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Introduction

Geoplot is an advanced graphics package that runs interactively, from command files, or as a subroutine package on 16 bit microcomputers. Geoplot contains many features usually found only in graphics packages on larger computers. A geoplot user can draw lines, symbols, and letters of any pattern, size, thickness, and orientation, using 29 different transformations, including 16 map transformations. Great circle and rhumbline paths are easily drawn. Two sets of world coastline data are available in files containing 5,000 and 80,000 points. Map data can be digitized using an X-Y table-top digitizer. Map coordinates can be rotated and shifted about any arbitrary sequence of poles. Complex plots can be generated simply using high-level routines or the user may access low-level calls. Plots may be stored in disk files and output to a wide variety of vector or raster graphics devices.

Development of Geoplot began in 1978 but was severely curtailed in 1981 for economic and political reasons. The version described in this report consists of all improvements as of September 14, 1983. Several advanced features such as multiple fonts, shading of arbitrary areas, and placing rectangular blank areas within plots, were planned but never completed. Most of the existing code has been tested, but not extensively. This version runs as a child process under the UNIX Operating System on a Digital Equipment Corp PDP-11/70 using an overlay scheme available in the Berkeley 2.9 version of Unix. The overlays are only required for the transformations and the package could be made significantly smaller by omitting some transformations. The full power of geoplot is best utilized through the interactive command language Geolab developed simultaneously by James Herriot.

The author does not intend to develop this package further or to provide anything but minimal support for the existing package. This report, therefore, provides a final report on this development effort as a stepping stone for future interest by others.

The author wishes to thanks Barbara Bekins for carefully reviewing this report.
A Very Preliminary Tutorial for Geoplot

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1. Introduction

Geoplot is an advanced graphics package that is easily used interactively within Geolab or may be called from compiled languages. Geoplot can also be used from a shell script of geolab commands. Geoplot is designed with three basic principles in mind:

a. The beginning user should be able to create complex plots with very few standard commands while the advanced user should have "hands-on" control of every parameter necessary for customizing plots as well as all basic low-level plot commands.

b. Plotting must be fully device independent but if a device supports hardware lettering, line dashing, etc., the device hardware should be used automatically when appropriate to increase speed. Interactive response time is important.

c. An advanced graphics package should be made available on minicomputers without usurping much of the users limited address space.

Most users needs for plots can be met with a few simple geoplot commands. For example if you have two arrays in Geolab (x and y), they can be plotted on a Tektronix 4014 display with the following commands:

```
ploton tek plot x y
```

To plot x versus y as a bar graph in log-log coordinates on a new page (clear screen) type:

```
5 = trans page TSplot x y
```

To plot y as a function of its index beginning at 1 type:

```
plot 1 y
```

To put the same plot on the Versatec type:

```
ploton vers plot 1 y
```

To plot a map of the world in mercator projection type:

```
14=trans world frame "world.co" map
```

Yet below this simple facade, the user can control most options to make lines dashed, vary the width of lines, change the size, font, aspect, and spacing of letters, vary the length of tic marks or the angle of labels on grids, add arrow tips or other symbols to the end of each line, etc.

2. Scope

This tutorial assumes sufficient knowledge of UNIX and Geolab to be able to log on to the machine, enter Geolab, and have a basic knowledge of how Geolab works. Geoplot may be called from compiled languages like Fortran. The
The easiest way to learn the features of Geoplot, however, is to use it interactively. Thus this tutorial uses only Geolab calls to Geoplot. All detailed descriptions of Geoplot commands in section GA2 of the manuals show both the Geolab command and the Fortran call. A geolab script and an identical Fortran sample program are included at the end of this tutorial. The reader should refer regularly to section GA2 of the manuals for details of commands discussed.

3. Getting Started

Assuming you have logged into your system and have entered Geolab, just type **ploton tek** if you are using a Tektronix 4014 display with enhanced graphics. Otherwise refer to **ploton(GA2)** for other device names. Geoplot creates a file in your home directory called **geoplot.w**. This file remembers the state of geoplot when you used it last time. To reset geoplot to the default options either remove geoplot or add a capital R to the device name (e.g. **ploton tekR**). You may plot into or from a file using **plotfrom** or **plotinto (ploton(GA2))**.

