

QC
807.5
.U66
no.140
1971

NOAA TR ERL 140-APCL 10

NOAA Technical Report ERL 140-APCL 10

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
Environmental Research Laboratories

Plotter Subroutine for Meteorological Straight Line Flight Data (SLENDER) (Revised)

HEINZ H. GROTE

BOULDER, COLO.
MARCH 1971



ENVIRONMENTAL RESEARCH LABORATORIES

The primary purpose of the Environmental Research Laboratories is to study the oceans, inland waters, and upper atmosphere, the space environment, and the earth, in search of knowledge needed to provide more useful services in improving man's prospects and understanding of the physical environment. Laboratories contributing to these studies are:

Earth Sciences Laboratories: Geomagnetism, seismology, geodesy, and related earth sciences; earthquake processes, internal structure and accurate figure of the Earth, and distribution of the Earth's mass.

Atlantic Oceanographic and Meteorological Laboratories: Oceanography, with emphasis on the geology and geophysics of ocean basins, oceanic processes, sea-air interactions, hurricane research, and weather modification (Miami, Florida).

Pacific Oceanographic Laboratories: Oceanography; geology and geophysics of the Pacific Basin and margins; oceanic processes and dynamics; tsunami generation, propagation, modification, detection, and monitoring (Seattle, Washington).

Atmospheric Physics and Chemistry Laboratory: Cloud physics and precipitation; chemical composition and nucleating substances in the lower atmosphere; and laboratory and field experiments toward developing feasible methods of weather modification.

Air Resources Laboratories: Diffusion, transport, and dissipation of atmospheric contaminants; development of methods for prediction and control of atmospheric pollution (Silver Spring, Maryland).

Geophysical Fluid Dynamics Laboratory: Dynamics and physics of geophysical fluid systems; development of a theoretical basis, through mathematical modeling and computer simulation, for the behavior and properties of the atmosphere and the oceans (Princeton, New Jersey).

Research Flight Facility: Outfits and operates aircraft specially instrumented for research; and meets needs of NOAA and other groups for environmental measurements for aircraft (Miami, Florida).

National Severe Storms Laboratory: Tornadoes, squall lines, thunderstorms, and other severe local convective phenomena toward achieving improved methods of forecasting, detecting, and providing advance warnings (Norman, Oklahoma).

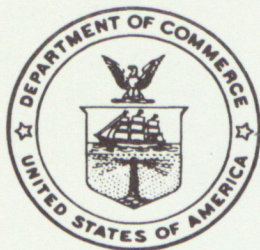
Space Disturbances Laboratory: Nature, behavior, and mechanisms of space disturbances; development and use of techniques for continuous monitoring and early detection and reporting of important disturbances.

Aeronomy Laboratory: Theoretical, laboratory, rocket, and satellite studies of the physical and chemical processes controlling the ionosphere and exosphere of the earth and other planets.

Wave Propagation Laboratory: Development of new methods for remote sensing of the geophysical environment; special emphasis on propagation of sound waves, and electromagnetic waves at millimeter, infrared, and optical frequencies.

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

BOULDER, COLORADO 80302



U.S. DEPARTMENT OF COMMERCE

Maurice H. Stans, Secretary

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Robert M. White, Administrator

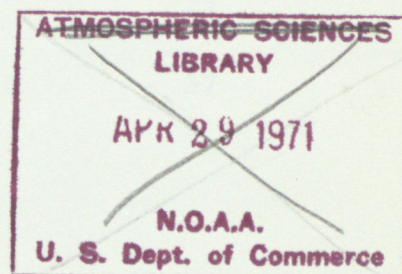
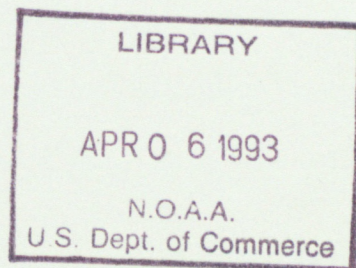
ENVIRONMENTAL RESEARCH LABORATORIES

Wilmot N. Hess, Director

NOAA TECHNICAL REPORT ERL 140-APCL 10

Plotter Subroutine for Meteorological Straight Line Flight Data (SLENDER) (Revised)

HEINZ H. GROTE



BOULDER, COLO.
March 1971

For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402
Price 55 cents

155 447

M (055)
U 55857c
ERL 140-
APCL 10
1971

FOREWORD

This Technical Report is a revision of ESSA
Technical Report ERL 140-APCL 10, December
1969, "Plotter Subroutine for Meteorological
Straight Line Flight Data (SLENDER)

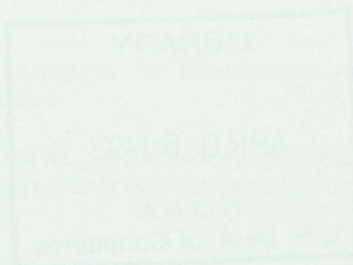
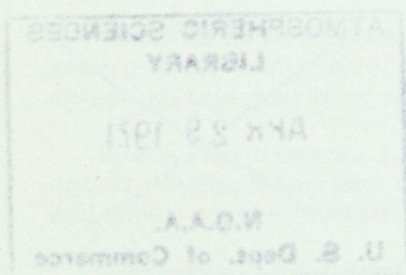


TABLE OF CONTENTS

1.	INTRODUCTION	1
2.	TILTING GEOMETRY	6
3.	INPUT VALUES	12
4.	GENERAL STRUCTURE	19
	4.1 Timing	20
	4.2 Flight path approximation	21
	4.3 Scaling	24
	4.4 Plotting of flight path	24
	4.5 Plotting of wind vectors	25
	4.6 Plotting of coordinate grid	25
	4.7 Scaling and plotting of meteorological parameters	28
5.	ACKNOWLEDGMENT	32
6.	REFERENCES	32
APPENDIX A	PROGRAM TESTSLEN	33
APPENDIX B	SUBROUTINE SLENDER	37

PLOTTER SUBROUTINE FOR METEOROLOGICAL
STRAIGHT LINE FLIGHT DATA (SLENDER)

Heinz H. Grote

This paper describes a subroutine SLENDER that works in connection with the plotting subroutine CRTPLT to provide a two-dimensional plot of a relatively straight flight path and four analog traces of selected meteorological parameters lined up with the flight path.

1. INTRODUCTION

The subroutine SLENDER works in connection with the plotting subroutine CRTPLT (Tucker, 1968, Lewis, 1970) to provide a two dimensional plot of a relatively straight flight path and four analog traces of selected meteorological parameters lined up with the flight path.

The flight path is approximated by a straight line that serves as the new x axis. A tilted coordinate system is then plotted and marked accordingly. Wind vectors and time notations are added to the flight path. The meteorological parameters are automatically scaled and marked. Figures 1 and 2 give examples of a plot. The legend provides the following information:

- (1) The flight number, LID, is expressed as a six-digit number and an index letter according to convention used by NOAA's Research Flight Facility. The first two digits represent the

