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ROYAL AIRCRAFT ESTABLISHMENT FARNBOROUGH (ENGLAND)
CONTRIBUTIONS TO THE UK MICROWAVE LANDING SYSTEM RESEARCH AND D--ETC(U)
MAY 79 J M JONES

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RAE-TR-79052-VOL-2

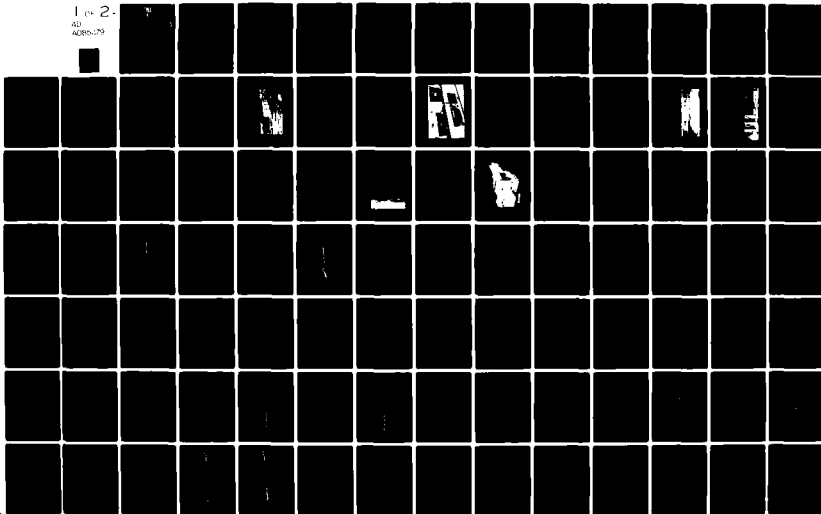
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ROYAL AIRCRAFT ESTABLISHMENT

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9 Technical Report 79052

11 May 1979

6 CONTRIBUTIONS TO THE UK MICROWAVE LANDING SYSTEM RESEARCH AND DEVELOPMENT PROGRAMME 1974 TO 1978.

Volume 2.

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VOLUME 2

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Procurement Executive, Ministry of Defence
Farnborough, Hants

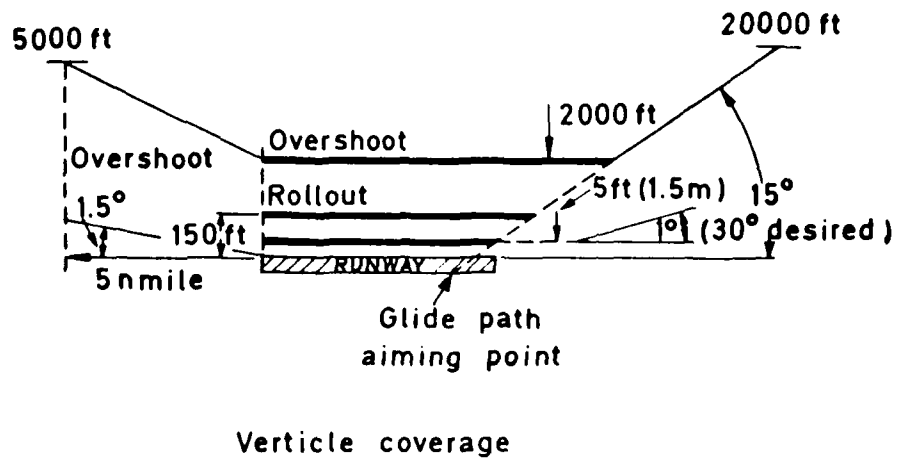
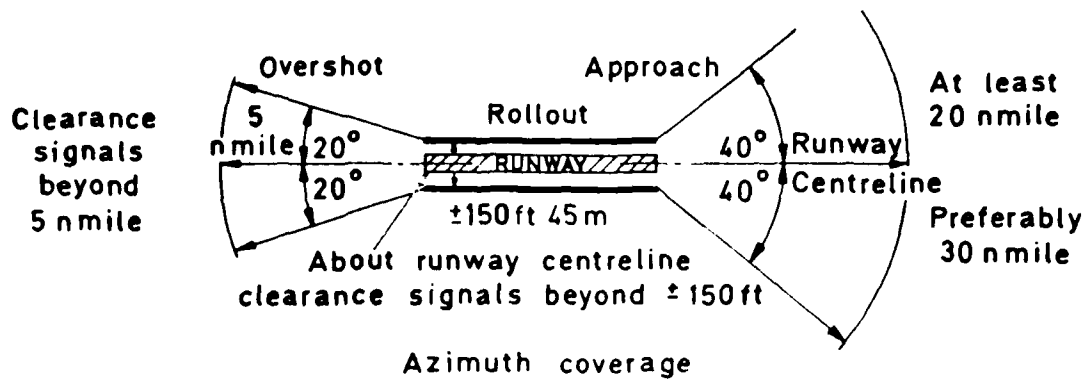
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Fig 1.1



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Fig 1.1 Coverage requirements for MLS

Fig 2.1

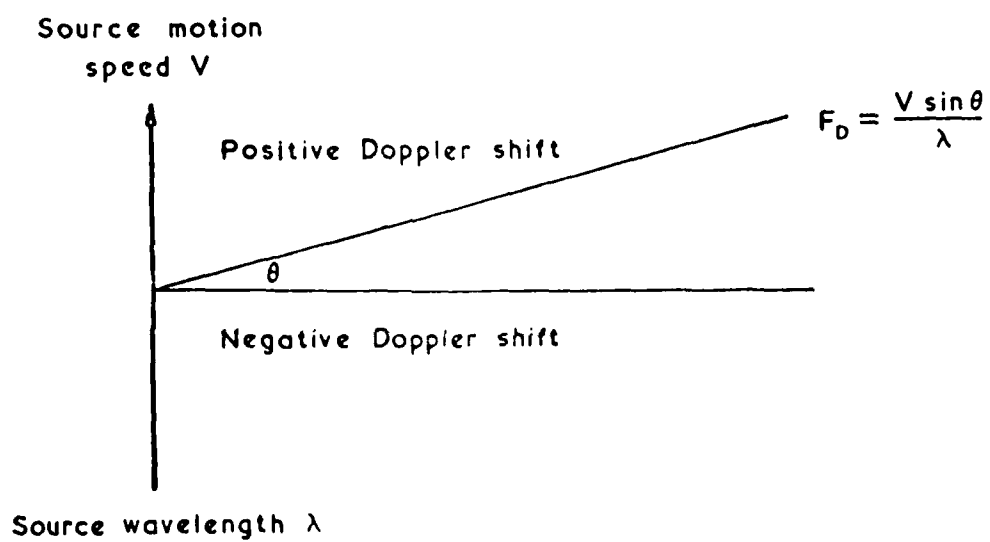


Fig 2.1 Doppler effect

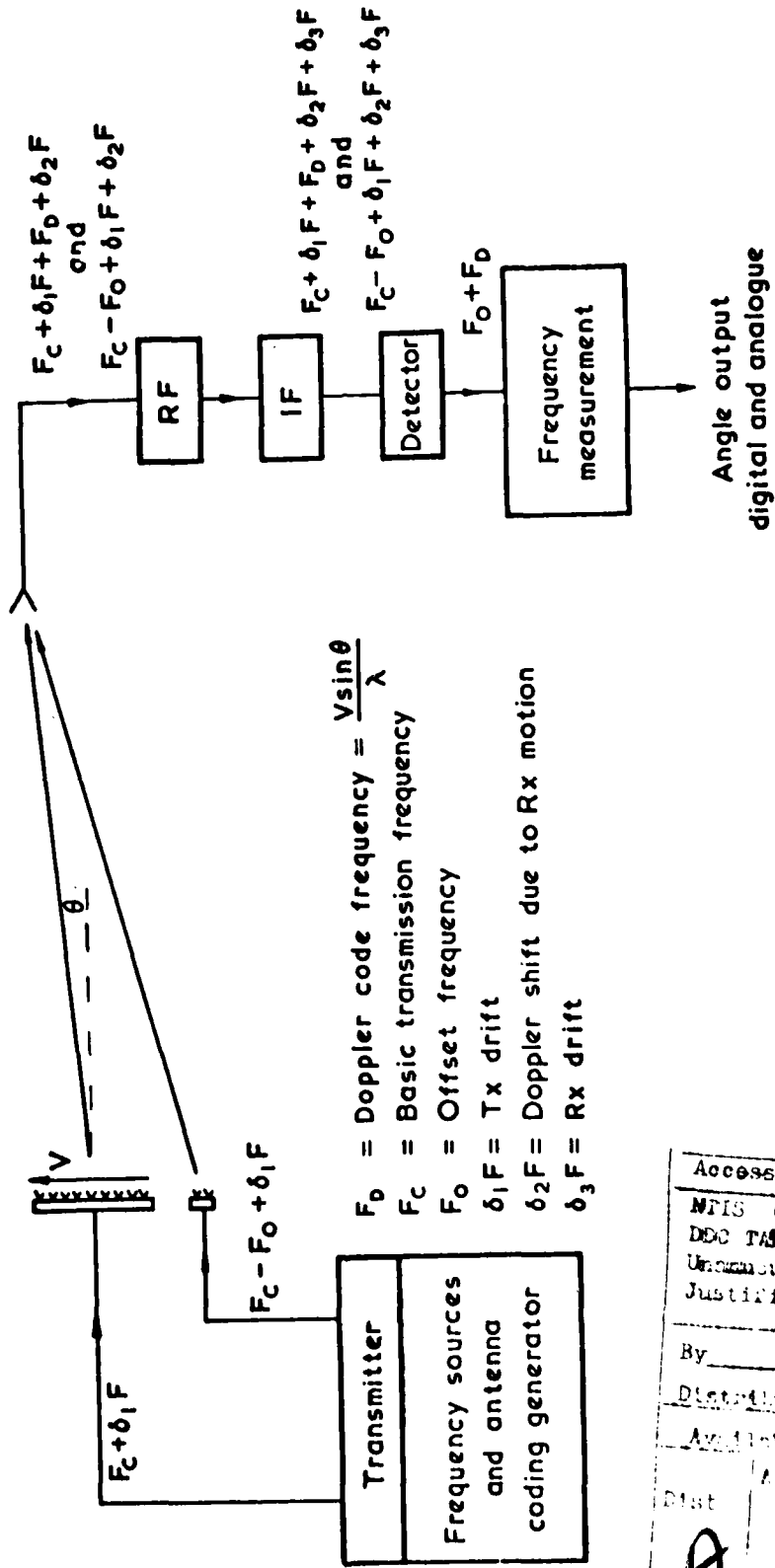
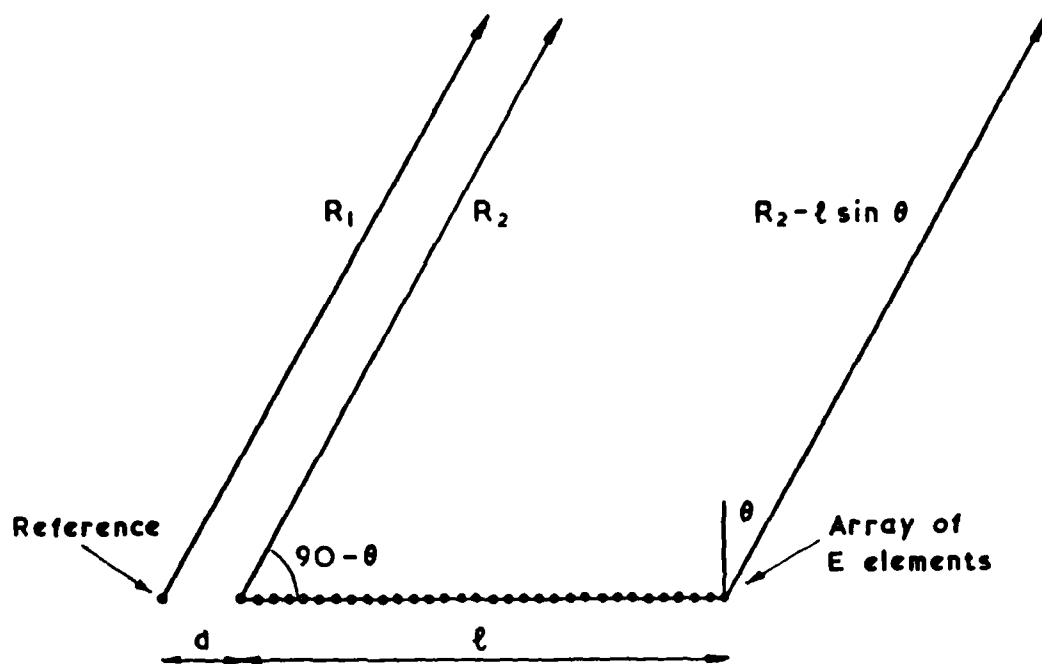


Fig 2.2

Fig 2.2 Basic system - block diagram

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Fig 2.3



$$d = D\lambda \quad l = L\lambda$$

Reference transmission $\exp j\omega_R t$

Array signal 'left to right' $\exp j(\omega_{A_1} t + \alpha)$

Array signal 'right to left' $\exp j(\omega_{A_2} t + \beta)$

Fig 2.3 Propagation geometry

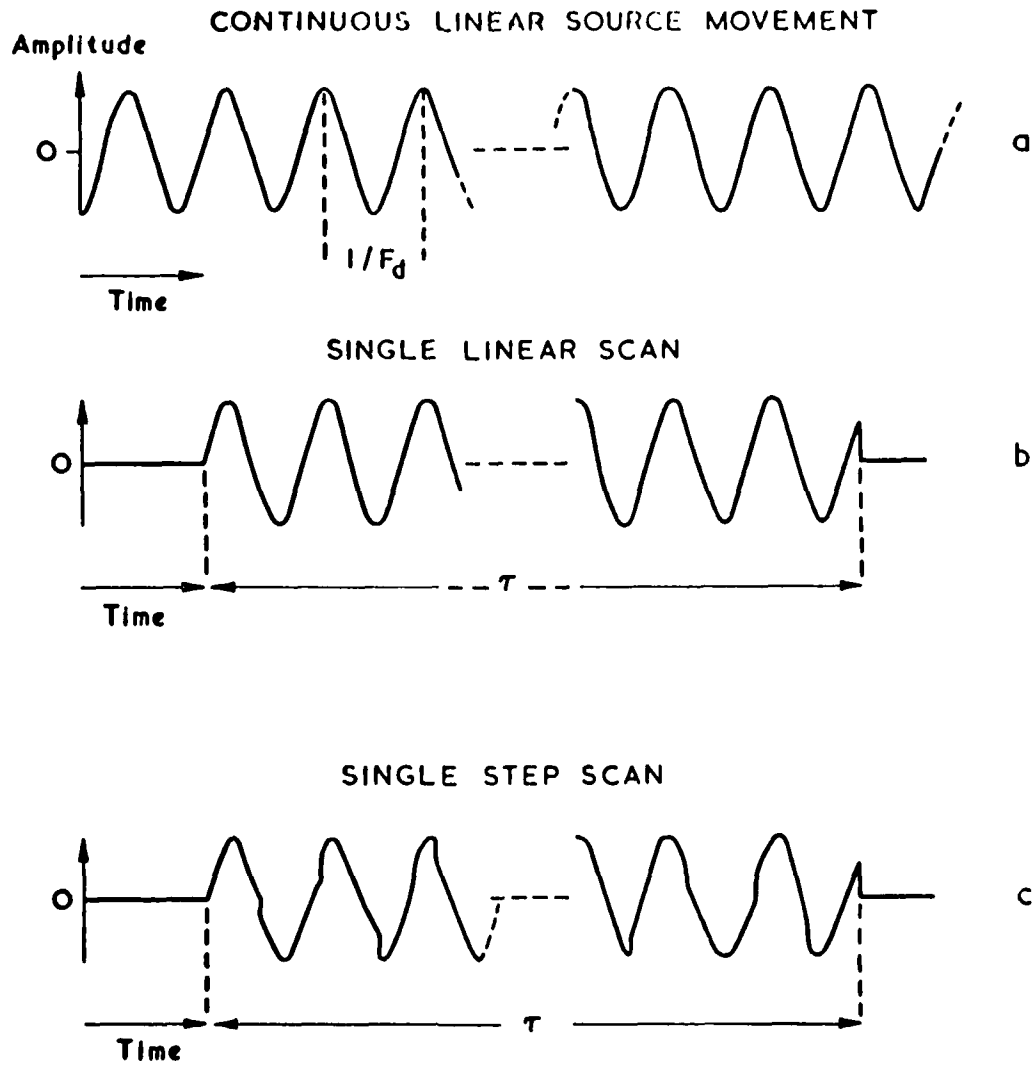


Fig 2.4 Doppler signal waveforms

Fig 2.5

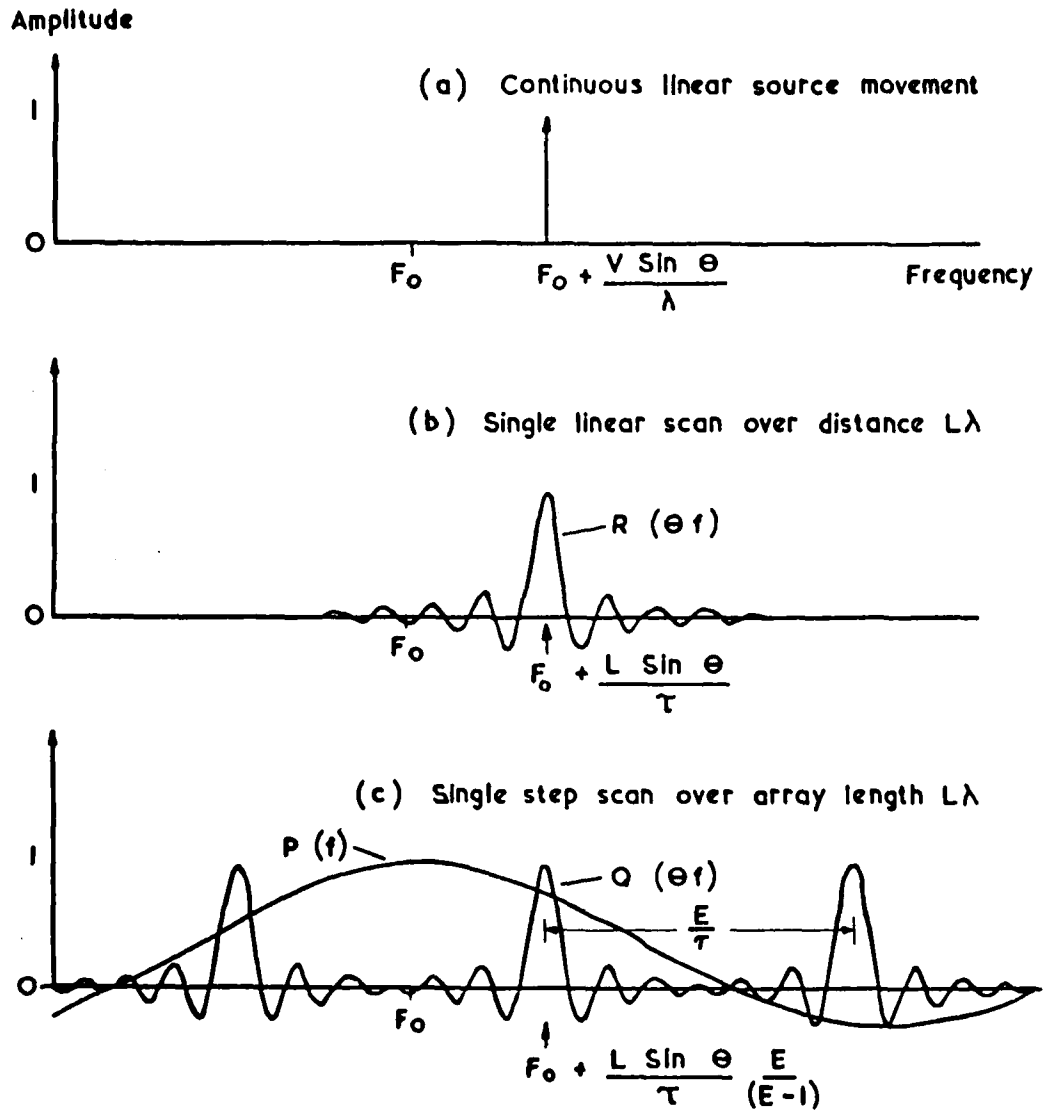


Fig 2.5 Doppler signal spectra

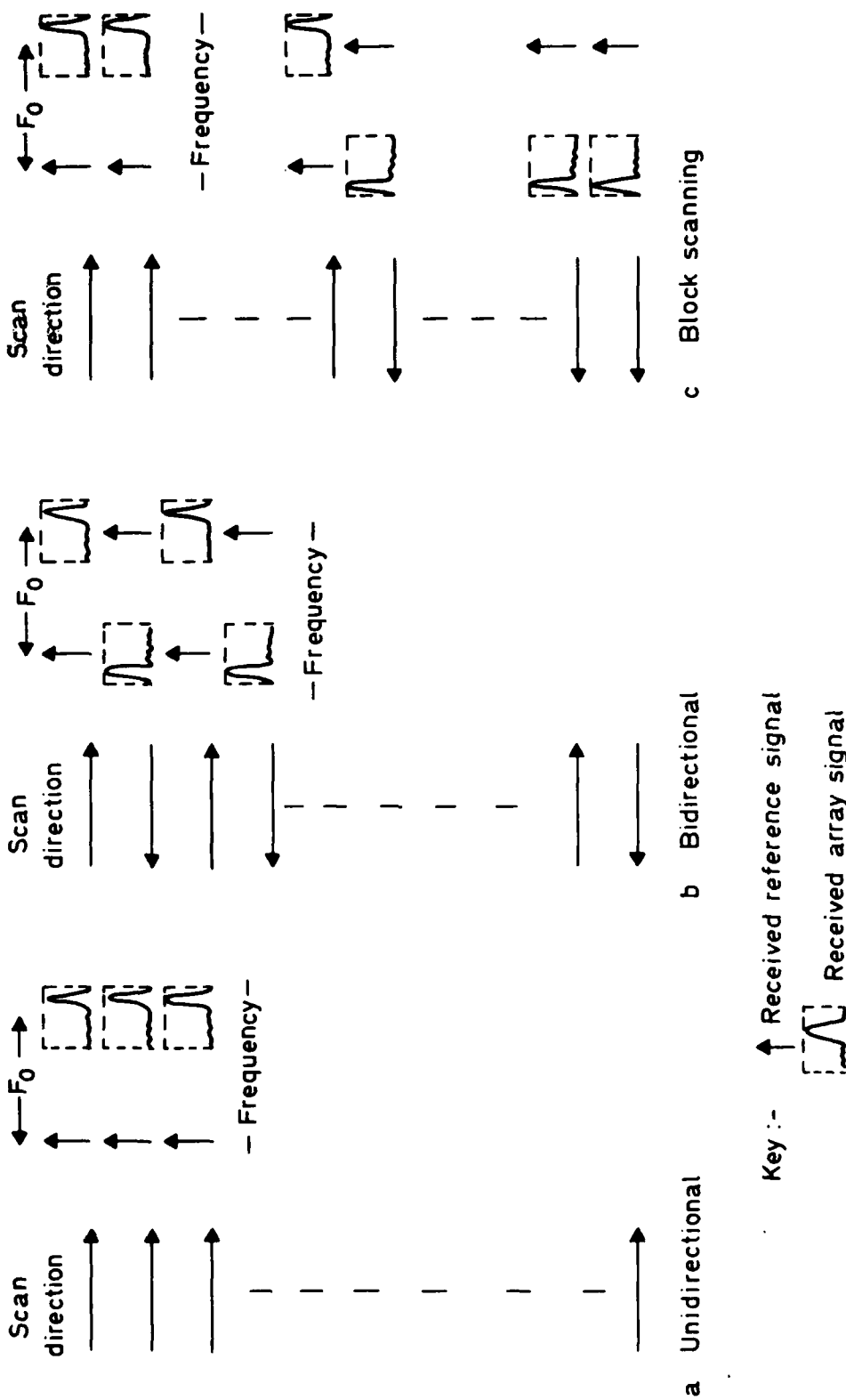


Fig 2.6

Fig 2.6 Typical angle transmission formats

Fig 2.7

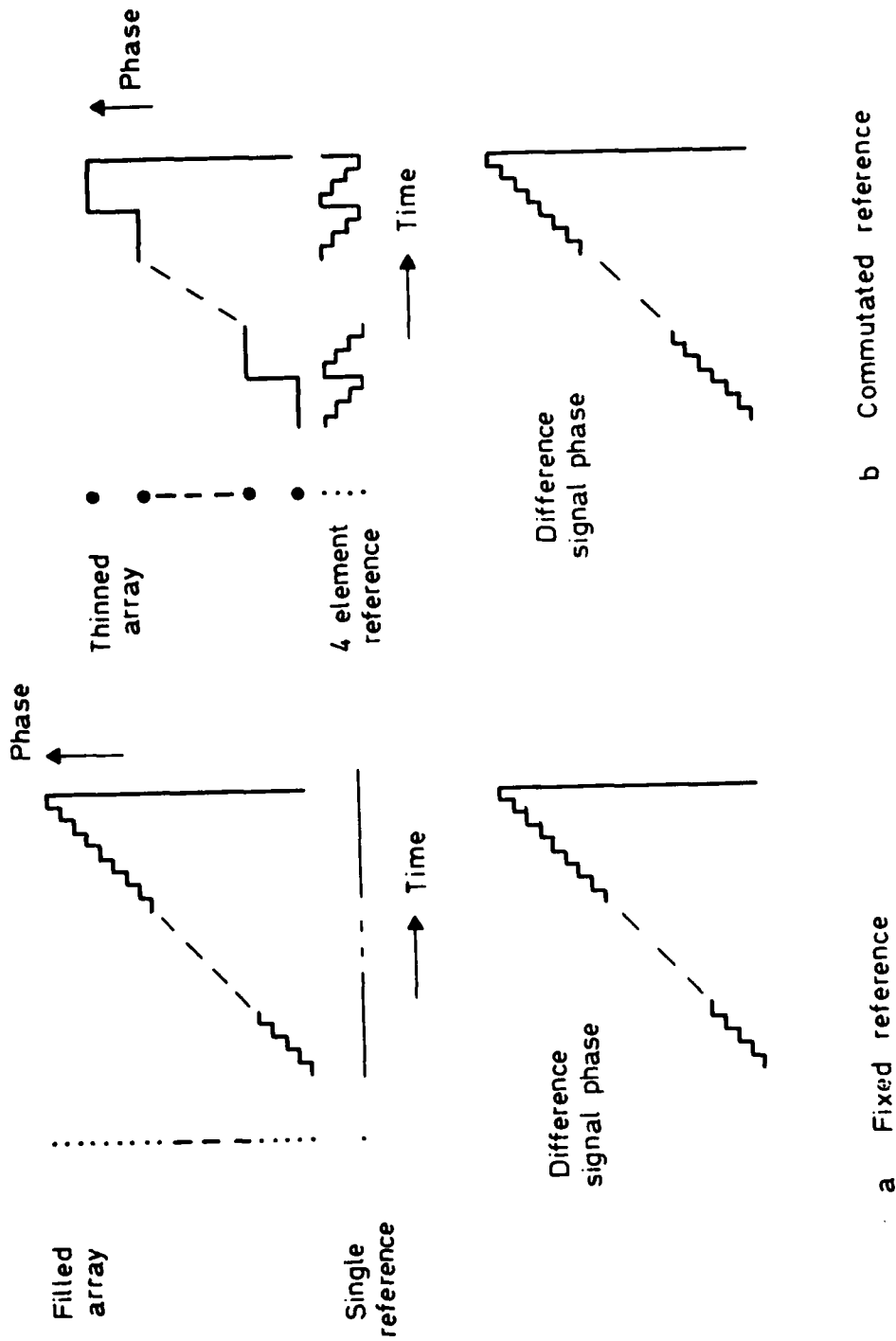
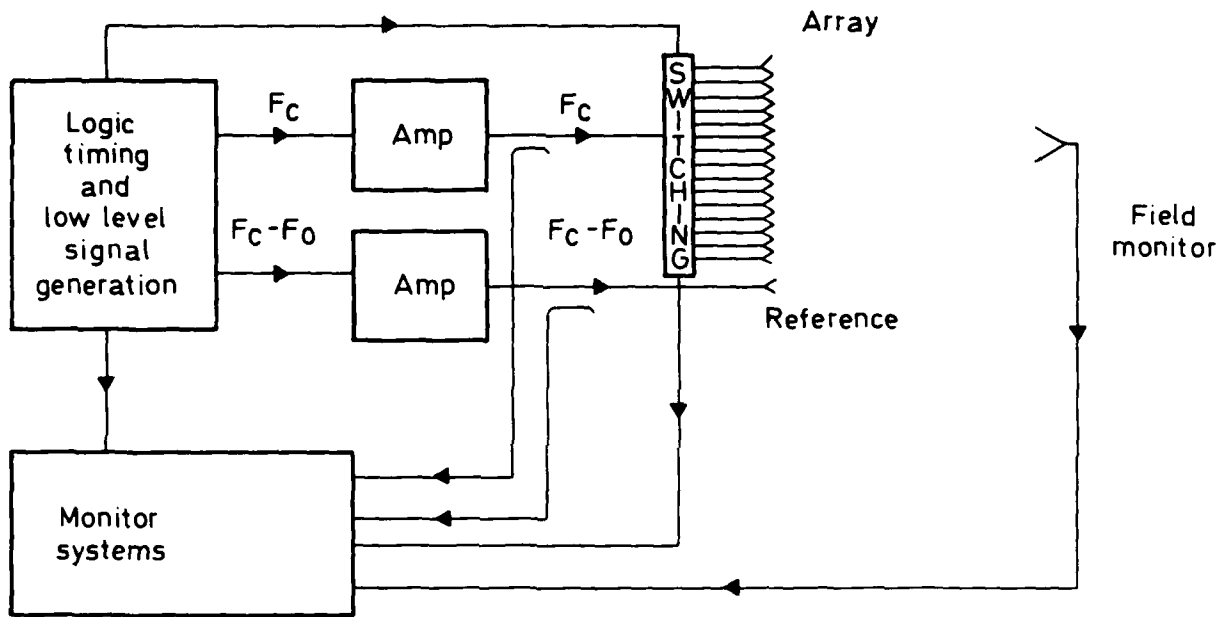


Fig 2.7 Fixed and commuted reference systems

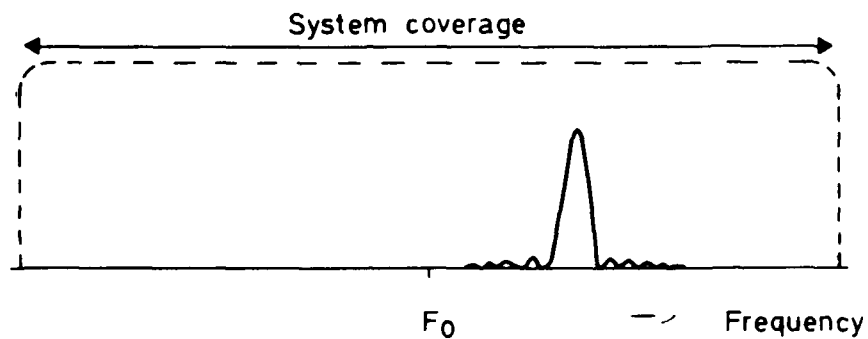
Fig 2.8



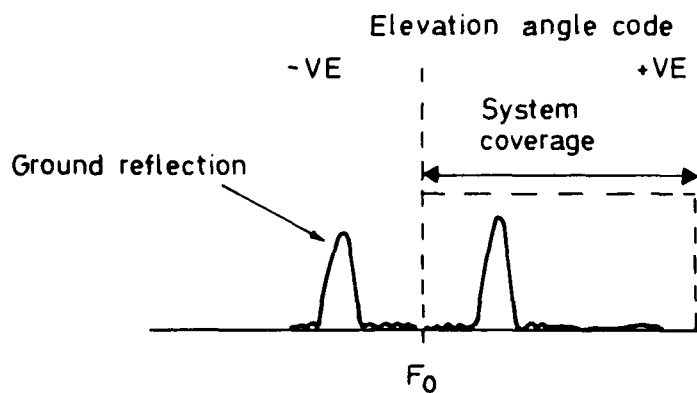
TR 79052

Fig 2.8 The basic DMLS ground system

Fig 2.9a&b



2.9a Azimuth system



2.9b Elevation system

Fig 2.9a&b Received difference signal spectra

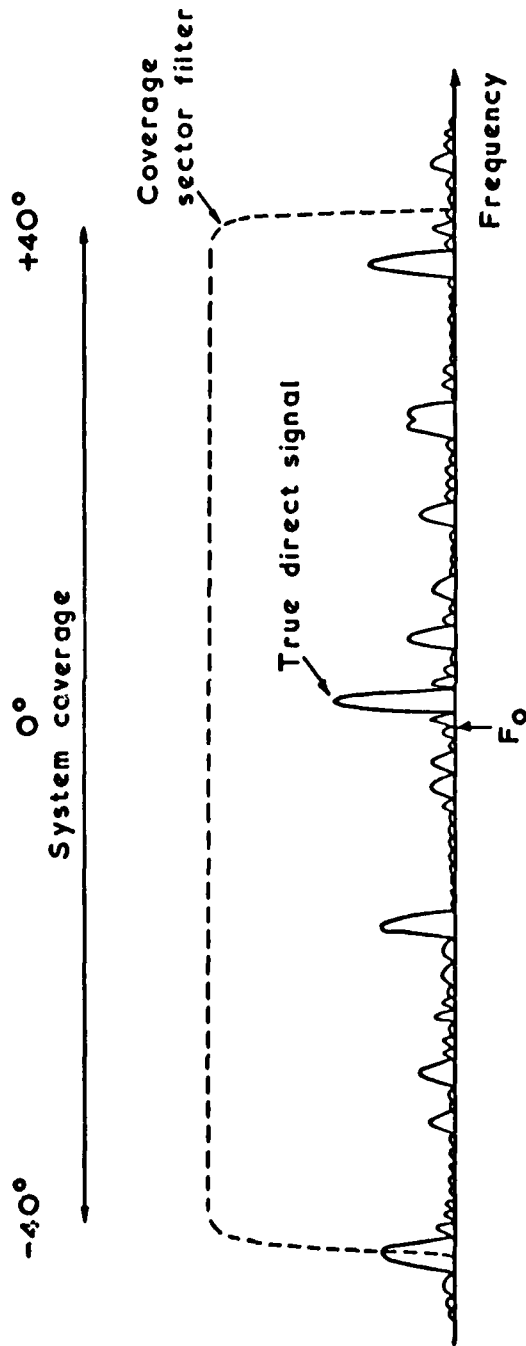


Fig 2.10 Doppler signal with multipath

Fig 2.11

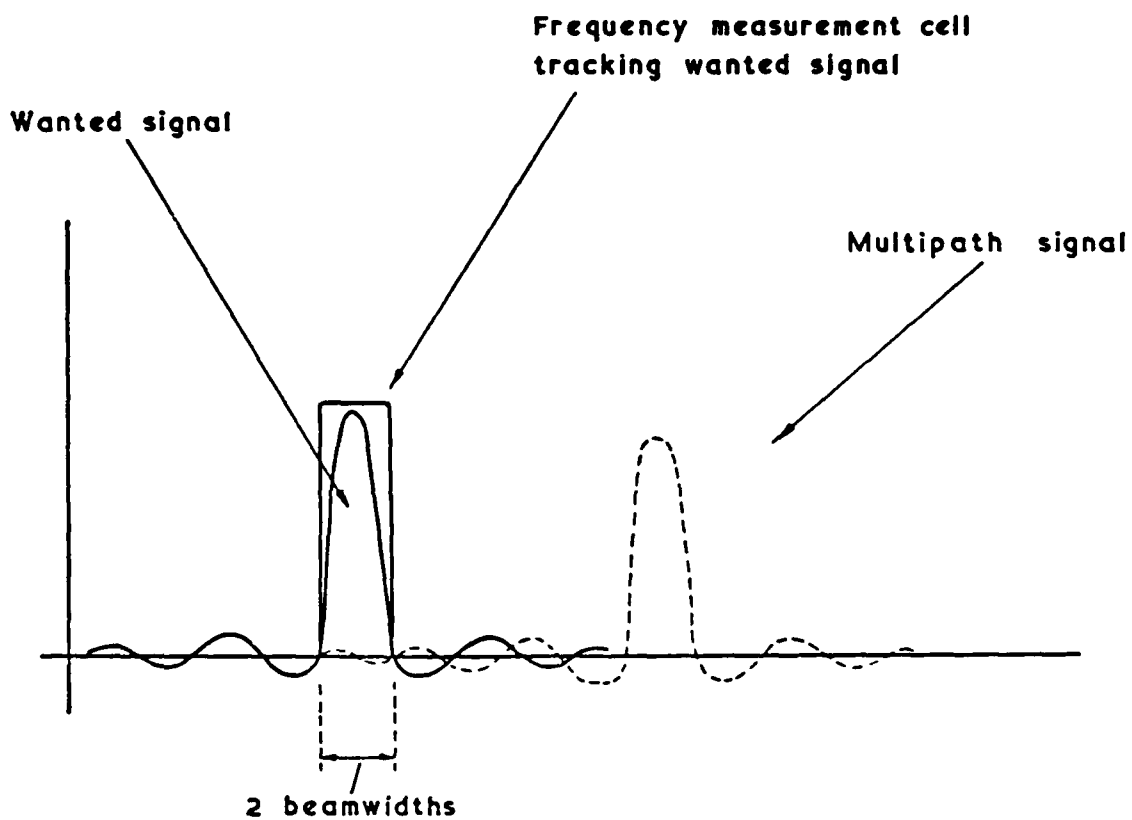


Fig 2.11 Separation of wanted signal using frequency cell

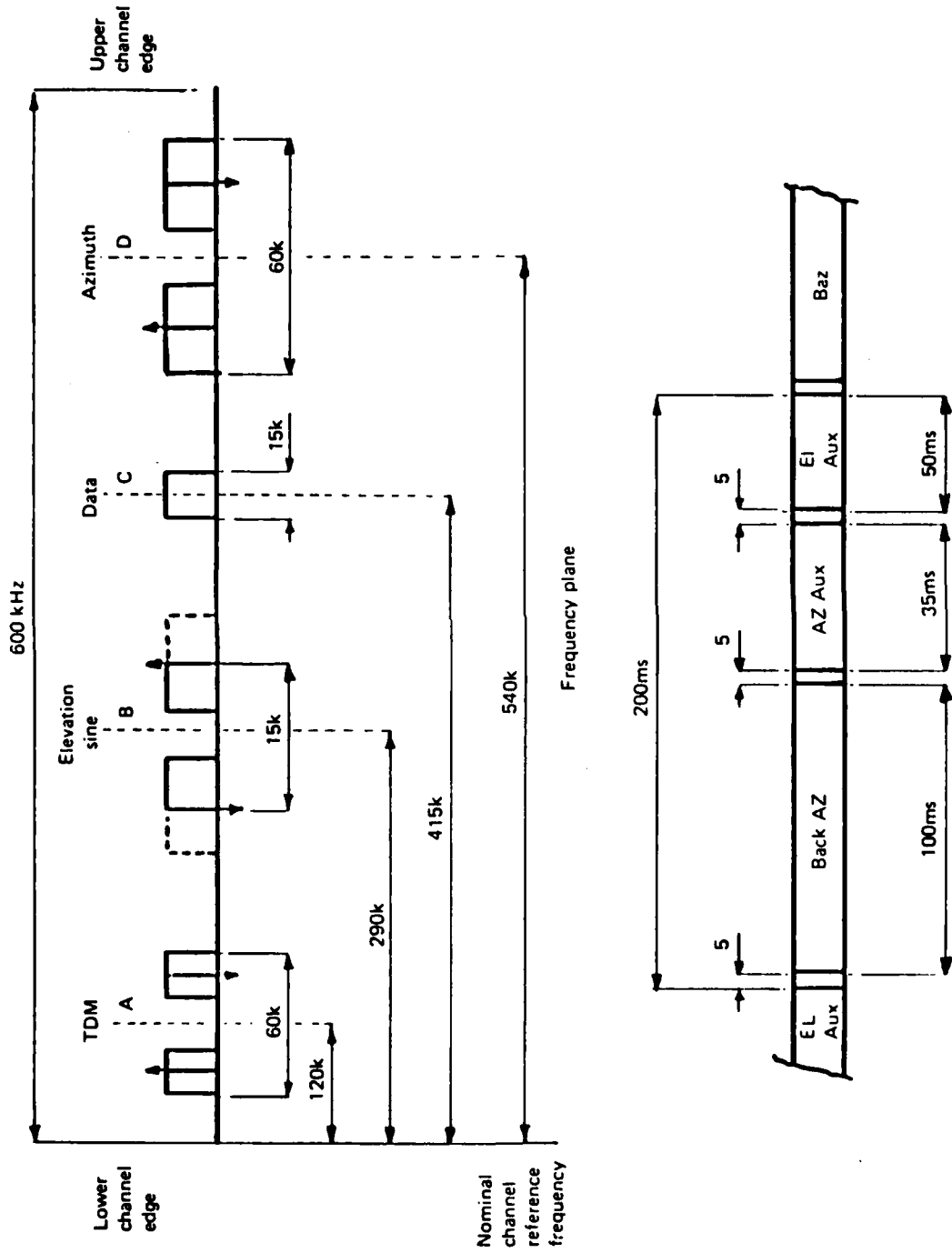


Fig 3.1

Time plane for TDM facility

Fig 3.1 Hybrid format

Fig 3.2

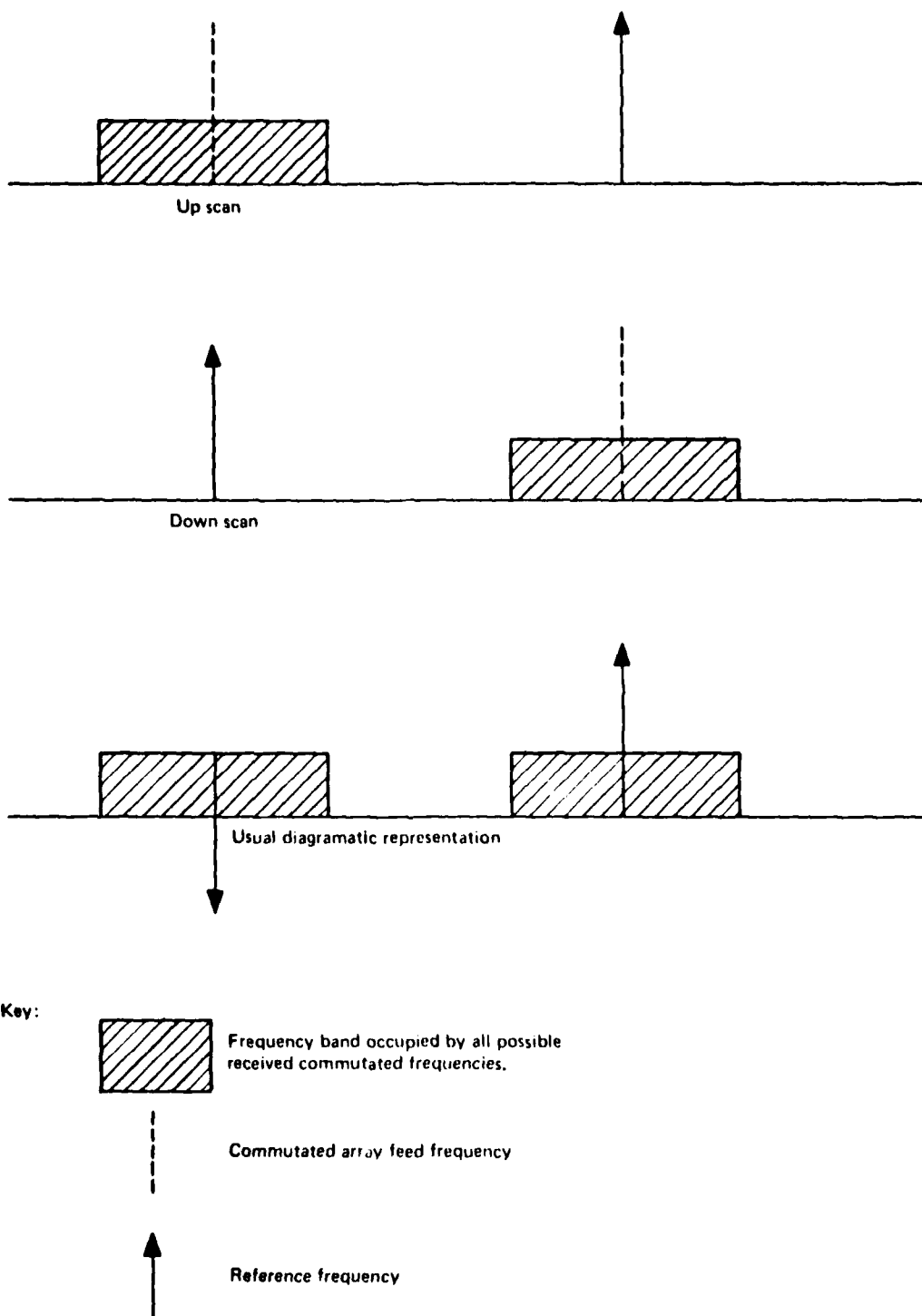


Fig 3.2 Frequency interchange method of providing offset frequency

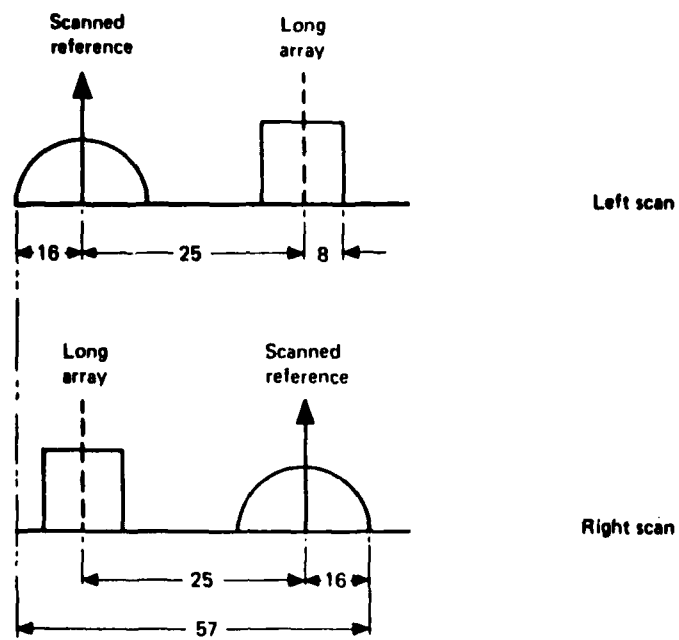


Fig 3.3 Azimuth sub-channel frequencies (kHz)

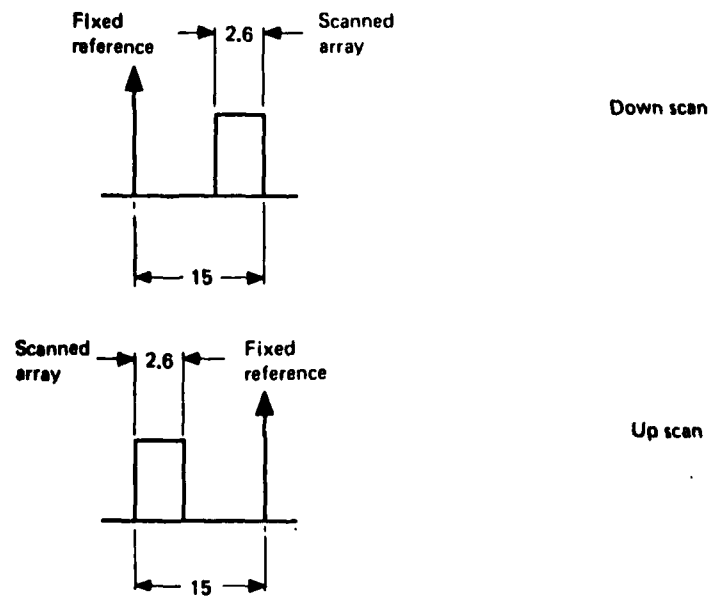


Fig 3.4 Elevation sub-channel frequencies (kHz)

Fig 3.5



Fig 3.5 120 wavelength azimuth antenna

Fig 3.6

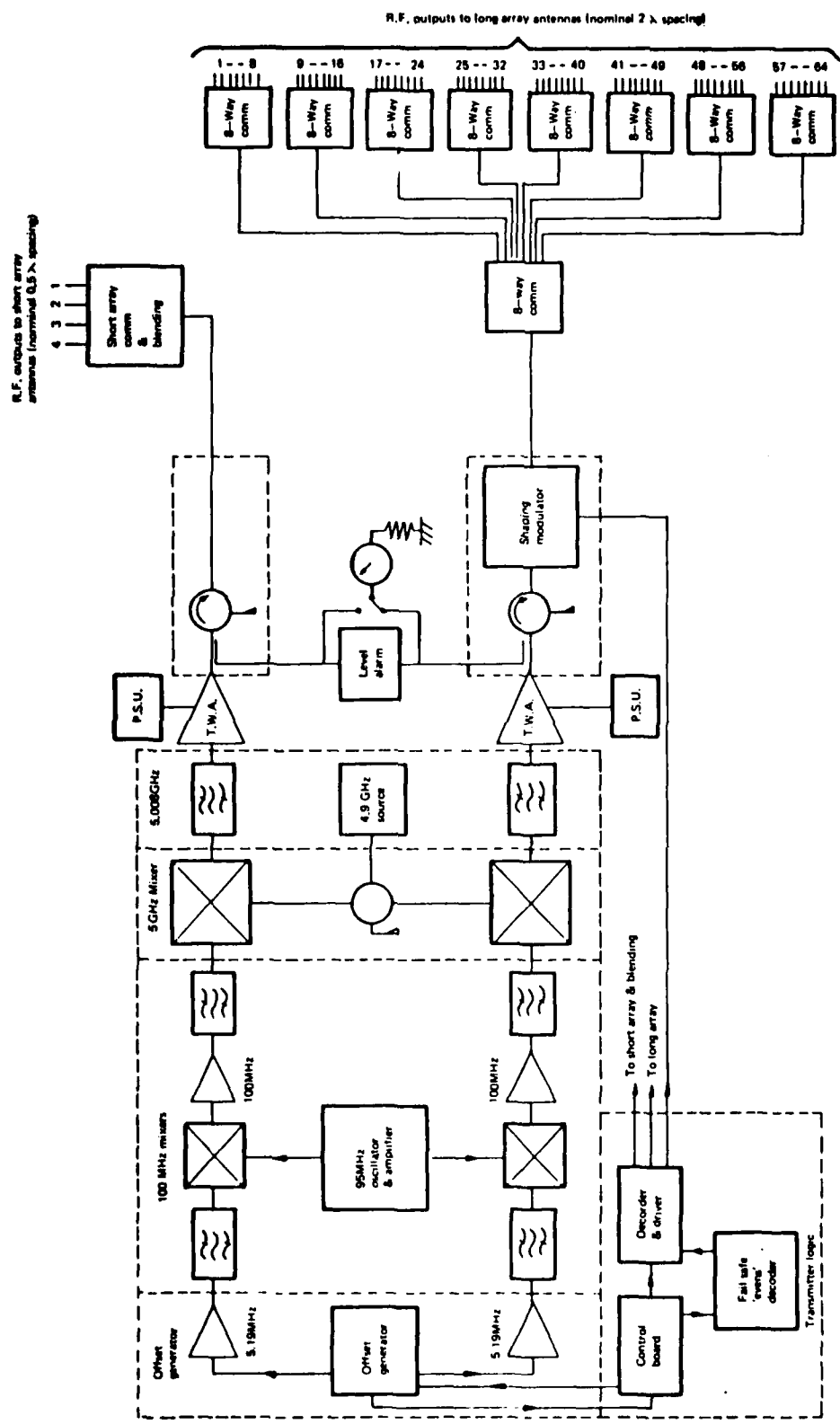


Fig 3.6 Azimuth transmitter block diagram

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Fig 3.7

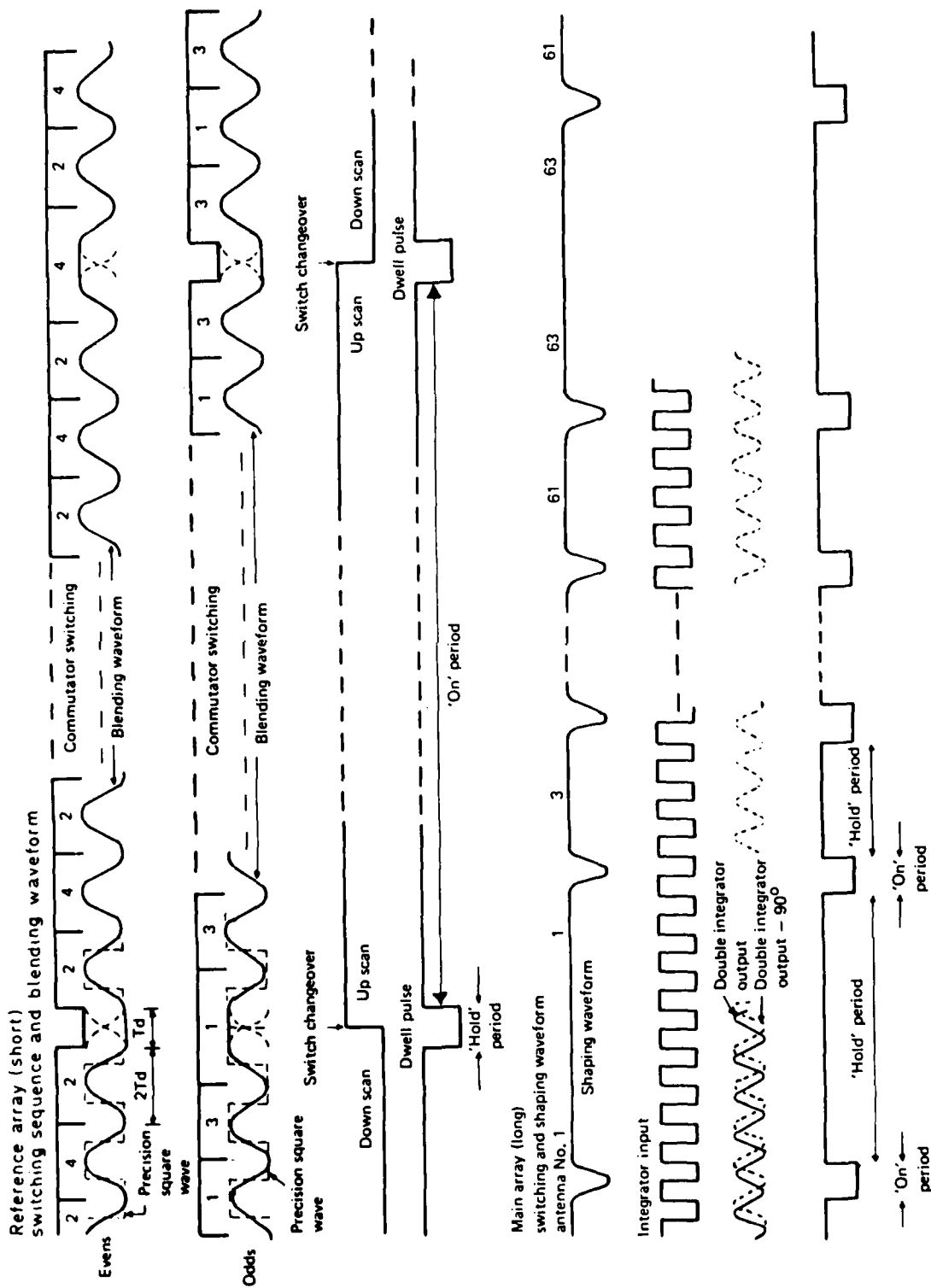
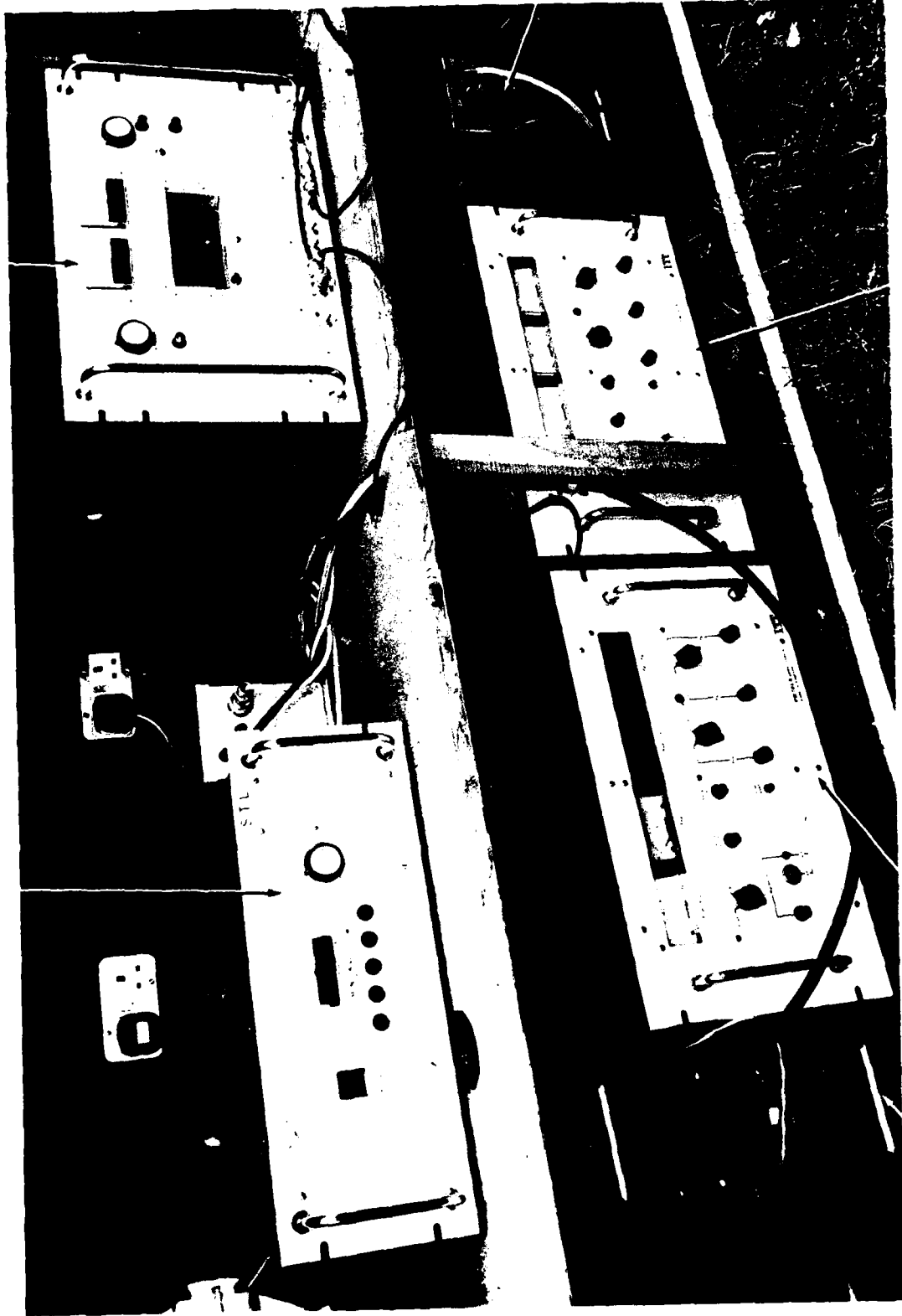


Fig 3.7 Azimuth facilities blending and shaping

TR 79052 C15526

Transmitter unit

Transmitter PSU



TWT PSU

Fig 3.8 Azimuth transmitter

TWT PSU

TWT

Fig 3.9

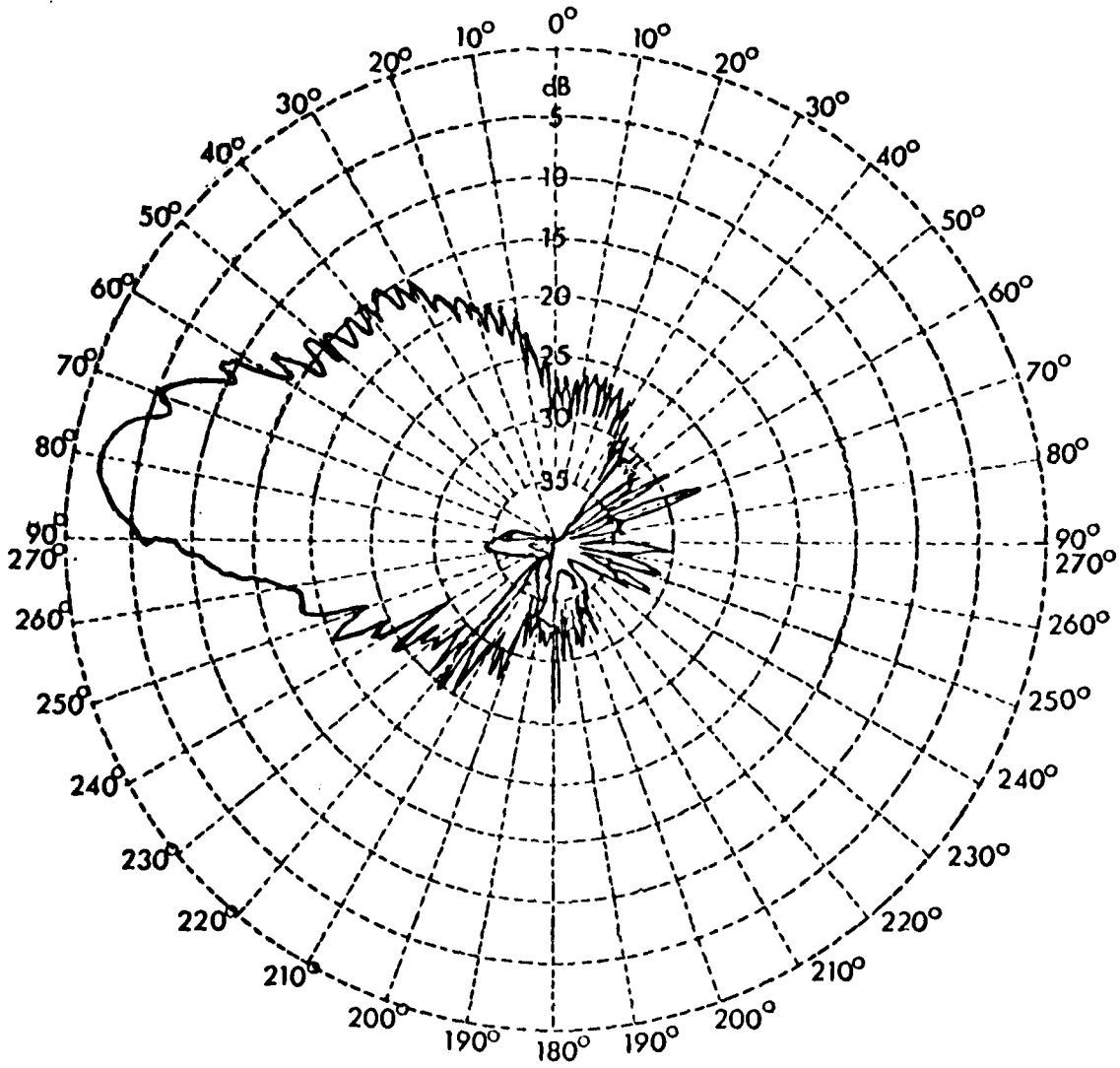
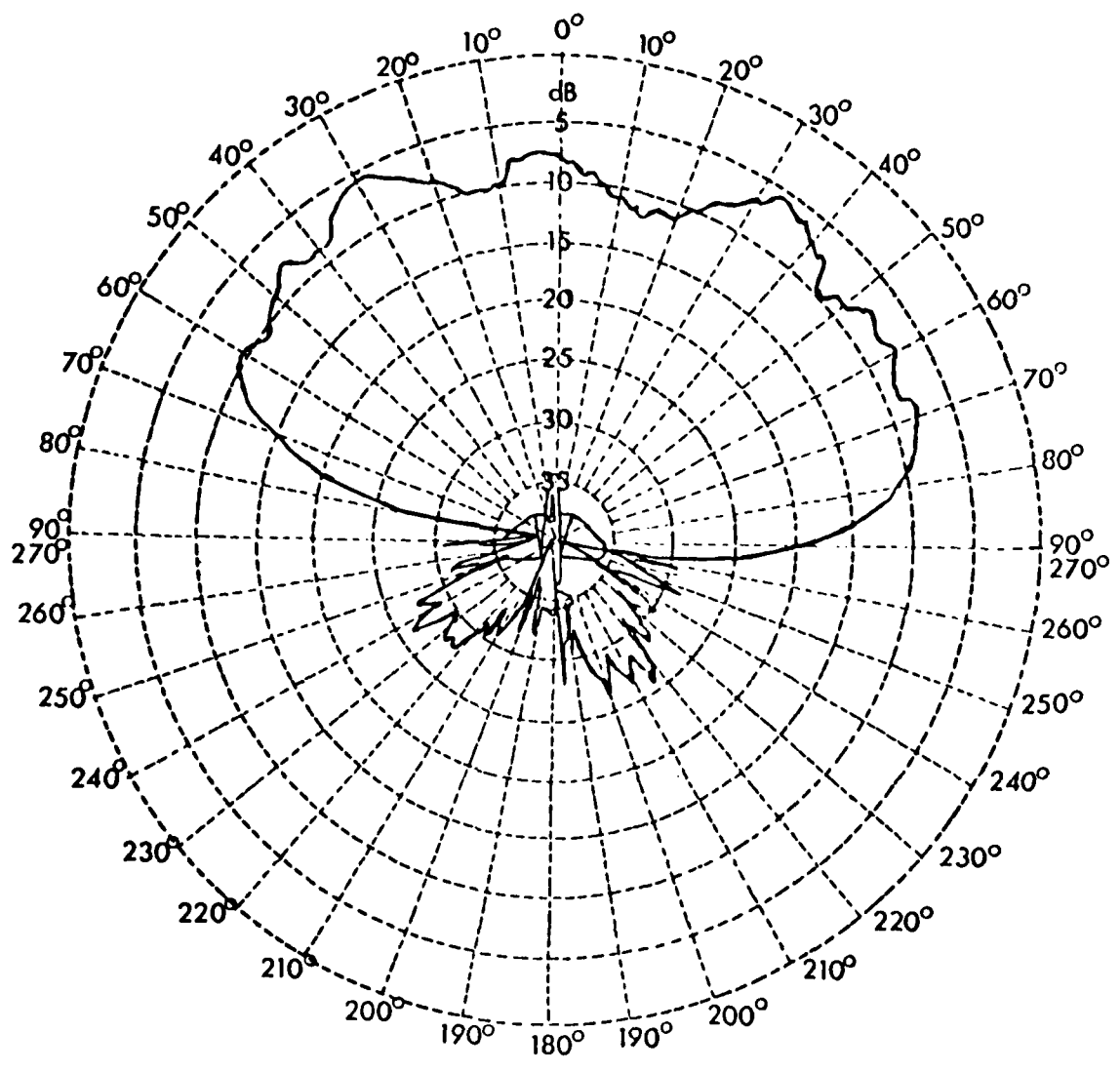


Fig 3.9 Monopole on 3 ft counterpoise (vertical pattern)

Fig 3.10



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Fig 3.10 Monopole on 3 ft counterpoise (horizontal pattern)

Fig 3.11

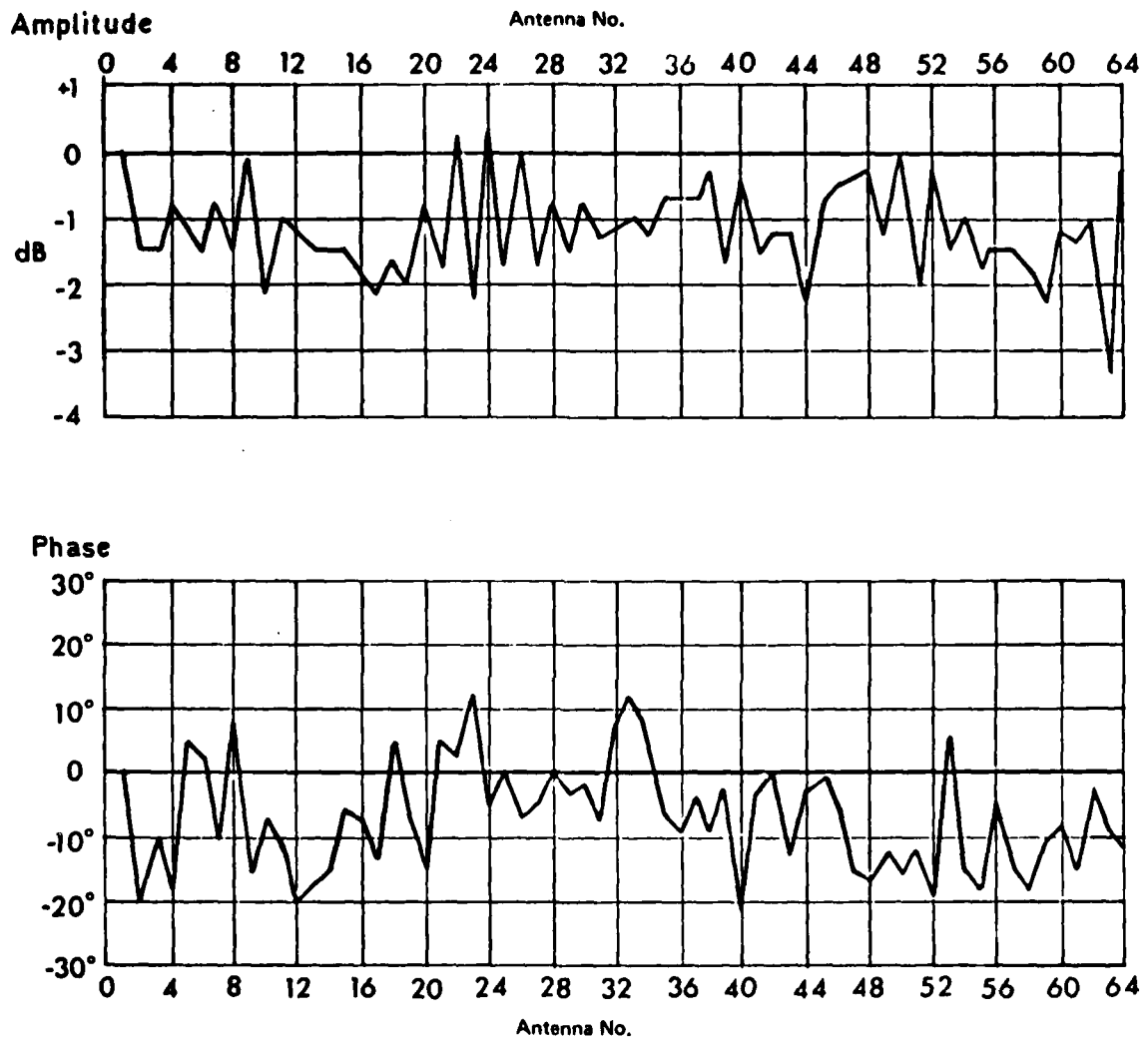


Fig 3.11 Transmitted signal phase and amplitude spread (approach azimuth)



