WPlot Version 2.1

Introduction

The WPlot program plots X-Y data read from a data file or typed interactively at the keyboard. Up to 250 sets of data can be plotted on the same 2-Dimensional plot using either one or two vertical axes. There can be up to 16000 data points per data set. Each data set can be plotted as a smooth curve plot, a scatter plot, a step plot or a histogram. Multiple data sets can also be plotted as a 3-Dimensional plot. The plot can have linear or log axes with auto or manual scaling. Two-Dimensional plots can also have cumulative normal probability axes, error bars and descending as well as ascending axes. Data can be fit by a smooth curve or a least squares polynomial or exponential. The Fast Fourier Transform can be used to fit the data with a discrete Fourier series and the magnitudes of the FFT coefficients can be plotted. An auxiliary program, WFIT, can fit a nonlinear function to data and use WPlot to plot the fit. Mathematical transformations of the data can be performed by entering equations that operate on one or more data sets. Functions can be evaluated and plotted.

WPlot's plotting features can be accessed interactively from the menu interface. However, WPlot is actually command driven and can automatically execute a sequence of plot commands read from a command file. A plot produced from the menu interface can be saved as a plot command file and later automatically re-drawn by loading the command file. A plot command file could also be produced by an editor, word processor or a user written program that generates the plot commands and data as output as does the auxiliary program WFIT.

This help file shows the syntax of each plot command and how the corresponding task is selected from the menu interface. A few of the more esoteric commands can not be selected from a menu. These commands can be executed from a command file or typed in a command dialog box by selecting the menu item "Options | Command Box".

Command Syntax

Each command consists of a single word specifying what task the command performs. Most commands are followed by one or more parameters, separated by spaces, that affect the operation of the command. One common parameter is the number of the data set that the command is to operate on. Some commands can, optionally, operate on a range of data sets. A data set range is specified in the form n-m where n and m are the first and last data sets, respectively, in the specified range, e.g. 3-8. There must not be any spaces around the dash "-"; the "-m" can be omitted when specifying a single data set.

If a command's task is selected from a menu then the parameters are input into a dialog box or selected from a sub-menu.

Menu Interface

The task performed by a plot command can also be selected from a menu (with a few exceptions). The description of a command and its parameters will be followed by the sequence of menu selections that will perform that task. If a task is selected from a menu then the parameters are input into a dialog box or selected from a sub-menu.

Data Input and Plot Command Files

The following command reads and executes the plot commands in the file "filename.PLT":

LOAD filename.PLT
DO filename.PLT (Same as LOAD command.)
Menu: File | Load Plot Command File

The following command saves to the file "filename.PLT" the data and plot commands that will redisplay the last displayed plot:

SAVE filename.PLT
Menu: File | Save Plot Command File

If the filename is omitted then it defaults to "SAVE.PLT". If the file already exists it is overwritten. The commands CLRPLOT, CLRDATA and CLOSE are written to the beginning of each command file created with the SAVE command.

The following command opens a file containing just data:

OPEN filename - Opens data file "filename" for read.
Menu: File | Open Data File

One or more of the following commands or menu selections must then be used to read the data after opening the data file.

READ n - Reads "n" X Y data points.
Menu: File | Read X Y Data

The READ command (or "Read X Y Data" menu selection) reads X Y data point pairs from either the keyboard, a data file or a plot command file. The X values will be plotted on the horizontal axis and the Y values will be plotted on the vertical axis. Successive data values must be separated by at least one non-numeric character other than "+", "-", ".", "E" or "e" (such as a SPACE or comma). Numbers can be in scientific notation with "E" or "e" preceding the exponent.

IF A DATA FILE IS OPEN then the data is read from the data file. If "n", the number of data points to read, is omitted then data will be read until the end of the file is reached.

IF NO DATA FILE IS OPEN and "Read X Y Data" is selected from the menu then the data is entered interactively from within a Windows edit control. A data set can be edited by selecting "Edit X Y Data Set" from the menu. DUE TO MEMORY LIMITATIONS OF EDIT CONTROLS, ONLY A LIMITED NUMBER OF DATA POINTS CAN BE INPUT INTERACTIVELY OR EDITED, APPROXIMATELY 1000.

IF NO DATA FILE IS OPEN and the READ command is in a command file then the data is read from the command file starting at the line after the READ command.

Multiple reads will result in multiple sets of data being plotted on the same plot.

Data can also be read in which all of the X values precede all of the Y values:

READX n - Reads "n" X data values; must precede READY command.
Menu: File | Read Other Formats | Read X Data Values

READY n - Reads "n" Y data values; X = 1, 2, 3 ... if no READX.
Menu: File | Read Other Formats | Read Y Data Values

If a READY command is not preceded by a READX (or READ) command then the Y values will be plotted at even intervals.

Multiple sets of data can also be read when the data is arranged in the form of a table:

READTAB m n - Reads "n" rows of a table with columns X, Y1, Y2,..., Ym. The X values must be in the first column and the corresponding Y values of data set #1 to data set #m must be in the remaining "m" columns.
Menu: File | Read Other Formats | Read Table X Y1...Yn

READTABY m n - Reads "n" rows of a table with columns Y1, Y2,..., Ym. If the command is not preceded by a READX command then the Y values will be plotted at even intervals.
Menu: File | Read Other Formats | Read Table Y1...Yn

READTAB and READTABY are not valid if other data sets have already been read.

