# Table of Contents

**Introduction** .................................................. 3

**Card Input**
- General rules ............................................. 4
- Limitations ................................................. 4
- Data input .................................................. 5

**Control input** ................................................ 5
- Command list ............................................... 6
- Command description ...................................... 8

**JCL** .............................................................. 19

**Sample input** ................................................ 20

**FORTRAN Calls** .............................................. 22
- Limitations ............................................... 22
- Arrays ....................................................... 22
- Abbreviated Calls ......................................... 22
- List of Calls ............................................... 23
- Descriptions of Calls ..................................... 24
- JCL .......................................................... 28
- Sample Job ................................................ 28

**Appendix A (Specific Output Devices)**
- Tektronix 4013 .............................................. 29
- CalComp ....................................................... 29
- Microfiche and 16-mm Film .............................. 30
- DTC-300 ..................................................... 30

- Versatec Electrostatic Plotter .......................... 31

**Appendix B (Interactive Mode)** ............................ 32

**Appendix C (User Scaling)** ................................. 33
- Scaling Function ........................................... 33
- Ticks and Labels .......................................... 34
- JCL .......................................................... 35

**Appendix D (Fancy Characters)** ............................ 36
TOP DRAWER--A Program to Draw Plots and Graphs

TOP DRAWER draws curves, histograms, and individual data points, with axes, ticks, numeric labels, and any titles the user specifies. Connection to the graphic device(s) used for output is through the SLAC Unified Graphics System¹ (U.G.), so output can be made on any non-interactive device known to U.G. Currently, this includes the Tektronix 4013 WYLBUR terminals, the DTC-300 terminals, the Versatec Electrostatic plotter, the 10" and 29" CalComp plotters, and the CalComp Microfilm Plotter. Titles may contain any of the characters of the U.G. extended character set.

Many of the features of a plot can be described by the user, with control cards containing keywords and values. In the absence of specific instructions, TOP DRAWER chooses values based on the given data. A good plot can usually be made just from the data points, with no additional instructions.

TOP DRAWER can be run as a self-contained program, reading a data set of cards or card-images. There are also FORTRAN-callable subroutines which allow the user's main program to control the plotting.

¹) Robert C. Beach, The SLAC Unified Graphics System CGTN No. 143 (revised September 1974)
A. **General Rules**

Data and commands are read from the input file, FORTRAN unit 5. Input is free-field. Field separators are $ *, /, = and blank. At most four, and sometimes fewer, characters are significant in control words. Subsequent characters, until a separator, are ignored. Input values may be given in integer, decimal, or exponential notation. (As a general rule, any FORTRAN output, with I, F, E, or D format, is a legal input value for TOP DRAWER.)

Comments on input cards may be enclosed in parentheses (). All enclosed characters are ignored. Comment fields are not continued to the next card.

A semicolon (;) ends the current card. Instead of reading a new card, TOP DRAWER continues after the semicolon. In this way, multiple commands and/or data points may be entered with one physical card.

TOP DRAWER makes two-dimensional plots. The "x-axis" is horizontal and the "y-axis" is vertical. On 10-inch CalComp, the x-axis runs along the paper, and is virtually unlimited. The y-axis is across, and may be no longer than 10".

B. **Limitations**

The TOP DRAWER input language has evolved according to the idea that TOP DRAWER should do what you expect it to. This ideal is not always possible to realize, and some of the exceptions are described in this section.

1) No more than 1000 points may be entered at one time. Blocks of this size or less must be separated by a PLOT or JOIN command.

2) The limits for a plot must be set at the first PLOT, HIST, or JOIN command. This means that if two or more separate sets of points are being JOINed, the automatic limit setter will look at the first set, and TOP DRAWER will make the axes before the second set is read in. In this case, to make sure the limits are big enough for both sets, an explicit SET LIMIT command must be used.
C. Data Input

Data points consist of value and error for x and y, and a plot symbol. A data point card may contain from one to five values. The order in which the values on this card are interpreted is set by the SET ORDER command. The default order is [X Y DX DY SYMBOL]. In a series of data cards, a value given on one card will be repeated for subsequent cards unless changed. The starting values for this scheme are zero for the numbers and blank for the plotting symbol.

D. Control Input

Commands which control the format of the plotting and the placement of titles and labels may be interspersed with data point cards. The next part of this section contains a brief description of each command. The following part contains more detail.

The command scan is generally a loop, after the first word (second for a SET command) is recognized, and keyword parameters may be given in any order, although the effect of one is unpredictable in case of a syntax error in another.

Examples: SET SCALE X LINEAR Y LOG BASE 2
SET LABEL TOP ON BOTTOM OFF

In this writeup, size measurements are made in "inches". One "inch" is a real inch, if it is reasonable for it to be so, as in the case of Calcomp plots. In other cases, for instance 16-mm film, an "inch" is defined relative to the size of the total plot, which is normally 13 "inches" wide by ten "inches" high. More details are given under the SET SIZE command.

The notation used in command description is taken from the WYLBUR manual. Briefly, "|" means "OR" and separates alternatives. Brackets [ ] enclose optional material. Braces {} enclose one or more options, one of which must be specified. An underscore indicates a default option, which need not be given explicitly. Upper case text must be used as specified. Lower case indicates text, characters, or values to be given by the user.
List of Commands

END

HISTOGRAM

JOIN [level] [GENERAL|SPLINE] [TEXT] [DOTS]
    makes a curve passing through given points.

NEW PLOT [[ALIAS=] 'alias']
    starts a new page.

PLOT
    plots given points, with error bars and symbol.

SMOOTH (x|y) [LEVEL n] [POINTS n1 TO n2] [LIST [n]]

SYMBOL [x] [SIZE n]
    sets symbol used for plot character.

RETURN [n]
    returns to calling program (see 'FORTRAN Calls')

TITLE [x|y|g][DATA] xxx yyy [SIZE n]
    [ANGLE x] [SPACES n] 'text'
    writes text on plot

CASE 'text'
    follows TITLE card. Invokes fancy characters.

[x|y|dx|dy] [(BINS|POINTS)[[n1 TO n2]]
    FROM xxx] [TO xxx] [BY xxx]

(continued...)
TOP DRAWER--A Program to Draw Plots and Graphs

SET AREA [X xxx TO xxx] [Y yyy TO yyy]
defines position of outline of current graph.
(Labels are outside this area. Titles and other
graphs may be made inside or outside.)

