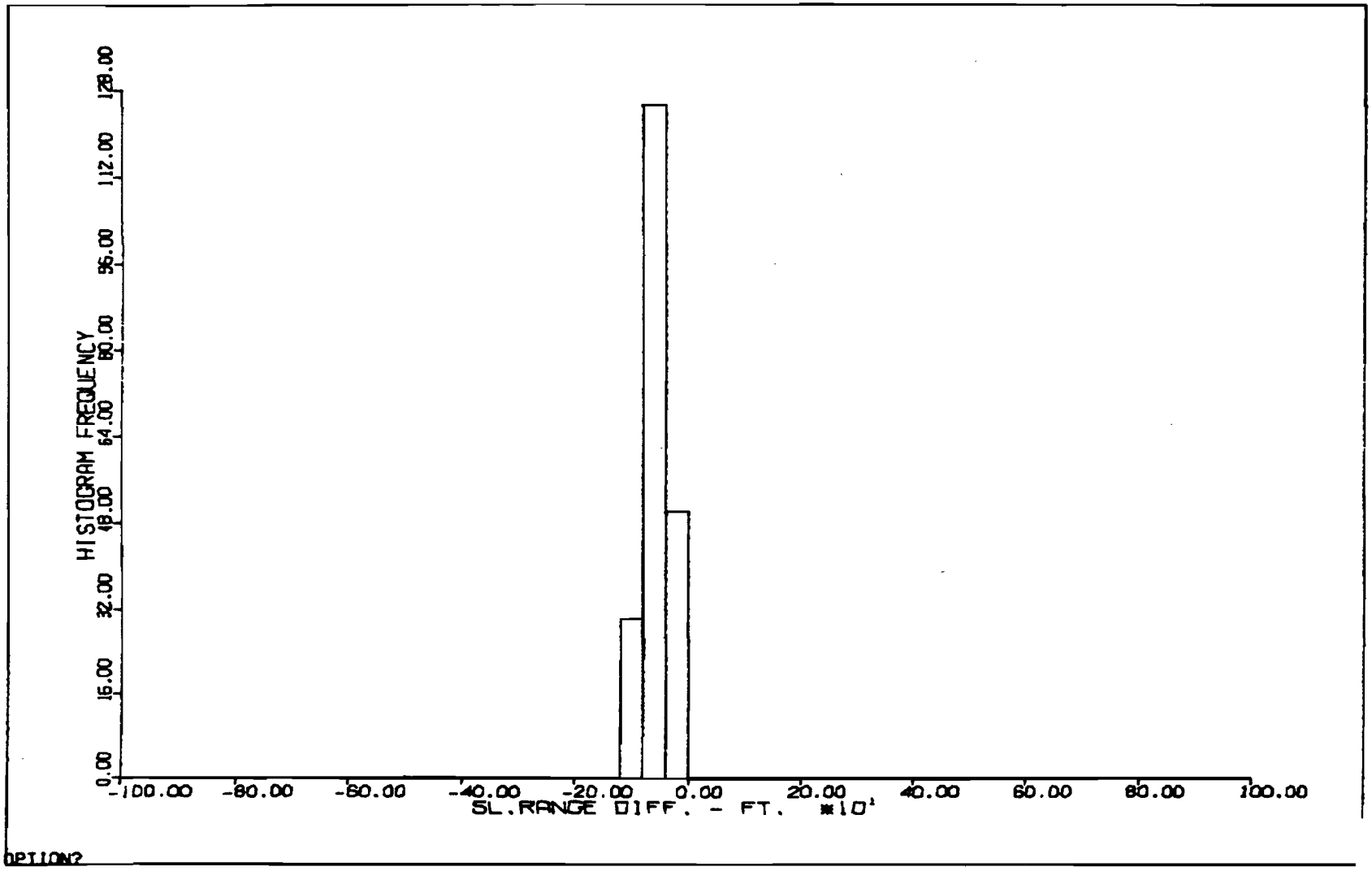
SAMPLE LISTING OF SOVIET REPLIES FOR OCTOBER 16, 1981, ORBITAL