Fig 3.12 Missed approach azimuth

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Fig 3.13

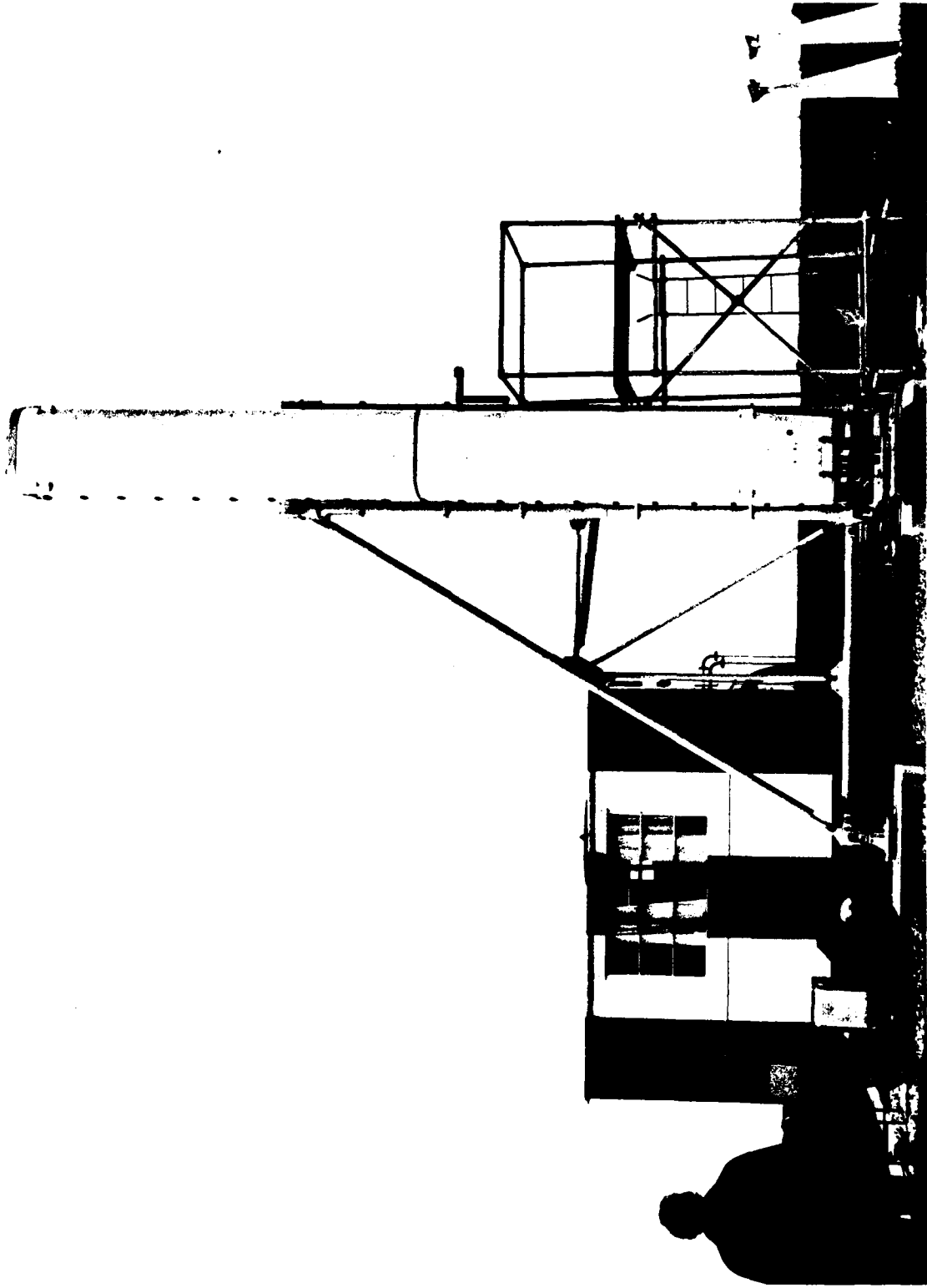


Fig 3.13 90 wavelength elevation array

Fig 3.14

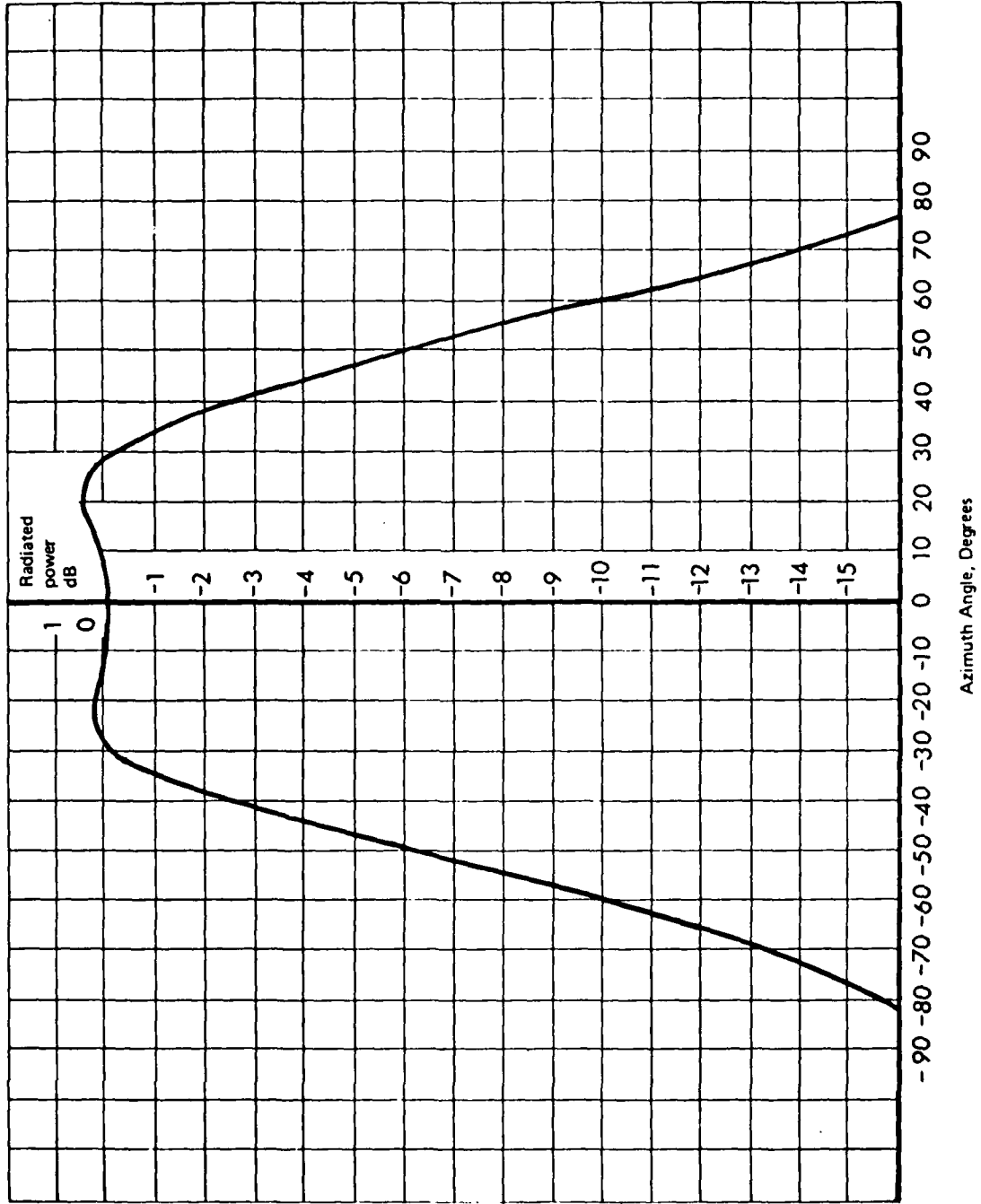


Fig 3.14 Array element azimuth radiation pattern

Fig 3.15

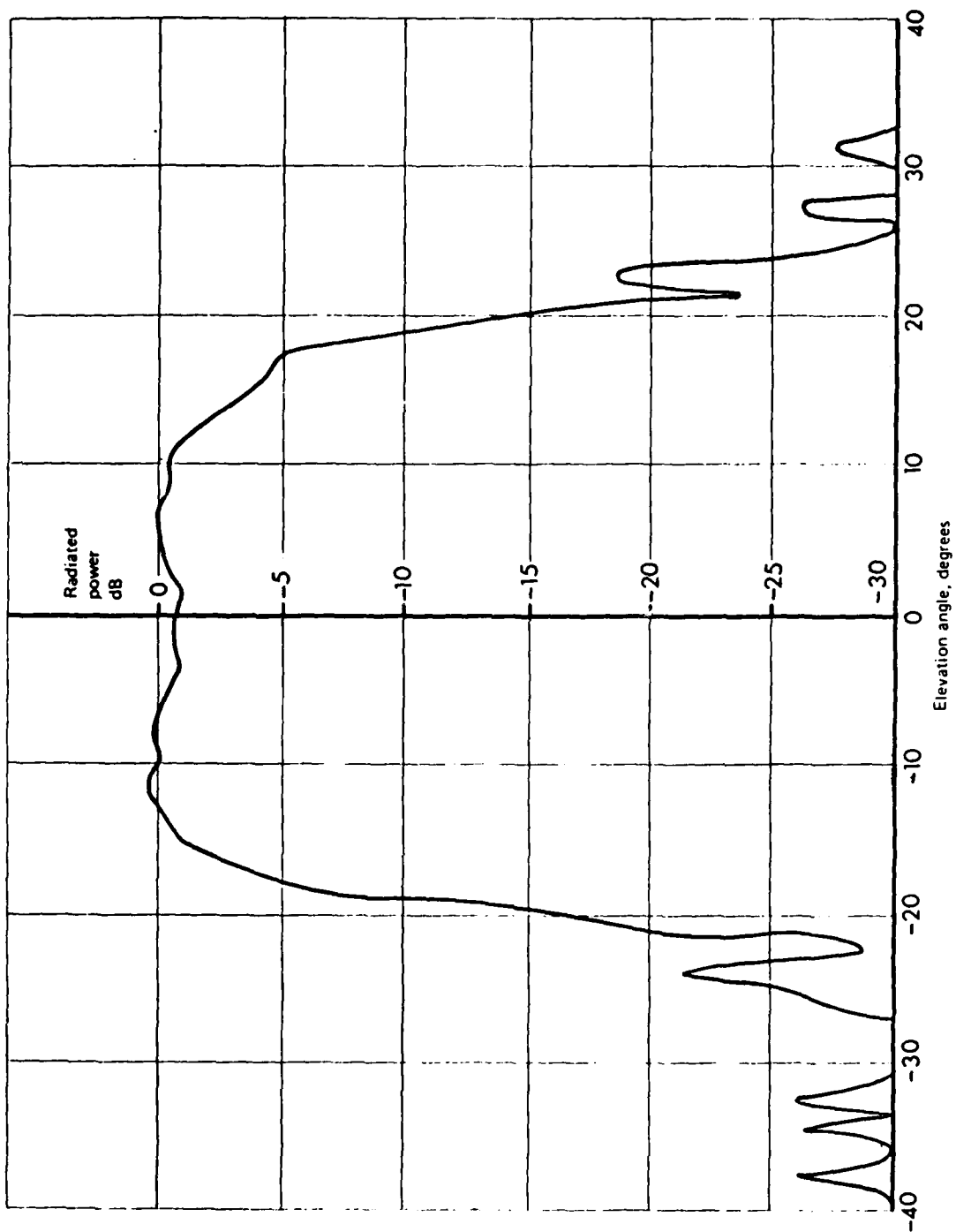
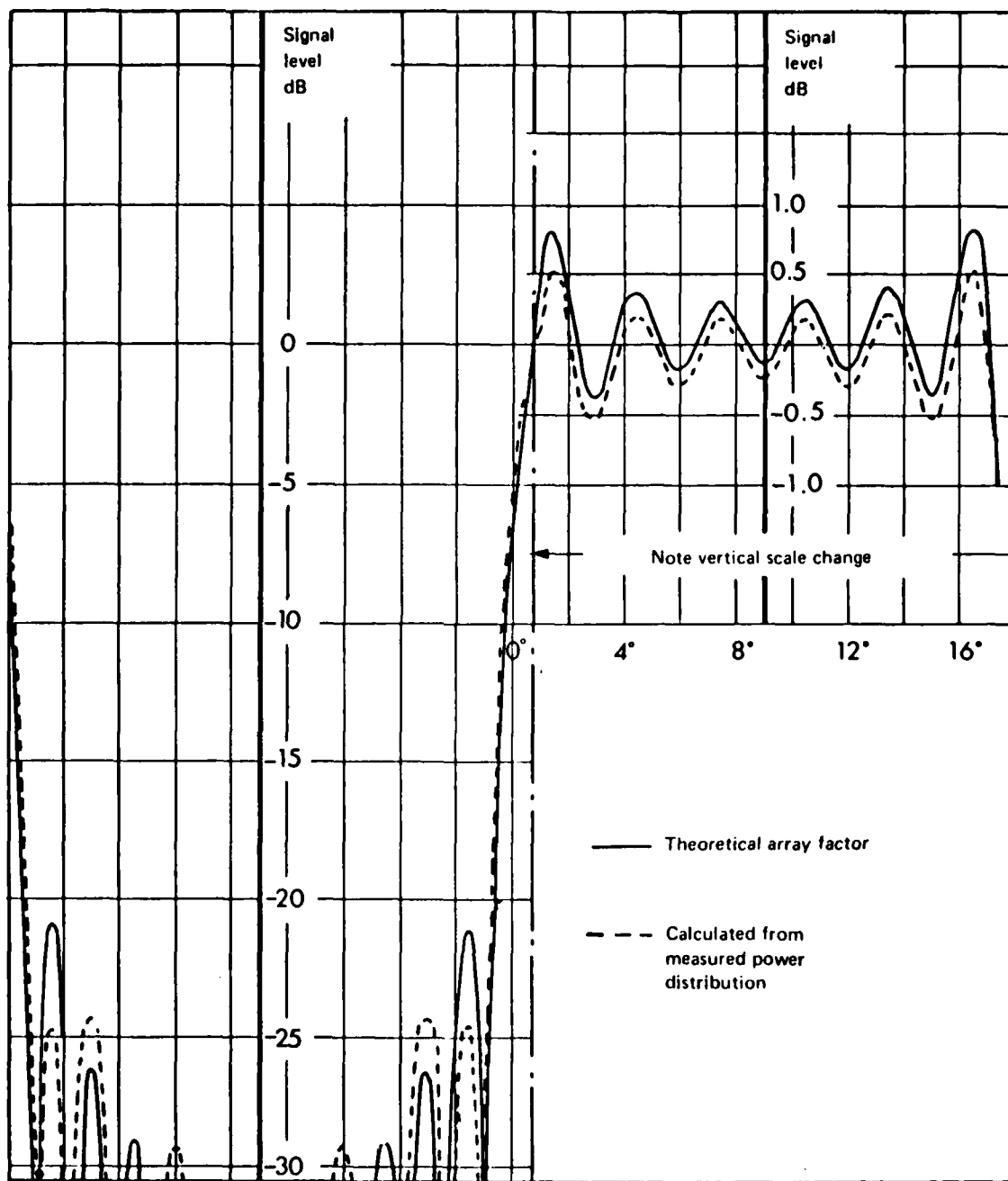


Fig 3.15 Array element elevation radiation pattern



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Fig 3.16 Reference antenna array factors

Fig 3.17

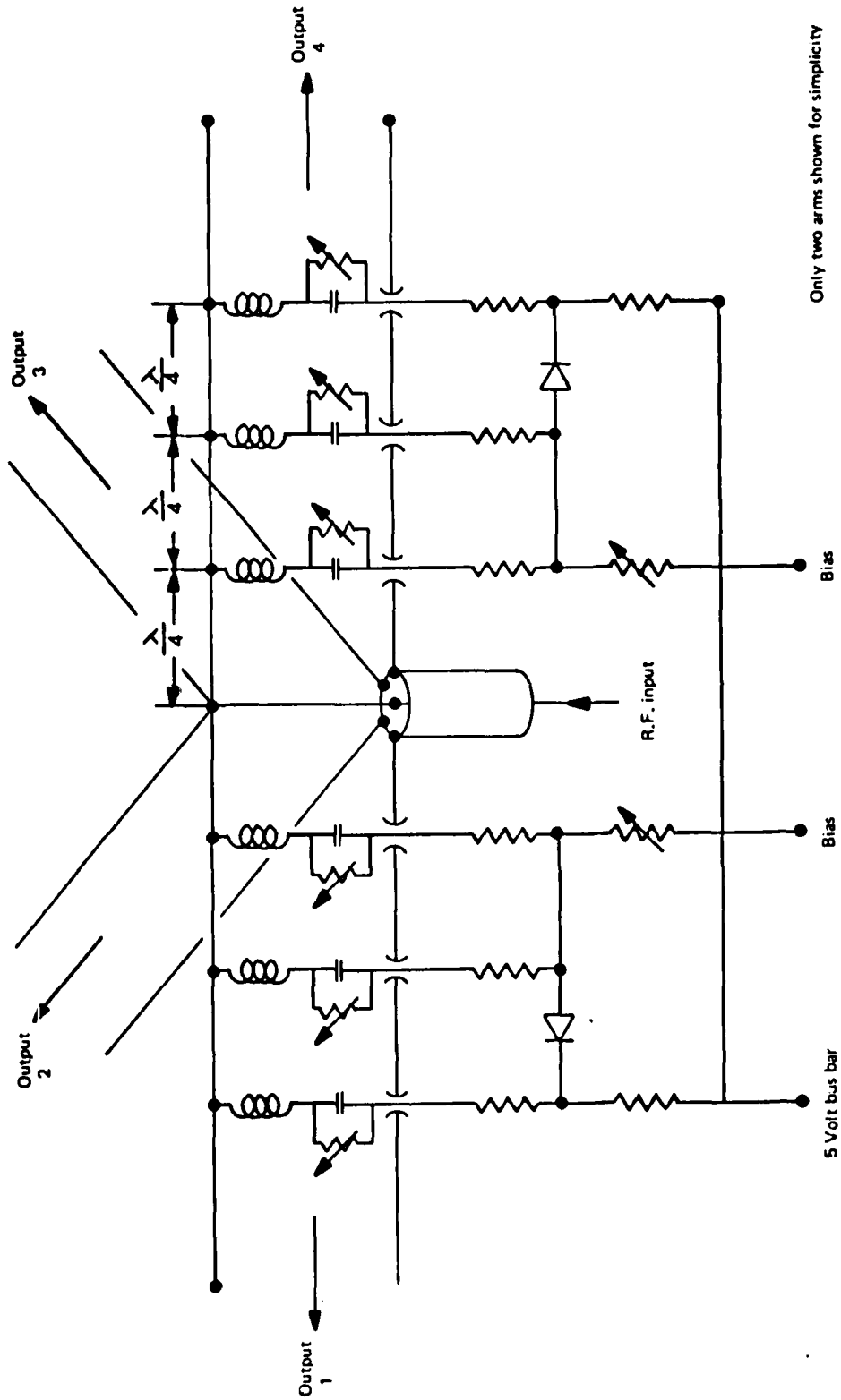


Fig 3.17 Resonant switch and biasing circuit

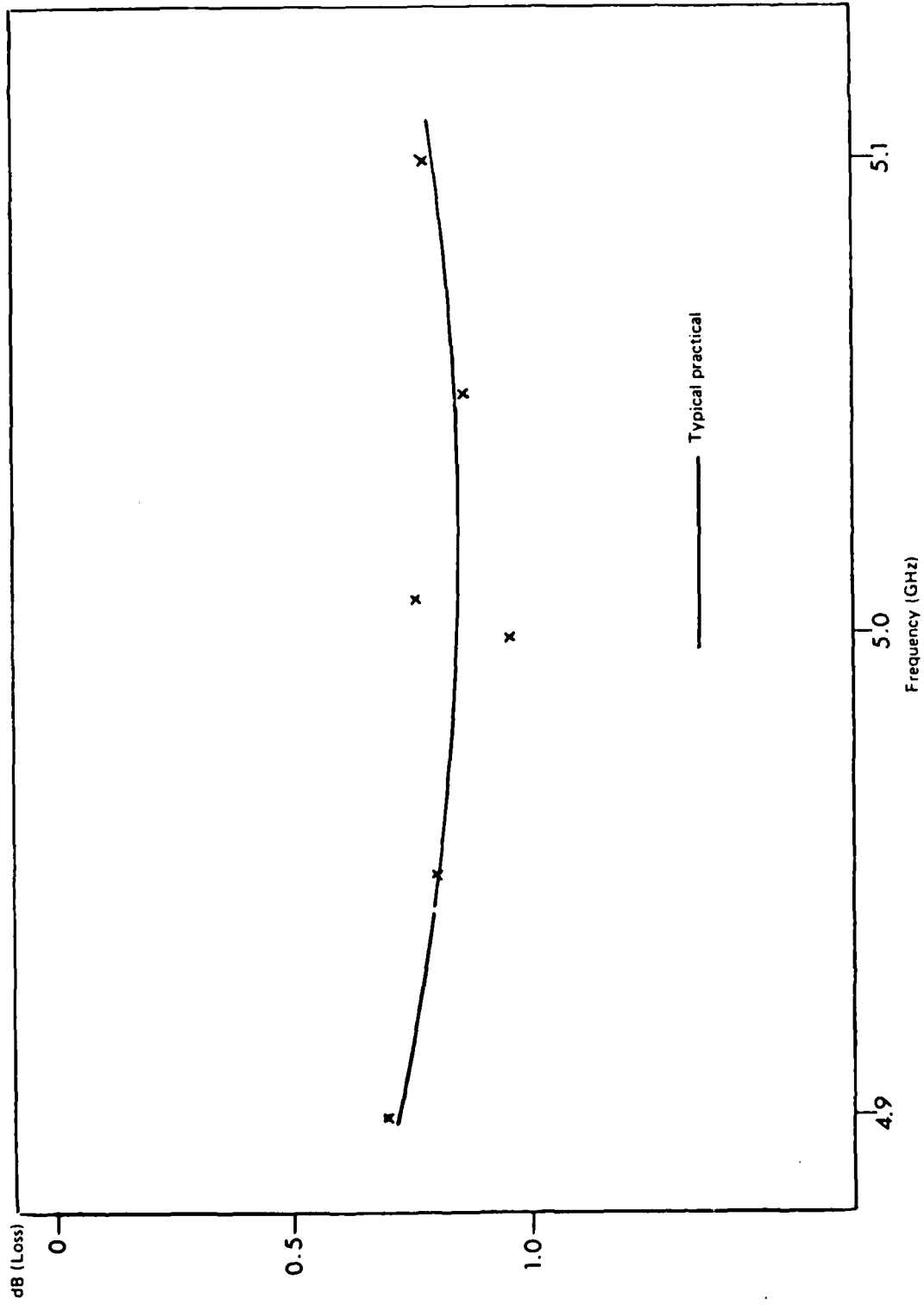


Fig 3.18

Fig 3.18 Curve of insertion loss for 4-way switching module

Fig 3.19

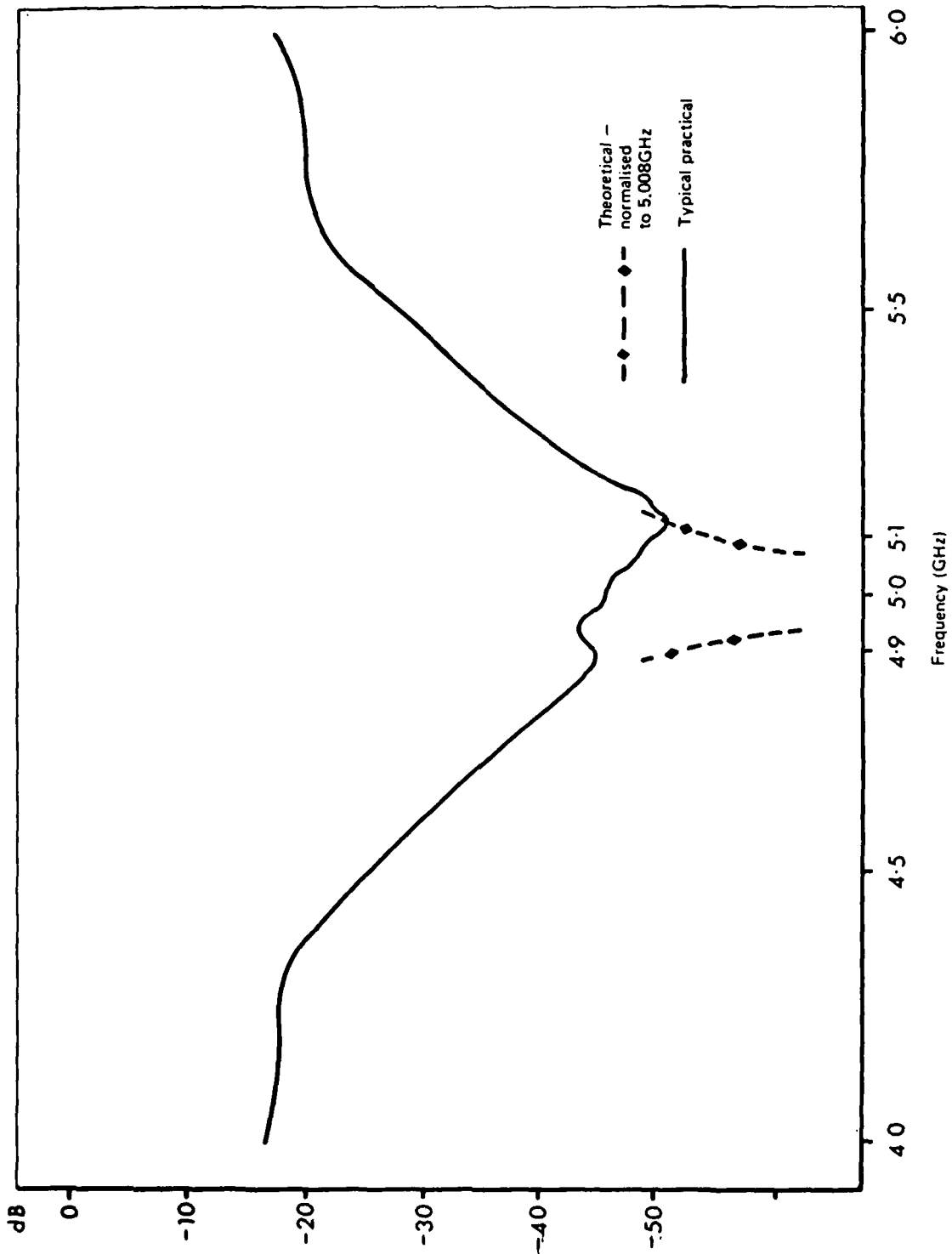


Fig 3.19 Theoretical and practical curves of isolation for 4-way switching module

Fig 3.20

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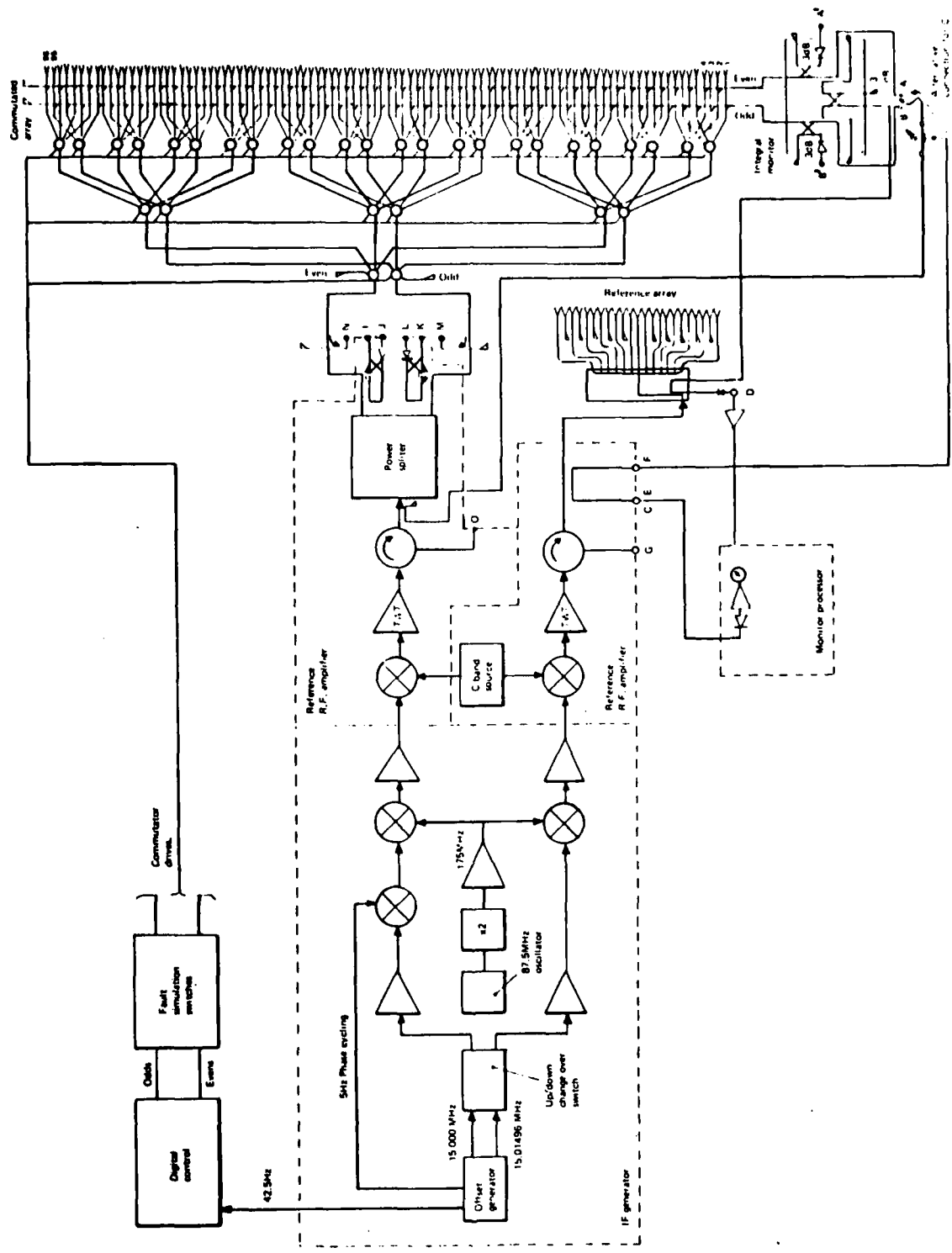


Fig 3.20 Elevation ground system

Fig 3.21

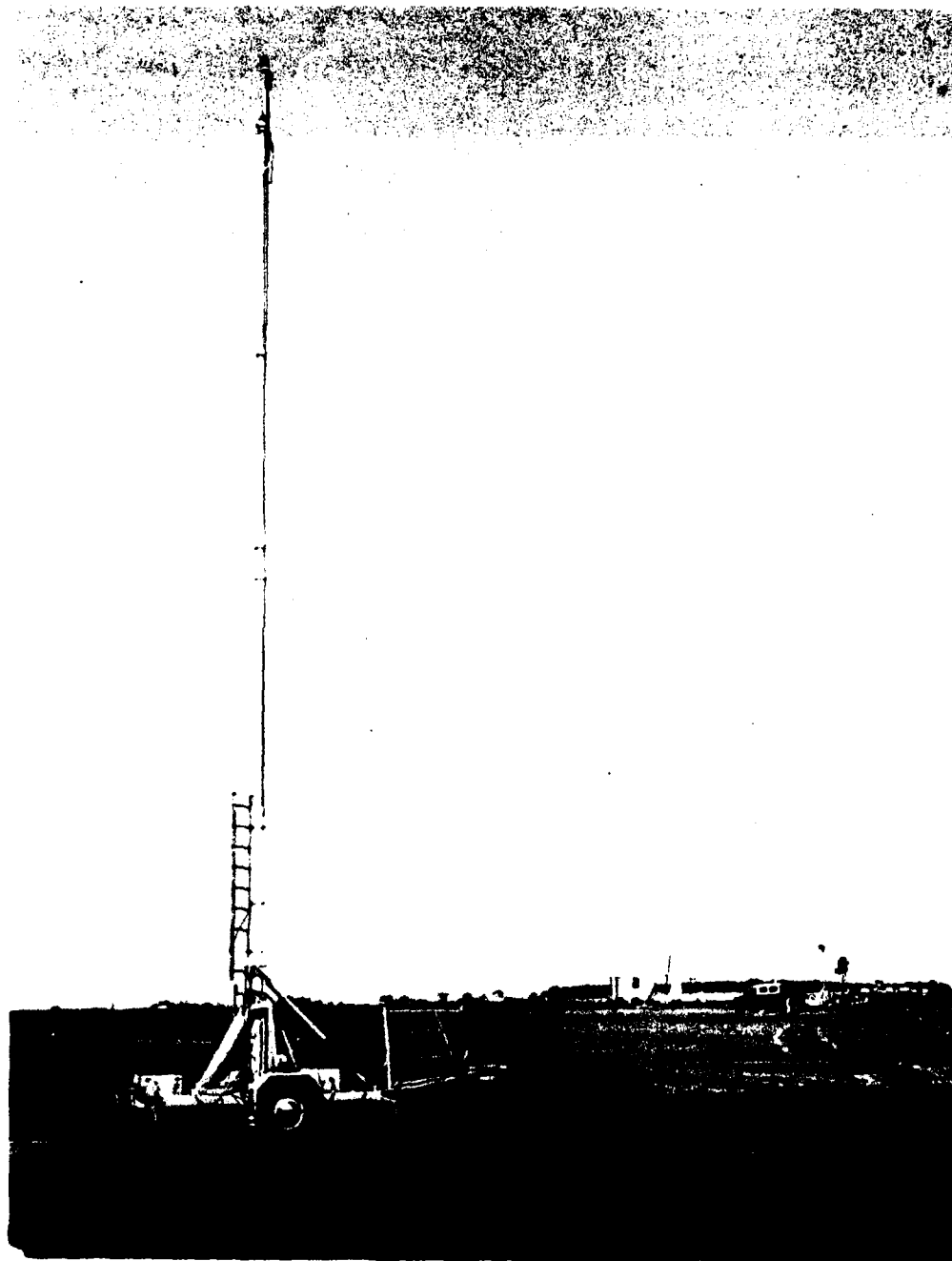


Fig 3.21 Elevation field monitor mounting

Fig 3.22

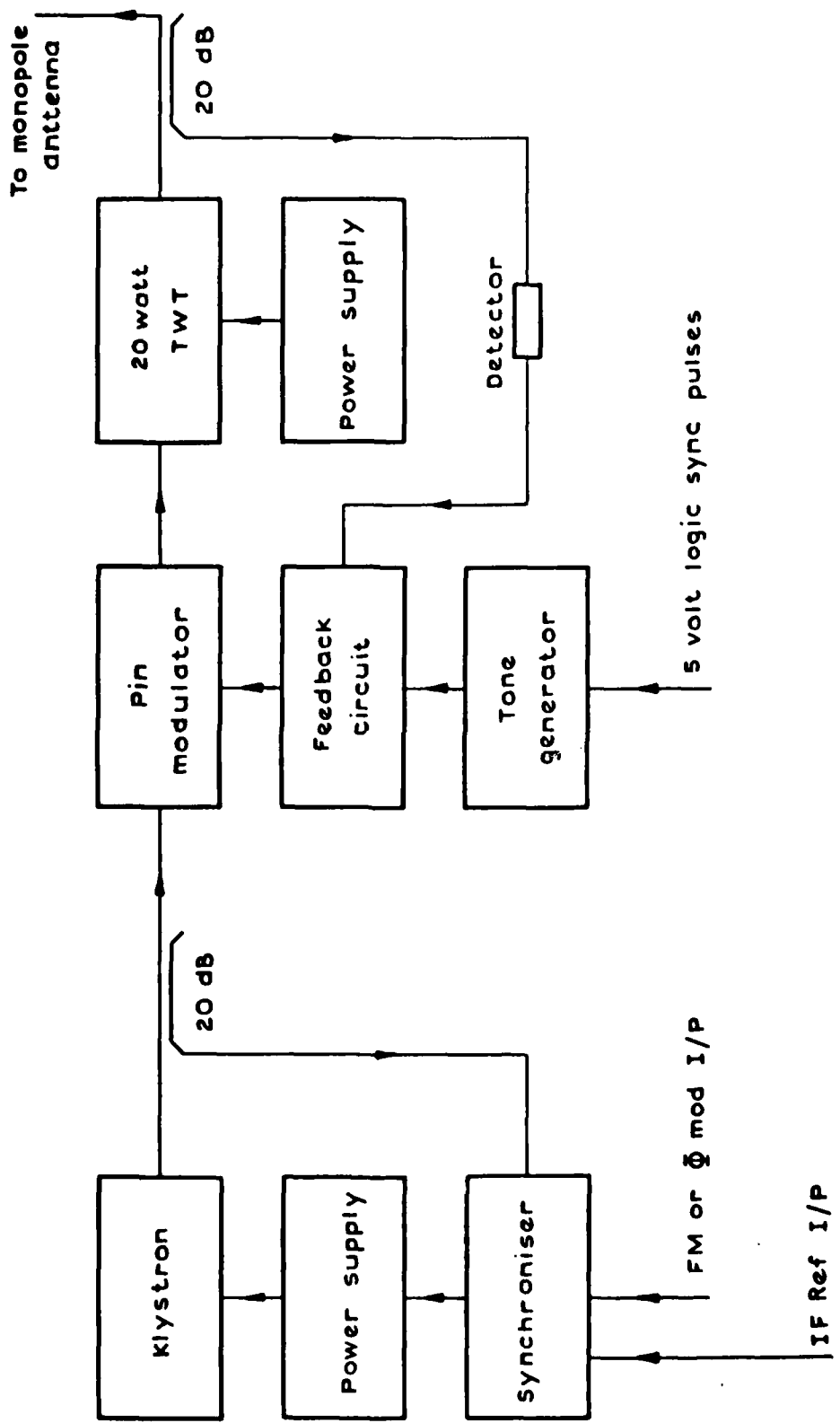


Fig 3.22 Data transmitter block diagram

Fig 3.23

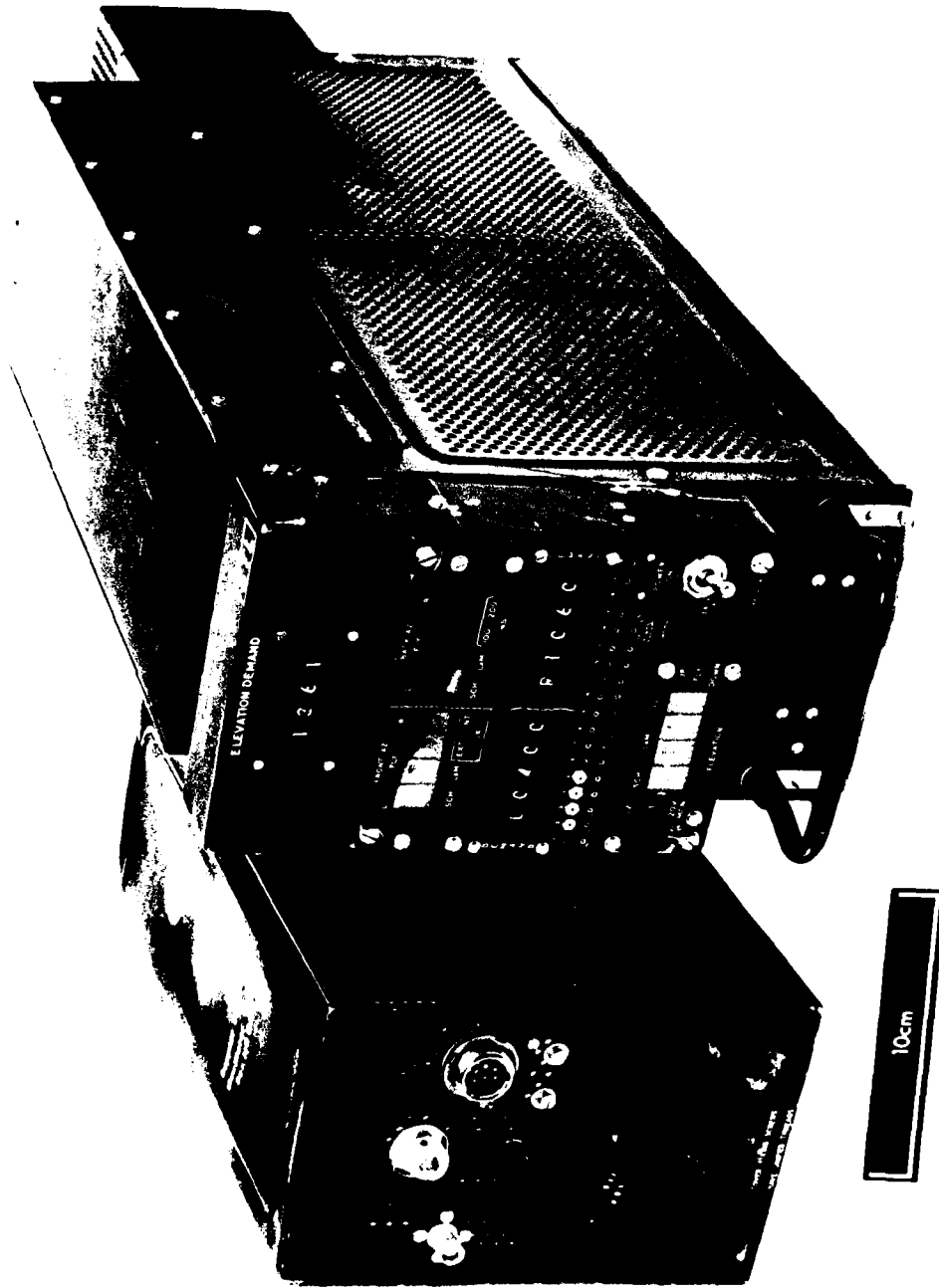


Fig 3.23 S type receiver system

Fig 3.24

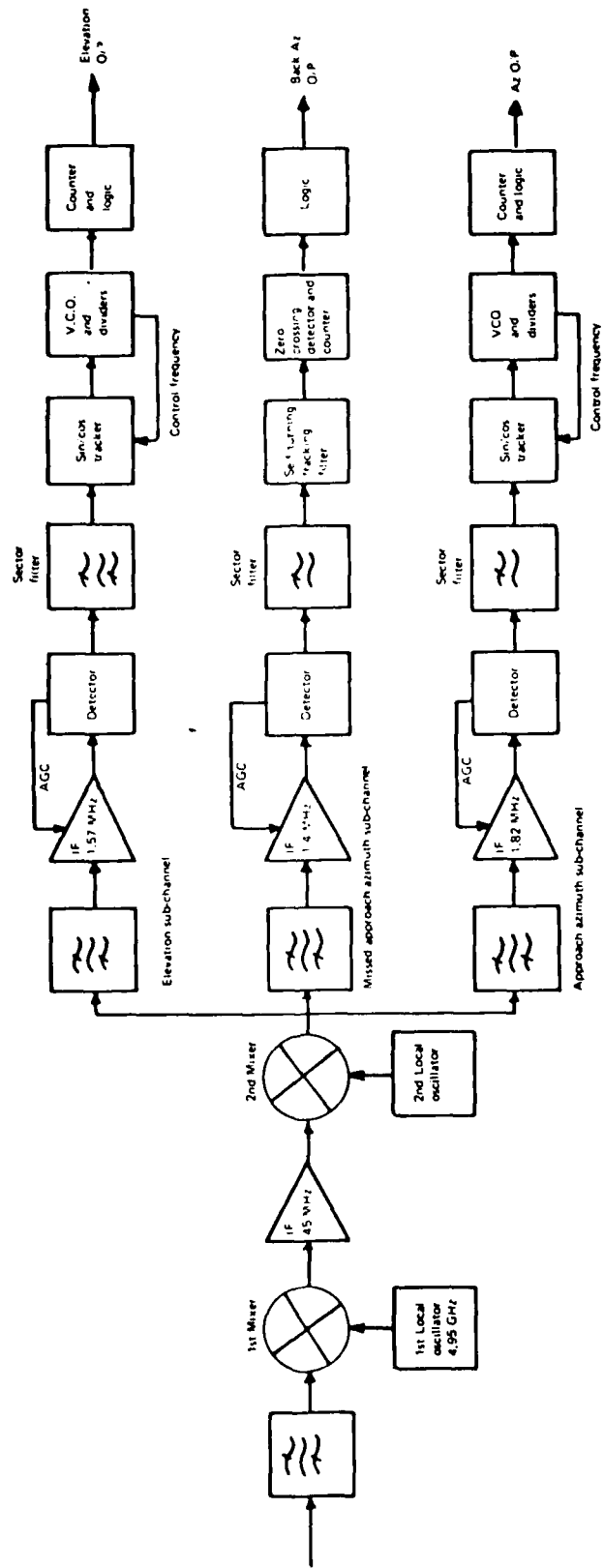


Fig 3.24 Outline block diagram of type S receiver

Fig 3.25

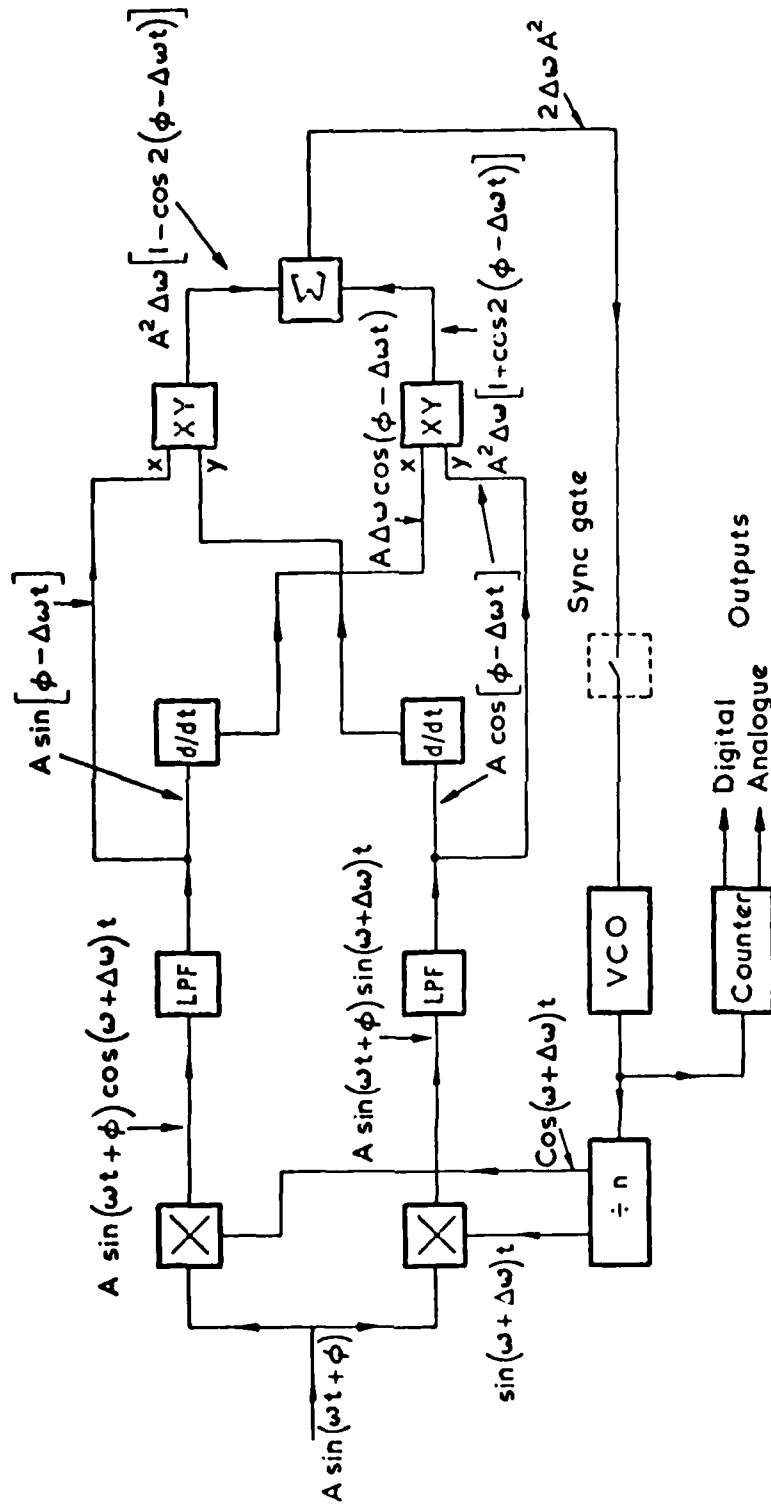


Fig 3.25 Sine/cosine tracker system detail diagram

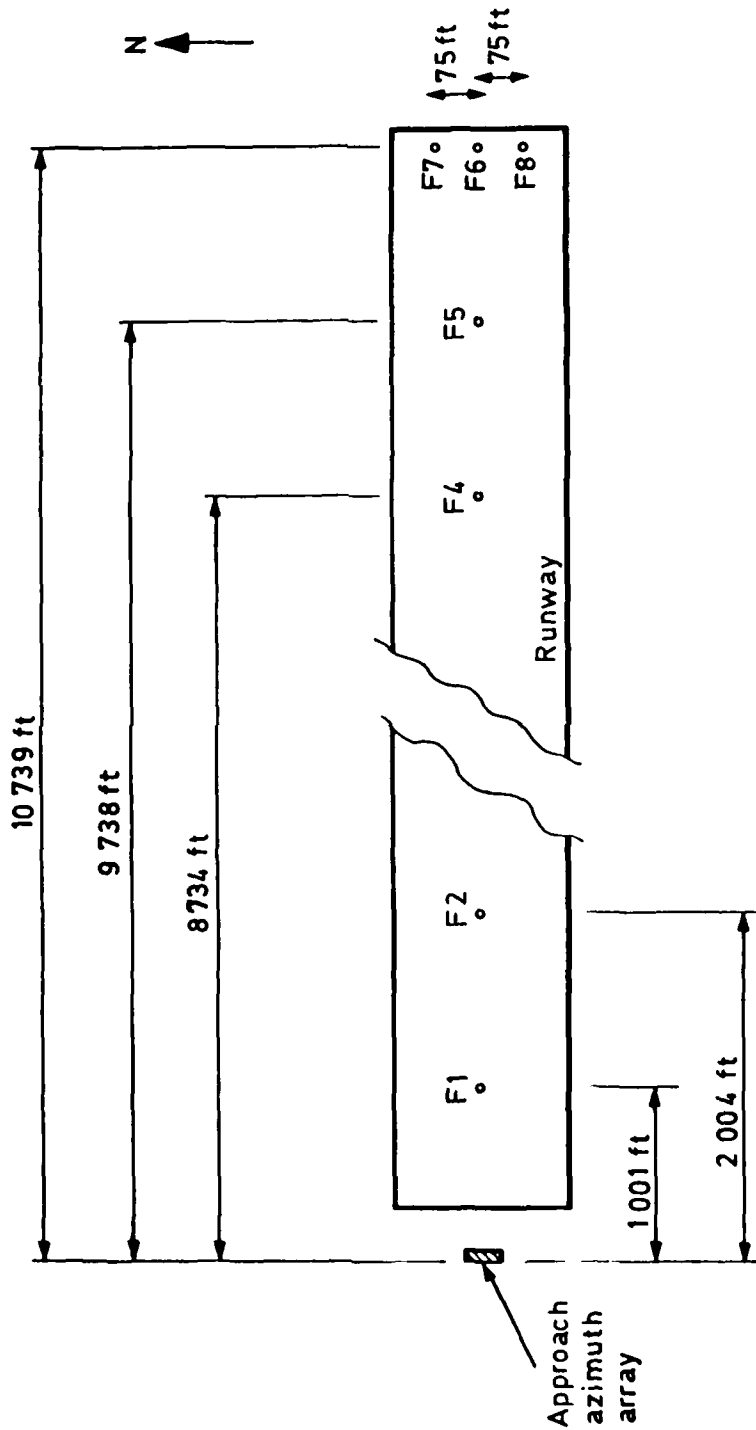


Fig 4.1a Close and long range approach azimuth test points

Fig 4.1b

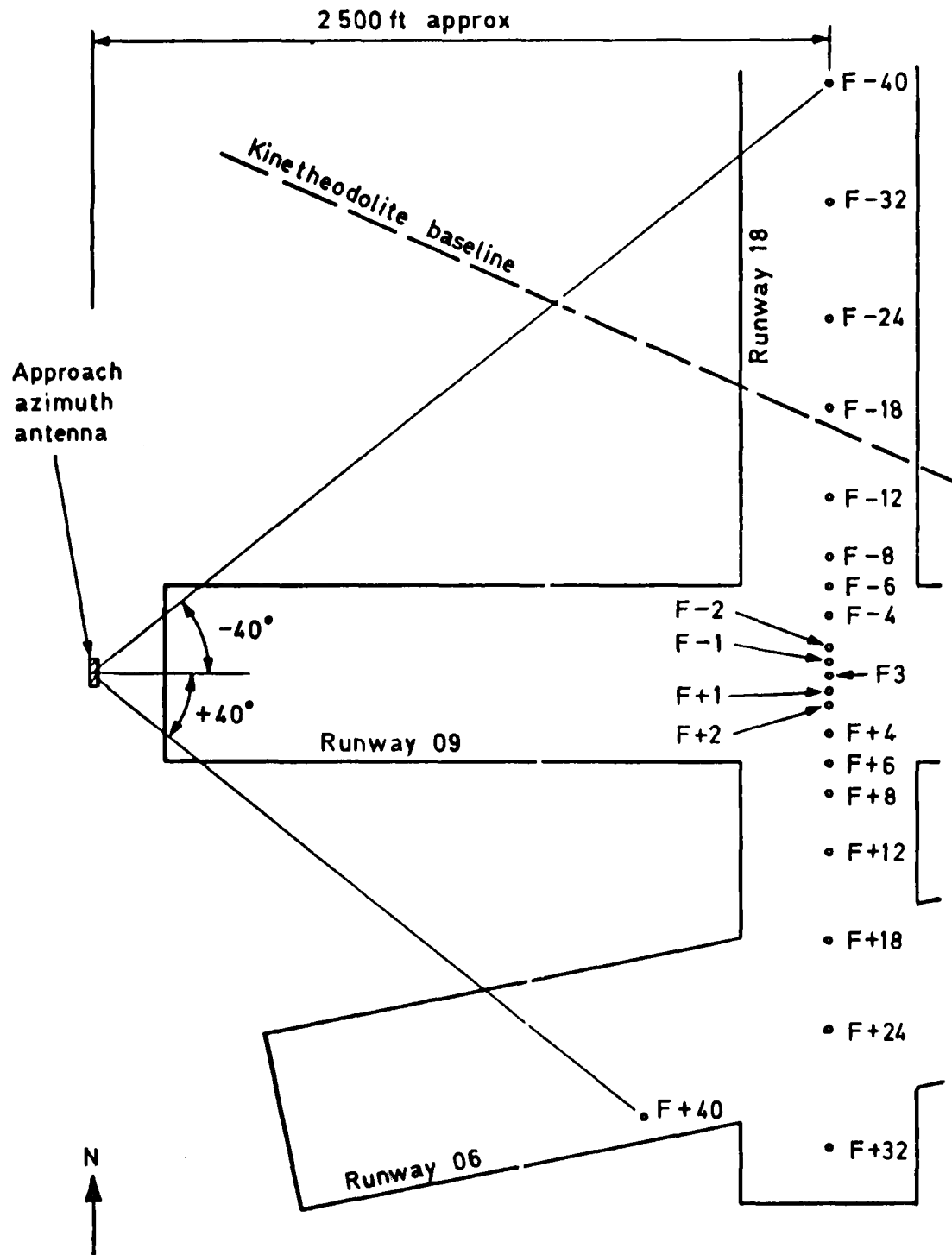


Fig 4.1b Cross runway approach azimuth test points

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DWL SFD-GSS6/H5-72-FRZLN/FB-PBS/2-25/5/75 STL
GROUND RANGE 10738.65 FEET

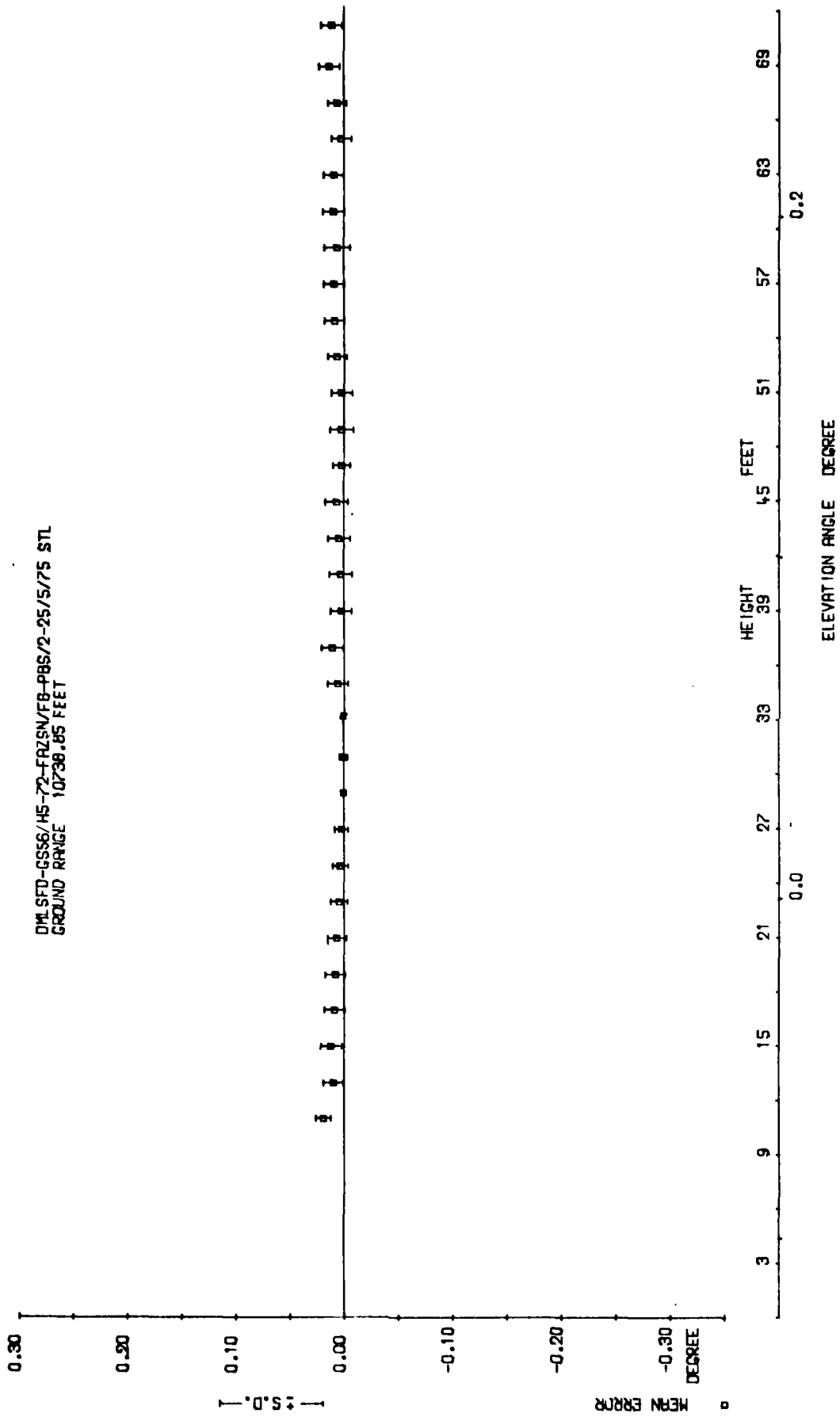


Fig 4.2

Fig 4.2 Approach azimuth static test GSS6, position F6

Fig 4.3a

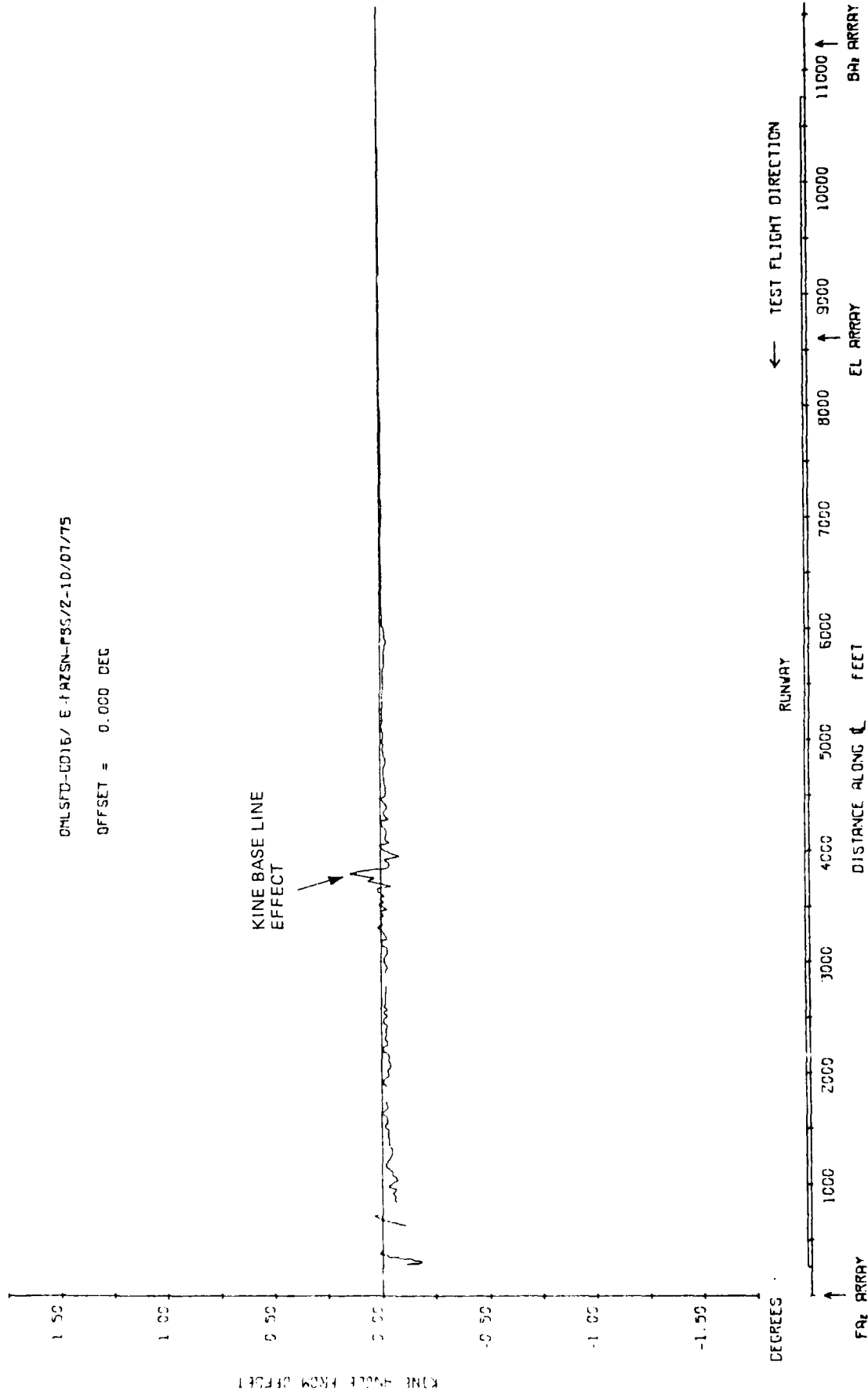


Fig 4.3a Approach azimuth. Vehicle run along test runway centre line.
Mast height 20 ft

TR 79052

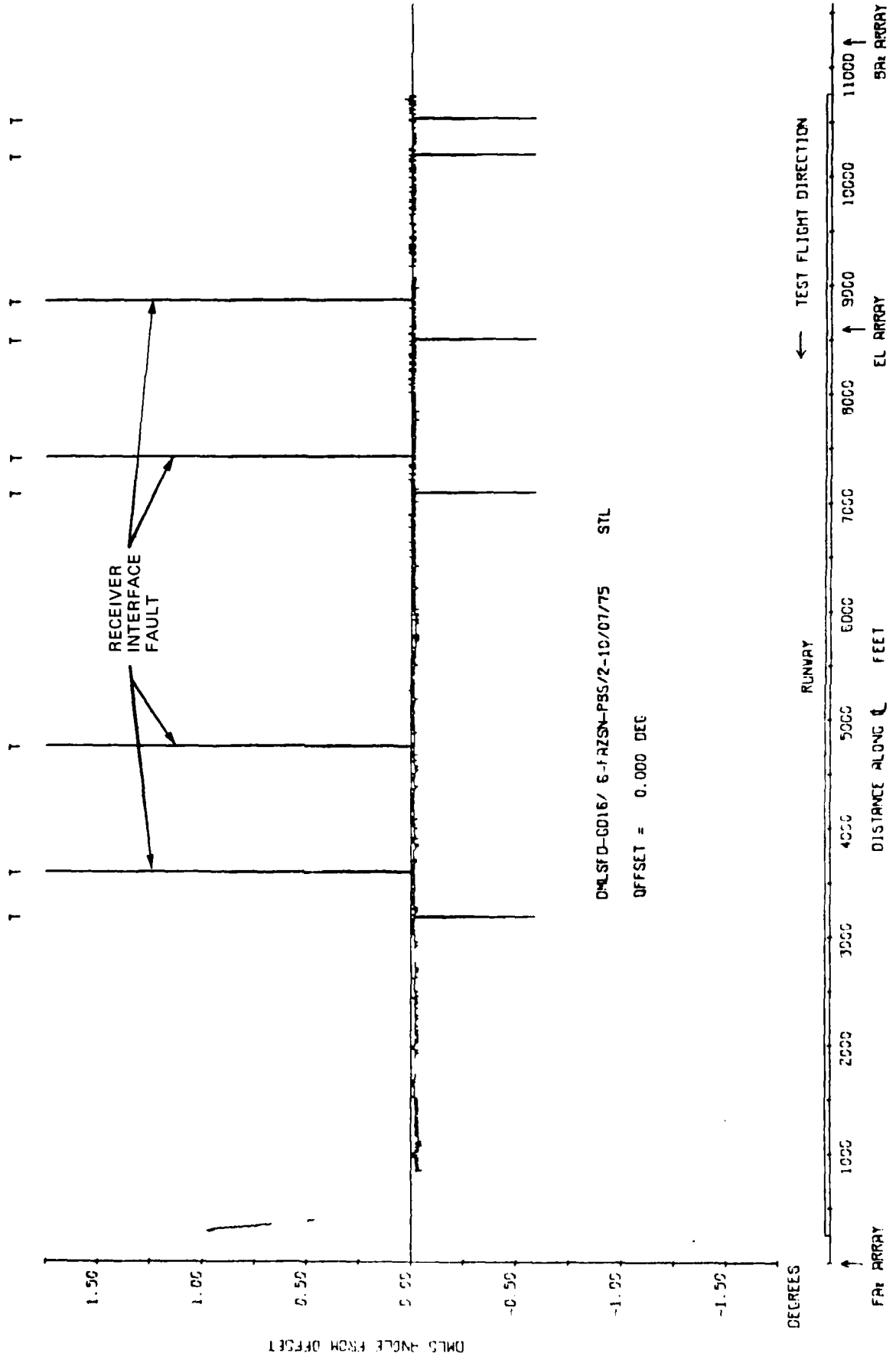


Fig 4.3b

Fig 4.3b Approach azimuth. Vehicle run along test runway centre line. Mast height 20 ft

Fig 4.3c

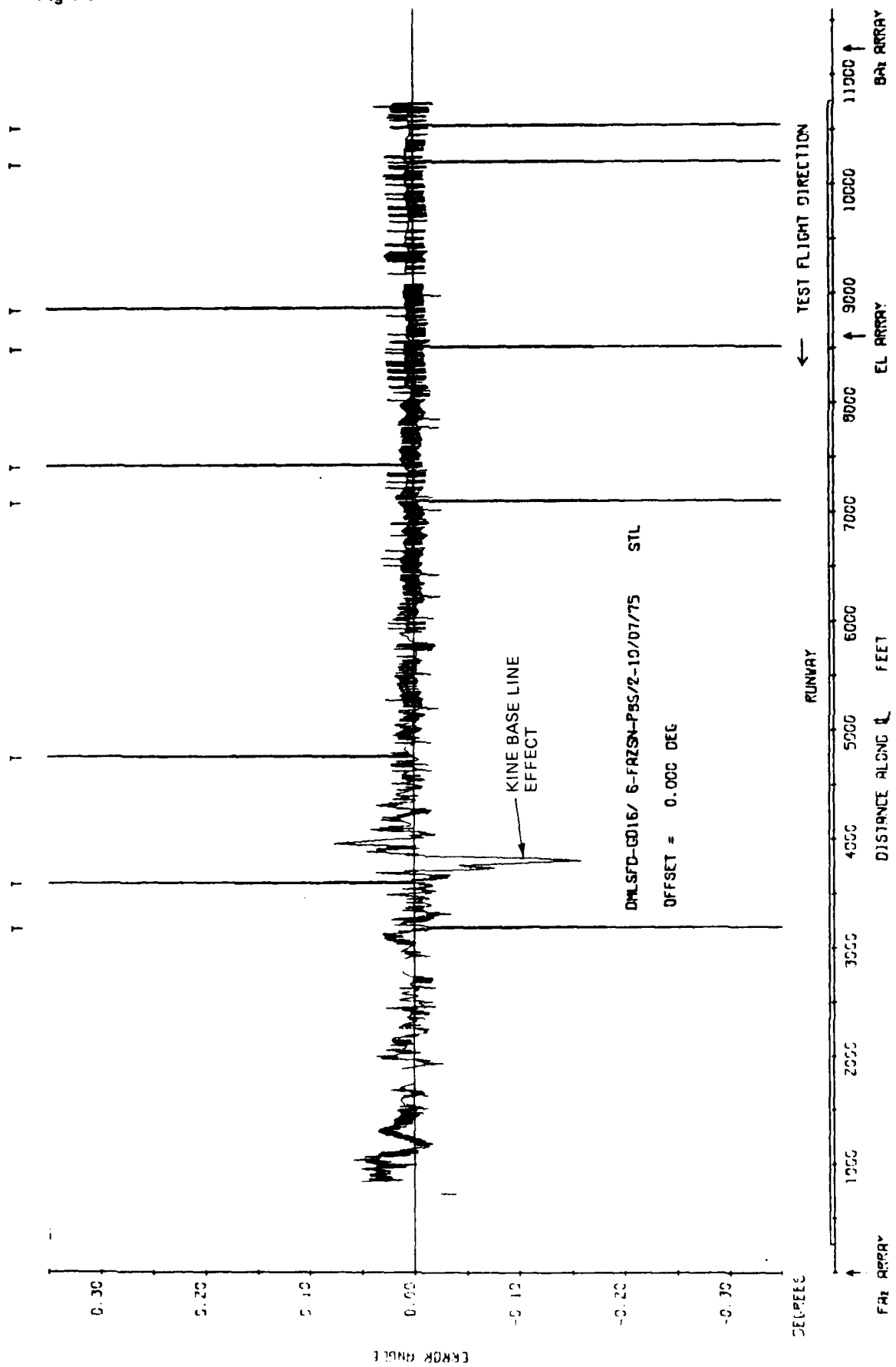


Fig 4.3c Approach azimuth. Vehicle run along test runway centre line. Mast height 20 ft

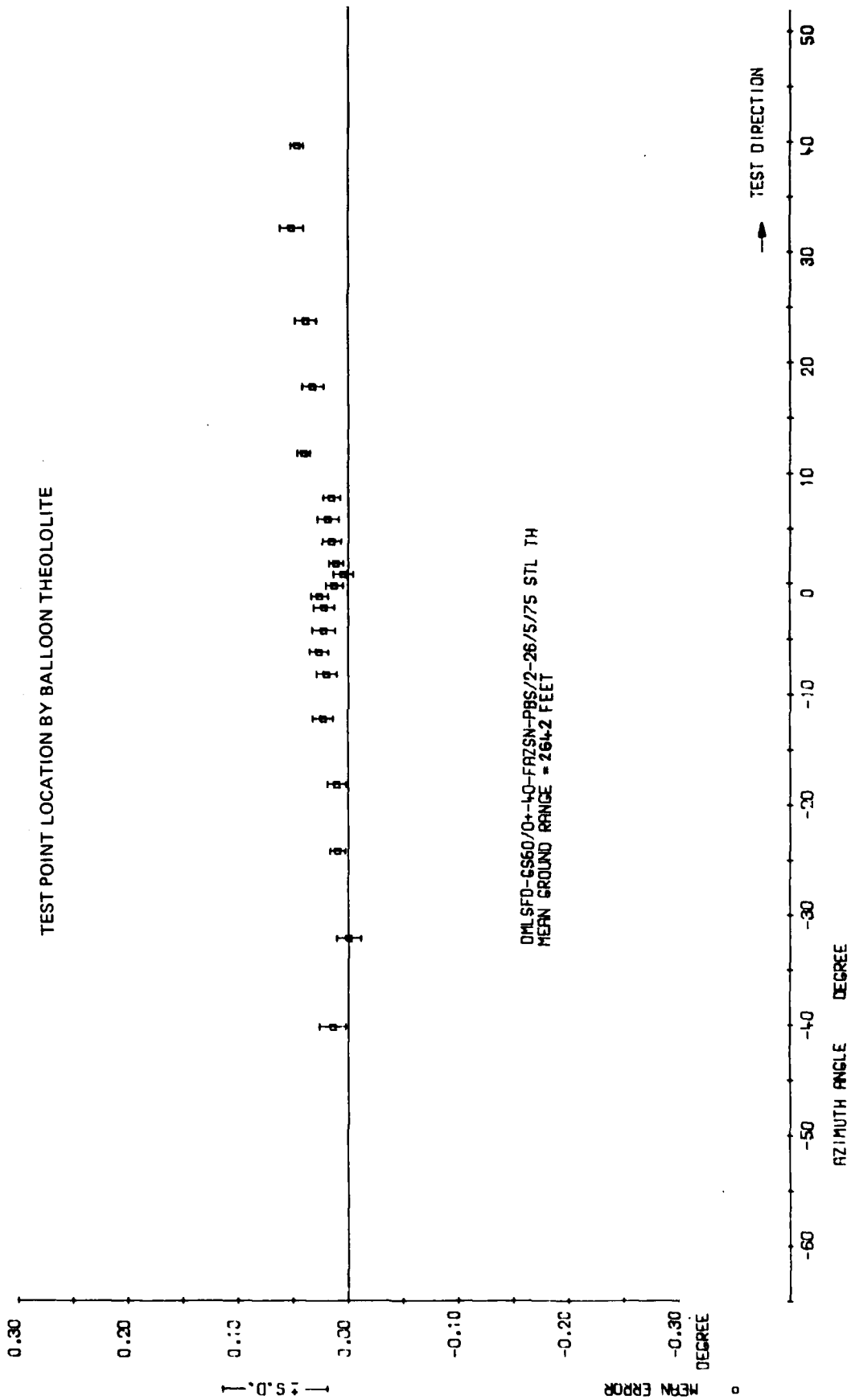


Fig 4.4

Fig 4.4 Approach azimuth cross runway test GS60

Fig 4.5a

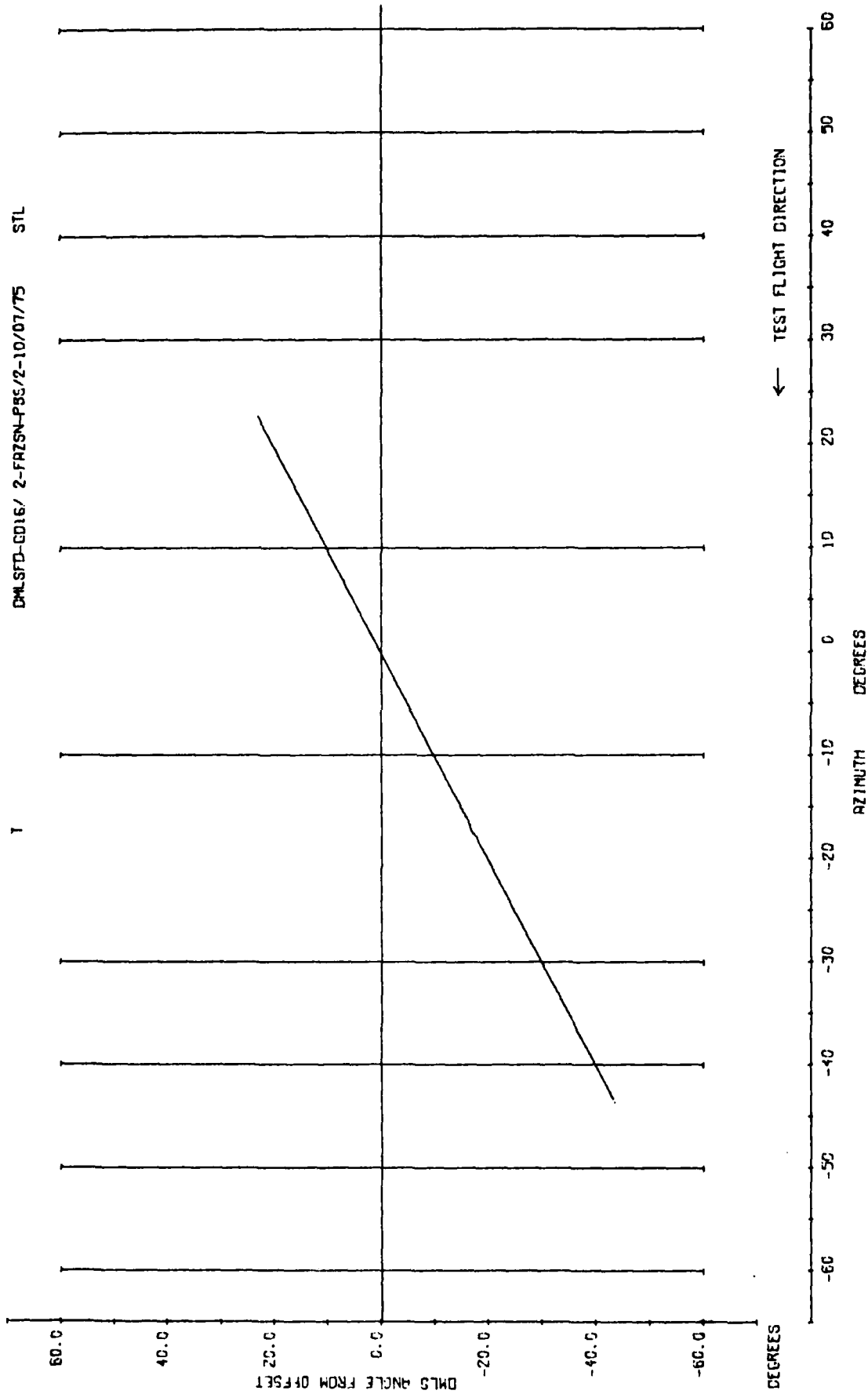


Fig 4.5a Approach azimuth. Vehicle run along N-S runway. Mast height 20 ft

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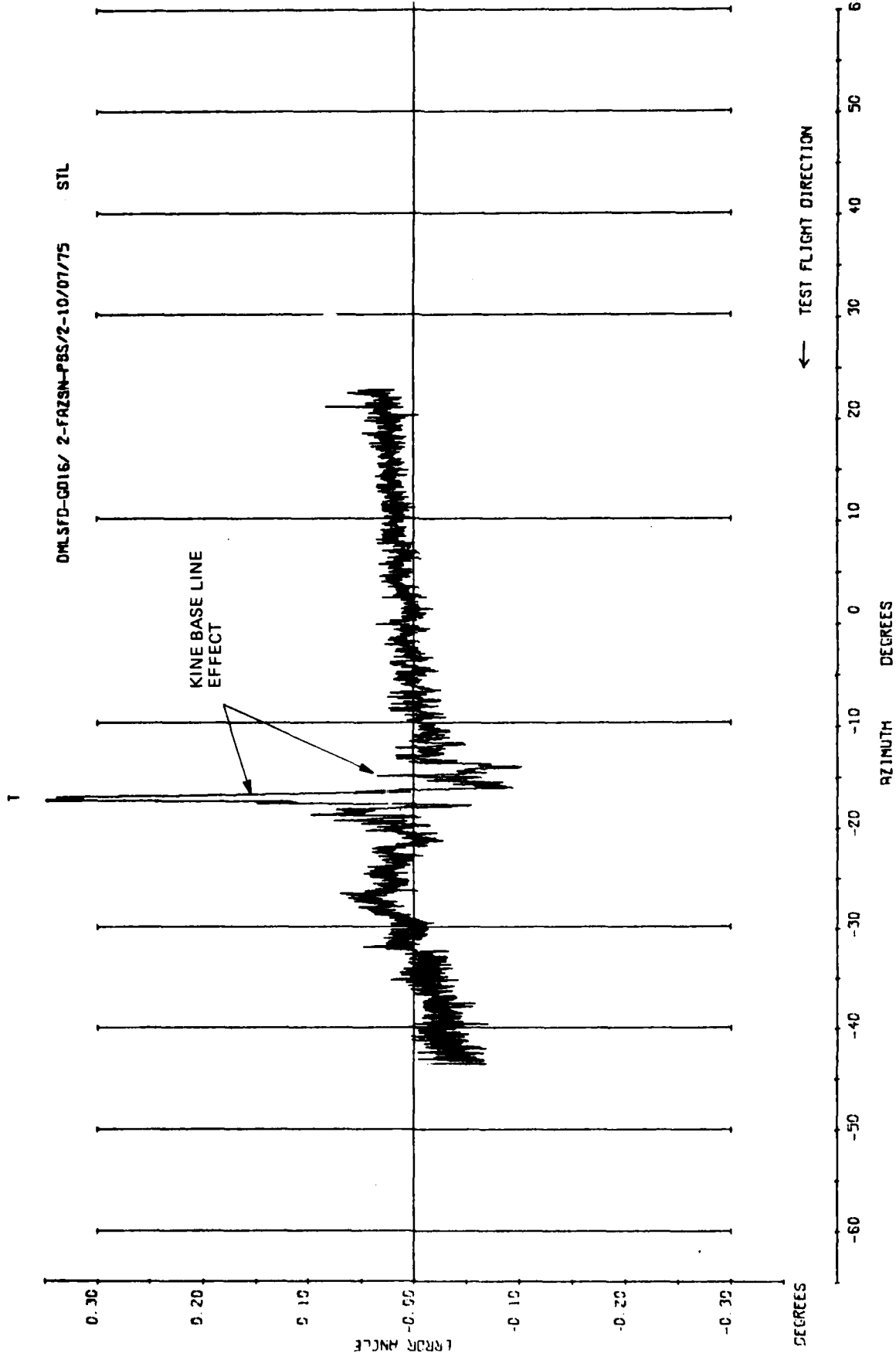