SET {AXIS|AXES} [[TOP|BOTTOM|RIGHT|LEFT] [ON|OFF|DEFAULT] ]
controls presence/absence of axes.

SET BAR [SIZE] xxx sets size of ends of error bars.

SET CARD [LENGTH] n sets length of input cards.

SET DEVICE device
chooses output device. (4013, CalComp,...)

SET LABEL [SIZE=n] [[TOP|BOTTOM|RIGHT|LEFT]
[ON|OFF|DEFAULT] ] [PLOT]
controls numeric labels along axes.

SET LIMITS [X xxx TO xxx] [Y yyy TO yyy] [XMIN xxx] [XMAX xxx]
[YMIN yyy] [YMAX yyy]
sets limits for each plot axis.

SET MODE [VECTOR] [NOVECTOR] [ECHO [n]] [NOECHO] [DEBUG]
[MODEBUG] [DEBR]
sets miscellaneous flags.

SET ORDER [X [fctr]] [Y [fctr]] [DX|BX [fctr]]
[DY|BY [fctr]] [SYMBOL]
determines interpretation of input data cards.

SET SCALE [X|Y] [LOG [BASE n]] [LINEAR] [USER [n]] [n1 n2]
sets scaling, number of labels, and ticks

SET SIZE xxx [BY] yyy [UNITS=units]
defines active area of paper or unit for screen.

SET SYMBOL [x] [SIZE n]
sets symbol used for plot character.

SET TICK [SIZE=n] [[TOP|BOTTOM|RIGHT|LEFT]
[ON|OFF|DEFAULT] ] [PLOT]
controls tick marks on axes.
HISTOGRAM

TOP DRAWER makes simple histograms, from data points. Bin edges are put halfway between the ends of the adjacent error bars, or halfway between the points if there are no error bars.

JOIN [level] [GENERAL|SPLINE] [TEXT] [DOTS]

Draw a line from point to point. Error bars and symbols are not used. If 'level' is specified, it is the number of straight line segments which will be used in connecting adjacent points.

The GENERAL curve is calculated using an algorithm which allows multiple-valued functions and repeated points. Because of its generality, it sometimes adds undesired loops and curls. SPLINE invokes a natural cubic spline fit to the given points. (For the SPLINE fit, there is a maximum number of points, and either the x- or y-values must be strictly increasing. TOP DRAWER checks these conditions, and uses the GENERAL fit if they are violated.)

TEXT instructs TOP DRAWER that the current points are part of the text or titles being plotted. The coordinate system used is the same as is used for positioning titles, and no plot axes are made.

DOTS specifies that a dotted line is to be drawn. (The number of dots drawn between each pair of your points is (level-1). If your points are not evenly spaced, the dots won't be, either.

(JOIN draws only the curve or line segments, not the symbol or error bars. For symbol and error bars, you must PLOT as well.)
TOP DRAWER--A Program to Draw Plots and Graphs

NEW PLOT [[ALIAS='alias']]

Start a completely new picture. Untreated points are PLOTTed before going on.

For some graphic devices, e.g. 4013, DTC-300, output is a PDS, and each member is one plot. In this case, member names are PICT001, PICT002, etc., but they may be given an alias. The given alias names the following plot, not the previous one.

PLOT

Plot the current points, with the given error bars and symbols. This command sets limits if not already set. If the current points have not been processed (i.e. by a PLOT, JOIN, or HIST command), PLOT is performed automatically at the end of input, or before a NEW PLOT or SET AREA command.

RETURN [n]

This is a command to return to the calling program. It is useful when Top Drawer has been called from a user program (see 'FORTRAN Calls') or the interactive driver (see Appendix B.) If Top Drawer was called by the FORTRAN statement CALL TDBMAIN(N), N becomes the fullword integer value n.
TOP DRAWER--A Program to Draw Plots and Graphs

SET AREA [X XXX TO XXX] [Y YYY TO YYY]

SET AREA sets the coordinates, in "inches", of the axes of the coming graph. (The available plotting surface is set by the SET SIZE command.) More than one area may be used before making a NEW PLOT. If neither X nor Y is specified, the values are reset to the original, nearly full-size, values. If only one is specified, the other is not changed. When one or both is specified, the corresponding limits are reset for automatic selection. They may of course be reset by a SET LIMITS command. Elementary safeguards are in effect to prevent putting the axis labels of the current plot inside the area of the previous plot. These safeguards are effective only if plots are moved from low to high (increasing Y) or left to right (increasing X).

SET [AXIS|AXES] [[TOP|BOTTOM|RIGHT|LEFT] [ON|OFF|DEFAULT] ]

Controls the presence or absence of each axis. This affects only the axis itself, not the ticks or labels. The axes are drawn at the first PLOT, HIST, or JOIN command, and this command will have no effect if it is given later. DEFAULT is the same as ON.

SET BAR [SIZE] xxx

This command sets the size of the lines on the ends of the error bars. As in the SET TICK SIZE command, the default value is 0.1, and the unit is "inches".

SET CARD [LENGTH] length

Sets the number of significant columns for the input cards. The starting value is 72.
TOP DRAWER--A Program to Draw Plots and Graphs

*********************************************************

SET DEVICE device

*********************************************************

Available output devices are

10-inch CalComp
20-inch CalComp
4013 'Scope
16-mm unsprocketed film
Microfiche
DTC-300
V1100 (Versatec Electrostatic Plotter Model 1100)

Only the first two characters are used in identifying the device type.

The JCL must define an output dataset appropriate for the (each) device. See the section on JCL for a description.

*********************************************************

SET LABEL [SIZE=n] [[TOP|BOTTOM|RIGHT|LEFT]
(ON|OFF|DEFAULT)] [PLOT]

*********************************************************

Sets the size of the numeric labels along the axes, and specifies which axes are to be labelled. The size, as usual for text size, describes the character spacing, in tenths of an "inch". The starting size is -2. The defaults are ON for left and bottom, and OFF for top and right.

PLOT signals that the labels and ticks are to be plotted immediately, using the limits that are currently in force.
TOP DRAWER--A Program to Draw Plots and Graphs

SET LIMITS [X xxx TO xxx] [Y yyy TO yyy] [XMIN xxx] [XMAX xxx] [YMIN yyy] [YMAX yyy]

This command is used to request or override the automatic selection of plot limits. With automatic selection, limits are set to 10% beyond the range of input values, at the first PLOT, JOIN, or HIST command. If no limits are given, all are set for automatic selection. If some are specified, the others are not changed.