Multiple sets of data can be plotted on a 3-Dimensional plot in which each data set represents a curve corresponding to a point on the Z axis:

READZ n - Reads "n" Z data values for 3-D plots; there should be one Z value per data set.
Menu: File | Read Other Formats | Read Z Data Values

A single 3-Dimensional curve can be plotted in which the coordinates of the points on the curve are the X-Y values in data set #1 and the corresponding Z values read with the READZ command. These 3-D coordinates can also be plotted as a 3-Dimensional scatter plot. There can be a maximum of 1024 points on the 3-D curve or 3-D scatter plot. A sequence of X Y Z coordinates can be read with the commands READXYZ or READZXY which are described below. NOTE: THESE COMMANDS ARE USED TO READ COORDINATES OF POINTS ON A 3-D CURVE OR POINTS ON A 3-D SCATTER PLOT ONLY; USE THE READ OR READTAB AND READZ COMMANDS TO READ COORDINATES OF CURVES ON A 3-D SURFACE.

READXYZ n - Reads "n" X Y Z coordinates of points on a single 3-D curve or points on a 3-D scatter plot.
Menu: File | Read Other Formats

READZXY n - Reads the 3-D coordinates in the order Z X Y.
Menu: File | Read Other Formats

The following are some more commands used in reading data:

CLOSE - Closes the data file; opening a new data file will also close a previously opened data tile.
Menu: File | Close Data File

SKIP n - Skips "n" lines of the data file.
Menu: (none)

SEARCH text - Reads from the data file until a line containing "text" is read.
Menu: (none)

Axes

The following plot commands specify the type of axes. The X axis is the horizontal axis and the Y axis is the vertical axis; a 3-Dimensional plot will also have a Z axis perpendicular to the X-Y plane. The Z axis can also be used as a second vertical axis on the right side of a 2-Dimensional plot (see USEZ command):

LINX - Selects linear X axis (the default).
LOGX - Selects log X axis.
PROBX - Selects cumulative normal probability X axis.
Menu: Axes | Set X-Axis Parameters

LINY - Selects linear X axis (the default).
LOGY - Selects log X axis.
PROBY - Selects cumulative normal probability X axis.
Menu: Axes | Set Y-Axis Parameters

LINZ - Selects linear X axis (the default).
LOGZ - Selects log X axis.
Menu: Axes | Set Z-Axis Parameters

By default the program will automatically set the scales of the axes based on the minimum and maximum data values. The scales of the axes can be set by the user with the following commands:

XSTART value - The X axis will start at "value".
XEND value - The X axis will end at "value".
XSTEP value - Linear X axis tic marks will be labeled in steps of "value".
Menu: Axes | Set X-Axis Parameters

YSTART value - The Y axis will start at "value".
YEND value - The Y axis will end at "value".
YSTEP value - Linear Y axis tic marks will be labeled in steps of "value".
Menu: Axes | Set Y-Axis Parameters

ZSTART value - The Z axis will start at "value".
ZEND value - The Z axis will end at "value".
ZSTEP value - Linear Z axis tic marks will be labeled in steps of "value".
Menu: Axes | Set Z-Axis Parameters

Automatic scaling of an axis can be re-enabled by setting the starting and ending values equal to the same value, i.e., "XSTART 0" and "XEND 0". If the step size is omitted from a linear axis then the program will select a step size and adjust the starting and ending values to match the step size. The step size is ignored with a log axis. A log axis will cover a maximum of 8 decades and will always start and end at decade boundaries. Data plotted on a normal probability axis must be in the range .0001 to .9999; the axis will be labeled using the scaled range .01 to 99.99.

The following commands specify other axes parameters:

XDESCEND - X axis (on 2D plots) will be labeled in descending order.
XDESCEND OFF - Turns off XDESCEND.
XGRID - Grid lines will be drawn at labeled X axis tic marks.
XGRID OFF - Turns off display of X axis grid lines.
XBASE value - Vertical base line will be drawn at "value" on X axis.
XBASE OFF - Turns off display of X axis base line.
XTICS n - Selects "n" minor X axis tic marks between labeled tic marks (default is 4).
XEQUALY - The X-Axis will be drawn so that it has the same physical length as the Y-Axis.