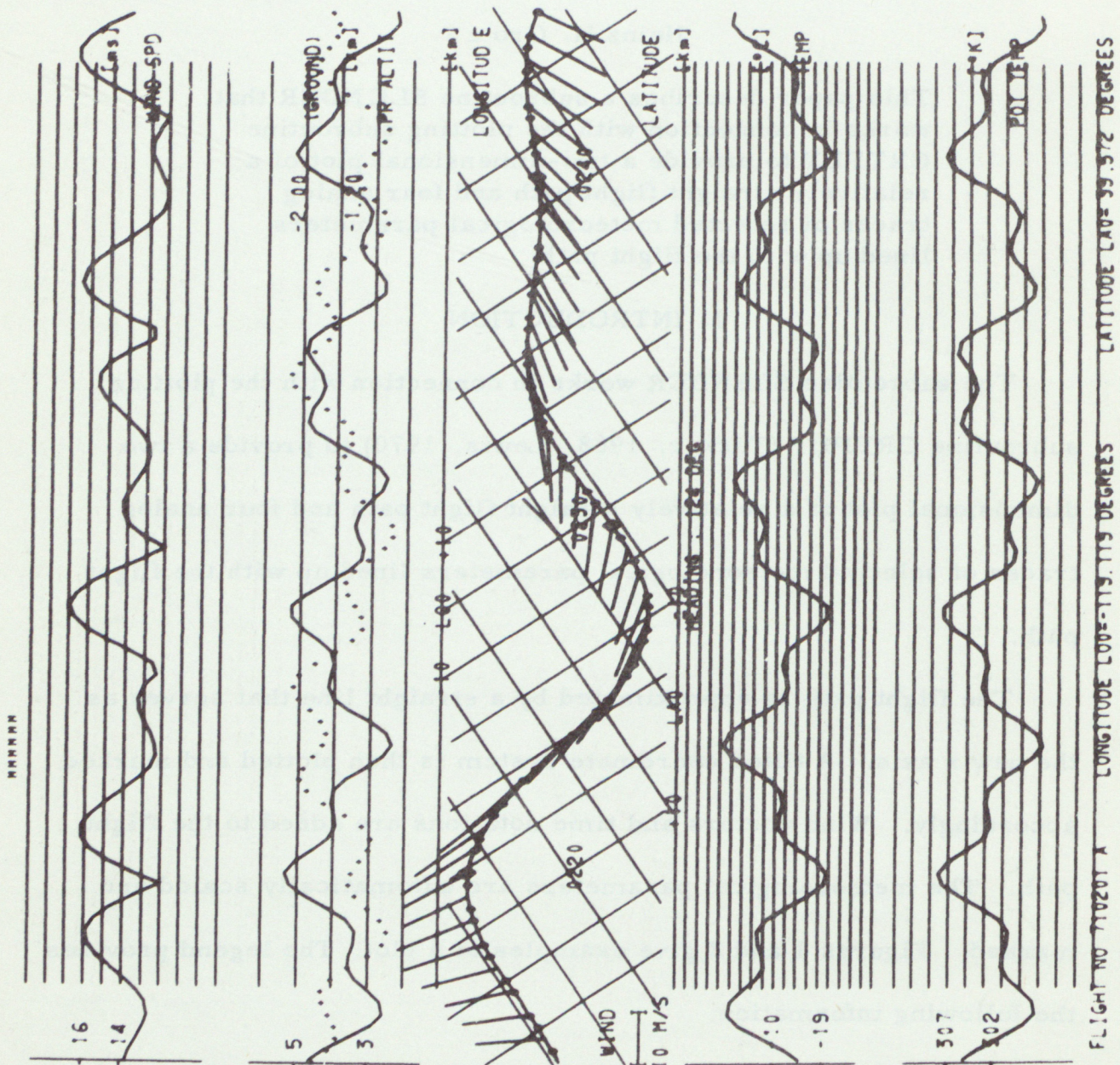


Figure 1. Computer plot

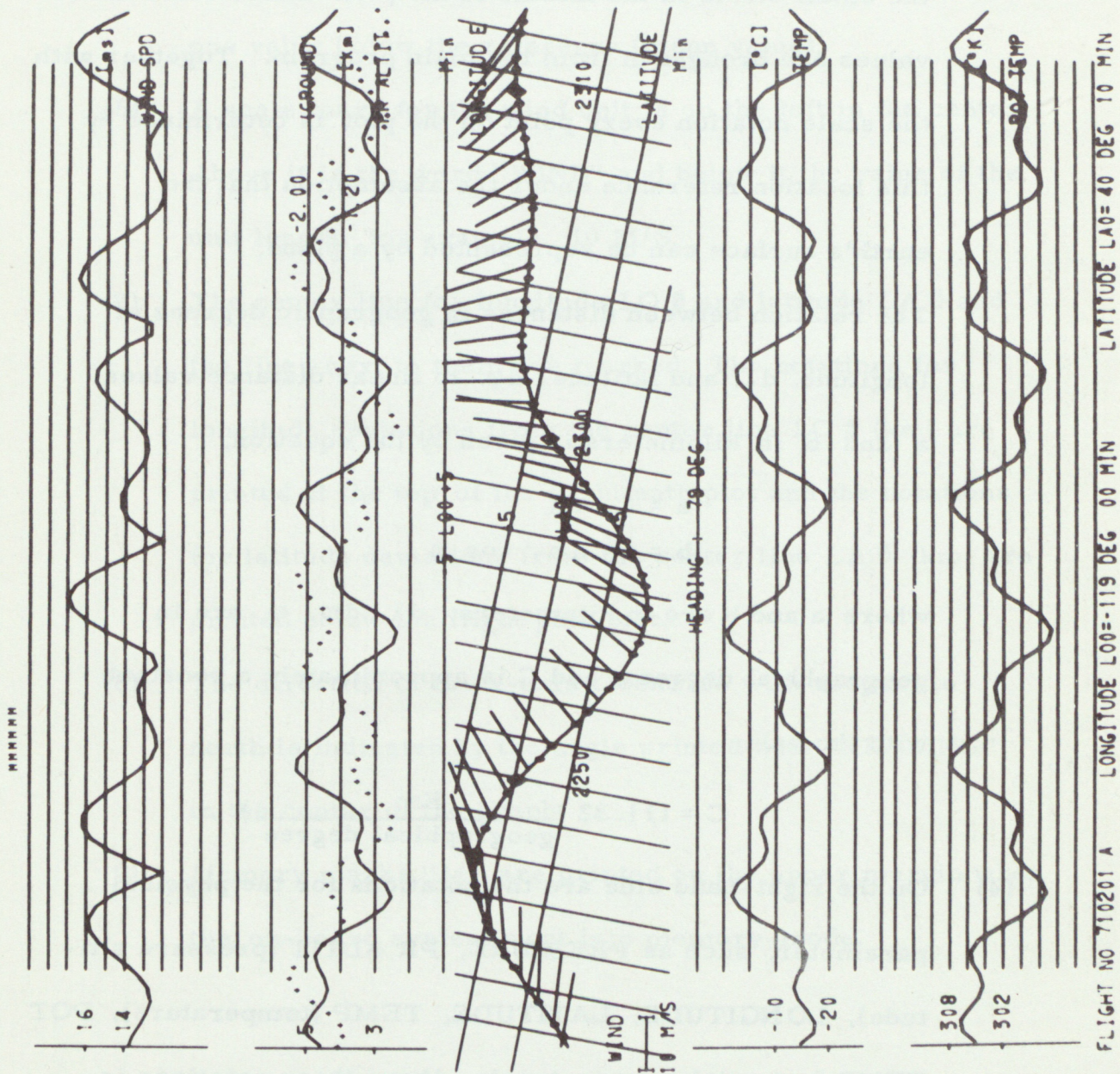


Figure 2. Computer plot

year, the next two the month, and the last two the day of the flight. The letter stands for the particular airplane.

- (2) The center longitude XC and latitude YC in degrees refer to the small circle in the middle of the plot. These reference values are brought in from the main program. Together with the scale notation every point on the plot is determined by this location reference under the assumption that the earth's surface can be represented by a plane.

The relation between distances in geographic degrees of longitude, $d\lambda$, and latitude, $d\varphi$, to linear distance values a and b , in kilometers is given by the equation,

$$\begin{aligned} a &= C \cdot d\lambda \\ b &= C \cdot d\varphi \cdot \cos \varphi, \end{aligned}$$

where a and b are in kilometers; $d\lambda$, $d\varphi$, φ are in geographical degrees; and C is approximately a constant with the value

$$C = 111.32 \left(\frac{\text{Km}}{\text{geographical degree}} \right) .$$

- (4) On the right-hand side are the notations for the physical parameter, such as PRESSURE, PR ALTIT (pressure altitude), LONGITUDE, LATITUDE, TEMP (temperature), POT TEMP (potential temperature). Above these notations is the unit of measurement, such as mb (millibar), km

- (kilometers), °C (degrees Celsius), °K (degrees Kelvin).
- (5) On the left-hand side are two values, automatically generated, for each parameter that determine the scale. The attempt was to select them so that one value is above and one value below the reference (mean value).
 - (6) A scale mark for the wind unit is on the left in the center. Above it is the word "WIND" and below it the value of the unit length, for example, 10 M/S.
 - (7) The center line for longitude LO $\emptyset$ and latitude LA $\emptyset$ and the lines next to them are marked. The notations for longitude deviations from the center line LO $\emptyset$ (km) are printed at the top of the flight path plot and the notations for latitude deviations from the center line LA $\emptyset$ (km) are printed below the flight path plot.
 - (8) The direction of the x-axis clockwise with respect to north is indicated by the angle printed with "HEADING:" in the center of the graph.
 - (9) Memory marks "M" are printed on the upper margin when the on-board system went into memory-mode.

2. TILTING GEOMETRY

Figure 3 shows the geometry involved in tilting the coordinate system. There α is the angle by which the straight line approximation has to be tilted to coincide with the x-axis; φ is the polar coordinate angle of a point on the curve, and R is its distance from the zero point; X and Y are the Cartesian coordinates of the curve point in reference to earth coordinates; and X' and Y' are the Cartesian coordinates of the curve point in reference to the tilted coordinate system.

The slope $f'(0)$ of the flight path with respect to earth coordinates at the center point of the coordinate system is

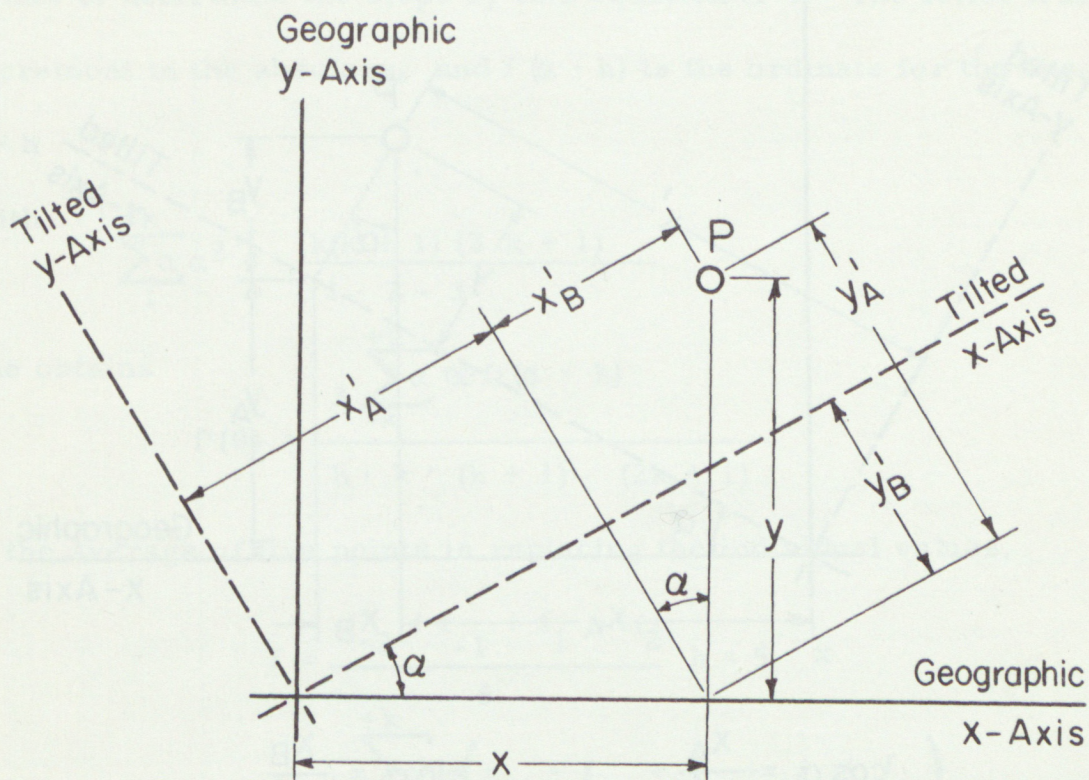
$$f'(0) = \frac{\sum_{\alpha=-k}^k \alpha \cdot f(\alpha \cdot h)}{2h \sum_{\alpha=1}^k \alpha^2}$$

where α is the increment count, and k is the count limit. For $k = 2$, for example, the count sequence is

$$\alpha = -2, -1, 0, 1, 2.$$

Thus the number of points is

$$n = 2k + 1.$$



$$\cos \alpha = \frac{x_A'}{x}$$

$$\sin \alpha = \frac{x_B'}{y}$$

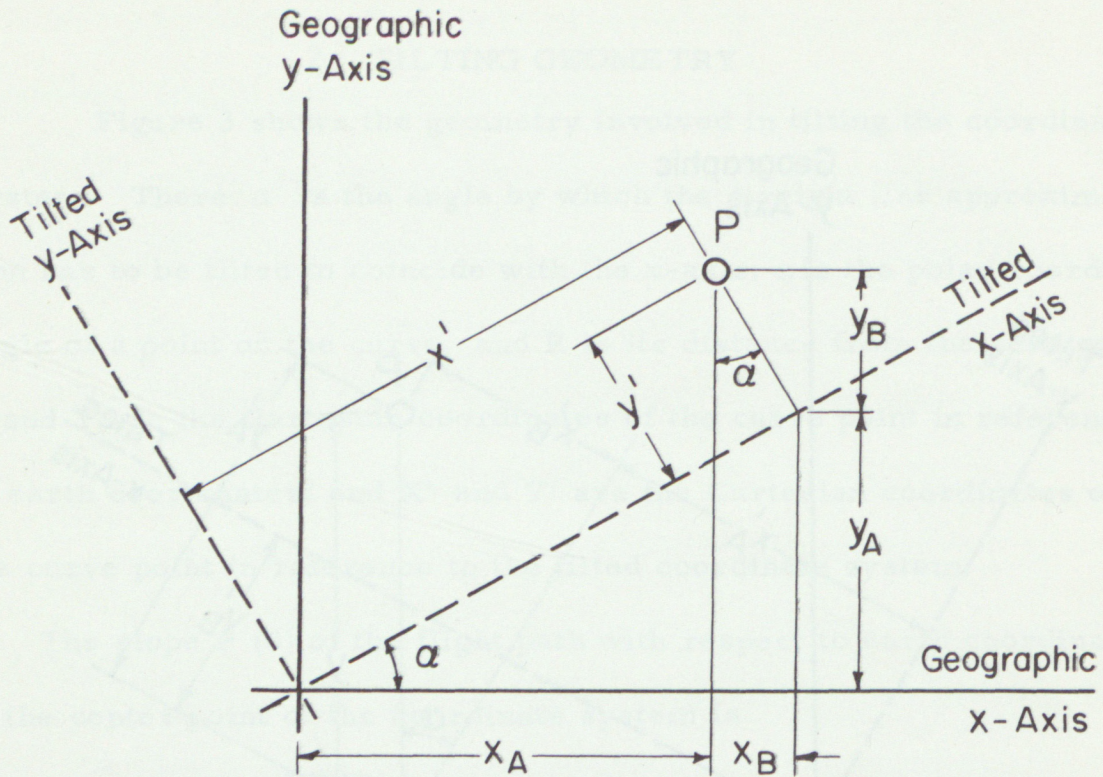
$$\cos \alpha = \frac{y_A'}{y}$$

$$\sin \alpha = \frac{y_B'}{x}$$

$$x' = x_A' + x_B' = x \cdot \cos \alpha + y \cdot \sin \alpha$$

$$y' = y_A' - y_B' = y \cdot \cos \alpha - x \cdot \sin \alpha$$

Figure 3. Geometry in Converting from the Geographical System to the Plotting System.



$$\cos \alpha = \frac{x_A}{x'}$$

$$\sin \alpha = \frac{x_B}{y'}$$

$$\cos \alpha = \frac{y_B}{y'}$$

$$\sin \alpha = \frac{y_A}{x'}$$

$$x = x_A - x_B = x' \cdot \cos \alpha - y' \cdot \sin \alpha$$

$$y = y_A + y_B = x' \cdot \sin \alpha + y' \cdot \cos \alpha$$

Figure 4. Geometry in Converting from the Plotting System to the Geographical System.

The lowest value that k can take is one; thus the smallest number of points to determine the slope by this equation is 3. The letter h is the increment in the abscissa, and $f(\alpha \cdot h)$ is the ordinate for the abscissa $\alpha \cdot h$

With

$$\sum_{\alpha=1}^k \alpha^2 = \frac{k(k+1)(2k+1)}{1 \cdot 2 \cdot 3}$$

one obtains

$$f'(0) = \frac{3 \sum_{\alpha=-k}^{+k} \alpha \cdot f(\alpha \cdot h)}{h \cdot k \cdot (k+1) \cdot (2k+1)}$$

If the average of five points is replacing the individual values,

$$f = \frac{f_{-2} + f_{-1} + f_1 + f_2}{5} \quad h = 5 \cdot x$$

$$f'(0) = \frac{3}{5} \cdot \frac{\sum_{\alpha=-k}^{+k} \alpha \cdot (f_{-2} + f_{-1} + f_0 + f_1 + f_2)}{h \cdot k \cdot (k+1) \cdot (2k+1)}$$

The flight path is represented by an uneven multiple of five points.