The difference between limits may have any non-zero value. XMIN gives the value at the left edge of the x-axis, and XMAX gives the value at the right end, but there is no requirement that XMIN be less than XMAX. (And the use of YMIN and YMAX is of course similar.) In the same way, the command SET LIMITS X FROM 10 TO -10 Y FROM 0 TO -20 is legal, and sets values from 10 at the left edge to -10 at the right, and from zero at the bottom to -20 at the top.

SET MODE [VECTOR] [NOVECTOR] [ECHO [n]] [NOECHO] [DEBUG] [NODEBUG] [DEBR]

This is a catch-all command, for controlling miscellaneous unrelated flags.

VECTOR requires vector characters in all text, even if the current device has a character generator. NOVECTOR nullifies a previous VECTOR command.

ECHO n sets the number of data point cards in each block which will be listed in the printed output. (There is no way to suppress the printing of control cards.) ECHO is equivalent to ECHO 10000. NOECHO is equivalent to ECHO 0. The starting value is 20.

DEBUG and DEBR set printing flags for the plotting routines and the card-reading routines, respectively. NODEBUG cancels them both. They are not for the general user.
TOP DRAWER--A Program to Draw Plots and Graphs

SET ORDER [X [fctr]] [Y [fctr]] [DX|RX [fctr]]
[DY|RY [fctr]] [SYMBOL]

This command sets the order in which the number fields on each data card will be interpreted. The default order is [X Y DX DY SYMBOL].

X and Y are central values. DX and DY are half-widths for the error bars used in the PLOT command. RX and RY signify that the errors to be given are relative to the central value.

"fctr" are four multiplicative factors which will be applied to the data on each input card. If a factor is not explicitly given, 1. is used. Values from a previous SET ORDER card are not retained.

SYMBOL is the symbol which will be used to PLOT the point. (The default symbol is given by the SYMBOL card.) It may be specified by a single character, a hex pair, or a U.G. extended-character-set pair, as for the SYMBOL command.

For instance,

```
SET ORDER X DX Y DY SY
10 3 50 10 80
```

is equivalent to

```
SET ORDER X RX Y RY SYM
10 .3 50 .2 0P
```

and to

```
SET ORDER X 10 RX Y DY 10 SYMBOL
1 .3 50 1 0P
```
TOP DRAWER--A Program to Draw Plots and Graphs

SET SCALE \{X\|Y\} [LOG [BASE n]] [LINEAR] [USER [n]] [n1 n2]

Scaling for each axis is independent. n1 and n2 specify the type and spacing of labels and ticks. If n1 and/or n2 are zero or omitted, TOP DRAWER chooses its own value(s). Control is different for linear and logarithmic scales.

Linear: There will be at most (|n1|+1) intervals (and |n1|+2 major ticks) on the axis. (Since labels are placed at round numbers, which may not coincide with the ends of the axis, there may be fewer.) Each interval is divided into |n2| subintervals by unlabelled ticks.

Positive n1 gives big ticks at major intervals. Positive n2 gives big ticks for subintervals. Negative gives small ticks. The default values are n1,n2=6,-5.

Logarithmic: Each decade is labelled the same.

n1 controls the labels. If n1 is positive, standard notation, e.g. 10000, is used for the labels. If n1 is negative, exponential notation, e.g. 10^4, is used at integral powers of ten, and only the first digit is used for any intermediate labels.

n2 controls ticks. If n2 is negative, short ticks are used except at integral powers of ten. If n2 is positive, long ticks are used exclusively. In any case, the magnitudes of n1 and n2 make bit patterns which specify the positions of intermediate ticks and labels, according to the following scheme:

<table>
<thead>
<tr>
<th>value</th>
<th>meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No intermediate labels (n1) or ticks (n2)</td>
</tr>
<tr>
<td>2</td>
<td>Label or tick at all positions, 2 thru 9</td>
</tr>
<tr>
<td>2**n</td>
<td>Label or tick at the n-th position</td>
</tr>
</tbody>
</table>

(A sum may be used to specify more than one position at a time, except for the values 1 and 2. Thus, n2 = -36 specifies a small tick at 2 and 5, since 36 = 2^2 + 2^5.)

BASE n affects only the labels made on logarithmic axes. The default is 10.

USER n invokes scaling given by user routines

FUNCTION TDFNCT(COORD,N) and
SUBROUTINE TDTICK(W,VMIN,VMAX,N1,N2,BASE,NUM,VALS,ITYPES). N is the scale identifier. (See Appendix C.)
TOP DRAWER—a Program to Draw Plots and Graphs

---

\texttt{SET SIZE xxx [BY] yyy [UNITS=units]}

---

The exact meaning of this command depends on the device in use. The \texttt{SIZE} of a plot is the active area, in which plotting can be done, and this command sets that area. The units are "inches", which may be real inches in the case of hard-copy plots. For hard-copy plots, and if the given values do not exceed the size allowed by the device, the given values are used as real inches. In other cases the plot made is the largest that will fit, with the given aspect ratio, and the units are defined so that the plot is just the given size. This allows one to define a plot size, e.g. 13" by 10", and to use that size on any output device. If you plan to test on the 4013 'scope, but to make a final plot on CalComp, it would be a good idea to decide the size first, and use that from the outset. If some positions, e.g. plot location and axis title positions, are set by TOP DRAWER, and some, e.g. additional titles, are explicit, then changing the \texttt{SIZE} will change the relative positions of these elements.

Outrageous definitions of plot size will produce reasonable plots, but the titles and labels may be wrong, since the character spacings are defined in tenths of the nominal "inch". Even in the case of the 4013 CalComp plotter, in which the paper is unlimited in the \texttt{x} -direction, no plotting or characters will be put outside the active area.

The default size is 13" (horizontally) by 10" (vertically).

'\texttt{units}' can be used to specify the number of paper coordinate units which will fit in one "inch". For instance, if you prefer to measure your plots in centimeters, put \texttt{UNITS=2.54}.

Examples: Most of the paper will be unused if the default \texttt{SIZE} is allowed on the 29" CalComp plotter, and one "inch" is a real inch. On the other hand, one "inch" will be slightly less than one real inch if the default is used for the Versatec plotter, which has a maximum width of only 10".

---

\texttt{SET TICK [SIZE=n] [[TOP|BOTTOM|RIGHT|LEFT] [ON|OFF|DEFAULT] ] [ PLOT]}

---

This command sets the length of the (smaller) ticks used on the axes, and controls ticks on each axis. 'DEFAULT' is the same as 'ON'. (The larger ticks are three times the smaller.) The value specified is in "inches". The default size is 0.1.
PLOT signals that the labels and ticks are to be plotted immediately, using the limits that are currently in force.