SLANT RANGE DIFF - FT

DATA PROCESSED BY THE FAA TECHNICAL CENTER
ATLANTIC CITY AIRPORT, N.J. 08405

USSR TRANSPONDER
10/16/81 ORBITAL
ALT(FT) = 12,500

MEAN = -55.87
STD DEV = 21.09
NO SAMPLES = 205

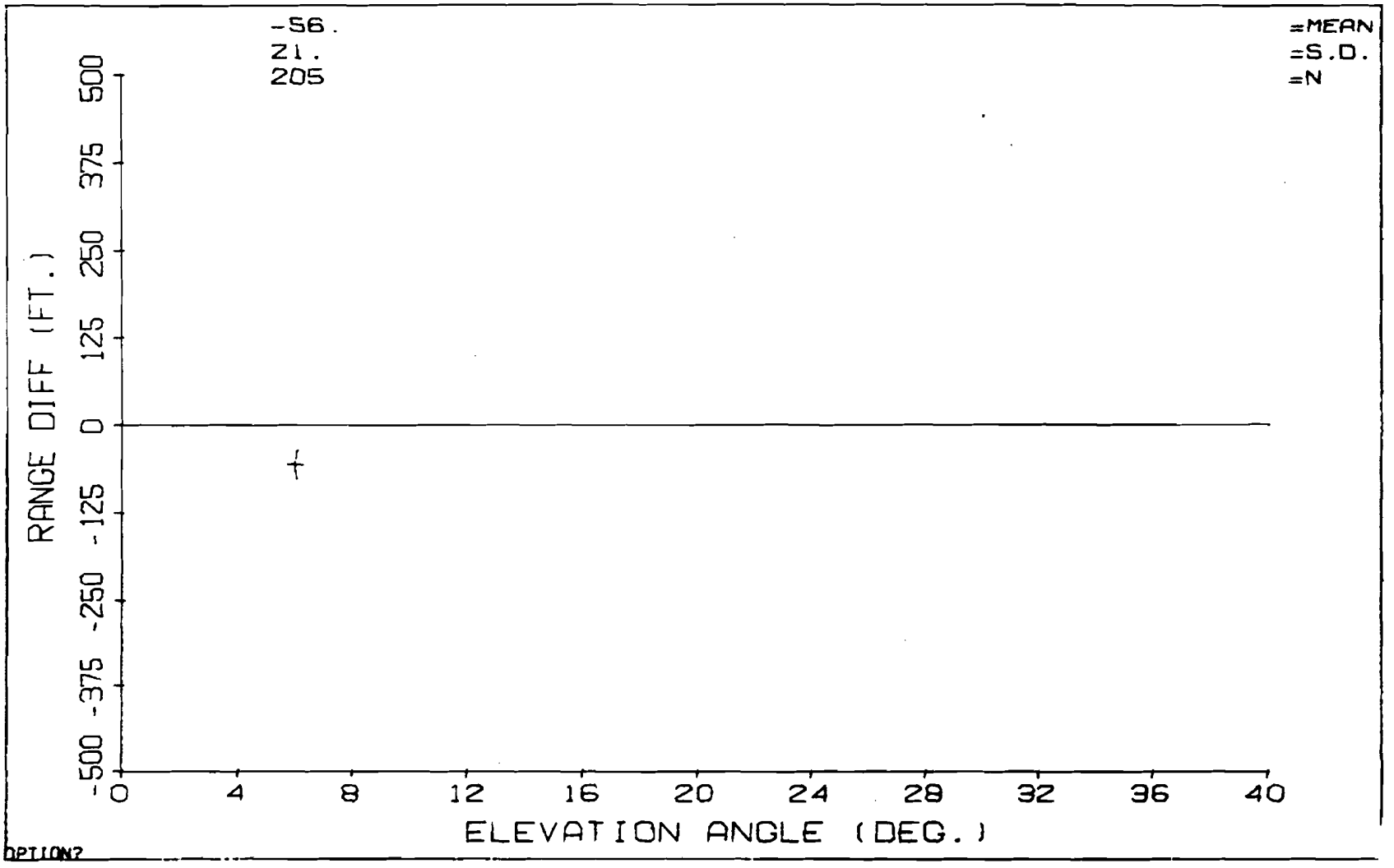