Table 1 shows the use of the coordinate points.

From the distribution of points the interval h is computed as

$$h = 5 * \frac{X_{IPQ} - X_{IQ}}{IP - 1}$$

As long as the average curve has a slope between -45° and $+45^\circ$ or between 135° and 225° , the abscissa values are used to determine h .

If the slope of the average curve is between 45° and 135° or between

Table 1. Use of Coordinate Points

Total Number of Points	Number of Intervals	Number of Lower Upper Limit Point		Number of Center Point	First Value of α -KP
n	IP - 1	IQ	IPQ	IR	KA+1
15	14	1	15	8	-1
16	14	1	15	8	-1
17	14	2	16	9	-1
18	14	2	16	9	-1
19	14	3	17	10	-1
20	14	3	17	10	-1
21	14	4	18	11	-1
22	14	4	18	11	-1
23	14	5	19	12	-1
24	14	5	19	12	-1
25	24	1	25	13	-2
26	24	1	25	13	-2
27	24	2	26	14	-2
28	24	2	26	14	-2
29	24	3	27	15	-2
30	24	4	28	16	-2
31	24	4	28	16	-2
32	24	4	28	16	-2
33	24	5	29	17	-2
34	24	5	29	17	-2
35	34	1	35	18	-3
36	34	1	35	18	-3
37	35	2	36	19	-3

225° and 315°, the ordinate values are used to determine h . The resulting slope is then reversed to obtain the slope with respect to the abscissa.

In most cases several grid lines reach the margin of the plot. Then the end points of the grid lines are computed from their intersection (XT for longitude lines; XU for latitude lines) with the abscissa and the abscissa increment (XM for longitude lines; XN for latitude lines) for full ordinate increments of $\pm YV$.

If less than 4 grid lines reach the margin, the end points have to be computed from the intersection of the grid line with the ordinate axis and the ordinate increment for full abscissa increments.

Formally the notations (XT, XM) respectively (XU, XN) are used as in the normal orientation. But before plotting, the end point coordinates (XA, YA) respectively (XB, YB) are interchanged so that computed ordinate values are plotted as abscissa values and computed abscissa values are plotted as ordinate values.

Normally the lettering for the longitude scale is located above the upper margin of the plot and the lettering for the latitude scaling below the margin. For abnormal orientation the lettering for that particular grid (either longitude or latitude) is provided along the ordinate axis to the right.

The spacing of the grid lines can either be in incremental values

JSP of kilometers (MD=0) or in incremental values of geographical minutes (MD=1). For the kilometer spacing the center point has an odd value in degrees. For the minute-spacing the center point has an integer value in respect to the increment JSP in geographical minutes.

3. INPUT VALUES

The following parameters listed alphabetically, enter the subroutine:

IFS A six-digit number that determines the scaling. The center two digits are without significance and serve only as a separator. The first two digits are the plotting scale values LSC. $SC = 50.0 / LSC$ is the factor with which the coordinates X and Y (km) are multiplied to obtain the plotting coordinates WX and WY in the 1024-point CRTPLT-system. The last two digits are the wind scale values LWS. $W = 50.0 / LWS$ is the factor with which the wind components OWX and OWY are multiplied to obtain appropriate values in the 1024-point CRTPLT-system. For IFS = 0 automatic scaling is obtained. Then the coordinate factor is $SC = 1024.0 / SPAN$, where SPAN is the largest span (km) in either abscissa or ordinate direction. The wind scale W is given below.

0.5 for WMAX larger than 100 m/sec; 1.0 up to 100 m/sec;

2.0 up to 50 m/sec; 5.0 up to 20 m/sec; 10.0 up to 10 m/sec.

The wind factor $LWS = 50.0/W$.

IM number of measurement points.

IT a 500-word array for the time of the measurement.

IT has seven digits. The first is a 1 needed for printing; the next two are the hour in 24-hour notation; the following two digits represent the minutes, and the last two represent the seconds.

KT record spacing (sec).

LID flight identification array of eight words, as follows:

LID(1) two digits representing the most significant digits of the year of the flight.

LID(2) number of the month, incremented by 1000 to maintain leading zeroes in printing.

LID(3) number of the day, incremented by 1000 to maintain leading zeroes in printing.

LID(4) airplane identifier in Hollerith notation. (The airplane identifier B is thus expressed as 1 HB.)

LID(5) day in two-digit presentation.

LID(6) the first eight letters of the month in Hollerith notation. (The month of September is thus expressed as 8HSEPTEMBE.)

LID(7) extension of the month for the eventually missing ninth letter in two-digit Hollerith notation. If the month has less than nine letters $LID(7) = 2H$.
(For the month of September $LID(7) = 2HR$.)

LID(8) equal to LID(1) and containing the last two digits of the year.

MD selector for grid net spacing.

MD = $\emptyset$ provides kilometer spacing

MD = 1 provides geographical degree spacing

MT spacing of the points on the plot (sec). By means of the equations

$$MI = MT/KT$$

$$MI = KI * KT,$$

it is assured that the spacing of the points on the plot is always an integer number of the record spacing KT. At the same time MT determines the time increments of the time prints. These increments are

1 min for $MT \leq 10$,
5 min for $10 < MT < 60$, and
10 min for $60 \leq MT$.

MW determines the spacing of the wind vectors on the plot.

MW = 1 means that a wind vector is drawn for every coordinate point.

MW = 2 indicates that a wind vector is drawn for every second coordinate point.

OWX 500-word arrays. To save memory spaces, OWX and OWY change their meaning in the program. In the input they represent the wind coordinates (m/sec) with respect to the earth coordinate system. In the course of the program,

OWX and OWY change their reference to the tilted plotting coordinate system.

WMAX largest wind speed (m/sec) to be represented. This value is used for automatic scaling of the wind vectors as explained under IFS.

WXA , x- and y- components of the bias wind .
WYA

If WXA = WYA = 0.0 the wind vectors on the flight path represent the wind actually measured. If the bias wind vector has a value, the wind vectors at the flight path are the difference between the measured and the bias wind.

X, Y 500-word arrays. To save memory spaces, X and Y change their meaning in the program. In the input they represent the flight path coordinates (km) from the reference point with respect to a plane earth coordinate system. In the course of the program, X and Y change their reference to the tilted plotting coordinate system.

XC } longitude and latitude of the reference point in geographical
YC } degrees. This value is printed on the legend.

YM(J) largest deviation of each of the four parameters (which are plotted as traces) from the respective mean value ZA.

YM(5) = $\emptyset$ provides the mean value reference.

Z a matrix of 500 x 5 representing the four meteorological parameters to be plotted and the reference line. The sequence is

Z(1)	pressure (mb).
Z(2)	pressure altitude (km).
Z(3)	temperature (°C)
Z(4)	potential temperature (°K).

ZA(J) mean value of each of the four meteorological parameters to be plotted.

The variables in the main program and SLENDER are compared in Table 2. The lettering is shown in Table 3.

The following variables are used for plotting:

IX, IY, XH	flight path
IX, KY, XH	trace of four meteorological parameters
WX, WY, MN	wind vectors
XA, YA, KM	longitude grid
XB, YB, KN	latitude grid
XCL, YCL, IB	abscissa lines for traces
XCM, YCM, IME	memory marks on upper margin
XD, YD, (KZ)	scaling letters on abscissa
3H = ∅ XE, YE, LN	diamond marks denoting points on the flight path for which time is printed out
XF, YE, (LF)	dimensions of parameters

Table 2. Comparison of Variables

MAIN PROGRAM		SLENDER	
	Dimension		
AY	(4)	ZA	
IFS		IFS	
IW		MW	
JJ	(500)	IT	
KY		MY	
LID	(8)	LID	
LT		MT	
MM		IM	
MT		KT	
OLA		YC	
OLO		XC	
OX	(500)	X	
OY	(500)	Y	
OWX	(500)	OWX	
OWY	(500)	OWY	
YM	(5)	WM	
WBX		WXA	
WBY		WYA	
WMAX		WMAX	
Z	(500.5)	Z	

TABLE 3

SLENDER Lettering

	F	-494					-32
	L	-483	11	(9)	D		-21
	I	-472	12	(7)	E		-10
	G	-461	13	(9)	G		+ 1
	H	-450					-12
	T	-439	(11)	D			-23
		-428	(12)	E	(1)		-34
	N	-417	(13)	G	(5)		-45
	O	-406		R			56
		-395		E	M		67
1	(8)	-384		E	I		78
2	(0)	-373		S	N		89
3	(7)	-362					
4	(0)	-351					
5	(3)	-340			L		184
		-329			A		195
6	(B)	-318			T		206
		-307			I		217
		-296			T		228
		-285			U		239
		-274			D		250
		-263			E		261
		-252					272
		-241			L		283
	L	-230			A		294
	O	-219			O		305
	N	-208			=		316
	G	-197	14				327
	I	-186	15	(4)			338
	T	-175	16	(0)			349
	U	-164					360
	D	-153	17	(8)	D		371
	E	-142	18	(7)	E		382
		-131	19	(4)	G		393
	L	-120					404
	O	-109			D		415
	0	- 98	17	E	(2)		426
	=	- 89	18	G	(5)		437
7		- 76	19	R			448
8	(2)	- 65		E	M		459
9	(5)	- 54		E	I		470
10	(8)	- 43		S	N		481

XG, YG, NG, LG	lettering of parameter names
XHD, YHD, NHD, IHD	lettering for heading
XHI, YHI, IHD	insert letters for heading
XJA, YJA, JLX	longitude scaling
XJB, YJB, JLY	latitude scaling
XK, YK, (IZ)	time numerals
XKL, YKL, NQ, KL	legend letters
XKQ, YKQ, (KQ)	legend inserts
XLA, YLA, LA	lettering of wind scaling
XNA, YNA	wind scale line
3H+ØI XNA, YNA	end points of wind scale
XP, YP	ordinate lines
3H+Ø(XR, YR, LL	circle time marks on the flight path
XZ, YZ, ID	limits of the plot and identifica- tion of the user

4. GENERAL STRUCTURE

0 PLUS 16	Data input
105	Values for time print
1601	Flight path approximation
1609	Conversion of path coordinates

1615	Determination of scale factors
1623	Path scaling
1630	Location of time letters
1640 PLUS 2	Plotting of flight path with circle marks and time notations
1650 PLUS 2	Conversion of wind components and plotting of wind vectors
1660 PLUS 3	Wind scale
1739	Longitude grid and scaling
23170	Latitude grid and scaling
29	Plotting of coordinate grid
41	Scaling and plotting of meteorological parameters
45	Determination of plotting of scale marks for meteorological parameters
49	Lettering of parameter plots
57	Lettering of legend

4.1 Timing

ITC	time of the first data point that enters the subroutine in six letter notation. The variables represent sets of two.
IZA	hours
IZC	minutes
IZD	seconds

The time ITC is then converted to seconds, represented by IZE.

Since the plotting time sequence is MT, the time IZF for the first point to be represented on the plot has to be an integer multiple of MT. The largest value that IZF can take is 86400 (midnight).

IZG time increment with which time numbers
 are printed on the plot.

IZH time of the last point on the plot.

IZI number of points to be plotted

IZM first time number to be printed.

JY(1) time of plot points (sec) (later converted to hour-
 minute-second notation).

IZN time number, composed of the four letters IZO,
 IZP, IZS, IZT.

LJK $=2^{30}$. Since Hollerith quantities with three characters
 are used in the plot routine, integer values have to be
 shifted by five characters for conversion (Control Data
 Corporation, 1967, 1.1, "Wind Structure"):

6	6	6	6	6	6	6	6
---	---	---	---	---	---	---	---

4.2 Flight path approximation

IP number of points that can be used for insertion into
 the approximating equation for the flight path. IP
 has to be an integer multiple of five.

IQ number of the first point to be used.

IQP number of the last point to be used in the flight
 path approximation.

IR number of the center point between IQ and IPQ.