Menu: Axes | Set X-Axis Parameters

YDESCEND - Y axis (on 2D plots) will be labeled in descending order.
YDESCEND OFF - Turns off YDESCEND.
YGRID - Grid lines will be drawn at labeled Y axis tic marks.
YGRID OFF - Turns off display of Y axis grid lines.
YBASE value - Horizontal base line will be drawn at "value" on Y axis.
YBASE OFF - Turns off display of Y axis base line.
YTICS n - Selects "n" minor Y axis tic marks between labeled tic marks (default is 4).
Menu: Axes | Set Y-Axis Parameters

ZTICS n - Selects "n" minor Z axis tic marks between labeled tic marks (default is 4).
Menu: Axes | Set Z-Axis Parameters

USEZ n-m - Data sets #n through #m will be plotted using the Z axis as a second vertical axis on right side of a 2-D plot. The scale of the second vertical axis is set by ZSTART, ZEND & ZSTEP and the axis label is set by ZLABEL. The list of data sets that plot on the second vertical axis is cleared with "USEZ" (with no parameters).
Menu: Axes | Use Z-Axis as Second Vertical Axis

CLRPLOT - Resets plot parameters to their default values.
Menu: Options | Reset Plot Parameters

Curve Fitting and Fast Fourier Transform

The following commands will generate a curve fit of a data set:

POLY m n - Generates an mth degree polynomial least squares fit of data set #n.
Menu: Transformations | Polynomial Curve Fit

EXP m n - Generates an exponential of an mth degree polynomial least squares fit of data set #n.
Menu: Transformations | Polynomial Curve Fit

The exponential curve fit will be of the form:

$$Y = e^{Cm X^m + Cm-1 X^{m-1} + \ldots + C1 X + C0}$$

AVG m n - Generates a nonweighted moving average smooth fit of data set #n using a moving window 2*m+1 data points wide. The data points must be equally spaced.
Menu: Transformations | Moving Average

If "m" is omitted from the above commands then it defaults to one; a polynomial fit's degree cannot be greater than 10. If "n" is omitted it defaults to the last read data set. The generated data is stored as a new data set. The commands "POLY m n X1 Y1 X2 Y2" and "EXP m n X1 Y1 X2 Y2" force the fitted curve to pass through point (X1,Y1) and, optionally, through point (X2,Y2); the parameters "m" and "n" cannot be omitted. Example: the command "POLY 2 1 0 0" fits a 2nd degree polynomial to data set #1 with the polynomial forced to pass through the origin.

If the POLY or EXP command is used again to fit the same data set with a different degree polynomial or the AVG command is used again with a different window size then the new fit will overwrite the old one. This feature can be particularly useful when doing a polynomial curve fit and it is not known what degree will give the best fit. When selected from the menu, a polynomial fit will display a statistic, the residual variance. First try a first degree fit and note the residual variance. Then try a second degree fit and again note the residual variance. Then try a third degree fit, etc. When a degree is reached in which the residual variance did not change by much from the previous value then the previous degree is the one that should be used.

KEEP - Keeps the last generated fit from being overwritten by a new one.
Menu: Transformations

OUTPOLY file - Outputs the last generated polynomial's coefficients to the specified file; if the file is omitted then the output will be to the screen.
EXPWT m - Exponential fits will be weighted with the Y data values raised to the mth power; m = 0,1,2. The default is m=2. If an exponential fit is used to fit a bell shaped curve, for example, then a closer fit of the points at the top of the peak will be made if Y squared is used as a weight. If the data is not weighted (m=0) then a closer fit of the tails of the peak will be made.
Menu: Transformations | Polynomial Curve Fit

FFT n - Calculates the Fast Fourier Transform of data set #n (last data set if n is omitted). The data must be equally spaced and the number of data points can not be greater than 8192 and should be equal to 2 raised to an integer power, i.e., 2, 4, 8, 16, 32, ... 8192; if not, then the data is padded with the smaller of the two end points. When the data is plotted it will be fit with a truncated Fourier series by inverting the FFT; the KEEP command will save the fit as a new data set.
Menu: Transformations | Fast Fourier Transform

PLOTFFT - Plots the magnitudes of the FFT coefficients.
PLOTFFT2 - Plots square of magnitudes of FFT coefficients.
FFTFREQ m - Specifies the number of FFT frequency components used to fit the data.

FFTMAG value - Specifies the maximum value to be plotted on the FFT magnitude axis.
Menu: Plot | FFT Plot

OUTFFT file - Outputs the FFT coefficients (corresponding to positive frequencies) to the specified file; if the file is omitted then the output will be to the screen.
READFFT m - Reads m complex FFT coefficients corresponding to zero frequency and m-1 positive frequencies; m-1 should equal 2 raised to an integer power. A new data set is generated by inverting the FFT (the X coordinates will be 0, 1, 2, ...).
Menu: (none)

CONVOLVE n m - Uses FFT to generate convolution of data set #n with data set #m. Both data sets must be equally spaced and contain the same number of data points.
Menu: Transformations | Convolution

2-D Plot Types

The following commands select the type of 2-D plot for each data set:

LINE n-m - Selects a line plot (the default) of data sets #n through #m in which successive data points are connected by straight lines.
SPLINE n-m - Selects a natural cubic spline plot of data sets #n through #m in which successive data points are connected by a smooth spline curve. NOTE: This option is not available from a menu.
CURVE n-m - Selects a smooth curve plot of data sets #n through #m using a proprietary method that does not oscillate as much as a spline curve.
SYMBOLS n-m - Specifies that symbols are to be drawn at the data points of data sets #n through #m along with the connecting lines or curve. See SYMTYPE command.
SCATTER n-m - Selects a scatter plot of data sets #n through #m with just the symbols for the data points and without the connecting lines or curve.
SPIKES n-m - Specifies that vertical spikes are to be drawn to the data points of data sets #n through #m along with the connecting lines or curve.
HISTOGRAM n-m - Selects a histogram of data sets #n through #m with the data points represented by vertical spikes and without the connecting lines or curve.
HISTWIDTH value - If "value" is nonzero then histograms will be plotted using bars of width "value" instead of spikes.
STEP n-m - Selects a step plot of data sets #n through #m with successive data points connected by horizontal steps.
Menu: Options | Set Data's Plot Type

NOTE: In order to make a SPLINE or CURVE plot the X values must be in ascending order.