4. The Two Major Plot Operators

The easiest way to plot in geoplot is to use the commands **plot** and **plotlet** which scale the plot, draw and label a frame and plot the data. Let's define two arrays and plot them:

```plaintext
real x:10    real y:10
count(10) = x   ** 2 = y
plot x y
```

Either one of the arrays may be a scalar. In this case the values for the axis are the counting numbers beginning at the scalar and continuing for the length of the other array. Thus:

```plaintext
page plot 1 y
```

Does the same thing. Page erases the screen. Then:

```plaintext
page plot -5 y
```

does it a little differently.

Many transformations are available (see **trans(GA2)**).

Thus to plot in log-log coordinates:

```plaintext
5 = trans page plot 1 y
```

There are many options for the type of plot to be drawn. See **plt(GA2)** and try:

```plaintext
1 = trans 8 do (page is plot 1 y)
```

Letters and strings may be plotted at each point.

To plot an x centered on each point rotated 20 degrees type

```plaintext
page plotlet 1 y 'x' 20 1
```

See **plotlet(GA2)** for the options. The string, angle, and position values may be arrays or scalars.

5. Plot spaces and page units

A primary concept in geoplot is the idea of page units. The narrowest dimension of a plot device output is considered to be one page unit and the other dimension is measured in these units. The maximum page units of the device you are using in x and y directions is given by typing in Geolab.
**fullsp is**

Fullspace on the tektronix 4014 is 1.31 in the x or horizontal direction and 1.0 in the y or vertical direction. Using page units we may then refer to parts of the plot surface.

Picture space (pictsp) is defined as the part of the plot surface into which the whole plot will be put including grid, labeling, and data. Lettering is typically clipped to fit within picture space. Several picture spaces might be defined successively at different parts of the same plot surface.

Grid space (gridsp) is the part of the picture space around which the grid or frame will be drawn.

Subject space (subjsp) is the part of the grid space within which the data will be plotted. Subject space is typically equal to grid space, but may not be equal when multiple data sets are plotted within the same grid. Data is typically clipped to fit within subject space.

Data space (datasp) is the value of the data units to be mapped into subject space.

The value of the plot spaces can be displayed by typing pspaces.

We can change picture space, for example, by typing

\[ [0.3 \ 0.9 \ 0.3 \ 0.7] = \text{pictsp pspaces} \]

and we note that grid and subject space also changed. Grid space is linked to picture space through all the default values of the tic lengths, letter sizes, angle of lettering, etc. Label space (lablsp) is also used to set the number of letter widths to be saved between picture and grid space when the lettering is outside of gridspace and the letters are written at an angle to the grid line.

You may set gridspace to some other value after setting picture space. Subject space is linked to gridspace but it may also be set separately after gridspace is set.

Picture space may be set up easily into parts of the display area using partx and party(GA2):

\[ \text{page partx 1 2 party 2 3} \]

Grid space may be divided up using propor(GA2).

### 6. Transformations

A wide variety of coordinate transformations exist in geoplot (trans(GA2)) and new ones can be added easily.

### 7. Basic plot ops

The basic operators are:

- **ploton**: initialize a plot device
- **movdrw**: move or draw a line in data, page, or relative units
- **letter**: same as movdrw but put a string at the end of the line
- **pit**: plot arrays
- **pltltr**: plot arrays and strings
- **scale**: scale data space
- **plot**: plot arrays with frame and scaling
- **plotlet**: plot arrays and strings with frame and scaling
- **map**: draw a map
- **page**: erase screen or move to next page
- **repro**: make a copy on the hard copy device if it exists
transform  change this point to or from page or data units
trans change transformation
axis draw and label an axis on the edge of gridspace
label put a title on an axis
grid draw and label a gridded line in any direction
frame draw four axes around grid space
fare pick a point using the cursor
pick pick points in a plot with multiple data sets

Operators for handling plot spaces are:

partx subdivide pictsp
party subdivide pictsp in y direction
pspaces list plot spaces
world set datasp for the whole world

Programs for making or modifying map files are:

mapdig digitize a map
maputil edit, convert, rotate or translate a map file

---

B. Gpcom, The Nerve Center

Most of the options on Geoplot may be controlled through gpcom(GA2). Try these options to find out how they work.