KP	first value of $-\alpha$ in the approximating equation.
HX	approximation intervals. The one with the largest absolute value is selected for further computations.
XO	shift of centerpoint in km in geographical
YO	system
SY	sum of weighted function values
P	slope $f'(0)$ of the approximated flight path = tangens of the slope angle.
COA, SIA	cosine and sine of the slope angle.

The approximation of the flight path by a straight line produces a nondirectional slope, so that the tilting angle is not defined in its quadrant. In order to determine the quadrant, directional parameters DX and DY are derived. Figure 5 presents the relation between the directional parameters and the slope. 8 regions can be distinguished.

region	tangens	directional	characteristic
I	+	DY > DX	DY +
II	+	DX > DY	DX +
III	-	DX > DY	DX +
IV	-	DY > DX	DY -
V	+	DY > DX	DY -
VI	+	DX > DY	DX -
VII	-	DX > DY	DX -
VIII	-	DY > DX	DY +

DX, DY difference in coordinates of the end points of the curve.

	0°	90°	180°	270°	360°
TAN	+	-	+	-	
COA	+	-	-	+	
SIA	+	+	-	-	

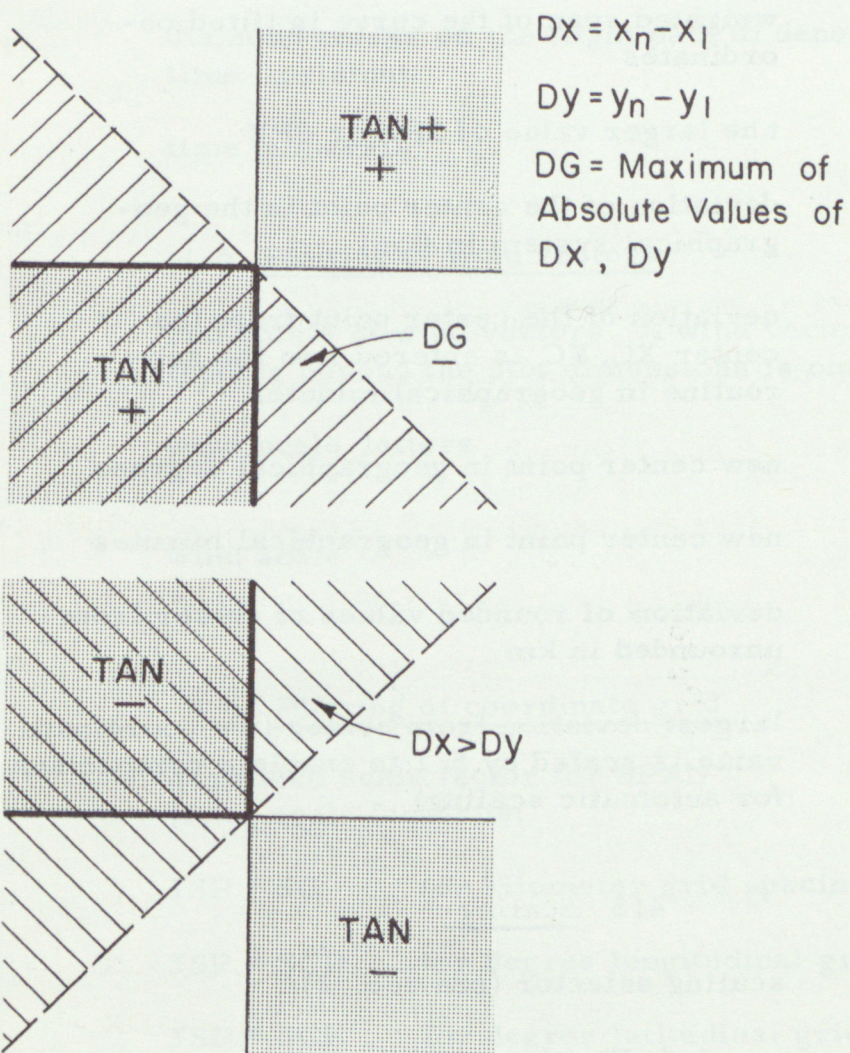


Figure 5. Determination of sign for COA and SIA.

DG	absolute value of the larger one of DX or DY
XMAX, XMIN YMAX, YMIN	extreme values of the curve in the tilted coordinate system
AXA, AYA	center point of the curve in the tilted co- ordinate system in (km)
SPX, SPY	weighted span of the curve in tilted co- ordinates
SPAN	the larger value of SPX or SPY
AX, AY	deviation of the center point in the geo- graphical system in (km)
BX, BY	deviation of the center point from the center XC, YC as entered into the sub- routine in geographical minutes
ZX, ZY	new center point in geographical degrees
CX, CY	new center point in geographical minutes
XQ, YQ	deviation of rounded values of center from unrounded in km
XSA, YSA XSB, YSB	largest deviation from center (the coordinate value is scaled by 5.1 to enable a comparison for automatic scaling)

4.3 Scaling

IFS scaling selector (see sec. 2).

4.4 Plotting of flight path

ZX central values of abscissa and ordinate
ZY in geographical coordinates

WX	scaled plot coordinate points. Their subscript is incremented by two in order to accommodate later the wind vector and points
IX	coordinate points in the integer plotting system
IY	
XR	circle marks on the flight path for time points
YR	
XE	diamond marks on the flight path to denote a time printout
YE	
XK	time numerals
YK	

4.5 Plotting of wind vectors

WX	end points of wind vectors. A wind vector extending beyond the plot dimensions is omitted
WY	
XLA	wind scale letters
YLA	
XNA	wind scale
YNA	

4.6 Plotting of coordinate grid

JSP	quantized scale factor for SPAN (total scale factor is:	
JSP * SC	for kilometer grid spacing	
JSP * SCD	for degree longitudinal grid spacing	
JSP * SCE	for degree latitudinal grid spacing)	

SC	scale factor (for automatic scaling $SC=1024/SPAN$)
SCD	scale factor for longitudinal degree grid
SCE	scale factor for latitudinal degree grid
MC	selector for orientation of longitudinal grid MC = 1 : lines in normal orientation MC = 2 : x- and y- coordinates interchanged
MG	selector for orientation of latitudinal grid MG = 1 : lines in normal orientation MG = 2 : x- and y- coordinates interchanged
XV, YV	coordinates for end of grid in plot units
XM	abscissa increment in plot units of longitudinal lines for ordinate increment of YV
XMA	abscissa increment in plot units of longitudinal lettering for ordinate increment of YVA
YVA	ordinate for longitudinal grid lettering in plot units
XN	abscissa increment in plot units of latitudinal lines for ordinate increment of YV
XNL	abscissa increment in plot units of latitudinal lettering for ordinate increment of YVL
YVL	ordinate for latitudinal grid lettering in plot units
JAX	spacing of longitude lines (on abscissa for $MC=1$; on ordinate for $MG=2$)
JNX	number of longitude lines on one side of the reference longitude line

JXM	number of longitude lines except the reference longitude line
JXN	$= 2 * JXM + 1$: count number of starting point of last longitude line
JXP	$= JXN + 1$ count number of end point of last longitude line
XY	slope value of longitude line for determination of end point of truncated longitude lines
XT	abscissa of center of longitude line
XA	abscissa value of end of longitude line
YA	ordinate value of end of longitude line. For full longitude lines in normal orientation $YA = +100$ plot units. If the line would extend beyond the borderlines of the plot, the line is truncated so that it extends only to $XA = +511.5$ plot units. Then YA has to be determined utilizing XY
XJA, YJA	coordinates of scaling letters, numbers, or signs for longitude
JLX	scaling letters, numbers, or signs for longitude
JNY	number of latitude lines on one side of the reference latitude line
JYM	number of latitude lines except the reference latitude line
JYN	$= 2 * JYM + 1$: count number of starting point of last latitude line
JYP	$= JYN + 1$: count number of end point of last latitude line

YX	slope value of latitude line for determination of end point of truncated latitude lines
XU	abscissa of center of latitude line
XB	abscissa value of end of latitude line
YB	ordinate value of end of latitude line. For full latitude lines in normal orientation $YB = +100$ plot units. If the line would extend beyond the borderlines of the plot, the line is truncated so that it extends only to $XB = +511.5$ plot units. Then YB has to be determined utilizing YX
XJB, YJB	coordinates of scaling letters, numbers, or signs for latitude
JLY	scaling letters, numbers, or signs for latitude

4.7 Scaling and plotting of meteorological parameters

Two different routines are being used depending on YM, the amount of the deviation of the parameter from its mean.

a. YM < 0.01

E scale factor = 0

N(1) = N(2) the truncated mean value ZA(J)

F multiplier for decimal point

The printed value for the mean ZA(J) appears at the ordinate of the particular reference line determined by KYO

Only one value is printed, and no ordinate lines are generated

b. $YM \geq 0.01$

E scale factor for plotting of meteorological parameters

V(1) maximum value of function

V(2) minimum value of function

Three cases are possible for the location of the maximum and the minimum:

	1	2	3
Maximum:	positive	positive	negative
Minimum	positive	negative	negative

Two markers within the range of the function shall be printed. The values are obtained by truncating the extreme values. In the second case this poses no problem. In the first case the minimum would fall outside the range; in the third case the maximum would fall outside the range. To avoid this the mean is replaced for the extreme.

A scale factor F is introduced to obtain a difference in the truncated extreme values from one to less than 10 in the least significant digit.

Then the difference BM of the marker values N from the mean ZA is determined.

For marker values that, including the decimal point, cannot be accommodated in 4 places an asterisk is printed on the abscissa

line, and only the last digits, that fit into 4 places are printed. The following table shows examples of how different values of V appear as ordinate markers.

<u>Value</u>	<u>Printout</u>
12345	*2345
2345	-2345
345	-345
45	-45
5	-5
-2345	*-345
-345	--345
-45	--45
-5	--5
234.5	*34.5
204.5	* 4.5
34.5	-34.5
-34.5	*-4.5
4.5	-4.5
-4.5	--4.5
0.5	-0.5
-0.5	--0.5
23.45	*3.45
3.45	-3.45
-3.45	*-.45
0.45	-0.45
-0.45	--.45
2.345	*.345
0.345	-.345
-0.345	*-*45

Determination and plotting of scale marks, letters, and ordinate lines.

ND	difference of scale marker values
BM	ordinate values of scale marks
KZ	individual scale letters and marks
DV	distance of ordinate lines

BN	ordinate deviation of ordinate line from reference line
IA	number of ordinate lines for each meteorological parameter
IB	total number of ordinate lines
XCL } YCL }	end coordinates of ordinate lines
KY	ordinate values of curves for meteorological parameters
XJ } YJ }	coordinates of ground curve
XL	abscissa values of scale letters for meteorological introduced from the data statement
XLG	abscissa values of scale letters for ground curve introduced from the data statement
XD } YD }	coordinates of scale letters

Lettering plots

XF	coordinates of dimension letters
YF	
LF	dimension letters (some in lower, some in upper case).
XG	coordinates of parameter name letters
YG	
LG	parameter name letters.
XP	ordinate lines.
YP	

Lettering of Legend

XKL	}	legend coordinates
YKL		
NQ		legend character specification
KL		legend letters
KQ		legend insert letters
XKQ	}	insert coordinates
YKQ		

5. ACKNOWLEDGMENT

The author wishes to thank Mrs. J. M. Tucker for her assistance in the debugging of the presented work.

6. REFERENCES

- Tucker, J. M. (1968), Cathode ray tube plotter subroutine, ESSA Tech. Memo. RLTM-OATS 3.
- Lewis, L. David (1970), User's Guide to Cathode Ray Plotter Subroutines, ESSA Tech. Memo. ERLTM-ORSS5
- Control Data Corporation (1967), 3800 Computer Systems Reference Manual: FORTRAN.