The following command is used to plot error bars:

ERRBARS m n - Data set #m will plot as upper or lower error bars of data set #n. To have upper and lower error bars for data set #n there must be two sets of data specified as error bars. One data set must contain lower limits and the other must contain upper limits on the corresponding Y values of data set #n; the X values of the error bar data sets should be the same as the corresponding X values of data set #n.
Menu: Options | Error Bars

DASH ON - Enables dashed lines; DASH OFF disables dashed lines.
Menu: Options | Dashed Lines
THICKLINES ON - Enables thick lines; THICKLINES OFF disables.
Menu: Options | Thick Lines

SYMTYPE k n-m - Specifies that symbol type "k" be used to plot data point symbols for data sets #n through #m. "k" can be one of the following number or two-letter codes:

```
 1  SQ  - Square
 2  DI  - Diamond
 3  CR  - Cross
 4  CI  - Circle
 5  AD  - Arrow Down
 6  AR  - Arrow Right
 7  AU  - Arrow Up
 8  AL  - Arrow Left
 9  HG  - Hour Glass
10  BO  - Bow
11  DO  - Dot
```

The SYMTYPE command with no parameters sets all symbol types back to the default types.
Menu: Options | Set Symbol Type

Title, Labels and Legends

The following commands are used to specify a title, axes labels and data set legends:

TITLE text - The character string "text" will be displayed above the plot as the title.
TITLESIZE n - Sets size of title; n = 1 (small), 2 (medium) or 3 (large).
TITLE2 text - The character string "text" will be displayed below the main title.
XLABEL text - The character string "text" will be displayed below the X-axis.
YLABEL text - The character string "text" will be displayed to the left of the Y-axis.
ZLABEL text - The character string "text" will be displayed to the right of the Z-axis on 3-D plots (or 2-D plots with a second vertical axis).
Menu: Labels | Enter Title & Labels

LEGENDn X Y text - The legend "text" associated with data set #n will be displayed at coordinate (X,Y). The LEGENDn coordinate (X,Y) is the coordinate of the center of the left side of the first character in the text. The coordinate values are specified as fractions of axis length and are normally between 0. and 1., i.e., (0.,0.) is at the origin, (1.,0.) is at the end of the X-axis and (0.,1.) is at the top of the Y-axis. The legend coordinates are screen coordinates; the legends are NOT repositioned if the origin or axes scales are changed. LEGEND1, LEGEND2, ..., LEGEND9 are associated with data sets 1 to 9, respectively, and LEGEND0 is associated with data set 10; only the first 10 data sets can be given legends. The legends are displayed using the same colors used to plot the corresponding data sets; if no data set corresponds to a legend then the axes color is used. Legends are displayed on 2-D plots only.

The LEGENDn command is intended for use within a plot command file. The SAVE command will save a plot's legends as LEGENDn commands. To manually place a legend on a plot (after the plot is drawn):

(1) Press function key Ctrl+Fn (or select "Labels | Enter Legends" from the menu); this calls up the legend's dialog box.
(2) Move the legend's dialog box to the desired position on the screen.
(3) Type into the dialog box the text of the legend.
(4) Press the ENTER key.

Legends can be temporarily disabled or cleared with the following commands:

LEGENDS OFF - Disables display of legends.
LEGENDS ON - Enables display of legends.
Menu: Labels | Legends Enabled

LEGENDS CLR - Clears all legends.
Menu: Labels | Clear Legends

If the first character in a legend is an "*" then the asterisk will actually be displayed as a data point symbol provided the corresponding data points plot as symbols (specified by the SYMBOLS or SCATTER commands) and a specific symbol type has been selected with the SYMTYPE command.

Function Syntax

A function is specified using the following syntax:

Y(X) = expression
Y(X,Z) = expression
or
Y(Xn) = expression (n = 1, 2, ...)

The X or Y values of a range of data sets (or the single set of Z values) can be modified using the following syntax:

Y<n-m> = expression
X<n-m> = expression
Z = expression

There must not be any spaces in the terms Y(X), Y(X,Z), Y(Xn), Y<n-m> and X<n-m>. There can be spaces around the "equals" sign and in the expression.