RANGE DIFF VS ELEVATION ANGLE

DATA PROCESSED BY THE FAA TECHNICAL CENTER
ATLANTIC CITY AIRPORT, N.J. 08405

USSR TRANSPONDER

10/16/81 ORBITAL
ALT(FT) = 12,500

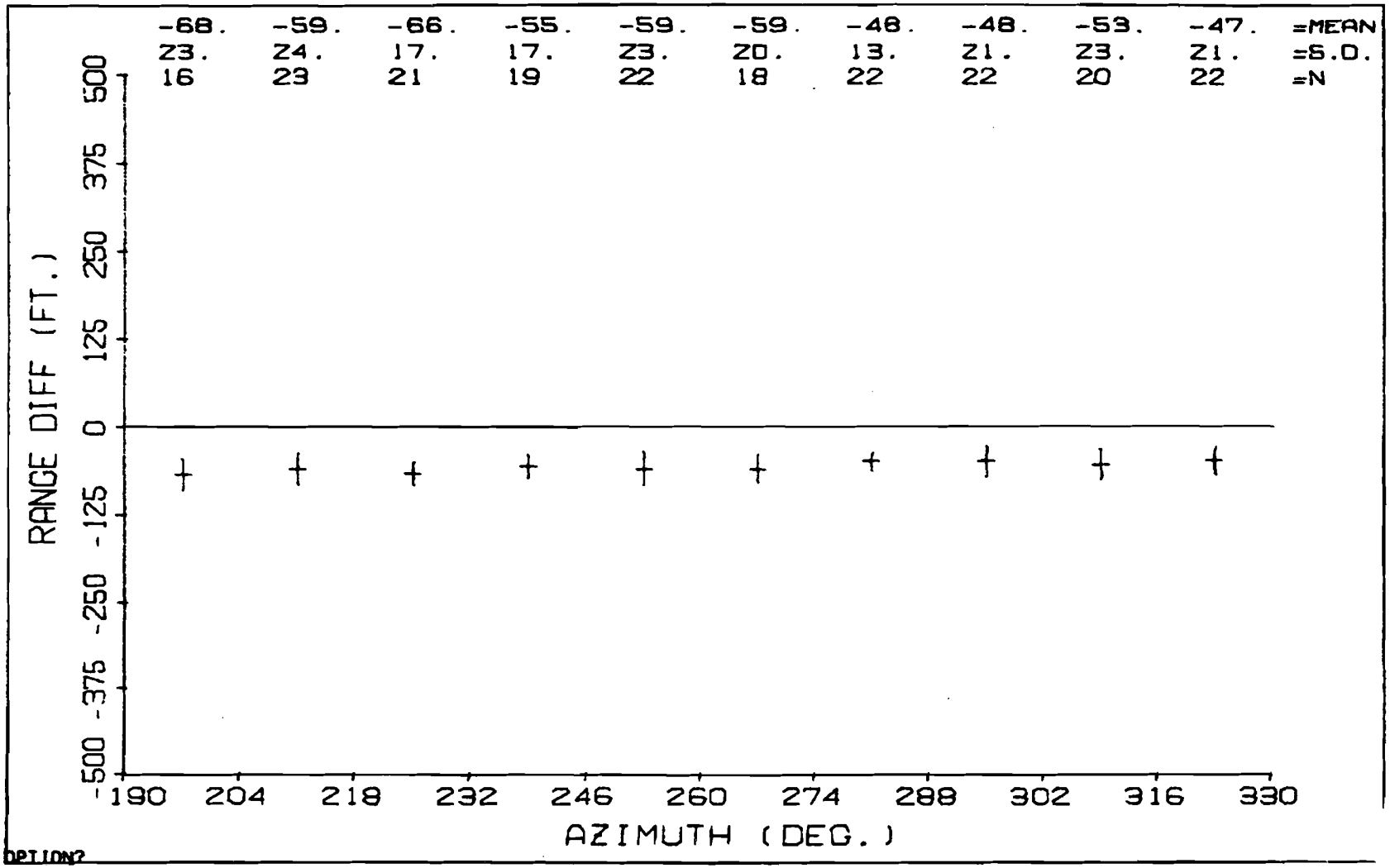