Fig 4.5b

Fig 4.5b Approach azimuth. Vehicle run along N-S runway. Mast height 20 ft

Fig 4.6a

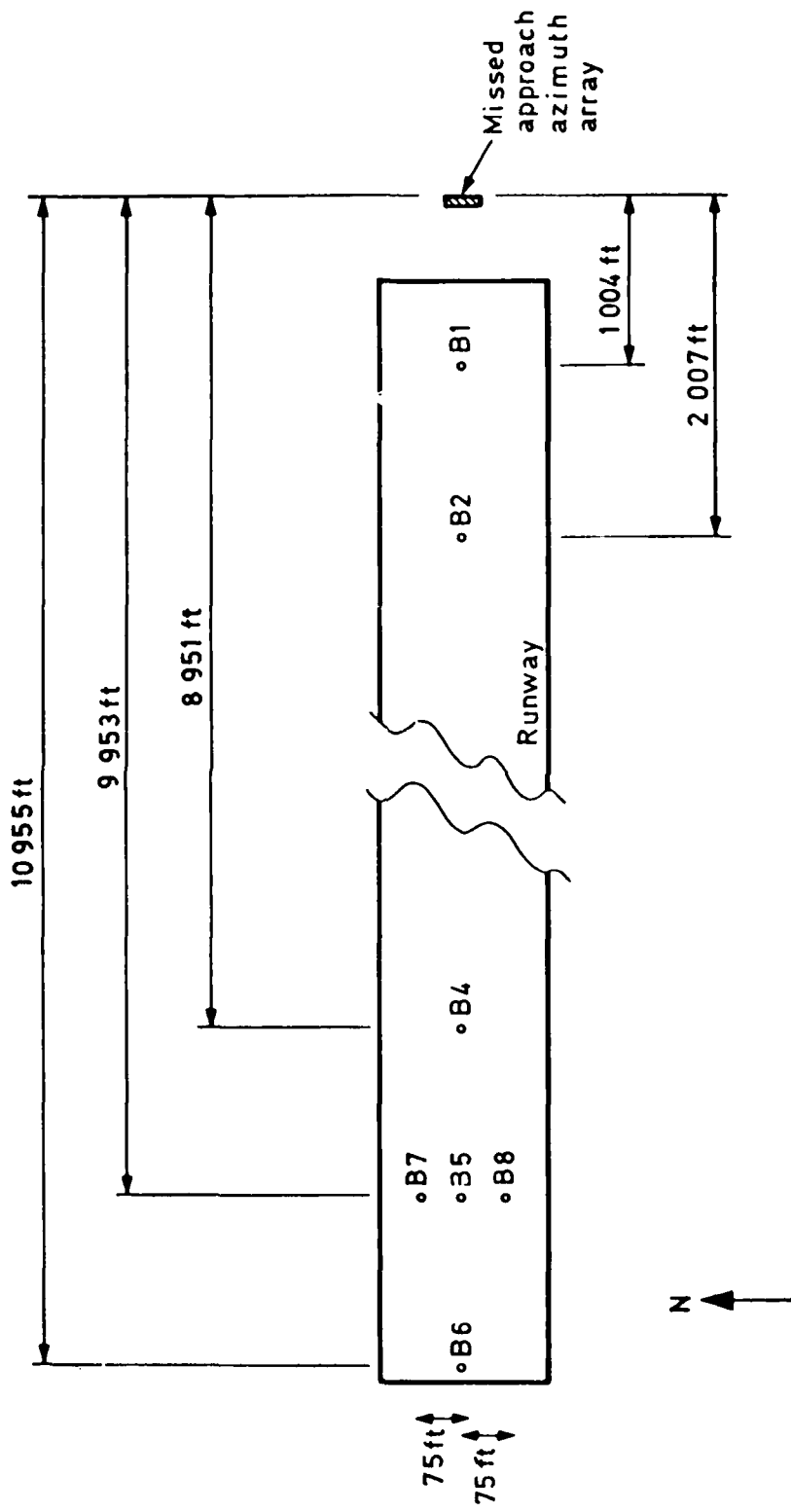
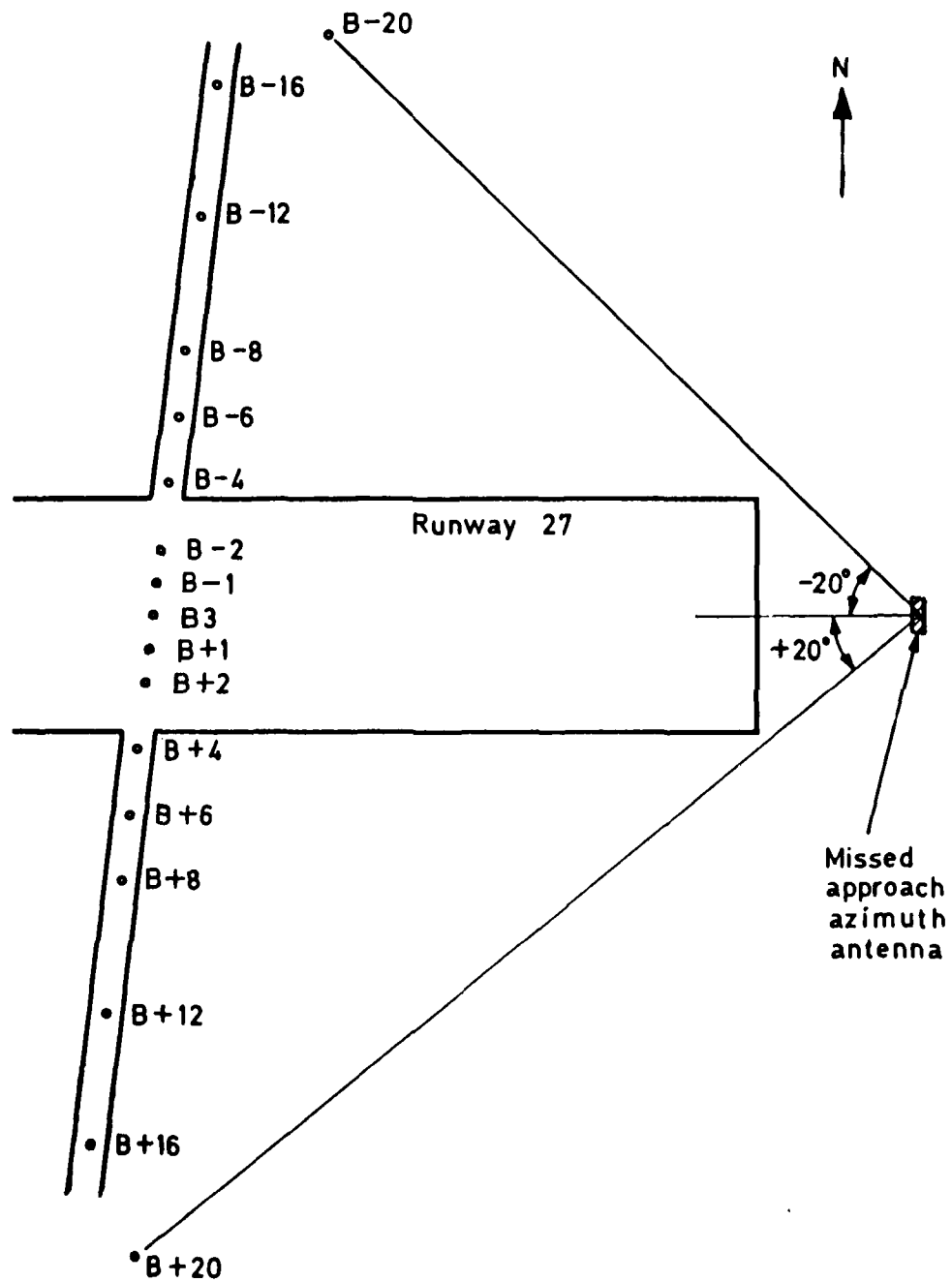


Fig 4.6a Close and long range missed approach azimuth test points

Fig 4.6b



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Fig 4.6b Cross runway missed approach azimuth test points

Fig 4.7

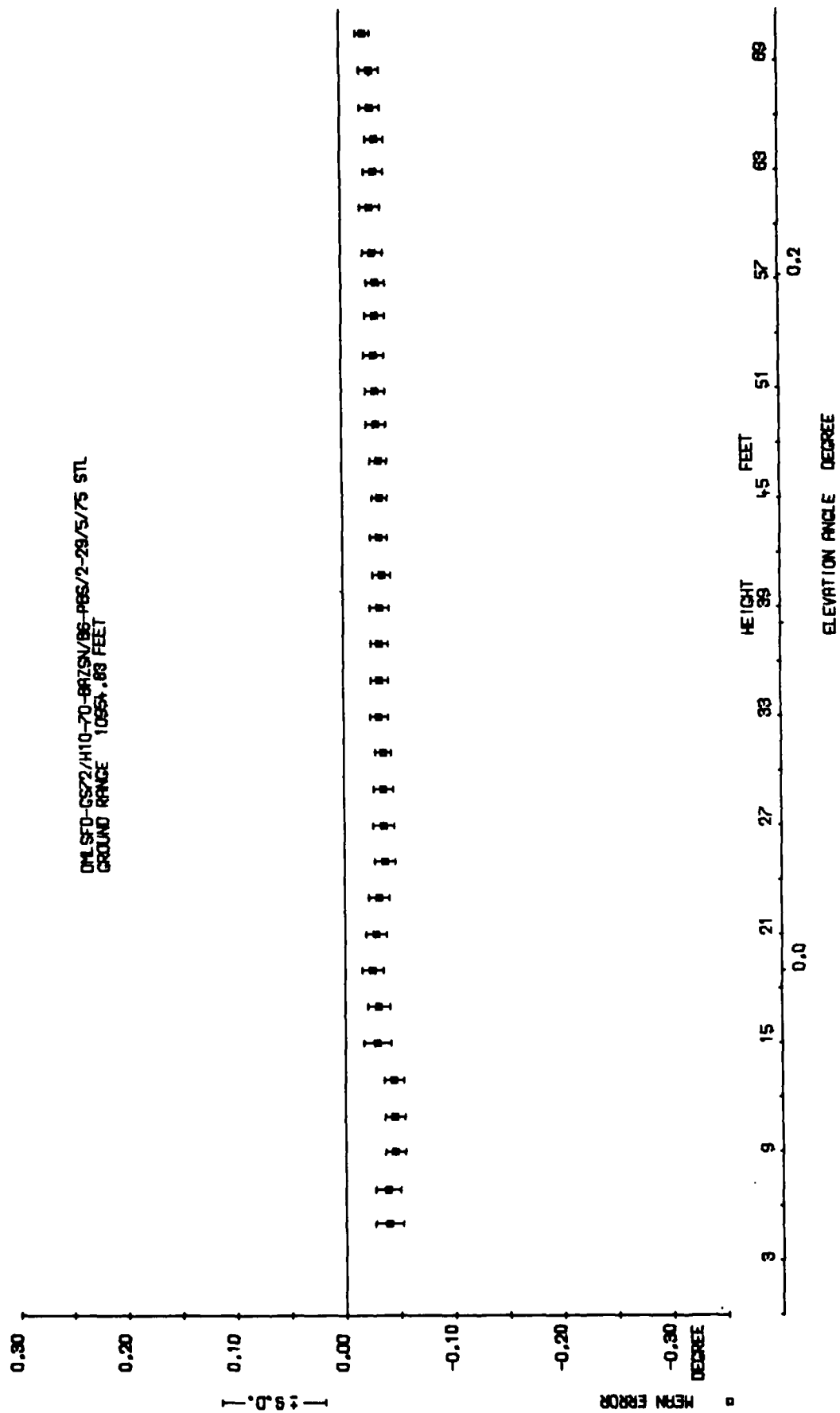


Fig 4.7 Missed approach azimuth static test GS72, position B6

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DNLSFD-G016/ 6-94ZSN-P55/2-10/07/75

OFFSET = 0.000 DEG

KINE ANGLE FROM OFFSET

KINE BASE LINE
EFFECT

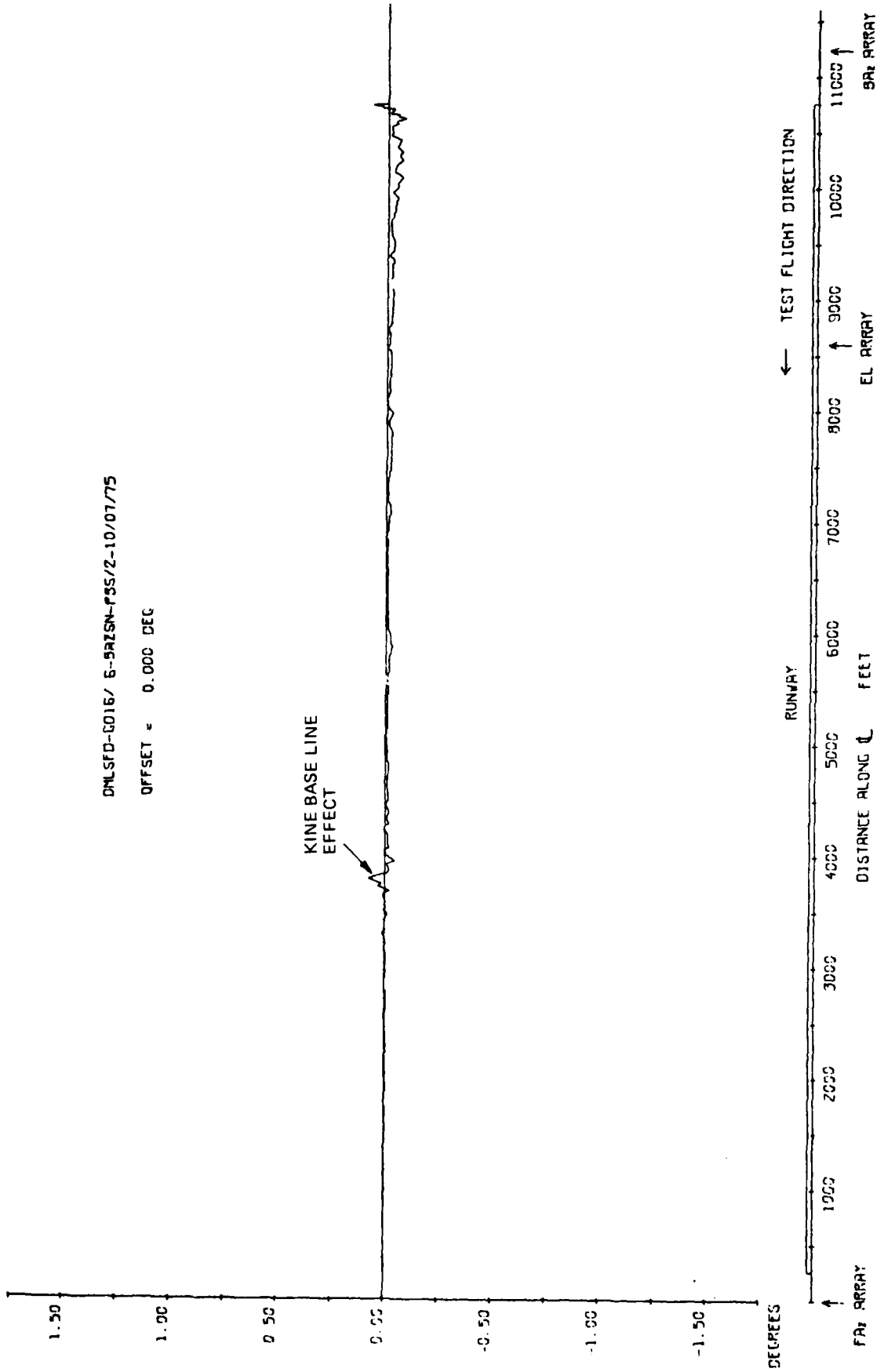


Fig 4.8a

Fig 4.8a Missed approach azimuth. Run along test runway centre line. Mast at 20 ft

Fig 4.8b

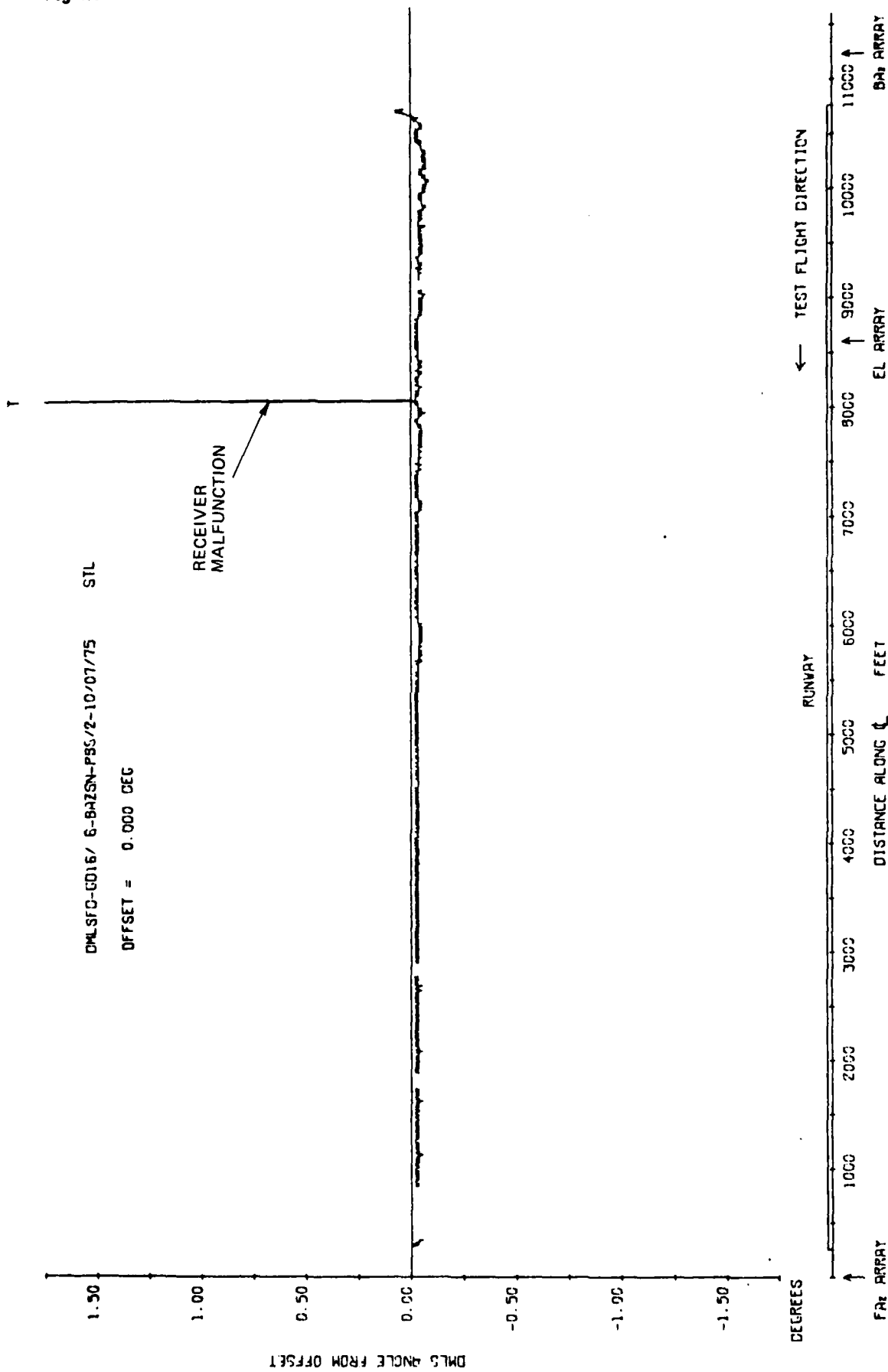


Fig 4.8b Missed approach azimuth. Run along test runway centre line. Mast at 20 ft

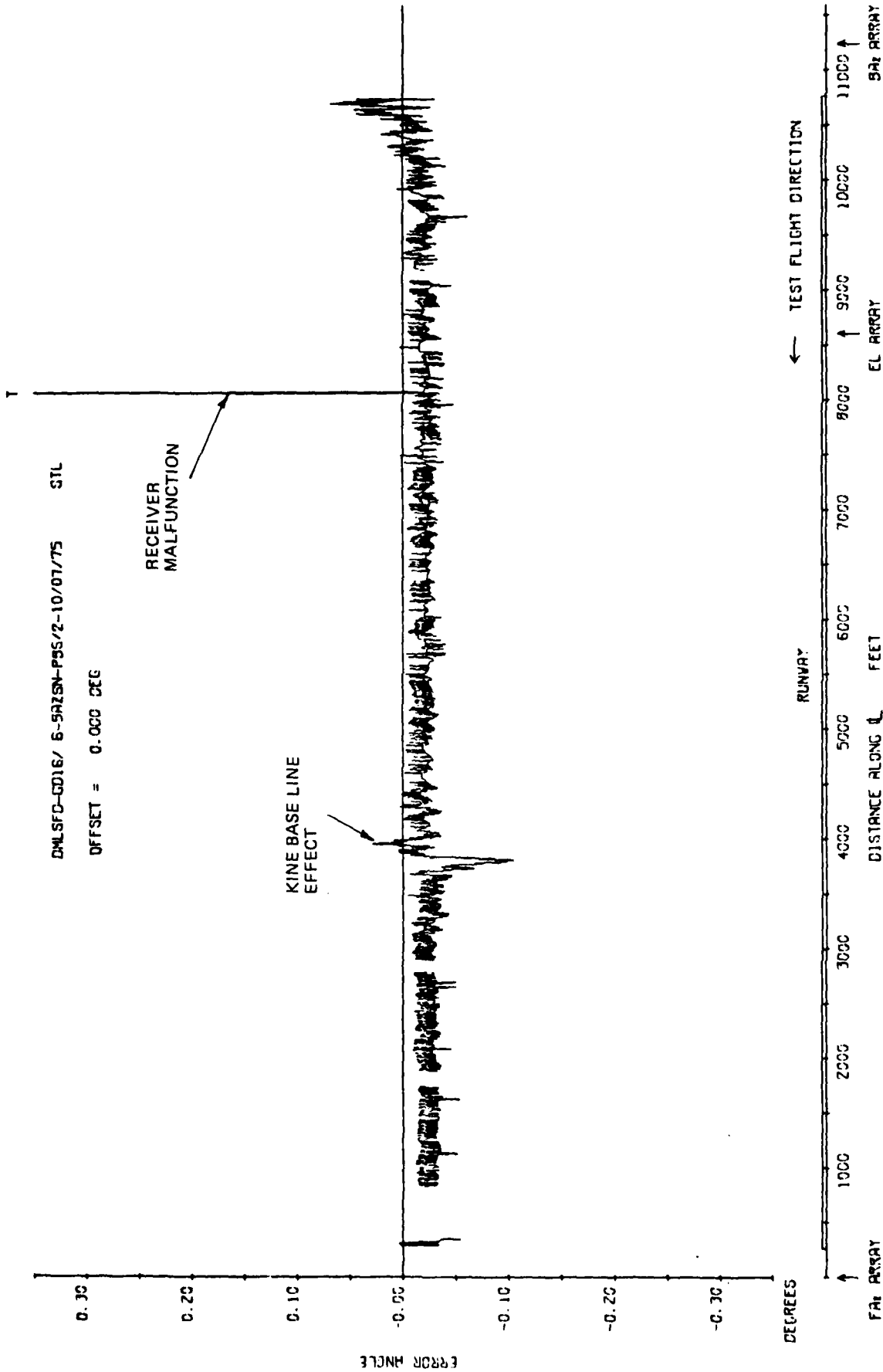


Fig 4.8c

Fig 4.8c Missed approach azimuth. Run along test runway centre line. Mast at 20 ft

Fig 4.9

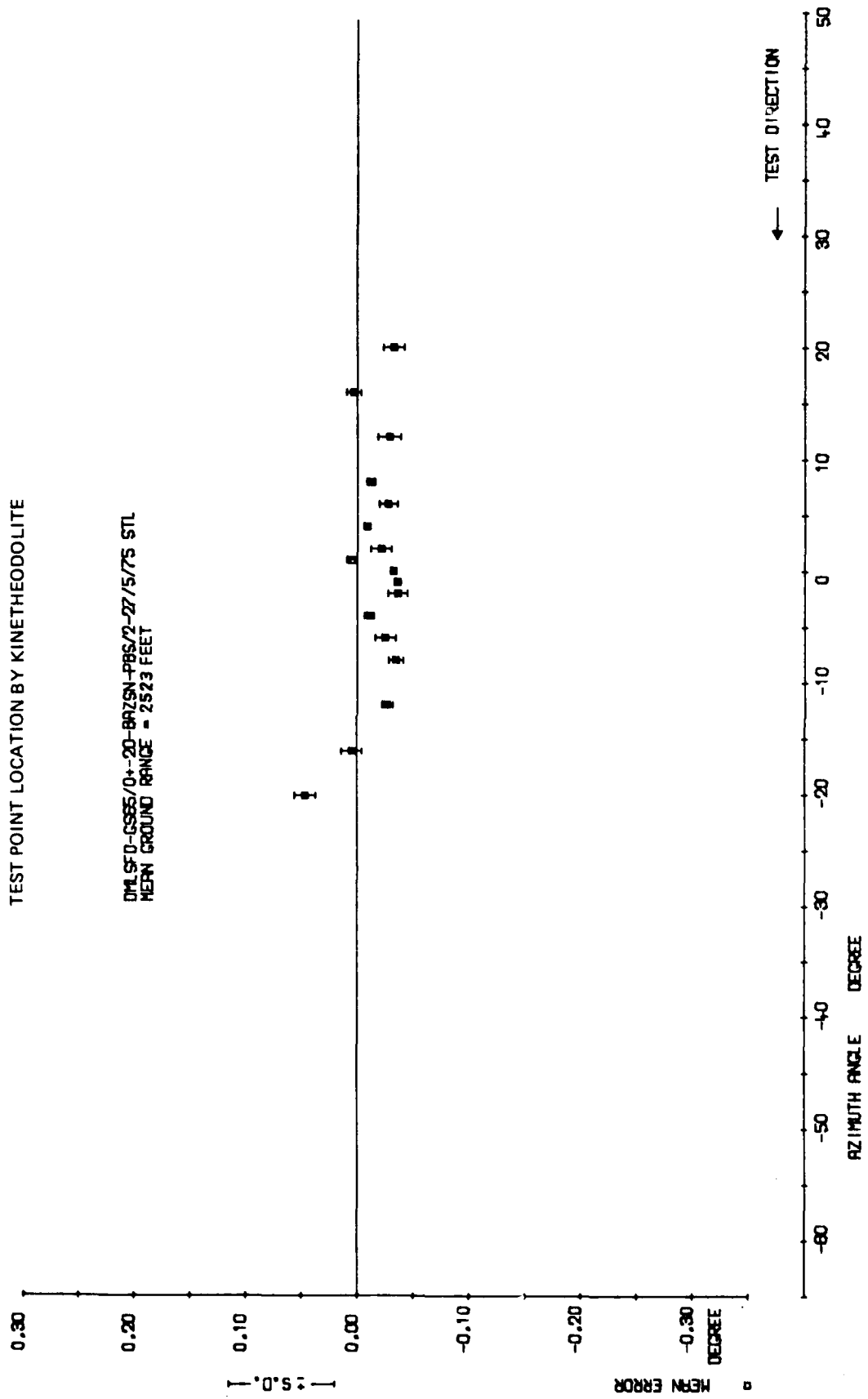


Fig 4.9 Missed approach azimuth cross runway test GS65

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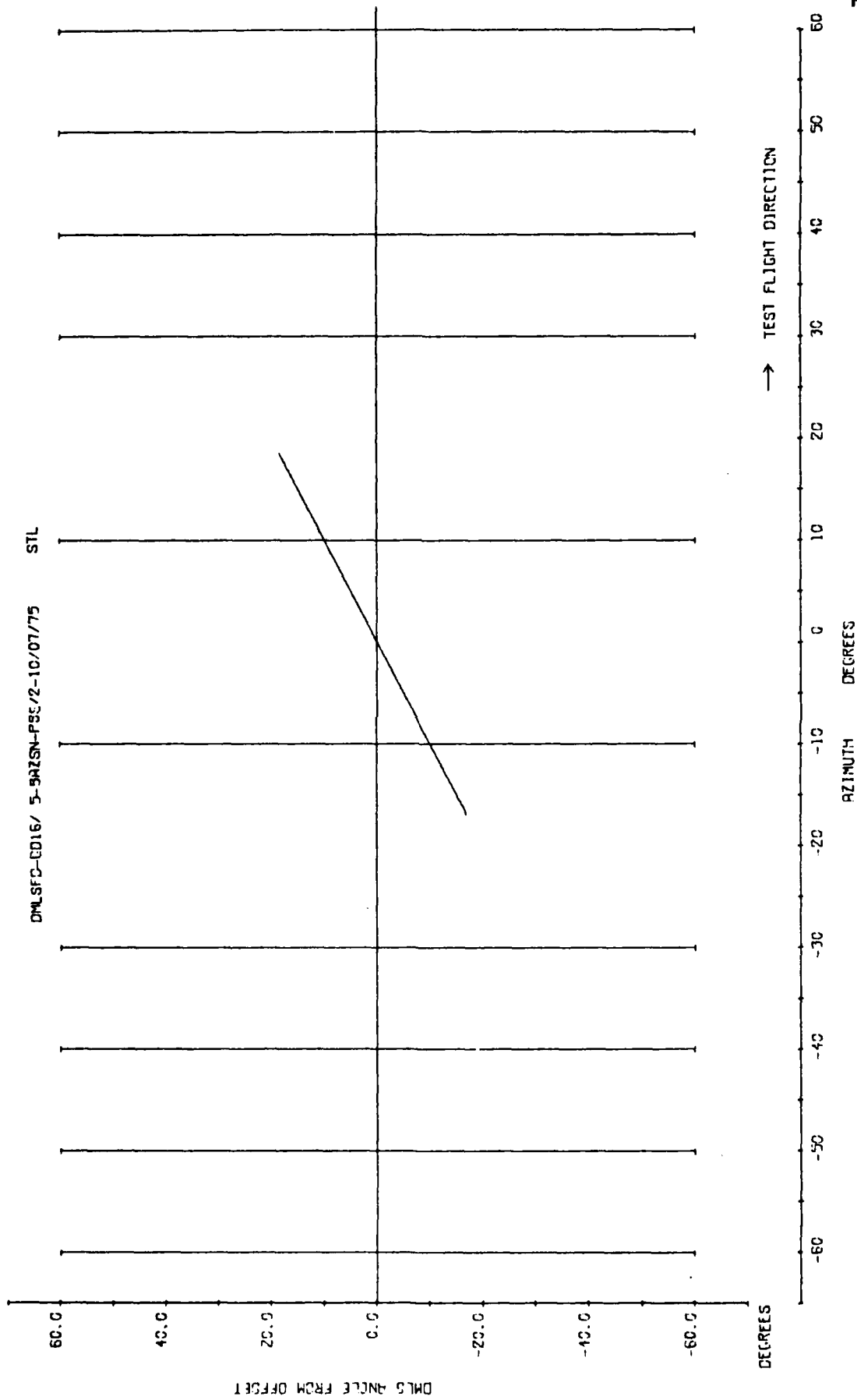


Fig 4.10a

Fig 4.10a Missed approach azimuth. Vehicle run along cross road.
Mast height 20 ft

Fig 4.10b

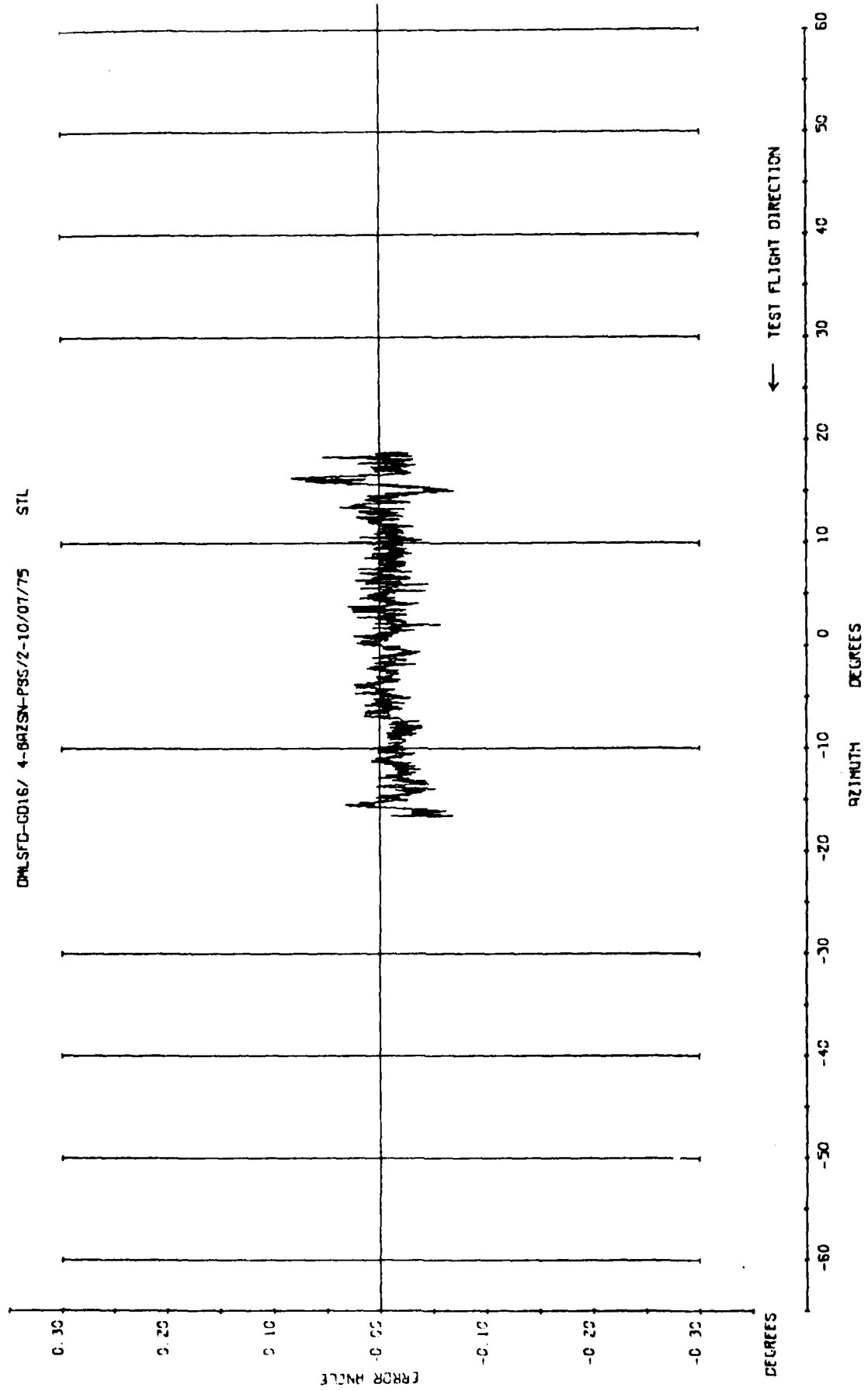


Fig 4.10b Missed approach azimuth. Vehicle run along cross road.
Mast height 30 ft

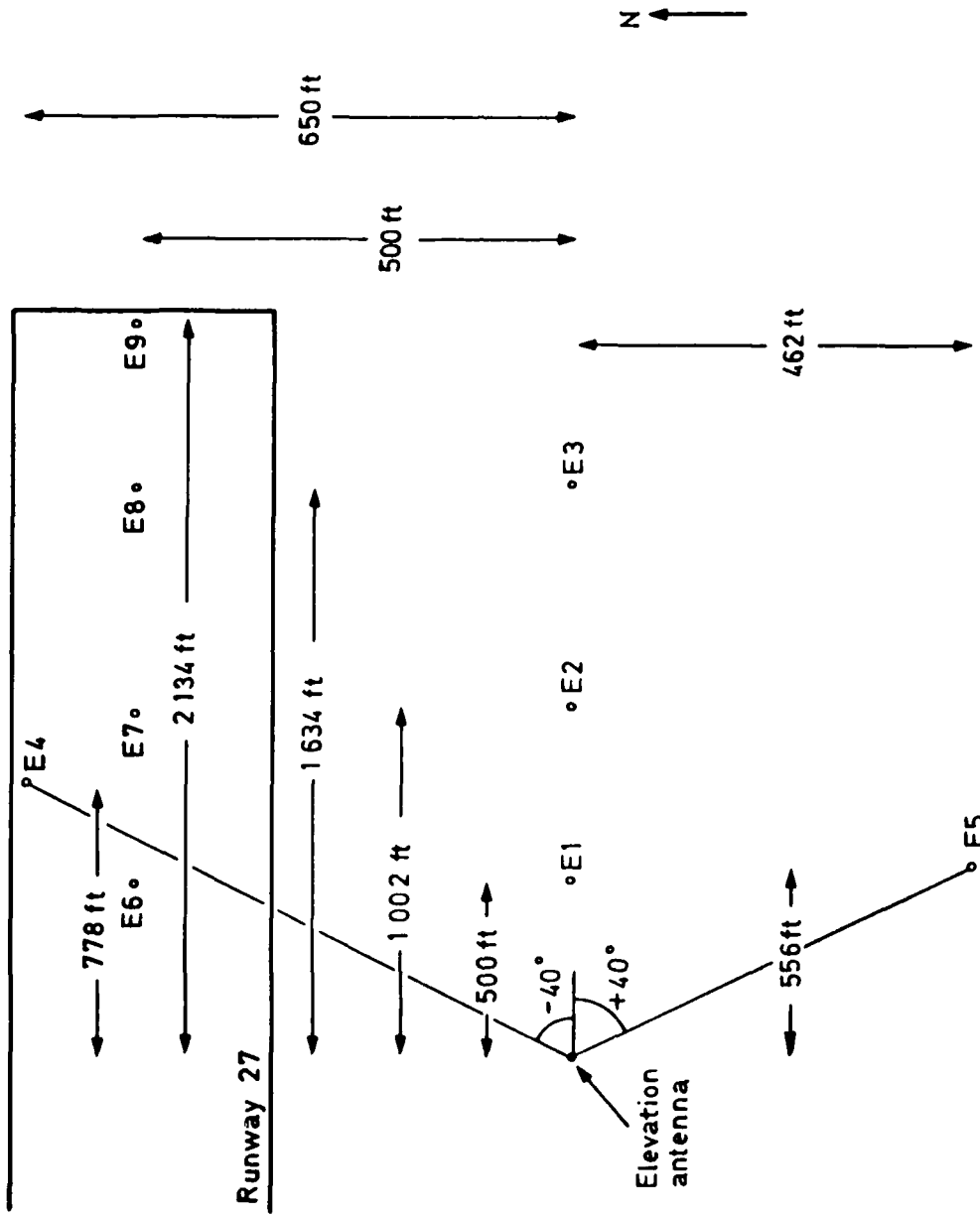


Fig 4.11 Elevation test points

Fig 4.12

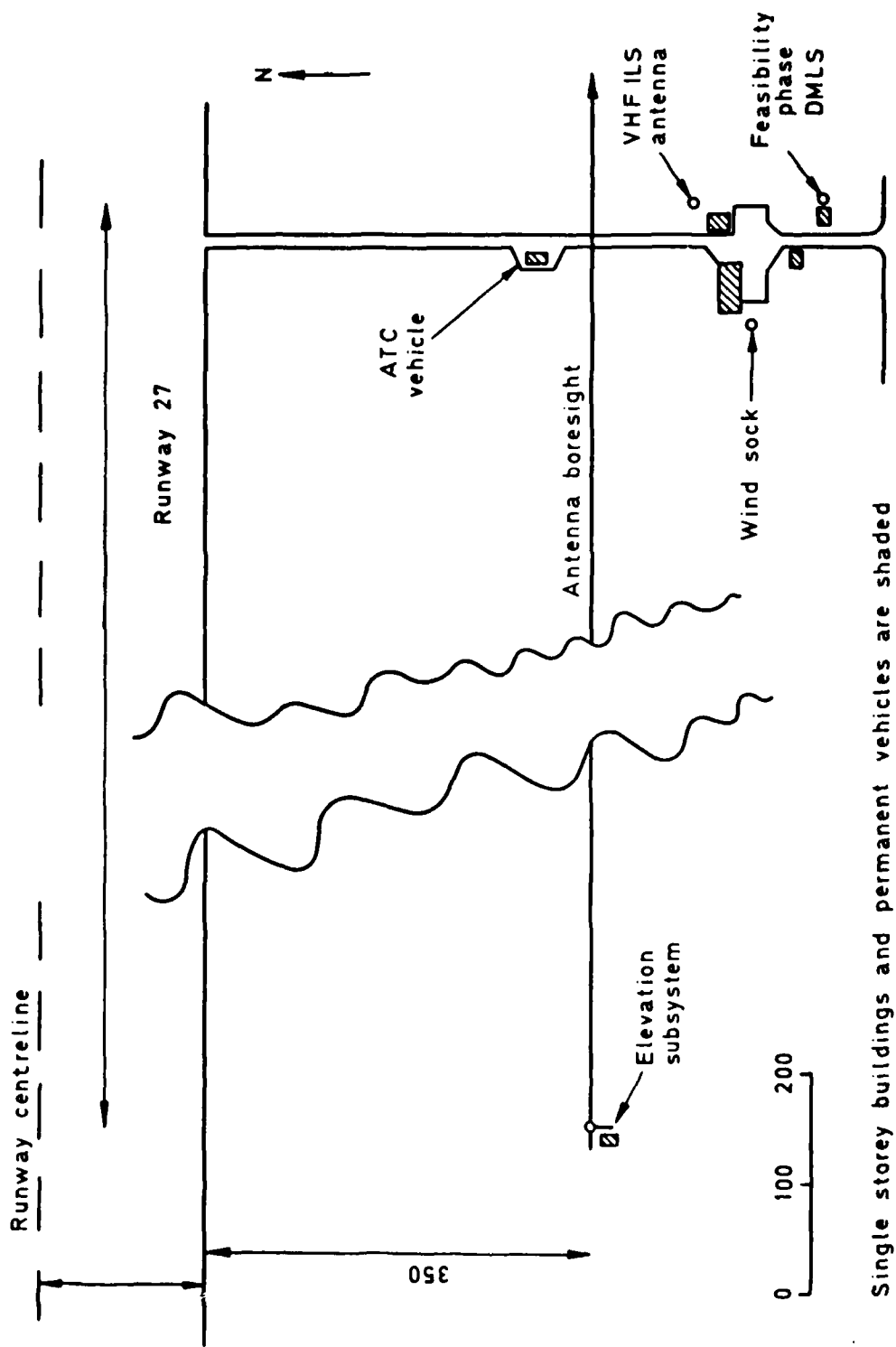


Fig 4.12 Elevation sub-system installation

Fig 4.13

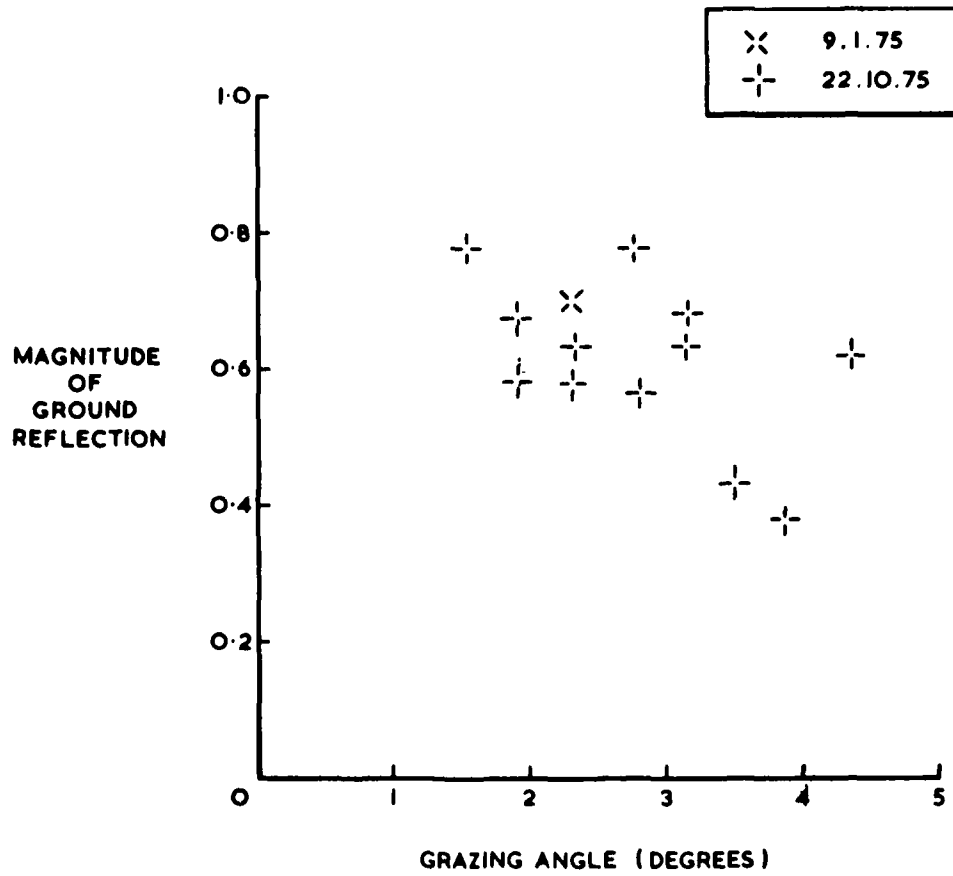


Fig 4.13 Magnitude of ground reflection in front of elevation transmitter.
Range 1000 ft

Fig 4.14

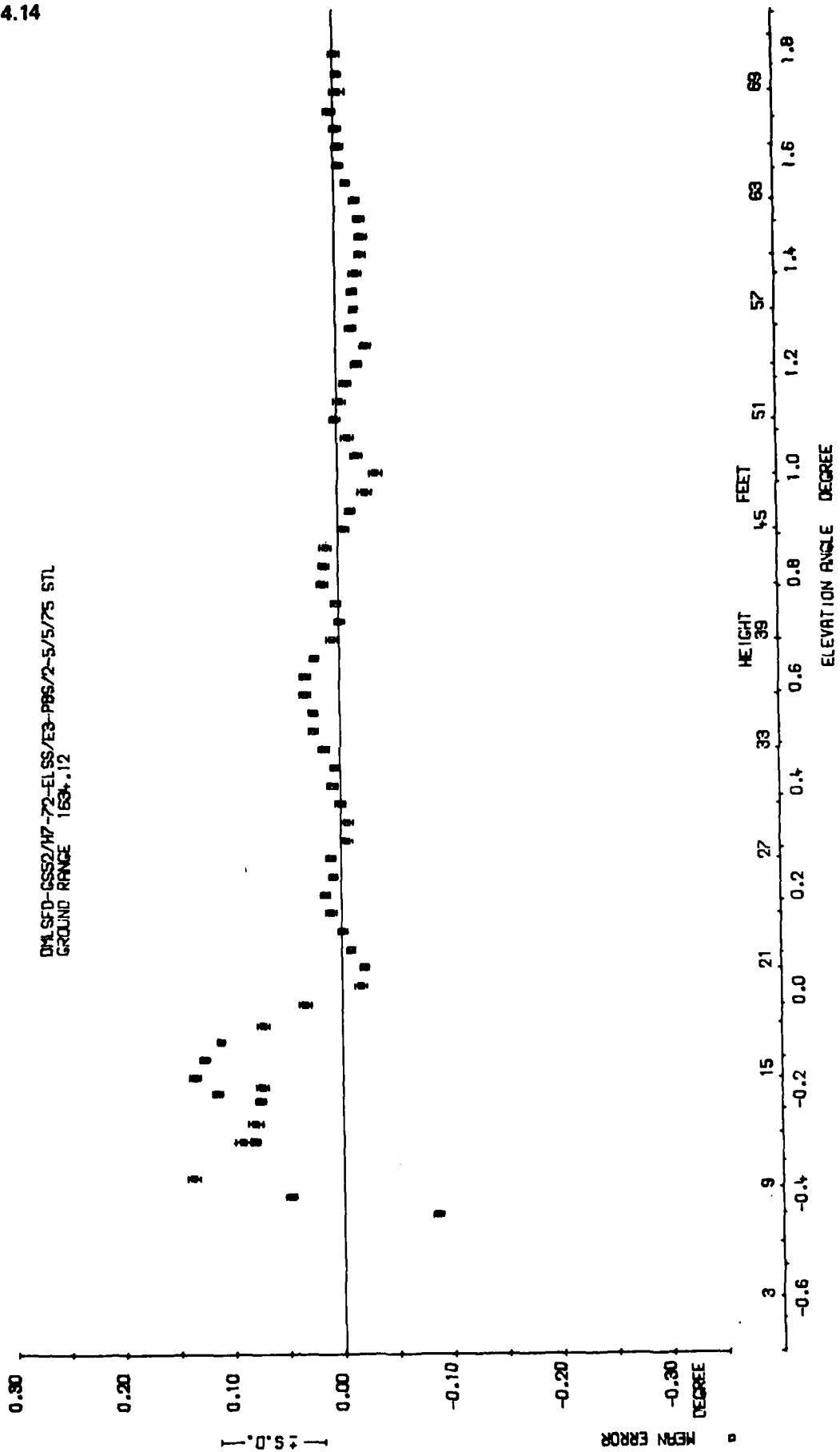


Fig 4.14 Elevation static test GSS2, position E3

DML STD-GS40/H16-65-EL /E7-PBS/ -12/2/75 STL
GROUND RANGE 1122.93

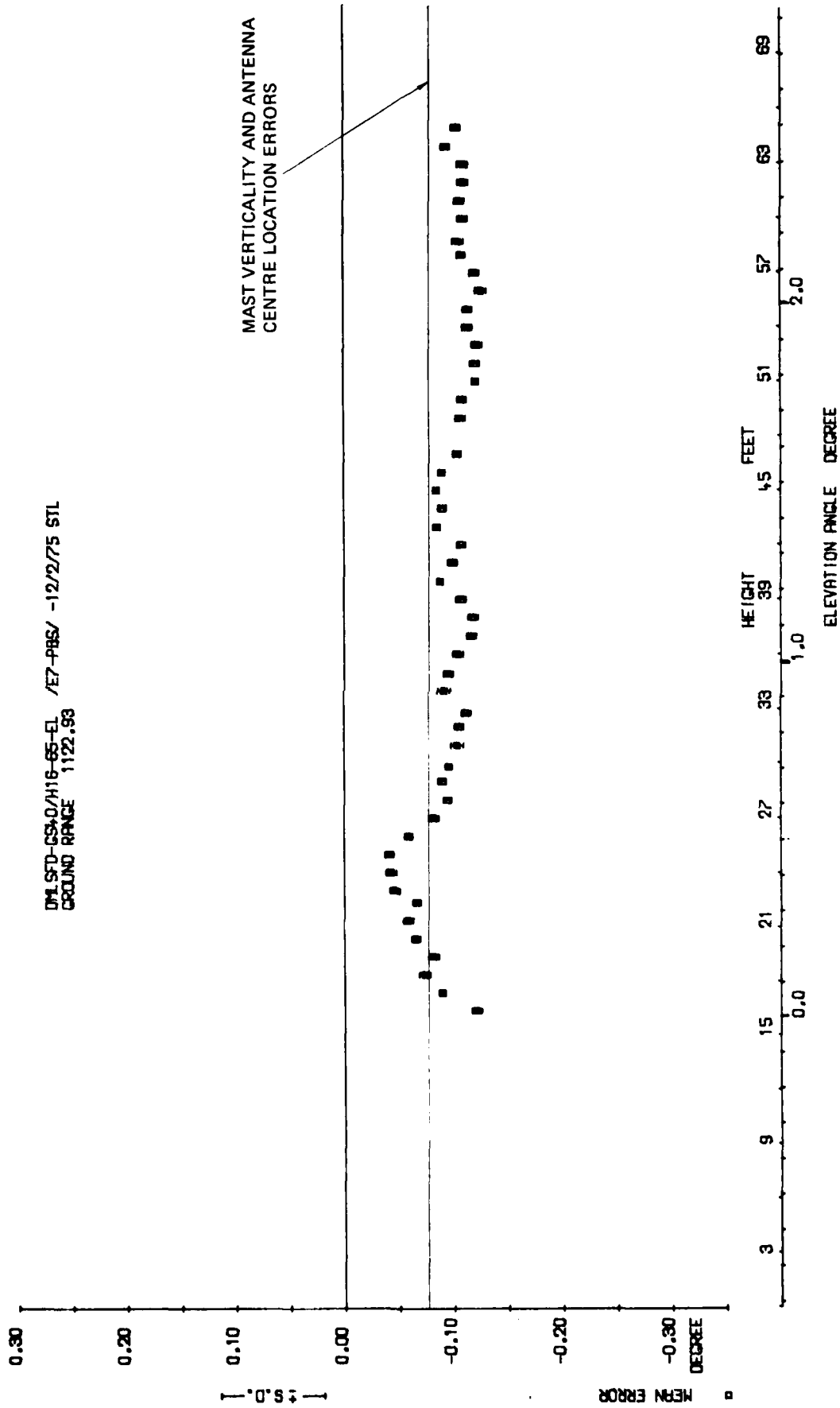


Fig 4.15a

Fig 4.15a Elevation static test GS40, position E7

Fig 4.15b

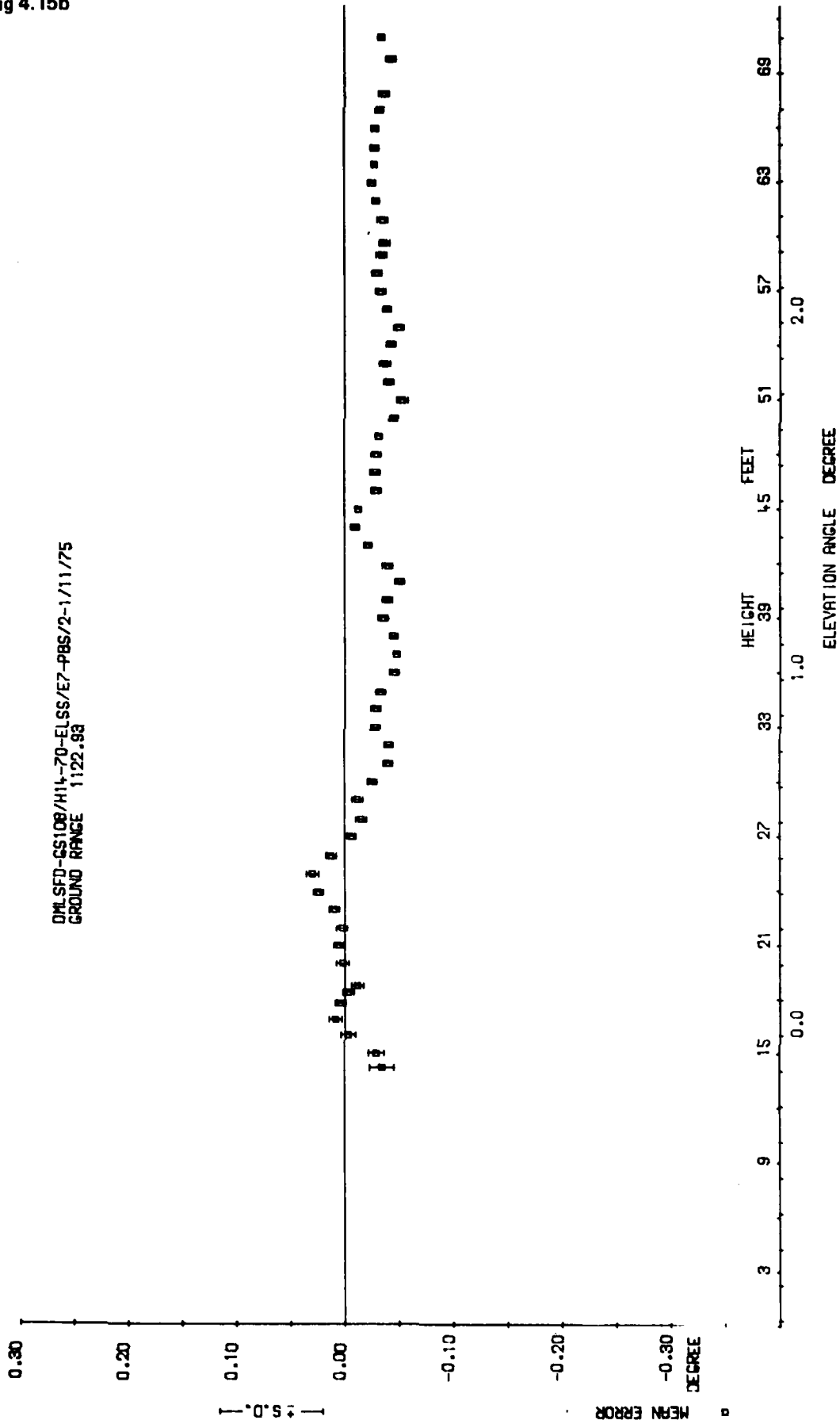


Fig 4.15b Elevation static test GS108, position E7

Fig 4.16a

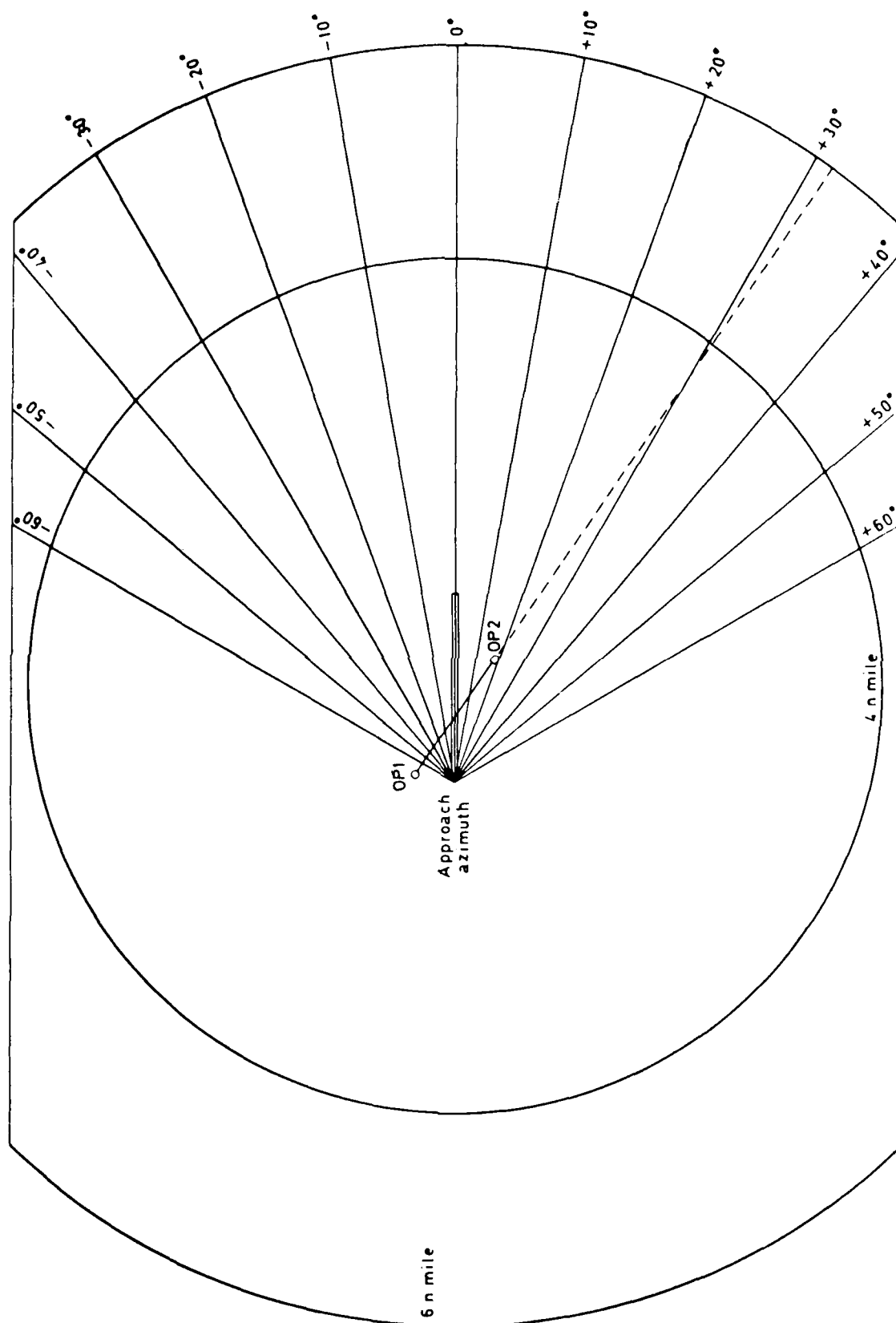


Fig 4.16a Kine base line in relation to approach azimuth flight paths

Fig 4.16b

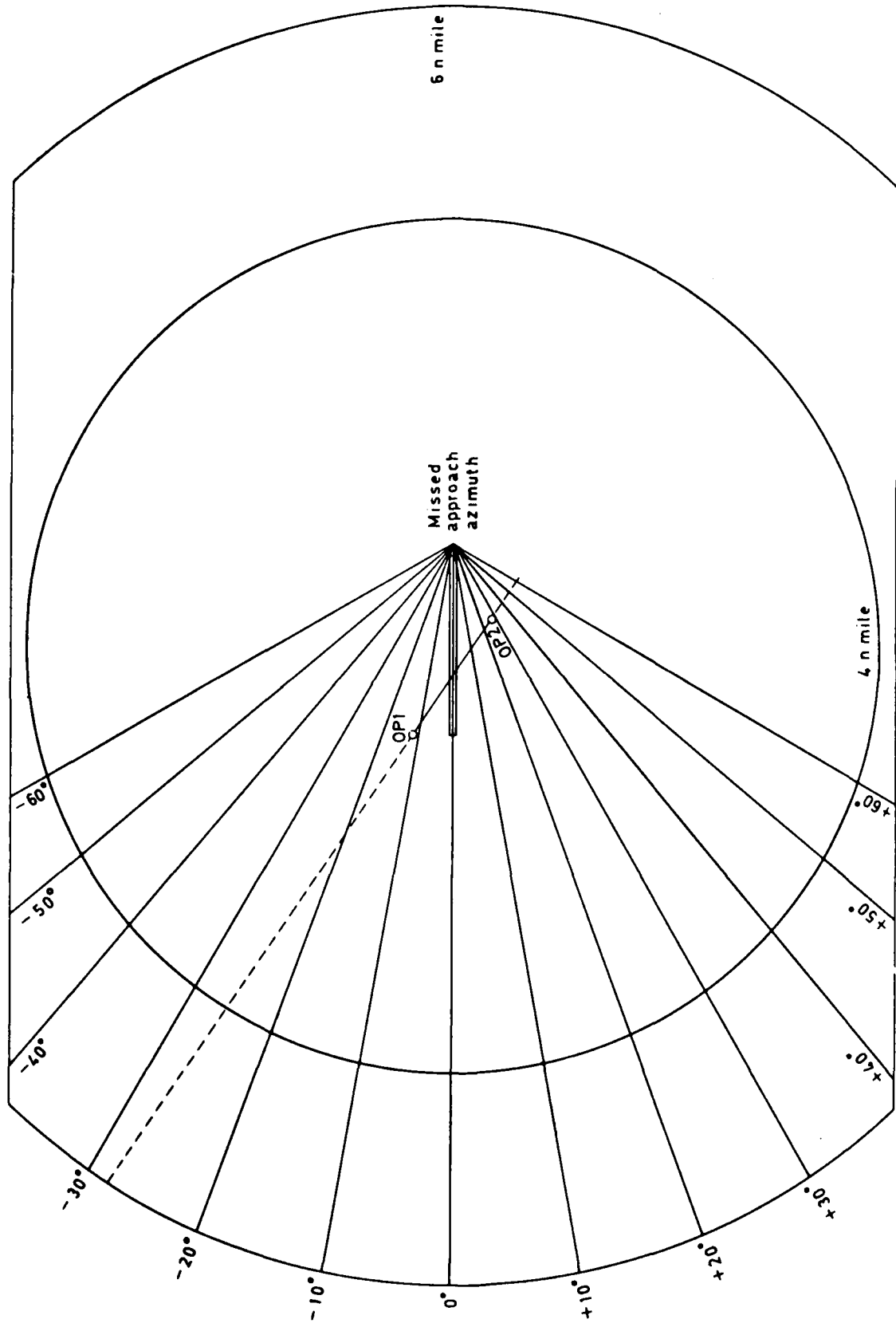


Fig 4.16b Kine base line in relation to missed approach azimuth flight paths

Fig 4.16c

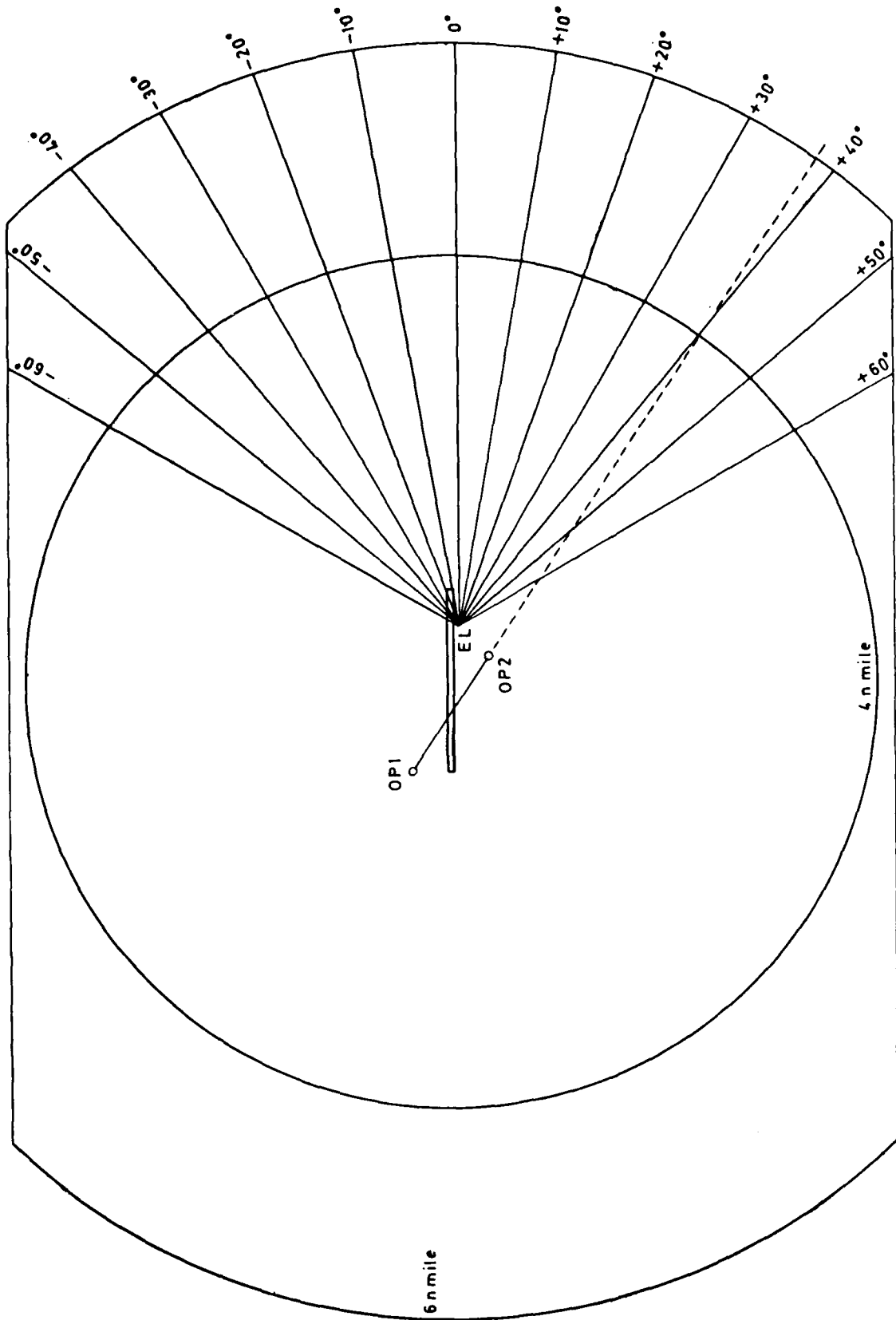


Fig 4.16c Kine base line in relation to elevation flight paths

Fig 4.17

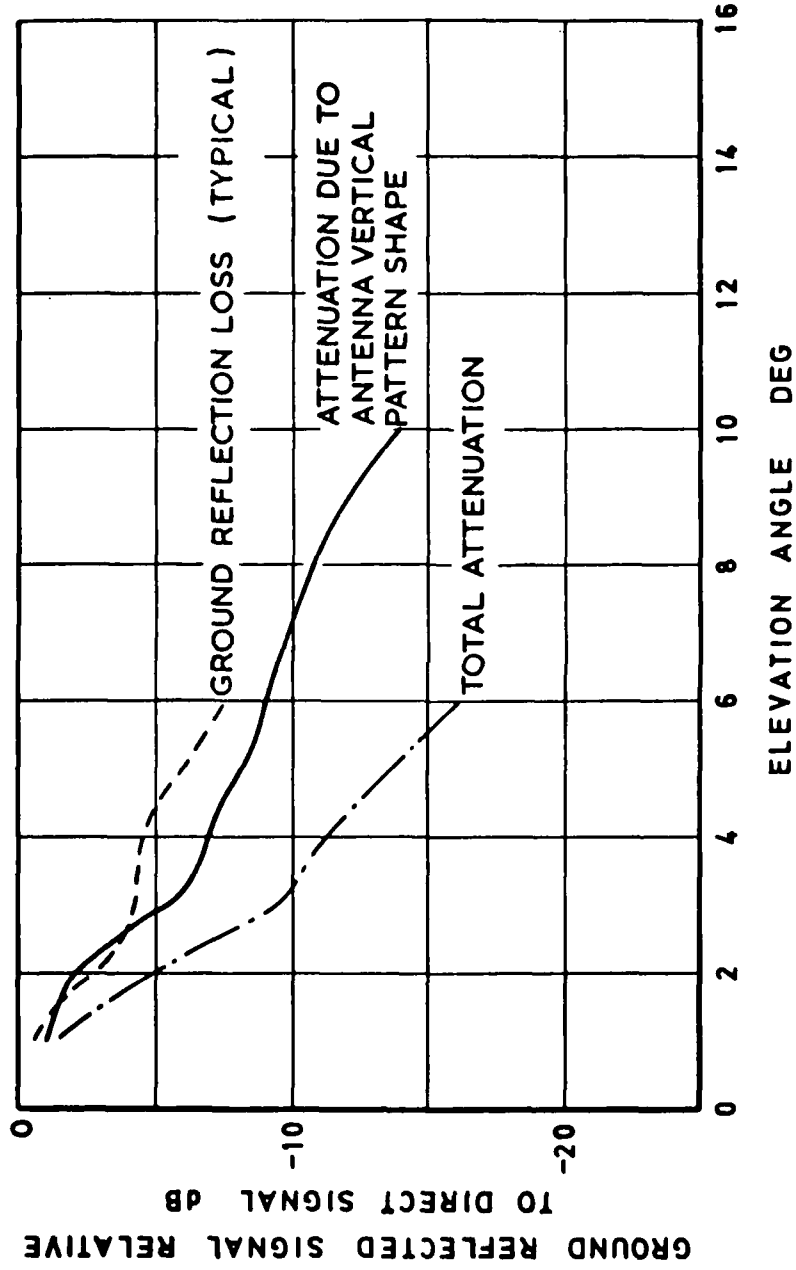


Fig 4.17 Estimated ground reflected signal for azimuth ground plane antenna

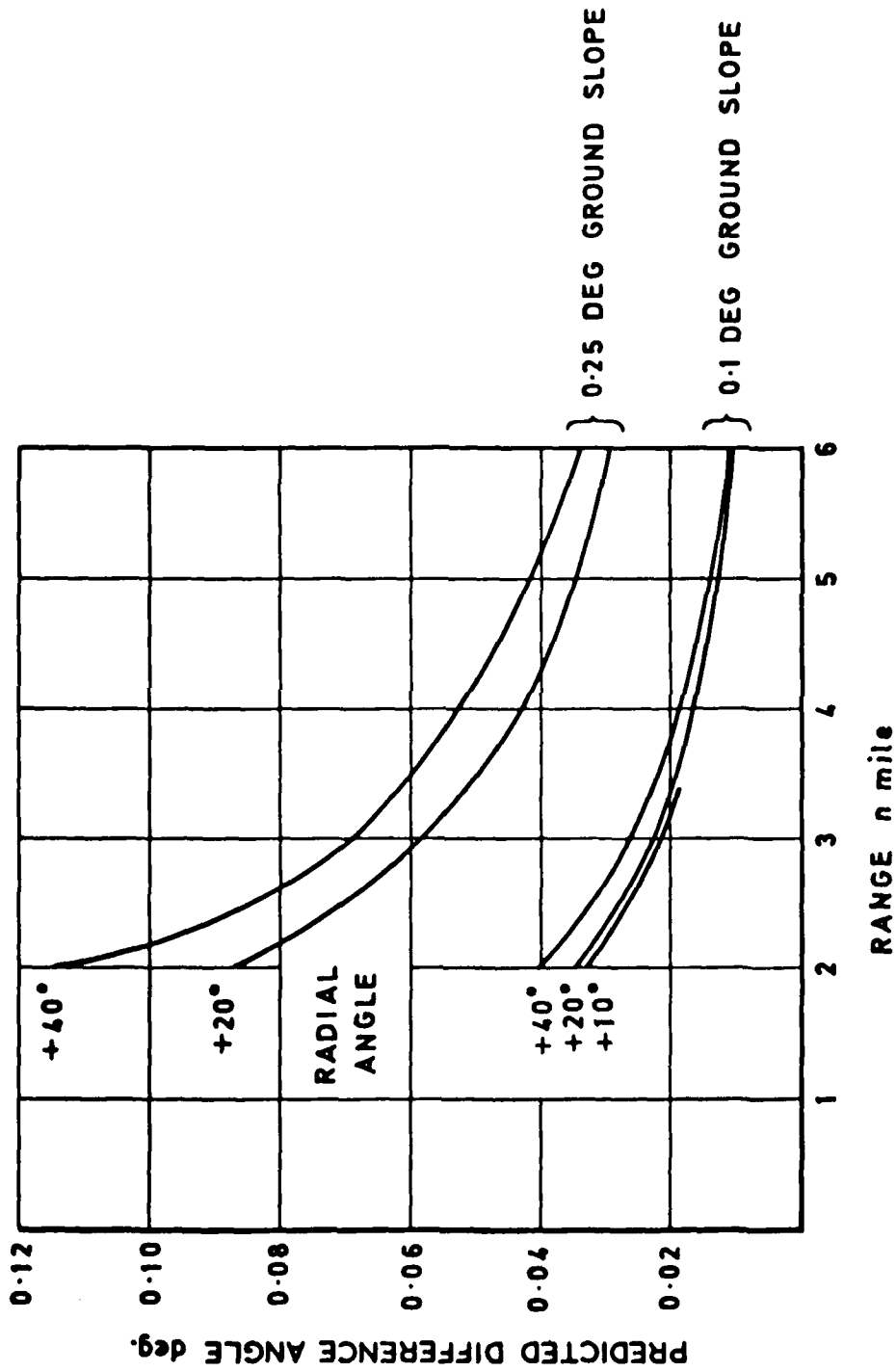


Fig 4.18 Predicted code angle difference between direct and ground reflected signal for 0.1 and 0.25 degree lateral slope during 2000 ft constant height radials