APPENDIX A

```

PROGRAM TESTSLEN
  DIMENSION AY(5),JJ(250),LID(8),OWX(250),OWY(250),OX(250),OY(250),
1 SY(5),X(250),Y(250),YM(5),WS(250),Z(250,5),ZMAX(5),ZMIN(5)
1 FORMAT (1H1,8X*MEAN*2X,2E13.3,26X,5E13.3/ 20X *DEGREES* 6X
1 *DEGREES* 34X *M/S* 11X *KM* 9X *DEG C* 8X *DEG K* 9X *KM* //
2 9X *DEVIATIONS FROM MEAN* /
3 11X*TIME*6X*LONG*10X*LAT*10X*WX*11X*WY*8X*WINDSPEED*7X
4 *ALT*9X*TEMP*7X*POT TEMP*6X*GROUND*/10X*H M S* 7X*KM* 12X *KM*
5 10X*M/S*10X*M/S*10X*M/S*11X*KM*9X*DEG C*8X*DEG K*9X*KM*//)
2 FORMAT (9X,I6,9E13.3)
3 FORMAT (1H1 ///8X*ALO REFERENCE LONGITUDE* 13X,F8.3 * DEG*/
1 8X *ALA REFERENCE LATITUDE * F8.3 * DEG*/
2 8X *WXA REFERENCE WIND X * F6.1 * M/S*/
3 8X *WYA REFERENCE WIND Y * F6.1 * M/S*/
4 8X *WMX MEAN WIND X * F6.1 * M/S*/
5 8X *WMY MEAN WIND Y * F6.1 * M/S*/
6 8X *ALT MEAN ALTITUDE * F6.1 * KM*/
7 8X *NN NUMBER OF COORDINATE POINTS * I4 /
8 8X *IFS SCALING CONSTANT * A2,I6 /
9 8X *LT RECORD SPACING * I4 * SEC*/
A 8X *IW WIND VECTOR SEQUENCE * I4 /
B 8X *SPAN COORDINATE SPAN * F8.3 * KM*/
C 8X *WMAX LARGEST WIND SPEED * F6.1* M/SEC*/
D 8X *MD PRESENTATION SELECTOR * I4 /
F 8X *AY(1) WIND SPEED MEAN * F6.1 * M/S*/
G 8X *YM(1) DEVIATION * F6.1 * M/S*/
H 8X *AY(2) PRESSURE ALTITUDE MEAN * F8.3 * KM*/
I 8X *YM(2) DEVIATION * F8.3 * KM*/
J 8X *AY(3) TEMPERATURE MEAN * F6.1 * DEG C*/
K 8X *YM(3) DEVIATION * F6.1 * DEG C*/
L 8X *AY(4) POTENTIAL TEMPERATURE MEAN * F6.1 * DEG K*/
M 8X *YM(4) DEVIATION * F6.1 * DEG K*/
N 8X *AY(5) GROUND MEAN * F8.3 * KM*/
O 8X *YM(5) DEVIATION * F8.3 * KM*////)
DATA (A=5.25588)
DATA (ATO=22.56 E-3)
DATA (CLA=111.32)
DATA (DF=0.03)
DATA (DG=0.2)
DATA (DH=0.3)
DATA (DTR=0.01745329253)
DATA (IA=22),(IB=42),(IC=0)
DATA (IFS=0)
DATA (IW=2)
DATA (LID=71,1002,1001,1HA,1,8HFEBRUARY,2H ,71)
DATA (LT=20)
DATA (NS=20)
DATA (NT=2)
DATA (PIQ=0.785398)
DATA (PF=0.2884)
DATA (NU=1800)
NN=NU/NS+1
CLO=ABS(CLA*COS(DTR*40))
B=0.2-PIQ

```



```

F=0.0
G=0.0
H=0.0
MD=0
P=-0.05*NT+0.5
XP=-45.5-NT
SWX=SWY=0.0
DO 11 I=1,NN
P=P+0.05*NT
X(I)=XP+NT
XP=X(I)
Y(I)=10.0*SIN(P)+6.0*SIN(1.7*P+4.0)
F=F+DF
G=G+DG
WS(I)=12.0+ABS(3.0*SIN(G)+2.0*SIN(2.3*G+2.0))
OWX(I)=WS(I)*COS(F)
OWY(I)=WS(I)*SIN(F)
SWX=SWX+OWX(I)
SWY=SWY+OWY(I)
11 CONTINUE
WMX=SWX/NN
WMY=SWY/NN
DO 50 K=1,8
B=B+PIQ
SIB=SIN(B)
COB=COS(B)
IF (MD .EQ. 0) 20,21
20 MD=1
GOTO 22
21 MD=0
22 SLO=SLA=0.0
SY(1)=SY(2)=SY(3)=SY(4)=SY(5)=0.0
OXMIN=OYMIN= 1.0 E306
OXMAX=OYMAX=-1.0 E306
WMAX =-1.0 E306
ZMIN(1)=ZMIN(2)=ZMIN(3)=ZMIN(4)=ZMIN(5)= 1.0 E306
ZMAX(1)=ZMAX(2)=ZMAX(3)=ZMAX(4)=ZMAX(5)=-1.0 E306
DO 40 I=1,NN
IC=IC+NS
IF (IC .GE. 60) 30,31
30 IB=IB+1
IC=IC-60
31 IF (IB .GE. 60) 32,33
32 IA=IA+1
IB=IB-60
33 IF (IA .GE. 24) IA=IA-24
JJ(I)=IA*10000+IB*100+IC+1000000
OX(I)=X(I)*COB-Y(I)*SIB
OY(I)=X(I)*SIB+Y(I)*COB
IF (OX(I) .LT. OXMIN) OXMIN=OX(I)
IF (OX(I) .GT. OXMAX) OXMAX=OX(I)
IF (OY(I) .LT. OYMIN) OYMIN=OY(I)
IF (OY(I) .GT. OYMAX) OYMAX=OY(I)
IF (WS(I) .GT. WMAX) WMAX=WS(I)

```



```

SLO=SLO+OX(I)
SLA=SLA+OY(I)
G=G+DG
H=H+DH
Z(I,2)=3.9+SIN(H)+0.5*SIN(2.7*H)
CP=(1.0-Z(I,2)*ATO)**A
Z(I,1)=WS(I)
Z(I,3)=14.98-6.49*Z(I,2)
Z(I,4)=(273.16+Z(I,3))/(CP**PF)
Z(I,5)=1.3+0.5*SIN(0.8+G)+0.3*SIN(3.6*G)
SY(1)=SY(1)+Z(I,1)
SY(2)=SY(2)+Z(I,2)
SY(3)=SY(3)+Z(I,3)
SY(4)=SY(4)+Z(I,4)
SY(5)=SY(5)+Z(I,5)
40 CONTINUE
SPX=ABS (OXMAX-OXMIN)
SPY=ABS (OYMAX-OYMIN)
SPAN=MAX1F (SPX,SPY)
WXA=WYA=0.0
ALO=SLO/NN/CLO-120.0
ALA=SLA/NN/CLA+40.0
DO 42 J=1,5
AY(J)=SY(J)/NN
42 CONTINUE
DO 44 J=1,5
DO 43 I=1,NN
Z(I,J)=Z(I,J)-AY(J)
IF (Z(I,J).LT.ZMIN(J)) ZMIN(J)=Z(I,J)
IF (Z(I,J).GT.ZMAX(J)) ZMAX(J)=Z(I,J)
43 CONTINUE
YM(J)=MAX1F(ABSF(ZMIN(J)),ABSF(ZMAX(J)))
44 CONTINUE
ALT=AY(2)
WXA=WYA=0.0
IFA=2H
IFB=IFS+1000000
48 PRINT 3, ALO,ALA,WXA,WYA,WMX,WMY,ALT,NN,IFA,IFB,LT,IW,SPAN,WMAX,
1 MD,AY(1),YM(1),AY(2),YM(2),AY(3),YM(3),AY(4),YM(4),AY(5),YM(5)
PRINT 1, ALO,ALA,(AY(J),J=1,5)
PRINT 2,((JJ(L),OX(L),OY(L),OWX(L),OWY(L),(Z(L,J),J=1,5)),L=1,NN)
DO 49 L=25,30
JJ(L)=JJ(L)+1000000
49 CONTINUE
CALL SLENDER (IFS,LID,IW,LT,JJ,NN,WMAX,YM,
1 ALO,ALA,WMX,WMY,AY,OX,OY,OWX,OWY,Z,MD)
50 CONTINUE
END

```


ALO	REFERENCE LONGITUDE	-119.493	DEG
ALA	REFERENCE LATITUDE	40.097	DEG
WXA	REFERENCE WIND X	0.0	M/S
WYA	REFERENCE WIND Y	0.0	M/S
WMX	MEAN WIND X	1.9	M/S
WMY	MEAN WIND Y	10.0	M/S
ALT	MEAN ALTITUDE	4.0	KM
NN	NUMBER OF CCORDINATE POINTS	91	
IFS	SCALING CONSTANT	000000	
LT	RECORD SPACING	20	SEC
IW	WIND VECTOR SEQUENCE	2	
SPAN	COORDINATE SPAN	175.184	KM
WMAX	LARGEST WIND SPEED	17.0	M/SEC
MD	PRESENTATION SELECTOR	1	
AY(1)	WIND SPEED	MEAN	14.2 M/S
YM(1)		DEVIATION	2.8 M/S
AY(2)	PRESSURE ALTITUDE	MEAN	3.966 KM
YM(2)		DEVIATION	1.556 KM
AY(3)	TEMPERATURE	MEAN	-10.8 DEG C
YM(3)		DEVIATION	10.1 DEG C
AY(4)	POTENTIAL TEMPERATURE	MEAN	302.5 DEG K
YM(4)		DEVIATION	5.9 DEG K
AY(5)	GROUND	MEAN	1.293 KM
YM(5)		DEVIATION	0.805 KM

APPENDIX B

```

SUBROUTINE SLENDER (IFS,LID,MW,MTI,IT,IM,WMAX,
1 YM,XC,YC,WXA,WYA,ZA,X,Y,OWX,OWY,Z,MD)
  DIMENSION BM(2),BN(20),E(5),EK(4),ID(3),IHD(3),IE(3),IT(250),
1 IX(250),IY(250),IZ(60),JLX(12),JLY(12),KH(12),KL(12),KQ(20),
2 KY(250),KYO(5),KZ(2,5,6),LA(9),LF(24),LG(8),LID(8),
3 N(2),NG(6),NHD(6),NQ(6),OWX(250),OWY(250),V(2),WX(500),WY(500),
4 X(250),XA(100),XB(100),XCL(100),XCM(250),XD(2,5,6),XE(15),XF(24),
5 XG(8),XHI(3),XJ(250),XJA(12),XJB(12),XK(60),XKQ(20),XKR(20),
6 XL(6),XLA(9),XLG(6),XNA(2),XP(8),XR(200),XT(100),XU(100),XX(2),
7 XZ(2),Y(250),YA(100),YB(100),YCL(100),YCM(250),YD(2,5,6),YE(15),
8 YF(24),YG(8),YHI(3),YJ(250),YJA(12),YJB(12),YK(60),YKQ(20),
9 YLA(9),YM(5),YNA(2),YP(8),YR(200),YY(2),YZ(2),Z(250,5),ZA(5)
  DATA (CLA=1.8553)
  DATA (DTR=0.01745329253)
  DATA (EK=10.0, 100.0, 10.0, 10.0)
  DATA (ID=19HH.GROTE EXT. 6270)
  DATA (IJK=1073741824)
  DATA (IHD=17HHEADING 9 DEG )
  DATA (KH=90HFLIGHT NO LONGITUDE LOO= DEG MIN
1 LATITUDE LAO= DEG MIN )
  DATA (KL=90HFLIGHT NO LONGITUDE LOO= . DEGREES
1 LATITUDE LAO= . DEGREES )
  DATA (KYO=922,717,307,102,717)
  DATA (LA=3H+0W,3H+0I,3H+0N,3H+0D,0,0,3H+0M,3H+0/,3H+0S)
  DATA (LF=6(3H+0'),3H+0M,3(3H+0K),2(3H+0*),
1 3H+0S,3(3H+0M),3H+0C,3H+0K,6(3H+0Z)),
  DATA (LG=8HWIND SPD,8H(GROUND),8HPR ALTIT,8HLONGITUD,1HE,
1 8HLATITUDE,4HTEMP,8HPOT TEMP)
  DATA (NG=1,0,0,0,0,1)
  DATA (NHD=3,0,0,0,0,1)
  DATA (NQ=12,0,0,0,0,1)
  DATA (XF=6(454.0),6(466.0),6(478.0),6(490.0)),
1 (YF=4(430.0, 205.0, 110.0, -110.0, -185.0, -390.0))
  DATA (XG=3(406.0),394.0,490.0,406.0,454.0,406.0),
1 (YG=390.0, 240.0, 170.0, 2(80.0), -80.0, -225.0, -430.0)
  DATA (XHD=-88.0),(YHD=-125.0)
  DATA (XHI=22.0,33.0,44.0),(YHI=3(-125.0))
  DATA (XKL=-494.0),(YKL=-511.5)
  DATA (XKQ=-384.0, -373.0, -362.0, -351.0, -340.0, -329.0, -307.0,
1 -76.0, -65.0, -54.0, -43.0, -21.0, -10.0, 1.0,
2 327.0, 338.0, 349.0, 371.0, 382.0, 393.0),(YKQ=20(-511.5))
  DATA (XKR=-384.0, -373.0, -362.0, -351.0, -340.0, -329.0, -307.0,
1 -76.0, -65.0, -54.0, -43.0, 34.0, 45.0, 56.0,
2 327.0, 338.0, 349.0, 426.0, 437.0, 448.0 )
  DATA (XLA=-499.5,-487.5,-475.5,-463.5,-511.5,
1-499.5,-475.5,-463.5,-451.5),(YLA=4(-50.0),5(-100.0))
  DATA (XLG=300.0,312.0,324.0,336.0,348.0,360.0)
  DATA (XNA=-511.5,-461.5),(YNA=2(-80.0))
  DATA (XX=0.0,1.0),(YY=0.0,1.0)
  DATA (XZ=511.5,-511.5),(YZ=511.5,-511.5)
  DATA (YP=490.0, 330.0, 285.0, 125.0,-125.0,-285.0,-330.0,-490.0)
  XMIN=YMIN=1.0E306
  XMAX=YMAX=-1.0E306
  MS=0