SMOOTH (X|Y) [LEVEL n] [POINTS n1 TO n2] [LIST [n]]

This command replaces the y-values specified by new values which give a smoother curve. The values are smoothed according to a non-linear algorithm which supposes that the given values are from a histogram of equally spaced bins. It is relatively insensitive to fluctuations in individual points. (The original values are destroyed.)

LEVEL=n refers, approximately, to the number of points on each side of the bin in question which will be used in setting the value for that bin.

LIST n will cause the smoothed values for the first n points to be listed, in case they are wanted for future calculations. (The job output is available through WILBUR, if it is held, and could be used as input to another job.) The default case is LIST 0, which does not list. LIST is equivalent to LIST 10000.

POINTS n1 TO n2 specifies the points, currently present in the TOP DRAWER point storage, which will be treated. (Remember that point storage is restarted with point 1 after each PLOT, JOIN, or HIST command.)

SYMBOL [x] [SIZE n]
SET SYMBOL [x] [SIZE n]

The symbol 'x' becomes the symbol to be PLOTTed for the following points. It may be specified by one character followed by a blank, by a two-digit hex number, or by a character pair from the U.G. extended character set. The latter two are useful for specifying plotting characters, as described in Appendix D. (In case of ambiguity between the latter two, which are both given by two characters, the hex interpretation holds. This affects only the "both-arrow" character, which must be given by its hex code, 1E.)

The default symbol is a blank or no character, which is plotted as a dot if zero error bars are specified. If 'SIZE n' is specified, n is the approximate width of the plotted
character, in tenths of an "inch".

The two forms of the command, 'SYMBOL...' and 'SET SYMBOL...' exist only for convenience. They are equivalent.

-------------------------------

TITLE [X|Y|G][DATA] xxx yyy [SIZE n] [ANGLE x] [SPACES n] 'text'
[CASE 'case text']

"text" will be written on the plot. It must be enclosed in apostrophes or quotes. The title size and orientation, and the position of the first character are set by the other parameters on the card. If the text delimiter ('" or ') appears in the text as well, it must be doubled. Thus, 'This Exp''t' is equivalent to "This Exp't".

If DATA is not specified, (xxx,yyy) are in inches, as for the SET AREA command. They give the coordinates of the center of the first character to be plotted. 'X', 'Y', or 'G', may be used instead, to indicate the x- or y-axis title, or a 'graph' title which will appear above the current area. If no position is given, the text will be placed below the most recent title line.

If DATA is specified, (xxx,yyy) are in the coordinate system of the data points, as set by the most recent SET LIMITS command or operation with the data points.

"SIZE" is the approximate spacing of the letters, in tenths of an "inch". A negative size allows the character generator to be used, if it is available on the particular output device, and if the magnitude is correct. For instance, size -2 gives the character generator on the 4013 'scope, while -1, -3, etc., are the same as +1, +3, etc.

"ANGLE" is in degrees, measured counter-clockwise from the x-axis.

SPACES=n is used to tell TOP DRAWER how wide the X, Y, or G title is, so that it can be centered. (When the extended character set is used, the number of characters in the title may not be the same as the number of spaces taken by the title.)
TOP DRAWER--A Program to Draw Plots and Graphs

CASE text is optional and may appear on the same card or the following card. The CASE text modifies the TITLE text that it follows.

"case text" must correspond, character for character, to "text" in the preceding card. Each pair of characters, the first from the TITLE card and the second from the CASE card, makes a character pair which will be interpreted according to the U.G. extended character set specifications, described in the U.G. writeup, and briefly listed in Appendix D.

For example,

```
TITLE X 'EOIP1=-1'
CASE 'LCLGC'
```

would produce the X-axis title "e to the i pi equals minus 1", since L as second character of a pair produces lower case Roman letters, G produces lower case Greek, and OC and UC are the control characters specifying, respectively, "enter superscript mode" and "leave superscript mode".

```
[X|Y|DX|DY] [ (BINS|POINTS) ] [ [n1 TO] n2 ] 
[ FROM xxx ] [ TO xxx ] [ BY xxx ]
```

This command can be used to put a linear sequence of values into one of the data point or error arrays. It is particularly useful for doing the base axis of a histogram, or installing constant errors.

POINTS means that the values are to be generated as defined. BINS gives values at the centers of bins whose edges are specified by the command. For instance,

```
X POINTS FROM 0 TO 10 BY 1
```

gives 11 values: 0,1,2,...,10.

```
X BINS FROM 0 TO 10 BY 1
```

gives 10 values: 0.5,1.5,2.5,...,9.5. POINTS is assumed if neither is specified.

n1 and n2 define the indices in the Top Drawer data array. If not given, n1 is taken as 1. Thus,

```
X BINS=10 FROM 0 TO 20
```

gives 10 values: 1,3,5,...,19.

If there is insufficient information to make the array, e.g. if only FROM and TO are given, the current number of data points is used for n2.
TOP DRAWER--A Program to Draw Plots and Graphs

JCL

// JOB ,CLASS=E
// EXEC LOADGO,
// LKEDPRM='EP=MAIN',
// LKEDLB2='WYL.CG.RBC.LOADMODS',
// LKEDLB3='WYL.CG.RCB.UGFLIB',
// GOSL1='WYL.CG.RCB.UGXLIB',
// GORGN=200K
//GO.SYSLIN DD DSN=WYL.CG.RBC.LOADMODS(TOPDRAW),DISP=SHR

JCL to define the output dataset(s) goes here.
(see Appendix A.)

//SYSLIN DD *

TOP DRAWER Input Cards Go Here.