Fig 4.19

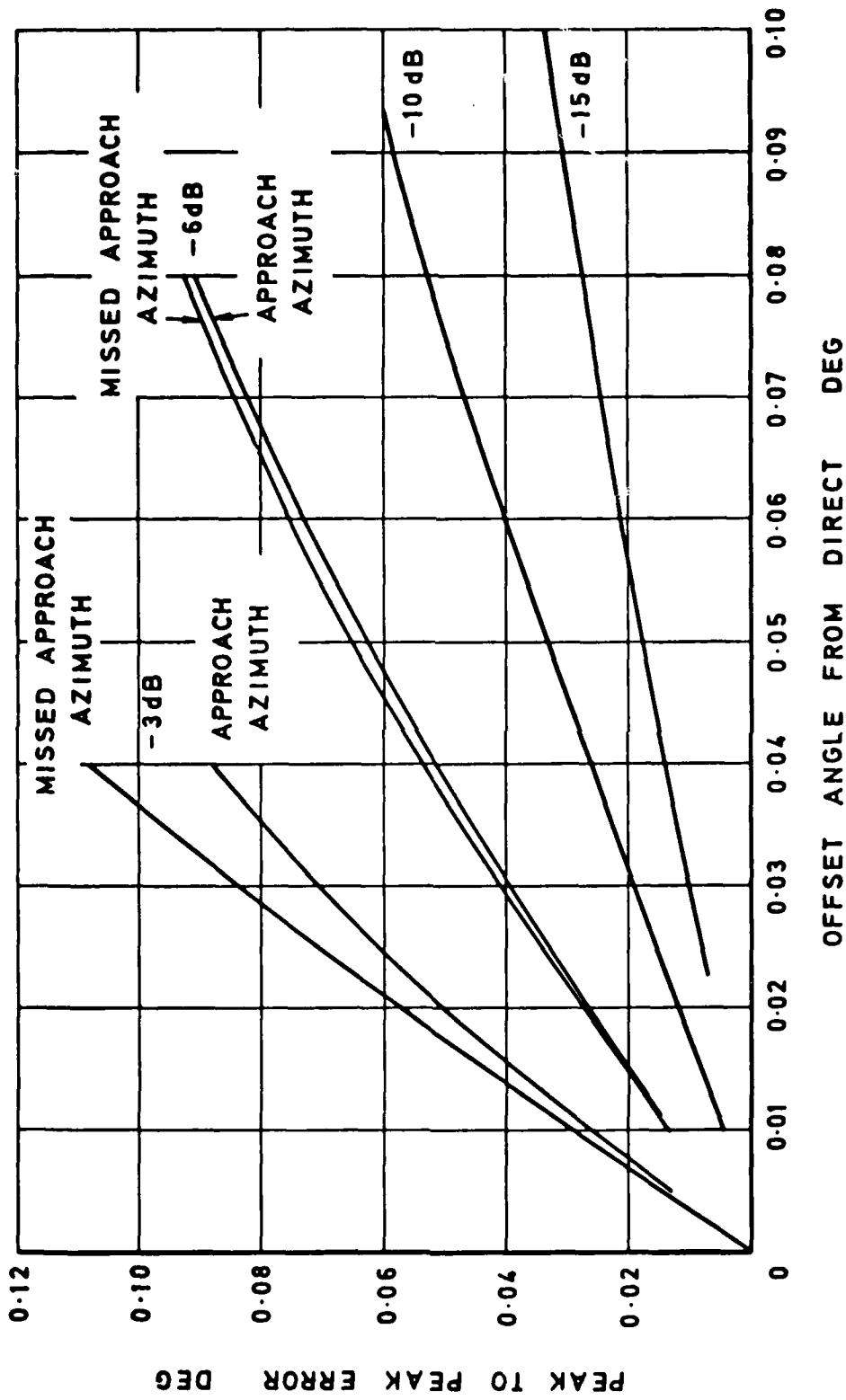
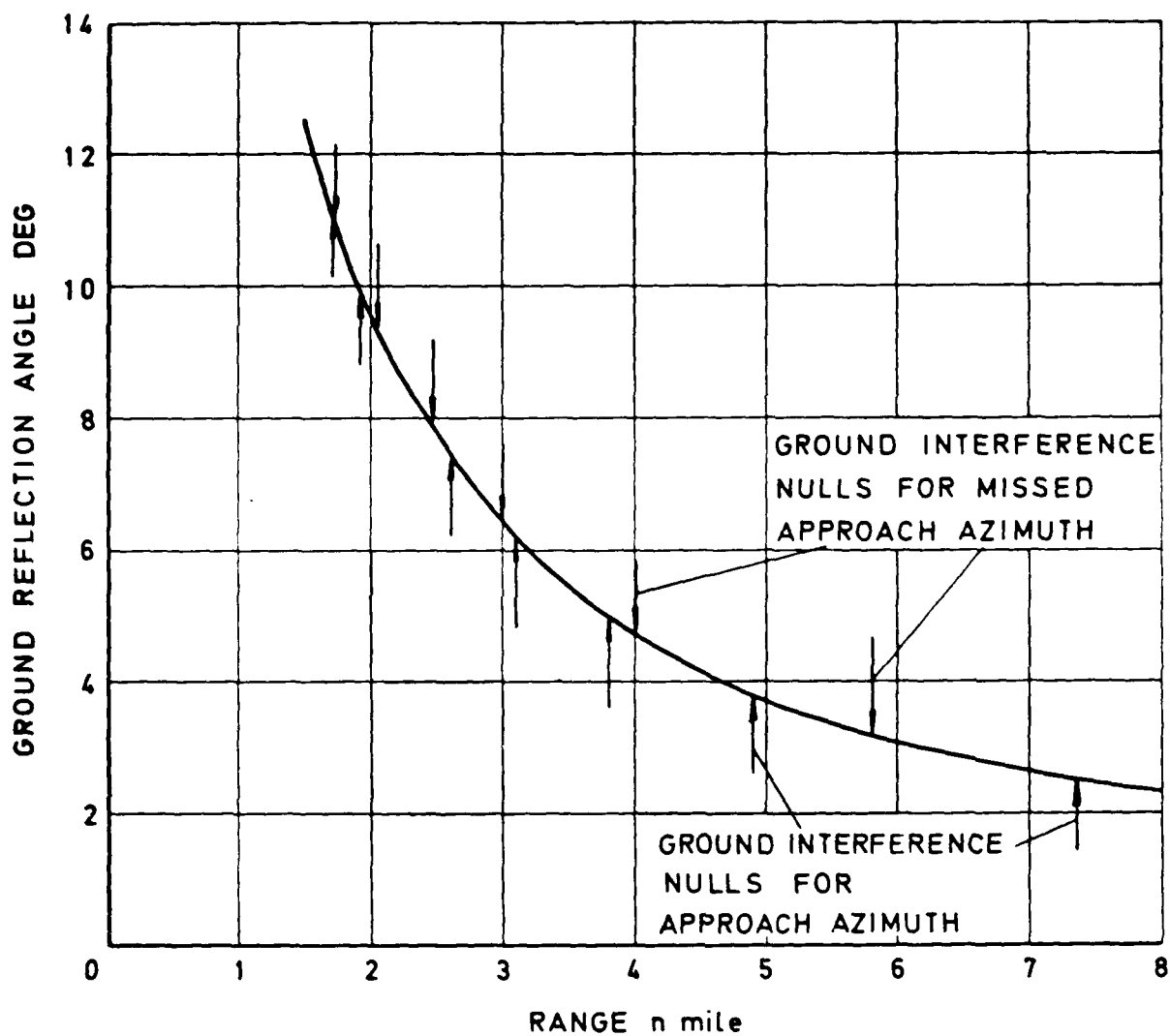


Fig 4.19 Calculated peak to peak error as a function of offset angle between direct and interfering signal



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Fig 4.20 Elevation angle and ground interference nulls for 2000 ft constant height radials

Fig 4.21a

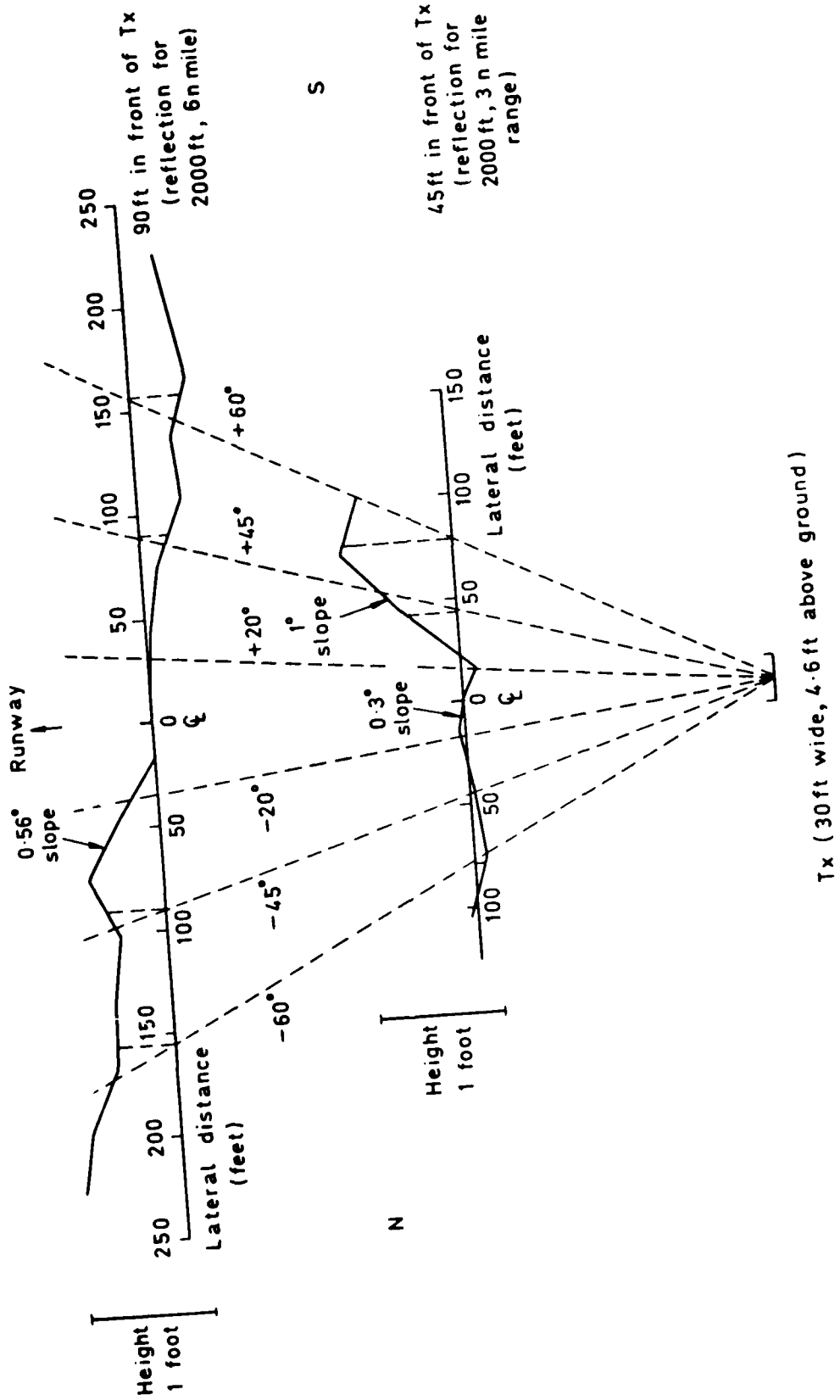
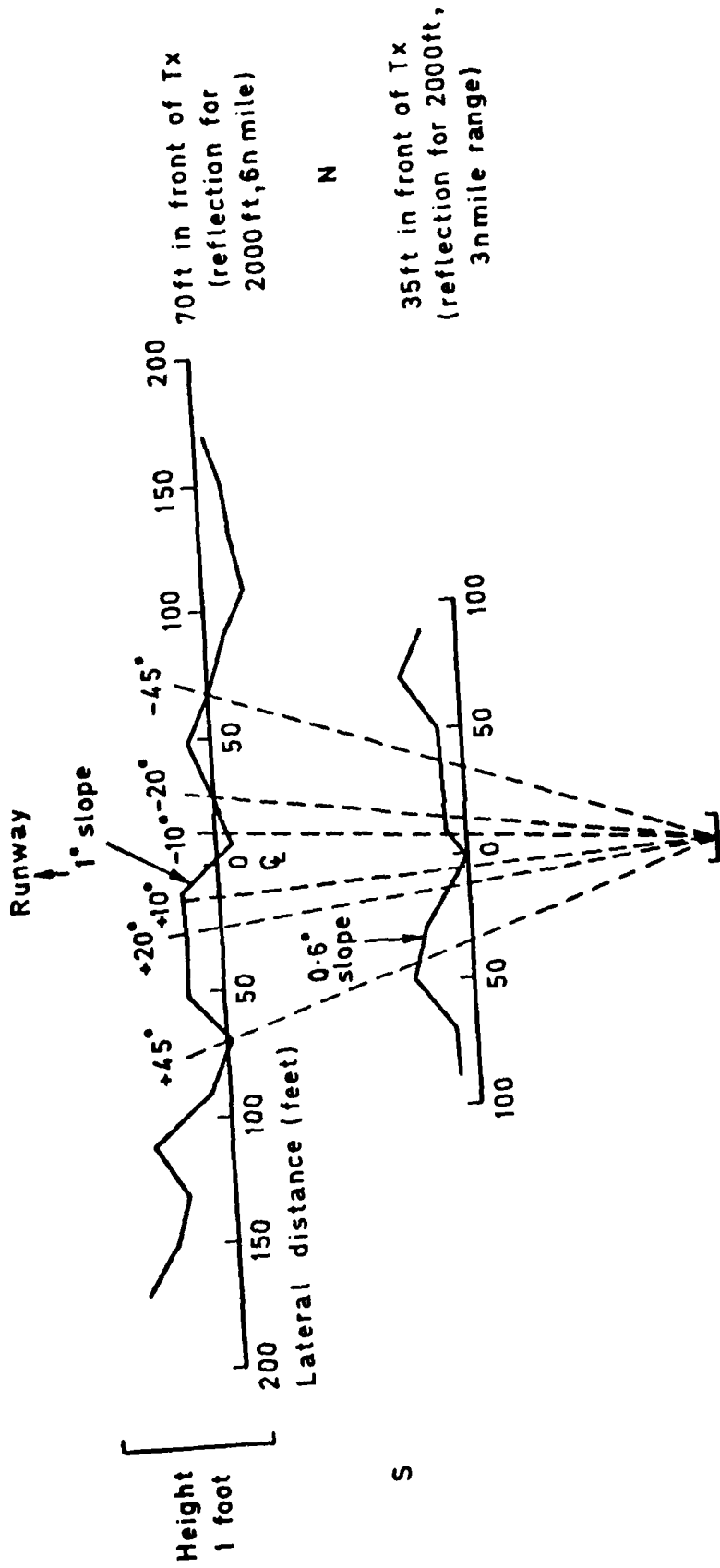


Fig 4.21a Lateral ground slope in front of approach azimuth transmitter

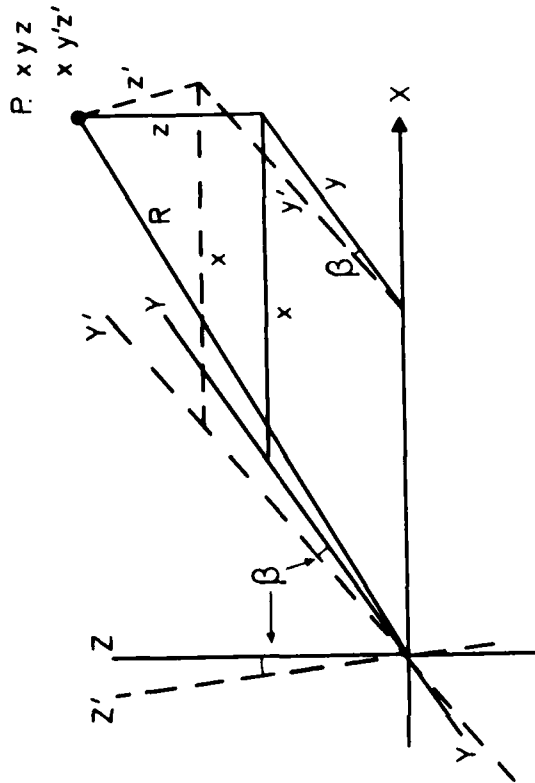


Tx (23 ft wide, 3.6 ft above ground)

Fig 4.21b

Fig 4.21b Lateral ground slope in front of missed approach azimuth transmitter

Fig 4.22



True azimuth code angle = ϕ

$$\cos \phi = \frac{y}{R}$$

Tilted array axis is $Y'Y'$

Array code angle = ϕ'

$$\cos \phi' = \frac{y'}{R} = \frac{1}{R} \left[\frac{y}{\cos \beta} + (Z - y \tan \beta) \sin \beta \right]$$

$$= \frac{1}{R} \left[Z \sin \beta + y \left(\frac{1 - \sin^2 \beta}{\cos \beta} \right) \right]$$