RANGE DIFF VS AZIMUTH

DATA PROCESSED BY THE FAA TECHNICAL CENTER
ATLANTIC CITY AIRPORT, N.J. 08405

USSR TRANSPONDER

10/16/81 ORBITAL
ALT(FT) = 12,500

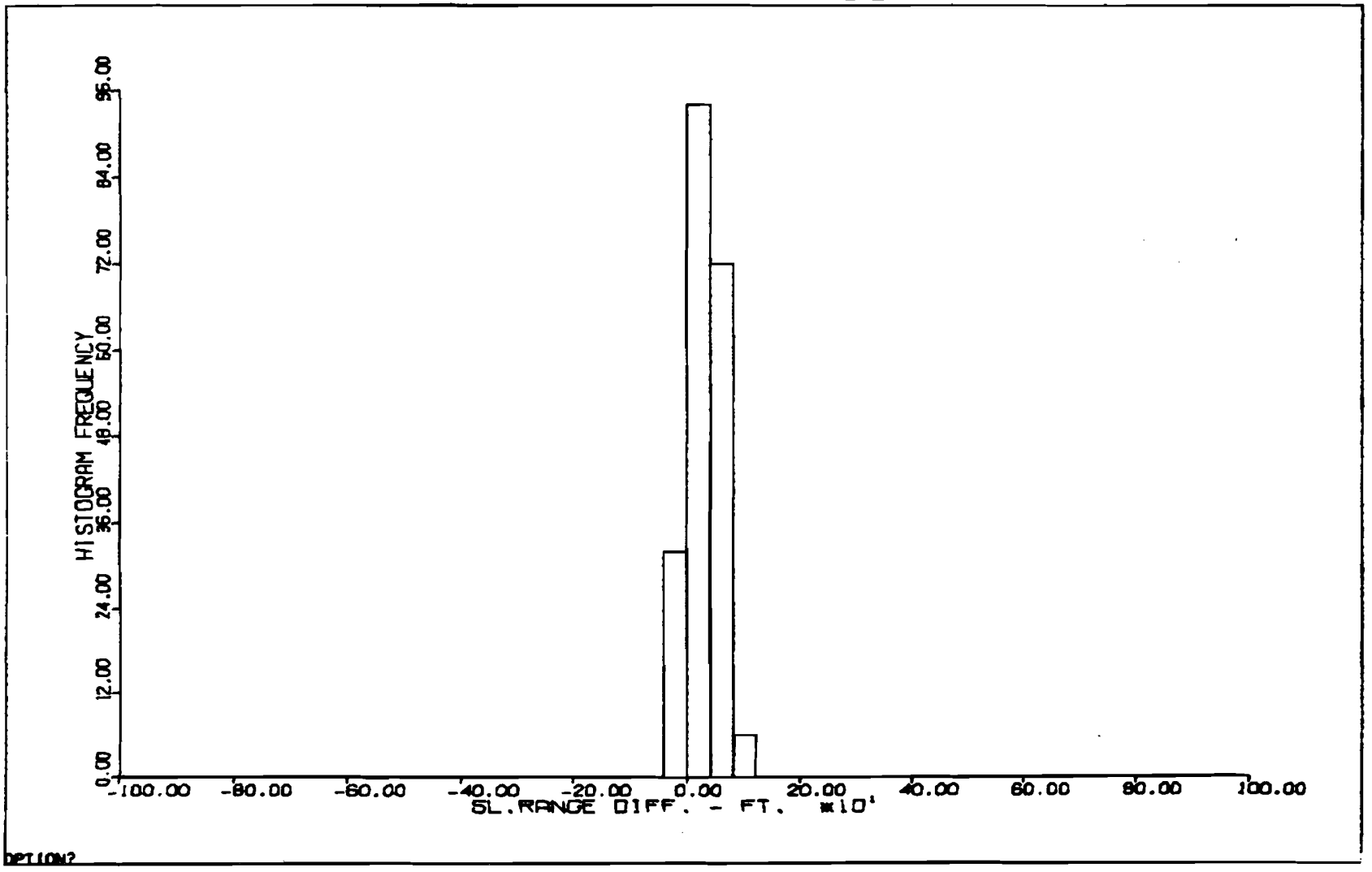


SLANT RANGE DIFF. - FT.