Function Evaluation

A function of a single independent variable can be graphed by entering the function in the following format:

Y(X) = function of X
Menu: Transformations | Function Evaluation

Example: Y(X) = 1 + 2 * EXP(-X^2) * SIN(PI*X)

The function Y(X) must be set equal to an expression that can contain constants, the symbol PI, the single independent variable X, the operators "+" (addition), "-" (substraction), "*" (multiplication), "/" (division) and "^" (exponentiation) and parentheses. The expression can also contain the following elementary functions:

```
ABS(X)     Absolute Value.
SQRT(X)    Square Root.
EXP(X)     Exponential (e to the power of x).
LOG(X)     Logarithm (base e).
LOG10(X)   Logarithm (base 10).
COS(X)     Cosine.
SIN(X)     Sine.
TAN(X)     Tangent.
ACOS(X)    Arccosine.
ASIN(X)    Arcsine.
ATAN(X)    Arctangent.
COSH(X)    Hyperbolic Cosine.
SINH(X)    Hyperbolic Sine.
TANH(X)    Hyperbolic Tangent.
SINC(X)    Sin(X) / X.
RND()      Random Number (between 0 and 1).
U(X)       Unit Step Function.  U(X-A) = 0  if X < A
ERF(X)     Error Function.
INVERF(X)  Inverse Error Function.
GAMMA(X)   Gamma Function.   Note:  GAMMA(X+1) = X!  if X is an integer.
J0(X) to J6(X)  Bessel Functions of the First Kind.
```

A new data set will be generated by evaluating the function at even intervals of X between starting and ending values specified by the XSTART and XEND commands: XSTART <= X <= XEND. The number of sample points (which defaults to 201) can be specified with the following command:

XSAMPLES n
Menu: Transformations | Function Evaluation

Three dimensional data can be generated by entering a function of two independent variables in the format:

Y(X,Z) = function of (X,Z)
Menu: Transformations | Function Evaluation

Example: Y(X,Z) = SINC(SQRT(X*X + Z*Z))

The function will be evaluated at even intervals of Z between starting and ending values specified by the ZSTART and ZEND commands: ZSTART <= Z <= ZEND. The number of Z sample points (which defaults to 51) can be specified with the following command:

ZSAMPLES n

Menu: Transformations | Function Evaluation

If a function is sampled for the purpose of finding its FFT then the last end point should not be included. The following command excludes the last end point, i.e., XSTART <= X < XEND (and ZSTART <= Z < ZEND):

ENDPOINT OFF
Menu: Transformations | Function Evaluation

A new data set can be generated from a mathematical transformation of one or more existing data sets by entering a function in the following format:

Y(Xn) = function of (Xn, Y1, Y2, ..., Yn, ..., Ym)
Menu: Transformations | Function Evaluation

Example: Y(X1) = (Y2-Y1)^2 / SQRT(1 + X1)

The Y-variables Y1, Y2, ..., Ym represent the Y-values of m different data sets. The Y-values of all data sets that appear in the expression must correspond to the same X-values, represented by a single X-variable Xn. The X-variable specified as the function argument, Xn, is the only X-variable that can appear in the expression. The expression is evaluated at each of the X-values in data set #n. In the above example, the Y-values of both data set #1 and data set #2 (represented by the variables Y1 & Y2) must correspond to the X-values in data set #1 (represented by the variable X1); this would be true, for example, if the data sets were read with the READTAB command.

Each of the three types of functions, Y(X), Y(X,Z), and Y(Xn), can be set equal to expressions that contain intermediate variables T1, T2, ... T9.

Example:
```
T1 = 1 + X
T2 = sin( 2 * X )
Y(X) = 1 + T2 / T1 + ( 1 - X * T2 ) / ( T1 * T1 )
```

The intermediate variables are not evaluated and are not checked for errors until a function specification is used to generate a new data set; then, at each point at which the function is to be evaluated, the intermediate variables are first evaluated in the order T1, T2, ... T9 then the function is evaluated. Note that if an intermediate variable is defined then it will be evaluated even if it does not appear in the function's expression. An intermediate variable can be cleared by setting it equal to nothing. Example: T1 =

The following commands do not generate new data sets but modify either the X or Y values of a range of existing data sets:

Y<n-m> = function of Y - Modifies Y values of data sets #n through #m.
X<n-m> = function of X - Modifies X values of data sets #n through #m.
Z = function of Z - Modifies Z values.
Menu: Transformations | Function Evaluation

Examples:
```
Y<2-5> = LOG( Y + 1 )
X<3-8> = 10 * X + 5
Z = 10^Z
```

The following commands numerically integrate or differentiate data sets:

INTEGRATE n - Generates the indefinite integral of data set #n using the trapezoidal method of numerical integration.

Menu: Transformations | Integrate Data

DIFFER n - Generates the derivative of data set #n.
Menu: Transformations | Differentiate Data

Display 2-D or 3-D Plot

The following commands are used to display a plot:

PLOT - Makes a 2-Dimensional plot.
Menu: Plot | 2-D Plot

If the PLOT command was executed from within a command file then the program will wait until the user presses the Tab key or selects the "More" menu item before executing the next command in the file. Selection of the "Quit" menu item will terminate execution of the command file; it does not terminate the program.

After a 2-Dimensional plot has been displayed, selection of the menu item "Options | Display Coordinates" will display the X and Y values associated with the point on the plot that is at the tip of the mouse cursor.