To generate a standard set of JCL, if you are logged onto
WILBUR, get your Top Drawer input cards in the active file, and
EXECUTE FROM WYL.CG.RBC.LIB#TDJCL ON CAT CLEAR
Sample Card Input

TITLE 3 9.5 SIZE 4 'SAMPLE OUTPUT'
CASE 'LLLLL LLLL'

SET AREA Y 1 TO 4.5
800 3; 840 3
880 0; 920 13
960 17; 1000 18
1040 22; 1080 20
1120 25; 1160 24
1200 40; 1240 58
1280 51; 1320 36
1360 37; 1400 29
1440 26; 1480 16
1520 0; 1560 0

HIST
SET AREA Y 4.5 TO 8
HIST (SINCE NO NEW POINTS HAVE BEEN FED IN)
(THESE COMMANDS OPERATE ON THE OLD ONES)

SMOOTH
JOIN
NEW PLOT
SET SCALE X LINEAR 5 4 Y LOG
SET BAR SIZE .02
TITLE G 'PO-1 + P R N H'
CASE 'GC C L A I G'
SYMBOL B3 (RICHARDS ET AL)
TITLE 8 8 '3 RICHARDS ET AL.'
CASE 'P LLLLLL L L L'

SET ORDER X Y DY
718. 1.520 .165
782. 2.413 .264
832. 2.446 .231
1005. 1.091 .165
1106. 1.190 .165
1249. 1.190 .132
1433. 0.661 .066

SYMBOL B2 (NELSON)
TITLE '2 NELSON'
CASE 'P LLLLL'

SET ORDER X Y 2.42 DY 2.42
(NELSON'S RESULTS DIFFER BY A FACTOR OF 2.42)
1590 .272 .02
1790 .202 .015
1990 .215 .016
2190 .170 .013
2390 .127 .010
Sample Output

\[ \pi^- + p \rightarrow n \eta \]

- \(\square\) Richards et al.
- \(\bigcirc\) Nelson
TOP DRAWER—A Program to Draw Plots and Graphs

FORTRAN Calls

One method for making Top Drawer plots from a user program is to write a dataset of commands, which will be read by Top Drawer in a later jobstep. Top Drawer can also be called directly, saving time and effort, at the cost of additional memory.

Limitations

1.) Calling TDJOIN, TDHIST, or TDPLTOJ fixes the plot limits if they have not been fixed already. If subsequent calls will contain points which lie beyond the points in the first call, the limits should be set by a SET LIMITS/COMMANd (through a call to TDSSET) or calls to TDLIMS.

2.) Top Drawer FORTRAN entry points will generally accept either REAL or INTEGER arguments. This is not true for the value and error arrays, which must be REAL.

3.) Character string arguments which have no implicit length (for TDSSET, TDITL, and TDCASE) must end with a semicolon ';'. A single semicolon to appear in the string should be doubled, e.g.

```
CALL TDITL('CALL TDITL('TITLE;','X');','X')
```

Arrays

The value and error arrays X, DX, Y, and DY have dimension NP (or greater). DX and/or DY may be replaced by the letters NONE [e.g. CALL TDHIST(50, X, Y, 'NONE', DY)] and the corresponding errors will be assumed zero. If DX or DY is the last argument in the call, it may be omitted with the same result.

For instance, CALL TDHIST(50, X, Y)

is the same as CALL TDHIST(50, X, Y, 'NONE', 'NONE')

Abbreviated Calls

As a general rule, leaving out the last argument in a call produces a default value for the omitted argument, if such a thing has meaning.

For instance, CALL TDJOIN(50, X, Y, 'NONE', 'NONE', 0, 0)

is the same as CALL TDJOIN(50, X, Y),

but CALL TDJOIN(50, X) is wrong because at least the x- and y-values for each point must be given.

The default values are 'NONE' for the error arrays DX and DY, and zero for other values.
TOP DRAWER—A Program to Draw Plots and Graphs

List of Calls

CALL TDEND
   empties Top Drawer buffers and closes graphic dataset.

CALL TDHIST(NP,X,Y,DX,DY)
   like HIST command

CALL TDJOIN(NP,X,Y,DX,DY,LEVEL,MODE)
   like JOIN command

CALL TDLIMS('keyword',NP,VALUES,ERRORS)
   sets plot limits

CALL TDMAIN(N)
   starts Top Drawer in card-reading mode.

CALL TDNEWP('alias')
   like NEW PLOT command.

CALL TDPILOT(NP,X,Y,DX,DY,'symbol')
   like PLOT command

CALL TDSET('text:')
   like SET command

CALL TDSTITL('text:',X,Y)
   like TITLE command

CALL TDCASE('text:','case text:',X,Y)
   like TITLE command with fancy characters

CALL TDTSBT(SIZE,ANGLE,ISP1CBl
   additional parameters for TDTITL or TDCASE

Description of Calls

See above, "Arrays", for a description of the data arrays X,DX,Y,DY, and their dimension NP.

The function of a subroutine is generally the same as of the corresponding Top Drawer input command. Refer to the command description for a more complete discussion.
TOP DRAWER--A Program to Draw Plots and Graphs

CALL TDEND

TDEND empties Top Drawer and U.G. buffers and closes the graphic output dataset. No more graphic work should be done. TDEND should be called exactly once in any job.

CALL TDHIST(NP,X,Y,DX,DY)
CALL TDHIST(NP,X,Y,DX)
CALL TDHIST(NP,X,Y)

TDHIST makes a simple histogram. Bin widths are as described for the HIST command.

CALL TDJOIN(NP,X,Y,DX,DY,LEVEL,MODE)
CALL TDJOIN(NP,X,Y,DX,DY,LEVEL)
CALL TDJOIN(NP,X,Y,DX,DY)
CALL TDJOIN(NP,X,Y,DX)
CALL TDJOIN(NP,X,Y)

TDJOIN provides the Top Drawer JOIN function.

MODE gives the type of fit to be used:

- MODE = 0 Default type (spline if possible).
- 1 Spline.
- 2 "General" (Non-linear robust algorithm).
- MODE+64 DOTS

LEVEL is the number of straight-line segments which will be used in connecting pairs of the given points. LEVEL=0 is default (Top Drawer will choose, depending on the value of NP).
CALL TDLINS('keyword',NP,VALUES,ERRORS)
CALL TDLINS('keyword',NP,VALUES)

This sets or resets a limit or limits for the plot. No plotting is done, and the argument values are not changed. 'keyword' may be 'X', 'XMIN', 'XMAX', 'Y', 'YMIN', or 'YMAX'.

VALUES should be the array of x-values, if X, XMIN, or XMAX is specified, or the array of y-values if Y, YMIN, or YMAX is specified. ERRORS is the corresponding error array, either DX or DY. Both are REAL arrays of dimension at least NP. The first NP values are used.

The plot limit(s) indicated by 'keyword' is(are) set to the minimum or maximum value found in VALUES, or VALUES+ERRORS. If they are already set, the plot limits will be expanded, but not reduced by this call, so multiple calls with different arrays may be used. (Compare the SET LIMIT command, which resets without reference to the previous value.)