```



```

CLO=CLA*(COS(YC*DTR))
MP=MTI*(IM/50 +1)
MT=300
IF (MP .LT. 210) MT=120
IF (MP .LT. 90) MT=60
IF (MP .LT. 45) MT=30
IF (MP .LT. 25) MT=20
IF (MP .LT. 15) MT=10
IF (MP .LT. 7) MT=5
MQ=MTI*IM
MU=30
IF (MQ .LT. 6000) MU=20
IF (MQ .LT. 3000) MU=10
IF (MQ .LT. 1500) MU=5
IF (MQ .LT. 600) MU=2
IF (MQ .LT. 300) MU=1
ITC=IT(1)-1000000
IF (ITC .GE. 1000000) ITC=ITC-1000000
IZA=ITC/10000
IZB=ITC-IZA*10000
IZC=IZB/100
IZD=IZB-IZC*100
IZE=IZA*3600+IZC*60+IZD
IZF=((IZE-1)/MT +1)*MT
JYH=IZF/3600
IZG=IZF-JYH*3600
JYM=IZG/60
JYS=IZG-JYM*60
IZH=(IZE+59)/60
IZI=((IZH-1)/MU +1)*MU
JZH=IZI/60
JZM=IZI-JZH*60
JY=JYH*10000+JYM*100+JYS
JZ=JZH*10000+JZM*100
108 IP=(IM+5)/10*10-5
IQ=(IM-IP)/2+1
IR=(IP-1)/2+IQ
IPQ=IP+IQ-1
SY=0.0
IQM=IQ+2
KP=IP/10
KA=-KP-1
HX=(X(IPQ)-X(IQ))/(IP-1)*5.0
HY=(Y(IPQ)-Y(IQ))/(IP-1)*5.0
XS=0.0
DO 109 I=1,IM
XS=XS+X(I)
109 CONTINUE
XO=XS/IM
YS=0.0
DO 11 I=1,IM
YS=YS+Y(I)
11 CONTINUE
YO=YS/IM

```



```

      IF (ABS(HY).GT.ABS(HX)) 12,14
12 DO 13 I=IQM,IPQ,5
      KA=KA+1
      SY=SY+KA*((X(I-2)+X(I-1)+X(I)+X(I+1)+X(I+2))/5.0-XO)
13 CONTINUE
      HX=HY
      MS=1
      GOTO 16
14 DO 15 I=IQM,IPQ,5
      KA=KA+1
      SY=SY+KA*((Y(I-2)+Y(I-1)+Y(I)+Y(I+1)+Y(I+2))/5.0-YO)
15 CONTINUE
16 P=SY/HX/KP/(KP+1)/(KP+KP+1)*3.0
      IF (MS.EQ.1) P=1.0/P
      SQ=SQRT(1.0+P*P)
      COA=1.0/SQ
      SIA=P/SQ
      DX=X(IM)-X(1)
      DY=Y(IM)-Y(1)
      DG=DY
      IF (ABS(DX).GT.ABS(DY)) DG=DX
      IF (((DG.LT. 0.0).AND. (P.GT. 0.0)).OR. ((DX.LT. DY).AND.
1 (P.LT. 0.0))) 1601,1602
1601 COA=-COA
      SIA=-SIA
1602 A=(ASIN(ABS(SIA)))/DTR
      IF ((SIA.GT. 0.0).AND. (COA.LT. 0.0)) A=180.0-A
      IF ((SIA.LE. 0.0).AND. (COA.LE. 0.0)) A=180.0+A
      IF ((SIA.LT. 0.0).AND. (COA.GT. 0.0)) A=360.0-A
      LH=90.5-A
      IF (LH.LT. 0) LH=LH+360
      DO 1603 I=1,IM
      XI=X(I)-XO
      YI=Y(I)-YO
      X(I)=XI*COA+YI*SIA
      Y(I)=YI*COA-XI*SIA
      IF (X(I).GT.XMAX) XMAX=X(I)
      IF (X(I).LT.XMIN) XMIN=X(I)
      IF (Y(I).GT.YMAX) YMAX=Y(I)
      IF (Y(I).LT.YMIN) YMIN=Y(I)
1603 CONTINUE
      AXA=(XMAX+XMIN)/2.0
      AYA=(YMAX+YMIN)/2.0
      SPX=XMAX-XMIN
      SPY=(YMAX-YMIN)*5.1
      SPAN=AMAX1(SPX,SPY)
      GOTO (1605,1604) MD+1
1604 JSP=50
      IF (SPAN.LE. 927.5) JSP=20
      IF (SPAN.LE. 463.8) JSP=10
      IF (SPAN.LE. 231.9) JSP= 5
      IF (SPAN.LE.  92.8) JSP= 2
      LF(3)=LF(4)=3H+0M
      LF(9)=LF(10)=3H+0I

```



```

LF(15)=LF(16)=3H+0N
LF(21)=LF(22)=3H+0
GOTO 1606
1605 JSP=50
IF (SPAN .LE. 500.0) JSP=20
IF (SPAN .LE. 250.0) JSP=10
IF (SPAN .LE. 125.0) JSP= 5
LF(3)=LF(4)=3H+0I
LF(9)=LF(10)=3H+0K
LF(15)=LF(16)=3H+0M
LF(21)=LF(22)=3H+0Z
1606 AX=AXA*COA-AYA*SIA
AY=AXA*SIA+AYA*COA
BX=(XO+AX)/CLO
BY=(YO+AY)/CLA
ZX=XC+BX/60.0
ZY=YC+BY/60.0
GOTO (1608,1607) MD+1
1607 ZXU=ZX
ZYU=ZY
CX=XC*60.0+BX
CY=YC*60.0+BY
R=JSP/2.0
ZX=INT((CX+SIGN(R,CX))/JSP)*JSP/60.0
ZY=INT((CY+SIGN(R,CY))/JSP)*JSP/60.0
XQ=(ZX-ZXU)*CLO*60.0
YQ=(ZY-ZYU)*CLA*60.0
AXA=XQ*COA+YQ*SIA+AXA
AYA=YQ*COA-XQ*SIA+AYA
1608 DO 1609 I=1,IM
X(I)=X(I)-AXA
Y(I)=Y(I)-AYA
1609 CONTINUE
XSA=XMAX-AXA
XSB=AXA-XMIN
YSA=(YMAX-AYA)*5.1
YSB=(AYA-YMIN)*5.1
SPA=AMAX1(XSA,XSB,YSA,YSB)
GOTO (1611,1610) IFS+1
1610 LSC=IFS/10000
LWS=IFS-LSC*10000
SC=50.0/LSC
W=50.0/LWS
GOTO 1612
1611 SC=510.0/SPA
LSC=50.0/SC
W=0.5
IF (WMAX.LE.100.0) W=1.0
IF (WMAX.LE. 50.0) W=2.0
IF (WMAX.LE. 20.0) W=5.0
IF (WMAX.LE. 10.0) W=10.0
LWS=50.0/W
1612 GOTO (1613,1614) MD+1
1613 SCD=SCE=SC

```



```

      GOTO 1615
1614 SCD=SC*CLO
      SCE=SC*CLA
1615 IME=0
      K=-3
      L=0
      LL=1
      DO 1632 I=1,IM
      IN=I+I-1
      WX(IN)=X(I)*SC
      IX(I)=WX(IN)+511.5
      WY(IN)=Y(I)*SC
      IY(I)=WY(IN)+511.5
      IT(I)=IT(I)-1000000
      IF (IT(I) .GE. 1000000) 1616,1617
1616 IT(I)=IT(I)-1000000
      IME=IME+1
      XCM(IME)=WX(IN)
      YCM(IME)=511.5
1617 IDY=IT(I)-JY
      IF (IDY) 1619,1621,1618
1618 IF (IDY .GE. MT) 1632,1621
1619 IF (IDY .LT. (MT-240000)) 1621,1632
1621 XR(LL)=IX(I)-512
      YR(LL)=IY(I)-512
      LL=LL+1
      JYS=JYS+MT
1622 IF (JYS .GE. 60) 1623,1624
1623 JYS=JYS-60
      JYM=JYM+1
      GOTO 1622
1624 IF (JYM .GE. 60) 1625,1626
1625 JYM=JYM-60
      JYH=JYH+1
1626 IF ((JYH .GE. 24) .AND. (IT(I) .LE. MT)) JYH=0
      JY=JYH*10000+JYM*100+JYS
      IDZ=IT(I)-JZ
      IF (IDZ) 1628,1629,1627
1627 IF (IDZ .GE. MU) 1632,1629
1628 IF (IDZ .LT. (MU-240000)) 1629,1632
1629 K=K+4
      L=L+1
      IZO=JZH/10
      IZP=JZH-IZO*10
      IZS=JZM/10
      IZT=JZM-IZS*10
      IZ(K )=IZO*IJK
      IZ(K+1)=IZP*IJK
      IZ(K+2)=IZS*IJK
      IZ(K+3)=IZT*IJK
      XE(L )=WX(IN)
      YE(L )=WY(IN)
      XK(K )=WX(IN)-12.0
      XK(K+1)=WX(IN)

```



```

      XK(K+2)=WX(IN)+12.0
      XK(K+3)=WX(IN)+24.0
      JZM=JZM+MU
      IF (JZM .GE. 60) 1630,1631
1630 JZM=JZM-60
      JZH=JZH+1
1631 IF ((JZH .GE. 24) .AND. (IT(I) .LE. MU)) JZH=0
      JZ=JZH*10000+JZM*100
1632 CONTINUE
      MK=K+3
      LN=L
      XH=IM
      CALL CRTPLT (XZ,YZ,3,ID,2)
      CALL CRTPLT (XH,1.0,IX,IY,18)
      CALL CRTPLT (0,0,3H+0M,0,5)
      CALL CRTPLT (XCM,YCM,IME,0,1)
      CALL CRTPLT (0,0,3H+0,,6,5)
      CALL CRTPLT (XE,YE,LN,0,1)
      DO 1640 K=1,MK
      YK(K)=-18.0
      CALL CRTPLT (0,0,IZ(K),1,5)
      CALL CRTPLT (XK(K),YK(K),1,1,1)
1640 CONTINUE
      CALL CRTPLT (XHD,YHD,NHD,IHD,10)
      IHA=LH/100
      IE(1)=IHA*IJK
      IF (IHA .EQ. 0) IE(1)=3H+0
      IHB=LH-IHA*100
      IHC=IHB/10
      IE(2)=IHC*IJK
      IF (IHC .EQ. 0) IE(2)=3H+0
      IHE=IHB-IHC*10
      IE(3)=IHE*IJK
      DO 1641 IH=1,3
      CALL CRTPLT (0,0,IE(IH),1,5)
      CALL CRTPLT ( XHI(IH),YHI(IH),1,1,1)
1641 CONTINUE
      IF (ABS(WX(M+1)) .GT. 511.5) 1642,1643
1642 WX(M+1)=WX(M)
1643 WY(M+1)=WY(M)+OWY(I)*W
      CALL CRTPLT (0,0,3H+0(,4,5)
      CALL CRTPLT (XR,YR,LL,0,1)
      M=-1
      IN=1-MW-MW
      DO 1650 I=1,IM,MW
      M=M+2
      IN=IN+MW+MW
      XW=OWX(I)
      YW=OWY(I)
      OWX(I)=XW*COA+YW*SIA
      OWY(I)=YW*COA-XW*SIA
      WX(M)=WX(IN)
      WX(M+1)=WX(M)+OWX(I)*W
      WY(M)=WY(IN)