The following commands make 3-Dimensional plots:

PLOT3D - Makes a 3-Dimensional plot of multiple X-Y data sets with the Z axis a parameter axis.
PLOT3D SURFACE - Makes a 3-Dimensional plot of multiple X-Y data sets representing curves on a surface Y = f(X,Z).
PLOT3D NOHIDE - Makes a 3-Dimensional plot of multiple X-Y data sets without removing hidden lines.
PLOT3D CURVE - Makes a plot of a 3-Dimensional curve.
PLOT3D SCATTER - Makes a 3-Dimensional scatter plot.
Menu: Plot | 3-D Plot

With a 3-D plot, each X-Y data set will correspond to a point on the Z axis. If Z values were read with the READZ command then the kth X-Y data set will correspond to the kth Z value. The Z values must be in ascending order. If no Z values were read then the X-Y data sets will be plotted at even intervals along the Z axis. With a normal 3-D plot the data sets are plotted in different colors as a sequence of stacked 2-D plots. With a surface 3-D plot all data sets are plotted with the same color using a different hidden line algorithm that allows the bottom of the surface to be visible as well as the top.

With a surface 3-D plot each data set is assumed to contain the points of a curve on the surface that corresponds to a constant value of Z, i.e., Y = f(X,Zk) where Zk is the value of Z that corresponds to the kth data set containing the X and Y values. If all data sets contain the same sequence of X values (i.e., the data values are points on a rectangular grid) then the easiest way of reading the points on the surface is to use a READTAB command and a READZ command (or select the corresponding menu items):

```
READTAB m n
X1 Y11 Y12 ... Y1m
X2 Y21 Y22 ... Y2m
.               .
:               :
Xn Yn1 Yn2 ... Ynm
READZ m
   Z1  Z2 ...  Zm
```

As previously mentioned, each data set represents a curve on the surface. If all data sets contains the same number of data points then the surface is drawn as a mesh with lines connecting corresponding data points on successive curves. The number of mesh lines that cross each curve is set with the following command:

MESH n - Specifies mesh lines be drawn at every nth data point.
Menu: Plot | 3-D Plot | Set Surface Mesh Interval

For example, MESH 2, specifies that mesh lines be drawn at every other data point; the default is MESH 1. The command MESH 0 disables the mesh lines. Note that the mesh lines connect corresponding points based

on the data point number not the value of the data point. The mesh lines will be evenly spaced only if all data sets contain the same sequence of X values and the X values are evenly spaced (i.e., the data values are points on a rectangular grid).

COLORLEVELS3D - Surface plots will have color coded levels.
COLORLEVELS3D OFF - Turns off color coded surface levels.
Menu: Plot | 3-D Plot

Each color level on a surface plot will correspond to a major tic-mark interval on the Y axis. To increase the number of color levels, decrease the Y axis step size; however, there will be a maximum of 10 different colors. Note that the algorithm for setting the color level of mesh lines is not perfect and the color of the mesh lines may be incorrect if there is a large gap between a pair of curves on the surface. Also, note that it will take longer to print a surface plot to a printer if color coded levels are enabled.

A 3-D curve is plotted as as sequence of (X,Y,Z) values in which the X-Y values were read as data set #1 using the READ command and the Z values were read using the READZ command. The (X,Y,Z) values can also be read using the READXYZ command (or the READZXY command).

If a group of (X,Y,Z) values contained in data set #1 and Z is plotted as a 3-Dimensional scatter plot then a symbol is drawn at each data point along with a vertical line connecting the symbol to the X-Y plane.

A different view of the a 3-D plot can be specified with the following command:

ROTATE - Next 3-D plot will be rotated 90 degrees.
ROTATE OFF - Next 3-D plot will be displayed using the normal view.
Menu: Plot | 3-D Plot

FRAME3D - Specifies that front part of box frame be drawn on 3-D plots.
FRAME3D OFF - Only back part of frame is drawn.
Menu: Plot | 3-D Plot

The following command can be used to temporarily disable the plotting of selected data sets:

NOPLOT n-m - Data sets #n through #m will not be plotted on the next plot; they are not deleted and can still be manipulated. The list of disabled data sets is cleared with the command "NOPLOT" (with no parameters).
Menu: Options | Disable Data Sets

The last displayed plot will be redrawn if the keys CTRL+P are pressed or the right mouse button is double clicked (when cursor is in the client window).

BGCOLOR WHITE - Sets background color to WHITE; default is BLACK.
Menu: Options | White Background

DATACOLOR k n-m - Specifies that color index (or name) "k" be used for plotting data sets #n through #m. The color index corresponds to one of the 15 color indexes (excluding 0) available with standard EGA/VGA. The color parameter "k" can also be specified by using the first two letters of the following color names: BLue, GReen, CYan, REd, MAgenta, BRown, MGray, DGray, LBlue, LGreen, LCyan, LRed, LMagenta, YEllow, BW (Black or White - opposite of background); (L=light, M=Medium, D=Dark).
AXISCOLOR k - Specifies that color index (or name) "k" be used for drawing axes and labels.
Menu: (none)

A simple way of handling color is to put your choice of color commands in a command file, COLOR.PLT for example, then put the command "LOAD COLOR.PLT" in all other command files or load it interactively. The AXISCOLOR or DATACOLOR command with no parameters sets the colors back to the default colors.