CALL TDMAIN(N)
CALL TDMAIN

This statement sends Top Drawer into its card-reading mode. Input comes from FORTRAN unit 5, at its current position. The command RETURN or RETURN n causes a return, and if appropriate, n becomes zero or the value from the RETURN command. Top Drawer cannot read WYLBUR EDIT format when called in this manner.

CALL TDNEWP('alias')
CALL TDNEWP(0)
CALL TDNEWP

This starts a new plot. An alias may be given, and will be used if the graphic output device is appropriate (e.g. 4013, DTC-300). Zero or no argument results in no alias being used.
CALL TDPLT(NP,X,Y,DX,DY,'symbol')
CALL TDPLT(NP,X,Y,DX,DY)
CALL TDPLT(NP,X,Y,DX)
CALL TDPLT(NP,X,Y)

TDPLT provides the Top Drawer PLOT command. The default symbol is set by the SET SYMBOL 'symbol' command, e.g. by CALL TDSET('SET SYMBOL X;').

CALL TDSET('text;')

TDSET allows the programmer to use any Top Drawer command beginning with the word 'SET'. The text of the command (with or without 'SET') is the argument in the call. The terminating semicolon is required, since there is no way in the local FORTRAN for a called routine to determine the length of an argument string.
Examples: CALL TDSET('SET SIZE 10 BY 8;')
CALL TDSET('LIMITS X 0 TO 86.2;')

CALL TDTITL('text;',X,Y)
CALL TDTITL('text;',X,Y,or G')
CALL TDTITL('text;')

CALL TDSCASE('text string;', 'case string;', X,Y)
CALL TDSCASE('text string;', 'case string;', 'X,Y or G')
CALL TDSCASE('text string;', 'case string;')

CALL TDTSET(SIZE,ANGLE,SPACES,DATA)
CALL TDTSET(SIZE,ANGLE,SPACES)
CALL TDTSET(SIZE,ANGLE)
CALL TDTSET(SIZE)

These routines provide the Top Drawer TITLE functions. A call to TDTSET is optional, to be used if the default SIZE, ANGLE, SPACES, or coordinate system aren't wanted. A call to TDTSET works only once--you must call TDTSET every time you call TDTITL, unless the defaults are okay.

The arguments X,Y may be replaced by a single argument consisting of the character 'X', 'Y', or 'G', as in the TITLE
command, or they may be omitted to write a line directly under the most recent line plotted by TDTITL.

A non-zero value for DATA will cause the position to be figured in the data coordinate system rather than the usual plot "inches".

TDCASE is identical to TDTITL except for the added argument, which contains the string of second characters for each of the U.G. extended character set pairs.

Example

```
CALL TDTSET(3.,0.,6).
CALL TDCASE('PO-1PRP001N;','
   X   
      'GC CLAGC CL;','X')
```

will produce the x-axis label 'pi-minus p -> pi-zero n'.
TOP DRAWER--A Program to Draw Plots and Graphs

JCL

You can use the standard FORTRAN or MORTAN catalogued procedures, with the following additions: WYL.CG.RBC.LOADMODS and WYL.CG.RCB.UGPLIB must be concatenated to the FORTRAN library datasets, and WYL.CG.RCB.UGXLIB to the GO-step step library. In addition, the graphic dataset(s) must be set up for the GO-step.

The subroutines in question reside in a loadmodule called WYL.CG.RBC.LOADMODS(TDEND). In order to call in all the subroutines, the user program must contain the statement CALL TDEND, even if graphic work is terminated by a Top Drawer END command.

Sample Job

```
// JOB ,CLASS=E
//STEPONE EXEC FORTHCG,
   // LKEDLB3='WYL.CG.RBC.LOADMODS',
   // LKEDLB4='WYL.CG.RCB.UGPLIB',
   // GOSL1='WYL.CG.RCB.UGXLIB',
   // GORN=200K
   //FORT.SYSIN DD *
   //FORT.SYSIN DD *
   DIMENSION X(101),Y(101)
   DO 10 I=1,101
      X(I)=5.0*(I-20)
      Y(I)=SIN(RADIAN)
      Z(I)=0.8*COS(RADIAN)
   10 CONTINUE
   CALL TDJOIN(101,1,
   CALL TDTITL('y = sin(x); ','G')
   CALL TDJOIN(101,1,Y)
   CALL TDJOIN(101,1,Z)
   CALL TDEND
   STOP
END
```

The following JCL sets up the output dataset for a TEKTRONIX 4013. Other devices could be used also. (See Appendix A.)

```
//GO.WYLPICT DD DSN=WYL.gg.uuu.libname,DISP=(NEW,KEEP),
   // VOL=SER=SCR001,UNIT=DISK,SPACE=(TRK,(5,1,3)),
   // DCB=(RECPS=PB,LRECL=80,BLKSIZ=1600)
//GO.SYSIN DD *
```

Input data, which may contain Top Drawer input cards, goes here.
Appendix A -- Specific Output Devices

4013

The JCL for the output dataset could be:

```
//GO.WYLXIPICT DD DSN=WYL.gg.uuu.libname,DISP=(NEW,KEEP),
// VOL=SER=SCR001,UNIT=DISK,SPACE=(TRK,(5,1,3)),
// DCB=(RECFM=PB,LBLRCL=80,BLKSIZE=1600)
```

This is the default output device, and a
SET DEVICE 4013 command is not necessary unless a different device was previously specified.

Plots for Tektronix 4013 terminals are made as members of a partitioned dataset. The first plot is member PICT001, and replaces any existing member with that name. Subsequent plots are members PICT002, PICT003, etc. To display a plot made by a TOP DRAWER batch job, you must sign onto WYLBUR on a 4013 terminal. Fetch the plot with the standard WYLBUR command

```
USE libname#PICT001 ON SCR001 CLE
```

and then "list" it:

```
LIST UNN CLEAN NOWL
```

Plots are similar to standard 80-column card images, and may be used, saved, and manipulated with standard WYLBUR commands.