$$= \frac{1}{R} (Z \sin \beta + y \cos \beta)$$

$$= \sin \theta \sin \beta + \cos \phi \cos \beta$$

Fig 4.22 Azimuth antenna tilt errors

TR 79052

DMLSD-AR32/ 3-FRZSN-PAS/2-30/09/75

OFFSET = -40.01Z DEC

AA 32/3 30/9/75

H = 2250 FT

V = 123 KT

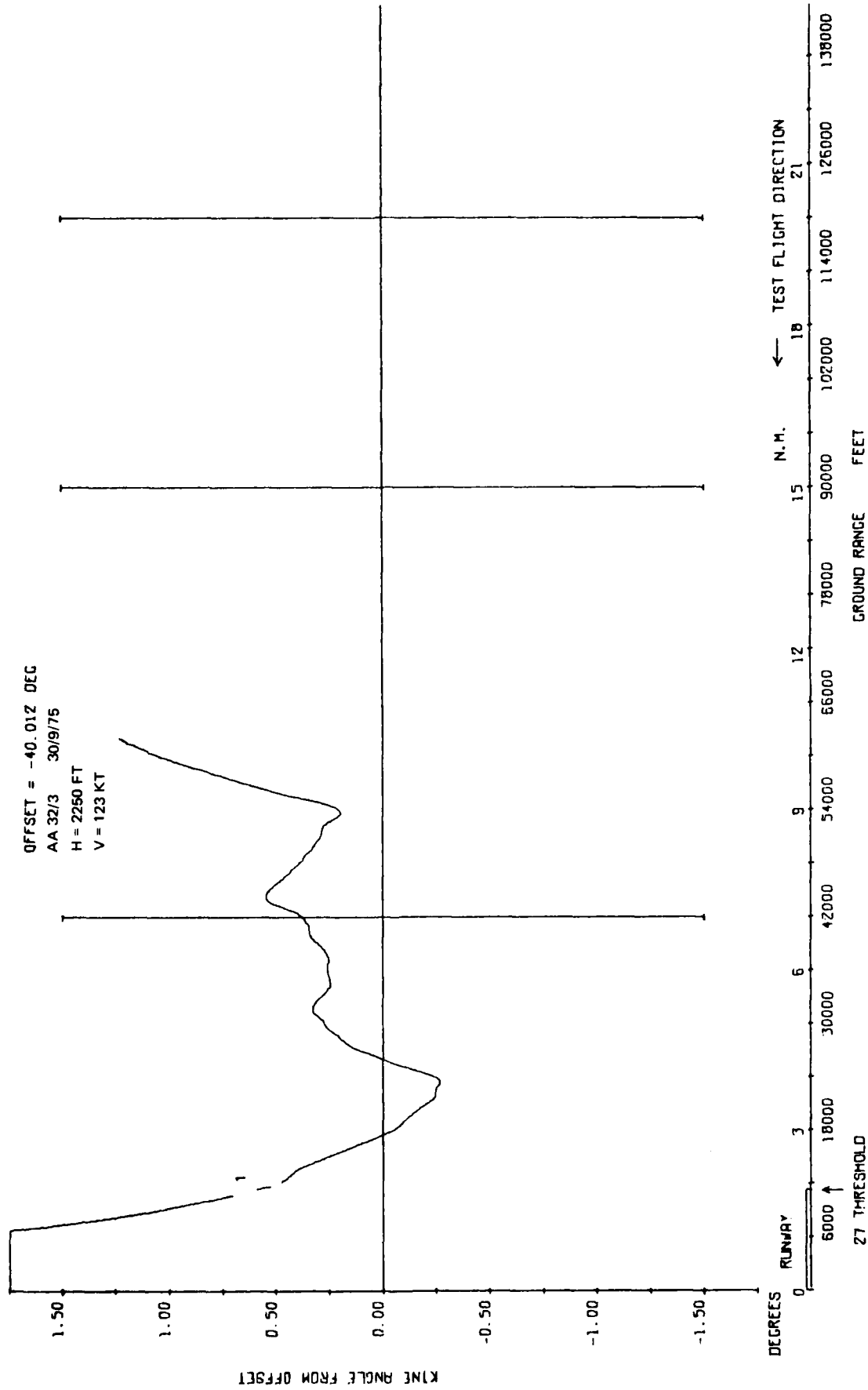


Fig 4.23a Approach azimuth radial at -40 degrees

Fig 4.23c

DMLSFD-AR32/ 3-FAZSN-PAS/2-30/09/75 STL

OFFSET = -40.012 DEG

AA 32/3 30/9/75

H = 2250 FT

V = 123 KT

$M = -0.010^\circ$
 $2S_T = 0.030^\circ$

$M = -0.005^\circ$
 $2S_T = 0.028^\circ$

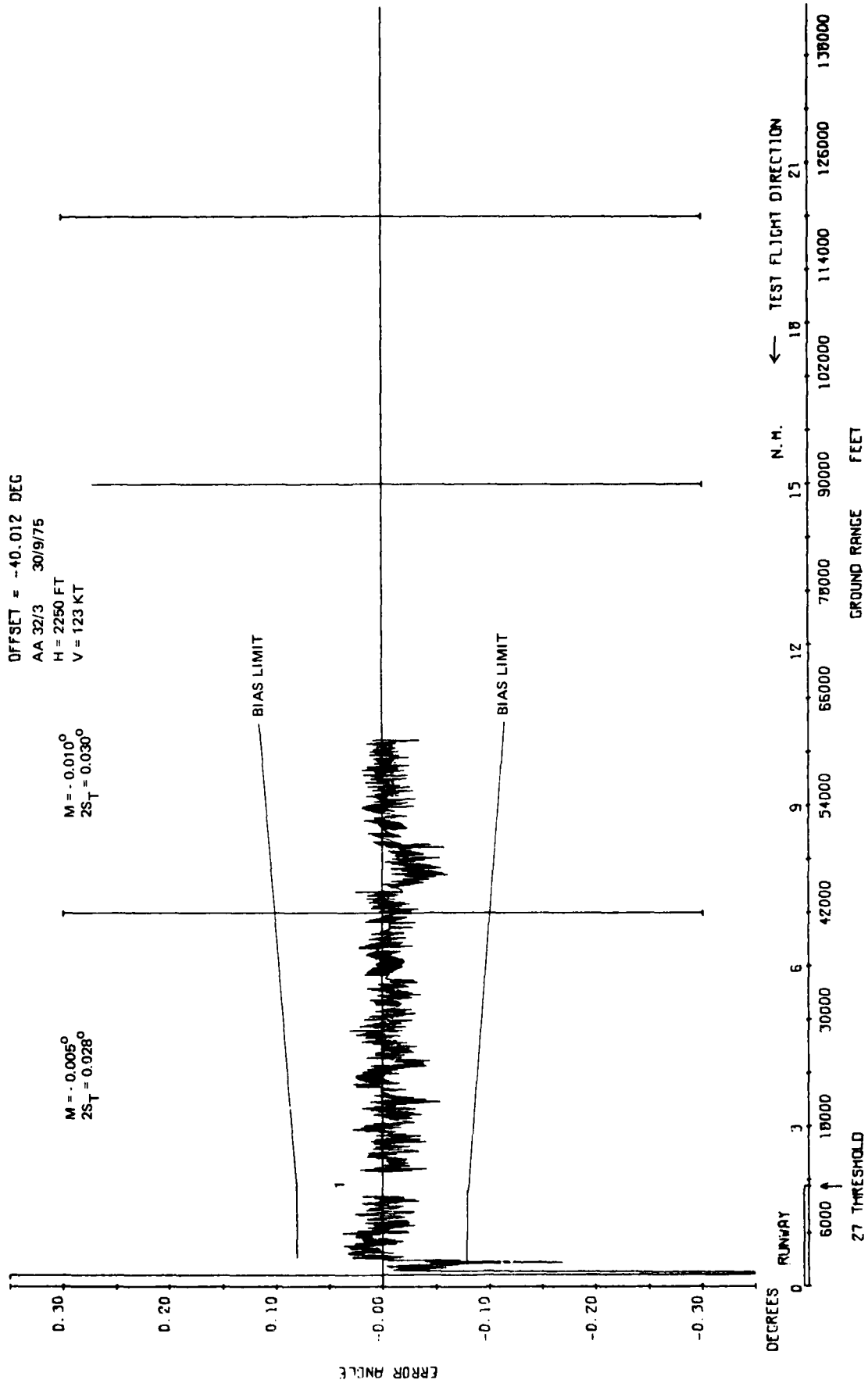


Fig 4.23c Approach azimuth radial at -40 degrees

TR 79052

DMLSFD-AR37/ 6-FAZSN-PBS/2-06/11/75 STL

OFFSET = -20.025 DEG
AA 37/6 6/11/75
H = 2890 FT
V = 143 KT

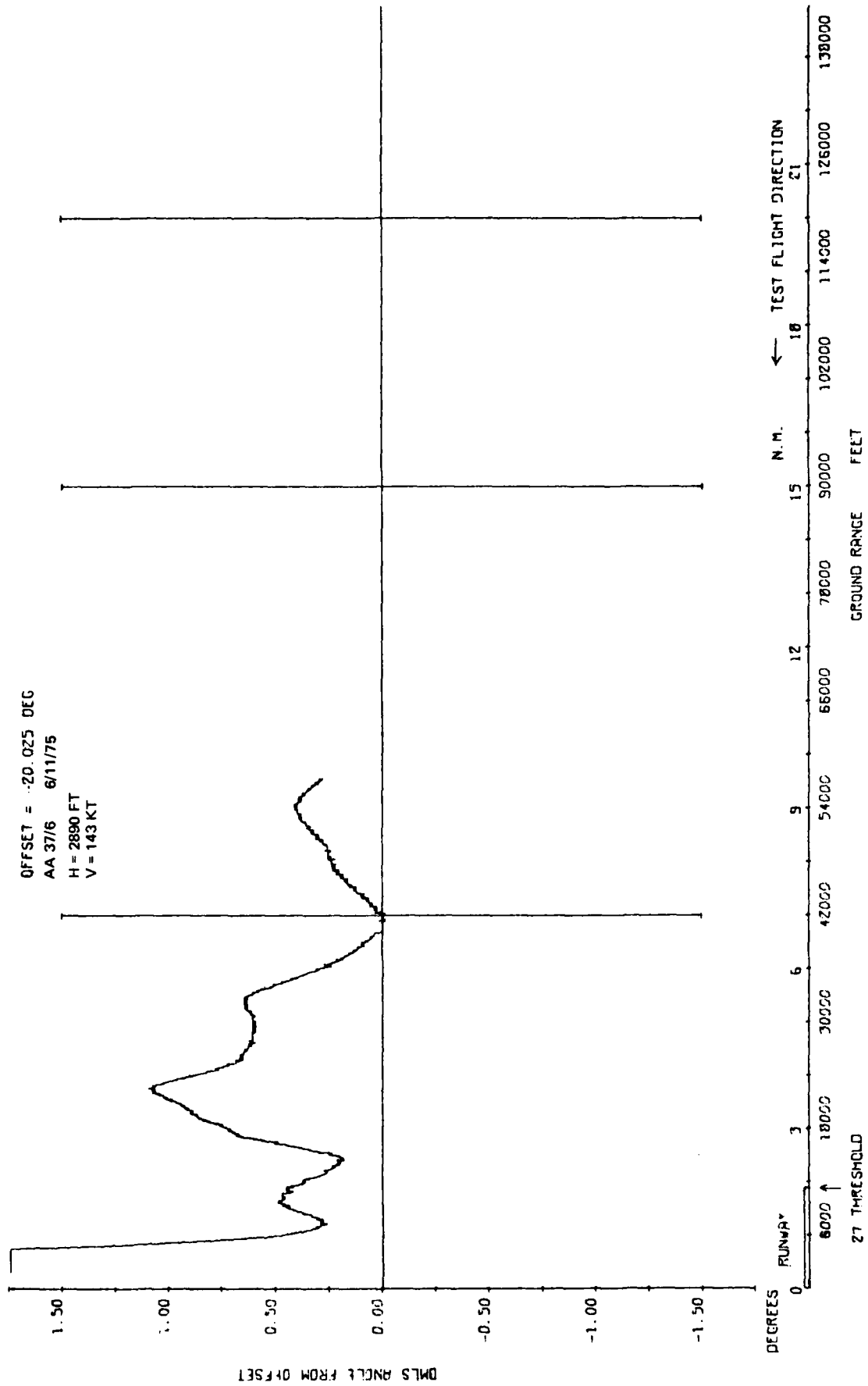


Fig 4.24b Approach azimuth radial at -20 degrees

Fig 4.24c

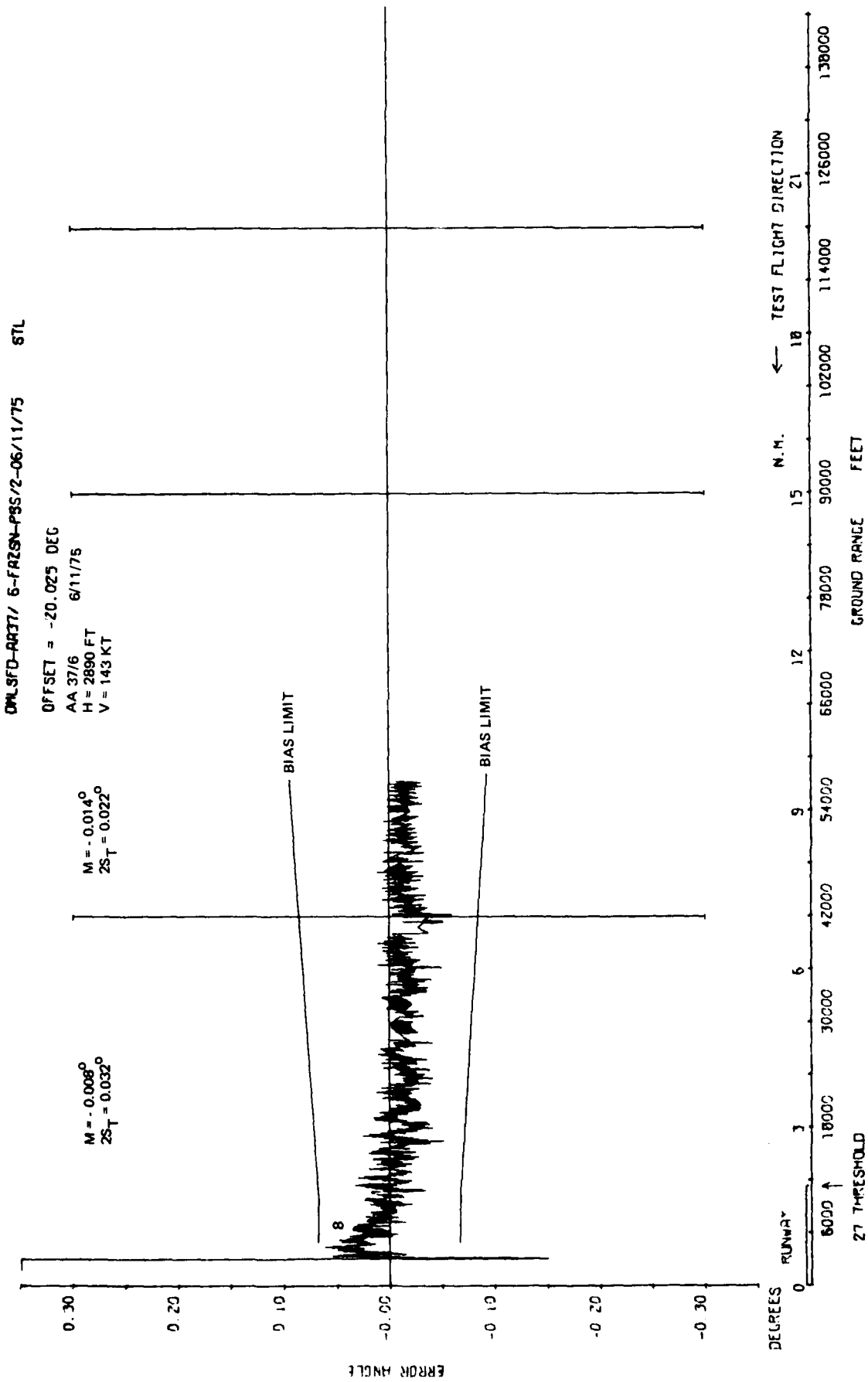


Fig 4.24c Approach azimuth radial at -20 degrees

TR 79052

DWLSFD-R014/ 7-1RZSN-P05/2-05/05/75

OFFSET = 0.000 DEG
AB 14/7 5/5/75
H = 1520 FT
V = 204 KT

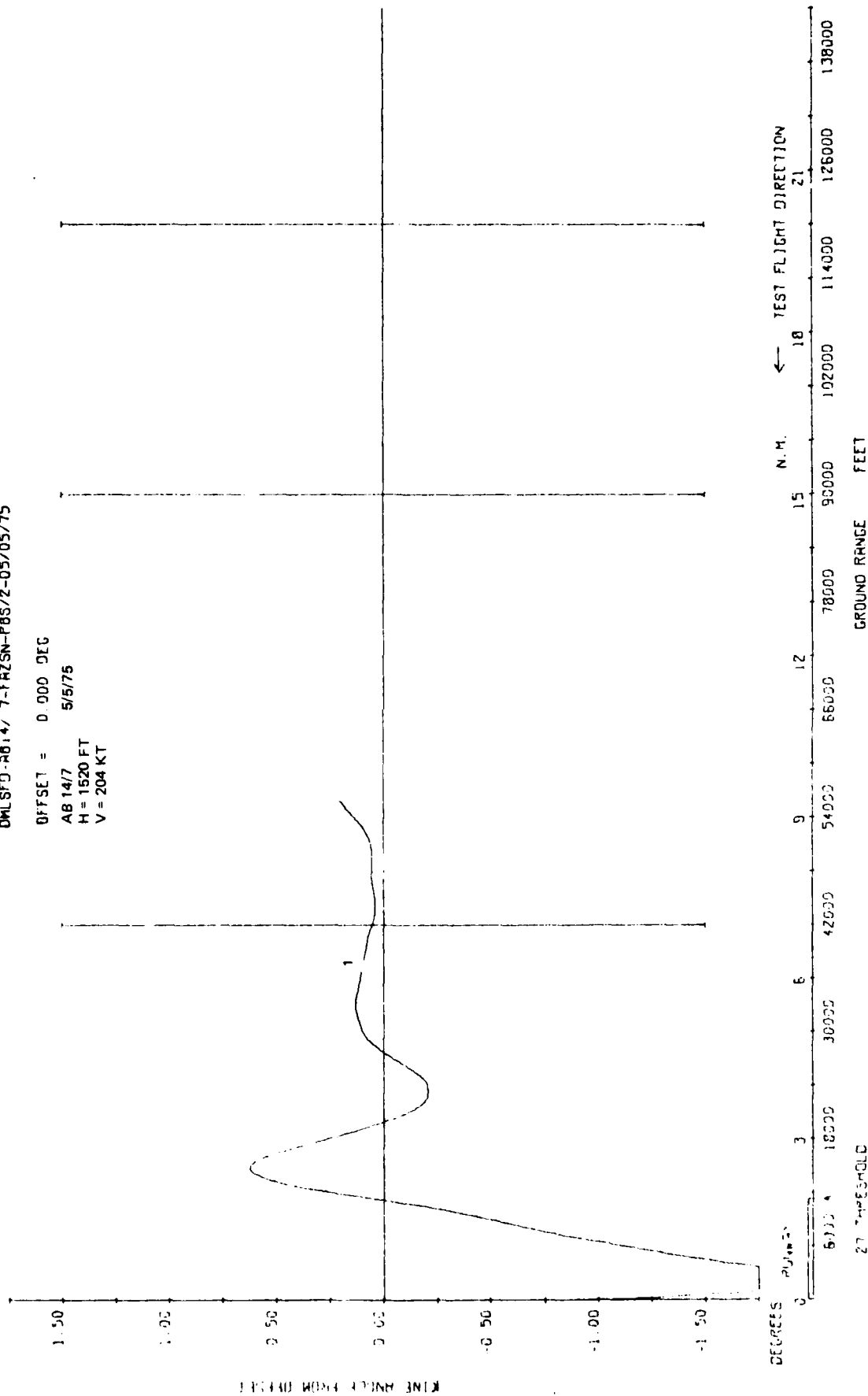


Fig 4.25a

Fig 4.25a Approach azimuth radial at 0 degree

Fig 4.25c

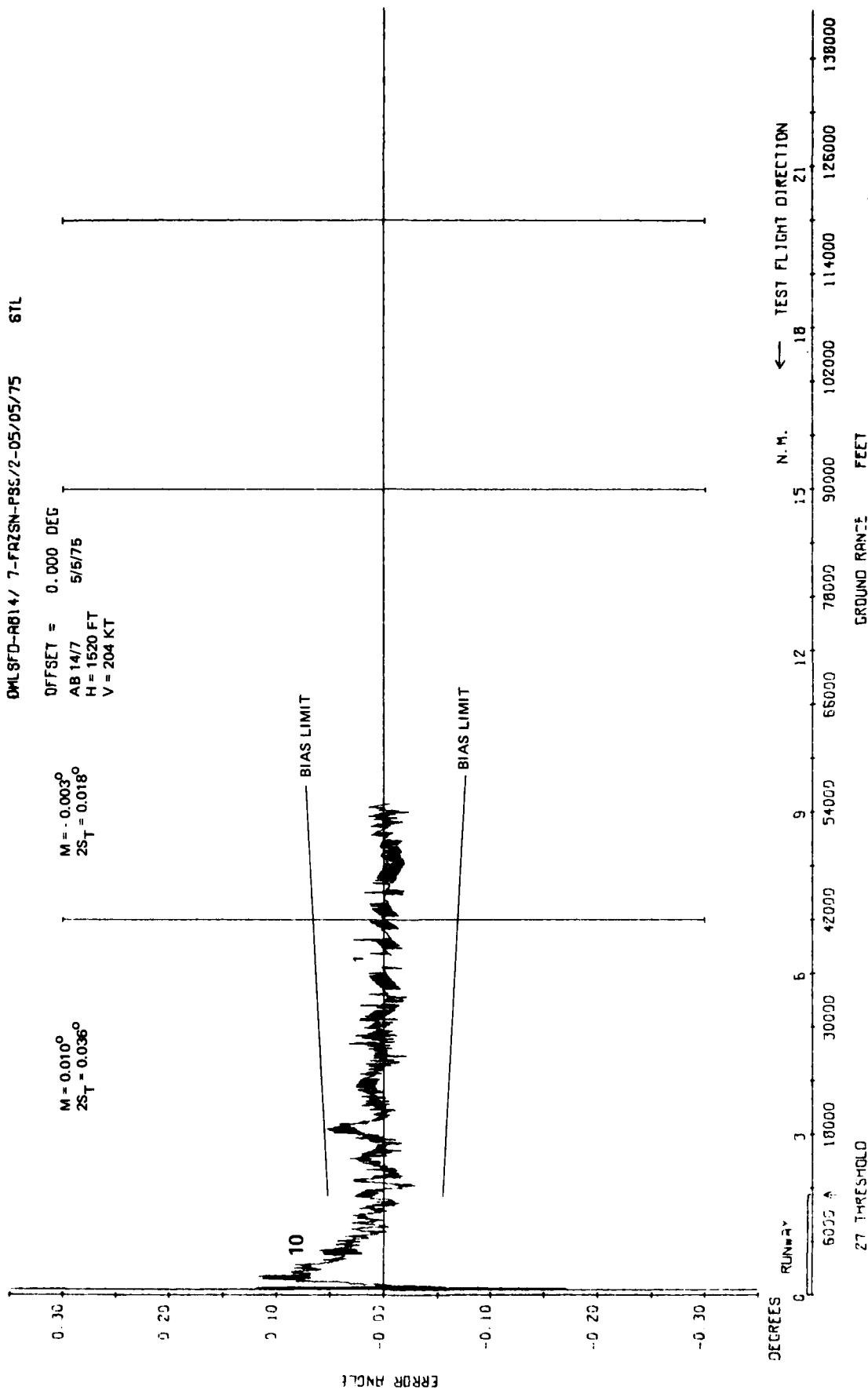


Fig 4.25c Approach azimuth radial at 0 degree

TR 79062

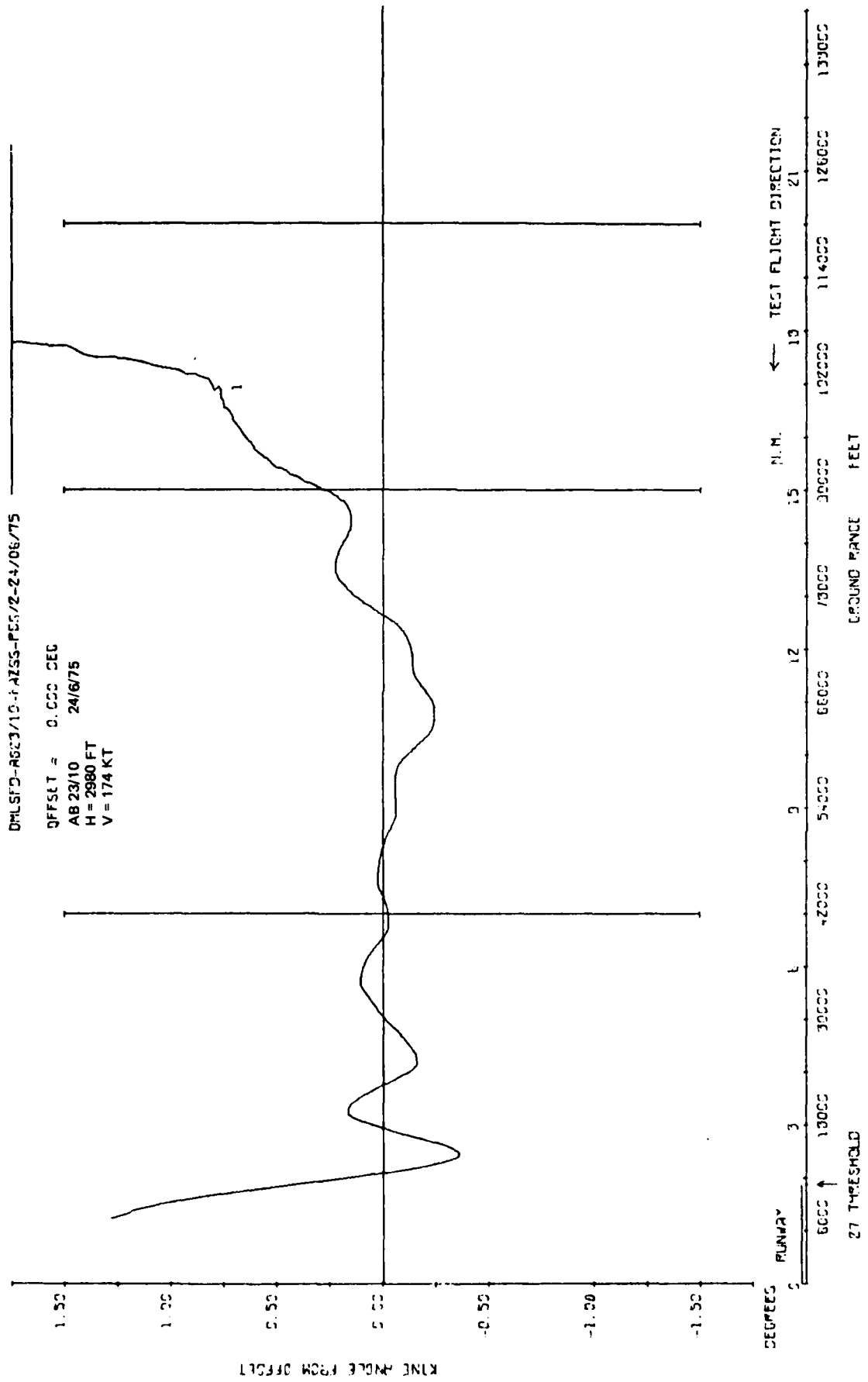


Fig 4.26a

Fig 4.26a Approach azimuth radial at 0 degree

Fig 4.26b

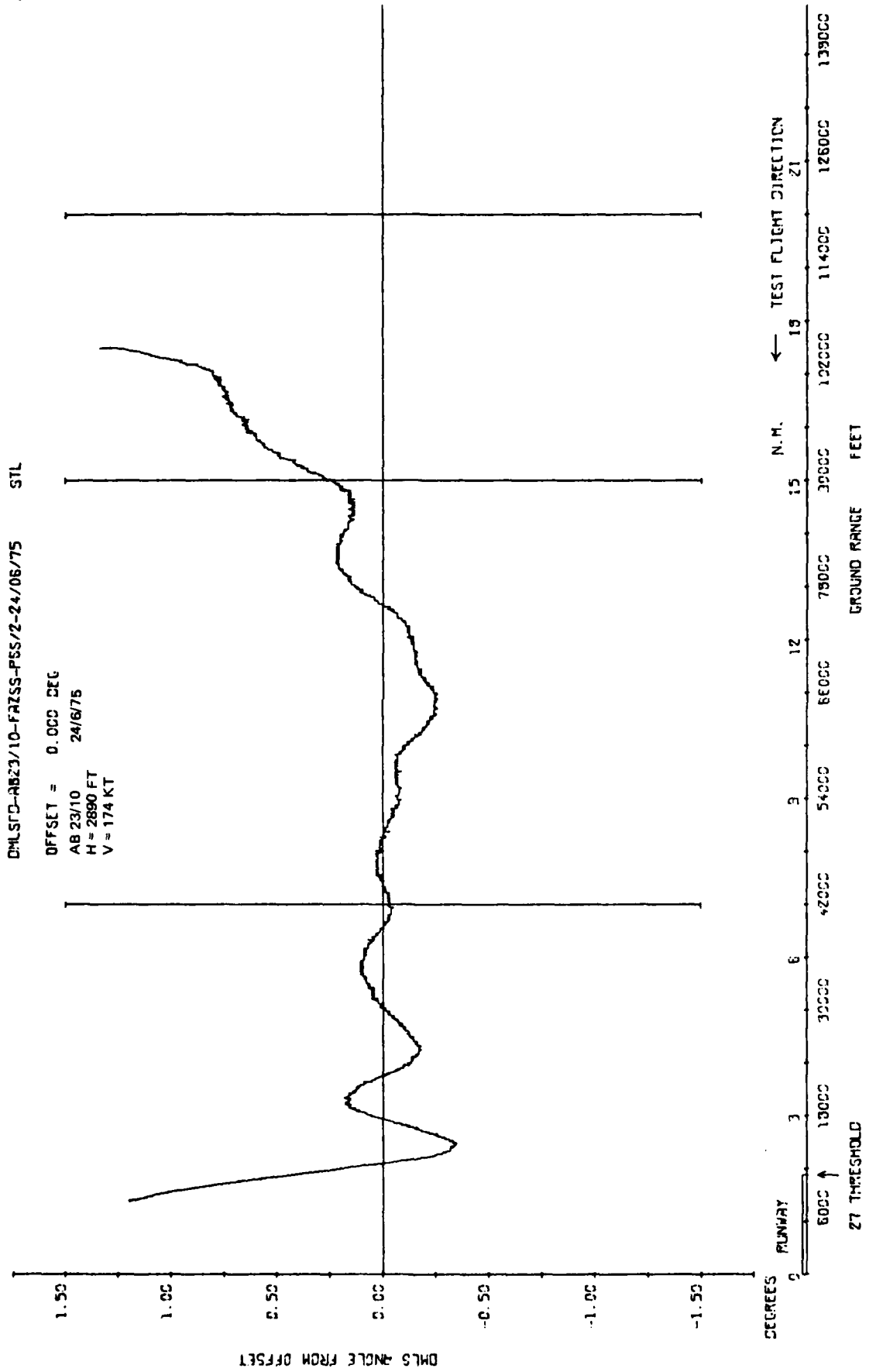


Fig 4.26b Approach azimuth radial at 0 degree

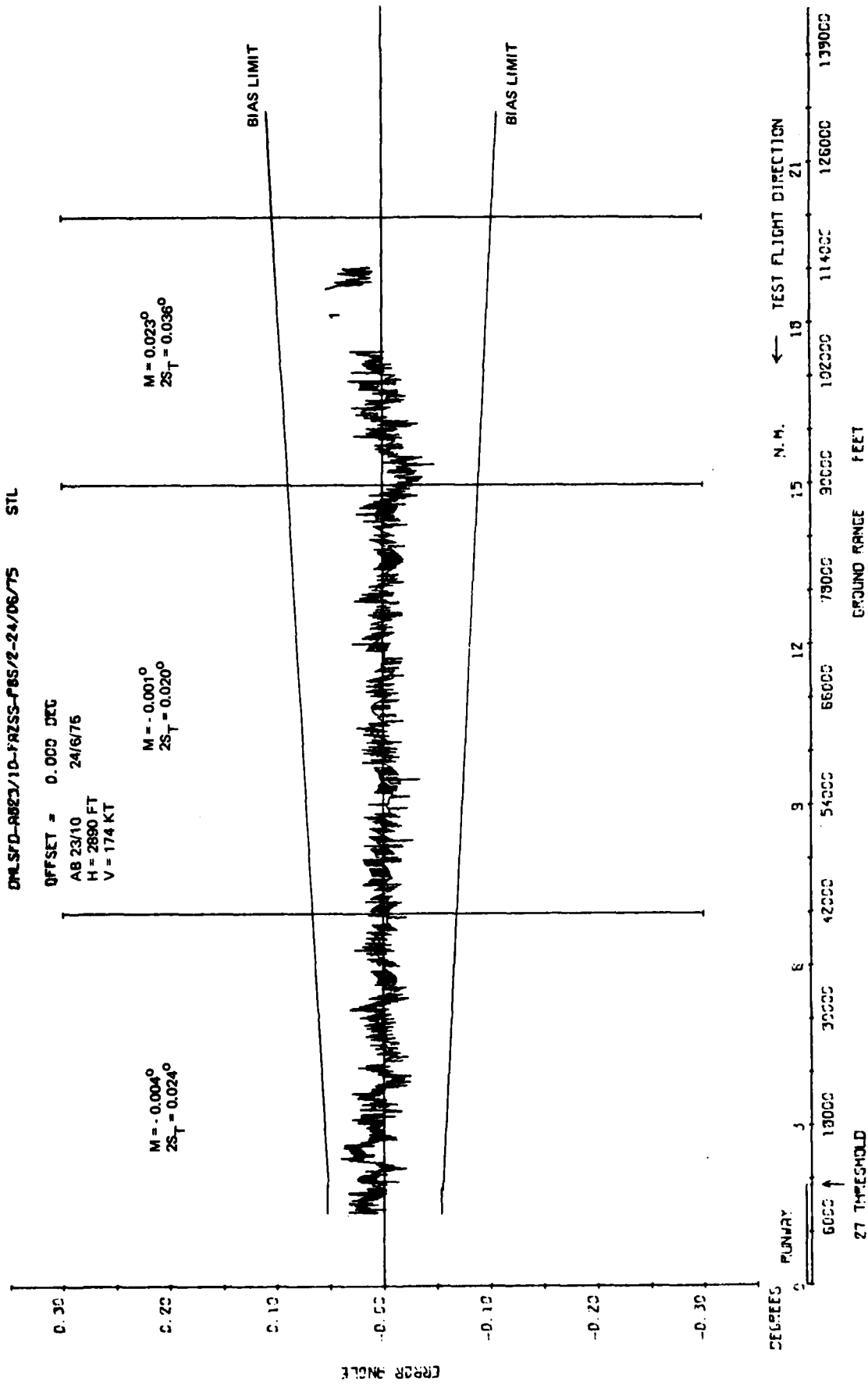


Fig 4.26c

Fig 4.26c Approach azimuth radial at 0 degree

Fig 4.27a

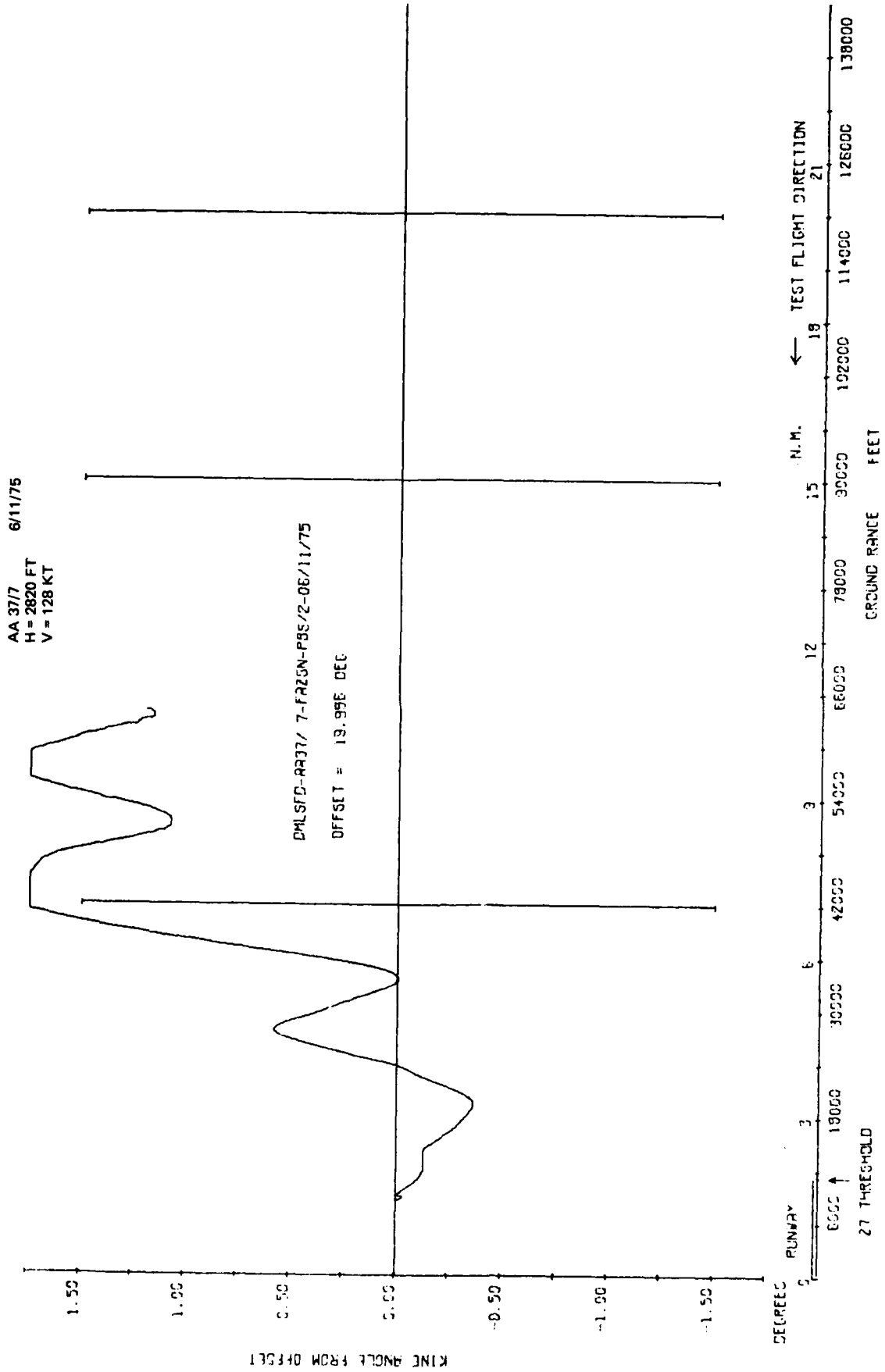


Fig 4.27a Approach azimuth radial at +20 degrees

TR 79062

AB 377 6/11/75
H = 2820 FT
V = 128 FT
DMLSD-AR37/ 7-FRZSN-P85/2-06/11/75 6TL
OFFSET = 19.996 DEG

M = 0.009°
2S_T = 0.042°

M = 0.001°
2S_T = 0.036°

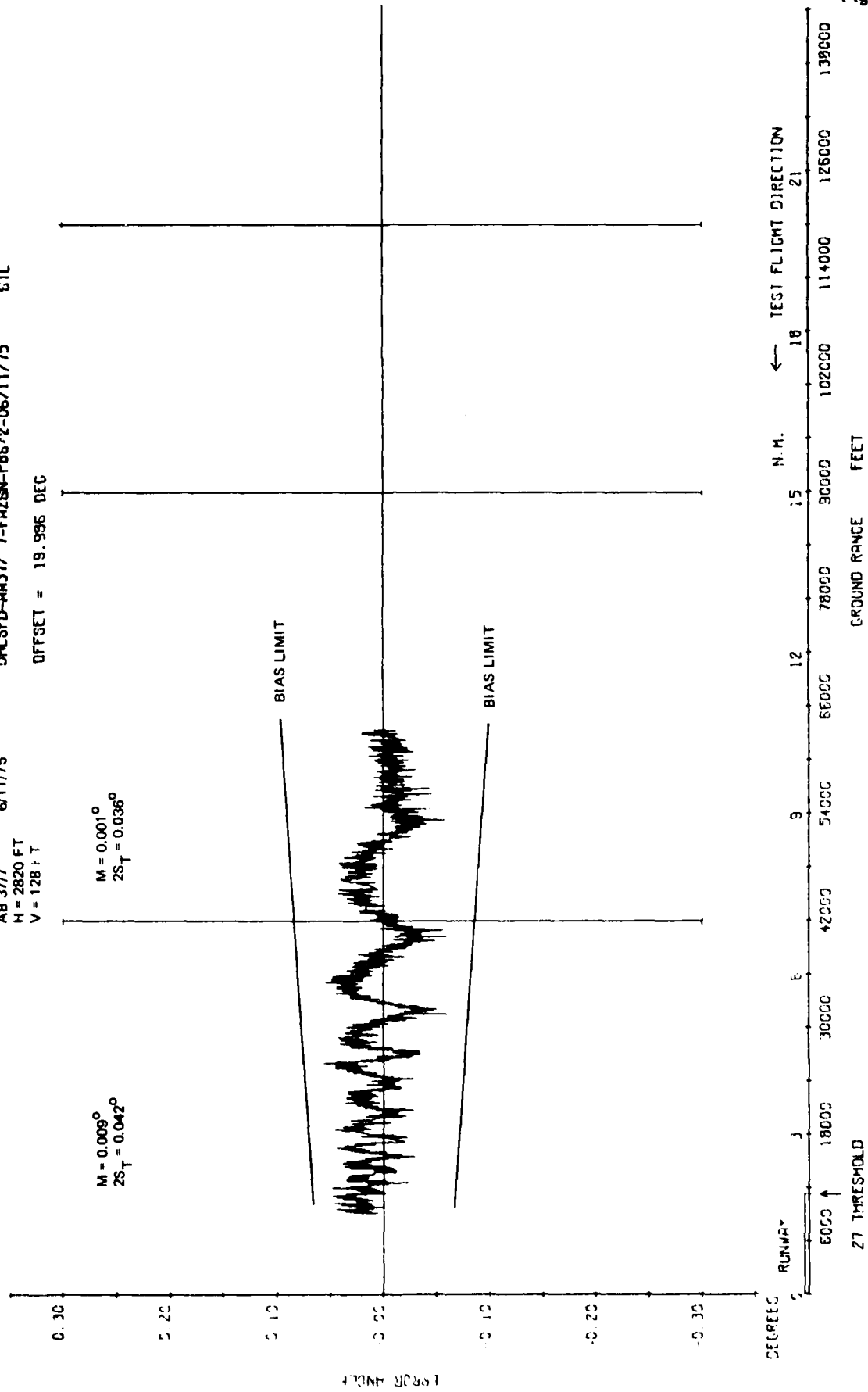


Fig 4.27c

Fig 4.27c Approach azimuth radial at +20 degrees

Fig 4.28b

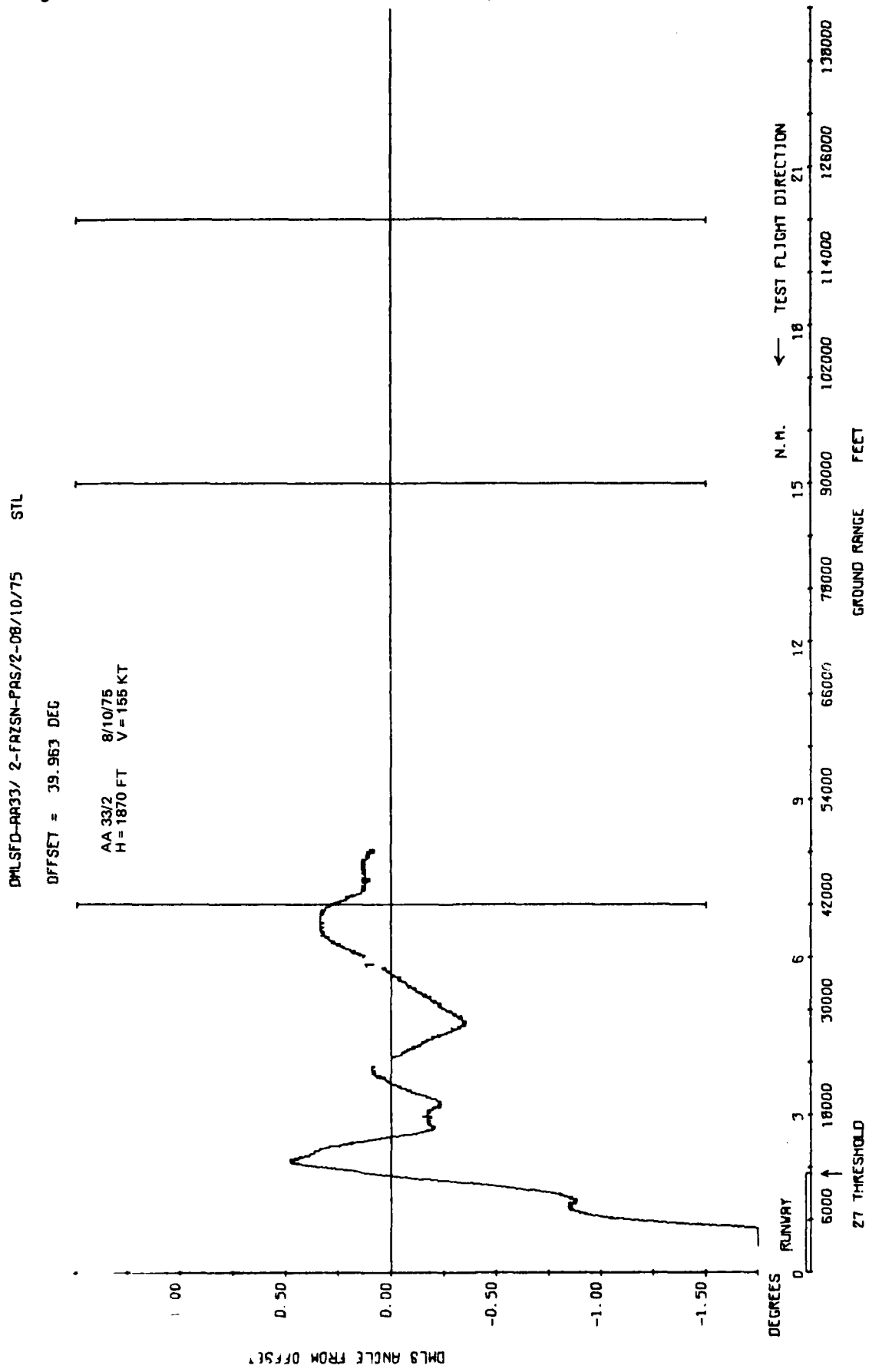


Fig 4.28b Approach azimuth radial at +40 degrees

TR 79052

DMLSTD-ARRJ, 2-FASIN-PAS/2-08/10/75 STL

OFFSET = 39.963 DEG
AA 33/2 8/10/75
H = 1870 FT V = 155 KT

$M = 0.044^\circ$
 $2S_T = 0.022^\circ$

$M = 0.045^\circ$
 $2S_T = 0.046^\circ$

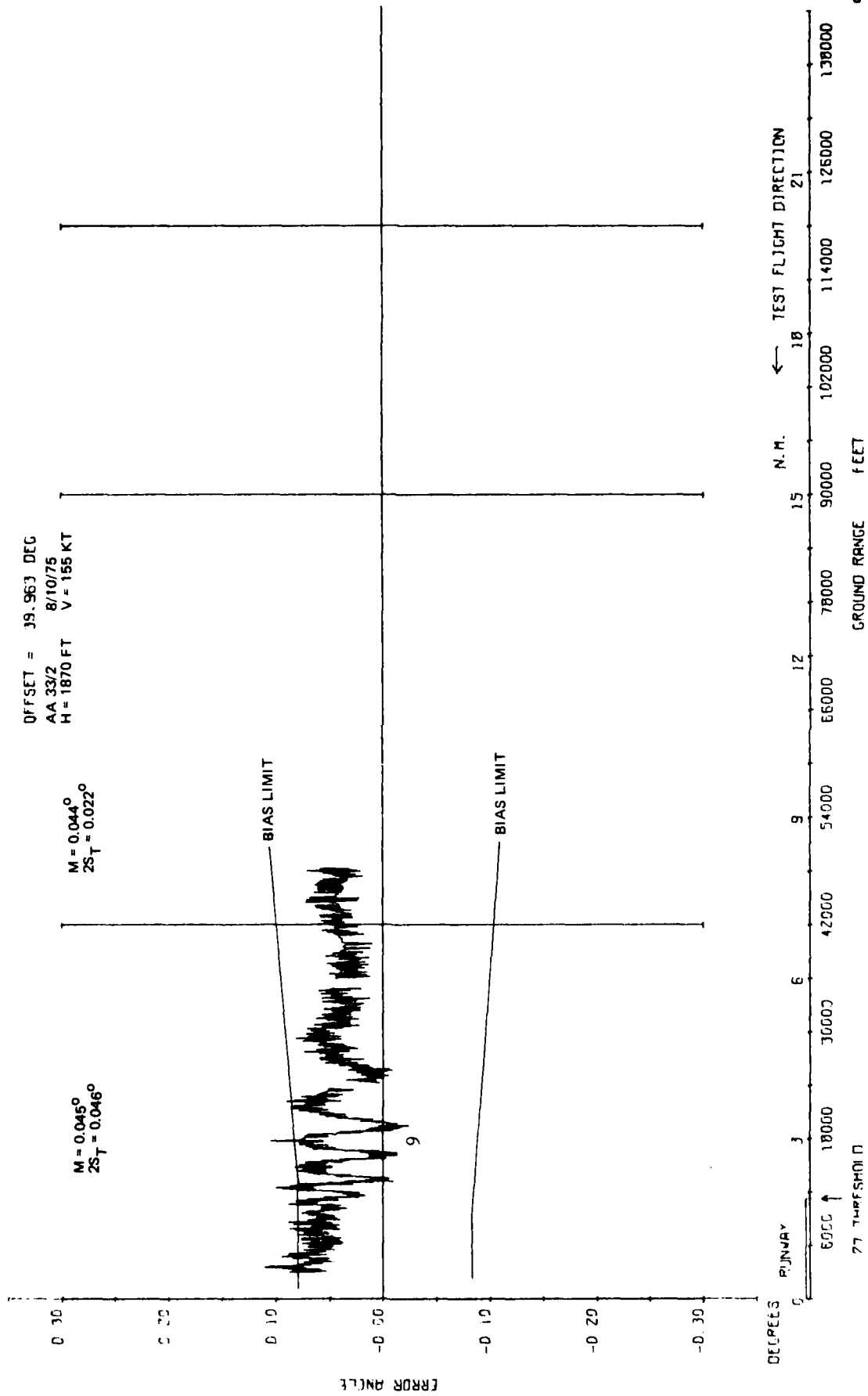


Fig 4.28c

Fig 4.28c Approach azimuth radial at +40 degrees

Fig 4.29a/b

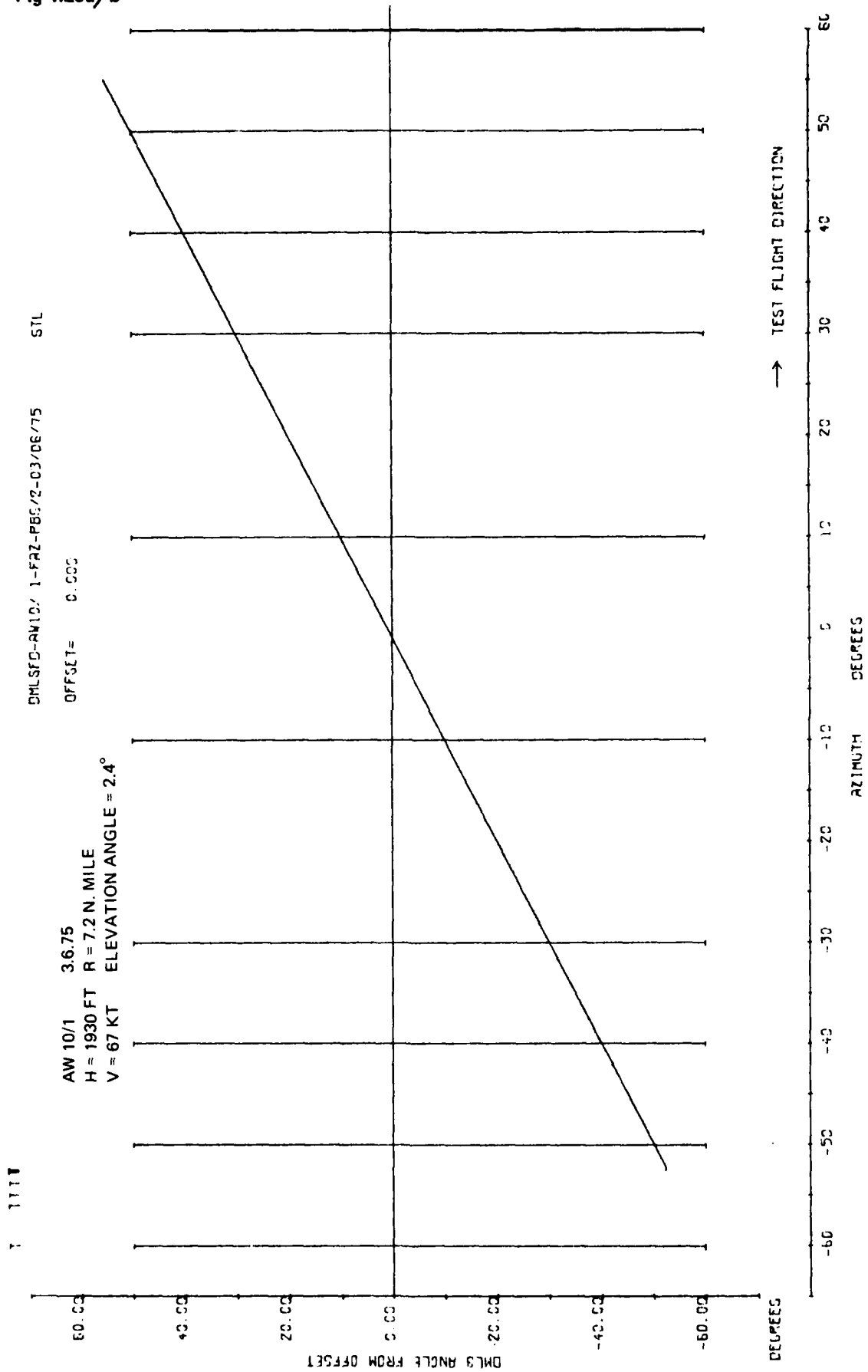


Fig 4.29a/b Approach azimuth orbital flight

TR 79052

TTTT

OMLSFD-AVIC/ 1-FRZ-PBS/2-03/06/75 6TL

OFFSET= 0.000

AW 10/1 3.6.75
H = 1930 FT R = 7.2 N. MILE
V = 67 KT ELEVATION ANGLE = 2.4°

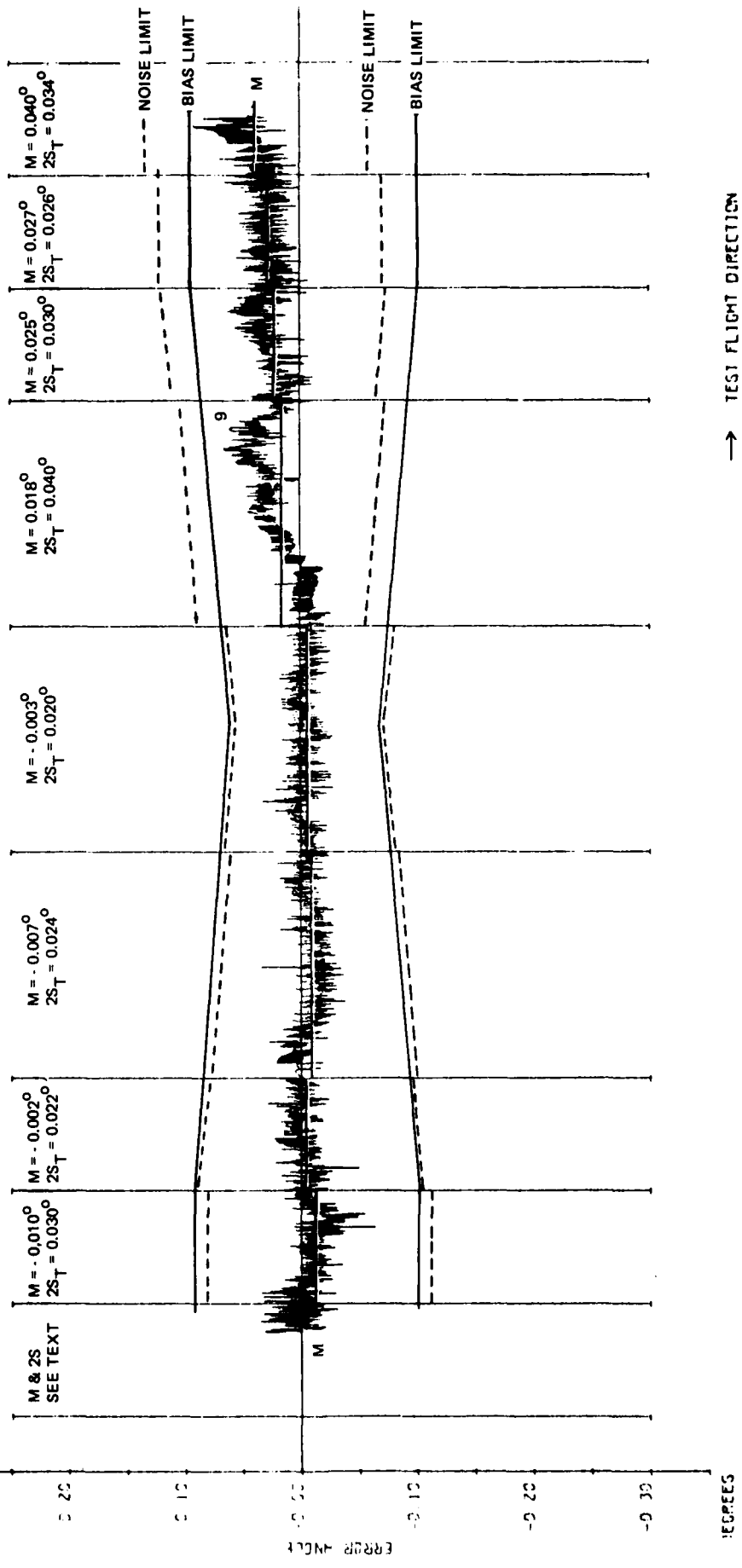


Fig 4.29c

Fig 4.29c Approach azimuth orbital flight

Fig 4.30c

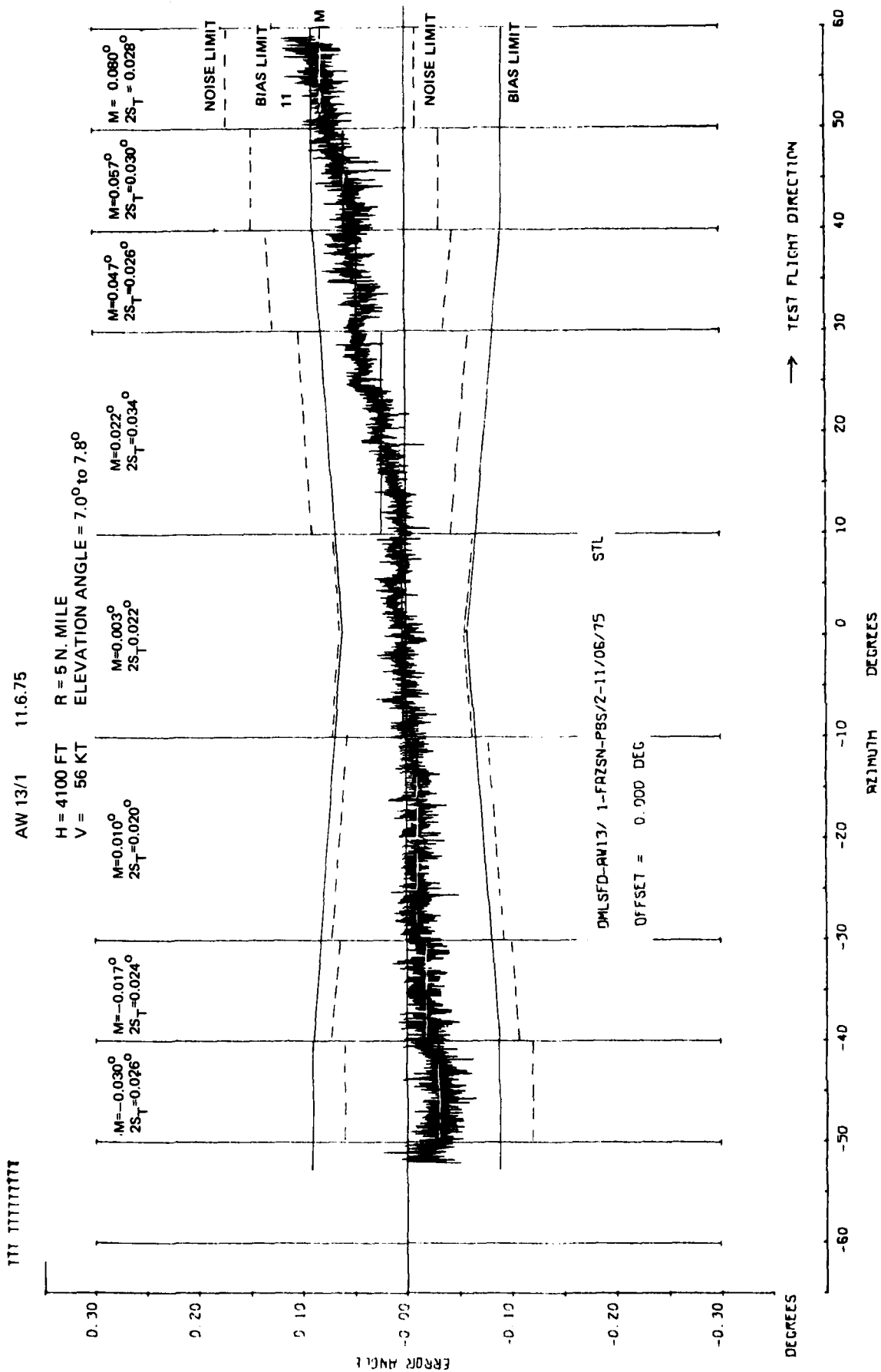


Fig 4.30c Approach azimuth orbital flight at 4100 ft. 5 n mile radius

TR 79052

CHSLF-RR33/ 3-FRIGN- S/2-22/12/75 STL
AA39/3 22/12/75
H = 1950 V = 156 KT

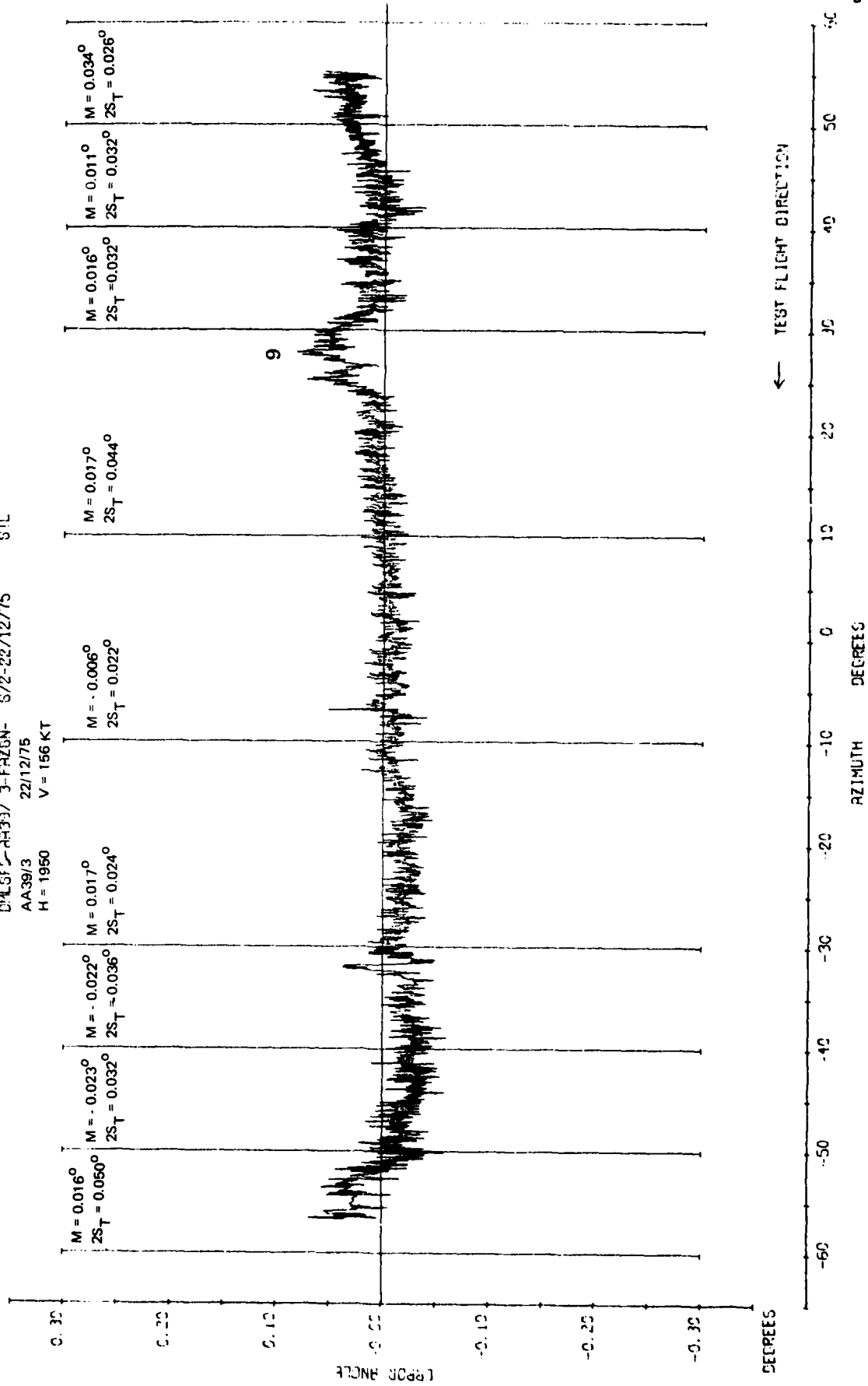


Fig 4.31c Approach azimuth orbital flight at 1950 ft. 6 n mile radius

Fig 4.32a

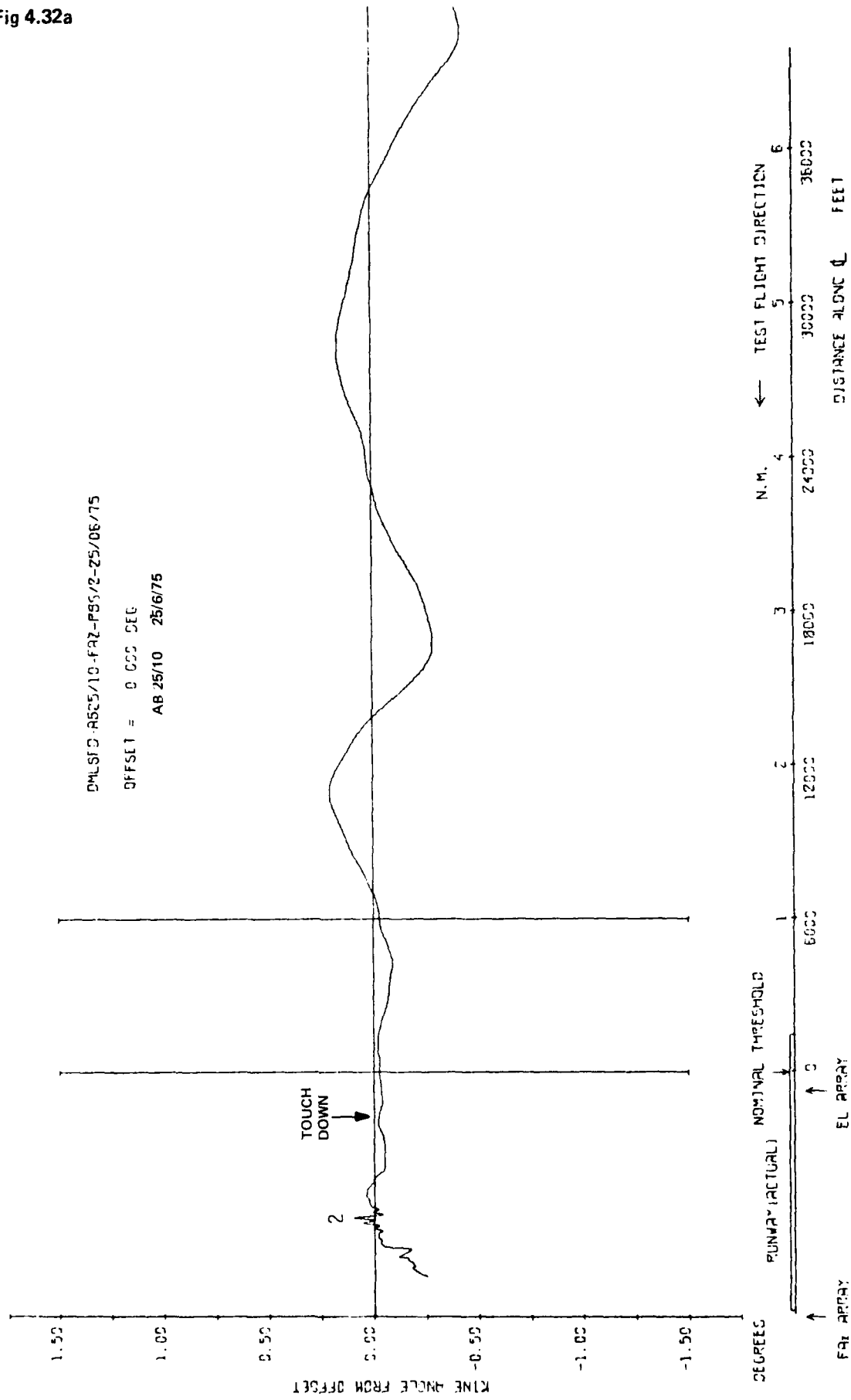


Fig 4.32a Approach azimuth accuracy. 3 degree approach to land and roll out

TR 79052

DHLSFD-8825/10-FRZ-FBS/2-25/06/75 STL

OFFSET = 0.000 DEG

M = -0.005°
2S_T = 0.020°

AB 25/10 25/6/75

M = 0.003°
2S_T = 0.022°

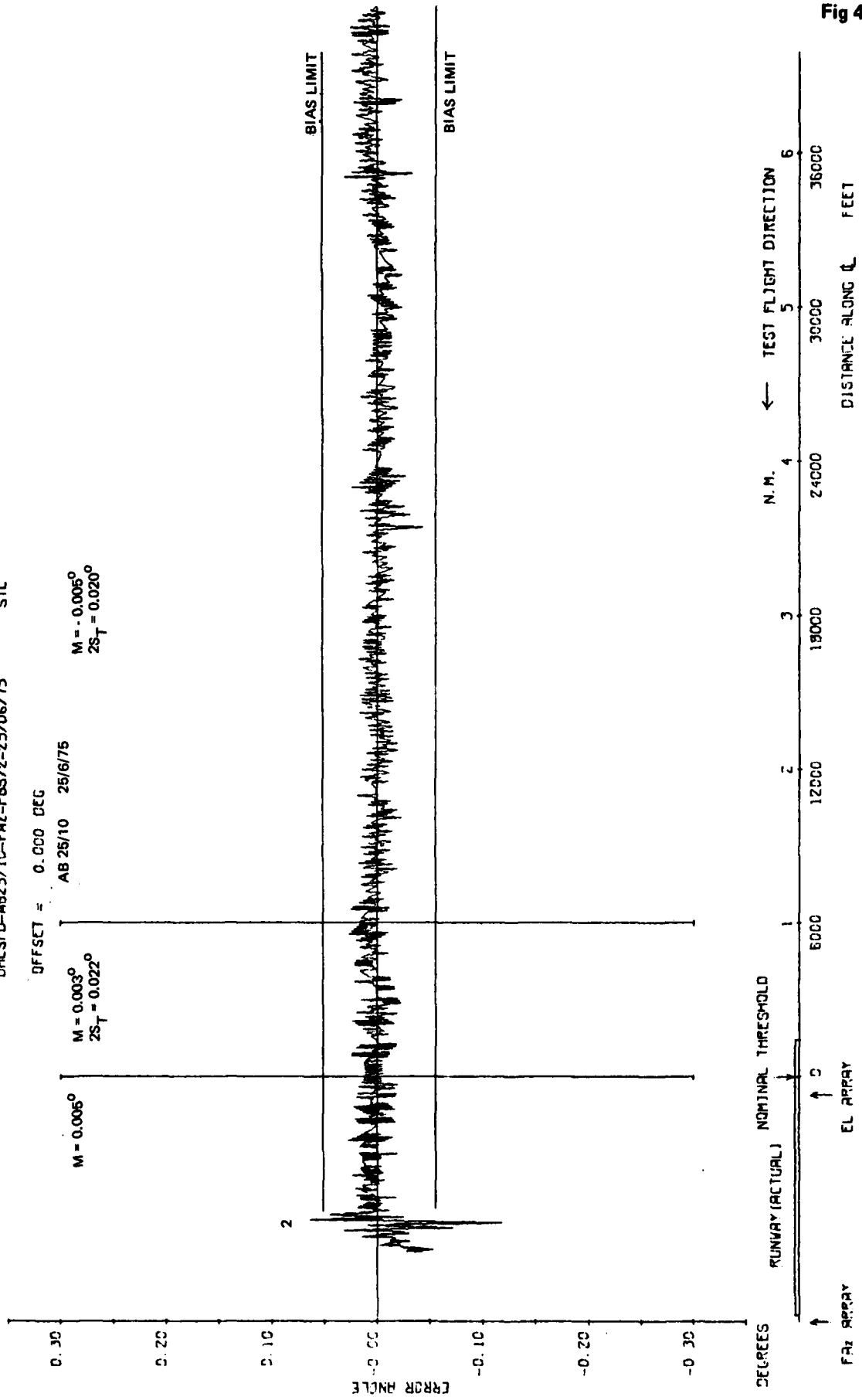


Fig 4.32c

Fig 4.32c Approach azimuth accuracy. 3 degree approach to land and roll out

Fig 4.33a

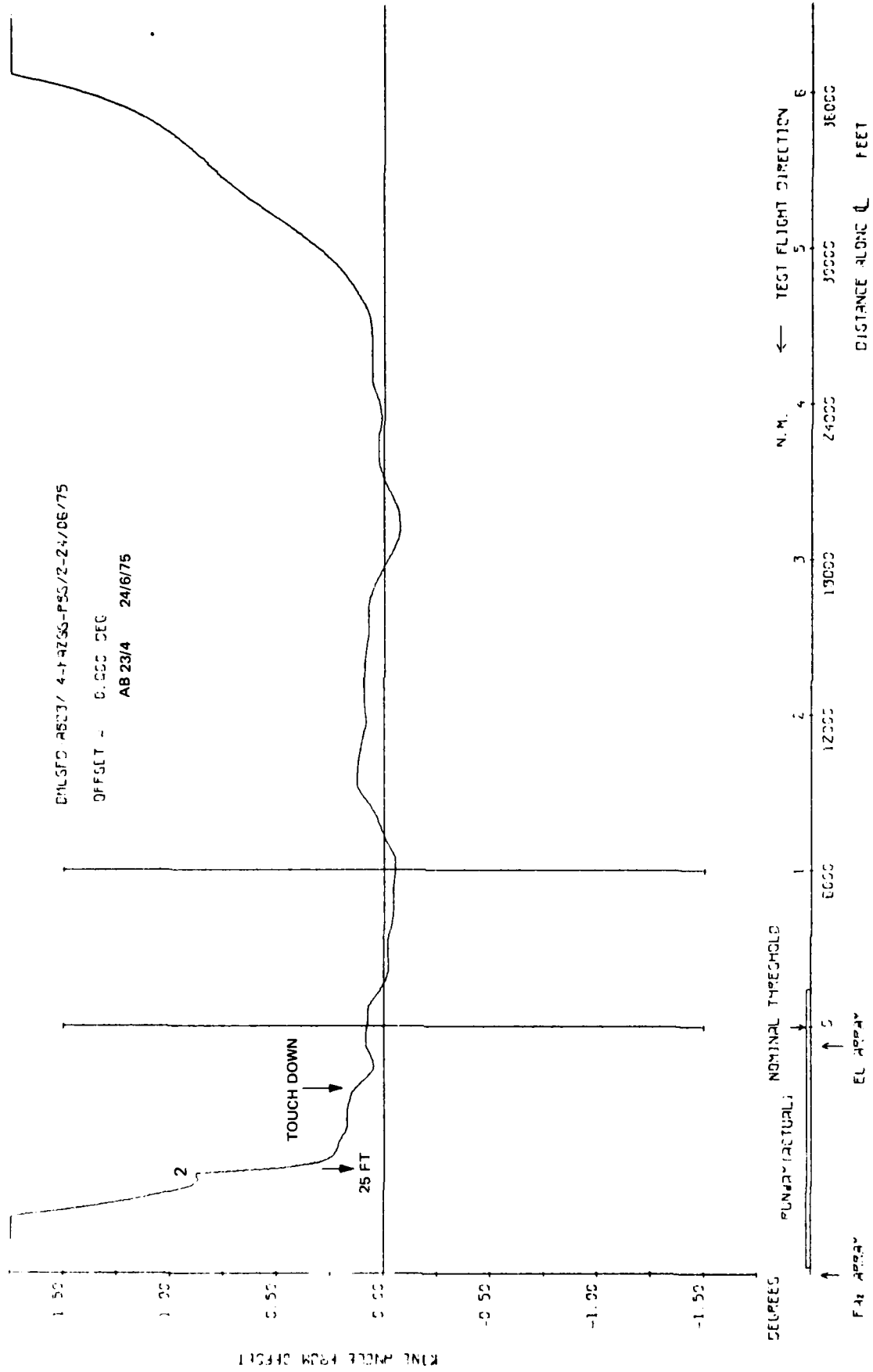


Fig 4.33a Approach azimuth accuracy. 3 degree approach to touch and go

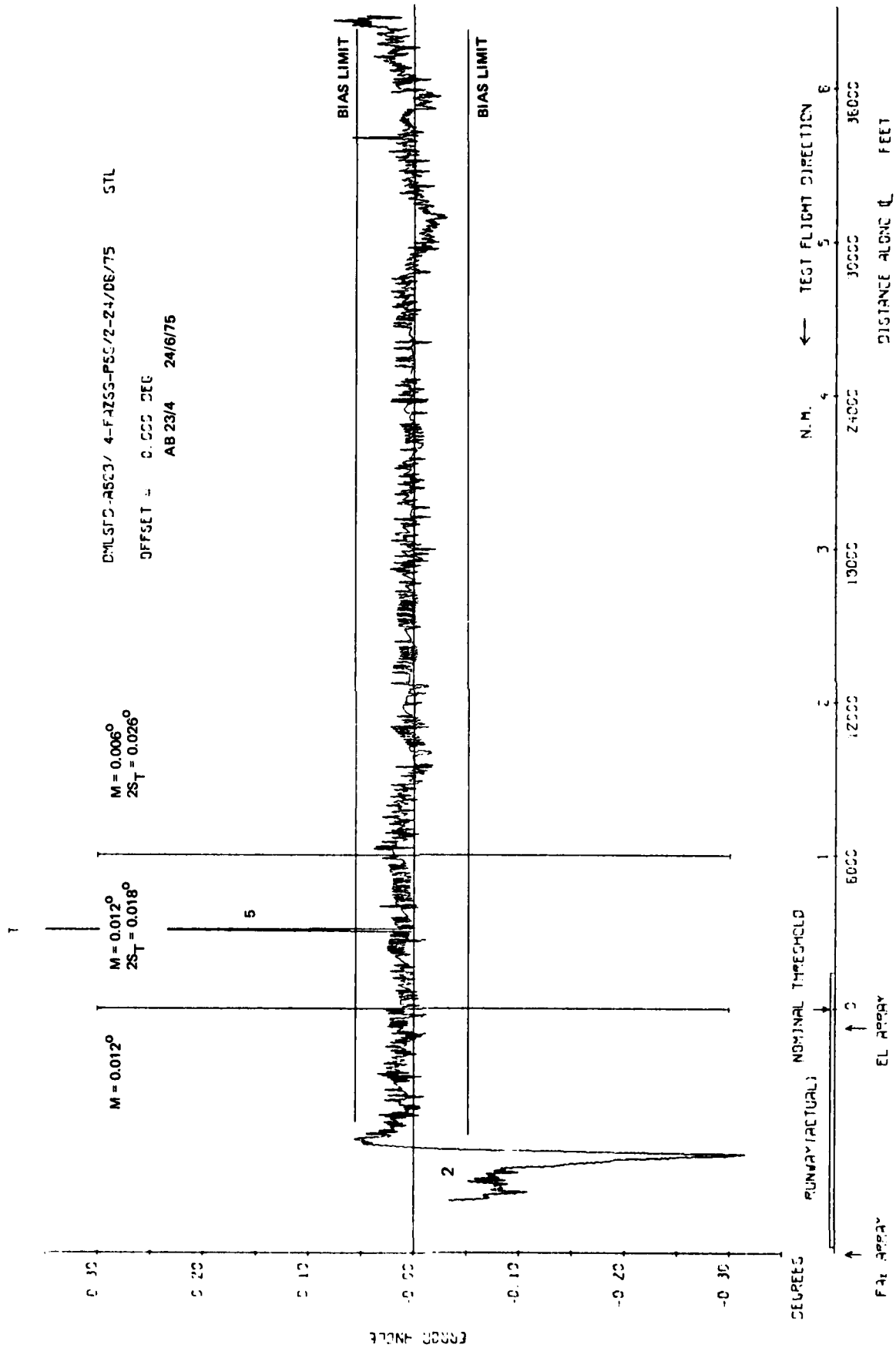


Fig 4.33c

Fig 4.33c Approach azimuth accuracy. 3 degree approach to touch and go

Fig 4.34a

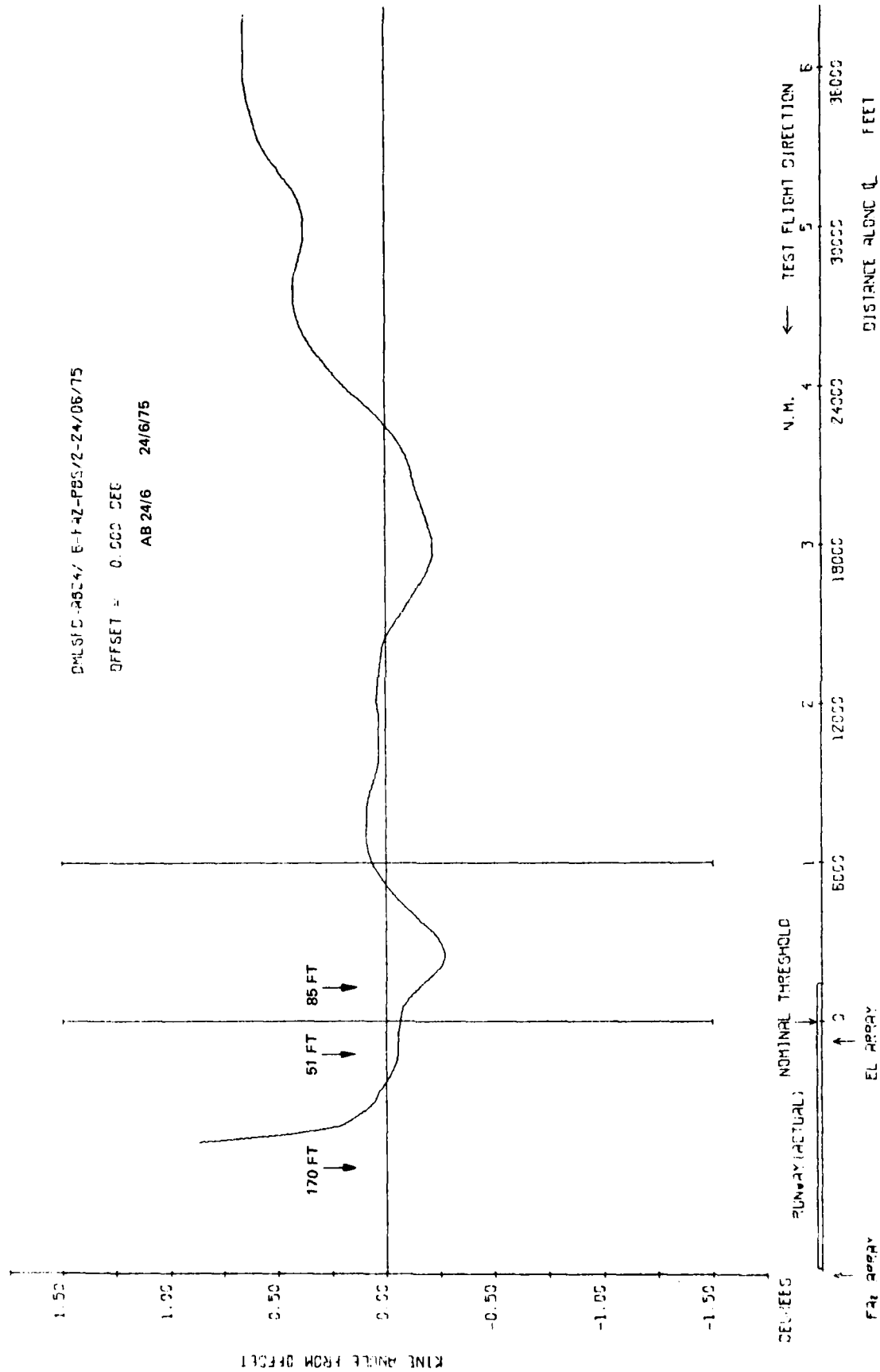


Fig 4.34a Approach azimuth accuracy. 3 degree approach to low overfly

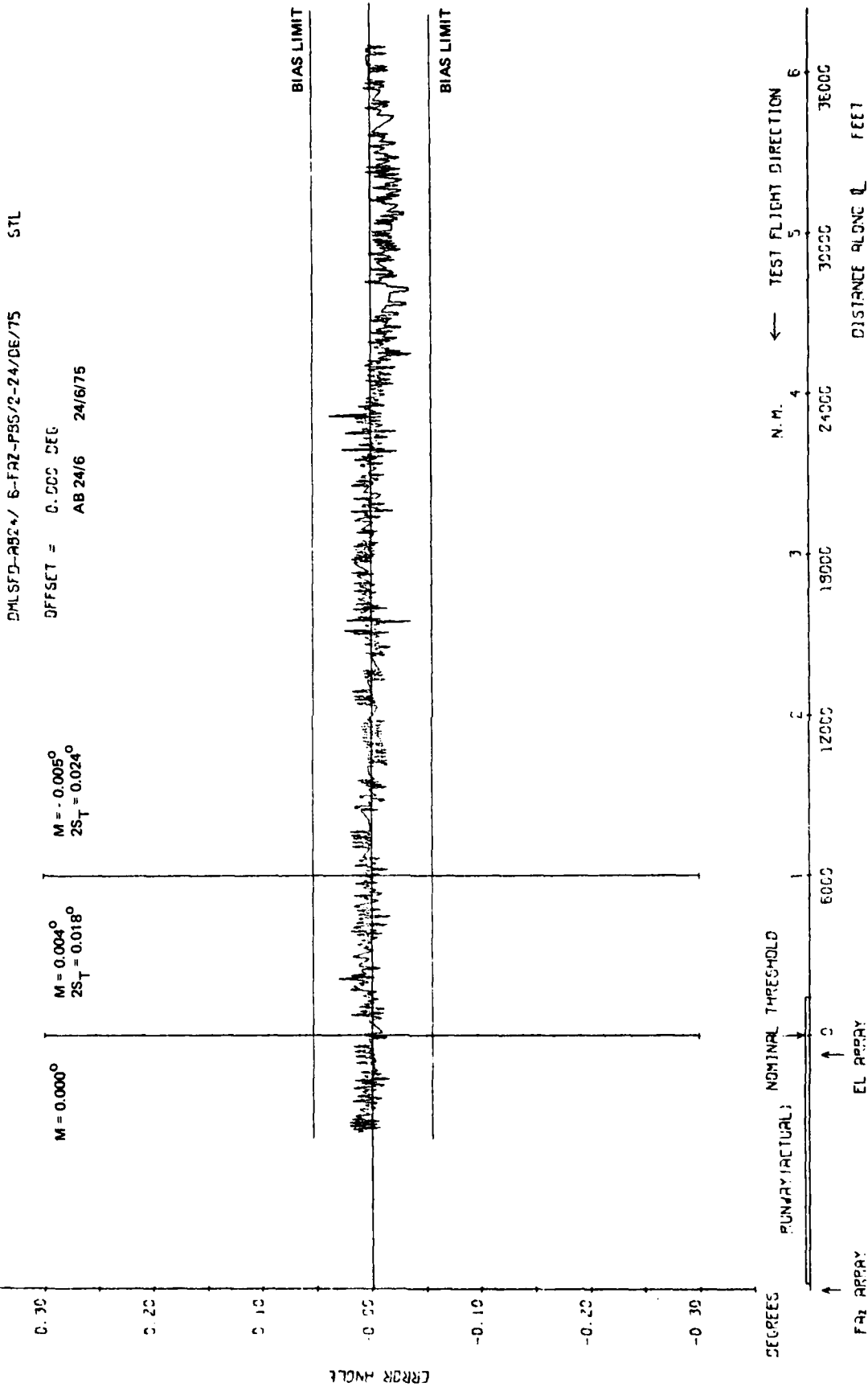


Fig 4.34c

Fig 4.34c Approach azimuth accuracy. 3 degree approach to low overfly

Fig 4.35a

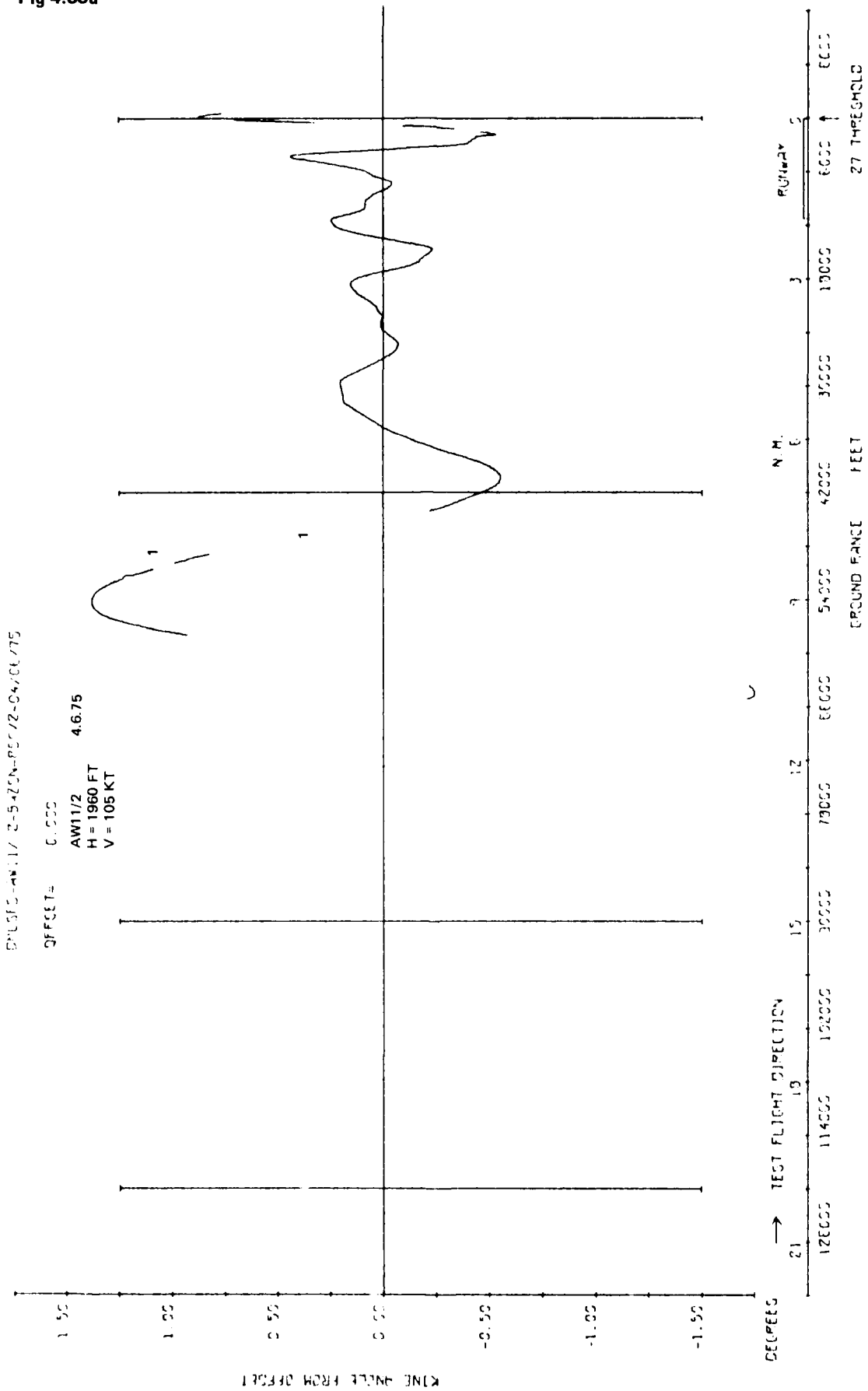


Fig 4.35a Missed approach azimuth radial flight on centre line

TR 79052

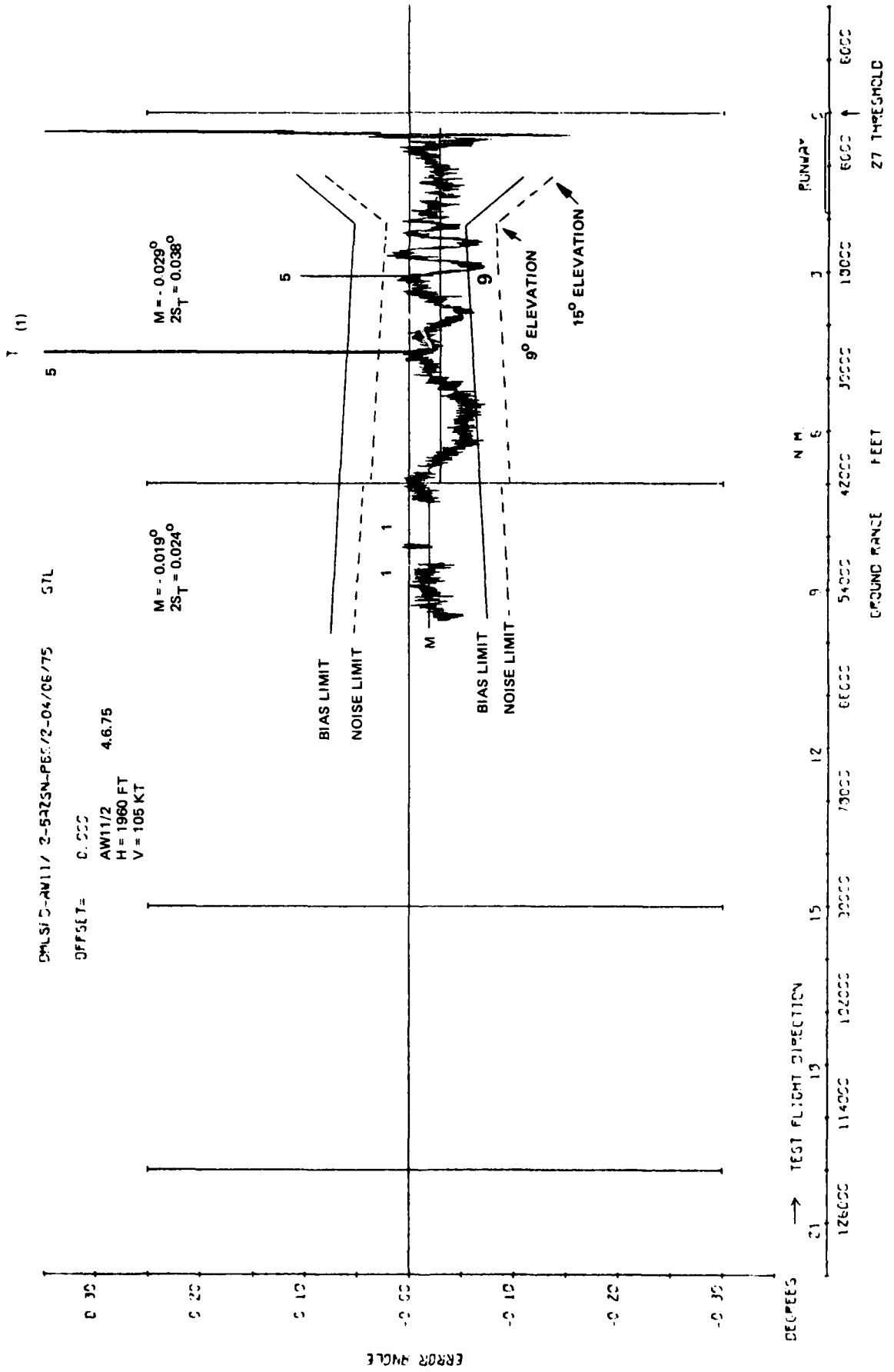


Fig 4.35c

Fig 4.35c Missed approach azimuth radial flight on centre line

Fig 4.36c

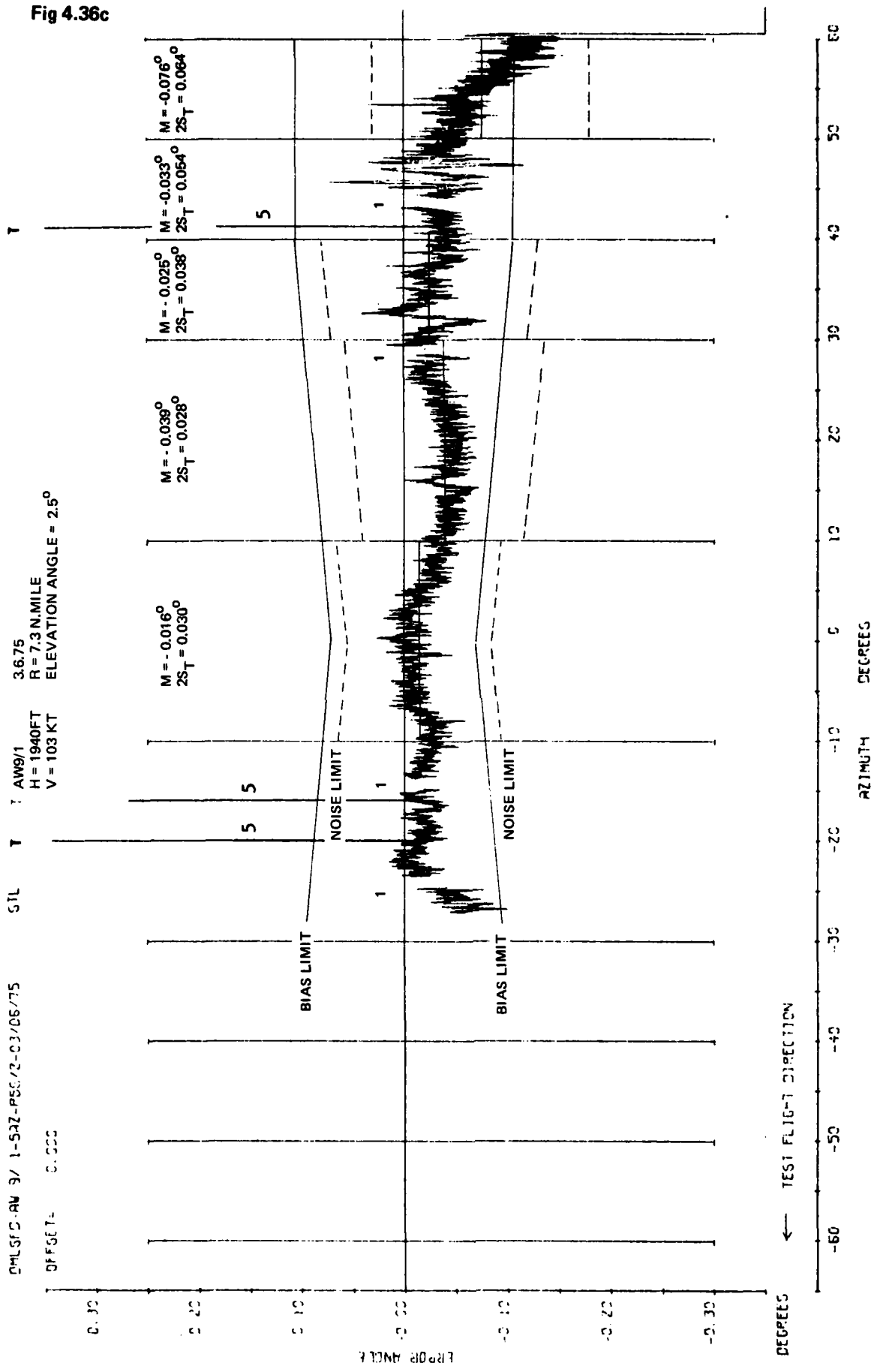


Fig 4.36c Missed approach azimuth orbital flight at 1940 ft and 7.3 n mile radius

TR 79052

DHLSPD-AW 9/ 3-5RZ-PDC/2-03/06/75 STL

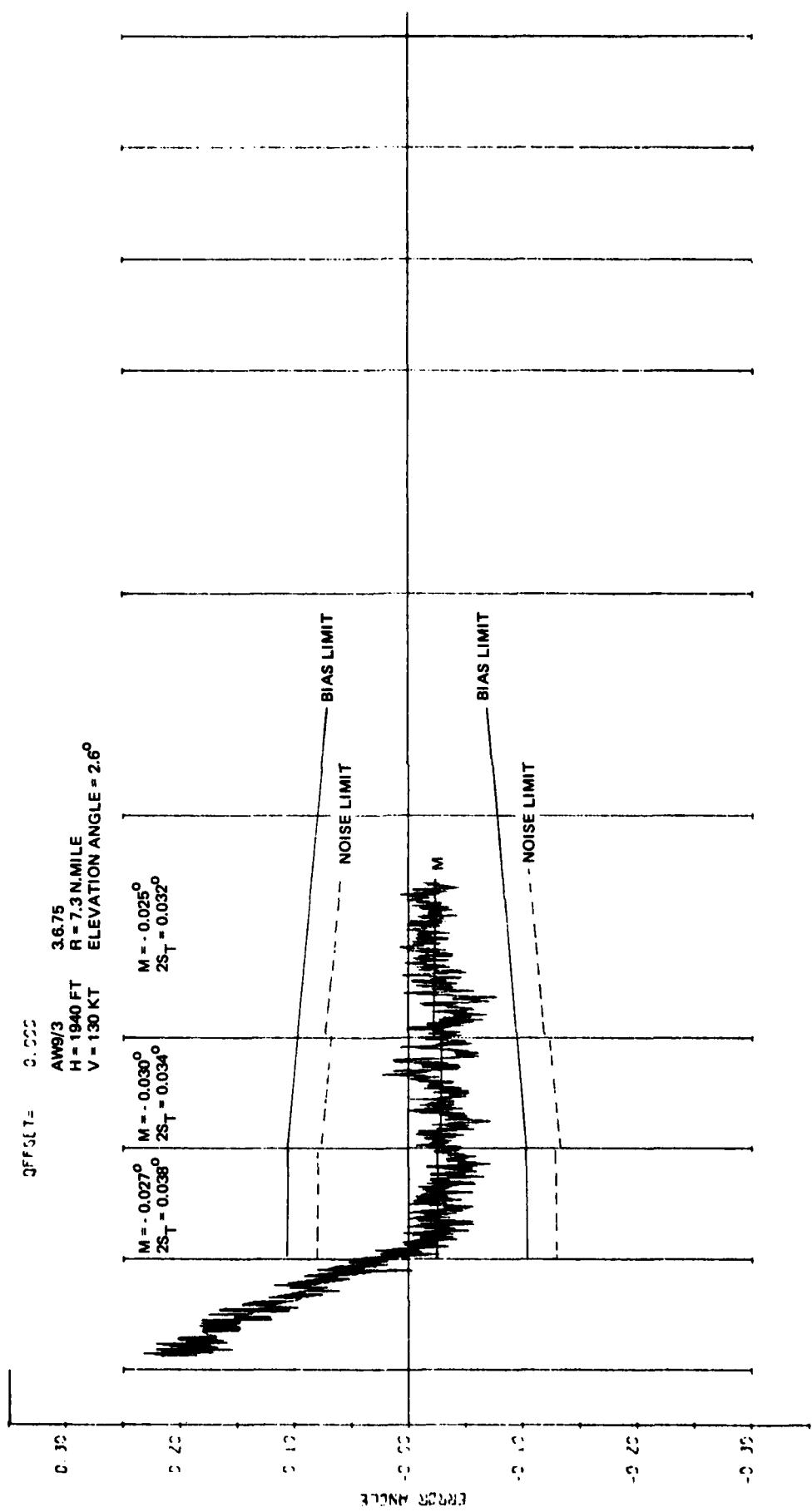
OFFSET = 0.000

AW9/3 3.675
H = 1940 FT R = 7.3 N.MILE
V = 130 KT ELEVATION ANGLE = 2.6°

$M = -0.027^\circ$
 $2S_T = 0.038^\circ$

$M = -0.030^\circ$
 $2S_T = 0.034^\circ$

$M = -0.025^\circ$
 $2S_T = 0.032^\circ$



← TEST FLIGHT DIRECTION

DEGREES AZIMUTH DEGREES

Fig 4.37c

Fig 4.37c Missed approach orbital flight at 1940 ft and 7.3 n mile radius

Fig 4.38c

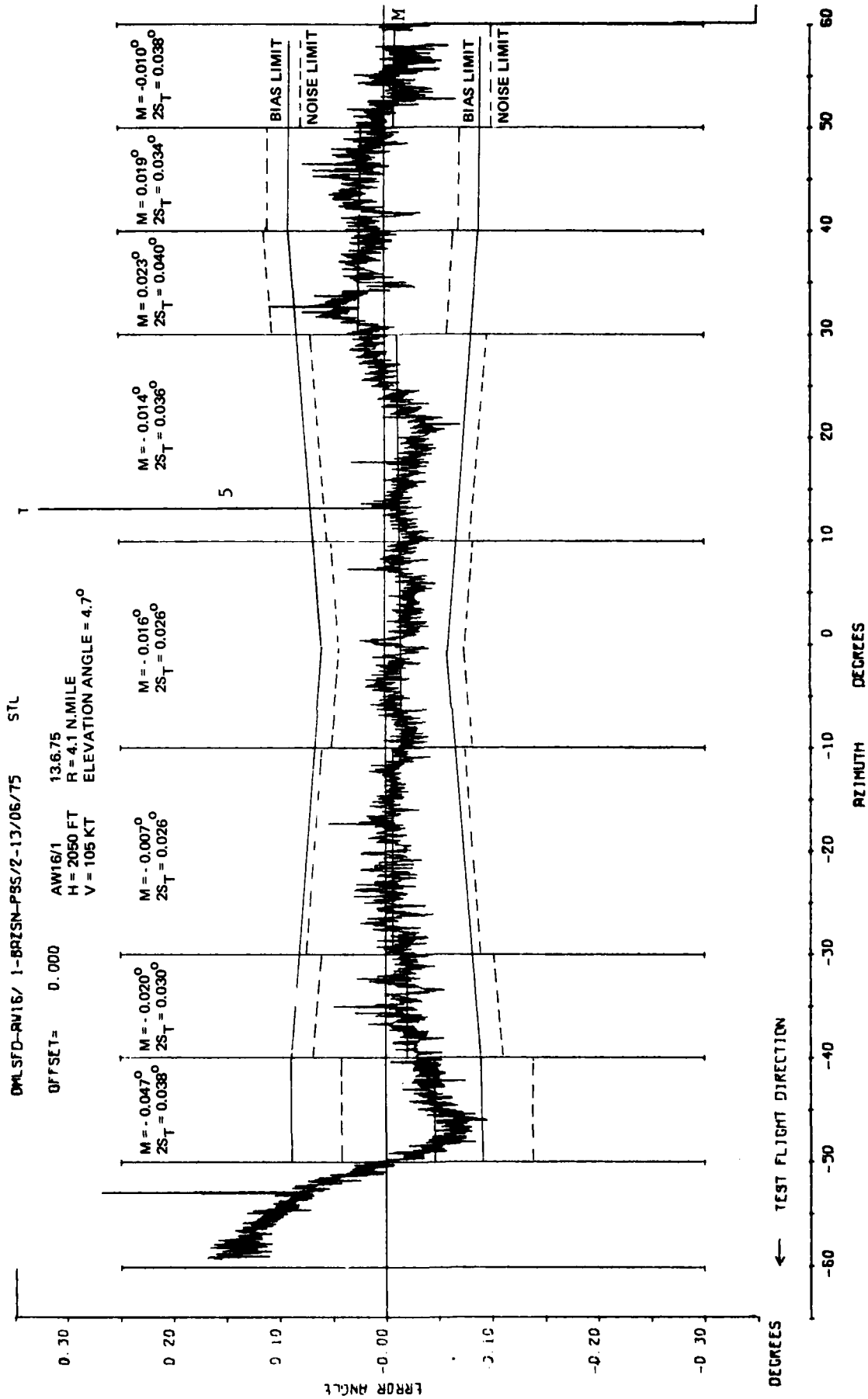


Fig 4.38c Missed approach orbital flight at 2050 ft and 4.1 n mile radius

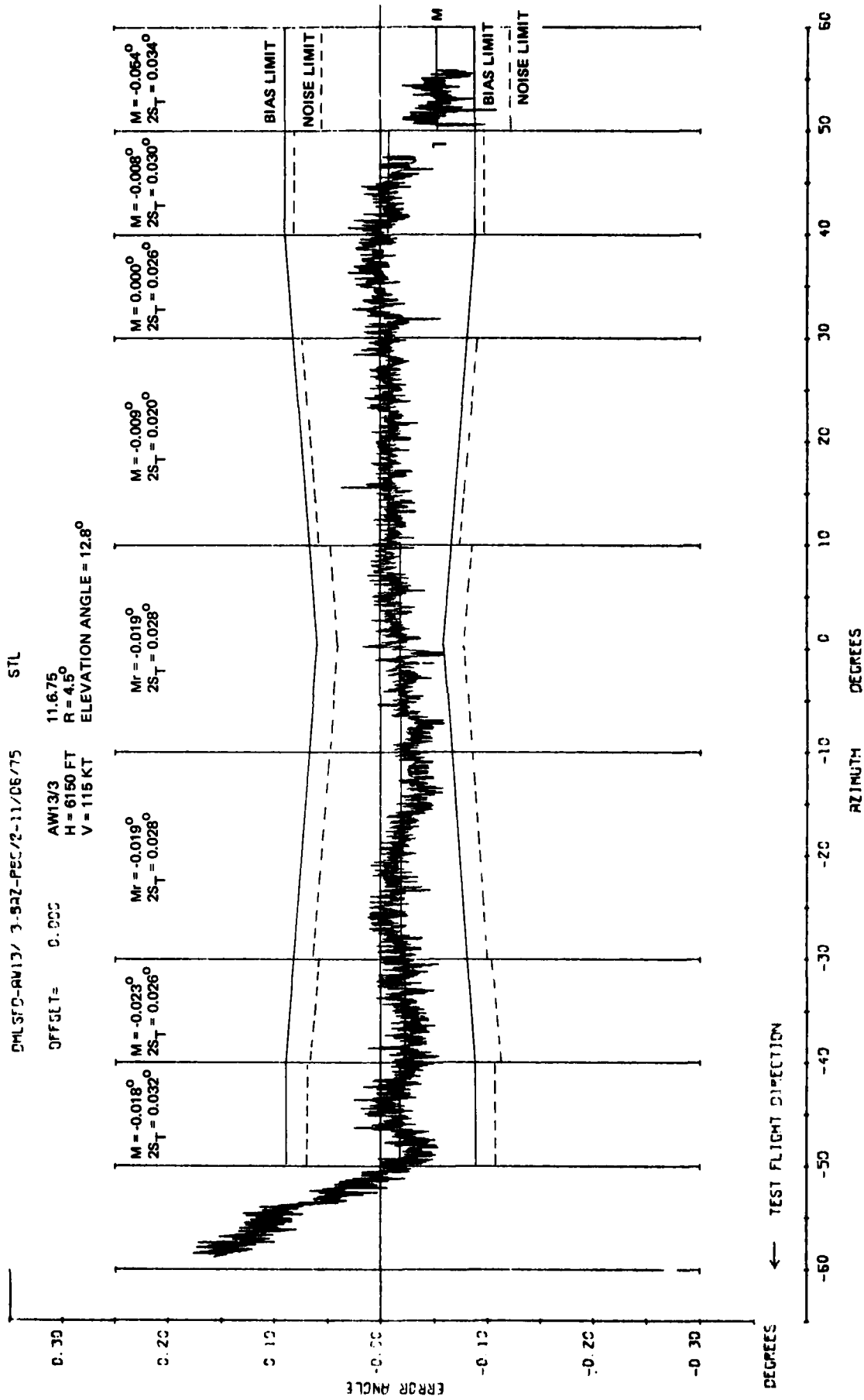


Fig 4.39c

Fig 4.39c Missed approach azimuth orbital flight at 6150 ft and 4.5 n mile radius

Fig 4.40a

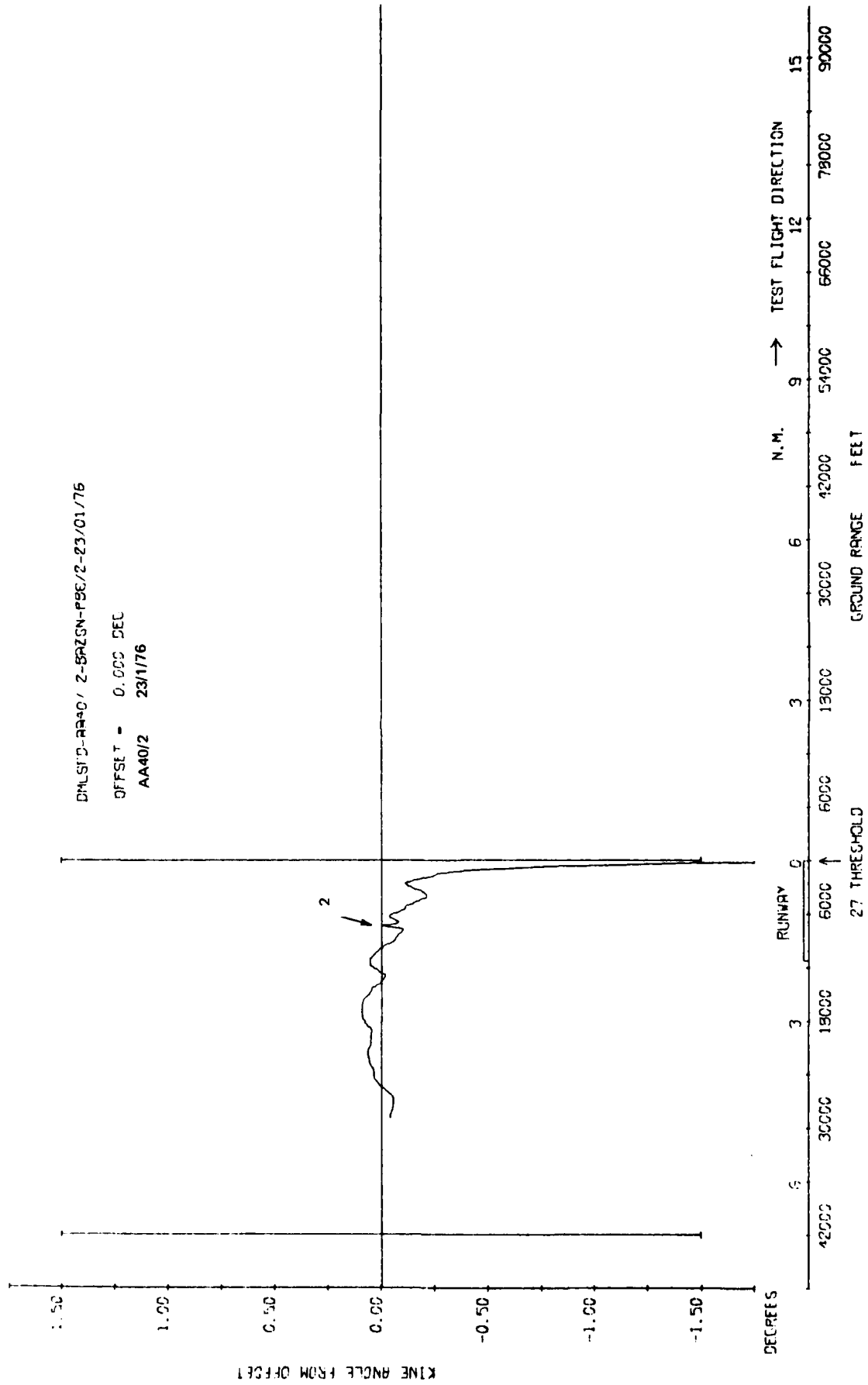


Fig 4.40a 3 degree approach using 60λ array missed approach guidance to low overshoot

TR 79052

DMLSD-RR40/ 2-BRZEN-P86/2-23/01/76 STL

OFFSET = 0.000 DEG

AA40/2 23/1/75

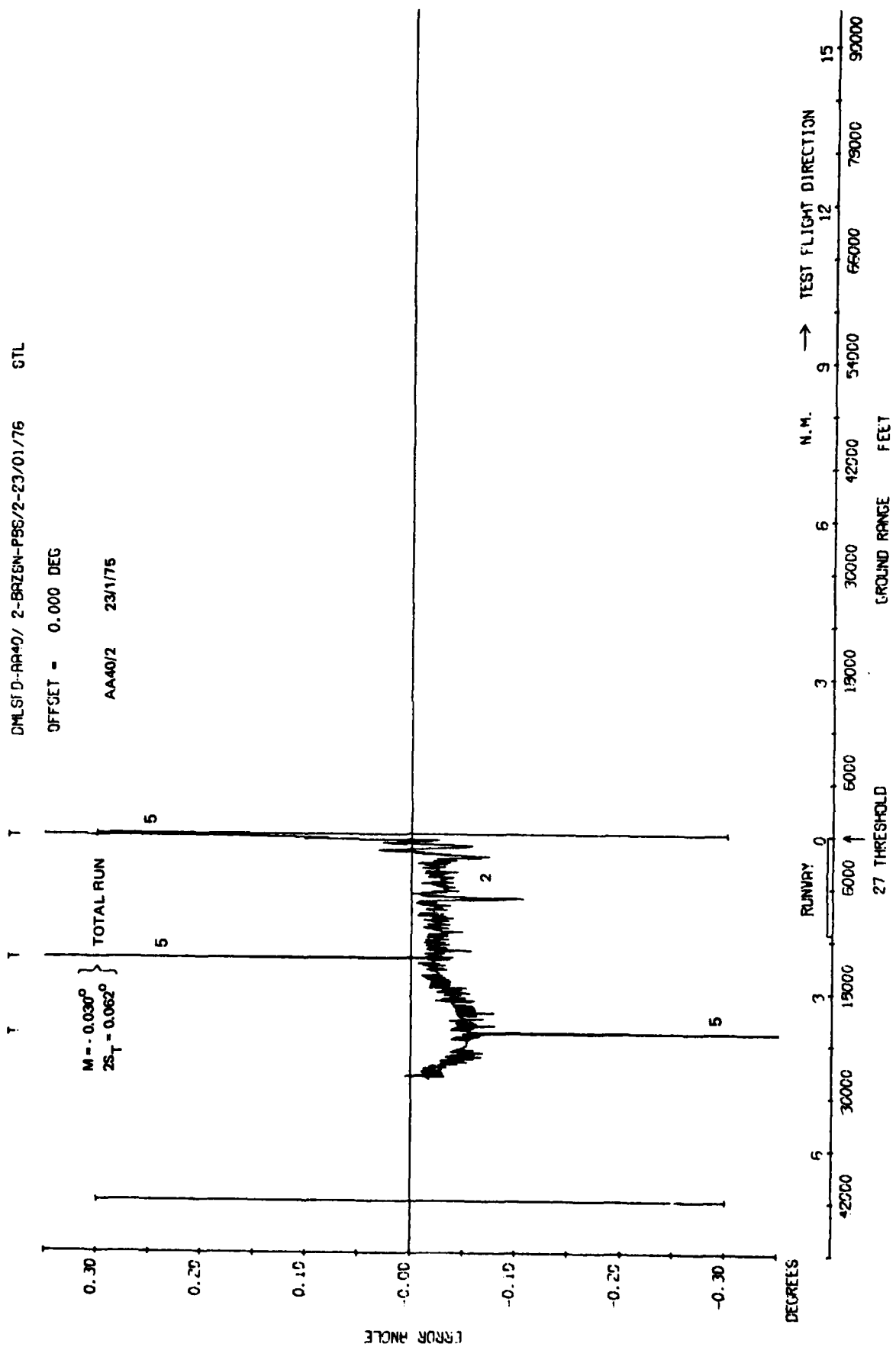


Fig 4.40c 3 degree approach using 60λ array missed approach guidance to low overshoot

Fig 4.40c

Fig 4.41a

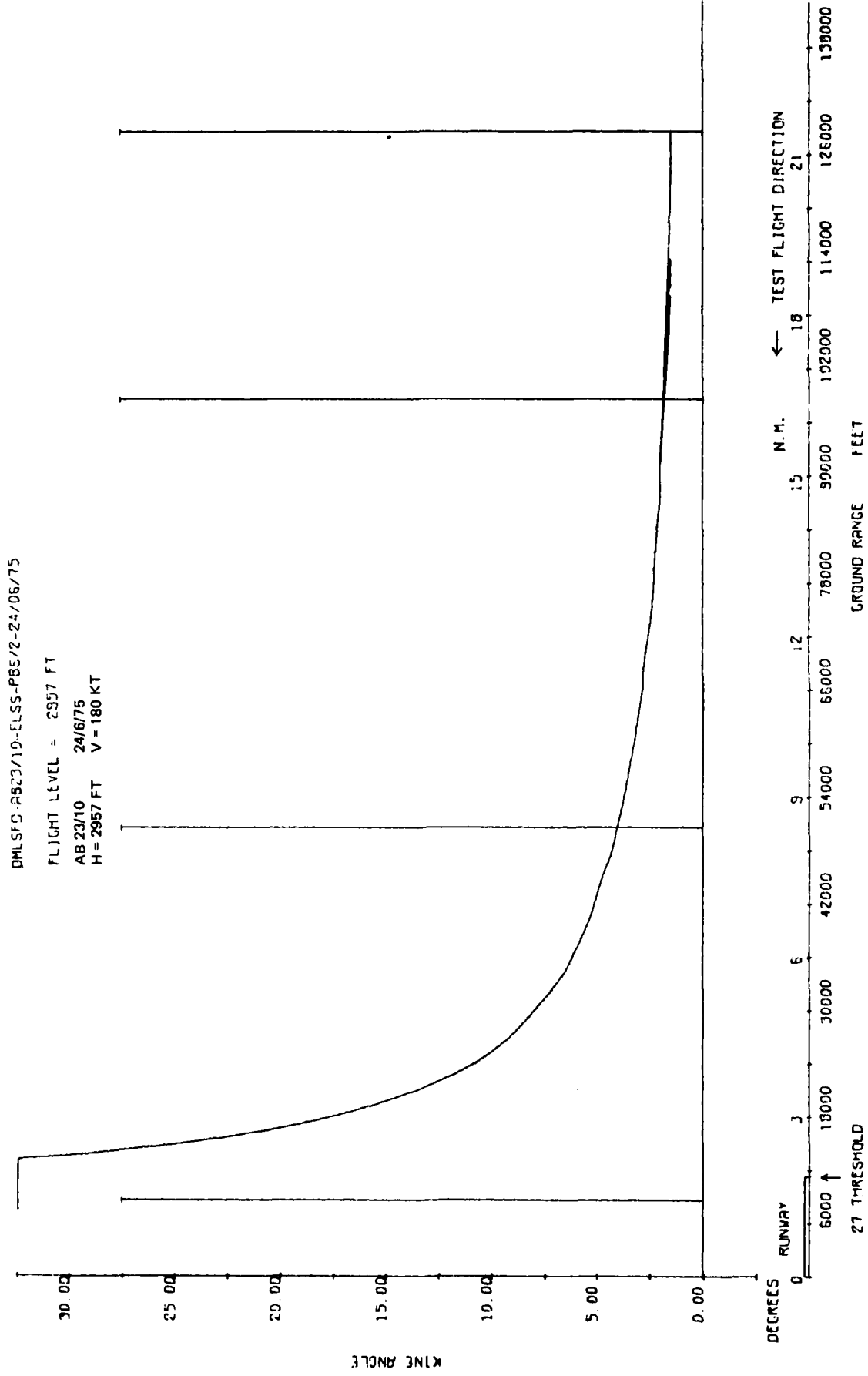


Fig 4.41a Elevation accuracy. Radial flight at 2957 ft and 0 degree

TR 79062

DMLS/D-25C3/10-ELSS-PBS/2-24/06/75 STL

FLIGHT LEVEL = 2957 FT

AB 23/10 24/6/75

H = 2957 FT V = 180 KT

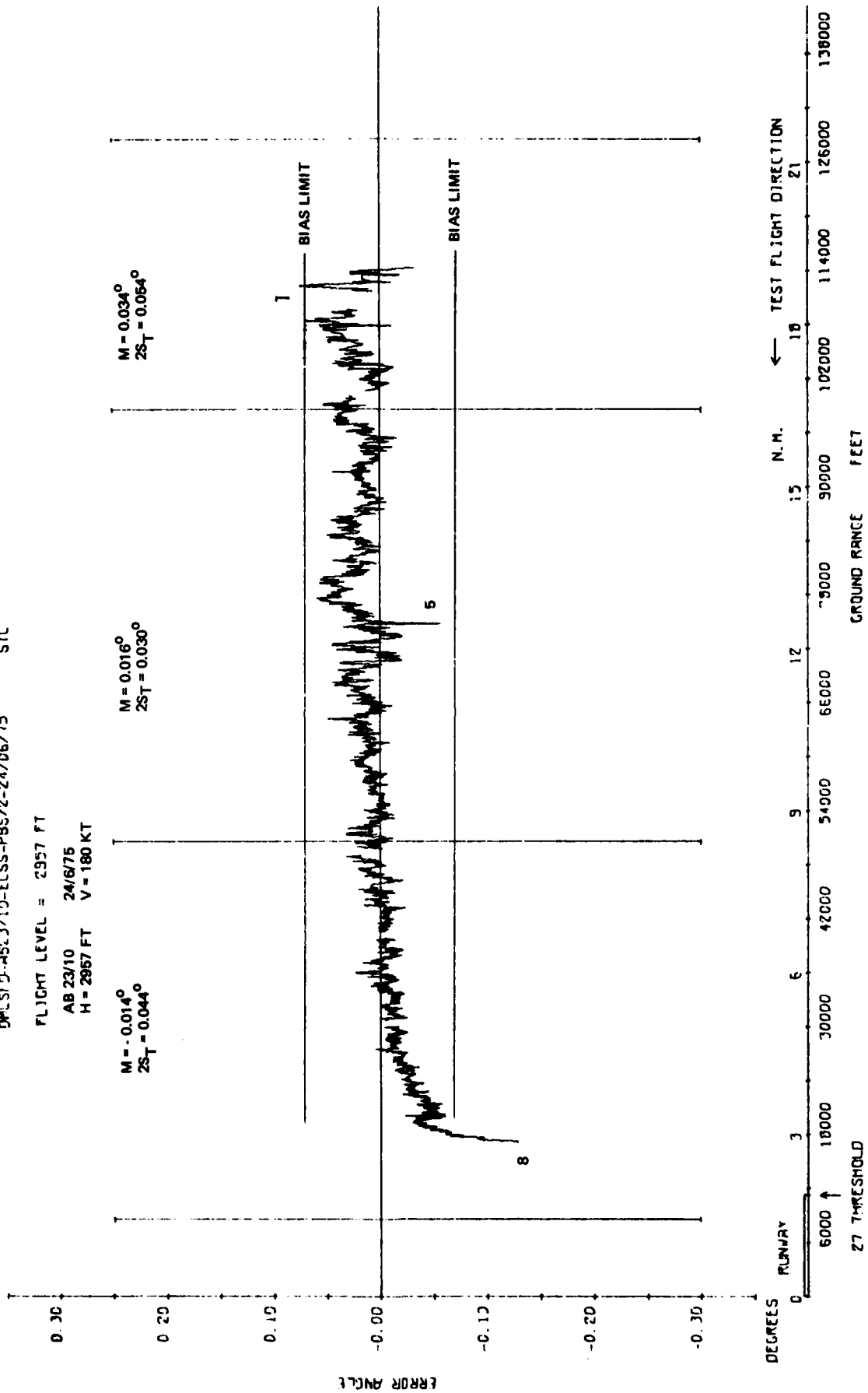


Fig 4.41c

Fig 4.41c Elevation accuracy. Radial flight at 2957 ft and 0 degree

Fig 4.42a

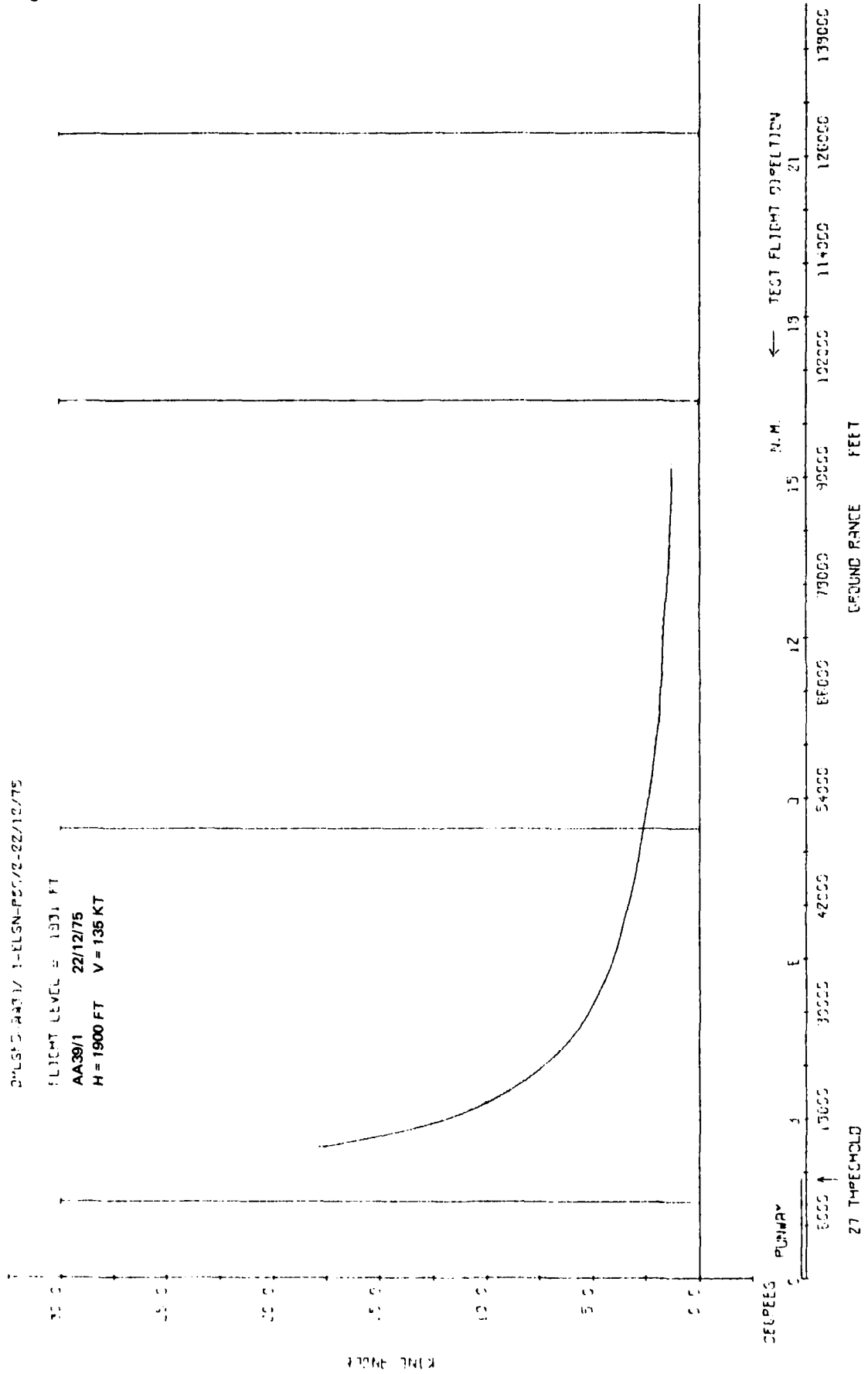


Fig 4.42a Elevation accuracy radial flight at 1900 ft and on -44 degrees radial

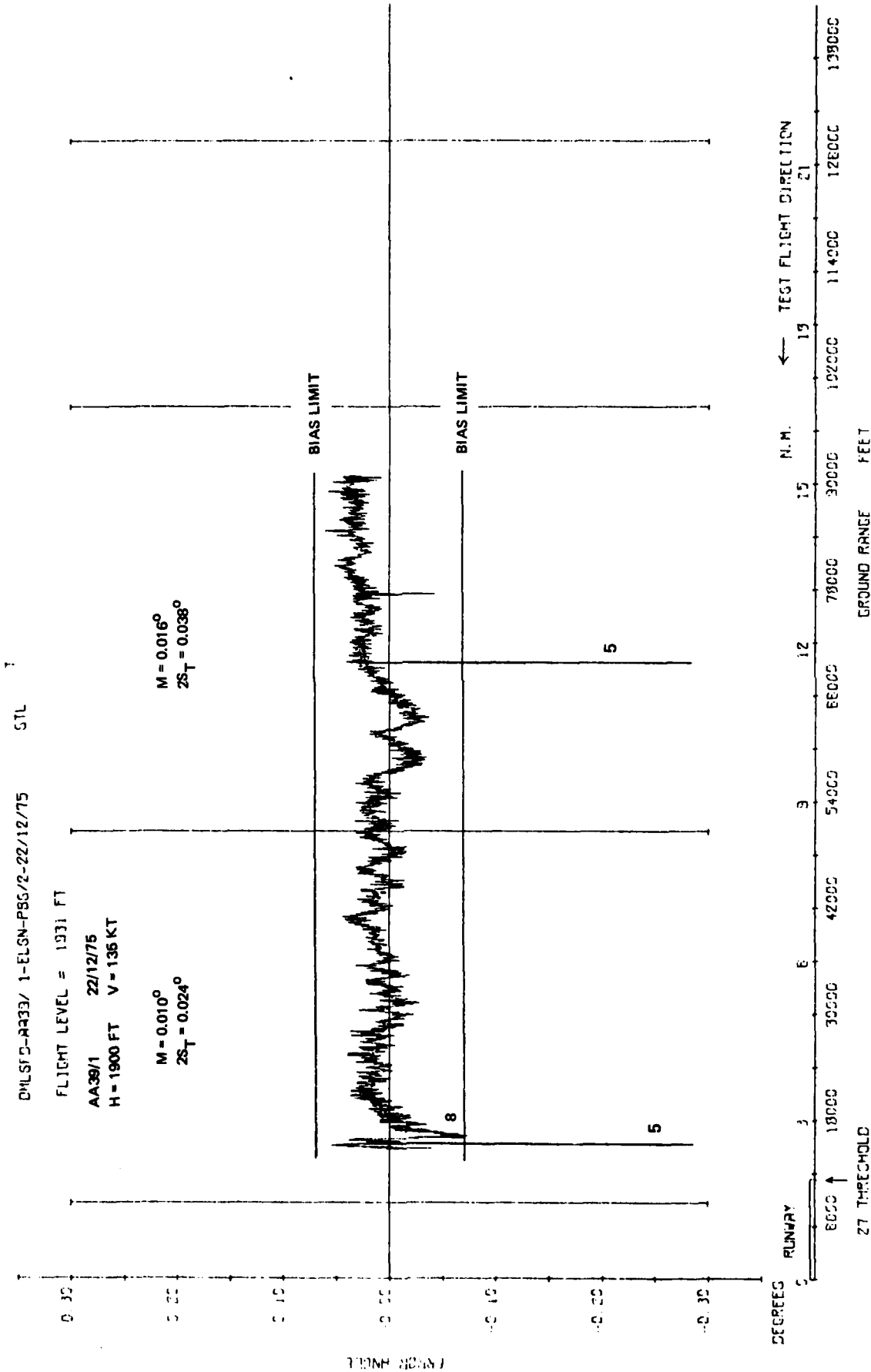


Fig 4.42c

Fig 4.42c Elevation accuracy radial flight at 1900 ft and on -44 degrees radial

Fig 4.43a

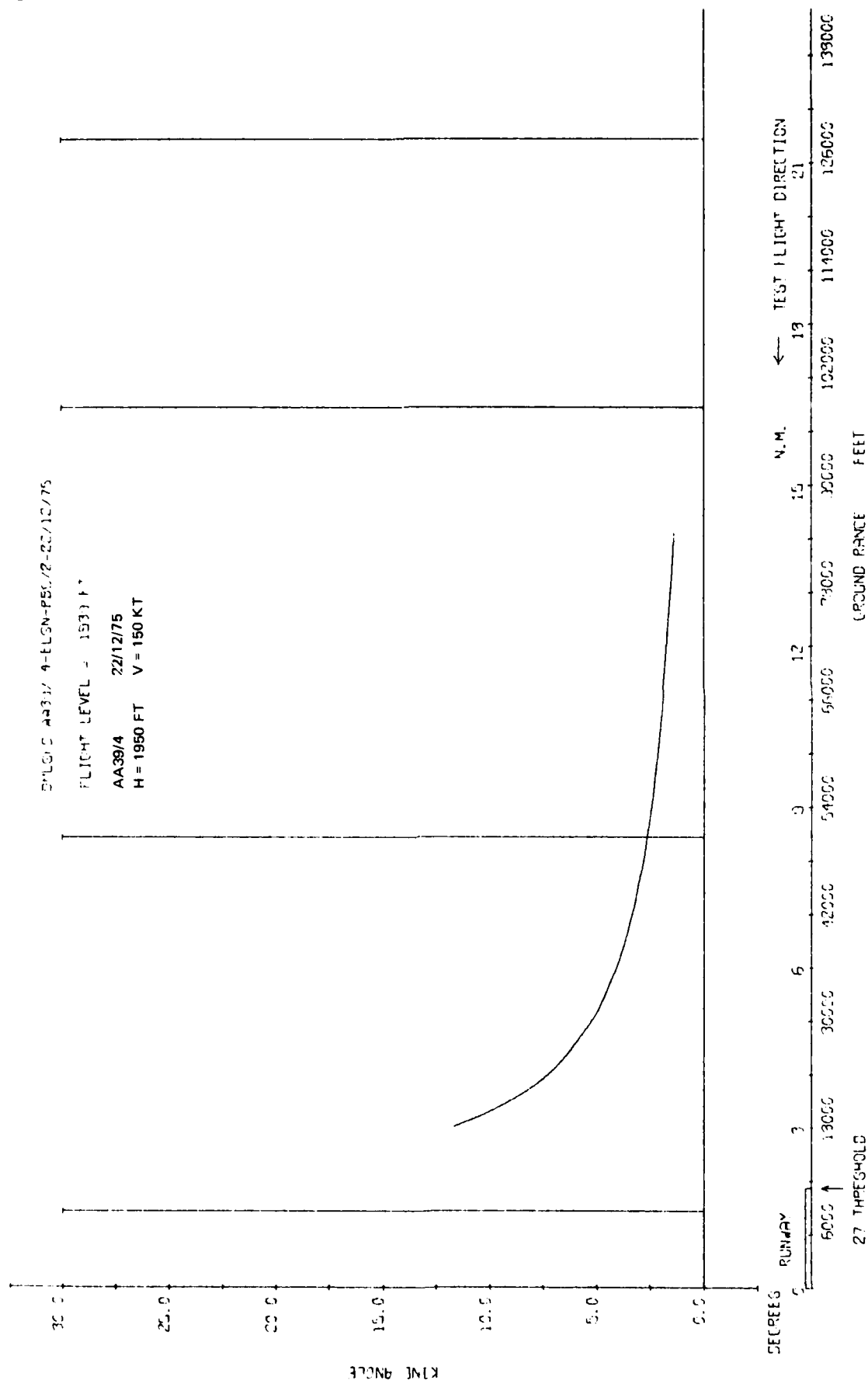


Fig 4.43a Elevation accuracy radial flight at 1950 ft and on +51 degrees radial

TR 79052

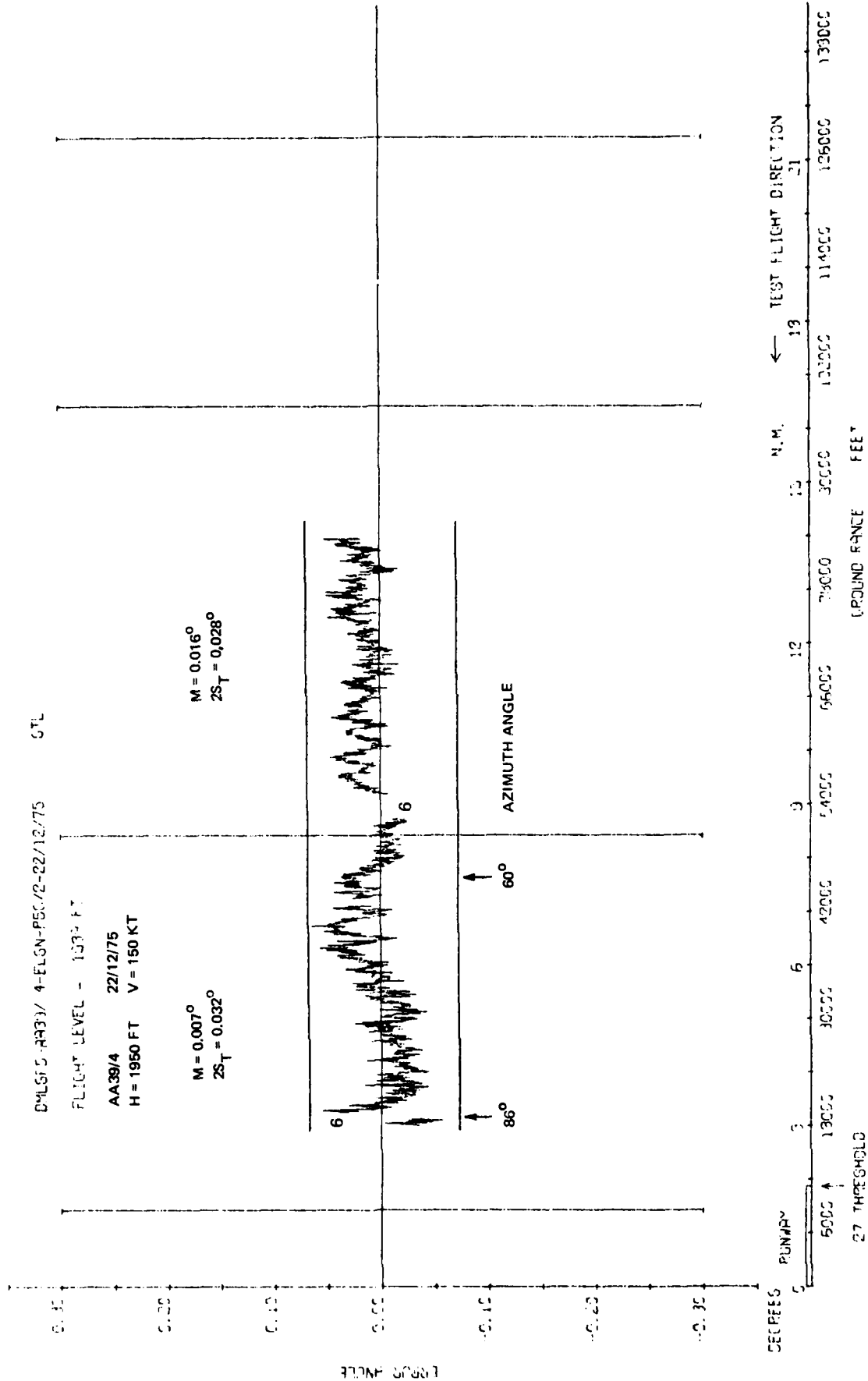


Fig 4.43c

Fig 4.43c Elevation accuracy radial flight at 1950 ft and on +51 degrees radial

Fig 4.44a

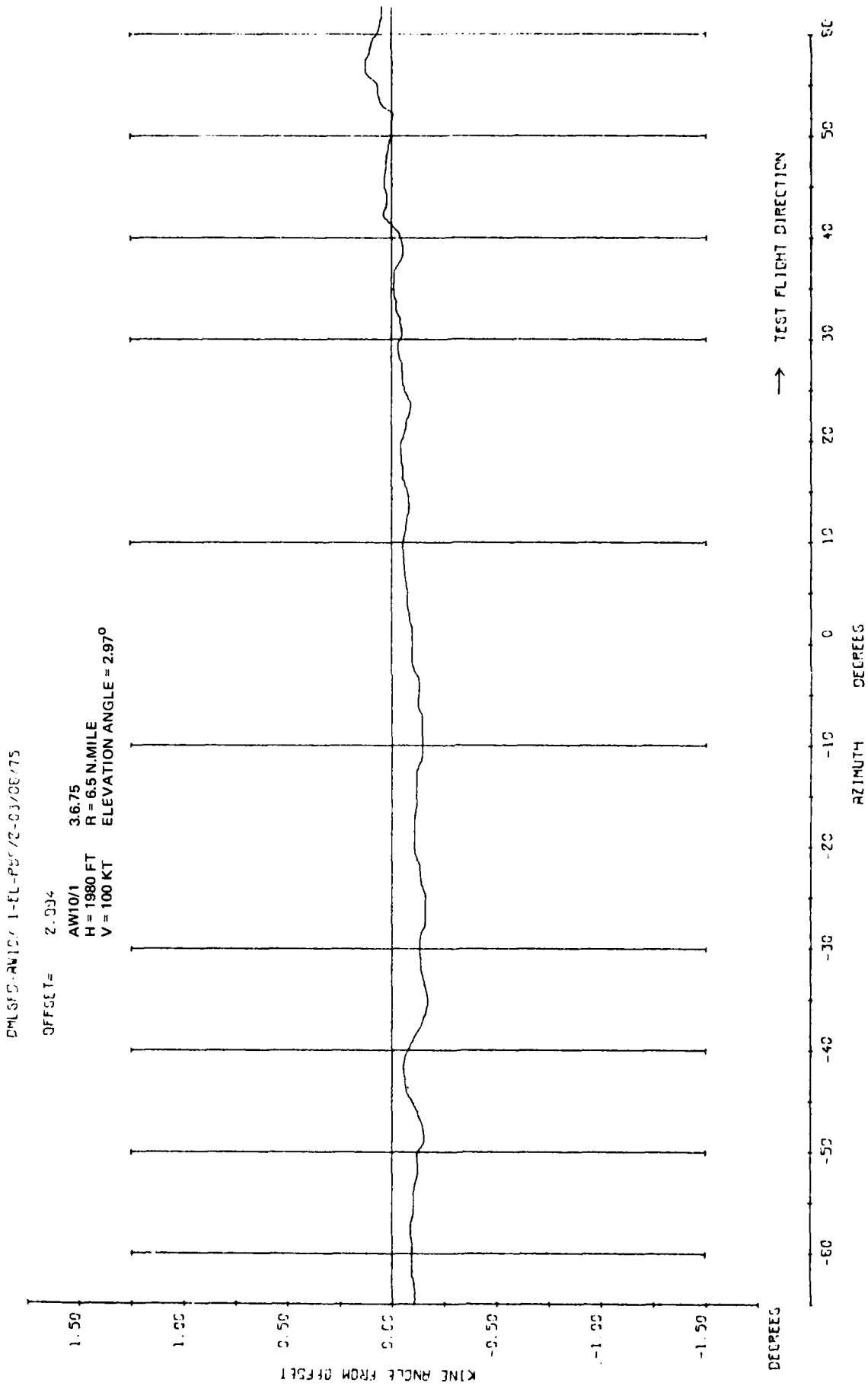


Fig 4.44a Elevation orbital flight at 1980 ft and 6.5 n mile radius

DWLSFD-RV12; 1-EL-PDS/2-03/CE/75 STL

OFFSET= 2.33;