Data Manipulation

Multiple sets of plotted data that correspond to different orders of magnitude or different ranges can be compared by using the Z axis as a second vertical axis on the right side of a 2-D plot (see USEZ command) or by using the following commands:

SCALEX value n-m - Multiplies the X values in data sets #n through #m by "value".
OFFSETX value n-m - Adds "value" to the X values of data sets #n through #m.
SCALEY value n-m - Multiplies the Y values in data sets #n through #m by "value".
OFFSETY value n-m - Adds "value" to the Y values in data sets #n through #m.
SCALEZ value - Multiplies the Z values by "value".
OFFSETZ value - Adds "value" to the Z values.
Menu: Transformations | Scale Data

The above commands can also be used to scale the data to keep scientific notation from being used in axes tic mark labels.

The following are some more commands for manipulating data:

CLRDATA n-m - Clears data sets #n through #n; clears all data sets if there is no parameter.
Menu: Options | Clear Data Sets(s)
CLRZ - Clears Z values.
Menu: Options | Clear Z values

REDUCE m n - Replaces data set #n with averages of successive groups of m data points, i.e., the number of data points is reduced by a factor of 1/m.
Menu: (none)

SWAPXY n-m - Swaps X and Y values of data sets #n through #m.
Menu: Transformations | Swap X and Y

COPY x1 x2 n - Copies data points between x1 and x2 from data set #n to a new data set; "COPY 0 0 n" copies all of the data set.
Menu: Transformations | Copy Data Set

APPEND m n - Appends data set #m to the end of data set #n and deletes data set #m.
Menu: Transformations | Append Data Set

YYTOXY n m - Generates a new data set with the X values copied from the Y values of data set #n and the new Y values copied from the Y values of data set #m, i.e., (Yn,Ym) is copied to new (X,Y). If a table of data is input with the READTABY command and plotting of the input data is disabled with the NOPLOT command then the YYTOXY command can be used to select any pair of columns from the table as a data set to be plotted.
Menu: (none)

YTOZ n - Copies Y values of data set #n to Z data array.
Menu: (none)

Examples

Suppose the file EXAMPLE.PLT contains the following commands and data:

```
title   Example Plot
xlabel   This is the X axis
ylabel   This is the Y axis
xstart   5
xend   15
xstep   2.5
ygrid
open   data2.dat
read   16
read
open   data1.dat
read
close
read   12
 6    178      7    193      7.5    212      8    243
 8.5    365      9.5    185    10       72    12    43
12.5    150      13    240      13.5    30      14    85
symbols   3
symbols   4
plot
```

And suppose data file DATA2.DAT contains:

```
 5    30      6      40      7    70      8    120
 9    250      9.5    450      10    800    10.25    900
10.5    950      10.75   880    11   700    11.5    290
12    150      13      80      14    50      15      40

 5    980      6    980      7    980      8    950
 8.5    900      9    800      9.5    500      10    400
10.5    300      11    250    11.5    220      12    200
13    200      14    200      15    200
```

And suppose data file DATA1.DAT contains:

```
 4      50      6    75      8    125      10    275
12    575      14    950
```

A plot will be displayed by loading the command file EXAMPLE.PLT with the LOAD command or selecting menu item "File | Load Plot Command File". The X and Y axes will be labeled and the plot will be titled. The X-axis will be linear by default and will range from 5 to 15 and be labeled in increments of 2.5. By default the WPlot program will set the scale of the Y-axis which will also be linear. Horizontal grid lines will be drawn. Four sets of data will be plotted. The first set of data will consist of 16 data points read from file data2.dat. The second set of data will be all of the remaining data in file data2.dat. The third set of data will be read from file data1.dat. The fourth set of data will be the 12 data points in the command file. All four sets of data will be plotted as line plots. Symbols will be drawn at the data points in the third and fourth sets of data.

The data in the following command file will be plotted at even intervals on the X-axis using a log Y-axis:

```
title   Example Log Plot
xlabel   X
```

```
ylabel   Y
logy
ready    24
 2.1     2.9      3.3      3.8      4.6      6.2
 8.3    12.4     17.1     29.3     53.7     75.4
92.1    62.3     25.4     15.2     11.2      7.4
 5.9     4.1      3.6      2.8      2.3      1.95
plot
```

The following commands will produce a 3rd degree polynomial curve fit:

```
title   Third Degree Polynomial Curve Fit
xlabel   X
ylabel   Y
read   10
.5       3        1.5     7      2.5    12.5
5.5     14.5      6.5    16      9.5    14.5
10.5    16       12.5    16     14.5    21
15.5    23
poly   3
plot
```

Other examples can be found in the example command files with a PLT extension.