DATA PROCESSED BY THE FAA TECHNICAL CENTER
ATLANTIC CITY AIRPORT, N.J. 08405

USA TRANSPONDER
10/16/81 ORBITAL
ALT(FT) = 12500

MEAN = 30.080
STD DEV = 26.433
NO SAMPLES = 204

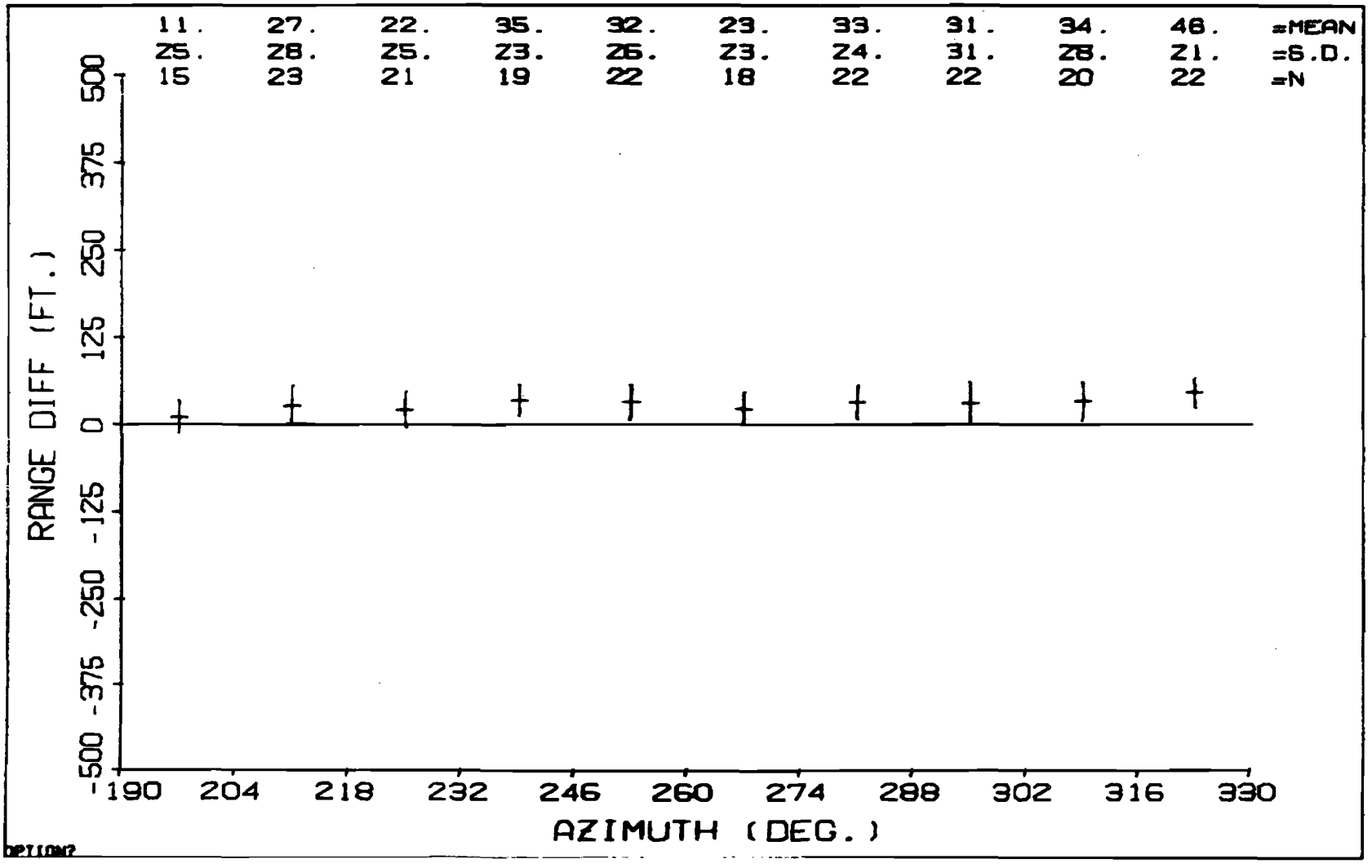


RANGE DIFF VS. AZIMUTH

DATA PROCESSED BY THE FAA TECHNICAL CENTER
ATLANTIC CITY AIRPORT, N.J. 08405

USA TRANSPONDER 10/16/81

ALT(FT): 12,500



RANGE DIFF VS. ELEVATION ANGLE

DATA PROCESSED BY THE FAA TECHNICAL CENTER
ATLANTIC CITY AIRPORT, N.J. 08405

USA TRANSPONDER 10/16/81

ALT(FT): 12,500