AW10/1 3.675
H = 1980 FT R = 6.5 N.MILE
V = 100 K.T ELEVATION ANGLE = 2.97°

T (1)

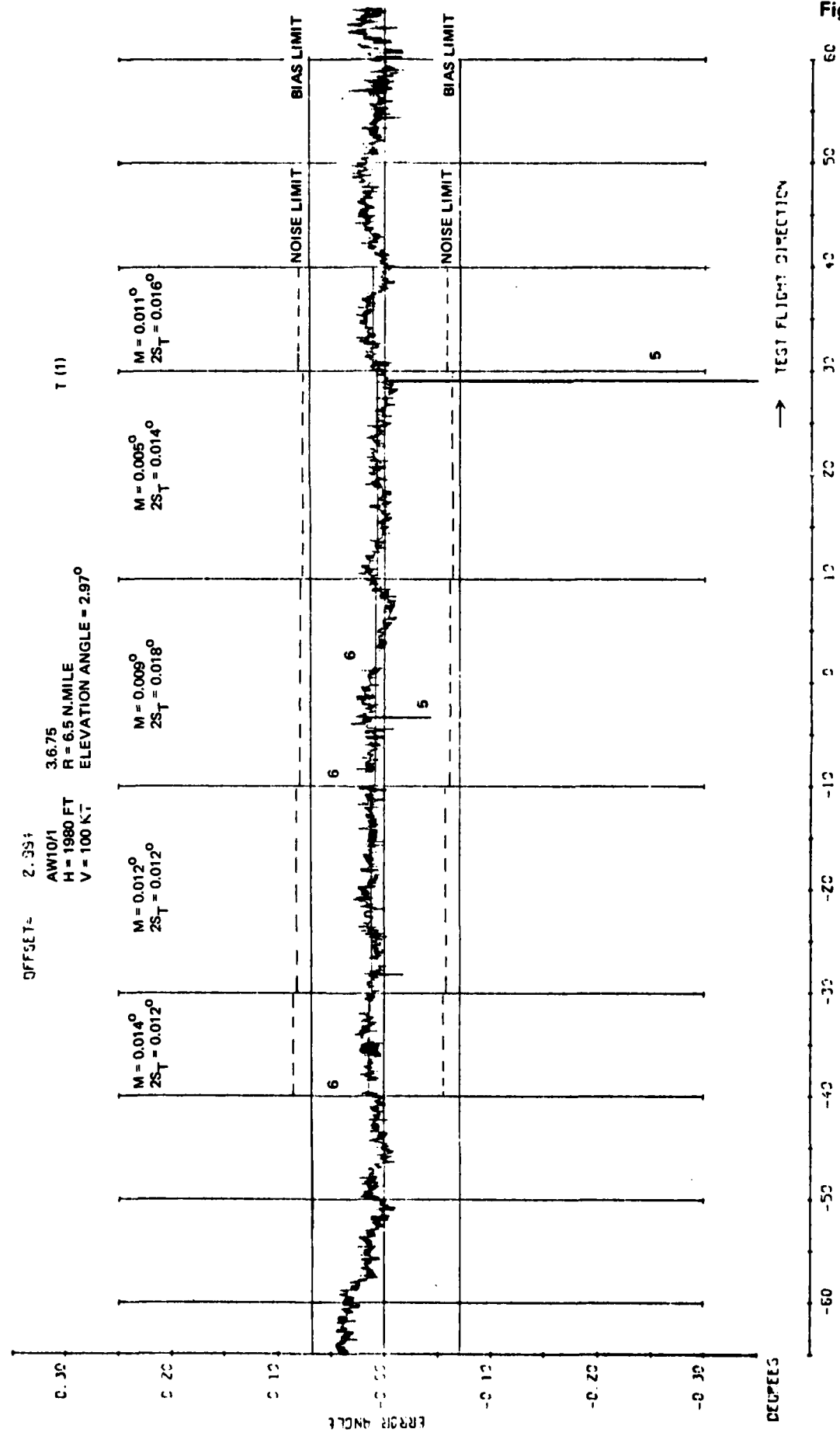


Fig 4.44c

Fig 4.44c Elevation orbital flight at 1980 ft and 6.5 n mile radius

Fig 4.45a

ORBITAL DATA 1-EL-PG/2-11/06/75

OFFSET = 0.000

AW 13/1 11.675

H = 4100 FT R = 4.1 N. MILE

V = 60 KT ELEVATION ANGLE = 9.5°

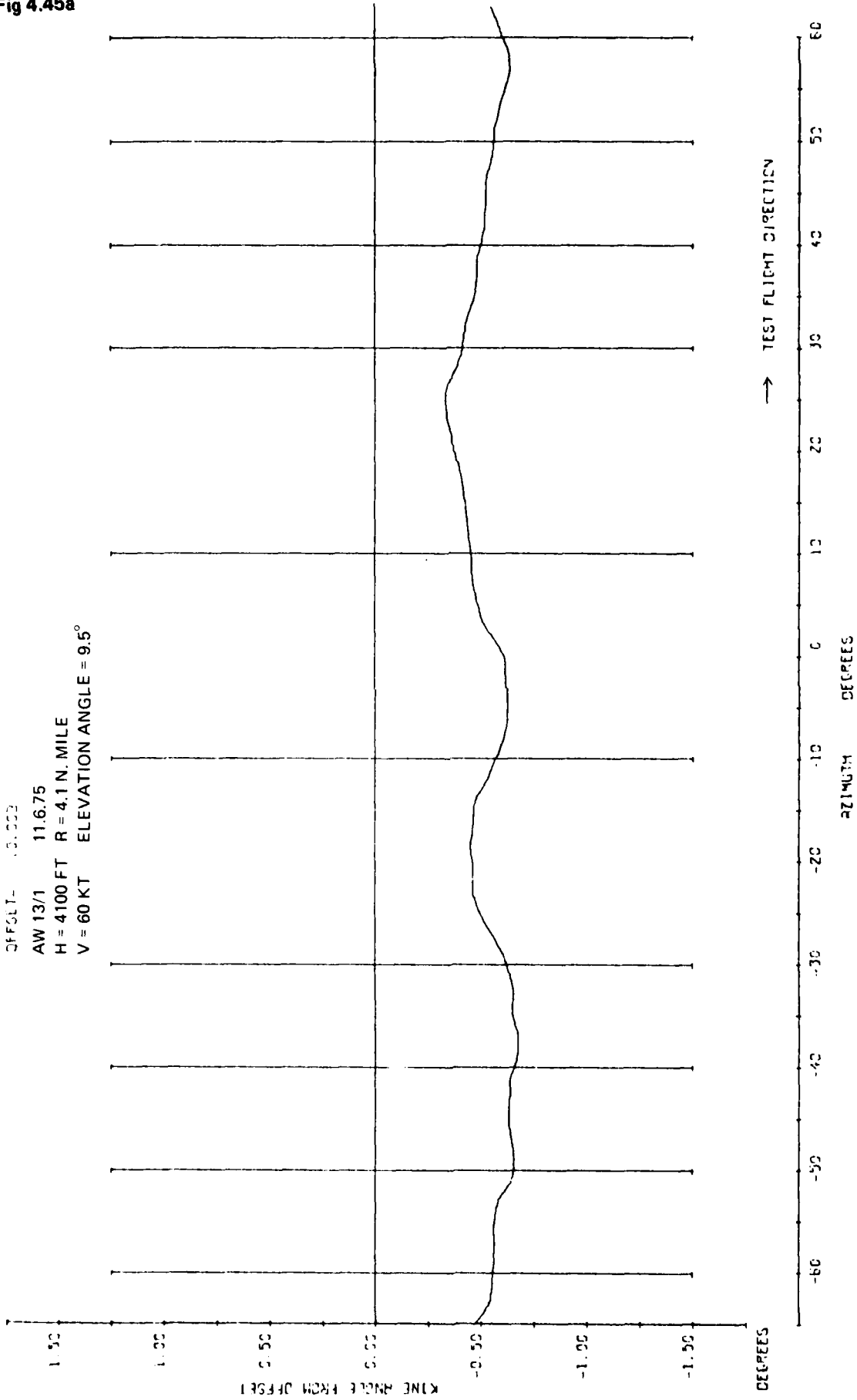


Fig 4.45a Elevation orbital flight at 4100 ft and 4.1 n mile radius

DMLSTC RW13/ 1-EL-PSS/2-11/DE/75 STL

OFFSET = 13.003

AW 13/1 11.6.75

H = 4100 FT R = 4.1 N. MILE

V = 60 KT ELEVATION ANGLE = 9.5°

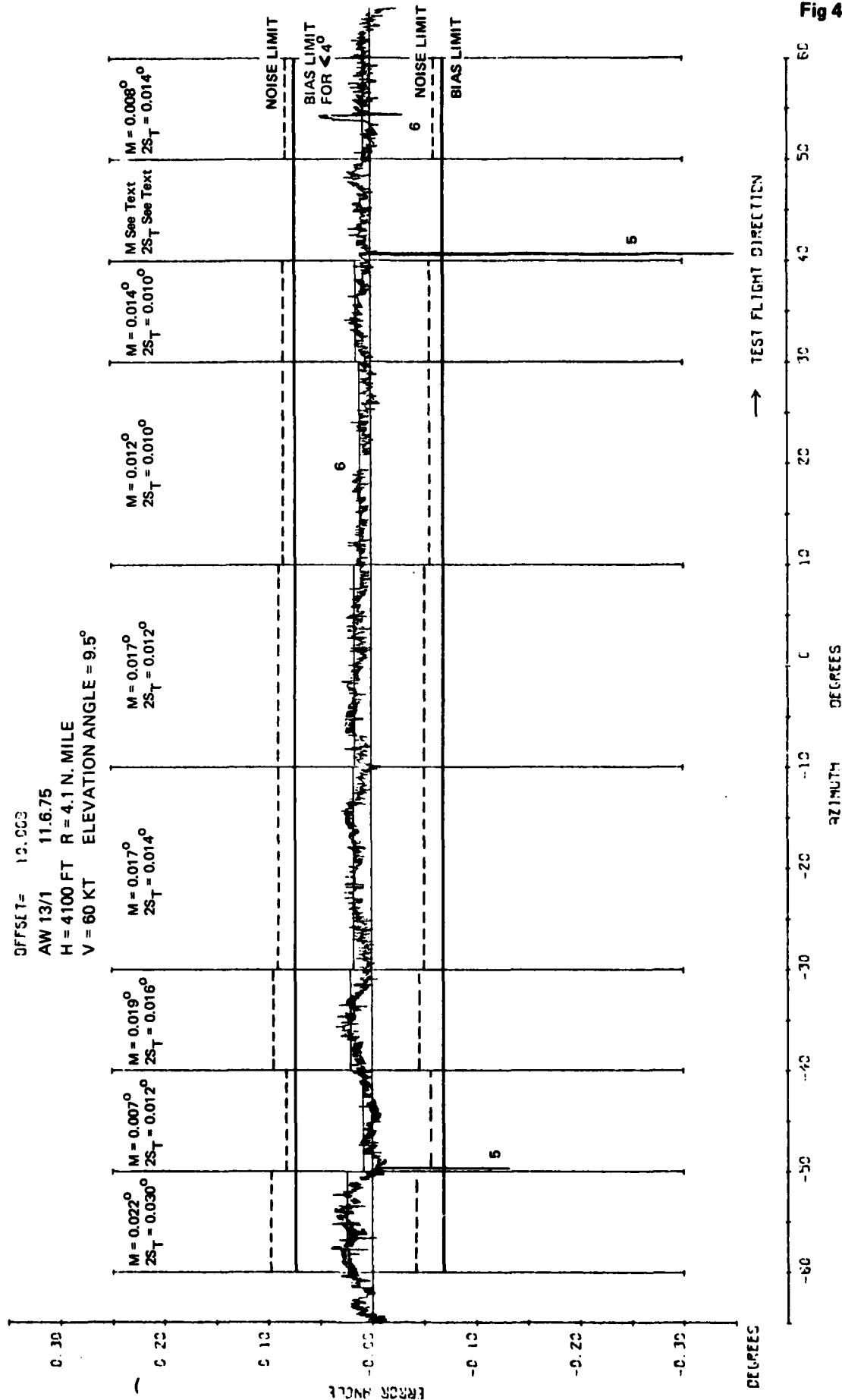


Fig 4.45c

Fig 4.45c Elevation orbital flight at 4100 ft and 4.1 mile radius

Fig 4.46a/b

0MLSTO-8W14/ 4-ELSN-PBE/2-12/06/75 STL

RANGE = 14524 FT
 AW14/4 12.675
 AZIMUTH ANGLE = -32°
 RATE OF ASCENT = 11 FT/SEC.

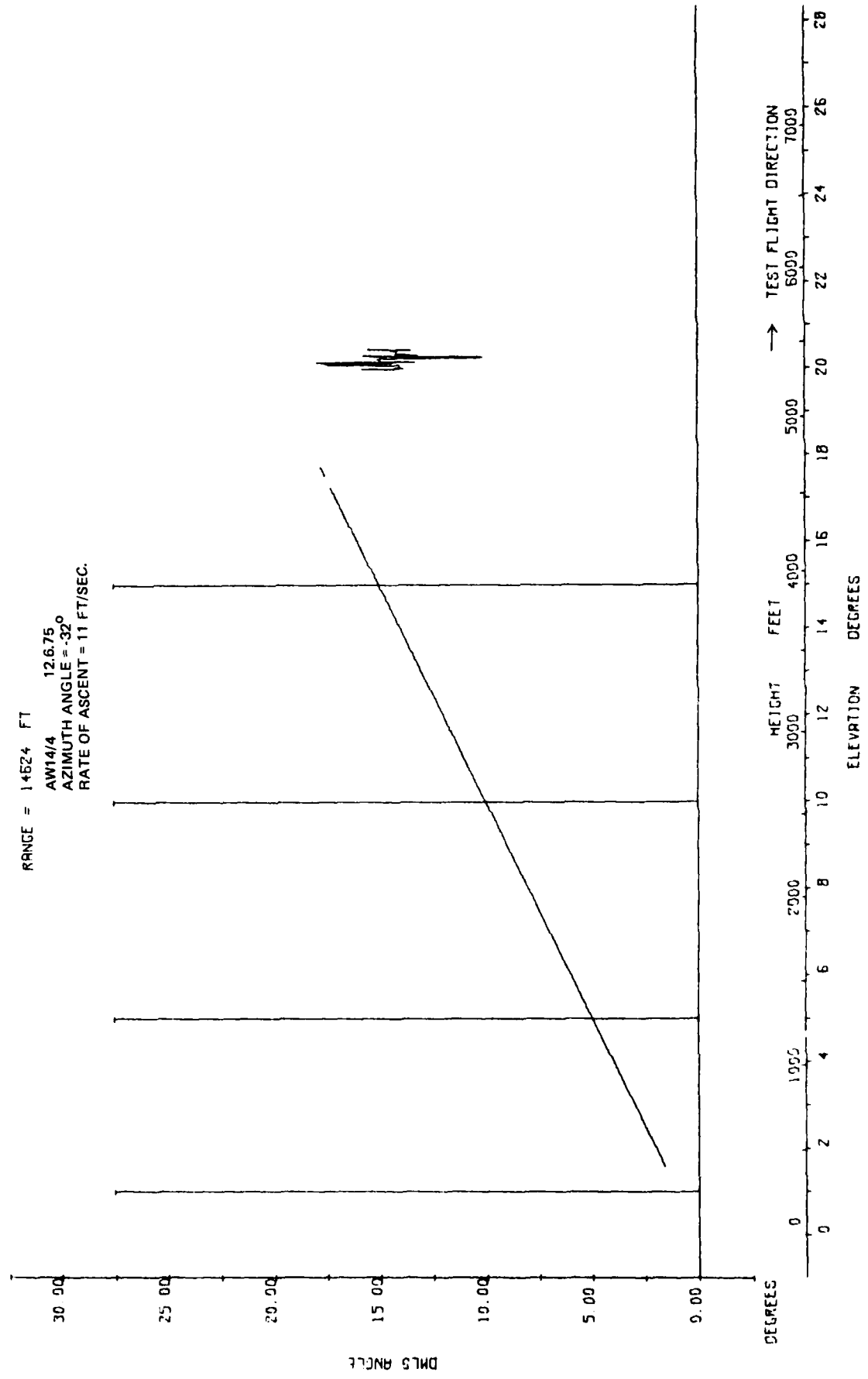


Fig 4.46a/b Elevation vertical ascent

DMLSFD-RV14/ 4-ELSN-P86/Z-12/06/75 STL

RANGE = 14624 FT

AW14/4 12.675

AZIMUTH ANGLE = .32°

RATE OF ASCENT = 11 FT/SEC.

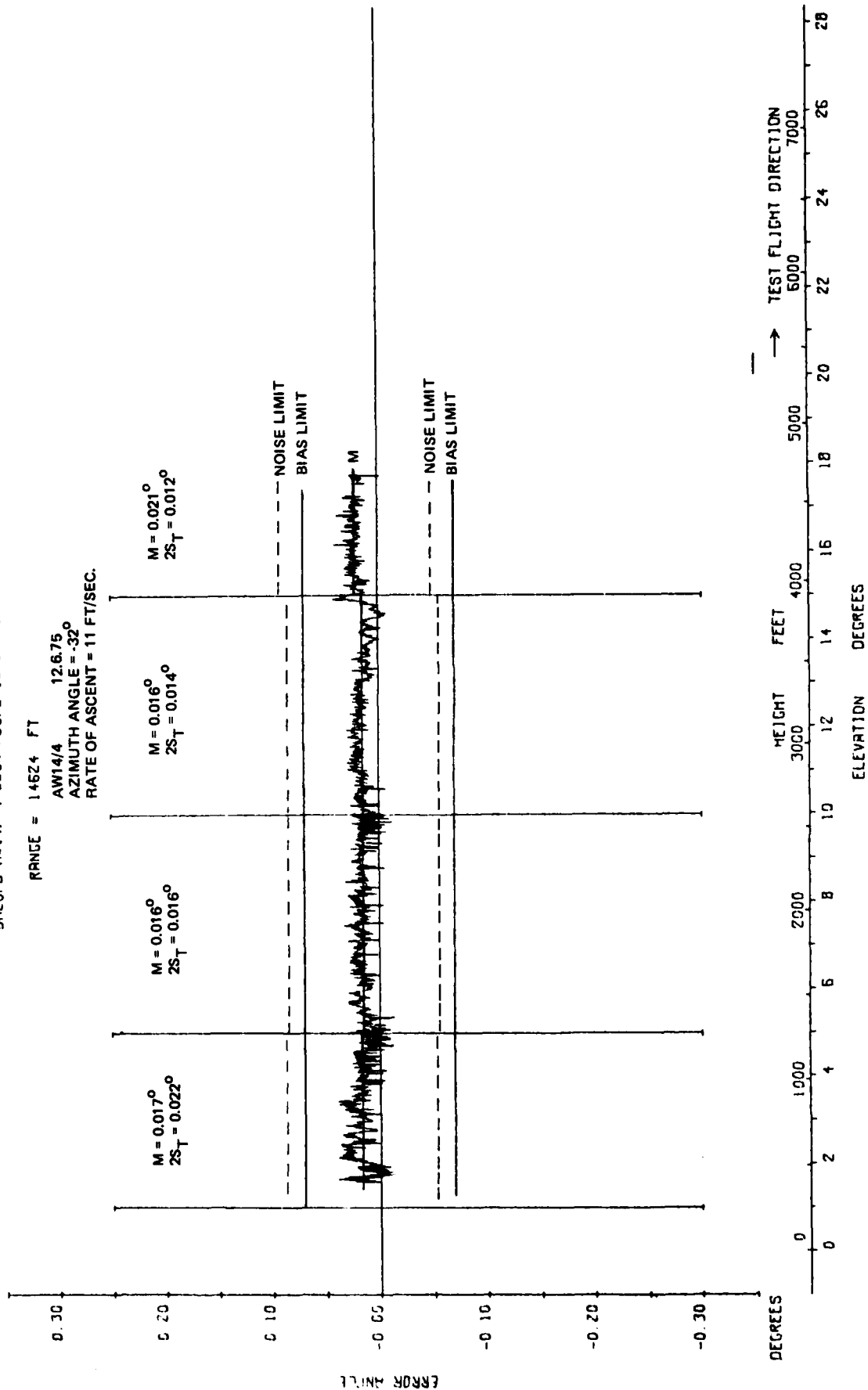


Fig 4.46c

Fig 4.46c Elevation vertical ascent

Fig 4.47a

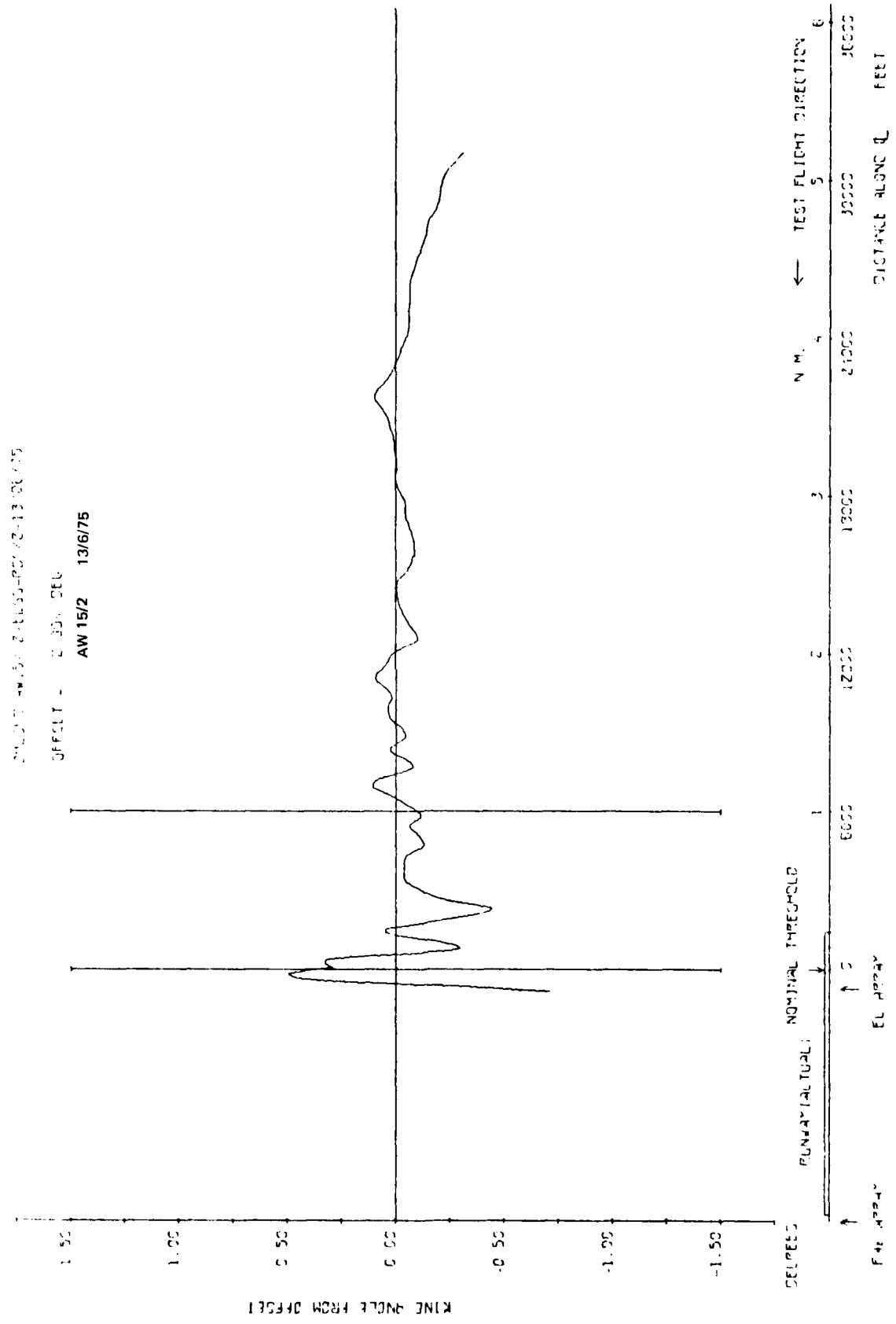


Fig 4.47a Elevation accuracy. 3 degree approach to touchdown

TR 79062

DHLSPC-AW15/ 2-ELSS-PBE/2-13/06/75 STL

OFFSET - 2.00 DEG

AW 15/2 13/6/75

$M = 0.007^\circ$
 $2\sigma_T = 0.026^\circ$

$M = 0.006^\circ$
 $2\sigma_T = 0.016^\circ$

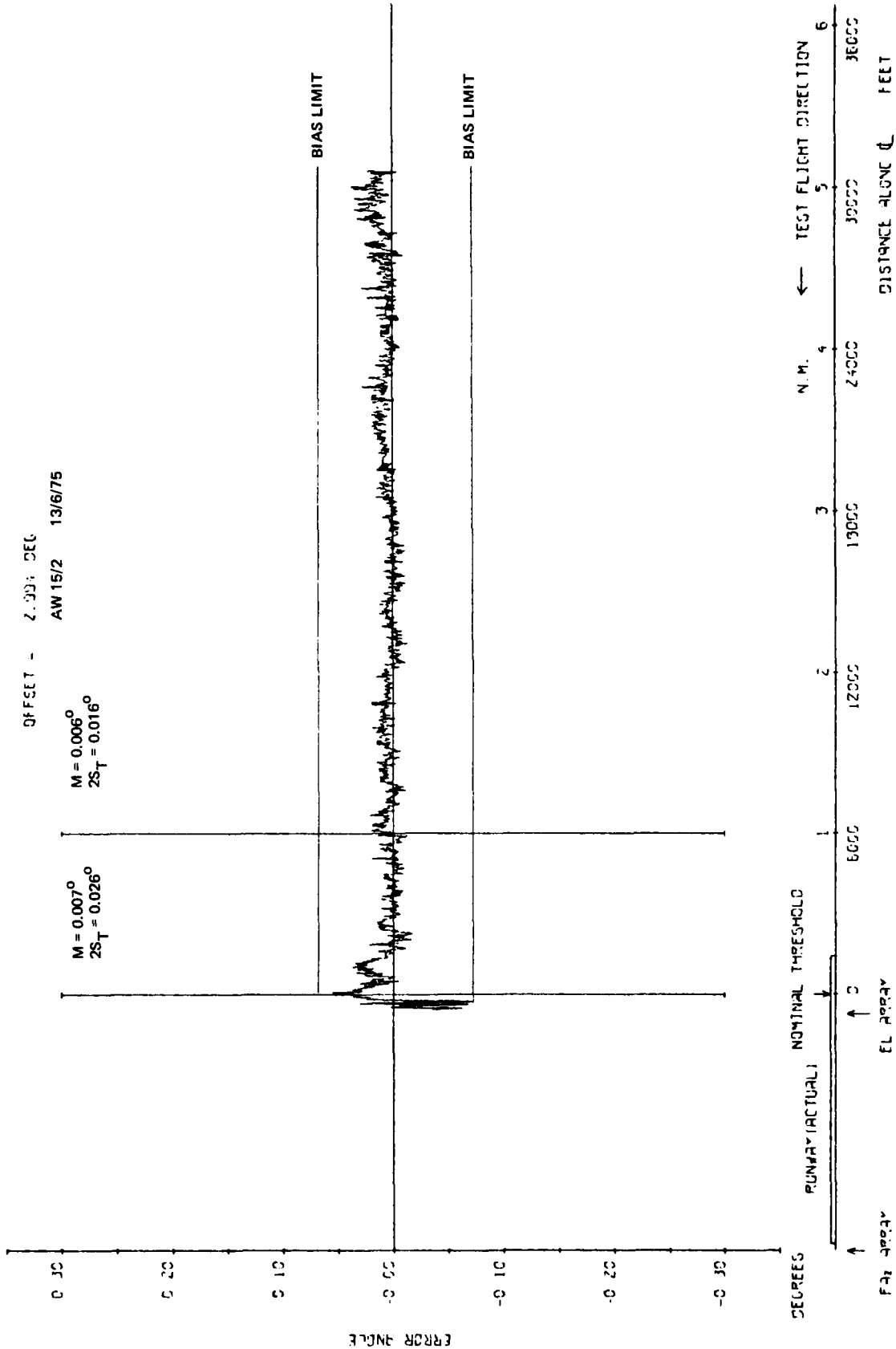


Fig 4.47c

Fig 4.47c Elevation accuracy. 3 degree approach to touchdown

Fig 4.48a

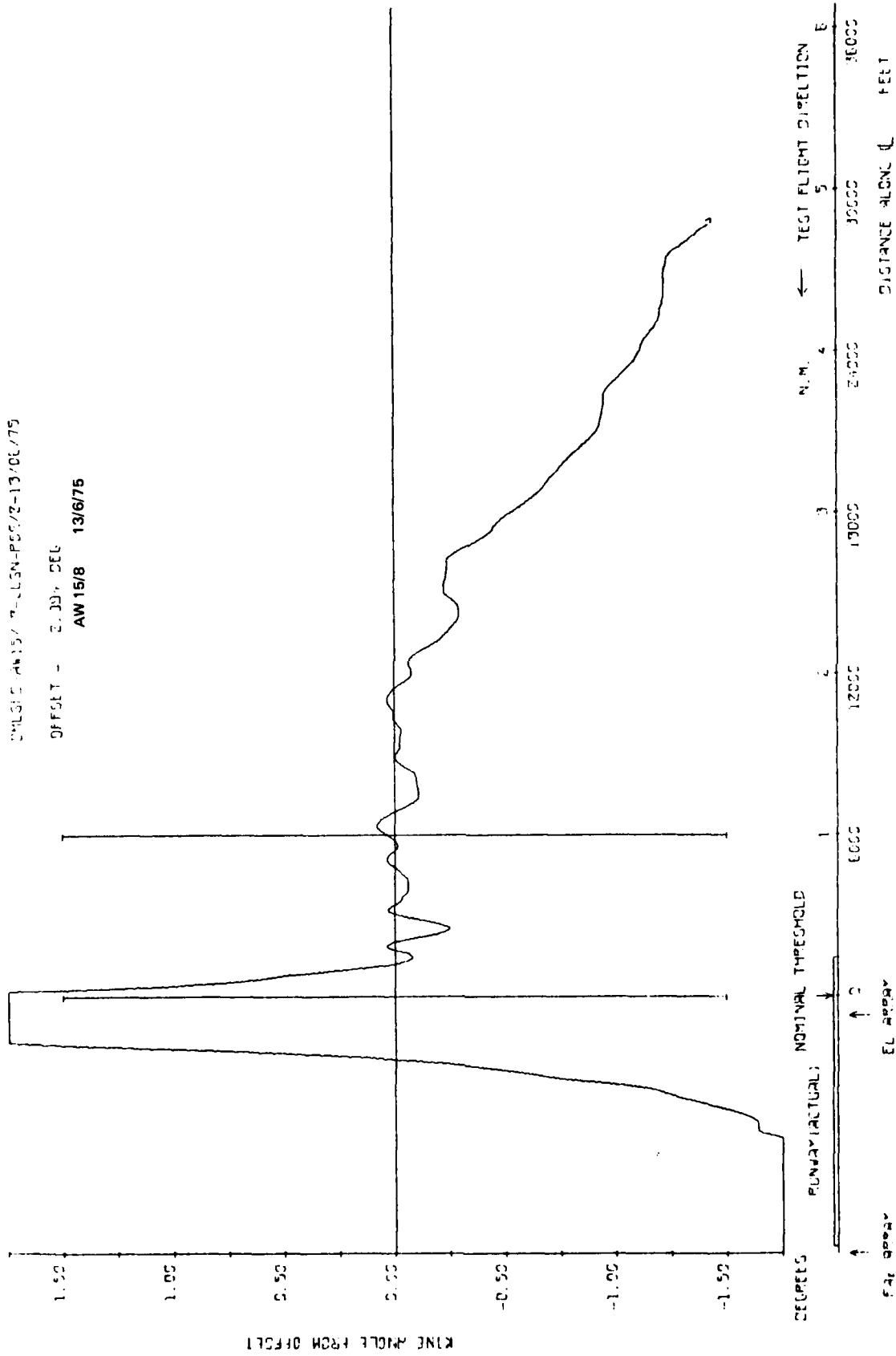


Fig.4.48a Elevation accuracy. 3 degree approach to 100 ft level overfly

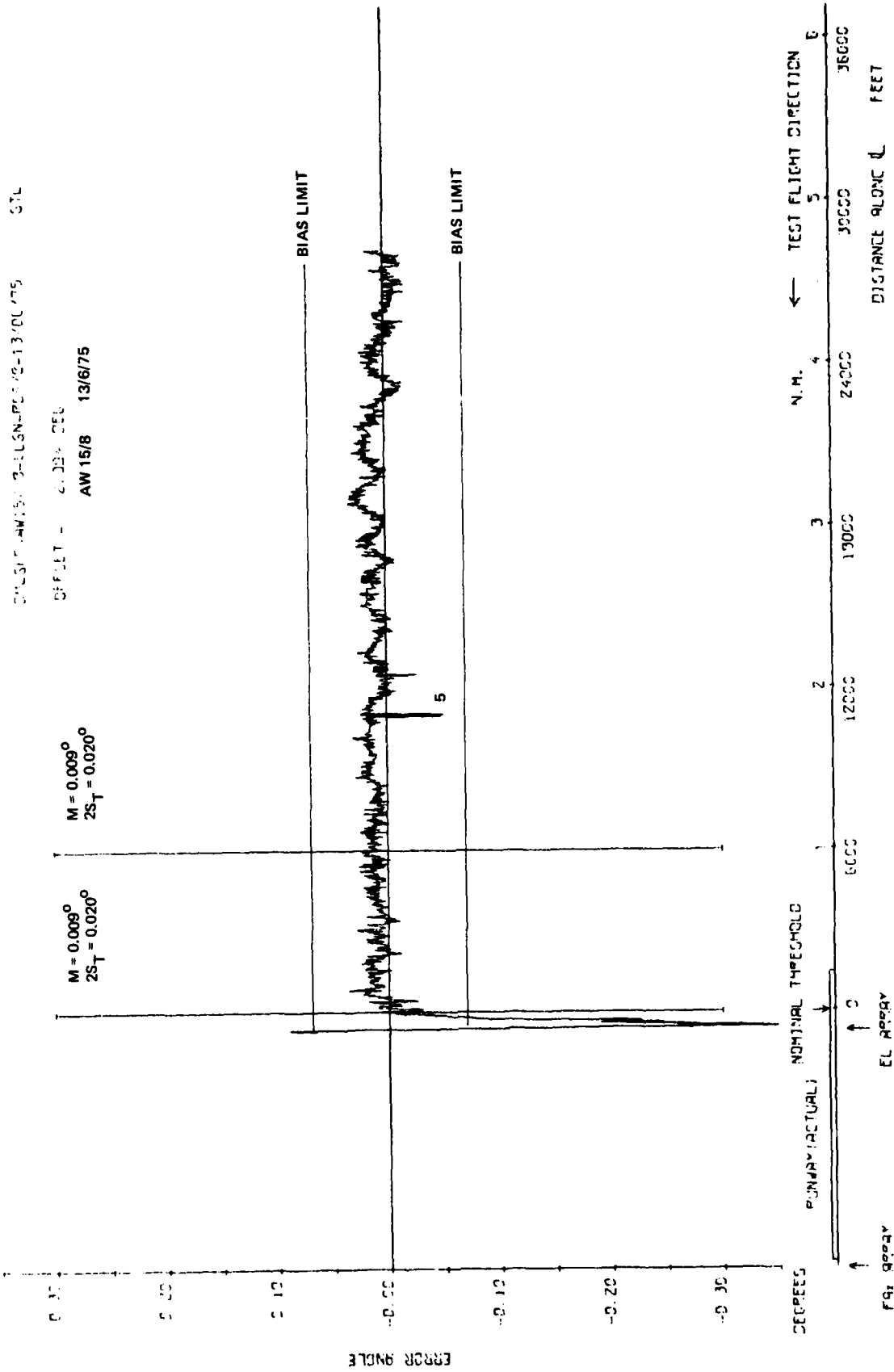


Fig 4.48c

Fig 4.48c Elevation accuracy. 3 degree approach to 100 ft level overfly

Fig 4.49a

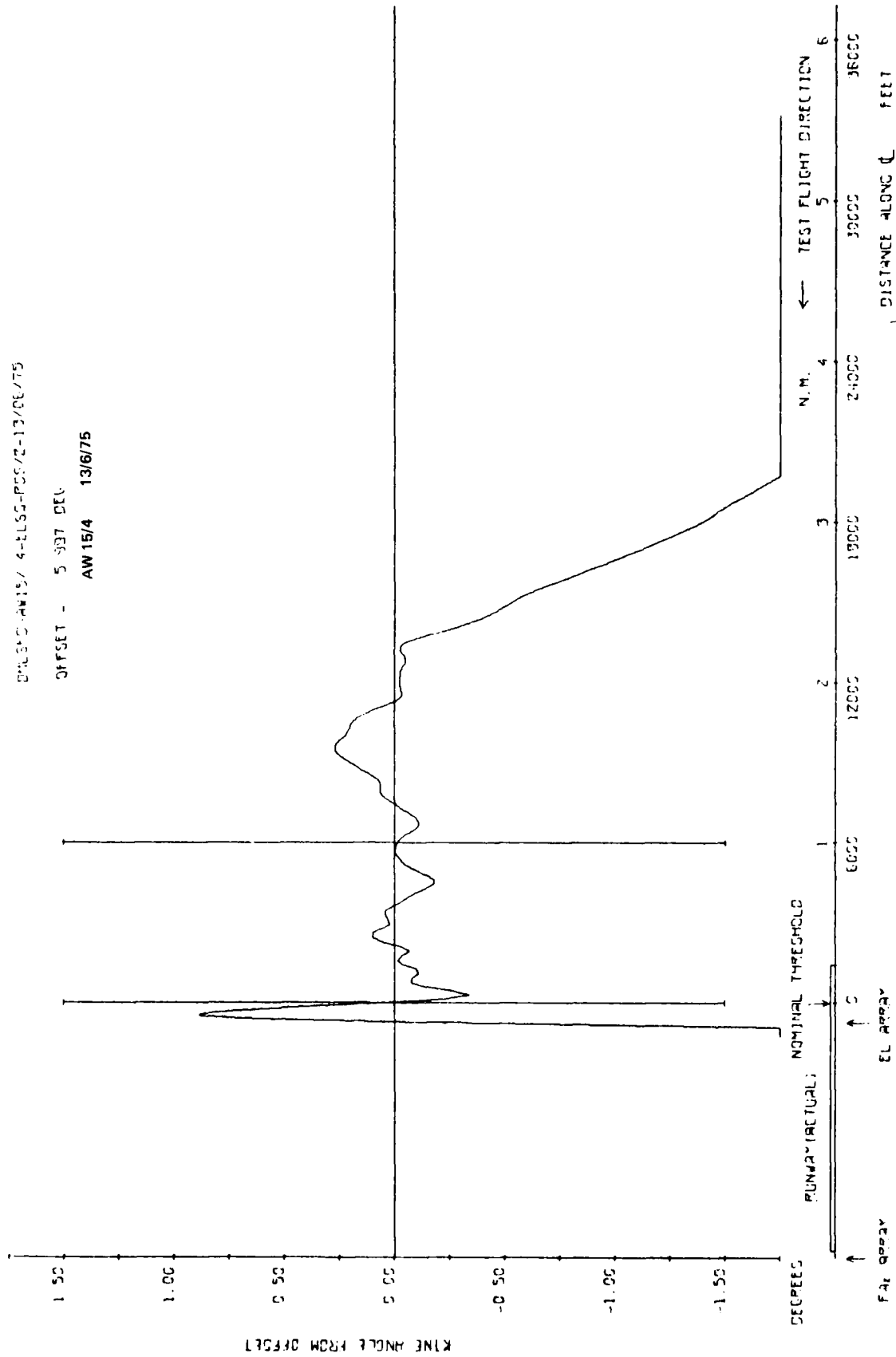


Fig 4.49a Elevation accuracy. 6 degree approach to 50 ft

TR 79052

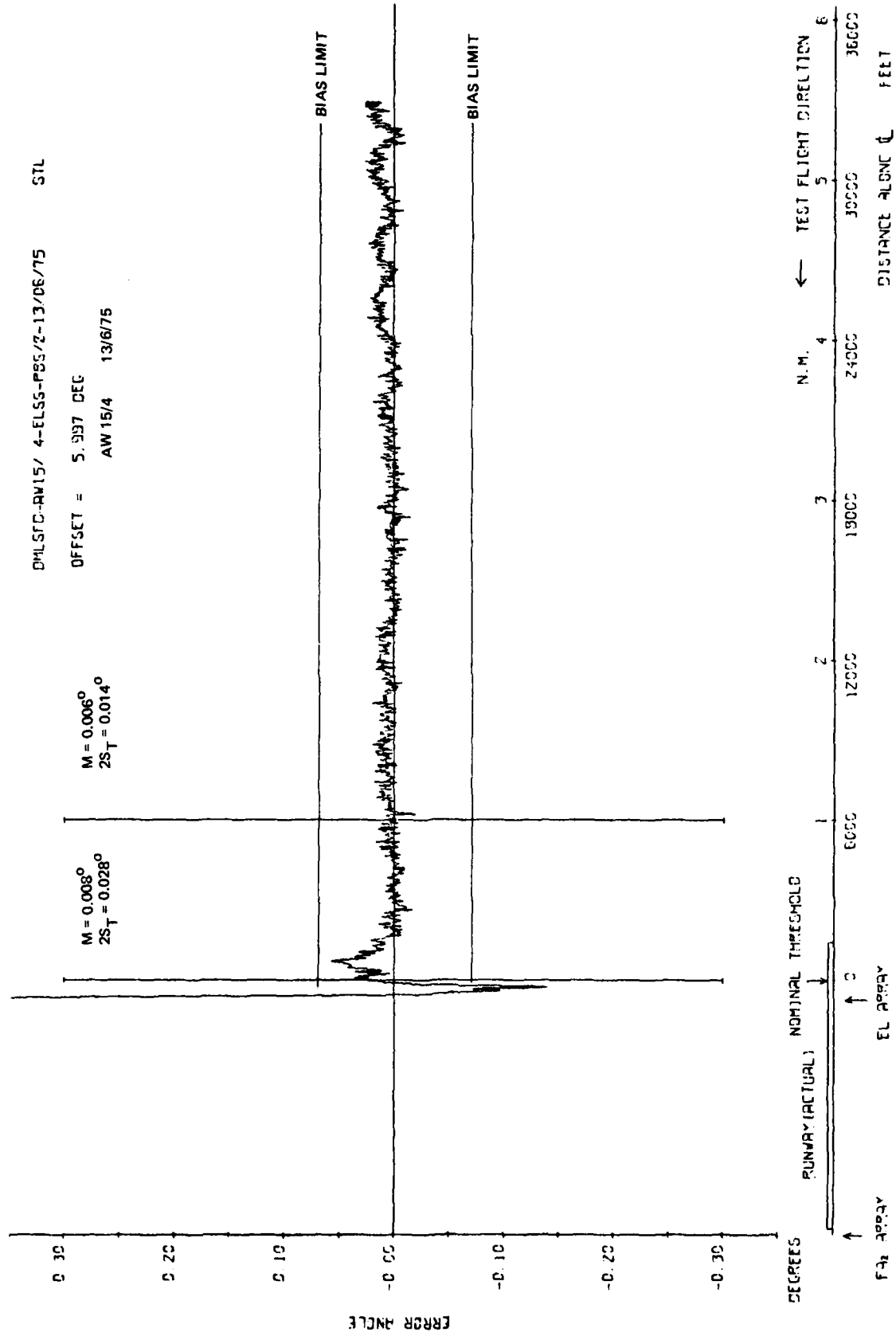


Fig 4.49c

Fig 4.49c Elevation accuracy. 6 degree approach to 50 ft

Fig 4.50

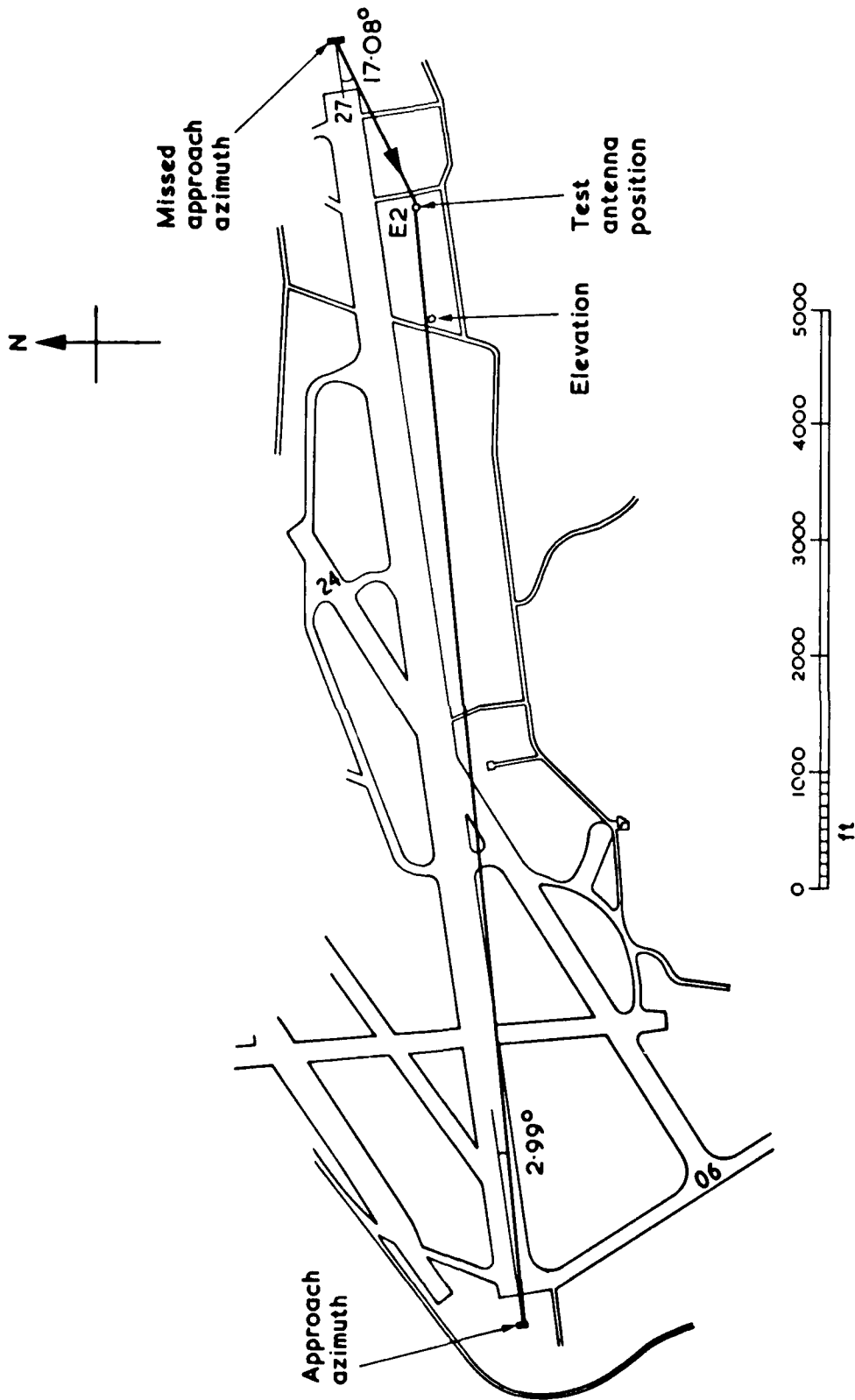


Fig 4.50 Stability test — general site plan Bedford

TR 79052

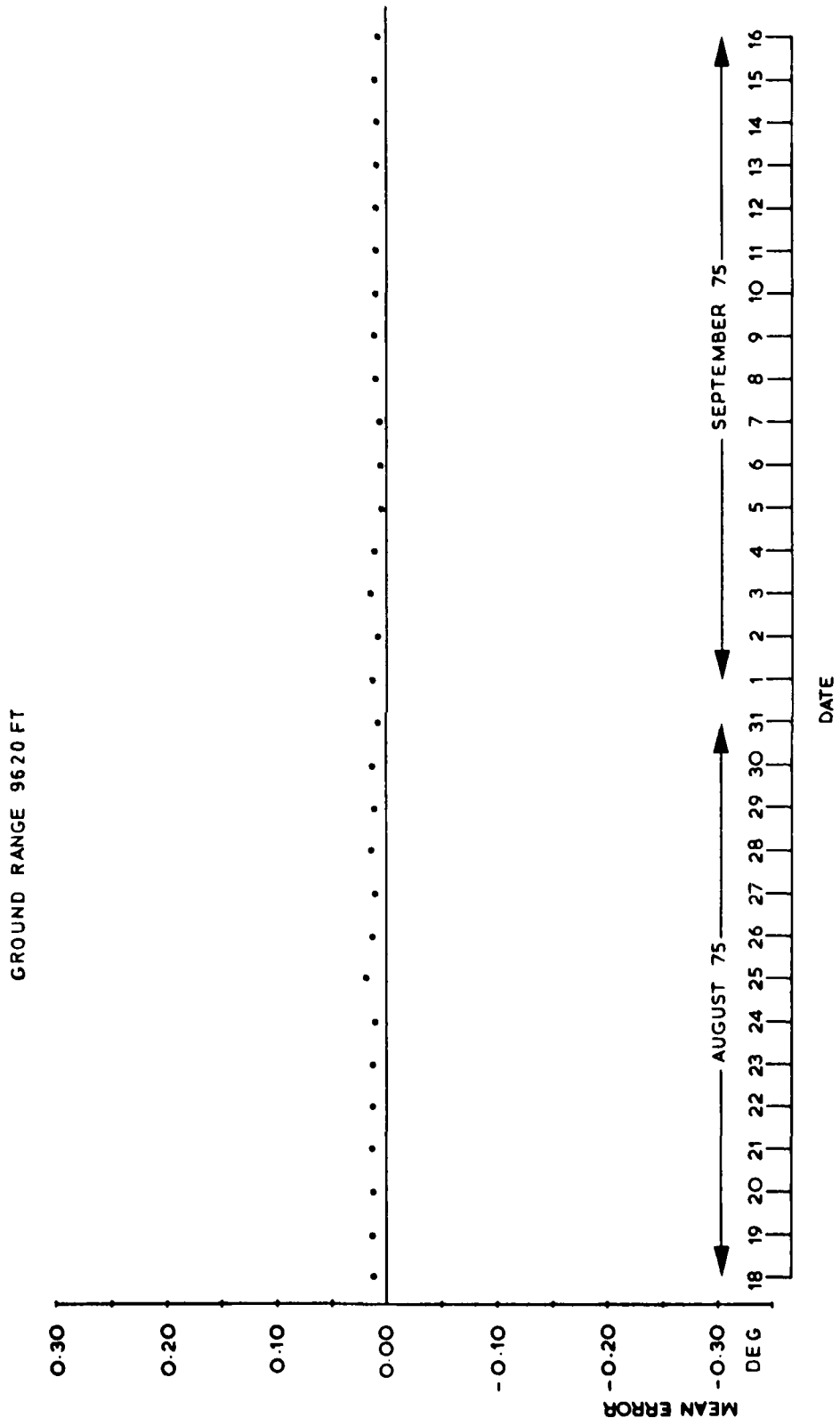


Fig 4.51 Stability test — approach mean error

Fig 4.52

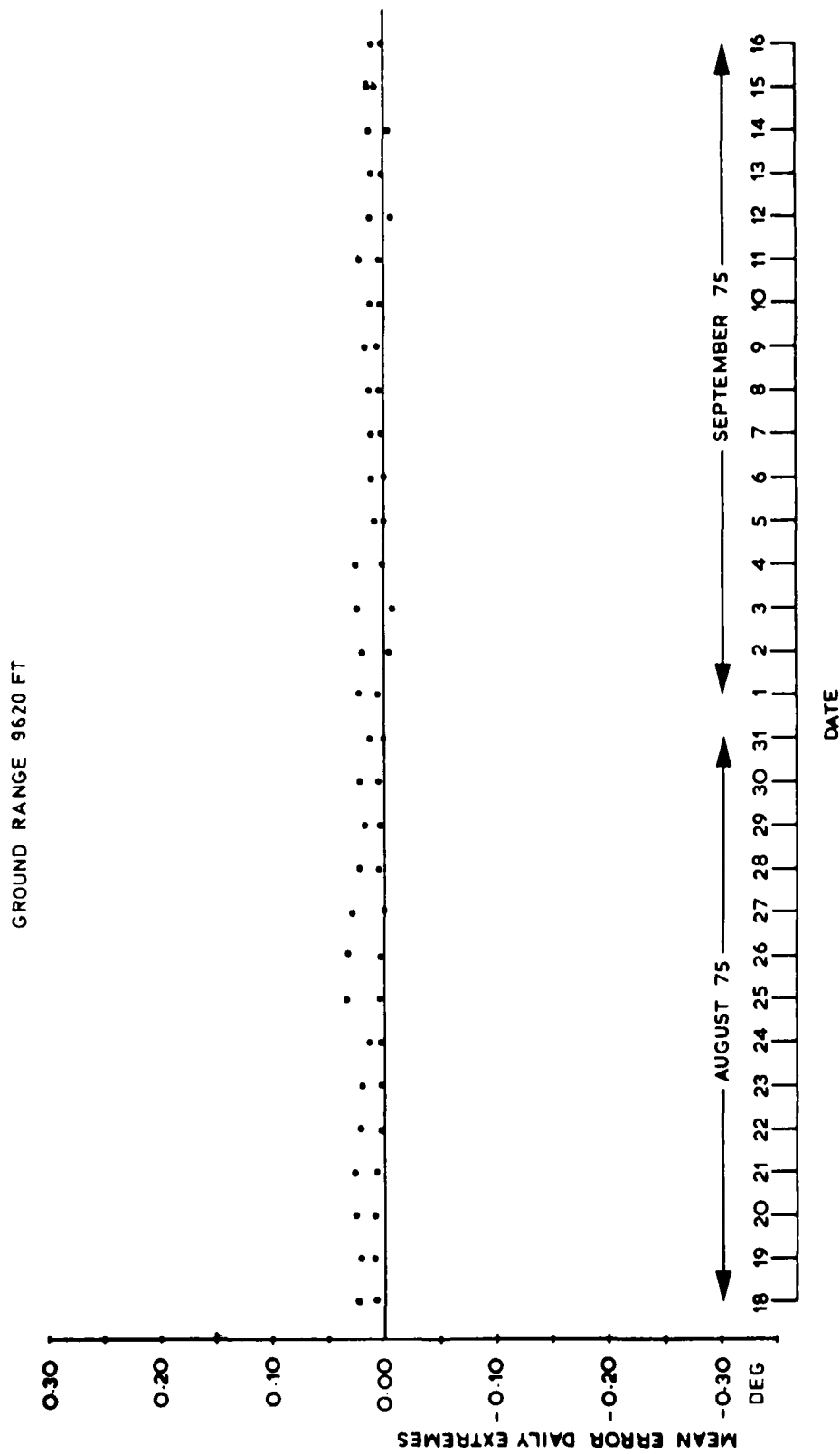


Fig 4.52 Stability test - approach azimuth daily mean error extremes

GROUND RANGE 9620 FT

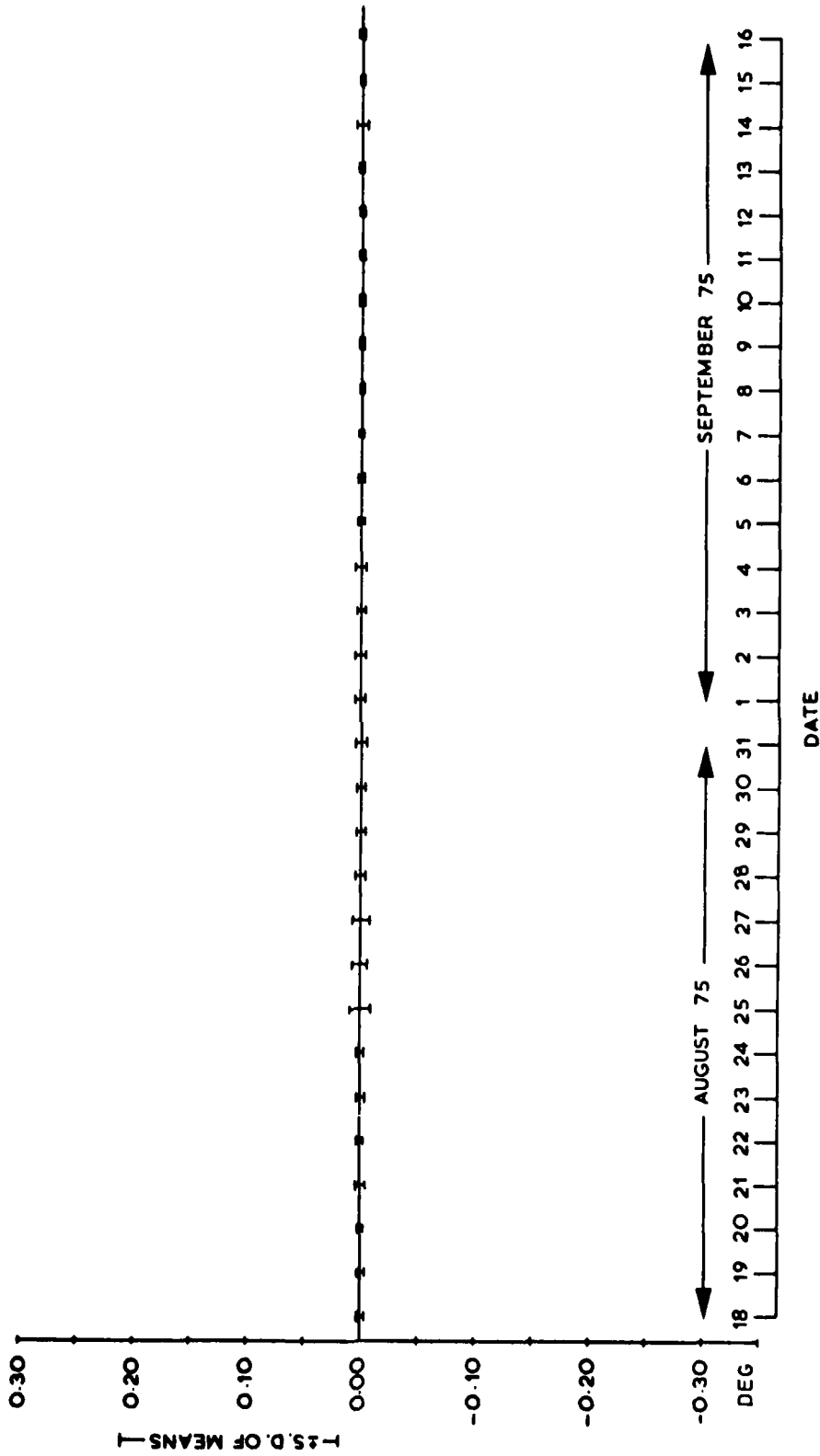


Fig 4.53 Stability test - approach azimuth daily standard deviation of means

Fig 4.54

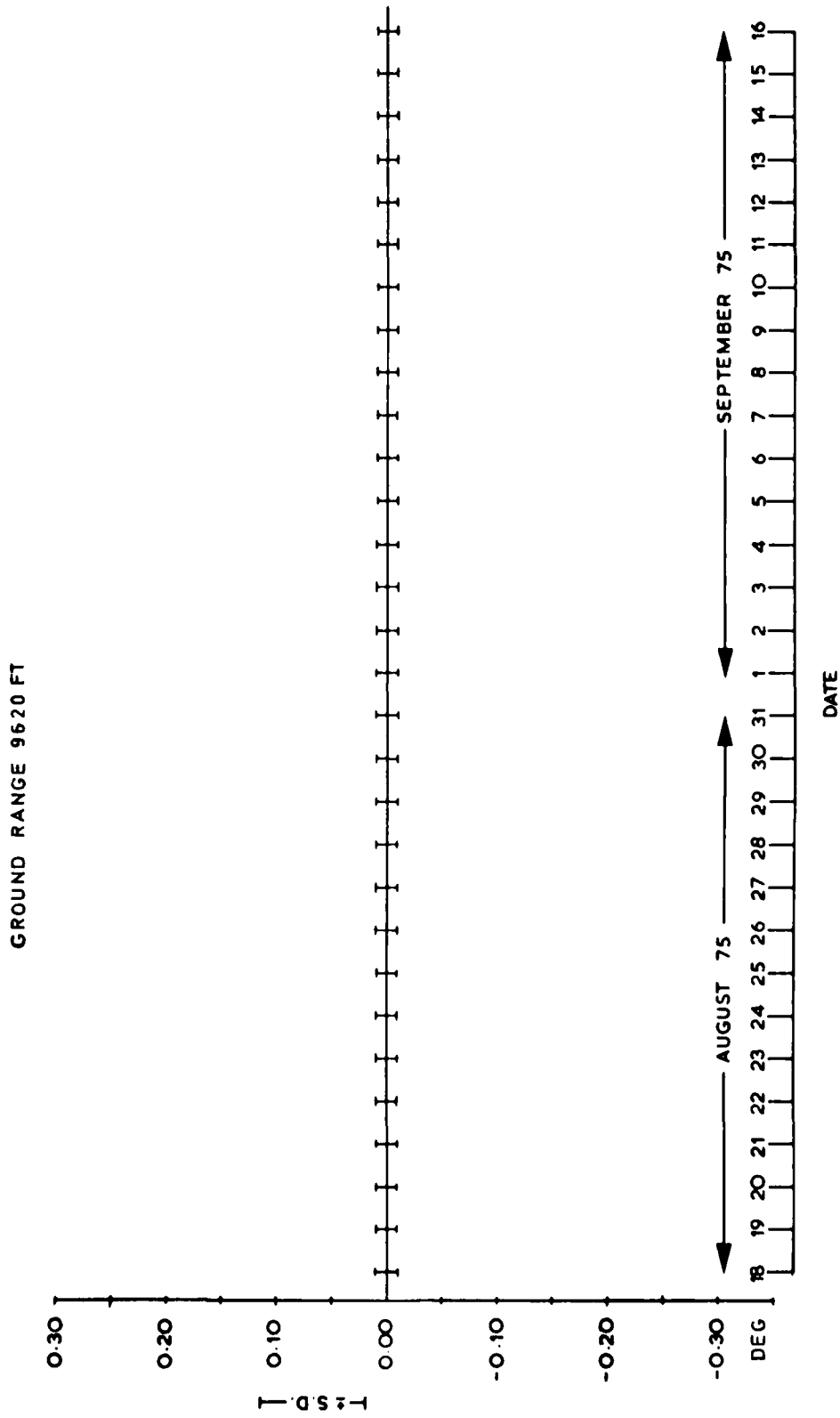


Fig 4.54 Stability test - approach azimuth noise error rms

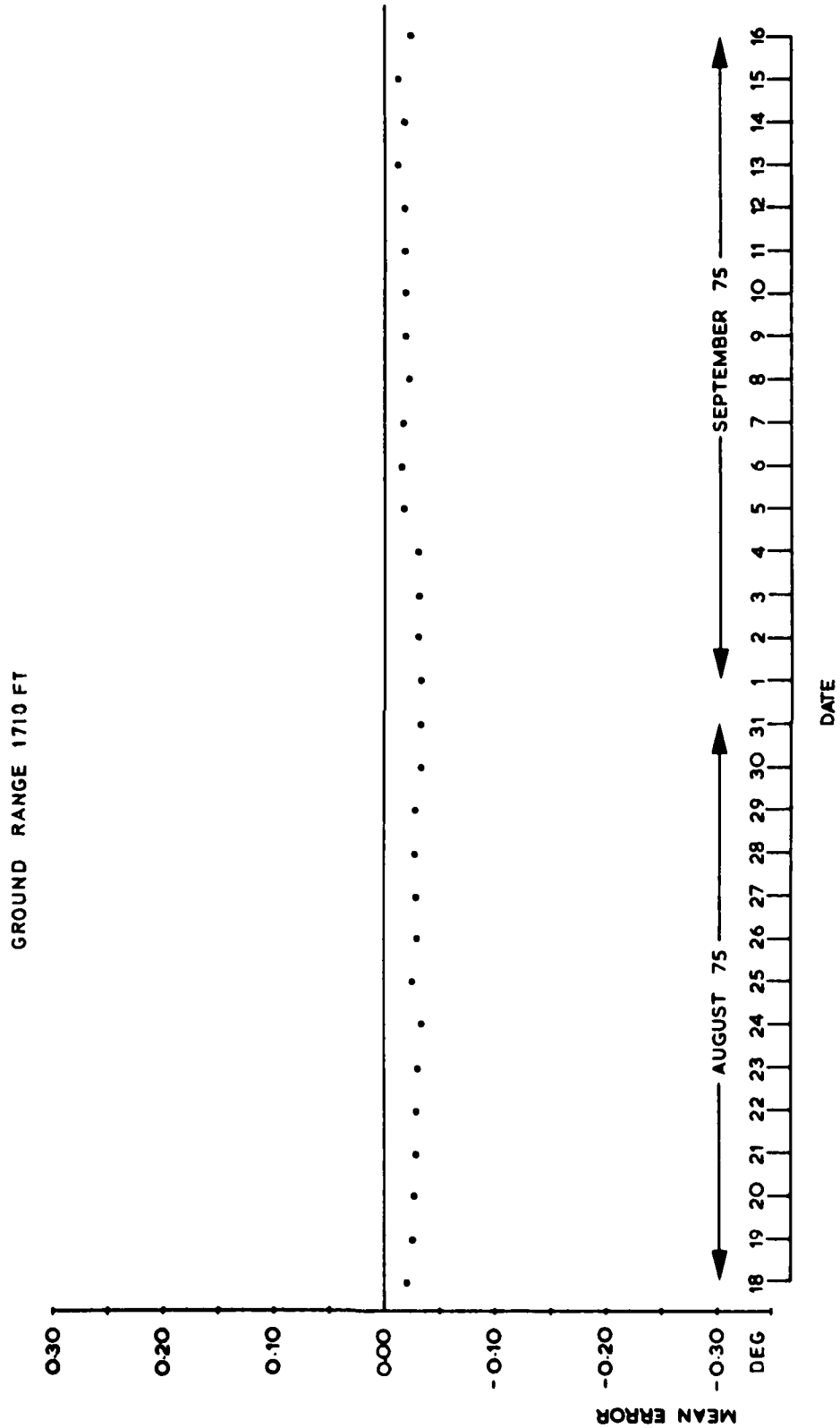


Fig 4.55

Fig 4.55 Stability test - missed approach azimuth mean error

Fig 4.56

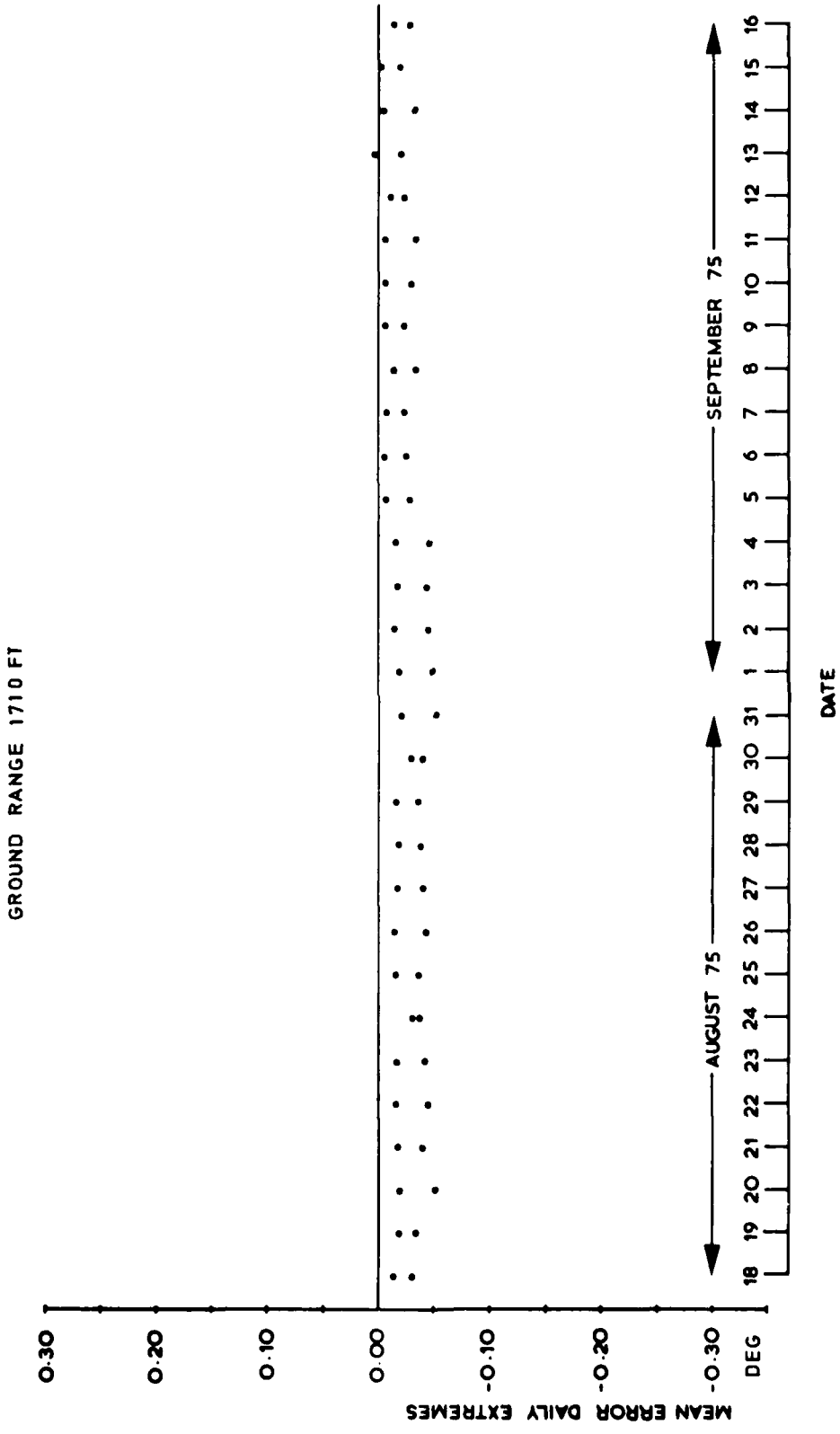


Fig 4.56 Stability test -- missed approach azimuth daily mean error extremes

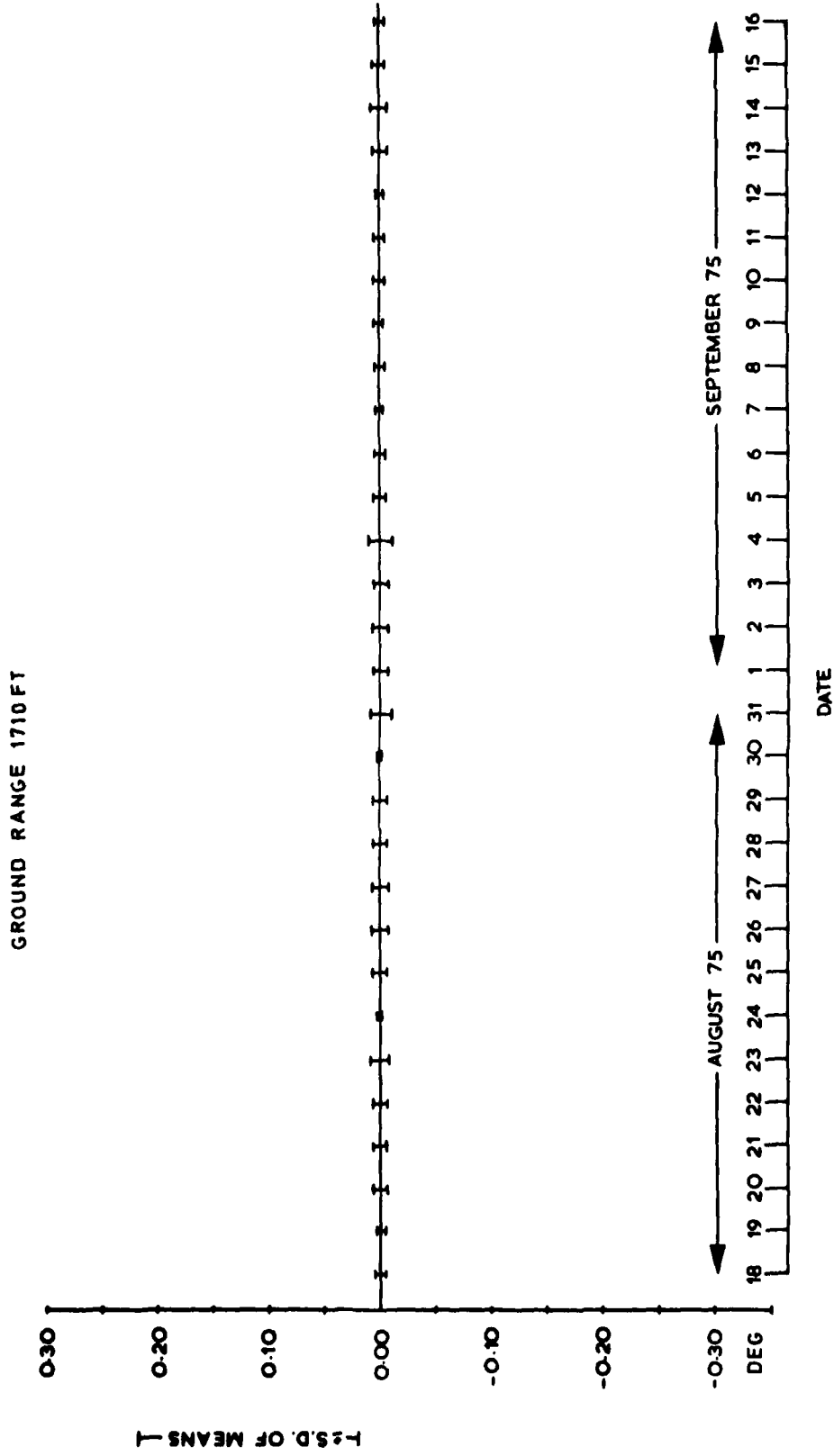


Fig 4.57

Fig 4.57 Stability test — missed approach azimuth daily standard deviation of means