```



```

      IF (ABS(WX(M+1)).GT.511.5) 1644,1645
1644 WX(M+1)=WX(M)
      WY(M+1)=WY(M)
      GOTO 1650
1645 WY(M+1)=WY(M)+OWY(I)*W
1650 CONTINUE
      MN=M+1
      WX(MN+1)=0.0
      WX(MN+2)=(WXA*SIA+WYA*COA)*W
      WY(MN+1)=0.0
      WY(MN+2)=(WXA*COA-WYA*SIA)*W
      MN=MN+2
      CALL CRTPLT (WX,WY,MN,1,9)
      LWA=LWS/10
      LWB=LWS-LWA*10
      LA(5)=LWA*IJK
      IF (LWA.EQ.0) LA(5)=2H+0
      LA(6)=LWB*IJK
      DO 1660 LZ=1,9
      CALL CRTPLT (0,0,LA(LZ),1,5)
      CALL CRTPLT (XLA(LZ),YLA(LZ),1,1,1)
1660 CONTINUE
      CALL CRTPLT (0,0,3H+0I,1,5)
      CALL CRTPLT (XNA,YNA,2,0,1)
      CALL CRTPLT (XNA,YNA,2,0,9)
      IF (ABS(COA) .LT. 0.01) 1703,1702
1702 JAX=(JSP*SCD)/COA
      JNX=IABS(512/JAX)
      IF (JNX .LE. 3) 1703,1704
1703 XV=100.0
      YV=YVA=511.5
      XM=XMA=YV/P
      XY=1.0/P
      MC=2
      JAX=(JSP*SCD)/SIA
      JNX=IABS(100/JAX)
      GOTO 1705
1704 XV=511.5
      YV=100.0
      YVA=1.1*YV
      XM=YV*P
      XMA=1.1*XM
      XY=P
      MC=1
1705 JXM=JNX+JNX
      XT(1)=-JNX*JAX
      DO 1706 I=1,JXM
      XT(I+1)=XT(I)+JAX
1706 CONTINUE
      JXN=JXM+JXM+1
      JXP=JXN+1
      KC=0
      DO 1716 K=1,JXN,2
      KC=KC+1

```



```

XA(K)=XT(KC)-XM
YA(K)=-YV
IF (XA(K) .LT. -XV) 1707,1708
1707 YA(K)=(-XT(KC)-XV)/XY
XA(K)=-XV
GOTO 1710
1708 IF (XA(K) .GT. XV) 1709,1710
1709 YA(K)=(-XT(KC)+XV)/XY
XA(K)=XV
1710 IF ((KC .GE. JNX) .AND. (KC .LE. (JNX+2))) 17100,1711
17100 XA(K+1)=XT(KC)+XMA
YA(K+1)=YVA
GOTO 1712
1711 XA(K+1)=XT(KC)+XM
YA(K+1)=YV
1712 IF (XA(K+1) .LT. -XV) 1713,1714
1713 XA(K+1)=-XV
YA(K+1)=(-XT(KC)-XV)/XY
GOTO 1716
1714 IF (XA(K+1) .GT. XV) 1715,1716
1715 XA(K+1)=XV
YA(K+1)=(-XT(KC)+XV)/XY
1716 CONTINUE
IF ((SIA .GE. 0.0) .AND. (COA .GE. 0.0)) 1717,1718
1717 JLX(1)=JLY(1)=3H+0-
JLX(9)=JLY(9)=3H+0+
GOTO 1724
1718 IF ((SIA .GE. 0.0) .AND. (COA .LT. 0.0)) 1719,1720
1719 JLX(1)=JLY(1)=3H+0-
JLX(9)=JLY(9)=3H+0+
GOTO 1724
1720 IF ((SIA .LT. 0.0) .AND. (COA .LT. 0.0)) 1721,1722
1721 JLX(1)=JLY(1)=3H+0-
JLX(9)=JLY(9)=3H+0+
GOTO 1724
1722 IF ((SIA .LT. 0.0) .AND. (COA .GE. 0.0)) 1723,1724
1723 JLX(1)=JLY(1)=3H+0-
JLX(9)=JLY(9)=3H+0+
1724 IF (JSP .GE. 100) 1725,1726
1725 JDA=JSP/100
JDD=JSP-JDA*100
JDB=JDD/10
JDC=JDD-JDB
JLX(2)=JLX(10)=JLY(2)=JLY(10)=JDA*IJK
JLX(3)=JLX(11)=JLY(3)=JLY(11)=JDB*IJK
JLX(4)=JLX(12)=JLY(4)=JLY(12)=JDC*IJK
GOTO 1729
1726 IF (JSP .GE. 10) 1727,1728
1727 JDA=JSP/10
JDB=JSP-JDA*10
JLX(2)=JLX(10)=JLY(2)=JLY(10)=JDA*IJK
JLX(3)=JLX(11)=JLY(3)=JLY(11)=JDB*IJK
JLX(4)=JLX(12)=JLY(4)=JLY(12)=3H+0
GOTO 1729

```



```

1728 JLX(2)=JLX(10)=JLY(2)=JLY(10)=JSP*IJK
      JLX(3)=JLX(4)=JLX(11)=JLX(12)=JLY(3)=JLY(4)=JLY(11)=JLY(12)=3H+0
1729 JLX(6)=JLY(6)=3H+0L
      JLX(5)=3H+0
      JLY(5)=3H+0
      JLX(7)=3H+00
      JLY(7)=3H+0A
      JLX(8)=JLY(8)=3H+00
      GOTO (1730,1738) MC
1730 XJA(1)=XA(JXM )-12.0
      XJA(2)=XA(JXM )
      XJA(3)=XA(JXM )+12.0
      XJA(4)=XA(JXM )+24.0
      IF ((XJA(1).LT.-439.5).OR.(XJA(4).GT.442.0)) 1731,1732
1731 XJA(1)=-511.5
      XJA(2)=-499.5
      XJA(3)=-487.5
      XJA(4)=-475.5
      XJA(5)=-463.5
      JLX(5)=3H+0-
1732 XJA(6)=XA(JXM+2)-12.0
      XJA(7)=XA(JXM+2)
      XJA(8)=XA(JXM+2)+12.0
      IF ((XJA(6).LT.-511.5).OR.(XJA(8).GT.442.0)) 1733,1734
1733 JLX(6)=JLX(7)=JLX(8)=2H+0
1734 XJA(9)=XA(JXM+4)-12.0
      XJA(10)=XA(JXM+4)
      XJA(11)=XA(JXM+4)+12.0
      XJA(12)=XA(JXM+4)+24.0
      IF ((XJA(9).LT.-511.5).OR.(XJA(11).GT.442.0)) 1735,1736
1735 JLX(9)=JLX(10)=JLX(11)=JLX(12)=2H+0
1736 DO 1737 K=1,12
      YJA(K)=YVA
1737 CONTINUE
      GOTO 25010
1738 XJA(1)=XJA(6)=XJA(9)=11.0
      XJA(2)=XJA(7)=XJA(10)=22.0
      XJA(3)=XJA(8)=XJA(11)=33.0
      XJA(4)=XJA(12)=44.0
      XJA(5)=55.0
      YJA(1)=YJA(2)=YJA(3)=YJA(4)=YJA(5)=XT(JNX)
      YJA(6)=YJA(7)=YJA(8)=XT(JNX+1)
      YJA(9)=YJA(10)=YJA(11)=YJA(12)=XT(JNX+2)
      JLX(1)=3H+0+
      JLX(9)=3H+0-
      DO 1739 K=1,JXP
      XAT=XA(K)
      XA(K)=YA(K)
      YA(K)=XAT
1739 CONTINUE
25010 IF (ABS(SIA) .LT. 0.01) 25012,25011
25011 JBX=(JSP*SCE)/SIA
      JNY=IABS(512/JBX)
      IF (JNY .LE. 3) 25013,2503

```



```

25012 YX=SIGN(100.0,P)
      GOTO 25014
25013 YX=1.0/P
25014 XV=100.0
      YV=511.5
      XN=YV*P
      MG=2
      JBX=(JSP*SCE)/COA
      JNY=IABS(100/JBX)
      GOTO 25030
2503 MG=1
      XV=511.5
      YV=100.0
      XN=YV/P
      YX=P
25030 JYM=JNY+JNY
      XU(1)=-JNY*JBX
      DO 2504 I=1,JYM
      XU(I+1)=XU(I)+JBX
2504 CONTINUE
      JYN=JYM+JYM+1
      JYP=JYN+1
      KC=0
      DO 2516 K=1,JYN,2
      KC=KC+1
      XB(K)=XU(KC)-XN
      YB(K)=YV
      IF (XB(K) .LT. -XV) 2505,2506
2505 YB(K)=(XU(KC)+XV)*YX
      XB(K)=-XV
      GOTO 2508
2506 IF (XB(K) .GT. XV) 2507,2508
2507 YB(K)=(XU(KC)-XV)*YX
      XB(K)=XV
2508 XB(K+1)=XU(KC)+XN
      YB(K+1)=-YV
2512 IF (XB(K+1) .LT. -XV) 2513,2514
2513 XB(K+1)=-XV
      YB(K+1)=(XU(KC)+XV)*YX
      GOTO 2516
2514 IF (XB(K+1) .GT. XV) 2515,2516
2515 XB(K+1)=XV
      YB(K+1)=(XU(KC)-XV)*YX
2516 CONTINUE
      GOTO (25160,25168) MG
25160 XNL=1.1*XN
      YVL=1.1*YV
      XB(JYM) =XU(JNY) +XNL
      XB(JYM+2)=XU(JNY+1)+XNL
      XB(JYM+4)=XU(JNY+2)+XNL
      YB(JYM)=YB(JYM+2)=YB(JYM+4)=-YVL
      XJB(1)=XB(JYM )-12.0
      XJB(2)=XB(JYM )
      XJB(3)=XB(JYM )+12.0

```



```

      XJB(4)=XB(JYM  )+24.0
      IF ((XJB(1).LT.-450.0).OR.(XJB(4).GT.442.0)) 25161,25162
25161 XJB(1)=-450.0
      XJB(2)=-438.0
      XJB(3)=-426.0
      XJB(4)=-414.0
      XJB(5)=-402.0
      JLY(5)=3H+0-
25162 XJB(6)=XB(JYM+2)-12.0
      XJB(7)=XB(JYM+2)
      XJB(8)=XB(JYM+2)+12.0
      IF ((XJB(6).LT.-450.0).OR.(XJB(8).GT.442.0)) 25163,25164
25163 JLY(6)=JLY(7)=JLY(8)=2H+0
25164 XJB(9)=XB(JYM+4)-12.0
      XJB(10)=XB(JYM+4)
      XJB(11)=XB(JYM+4)+12.0
      XJB(12)=XB(JYM+4)+24.0
      IF ((XJB(8).LT.-450.0).OR.(XJB(11).GT.442.0)) 25165,25166
25165 JLY(9)=JLY(10)=JLY(11)=JLY(12)=2H+0
25166 DO 25167 K=1,12
      YJB(K)=-YVL
25167 CONTINUE
      GOTO 26
25168 XJB(1)=XJB(6)=XJB(9)=11.0
      XJB(2)=XJB(7)=XJB(10)=22.0
      XJB(3)=XJB(8)=XJB(11)=33.0
      XJB(4)=XJB(12)=44.0
      XJB(5)=55.0
      YJB(1)=YJB(2)=YJB(3)=YJB(4)=YJB(5)=XU(JNY)
      YJB(6)=YJB(7)=YJB(8)=XU(JNY+1)
      YJB(9)=YJB(10)=YJB(11)=YJB(12)=XU(JNY+2)
      JLY(1)=3H+0-
      JLY(9)=3H+0+
      DO 25170 K=1,JYP
      XBT=XB(K)
      XB(K)=YB(K)
      YB(K)=XBT
25170 CONTINUE
26 DO 29 K=1,12
      CALL CRTPLT (0,0,JLX(K),1,5)
      CALL CRTPLT (XJA(K),YJA(K),1,0,1)
      CALL CRTPLT (0,0,JLY(K),1,5)
      CALL CRTPLT (XJB(K),YJB(K),1,0,1)
29 CONTINUE
      KM=JXN+1
      KN=JYN+1
      CALL CRTPLT (XA,YA,KM,0,9)
      CALL CRTPLT (XB,YB,KN,0,9)
      E(5)=0.0
      IB=0
      DO 399 J=1,5
      IF (ABS(YM(J)) .LT. 0.01) 31,32
31 E(J)=0.0
      VE=ABS(ZA(J))