CalComp

The JCL for the output dataset could be:

```
//GO.PLOTTAPE DD DSN=6&PLOT,DISP=(NEW,PASS),
// VOL=SER=PLOTAP,UNIT=TAPE7,LABEL=(1,NL),
// DCB=(RECFM=U,DEN=0,BLKSIZE=3000)
```

TOP DRAWER input for CalComp plots should be preceded by the control statement

```
SET DEVICE 10" CALCOMP
```

or

```
SET DEVICE 29" CALCOMP.
```

You must submit a Job Instruction Card with the word "PLOTTAPE" under Volume Mounting Instructions. Put your CAMPUS account number, the plot size (10" or 29"), pen width (0.5 is okay), and paper desired (plain), under user comments. Weekend CalComp operators on campus are sometimes less experienced than the usual weekday staff. Plot tapes made in the morning may be returned by the afternoon of the following day, but 48-hour service is more usual. The process can be speeded by taking the tape to the campus center yourself.
Appendix A -- Specific Output Devices

**Microfiche and 16-mm Film**

The JCL for the output dataset could be:

```
//GO.PLOTDATA DD DSN=egov.plot,DISP=(NEW,KEEP),
// VOL=SER=xxxxxx,LABEL=(1,SL),UNIT=T9-1600,
// DCB=(RECFM=FB,LRECL=1500,BLKSIZE=1500,DEN=3)
```

TOP DRAWER input for the CalComp microfilm plotter should be preceded by the control statement

```
SET DEVICE 16-MM FILM
```

or

```
SET DEVICE MICROFICHE
```

The plotter runs off-line at present, and you must make an output tape. You must supply your own tape. When your job has run, you can ask Mickey Bryant to plot your graphic output tape on 16-mm film or 105-mm fiche film.

**DTC-300**

The JCL for the output dataset could be:

```
//GO.WYLPICT DD DSN=WYL.gg.uuu.libname,DISP=(NEW,KEEP),
// VOL=SER=SCRO01,UNIT=DISK,SPACE=(TBD,5,1,3)),
// DCB=(RECFM=FB,LRECL=80,BLKSIZE=1600)
```

TOP DRAWER input should be preceded by the control statement

```
SET DEVICE DTC-300.
```

Plots for DTC-300 terminals are made as members of a partitioned dataset. The first plot is member PICT001, and replaces any existing member with that name. Subsequent plots are members PICT002, PICT003, etc. To display a plot made by a TOP DRAWER batch job, you must sign onto WYLBUR on a DTC-300 terminal. Fetch the plot with the standard WYLBUR command

```
USE libname$PICT001 ON SCRO01 CLE
```

and then "list" it:

```
LIST UMN CLEAN NONL
```

Plots are similar to standard 80-column card images, and may be used, saved, and manipulated with standard WYLBUR commands.
Appendix A -- Specific Output Devices

**Versatec Electrostatic Plotter**

The JCL for the output dataset could be:

```
//GO. PICTTAPE DD DSN=5&PLOT,DISP=(NEW,PASS),
// VOL=SER=xxxxxx,LABEL=(1,SL),UNIT=T9-800,
// DCB=(RECFM=FB,RECL=130,BLKSIZE=4160,DEM=2)
```

**TOP** DRAWER input for the Versatec plotter should be preceded by the control statement

```
SET DEVICE V1100
```

Use of the Data Analysis Group's Versatec plotter is on an informal basis. You must use your own output tape and plot the tape yourself.
Appendix B -- Interactive Mode

A program called BACK DOOR provides rapid turnaround for making Top Drawer plots on the Tektronix 4013, by using the interactive 4013 capabilities of the U.G. package. BACK DOOR can access any dataset on a permanently mounted volume. The trick is that the user can leave BACK DOOR and enter WYLBUR by typing the U.G. command $WYL<CR>. Once in WYLBUR, the dataset can be edited, the new version SAVED, and control returned to BACK DOOR by typing the BACK DOOR subsystem name.

```plaintext
// JOB ,CLASS-I
// EXEC LOADGO,LKEDPRM='EP=MAIN',
// GOPRM='SSNAME=subsystem,MAGICWD=magic',
// LKEDLB2='WYL.CG.RBCLOADMODS',
// LKEDLB3='WYL.CG.RBC.UGPLIB',
// GOSL1='WYL.CG.RBC.UGPLIB',GORGN=200K
// SYSLIN DD DSN=WYL.CG.RBCLOADMODS(BACKDOOR),DISP=SHR
// INPUT DD UNIT=DISK, VOL=SER=WYL001,DISP=SHR
```

Sign onto WYLBUR and submit this job, using your own subsystem name and magic word (each of eight letters or fewer). When the job is running, your subsystem name will appear in response to the command SHOW SYSTEMS. To leave WYLBUR and enter BACK DOOR, type your subsystem name. (The default subsystem name is the same as the job name. The default magic word is XXXXXXXXXXX. Give the subsystem a relatively unpopular name, like NIXOW or ASP, rather than a popular one like DRAW or BACKDOOR, to avoid conflict with other jobs using the same name.)

BACKDOOR text input is similar to the WYLBUR EDIT command, but there is no initial control character. The first time you enter BACK DOOR, give the dataset name for the input file. The starting value is WYL.GG.000.LIB, which you could change, for instance, to WYLAB.XYZ.LIB#TDINPUT, or to WYL.CD.ZYM.LOB. After that, a list of allowed commands will appear.

The use of the $WYL command, for returning to WYLBUR, is unusual. It may help to remember that this is a command to the program that runs the terminal, not to BACK DOOR. BACK DOOR never sees this command, and has no idea that you have changed the input file. For this reason, the positioning of the text on the screen following the return to BACK DOOR may be strange, and you should give a REW command to tell BACK DOOR to restart the (new) input file.

BACK DOOR looks in the system catalog to find the input volume. You can also set the volume from the terminal. The volume (e.g. WYL001) on the INPUT DD card is a dummy, but it must be given.

One final warning: you must give a STOP command from BACK DOOR before you log off from WYLBUR. If you don't, you will remain logged on to MILLEN with BACK DOOR, but you will be unable to sign on in order to sign off. (If this happens, PURGE the job from another terminal with someone else's account, responding with your keyword when WYLBUR objects.)
Appendix C -- User Scaling

It is possible to scale either or both axes, using an arbitrary function in the same way that logarithmic scaling uses the logarithm. Functions which might be useful are probability (normal probability distribution), square root (for comparing fits to experimental data), etc. USER scaling requires at least one user FORTRAN routine to be loaded with the program.

**Scaling Function**

If the command 'SET SCALE [X|Y] USER [n]' is given, Top Drawer will call the function TDFNCT(COORD,N) each time a point or tick is plotted, and the plotting will be done at a distance along the axis determined by the value given by TDFNCT. In this call, COORD is the appropriate x or y value, and N is an identifying non-negative integer, which is the value given by the USER n command.