Fig 4.58

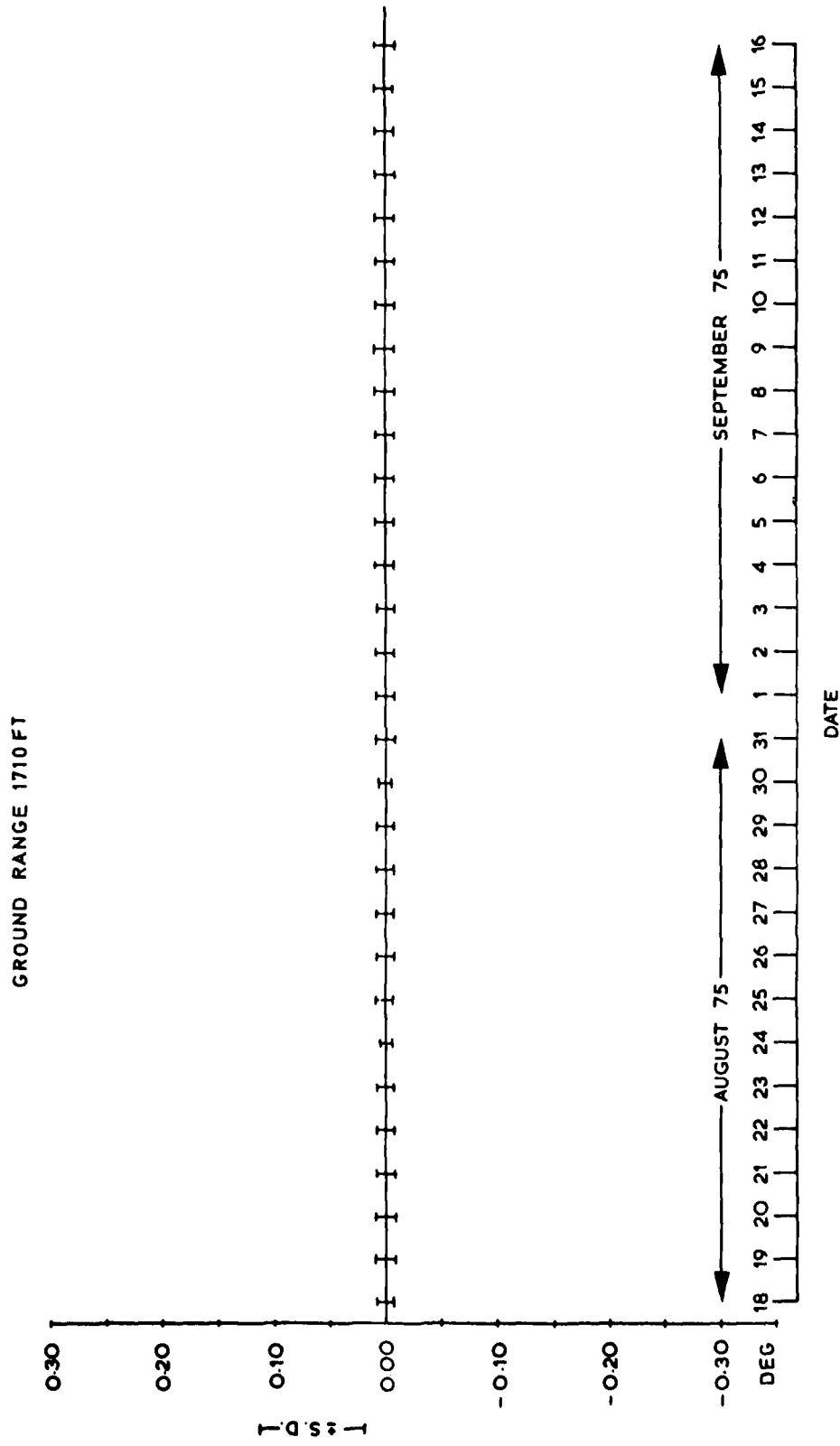


Fig 4.58 Stability test -- missed approach azimuth noise error rms

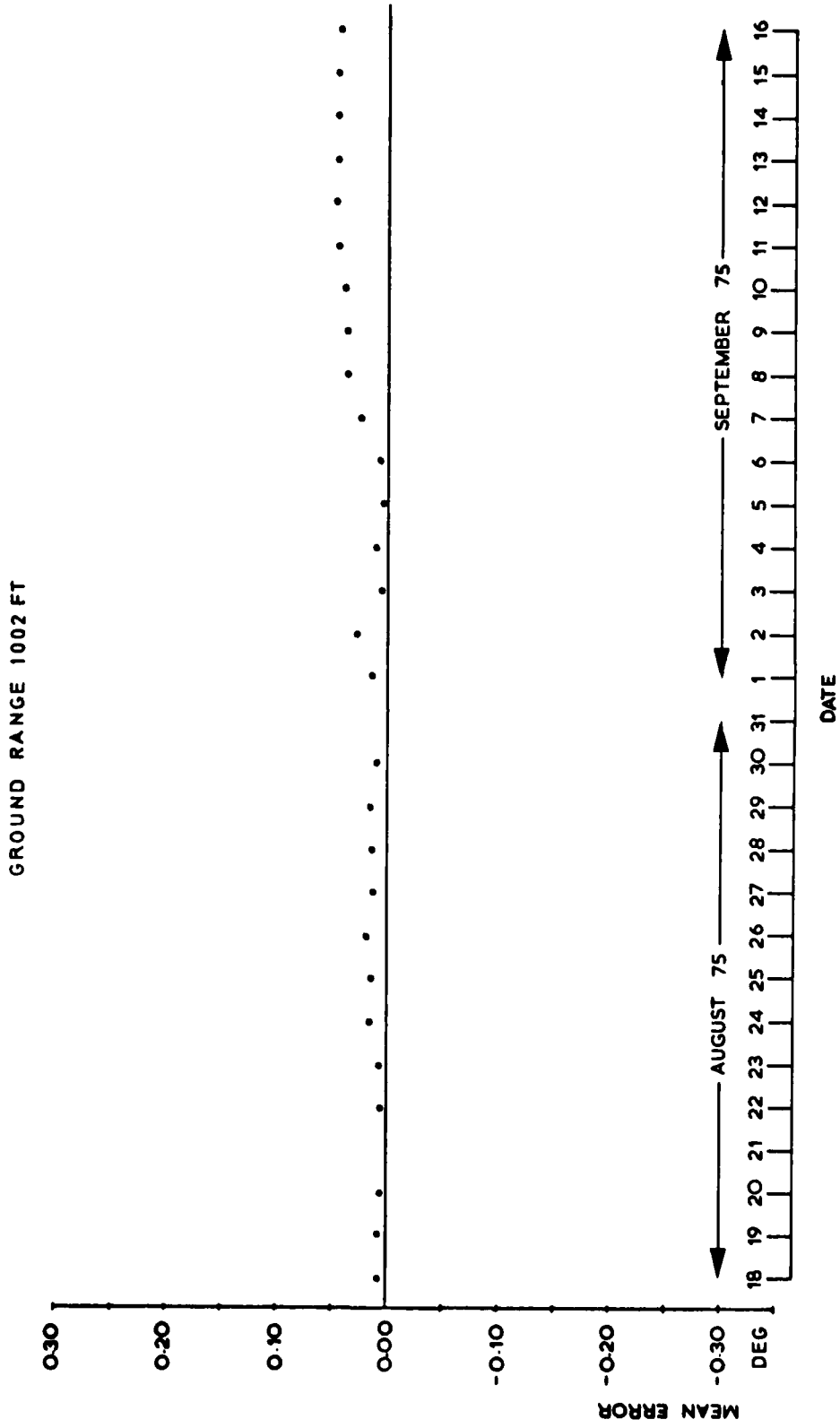


Fig 4.59

Fig 4.59 Stability test - elevation mean error

Fig 4.60

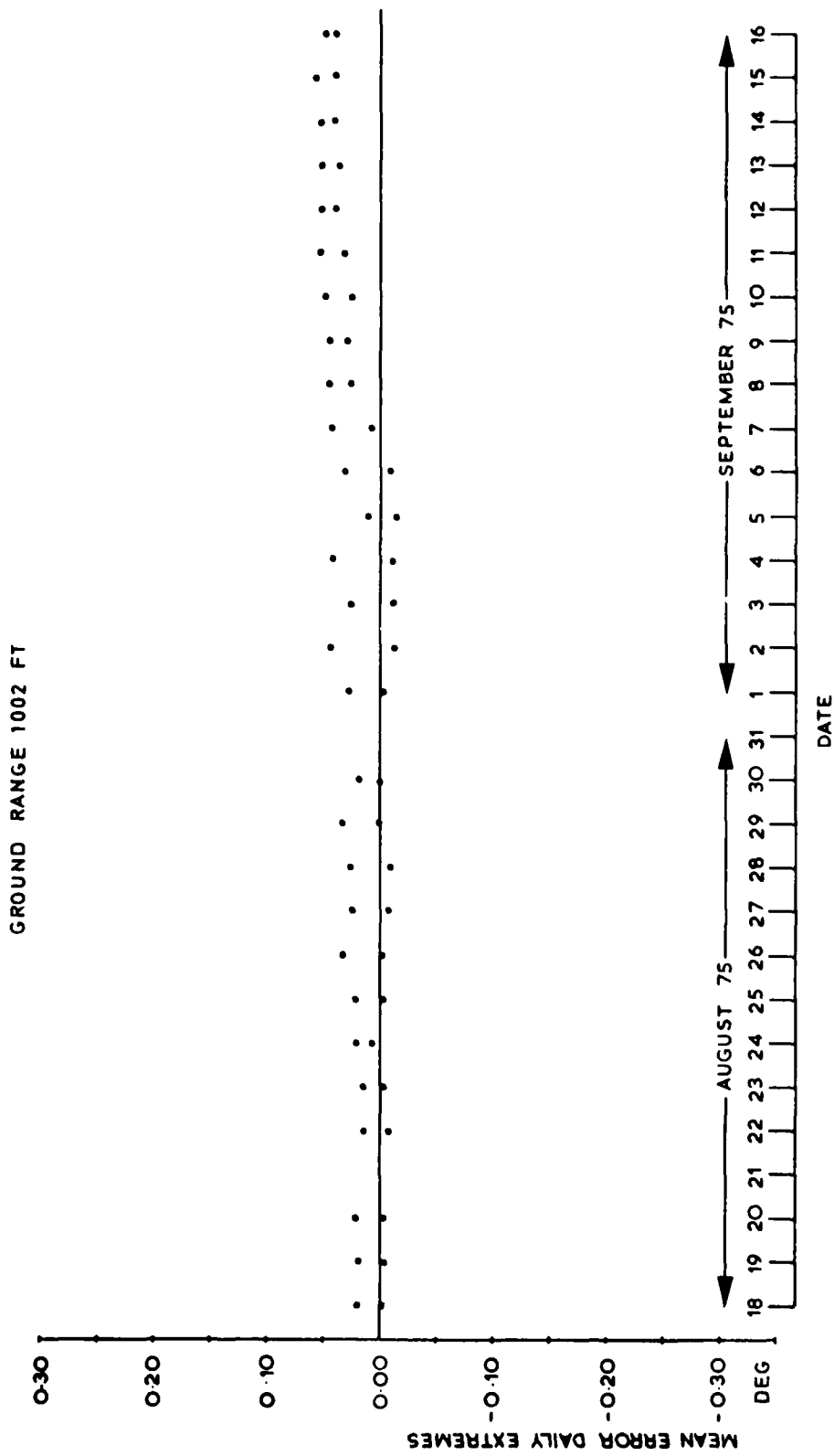


Fig 4.60 Stability test -- elevation daily mean error extremes

GROUND RANGE 1002 FT

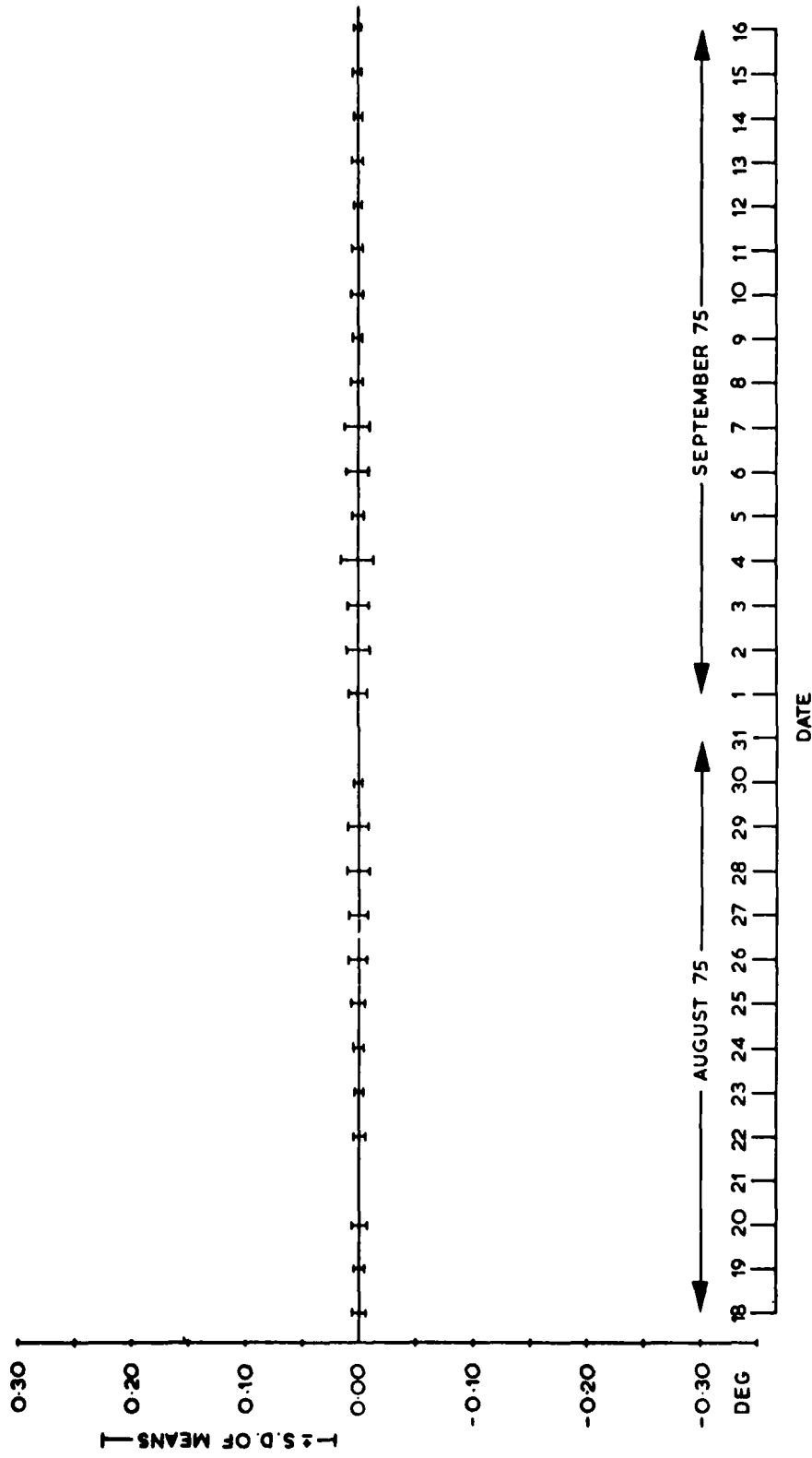


Fig 4.61

Fig 4.61 Stability test - elevation daily standard deviation of means

Fig 4.62

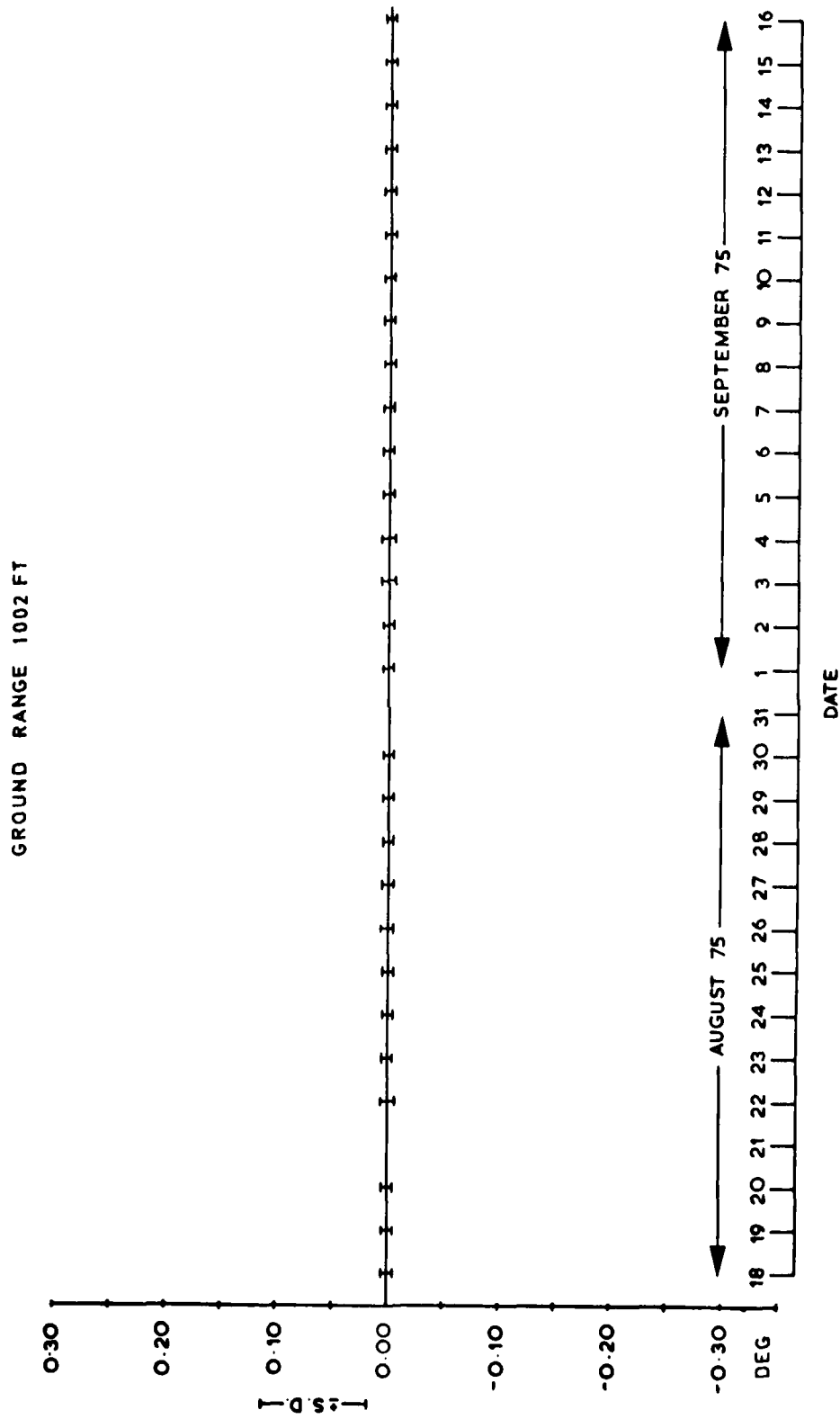


Fig 4.62 Stability test — elevation noise error rms

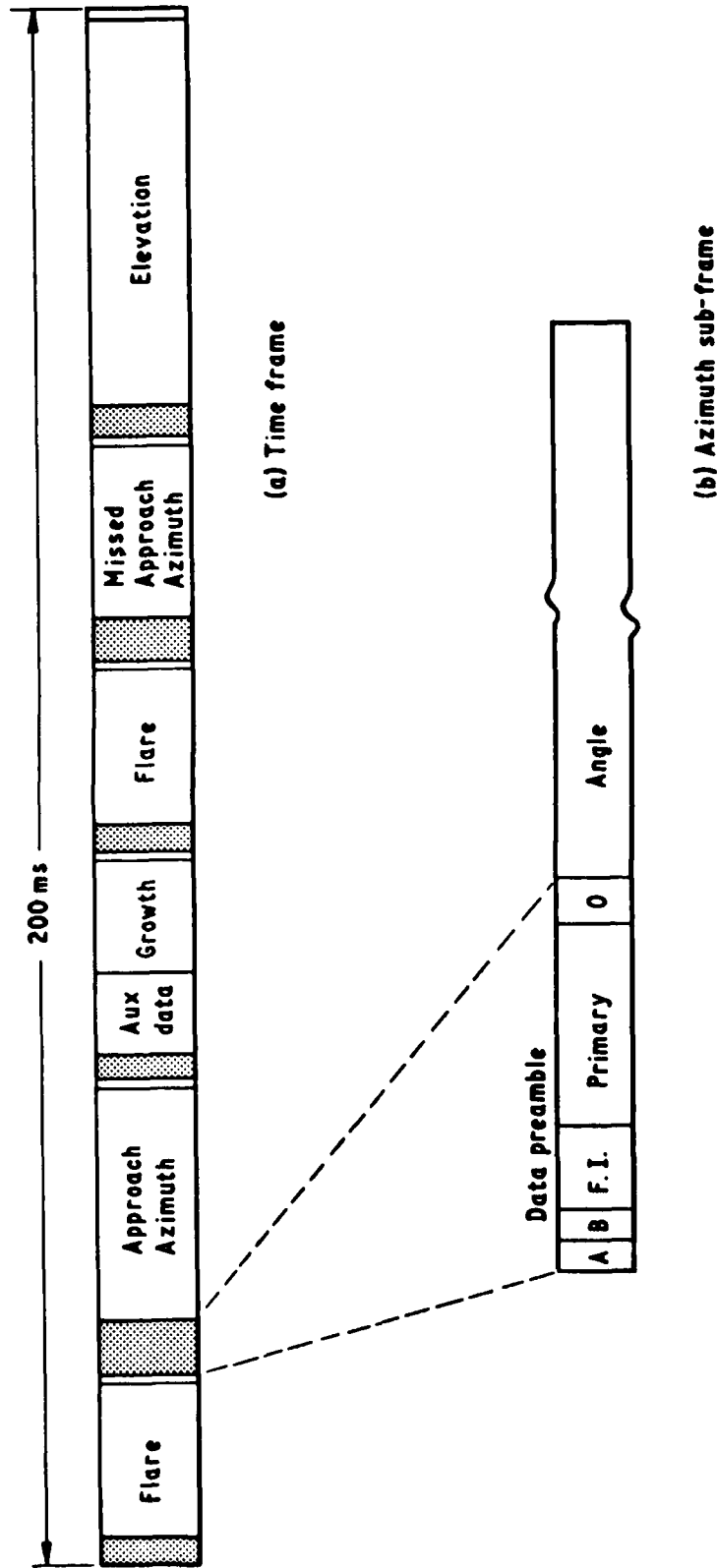


Fig 5.1 TDM signal format

Fig 5.2

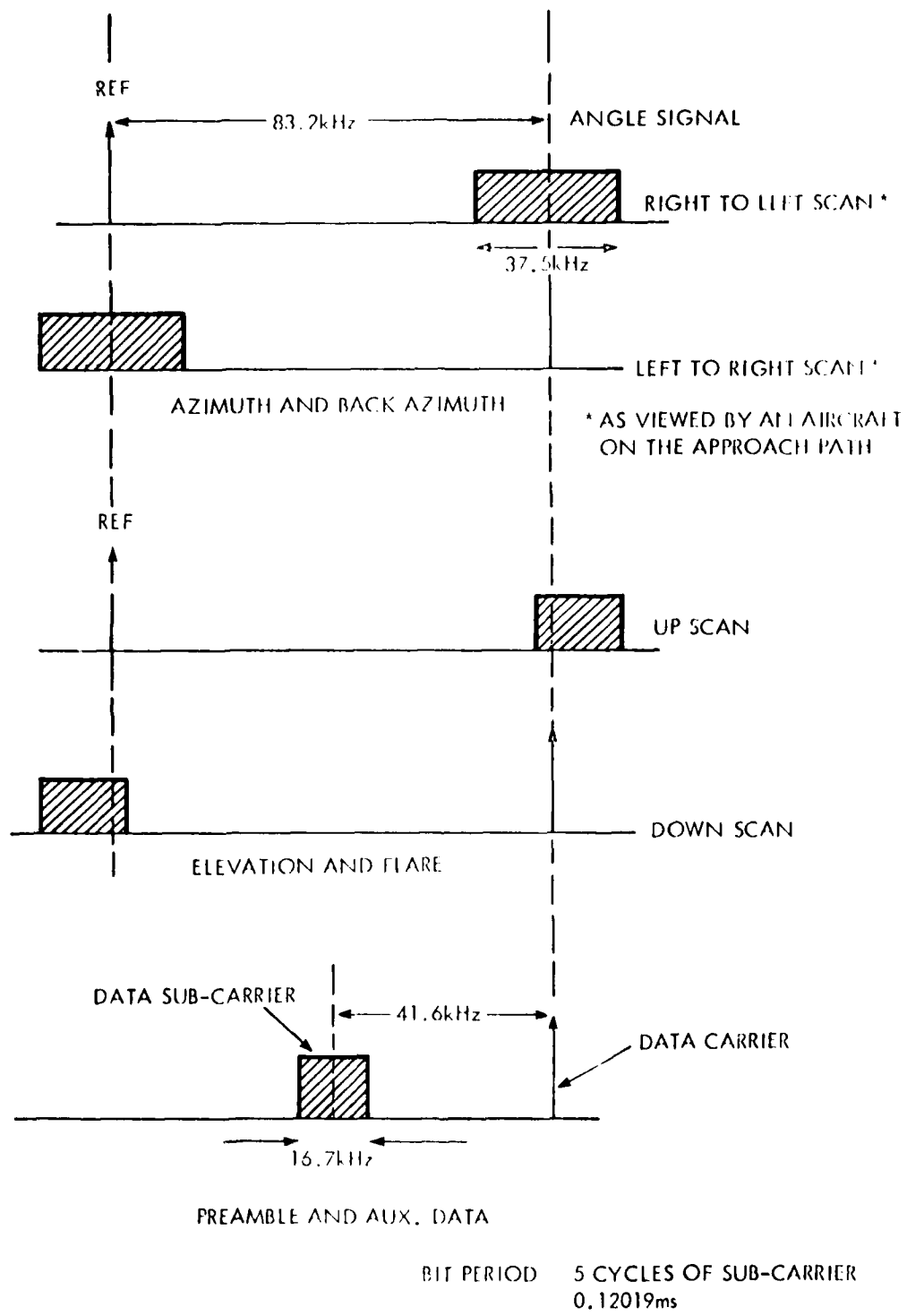


Fig 5.2 Relative frequencies of the angle and data components of the system

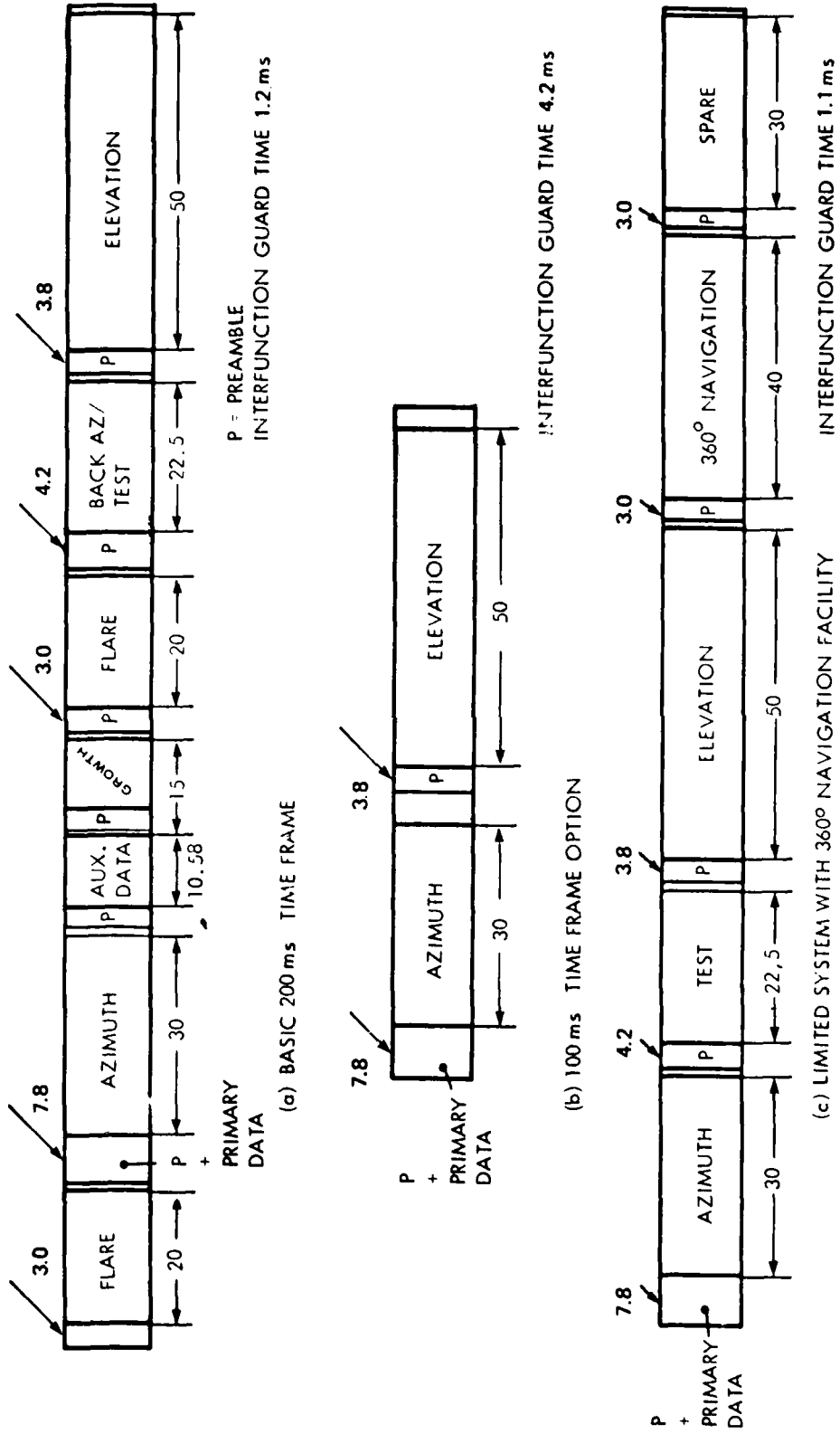
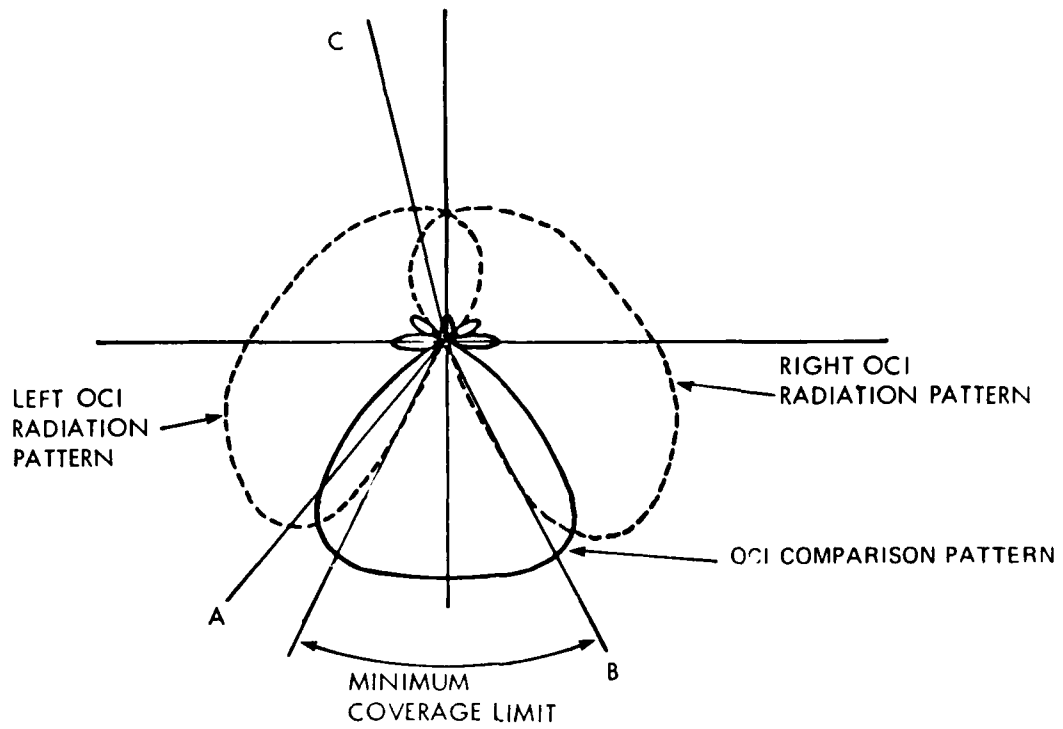


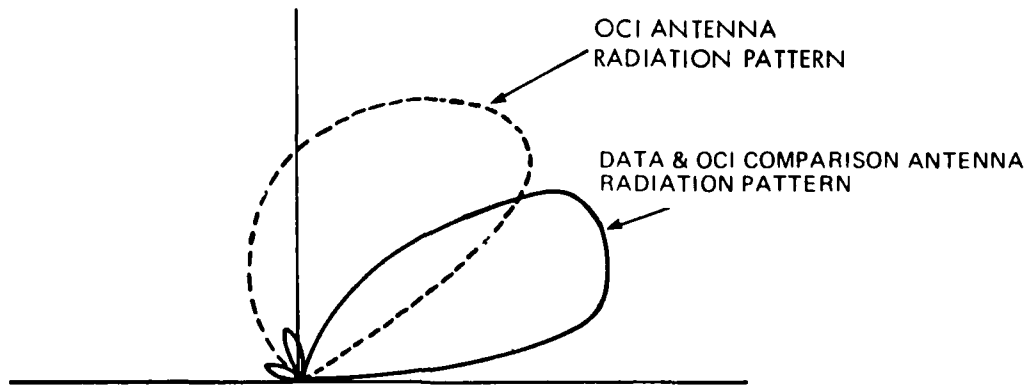
Fig 5.3

Fig 5.3 Time frame arrangement (major alternatives)

Fig 5.4

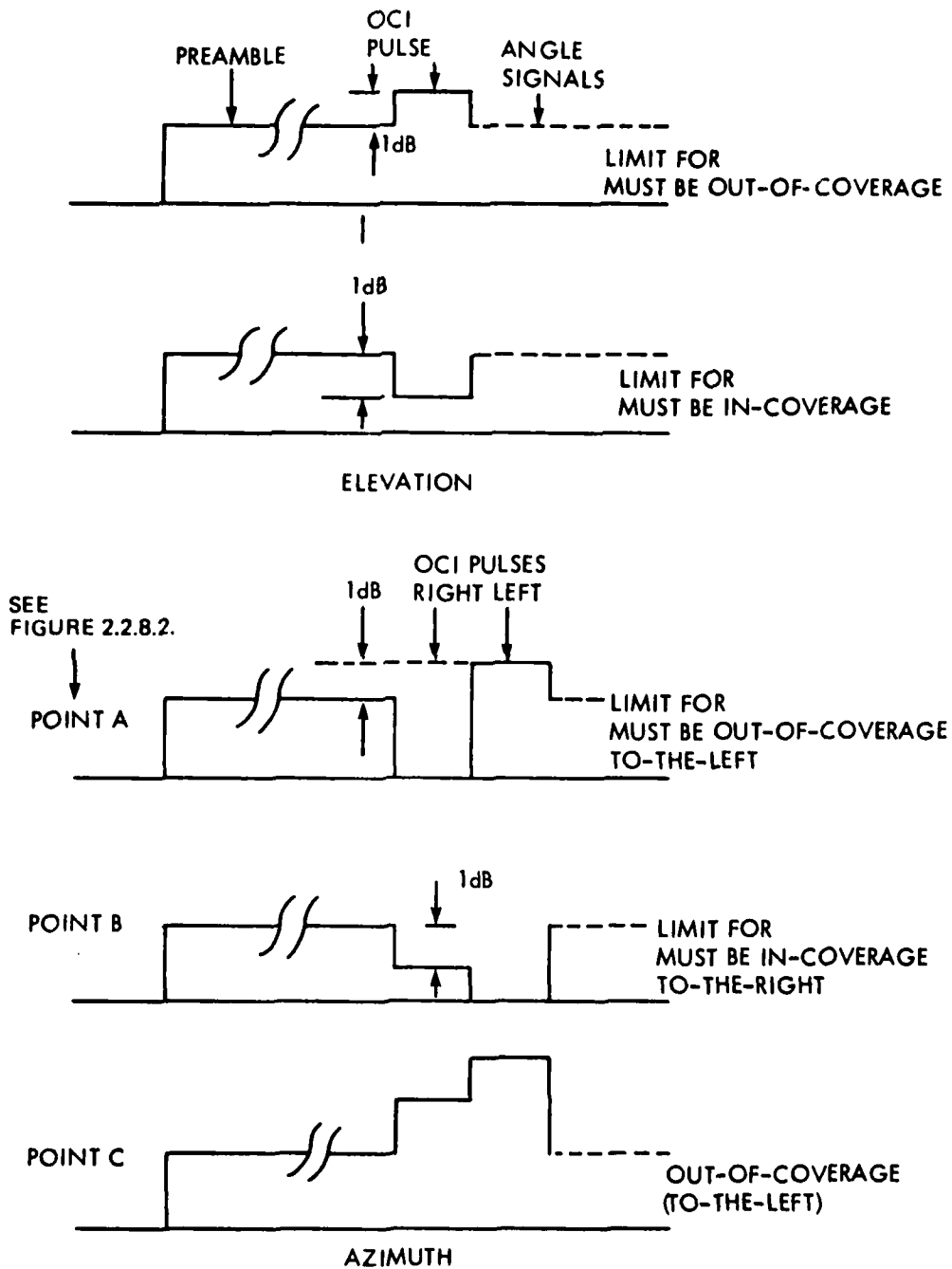


(a) AZIMUTH SYSTEM - AZIMUTH COVERAGE PATTERN



(b) ELEVATION SYSTEM - ELEVATION COVERAGE PATTERN

Fig 5.4 OCI antenna patterns



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Fig 5.5 OCI limits (as seen by the aircraft)