```



```

      N(1)=N(2)=ZA(J)
311 F=1.0
312 NE=INT(VE*F)
      IF (NE .LE. 99) 313,314
313 F=F*10.0
      GOTO 312
314 IF (NE .GT. 999) 315,316
315 F=F*0.1
      GOTO 312
316 BM(1)=BM(2)=0.0
      YD(1,J,1)=YD(2,J,1)=KYO(J)-511.5
      GOTO 370
32 E(J)=50.0/YM(J)
33 F=100.0
      V(1)=ZA(J)+YM(J)
      V(2)=ZA(J)-YM(J)
      IF (V(1) .LT. 0.0) V(1)=ZA(J)
      IF (V(2) .GT. 0.0) V(2)=ZA(J)
34 N(1)=INT(V(1)*F)
      N(2)=INT(V(2)*F)
      ND=IABS(N(1)-N(2))
      IF (ND .LT. 1) 35,36
35 F=F*10.0
      GOTO 34
36 IF (ND .GT. 10) 361,362
361 F=F*0.1
      GOTO 34
362 BM(1)=N(1)/F-ZA(J)
      BM(2)=N(2)/F-ZA(J)
370 DO 392 I=1,2
      KZ(I,J,1)=3H+0-
      NIF=IABS(N(I))
      IF (NIF .GE. 10000) 371,372
371 KAA=NIF/10000
      NIF=NIF-KAA*10000
      KZ(I,J,1)=3H+0*
372 KAB=NIF/1000
      KAC=NIF-KAB*1000
      KAD=KAC/100
      KAE=KAC-KAD*100
      KAF=KAE/10
      KAG=KAE-KAF*10
      KZ(I,J,5)=KAG*IKJ
      IF (F .EQ. 10.0) 373,376
373 KZ(I,J,4)=3H+0.
      KZ(I,J,3)=KAF*IKJ
      IF (N(I) .LT. 0) 374,375
374 KZ(I,J,2)=3H+0-
      IF (NIF .GE. 100) 390,391
375 KZ(I,J,2)=KAD*IKJ
      IF (NIF .GE. 1000) 390,3751
3751 IF (KAD .EQ. 0) 3752,391
3752 KZ(I,J,2)=KZ(I,J,3)
      KZ(I,J,3)=KZ(I,J,4)

```



```

      KZ(I,J,4)=KZ(I,J,5)
      KZ(I,J,5)=3H+0
      GOTO 391
376 KZ(I,J,4)=KAF*IJK
      IF (F .EQ. 100.0) 377,380
377 KZ(I,J,3)=3H+0.
      IF (N(I) .LT. 0) 378,379
378 KZ(I,J,2)=3H+0-
      IF (NIF .GE. 100) 390,391
379 KZ(I,J,2)=KAD*IJK
      IF (NIF .GE. 1000) 390,391
380 KZ(I,J,3)=KAD*IJK
      IF (F .EQ. 1000.0) 381,386
381 IF (N(I) .LT. 0) 382,385
382 KZ(I,J,2)=3H+0-
      GOTO 384
383 KZ(I,J,2)=3H+0*
      KZ(I,J,5)=3H+0*
      KZ(I,J,4)=3H+0*
384 KZ(I,J,3)=3H+0*
      GOTO 390
385 KZ(I,J,2)=3H+0.
      IF (NIF .GE. 1000) 390,391
386 IF (N(I) .LT. 0) 387,388
387 KZ(I,J,2)=3H+0-
      IF (NIF .GE. 1000) GOTO 390
      IF (KAD .EQ. 0) 3871,391
3871 KZ(I,J,3)=KZ(I,J,4)
      KZ(I,J,4)=KZ(I,J,5)
      KZ(I,J,5)=3H+0
      IF (KAF .EQ. 0) 3872,391
3872 KZ(I,J,3)=KZ(I,J,4)
      KZ(I,J,4)=KZ(I,J,5)=3H+0
      GOTO 391
388 KZ(I,J,2)=KAB*IJK
      IF (NIF .GE. 10000) 390,389
389 IF (KAB .EQ. 0) 3891,391
3891 KZ(I,J,2)=KZ(I,J,3)
      KZ(I,J,3)=KZ(I,J,4)
      KZ(I,J,4)=KZ(I,J,5)
      KZ(I,J,5)=3H+0
      IF (KAD .EQ. 0) 3892,391
3892 KZ(I,J,2)=KZ(I,J,3)
      KZ(I,J,3)=KZ(I,J,4)
      KZ(I,J,4)=KZ(I,J,5)=3H+0
      IF (KAF .EQ. 0) 3893,391
3893 KZ(I,J,2)=KZ(I,J,3)
      KZ(I,J,3)=KZ(I,J,4)=KZ(I,J,5)=3H+0
      GOTO 391
390 KZ(I,J,1)=3H+0*
391 KZ(I,J,6)=3H+0
      YD(I,J,1)=BM(I)*E(J)+KYO(J)-511.5
392 CONTINUE
      IF (J .GE. 5) GOTO 399

```



```

      FK=2.0
      IF (ND .LT. 5)  FK=1.0
      IF (ND .EQ. 1)  FK=0.5
      DV=FK*E(J)/F
      BN(1)=BM(1)*E(J)+DV
393  IF (BN(1) .LT. 100.0)  394,395
394  BN(1)=BN(1)+DV
      GOTO 393
395  BN(1)=BN(1)-DV
      IA=1
396  IA=IA+1
      BN(IA)=BN(IA-1)-DV
      IF (BN(IA) .GE. (-100.0+DV))  396,397
397  IF (J .GE. 5)  GOTO 399
      DO 398  I=1,IA
      ICI=IB+I+I-1
      XCL(ICI)=IX(1)-441
      XCL(ICI+1)=IX(IM)-561
      YCL(ICI)=BN(I)+KYO(J)-511.5
      YCL(ICI+1)=YCL(ICI)
398  CONTINUE
      IB=ICI+1
399  CONTINUE
      DO 41  J=1,4
      DO 40  I=1,IM
      KY(I)=KYO(J)+Z(I,J)*E(J)
40  CONTINUE
      CALL CRTPLT (XH,1.0,IX,KY,18)
41  CONTINUE
      DO 410 I=1,IM
      XJ(I)=IX(I)-511.5
      YJ(I)=KYO(5)+Z(I,5)*E(5)-511.5
410  CONTINUE
      CALL CRTPLT (0.0,0.0,3H0+,0,5)
      CALL CRTPLT (XJ,YJ,IM,0,1)
      CALL CRTPLT (XCL,YCL,IB,0,9)
      XL(1)=IX(1)-512
      XL(2)=IX(1)-492
      XL(3)=IX(1)-480
      XL(4)=IX(1)-468
      XL(5)=IX(1)-456
      XL(6)=IX(1)-444
      DO 43  K=1,6
      DO 42  J=1,5
      DO 42  I=1,2
      IF (J .GE. 5)  GOTO 411
      XD(I,J,K)=XL(K)
      GOTO 412
411  XD(I,J,K)=XLG(K)
412  YD(I,J,K)=YD(I,J,1)
42  CONTINUE
43  CONTINUE
      DO 45  I=1,60
      CALL CRTPLT (0,0,KZ(I),1,5)

```



```

CALL CRTPLT (XD(I),YD(I),1,1,1)
45 CONTINUE
DO 46 I=1,6
CALL CRTPLT (0,0,LF(I),1,5)
CALL CRTPLT (XF(I),YF(I),1,1,1)
46 CONTINUE
DO 47 I=7,16
CALL CRTPLT (0,0,LF(I),5,5)
CALL CRTPLT (XF(I),YF(I),1,1,1)
47 CONTINUE
DO 48 I=17,24
CALL CRTPLT (0,0,LF(I),1,5)
CALL CRTPLT (XF(I),YF(I),1,1,1)
48 CONTINUE
DO 49 I=1,8
CALL CRTPLT (XG(I),YG(I),NG,LG(I),10)
49 CONTINUE
DO 50 I=1,8
XP(I)=XL(1)
50 CONTINUE
CALL CRTPLT (XP,YP,8,0,9)
KPA=LID(1)/10
KQ(1)=KPA*IJK
IF (KPA .EQ. 0) KQ(1)=3H+0
KPB=LID(1)-KPA*10
KQ(2)=KPB*IJK
KQA=LID(2)-1000
KQB=KQA/10
KQ(3)=KQB*IJK
KQC=KQA-KQB*10
KQ(4)=KQC*IJK
KQD=LID(3)-1000
KQE=KQD/10
KQ(5)=KQE*IJK
KQF=KQD-KQE*10
KQ(6)=KQF*IJK
KQ(7)=LID(4)/4096
KQ(8)=2H+0
IF (ZX.LT.0.0) KQ(8)=3H+0-
KQG=ABS(ZX)
KQH=KQG/100
KQ(9)=KQH*IJK
IF (KQH .EQ. 0) KQ(9)=3H+0
KQI=KQG-KQH*100
KQJ=KQI/10
KQ(10)=KQJ*IJK
IF ((KQJ .EQ. 0) .AND. (KQH .EQ. 0)) KQ(10)=3H+0
KQK=KQI-KQJ*10
KQ(11)=KQK*IJK
KQL=ABS(ZX)*1000.0
KQM=KQL-KQG*1000
GOTO (51,52) MD+1
51 KQN=KQM/100
KQ(12)=KQN*IJK

```



```

      KQO=KQM-KQN*100
      KQP=KQO/10
      KQ(13)=KQP*IJK
      KQQ=KQO-KQP*10
      KQ(14)=KQQ*IJK
      GOTO 53
52  KQN=KQM*0.06+0.5
      KQO=KQN/10
      KQ(12)=KQO*IJK
      KQP=KQN-KQO*10
      KQ(13)=KQP*IJK
      KQ(14)=2H+0
53  KQ(15)=2H+0
      IF (ZY.LT.0.0)  KQ(15)=3H+0-
      KQR=ABS(ZY)
      KQS=KQR/10
      IF (KQS.EQ.0)  KQ(16)=3H+0
      KQ(16)=KQS*IJK
      KQT=KQR-KQS*10
      KQ(17)=KQT*IJK
      KQU=ABS(ZY)*1000.0
      KQV=KQU-KQR*1000
      GOTO (54,55)  MD+1
54  KQW=KQV/100
      KQ(18)=KQW*IJK
      KQX=KQV-KQW*100
      KQY=KQX/10
      KQ(19)=KQY*IJK
      KQZ=KQX-KQY*10
      KQ(20)=KQZ*IJK
      GOTO 57
55  KQW=KQV*0.06+0.5
      KQX=KQW/10
      KQ(18)=KQX*IJK
      KQY=KQW-KQX*10
      KQ(19)=KQY*IJK
      KQ(20)=2H+0
      CALL CRTPLT (XKL,YKL,NQ,KH,10)
      DO 56  I=1,20
      CALL CRTPLT (0,0,KQ(I),1,5)
      CALL CRTPLT (XKR(I),YKQ(I),1,0,1)
56  CONTINUE
      GOTO 59
57  CALL CRTPLT (XKL,YKL,NQ,KL,10)
      DO 58  I=1,20
      CALL CRTPLT (0,0,KQ(I),1,5)
      CALL CRTPLT (XKQ(I),YKQ(I),1,0,1)
58  CONTINUE
59  CALL CRTPLT (XX,YY,0,0,2)
      CALL CRTPLT (0,0,0,0,20)
      END

```