Miscellaneous

These commands are for use within user written plot command files:

AUTOPRINT ON - Causes each subsequent plot created by the command file to be automatically displayed and printed without waiting for the user's input. Auto print is turned off when the end of the command file is reached or by the command AUTOPRINT OFF.
Menu: (none)

PRINT - Prints currently displayed plot using default printer.
Menu: File | Print

PLOTSIZE n - Sets size of plot: 1 = Half Size, 2 = Three-Quarters Size, 3 = Full Size.
Menu: Options

WINPOS x y - Sets position of upper left corner of client window. The coordinates are percentages of the full screen dimensions and must be between 0.1 and 95.0 percent. A value of 0 lets Windows determinate the corresponding coordinate position. To take affect, the command should precede the PLOTSIZE command.
Menu: (none)

EXIT - Exits WPlot, i.e., closes WPlot's window.
Menu: File | Exit

WAIT - Waits until user presses the Tab key or selects "Next" menu item.
Menu: (none)

MESSAGE text - Displays single line of text in client window.
Menu: (none)

MESSAGES n - Displays n lines of text that follow MESSAGES command.
text line #1
text line #2
:
text line #n
Menu: (none)

* A line in a command file that begins with an asterisk is treated as comment.

Copy Plot to Clipboard

A displayed plot will be copied as a bitmap to the Clipboard by holding down the Ctrl key then pressing the C key (Ctrl+C) or by selecting the following menu item:

File | Copy Plot to ClipBoard

The plot can then be pasted from the Clipboard into a word processor document. For best results, select "White Background" and "Three-Quarter Size Plot" from the options menu before copying a plot to the clipboard.

WPlot does not have the capability to write a plot directly to a BMP bitmap file. However, a plot can still be written to a BMP file using the Clipboard and the Windows Paintbrush utility. First copy the plot to the Clipboard as described above. Then start the Paintbrush program and maximize it to make sure there is room to display the plot. Then from the "Edit" sub-menu select "Paste" to display the plot. Then from the "Edit" sub-menu select "Copy To"; you will be prompted for the name of the BMP file.

User Program Control of WPlot

WPlot can be used to plot data collected, calculated, or processed by a user written C or Visual Basic program. The user's program can write the data and plot commands to a plot command file and then launch WPlot with the command file as a command line argument using the Windows C function WinExec (as does the auxiliary program WFIT) or the Visual Basic function Shell. For example:

```
WinExec( "wplot commands.plt", SW_SHOWNORMAL );
  or
Shell( "wplot commands.plt", 1 )
```

The WPlot software now comes with a Dynamic Link Library (DLL), WPLOTCMD.DLL, containing functions that the user's program can call to launch WPlot and send plot commands and data directly to WPlot. The following functions are in WPLOTCMD.DLL:

```
int FAR PASCAL _export StartWPlot( int id, char far *path );
```

This function launches WPlot with parameter "#n" where n is a specified buffer id (1 to 4). The id allows up to 4 different instances of WPlot to be controlled. The path to WPlot is specified by the second parameter (may be an empty string or NULL to specify the default working directory). If the path specifies a directory then the directory name must be followed by the backslash character "\". The function returns 0 if successfull, else one of the following error codes: 1- Out of memory, 2- Invalid id, 3- File WPLOT.EXE not found, 4- Path to WPLOT.EXE not found, 5 or greater- unspecified error.

```
int FAR PASCAL _export WPlotcmd( int id, char far *pcmd, int nocheck );
```

This function puts the command pointed to by pcmd into the internal buffer associated with the specified id if the buffer is empty. The function returns 0 if successfull; it returns 1 if the buffer is not empty, i.e. the buffer has not yet been read by WPlot. The test for an empty buffer is disabled if nocheck is nonzero. WPlotcmd can be called with pcmd = NULL (and nocheck = 0) to just check that the buffer is empty. NOTE: The WPlotcmd function calls the Windows PeekMessage function to make sure WPlot had a chance to read the previous command.

The user's C program must be linked with the import library WPLOTCMD.LIB or must have a DEF file containing the following lines:

```
IMPORTS   WPLOTCMD.StartWPlot
          WPLOTCMD.WPlotcmd
```

The user's Visual Basic program must declare the functions as DLL functions with arguments passed "ByVal".

See the example C and Visual Basic programs that are included with the WPlot software. Note that Windows must know the path to WPLOTCMD.DLL, i.e., the DLL file should be in the Windows directory or the application's default working directory.

Some special commands were added to WPlot for real-time data display:

RTPLOT - Displays axes, title and labels even if no data.
RTDATA m n - Allocates memory for a maximum of m data points for n data sets. If "n" is omitted it defaults to 1. This command must be given AFTER the RTPLOT (or PLOT) command has been given.
RTPOINT x y - Inputs and plots point (x,y). If more than one data set was specified with the RTDATA command (n > 1) then follow the data point with the number of the real-time data set, i.e.
RTPOINT x y k - Where "k" is between 1 and n, inclusive.
RTEND - Terminates real-time plot and frees Windows resources. This command must be given after all real-time data has been plotted.

The WPlotcmd DLL function can be used to send any WPlot command including the command to load a plot command file. Since WPlot automatically waits on user response after displaying a plot in a command file, the following commands were also added:

CONT - Continues execution of a plot command file.
DISCONT - Discontinues execution of a plot command file.