Fig 5.6

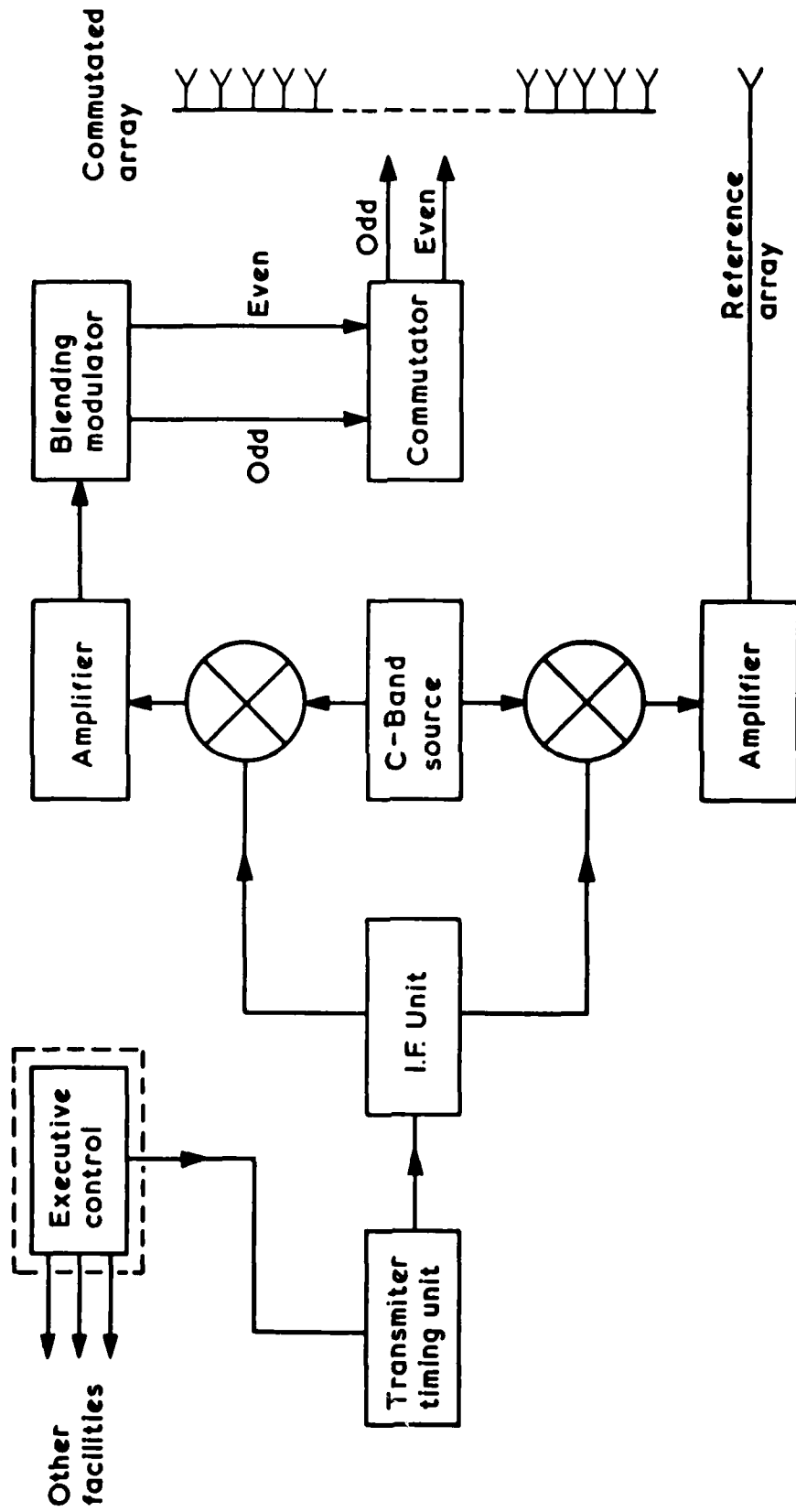


Fig 5.6 Typical ground facility

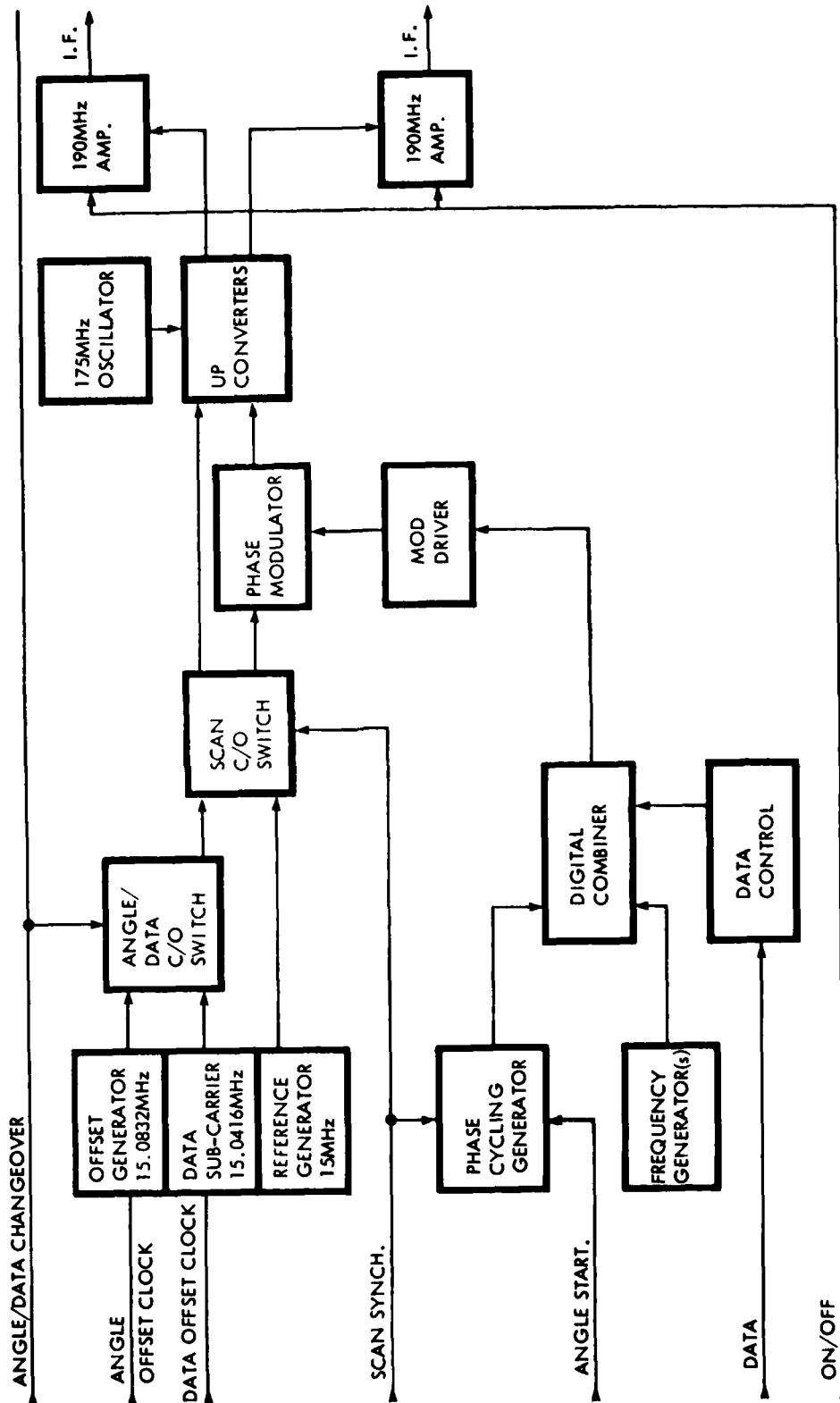


Fig 5.7

Fig 5.7 Transmitter IF unit

Fig 5.8

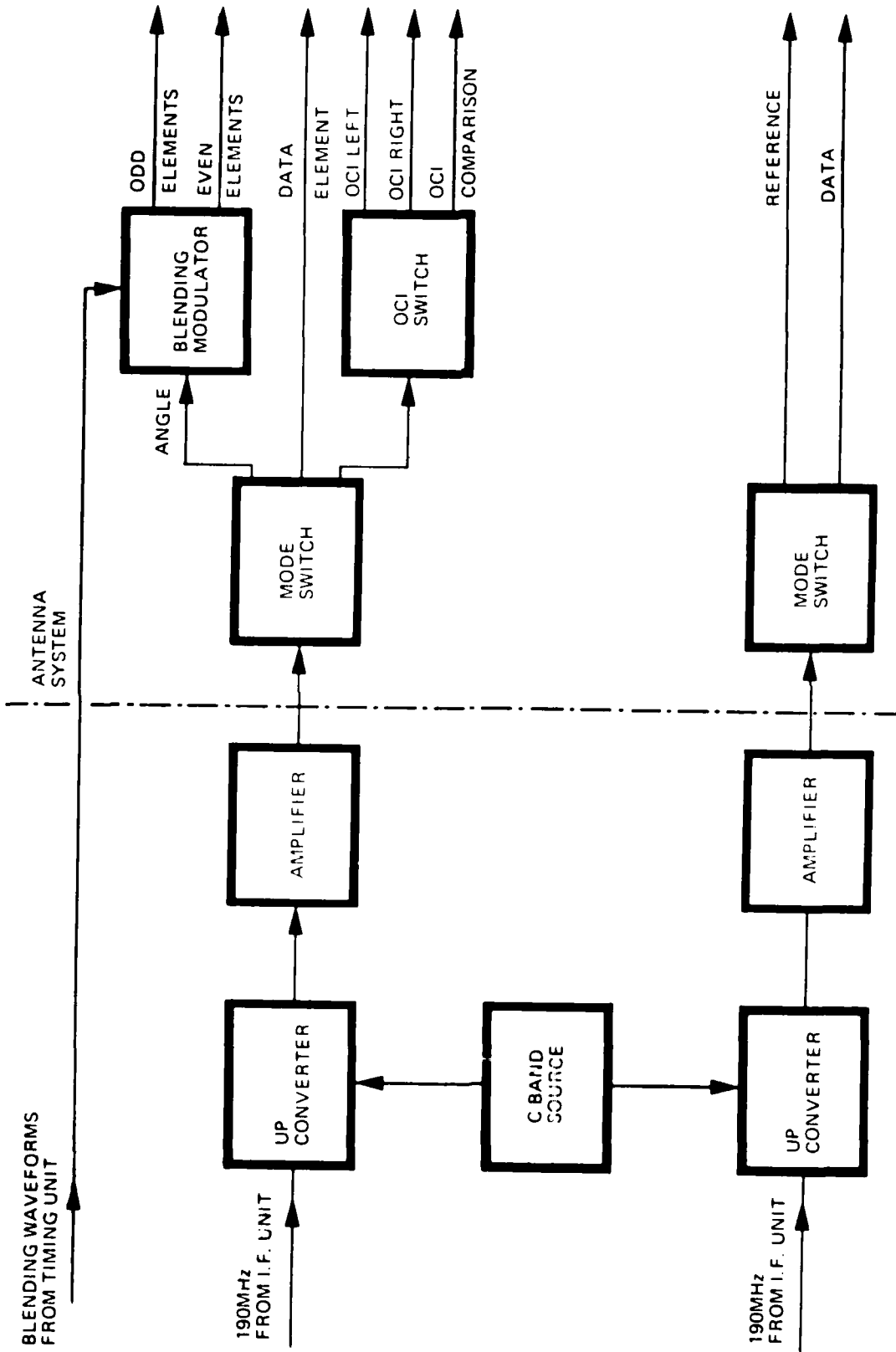


Fig 5.8 Transmitter and antenna RF

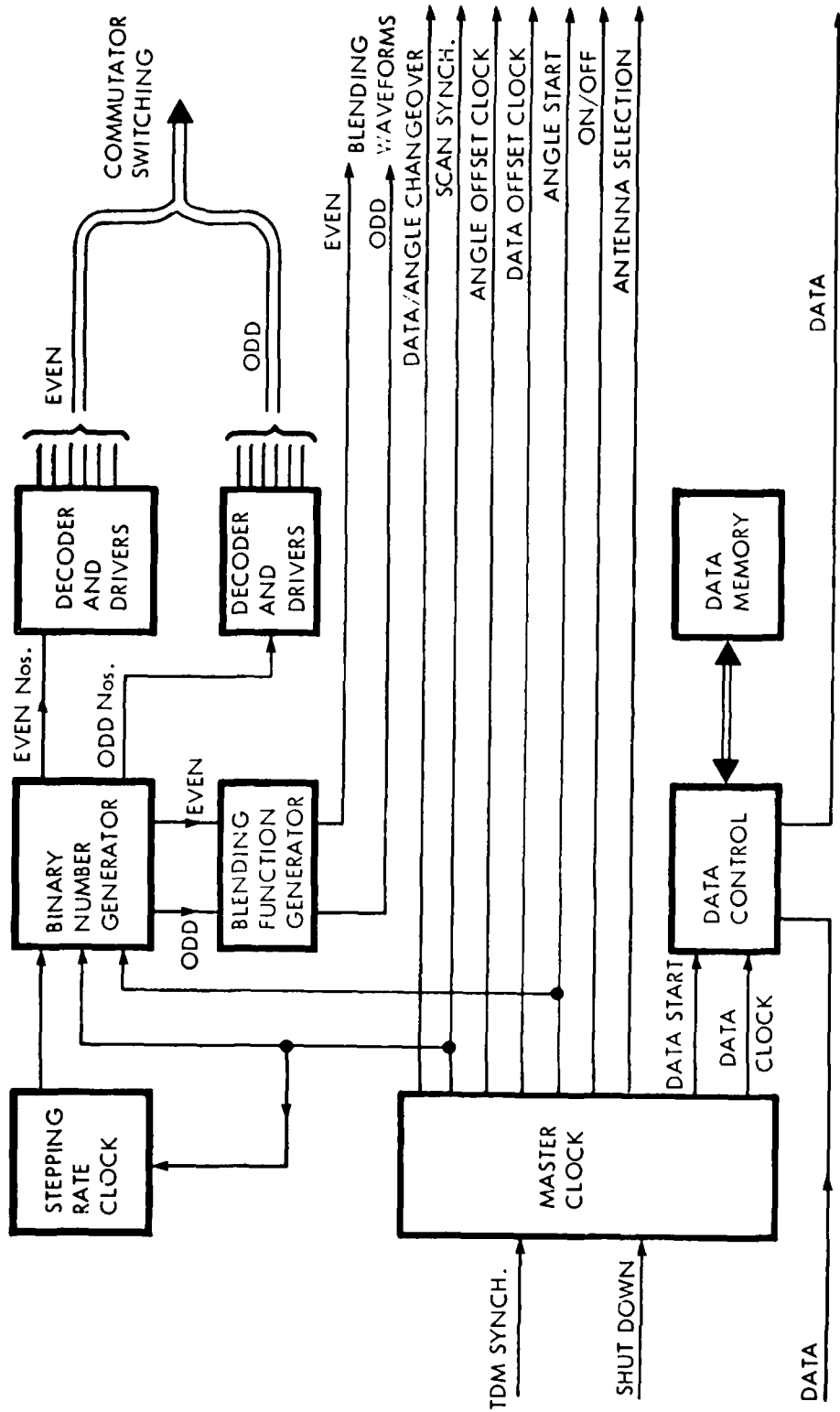


Fig 5.9

Fig 5.9 Transmitter timing unit

Fig 5.10

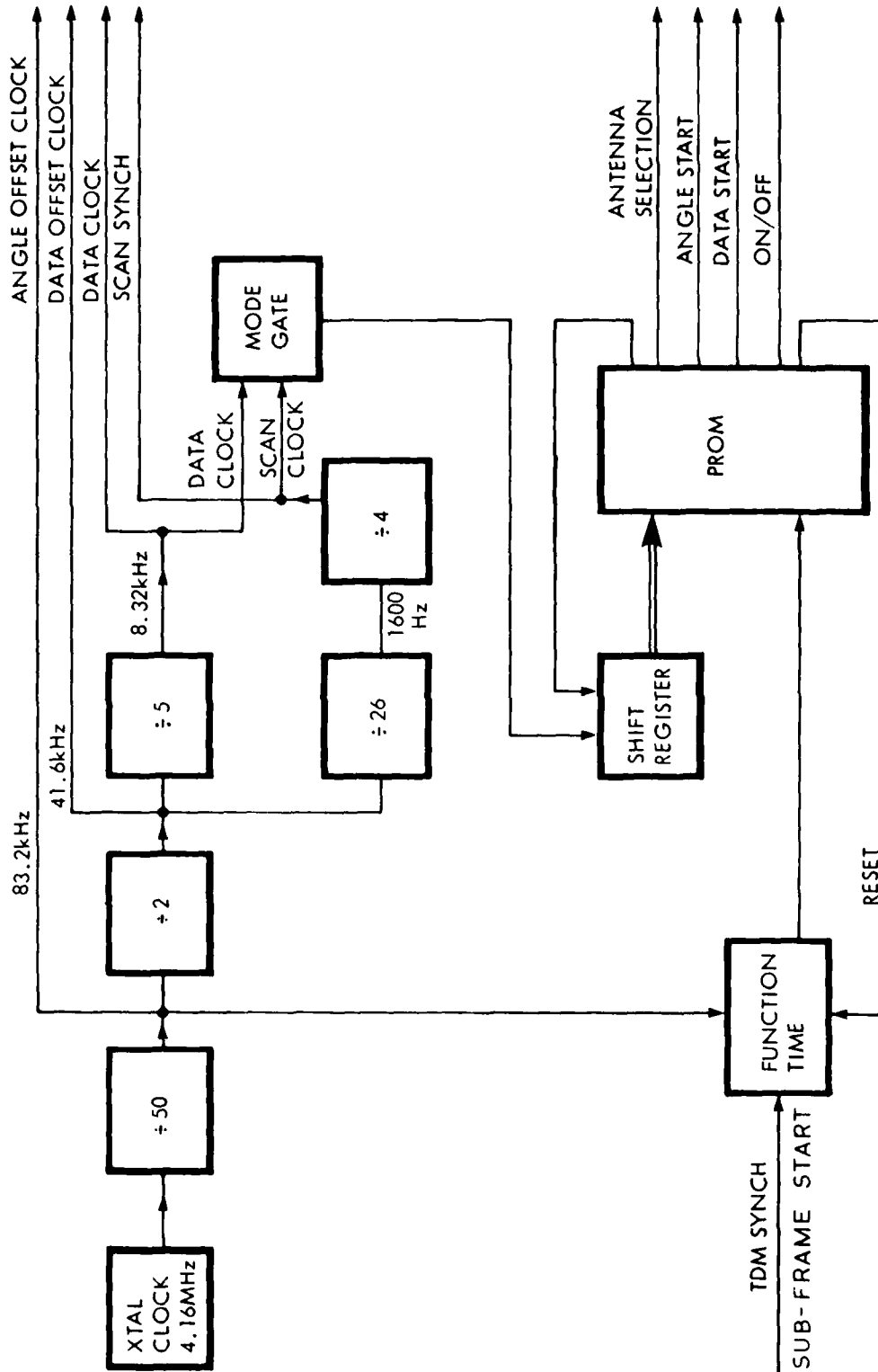


Fig 5.10 Master clock

Fig 5.11

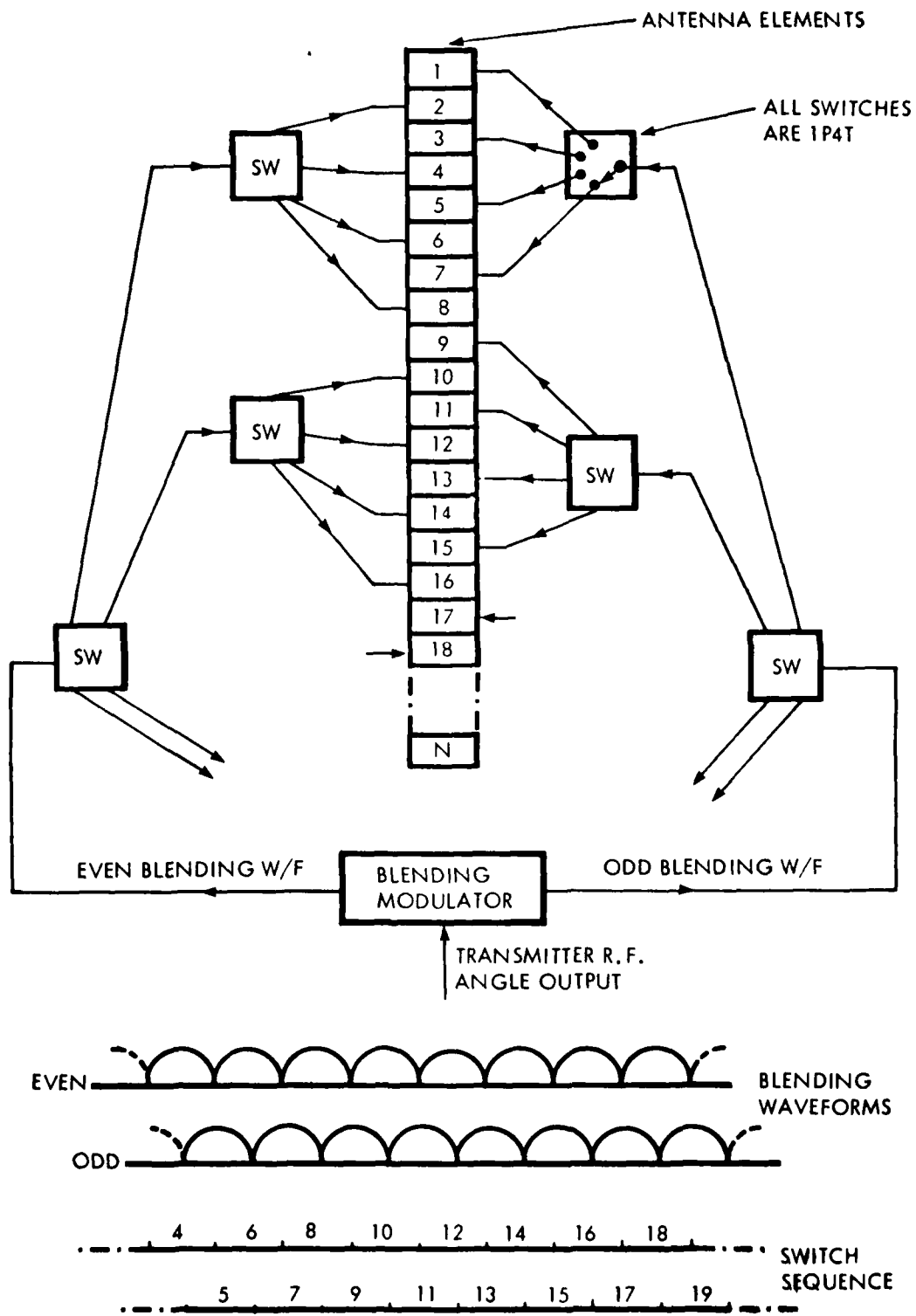


Fig 5.11 Commutator switching

Fig 5.12

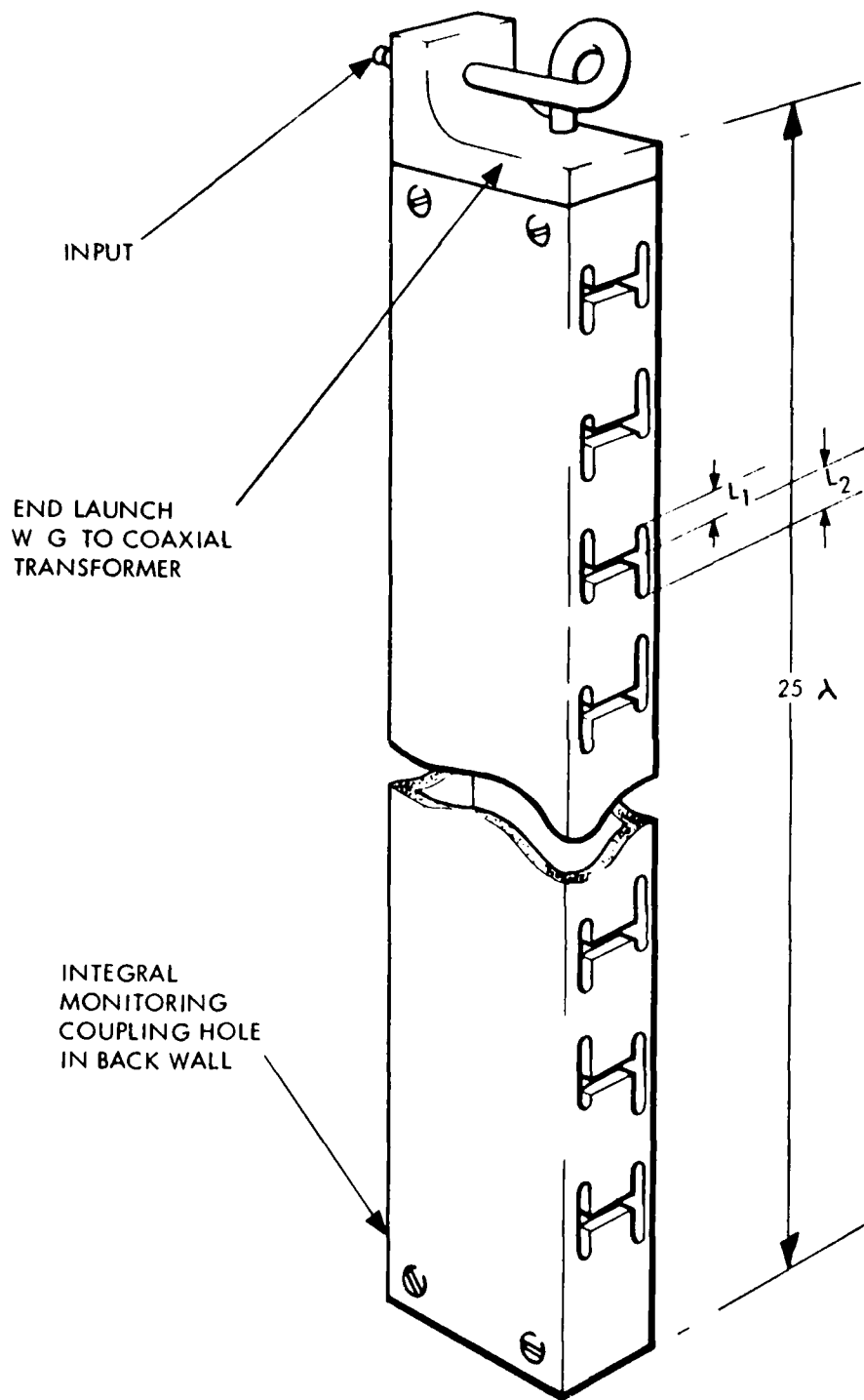


Fig 5.12 Azimuth vertical column element

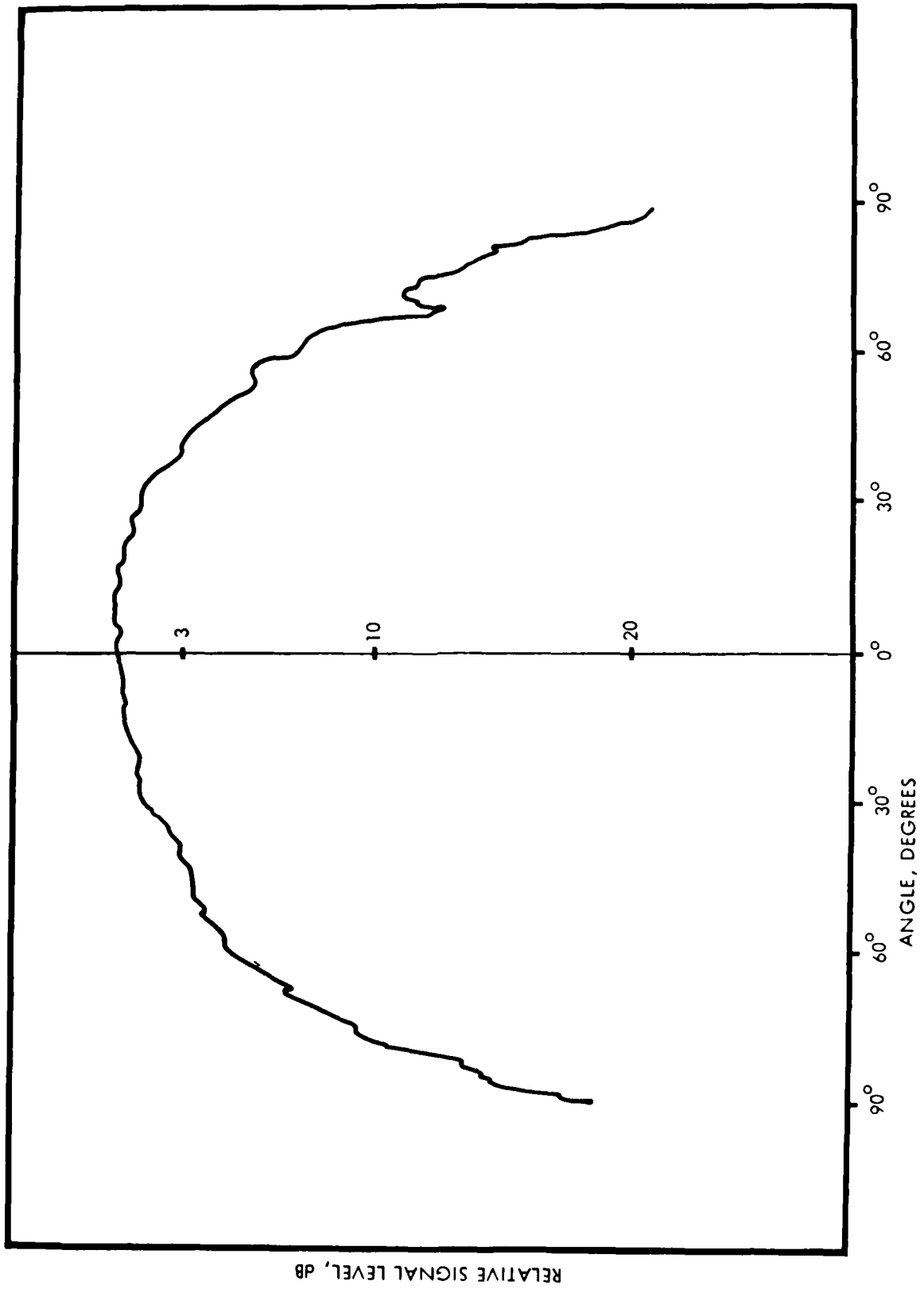


Fig 5.13

Fig 5.13 Azimuth array — typical azimuth radiation pattern

Fig 5.14

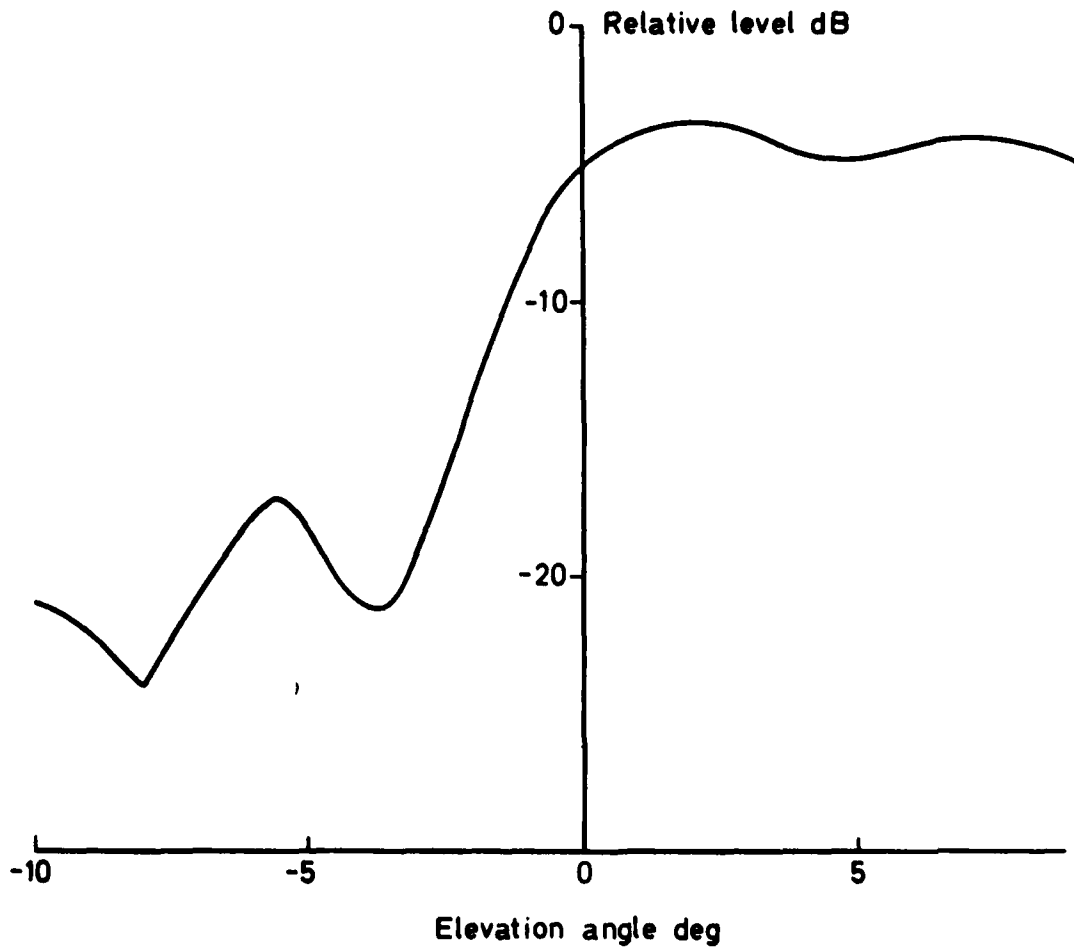


Fig 5.14 Column element typical vertical radiation pattern

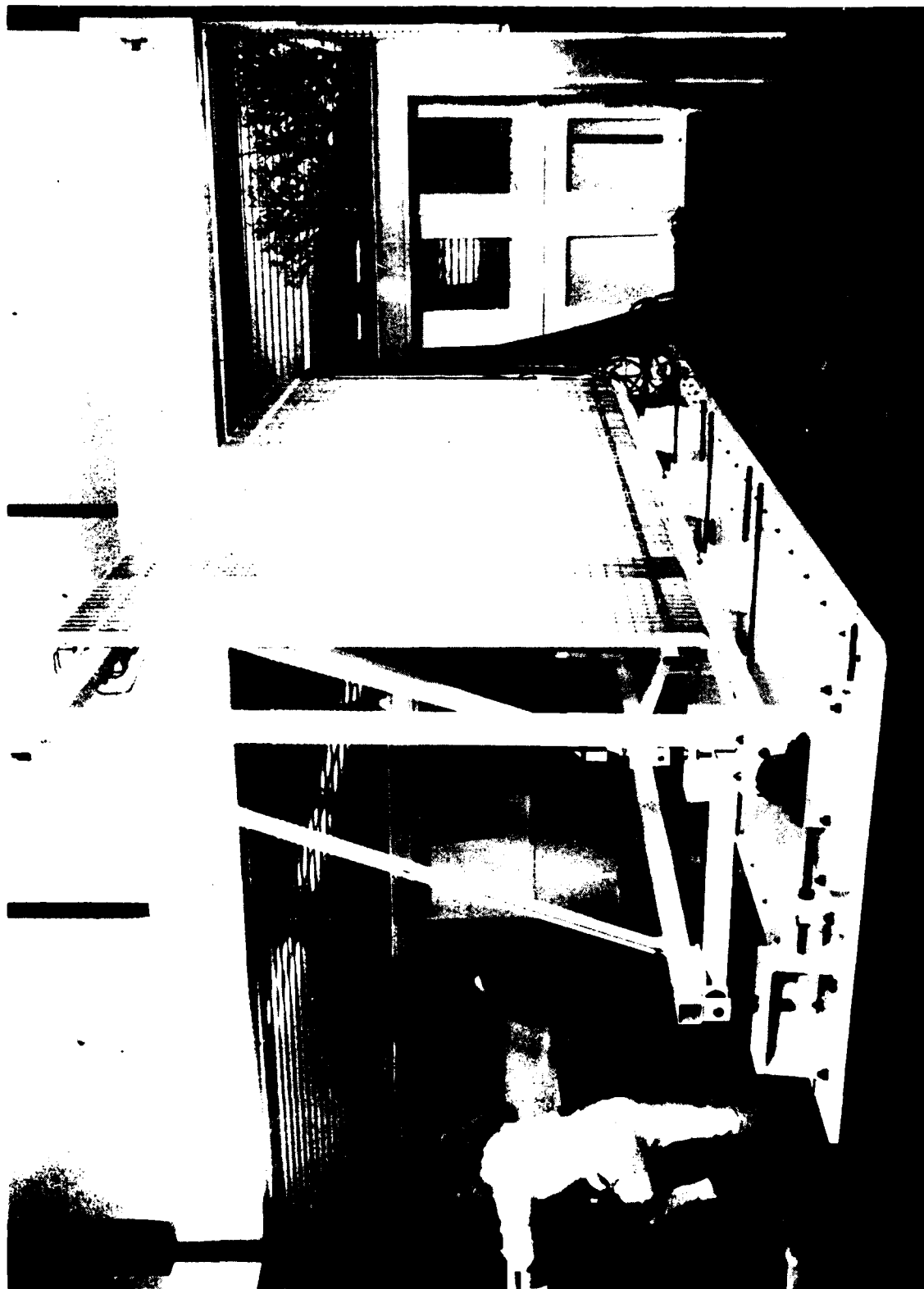


Fig 5.15 Azimuth array showing slotted columns and support frame

Fig 5.16

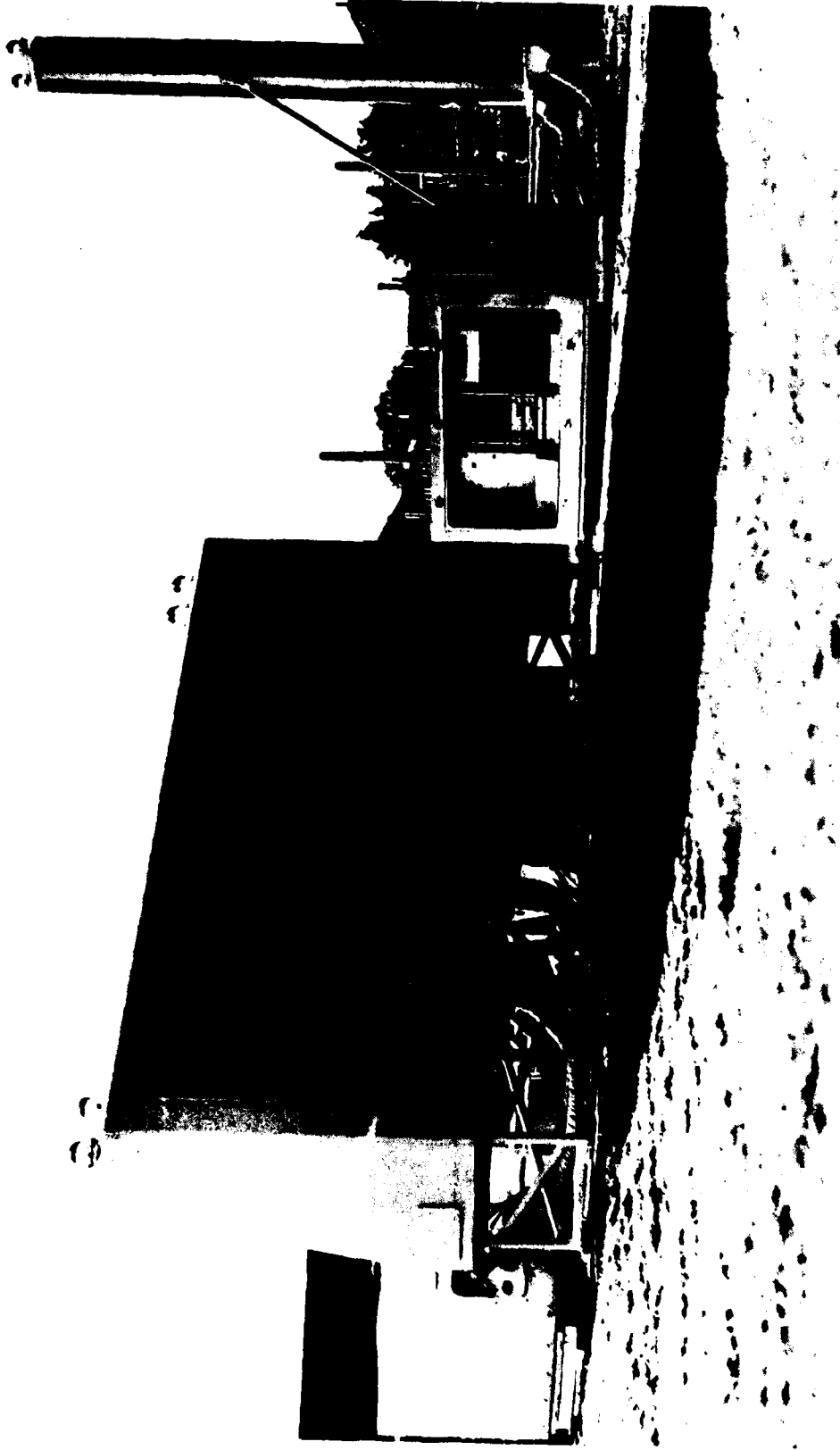


Fig 5.16 Collocated elevation and azimuth arrays

Fig 5.17

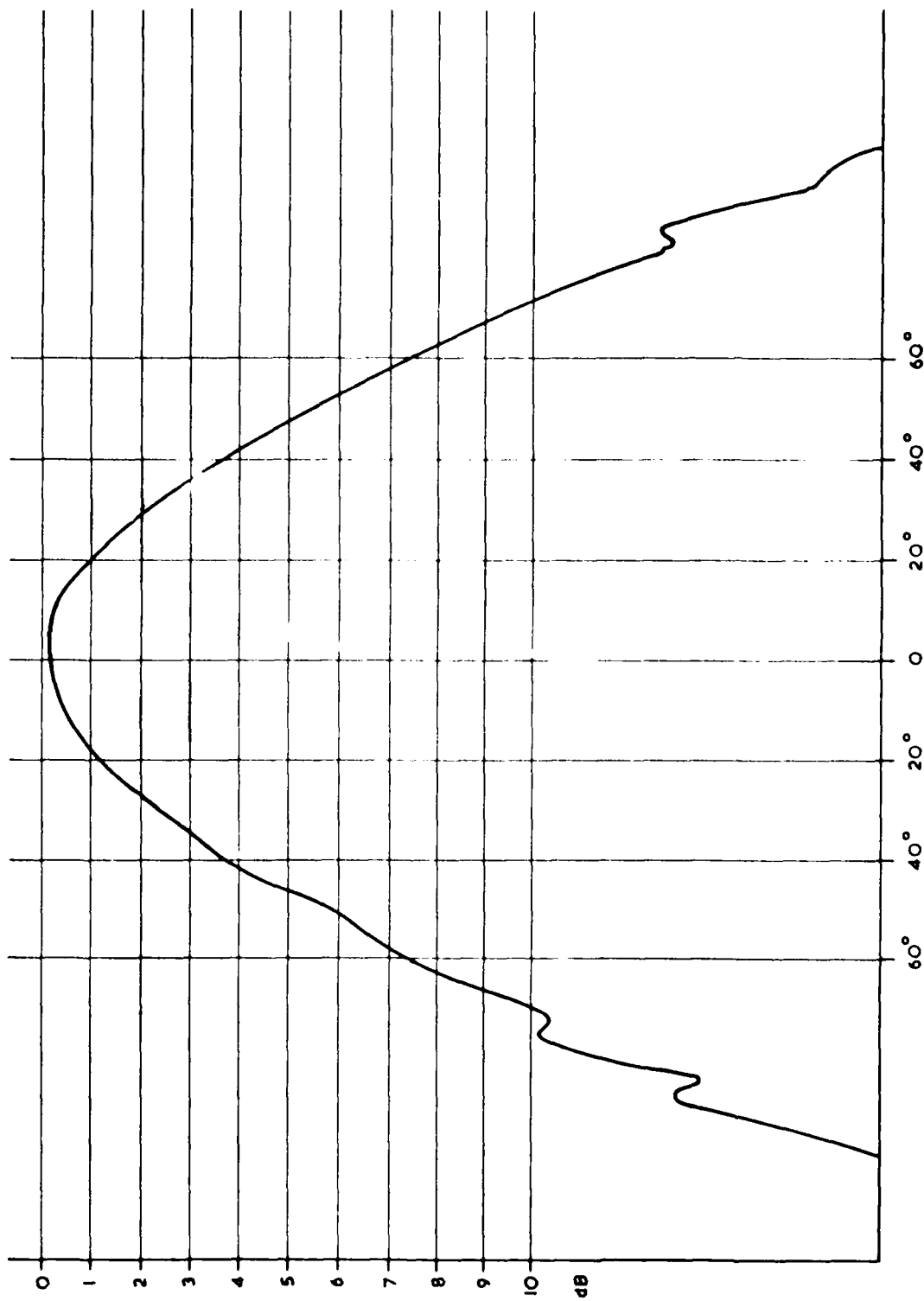


Fig 5.17 Elevation array element - azimuth radiation pattern

Fig 5.18

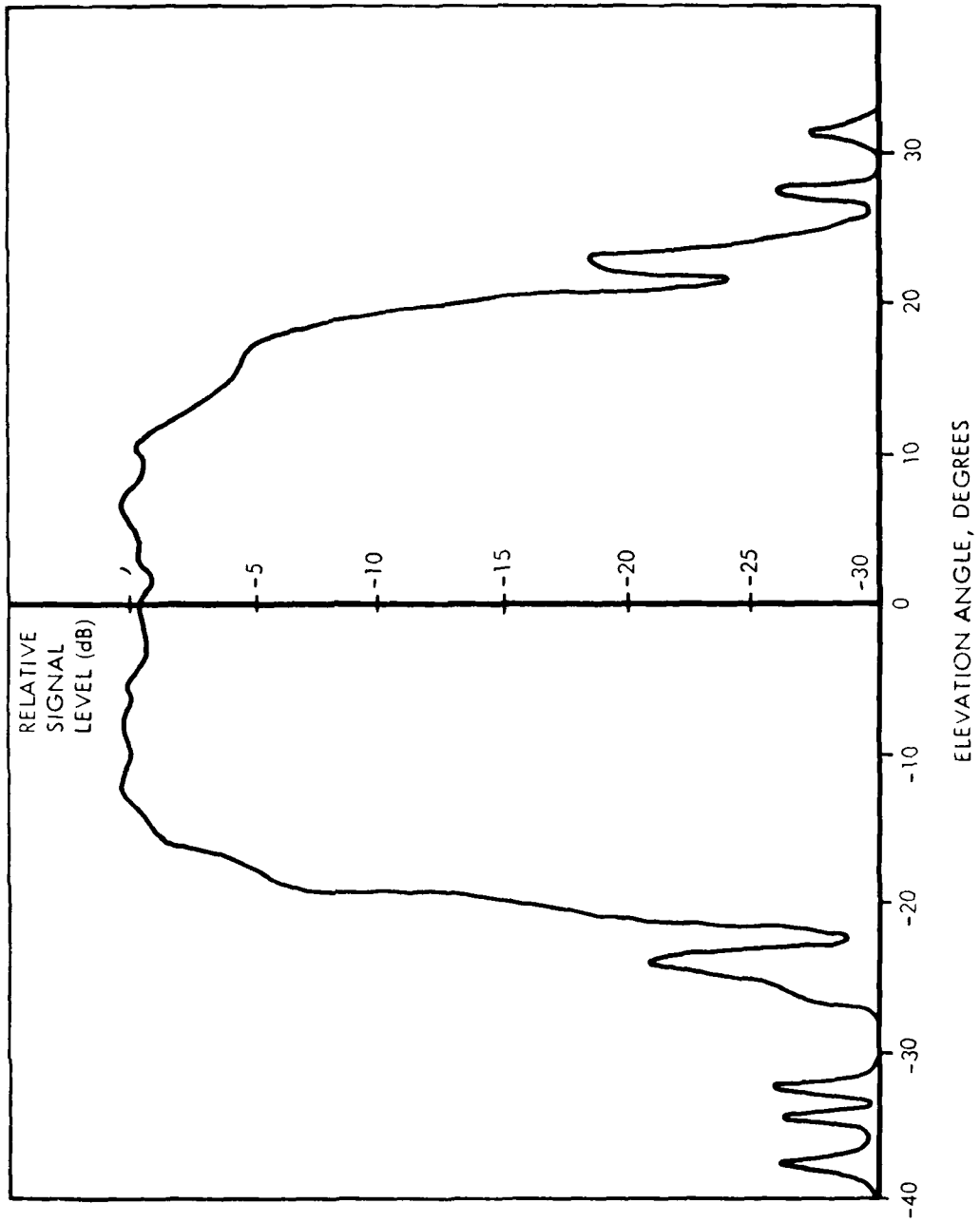


Fig 5.18 Elevation array element - elevation radiation pattern

Fig 5.19



Fig 5.19 Completed 54 wavelength GRP elevation array

Fig 5.20

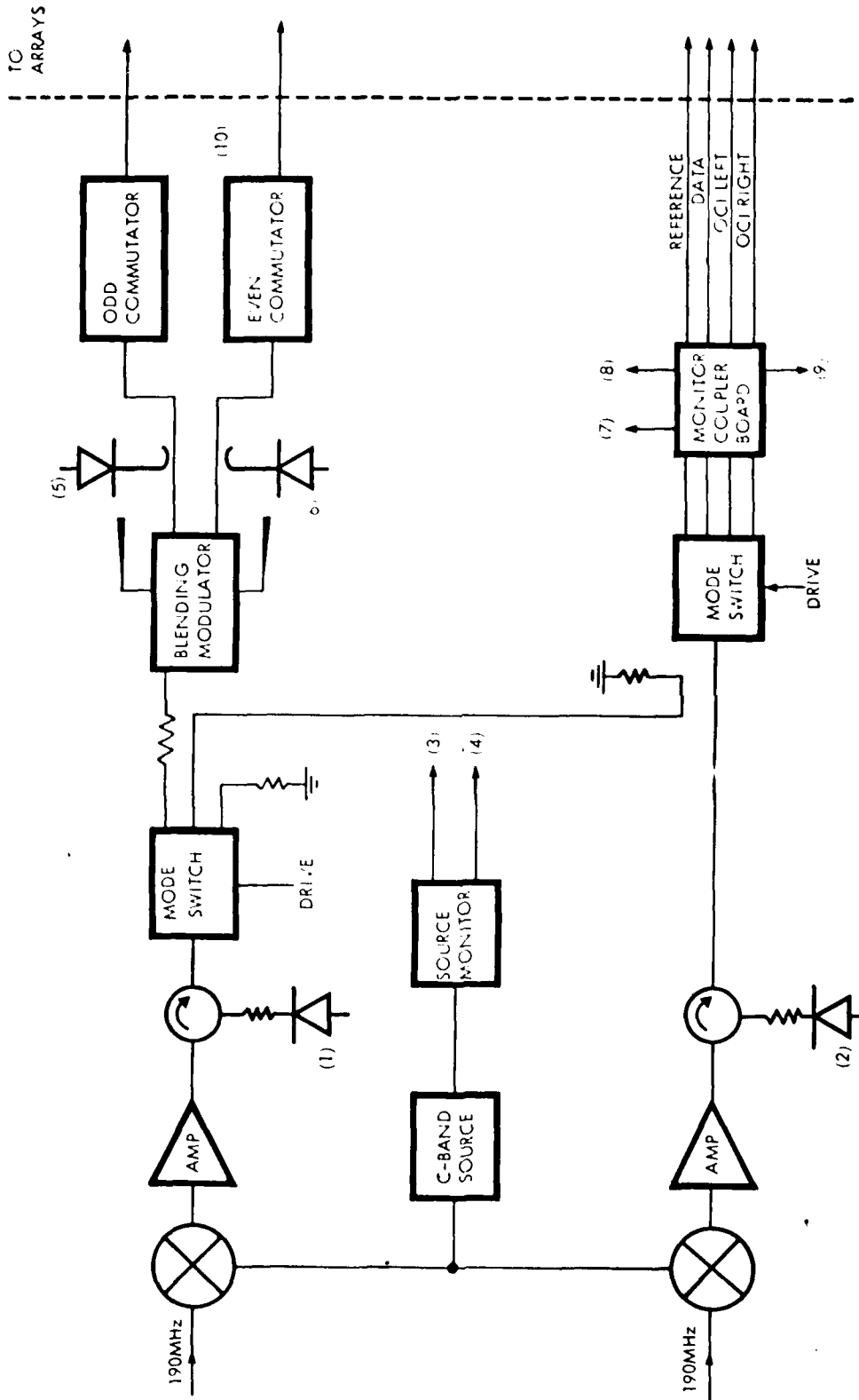


Fig 5.20 Internal monitor — azimuth facility

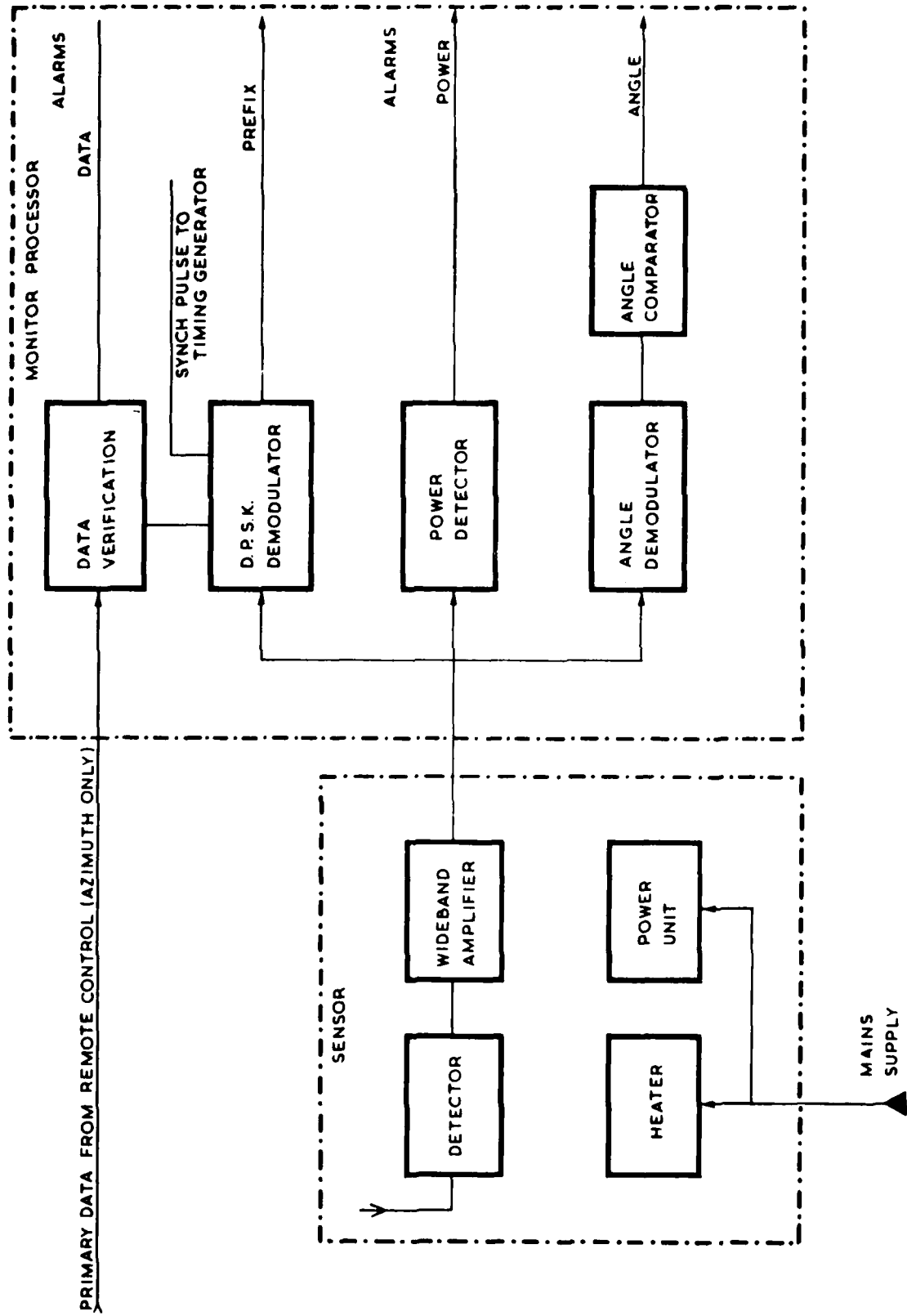


Fig 5.21 Integral monitor

Fig 5.22

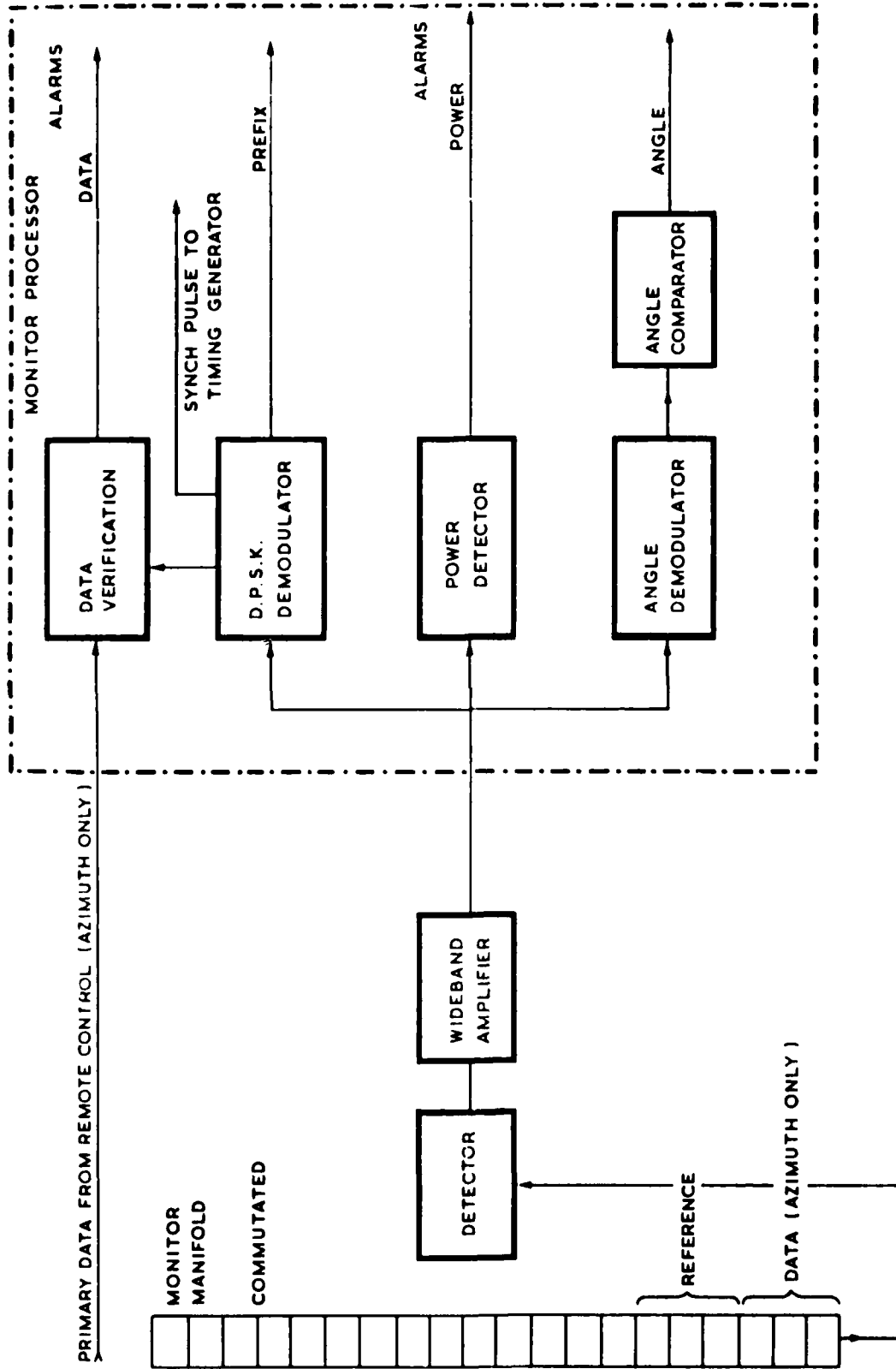


Fig 5.22 Field monitor

Fig 5.23a&b

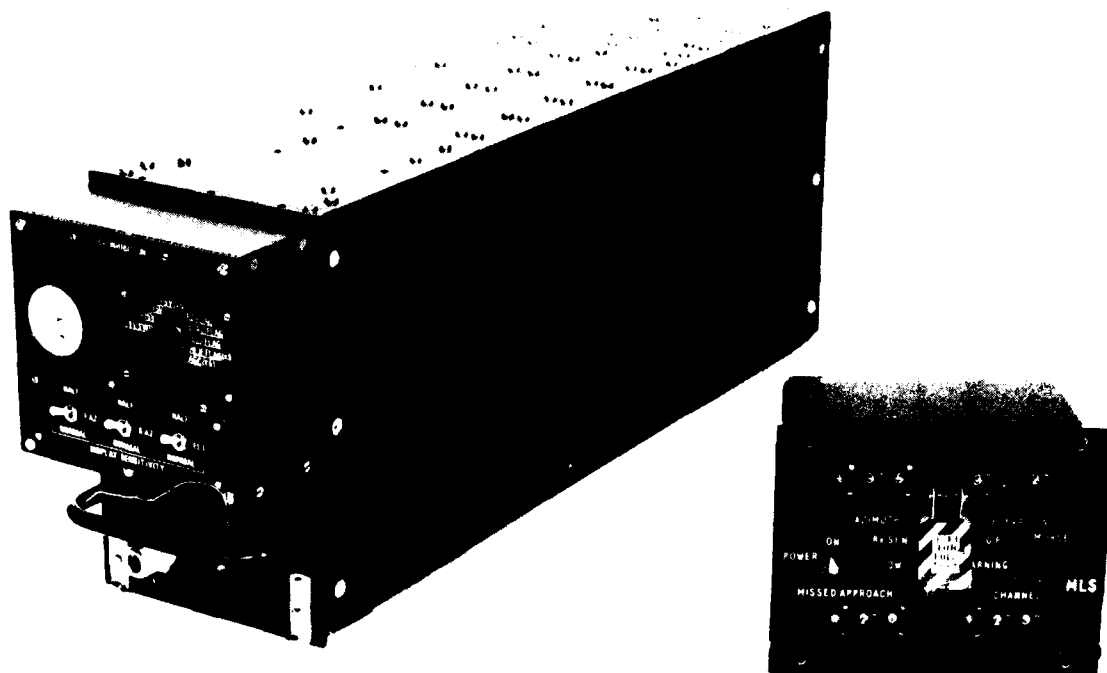


Fig 5.23a Full capability receiver and control unit

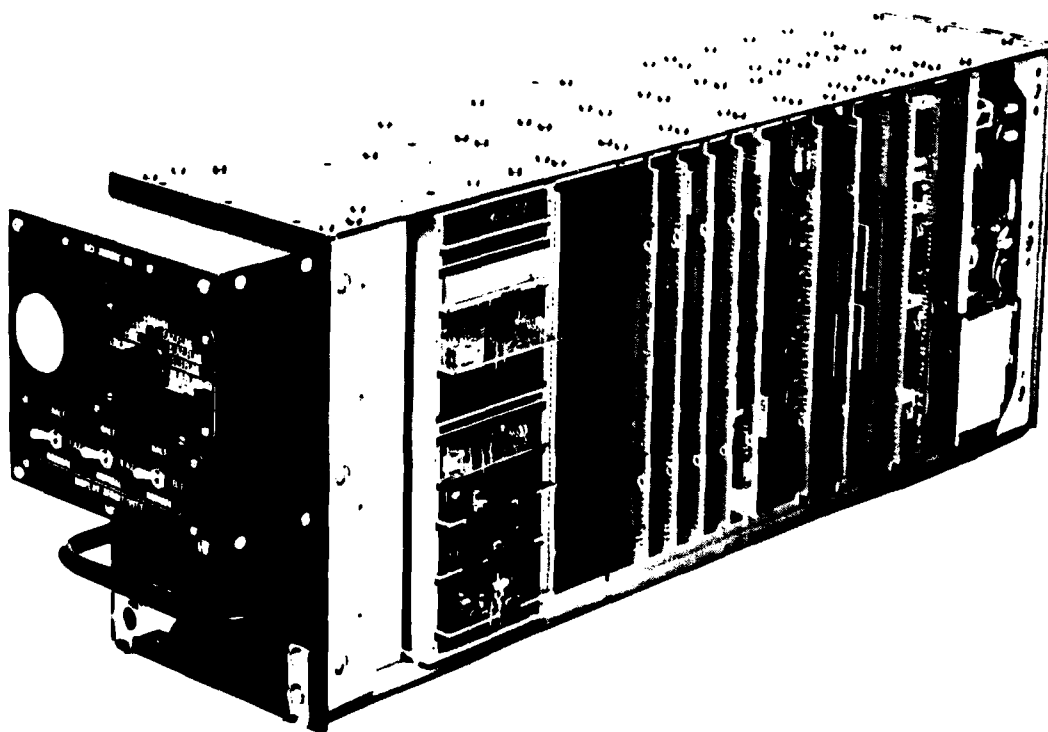


Fig 5.23b Internal view of receiver

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Fig 5.24

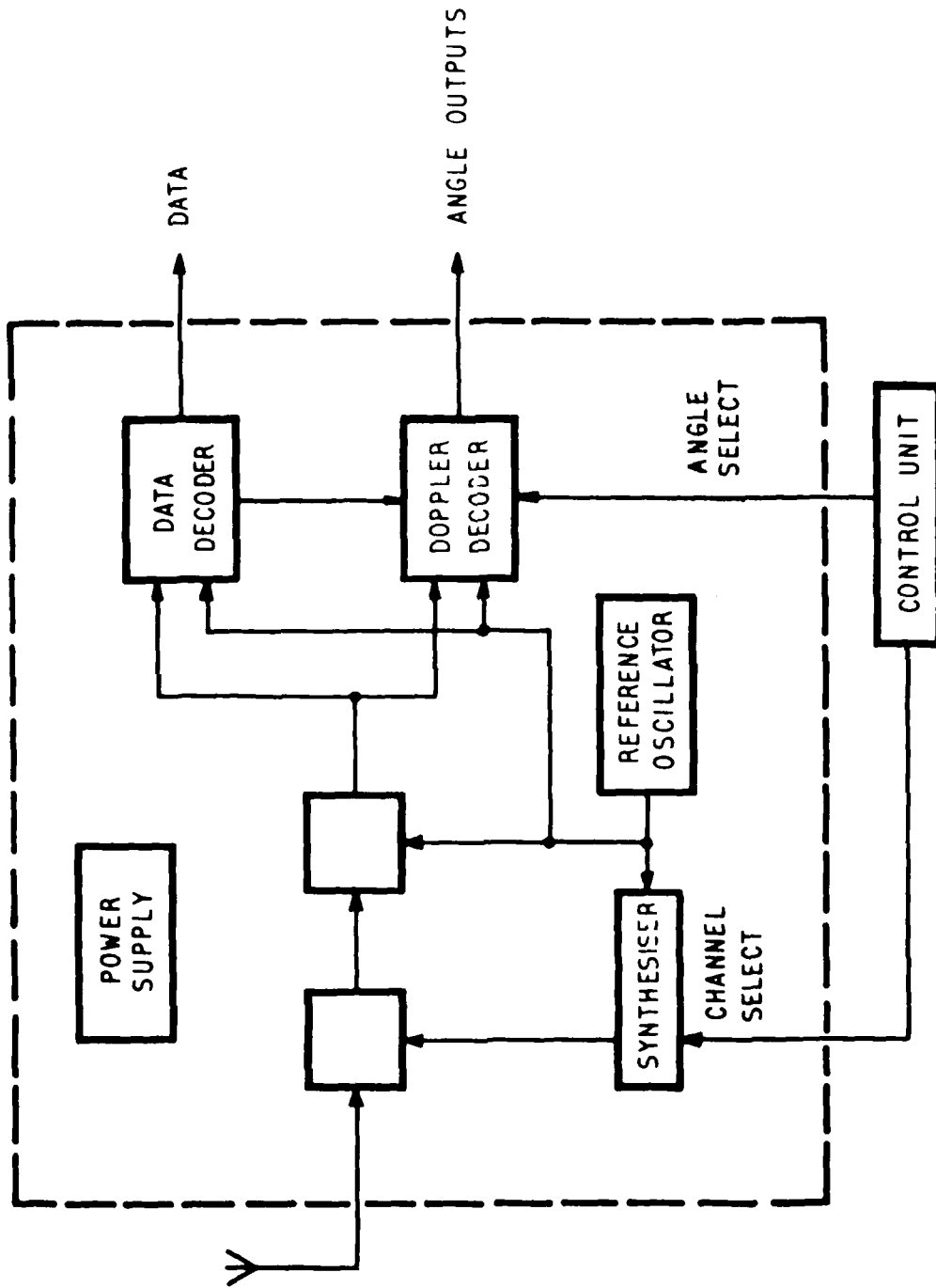
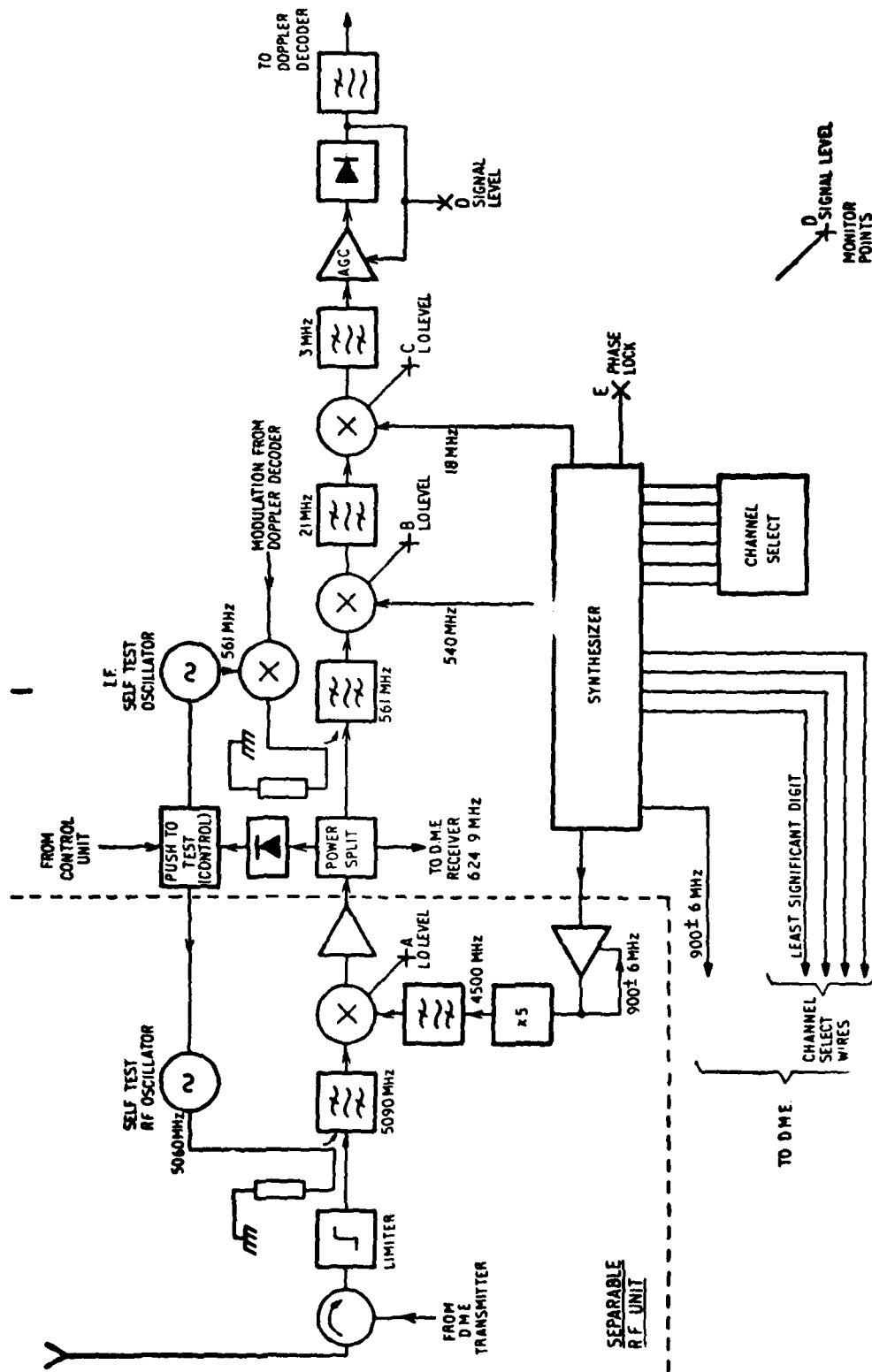


Fig 5.24 Block diagram for TDM receivers

Fig 5.25



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Fig 5.25 Receiver RF/IF circuits

Fig 5.26

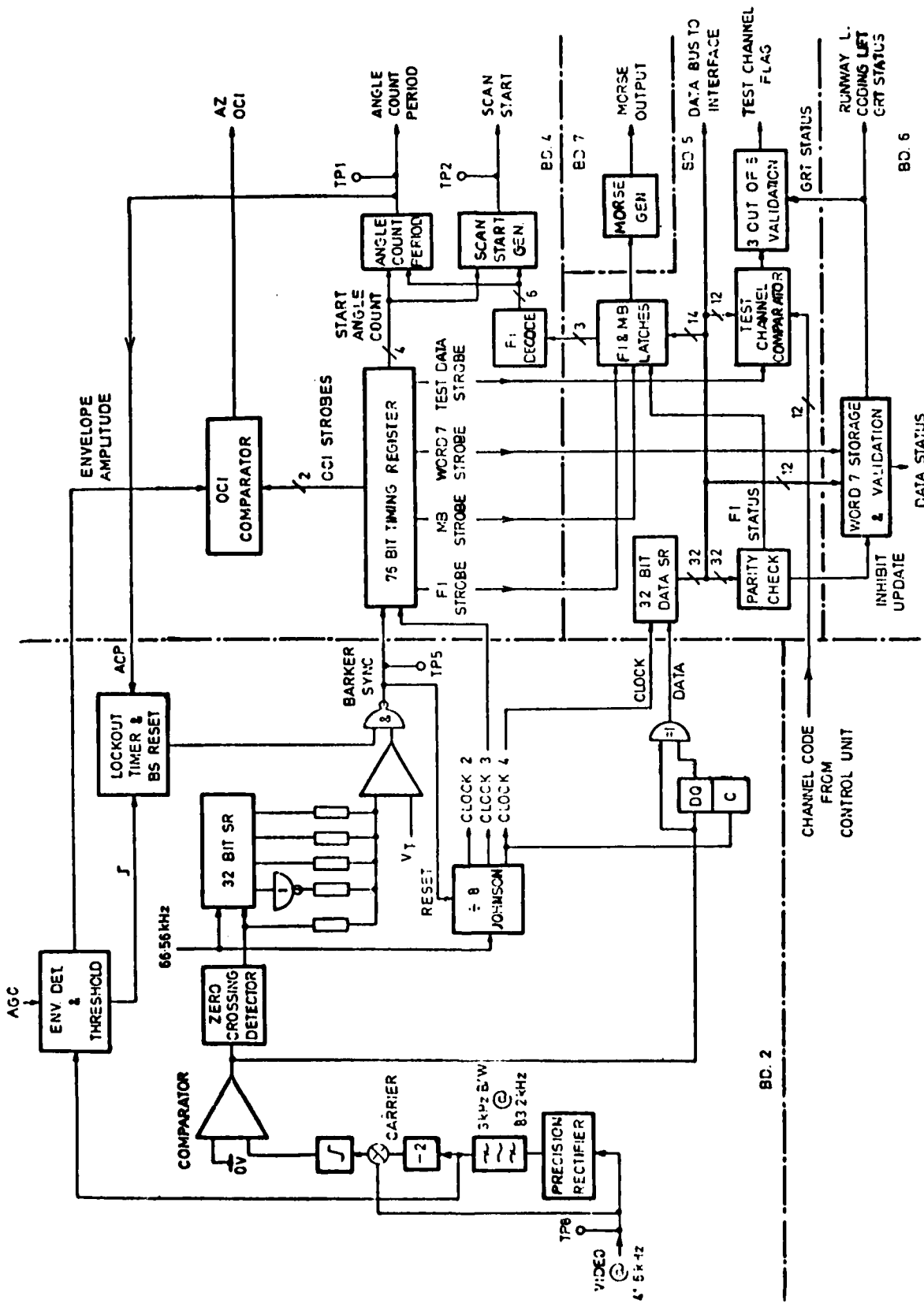
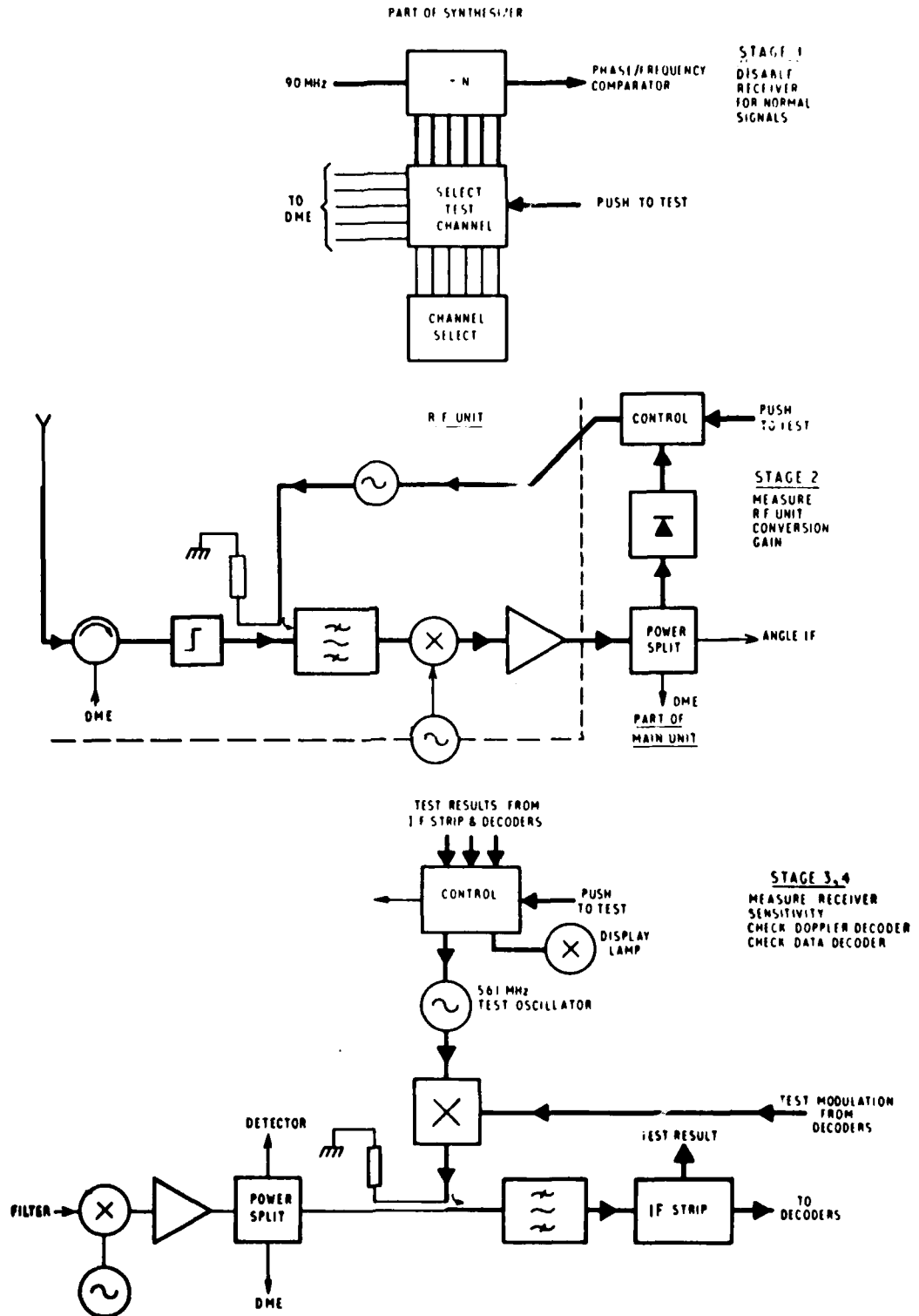


Fig 5.26 Data demodulator and decoder

Fig 5.27



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Fig 5.27 RF/IF self test circuit

Fig 5.28

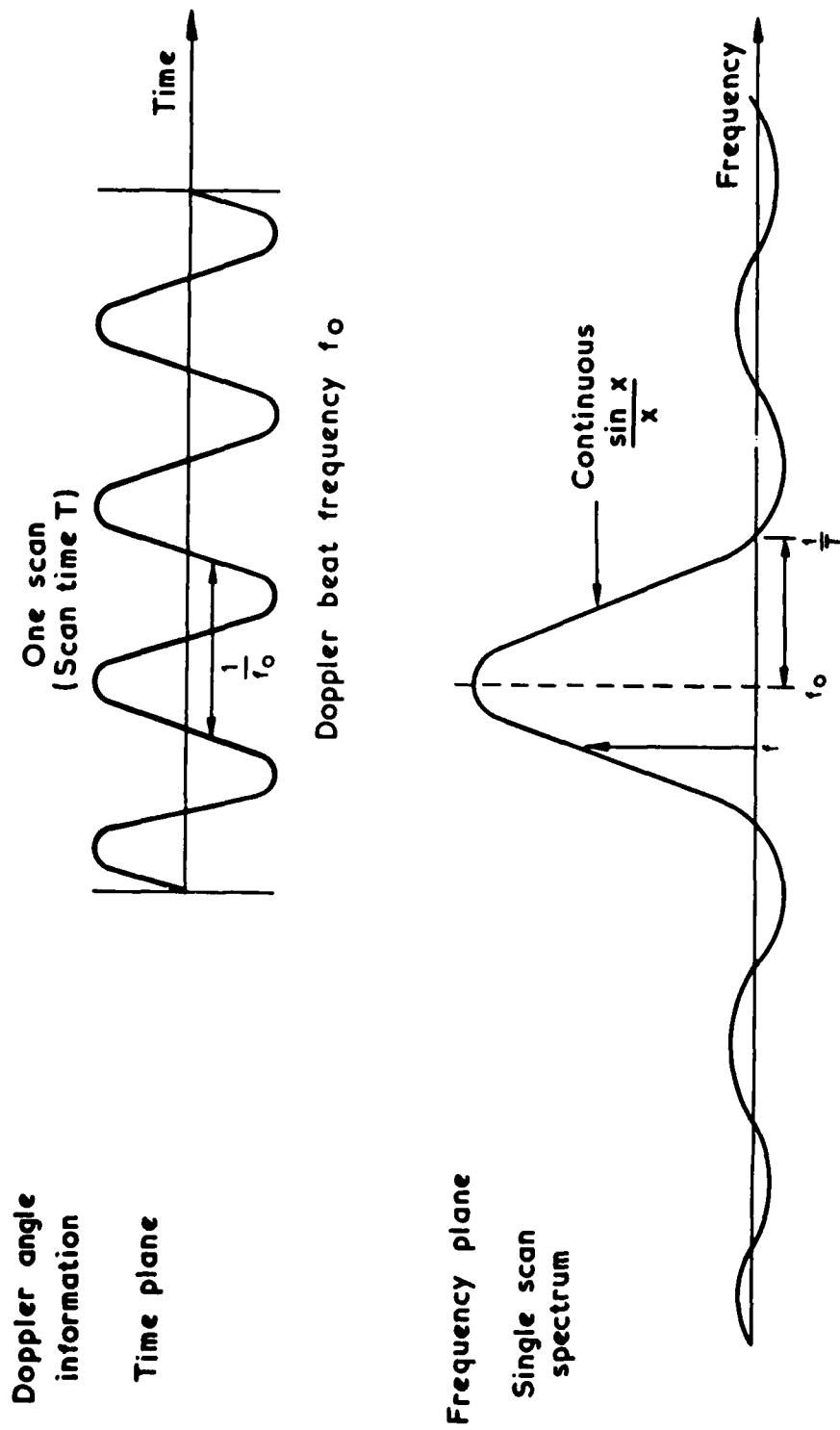


Fig 5.28 The Doppler signal

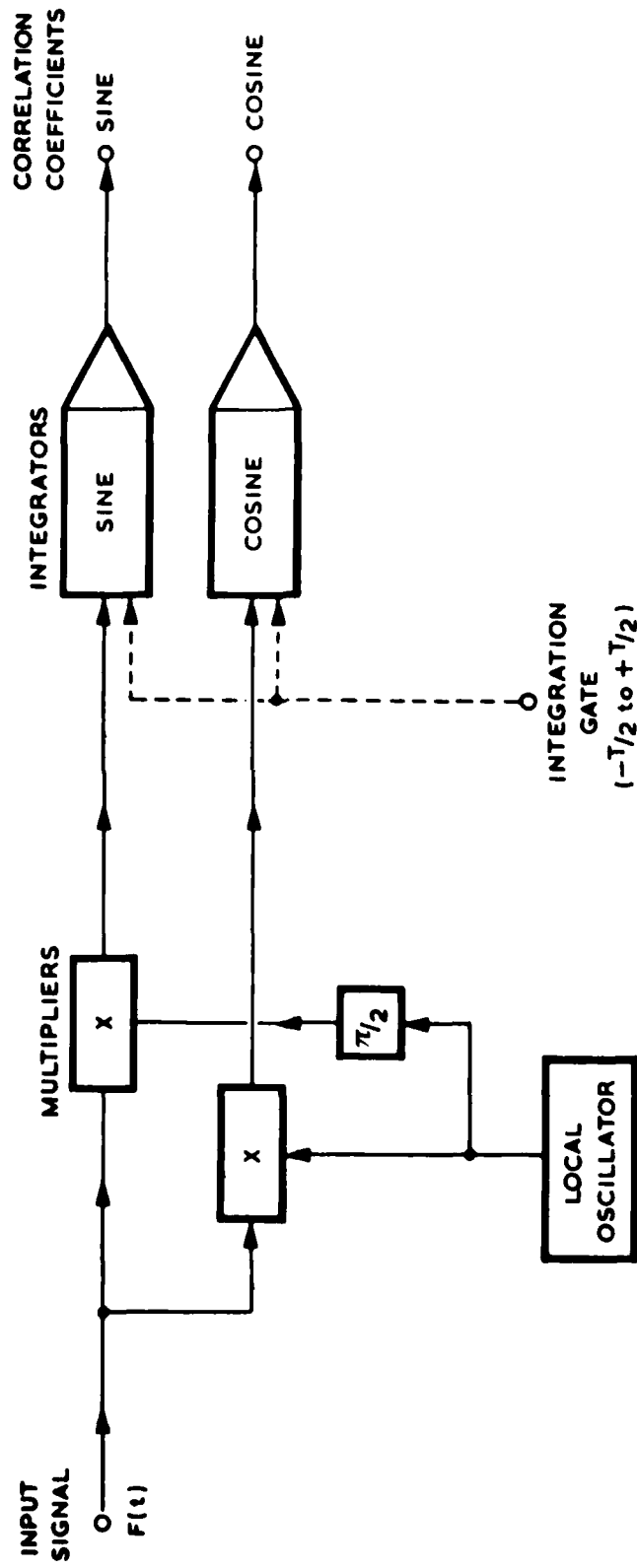


Fig 5.29 Single frequency analogue correlator

Fig 5.30

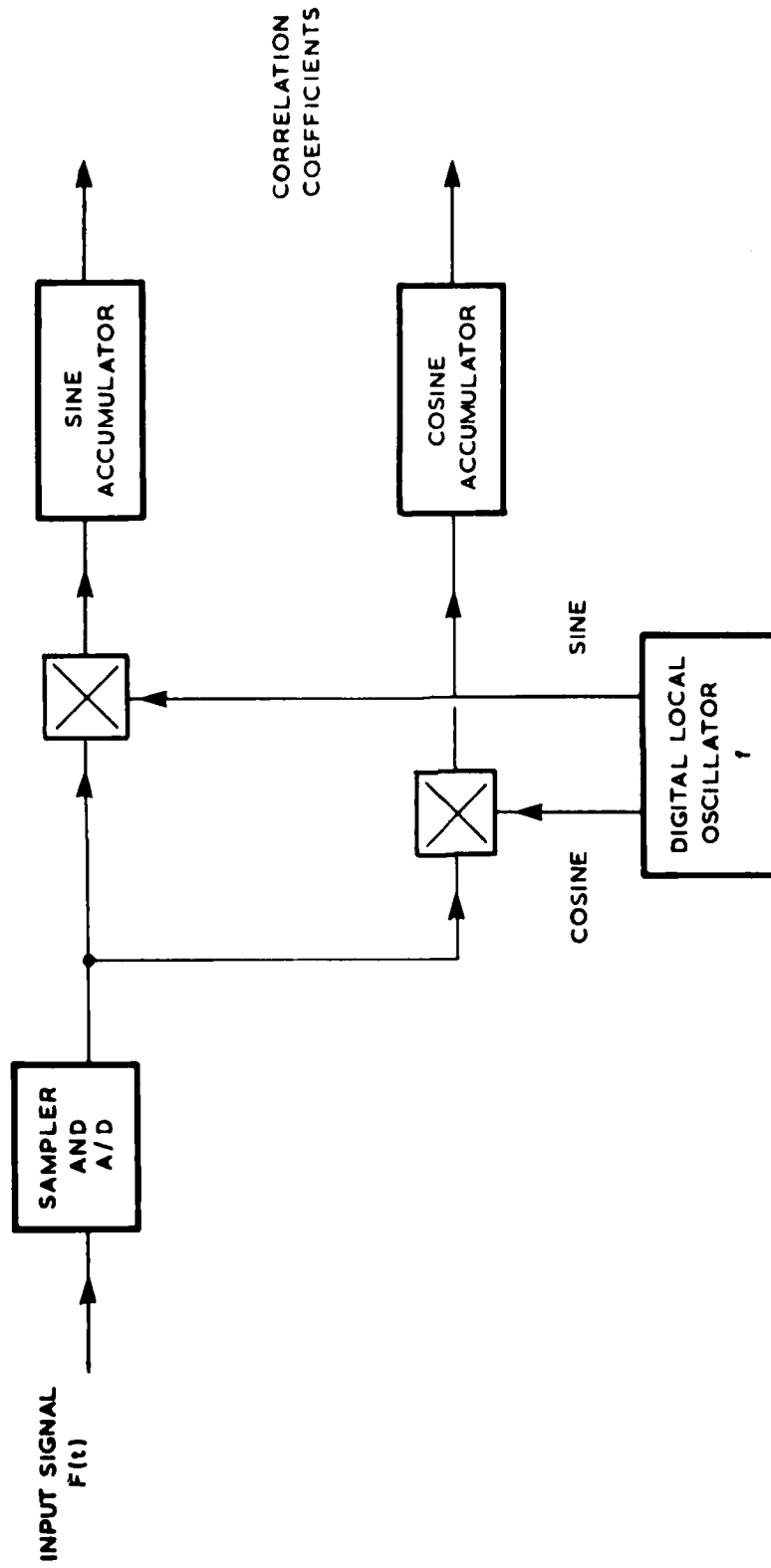


Fig 5.30 Digital frequency correlator

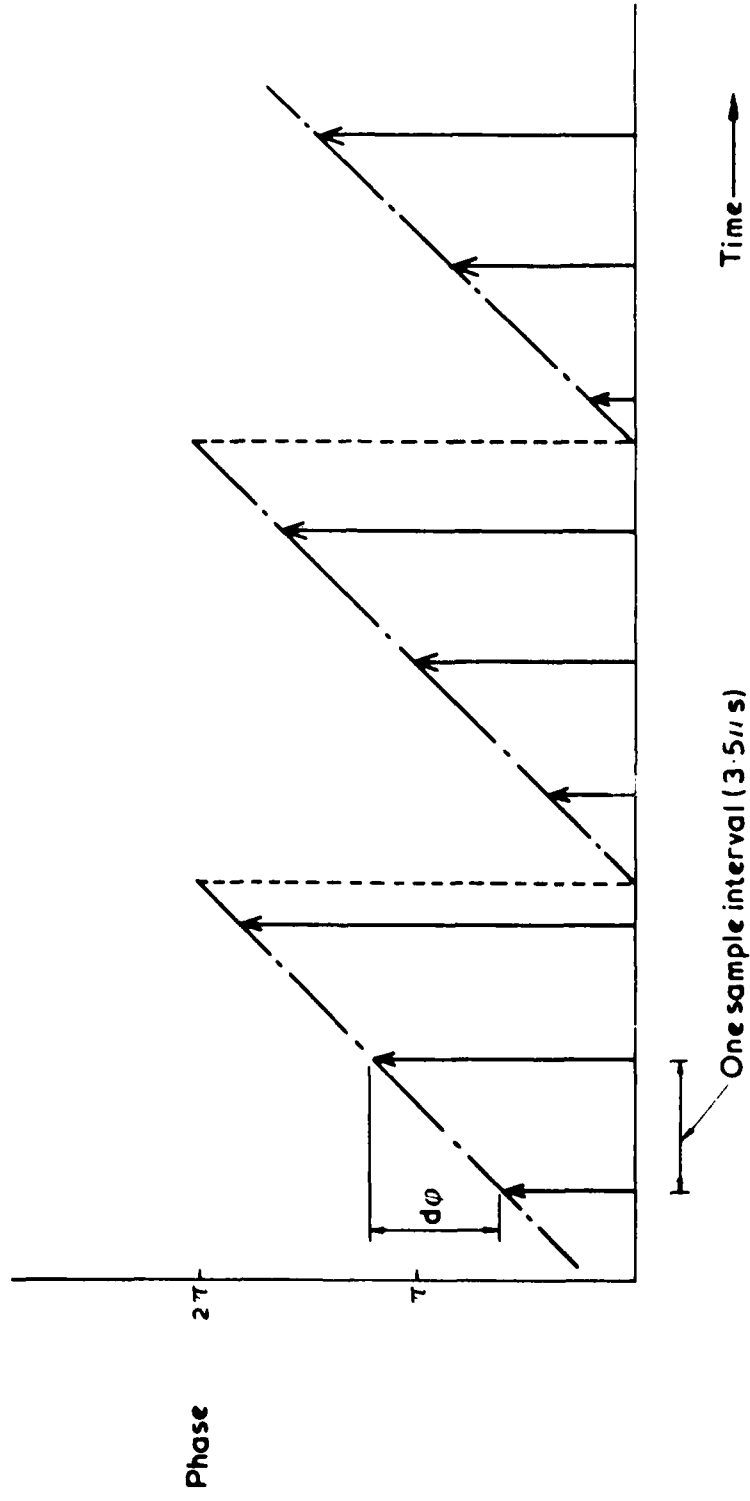


Fig 5.31

Fig 5.31 Digital frequency generation

Fig 5.32

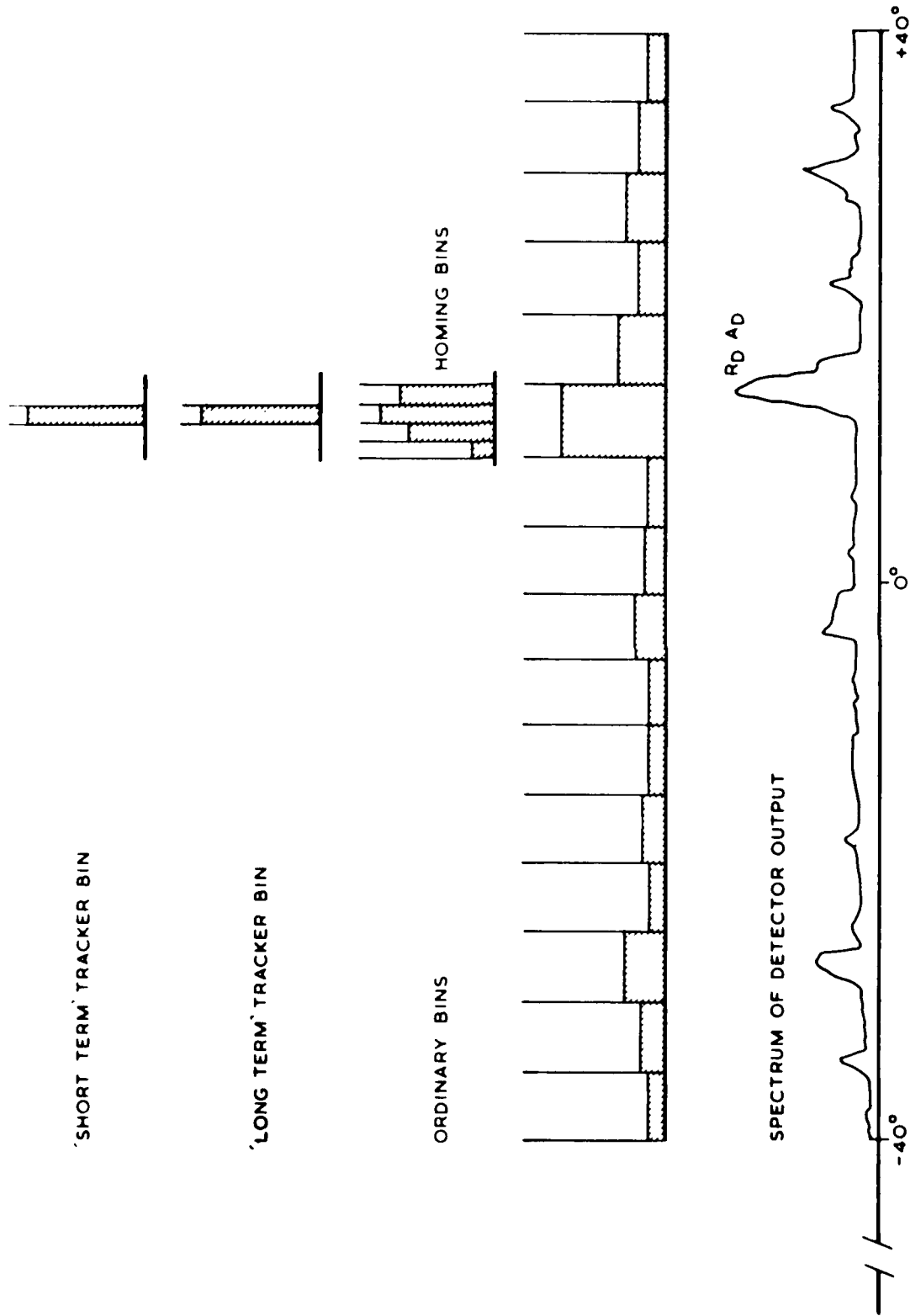


Fig 5.32 Correlator acquisition and validation process

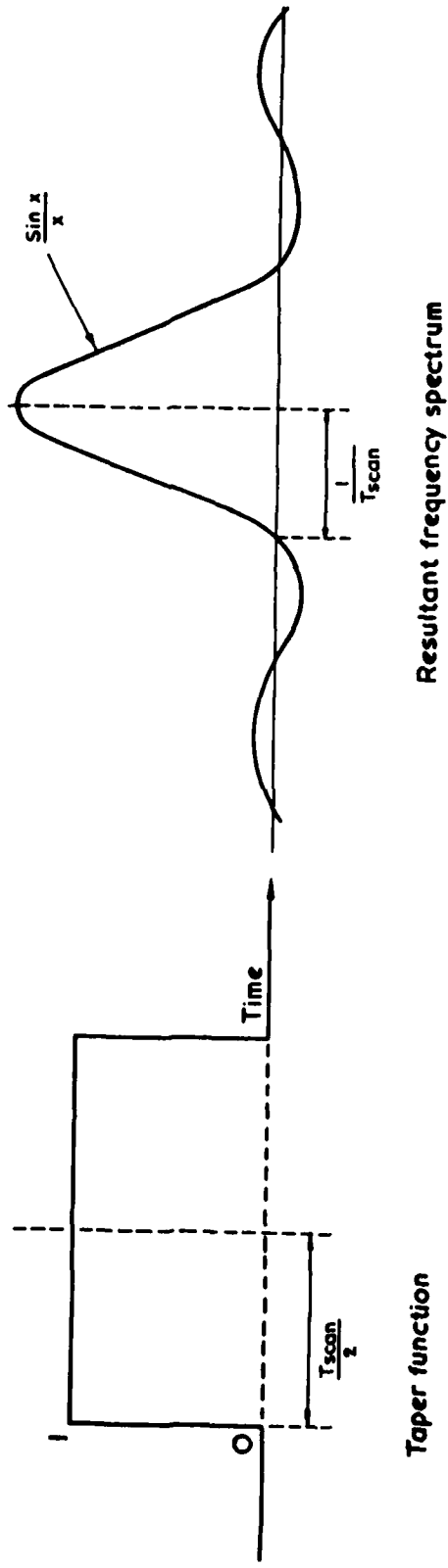


Fig 5.33 The frequency spectrum resulting from the use of a sum taper function

Fig 5.34

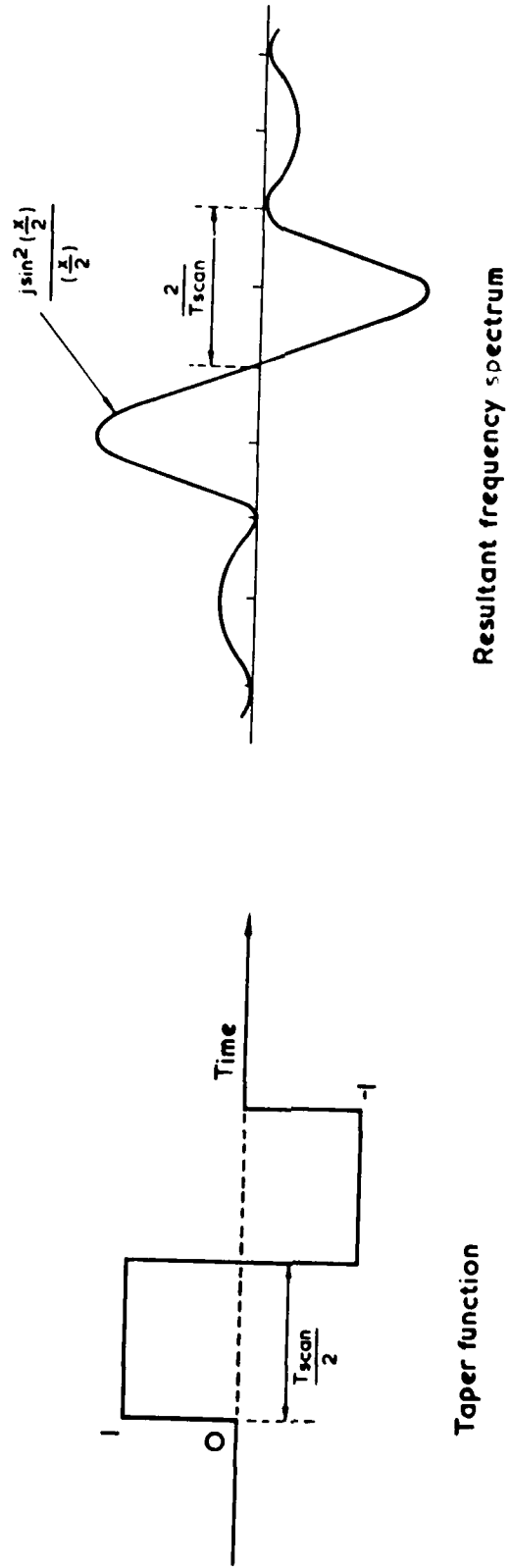


Fig 5.34 The frequency spectrum resulting from the use of a taper function difference

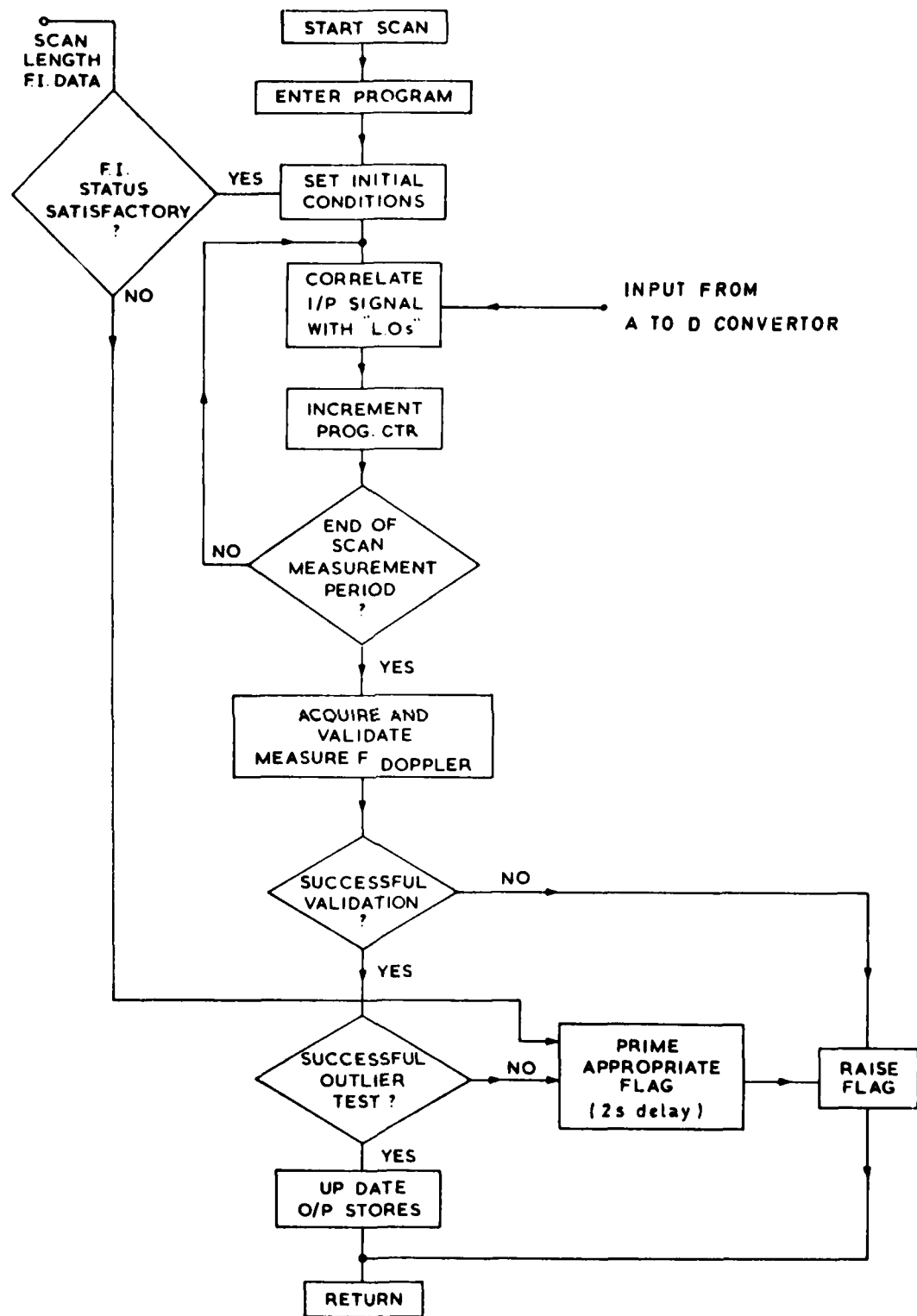


Fig 5.35 Simple correlation system flow diagram

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