Example:

```plaintext
REAL FUNCTION TDFNCT(COORD,N)
REAL COORD
INTEGER N
REAL MEAN /100./,STDDEV/5./,ROOT2/1.414/
IF (N.EQ.2) GO TO 50
C LOGARITHMIC SCALING
IF (COORD.GT.0.) GO TO 10
TFDNCT = -300.
RETURN
10 TDFNCT=ALOG(COORD)
RETURN
C PROBABILITY SCALING (ERF IS AN IBM-SUPPLIED ROUTINE)
50 TDFNCT=ERF((COORD-MEAN)/(STDDEV*ROOT2))
RETURN
END
```

If this routine is loaded with the Top Drawer routines, then the command SET SCALE X USER 2 will cause the x-axis to be scaled according to a normal probability distribution. Any other value for N, for instance from the command SET SCALE X USER 25, will give logarithmic scaling.

**Note:**

1.) The function is not told which axis is involved, and the same function could be used for both axes.

2.) There is a check in the above function against illegal values of the argument for the logarithms. Top Drawer may exceed allowed values, in setting limits automatically or in trying to plot points or error bars that lie outside the limits.
Appendix C -- User Scaling

3.) ERF is different from the normal probability distribution function by a linear relationship. Since the values supplied by TDFNCT are mapped onto the axis by another linear transformation, any linear function of the desired function may be used.

4.) TDFNCT should be a monotonic function of COORD.

**Ticks and Labels**

It is possible also to specify the position of ticks along a user-scaled axis. The user must load

`SUBROUTINE TDTICK(N,VMIN,VMAX,N1,N2,BASE,NUM,VALS,ITYPES)`

Input variables:

- `N` INTEGER scale identifier from the SET SCALE command
- `VMIN` REAL coordinate value at the left (bottom) edge
- `VMAX` REAL coordinate value at the right (top) edge
- `N1,N2` INTEGER values from the SET SCALE command
- `BASE` REAL value from the SET SCALE command

Output variables:

- `NUM` INTEGER number of ticks that the subroutine gives
- `VALS` REAL dimensioned array of coordinate values
- `ITYPES` INTEGER dimensioned array of tick/label types to be put at the corresponding positions.

<table>
<thead>
<tr>
<th>Type</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>positive</td>
<td>big tick</td>
</tr>
<tr>
<td>negative</td>
<td>small tick</td>
</tr>
<tr>
<td>±1</td>
<td>no label</td>
</tr>
<tr>
<td>±2</td>
<td>normal label</td>
</tr>
<tr>
<td>±3</td>
<td>exponential label</td>
</tr>
<tr>
<td>±4</td>
<td>first decimal digit only</td>
</tr>
</tbody>
</table>
Appendix C -- User Scaling

JCL

If the FORTRAN-call control method is used, TDFNCT and TDTICK can be included with the other FORTRAN routines. If Top Drawer is run as a main program, the following deck will work:

```
// JOB ,CLASS=E
// EXEC FORTGC,.
// LKEDPRM='EP=MAIN',
// LKEDLB='WYL.CG.RBC.LOADMODS',
// LKEDLB2='WYL.CG.RBC.UGPLIB,'
// GOSL1='WYL.CG.RCB.UGXLIB',
// GORGN=200K
//PORT.SYSIN DD *
FUNCTION TDFNCT(VALUE,N)
...
END
SUBROUTINE TDTICK(...) 
...
END
//GO.SYSLIN2 DD DSN=WYL.CG.RBC.LOADMODS(TOPDRAI),DISP=SHR

JCL to define the output dataset(s) goes here.
(See Appendix A.)

//GO.SYSIN DD *
TOP DRAWER Input Cards Go Here.
```
Appendix D -- The Unified Graphics Character Set

The U.G. System module UGX103A, invoked in loading TOP DRAWER, has an expanded character set which includes upper and lower case Roman and Greek letters, many special characters, and any number of levels of sub- or superscripts. These characters can be specified by encoding the proper hex code on a TITLE card, or by specifying the proper character pair with a TITLE card followed by a CASE card. The following table is taken from the U.G. writeup. It gives the hex code, the character pair, and a description of each character. Figure C.1.1 of the U.G. writeup shows all the characters.

<table>
<thead>
<tr>
<th>Hex. Char</th>
<th>Character</th>
<th>Hex. Char</th>
<th>Character</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>S</td>
<td>08</td>
<td>QG</td>
</tr>
<tr>
<td>01</td>
<td>AG</td>
<td>09</td>
<td>IG</td>
</tr>
<tr>
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<td>0B</td>
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<tr>
<td>0E</td>
<td>S</td>
<td>0F</td>
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</table>

| 10        | ?S        | 11        | KG        |
| 11        | KG        | 12        | LG        |
| 12        | LG        | 13        | MG        |
| 13        | MG        | 14        | NG        |
| 14        | NG        | 15        | XG        |
| 15        | XG        | 16        | OG        |
| 16        | OG        | 17        | PG        |
| 17        | PG        | 18        | RG        |
| 18        | RG        | 19        | SG        |
| 19        | SG        | 20        | NX        |
| 20        | NX        | 21        | EX        |
| 21        | EX        | 22        | AX        |
| 22        | AX        | 23        | TG        |
| 23        | TG        | 24        | UG        |
| 24        | UG        | 25        | FG        |
| 25        | FG        | 26        | CG        |
| 26        | CG        | 27        | GC        |
| 27        | GC        | 28        | MG        |
| 28        | MG        | 29        | WG        |
| 29        | WG        | 30        | OC        |
| 30        | OC        | 31        | GC        |
| 31        | GC        | 32        | 2C        |
| 32        | 2C        | 33        | 3C        |
| 33        | 3C        | 34        | 4C        |
| 34        | 4C        | 35        | 5C        |
| 35        | 5C        | 36        | 6C        |
| 36        | 6C        | 37        | 7C        |

<table>
<thead>
<tr>
<th>Description</th>
<th>Code Pair</th>
<th>Description</th>
<th>Code Pair</th>
</tr>
</thead>
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<td>Alpha</td>
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<td>Times Sign</td>
<td></td>
</tr>
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<td>Beta</td>
<td></td>
<td>Division</td>
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</tr>
<tr>
<td>Gamma</td>
<td></td>
<td>Approximately Equal</td>
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<td>Partial Derivative</td>
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</tr>
<tr>
<td>Omicron</td>
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<td>Left/Right Arrow</td>
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</tr>
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<td>Pi</td>
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<td>Unassigned</td>
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</tr>
<tr>
<td>Membership Symbol</td>
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<tr>
<td>Existential Quant.</td>
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