For example:

\[
\begin{align*}
123456 &= \text{lintype} \\
0.002 &= \text{linwidth} \\
1.0 &= \text{symshape} \\
\text{plot} \ 1 \ y
\end{align*}
\]

HAVE FUN!!!
% SAMPLE geoplot program using geolab commands

% Initialize variables, etc.
!real x:10 !real y:10 !real angles:10
!char names:10:5 "AB+CD"=names:1 "\$"=names:2 "hi+ "=names:3
"abcde"=names:4 "1+2"=names:5 "\A\B"=names:6 "bop"=names:7
"+\bO"=names:8 "\5\_2"=names:9 "<-+->"=names:10
count 10 *3=x count 10 *2=y count 10 *33=angles
!top sleep(e "sleep 10")

plot on tekR
0=gprint 1=letheight 0.1=letheight 0.007=linwidth:2 4=lintype:2
0.005=linspace:2
page 0.5 0.5 1 "GEOPLOT" 30 1 letter
% geolab flushes the plot buffer before each line of input
% thus sleep should be on a new line
sleep

0.0016=linwidth:2 0.0003=linspace:2 0.05=letheight [3 1 1]=lintype
page "This is an example of drawing vectors." is
0 0 1 movdrw 0.3 0.3 2 movdrw 0.1 0.2 4 movdrw
0.7 0.7 2 "AB+CD" 305 1 letter -0.1 -0.4 4 "\A\B" -10 1 letter
sleep

1=letheight:1 0=linwidth:2 1=lintype:1
[0.1 fullsp:1 0.1 (fullsp:2 - 0.2)]=pictsp
page "This is an example of plotting ticmarks for x vs y." is
3$plot x y label -1 "This is the x-axis" label 3 "This is the y-axis." sleep
page "This is an example of plotting y vs its index as a bar graph" is
"and x vs its index as triangles about the y axis." is
scale 10 y 7 pit scale x 10 6 pit
sleep

"Now plot x vs y using arrow tipped vectors." is 0.5=symshape
scale x y 1 plt
sleep

page "This is an example of plotting x vs y vs a character array." is
0=symshape x y 1 names angles 1 pltltr
sleep
page "Now plot a map in orthographic azimuthal projection." is
21=trans [ -140 -50 0 65]=datasp frame "world.co" map
% Note space after [ and before minus sign. Geolab gives incorrect
% results if this space is left out due to parsing problems and
% confusion in differentiating unary and binary minus.
sleep

3=letheight:1 1=trans page q
c--PLTFOR---SAMPLE PLOT PROGRAM IN FORTRAN USING THE GEOPLOT PACKAGE--
c program pltfor

-----Programmer: PLWard,USGS, Menlo Park, California 94025 12/13/79

-----Compile: f77 pltfor.f -lgeop
or: f77 -l4 pltfor.f -lgeop4

integer i
integer length
integer idelay
real x(10),y(10),angle(10),space(4)
character*5 name(10)

include "usr/include/GPCOM.h"
real pltcom
external pltcom

data name /'AB+CD', 'hi+', '1+2\0', 'A\B' 
1    'b0\0', '+\b0\0', 'b0\0', '5\2', '++++' /

c idelay=10

c length=10
do 100 i=1,length
   x(i)=i**3
   y(i)=i**2
100 angle(i)=33. *i

c Initialize the tektronix 4014 to begin geoplot process
The R resets common to default values
call ploton(1,"tekR",0.0,-8,99999.0)
call putcom(GPRINT, 1,0.0)

c Set the character size to the largest hardware size.
call putcom(LETHEI,1,1.0)

c Set the software character size
call putcom(LETHEI,1,0.1)

c Set the line width for letters
call putcom(LINWID+1,1,0.007)

c Set the line type for letters
call putcom(LINTYP+1,1,4.0)

c Set line spacing for letters
call putcom(LINSPA+1,1,0.005)

c Erase screen
call page

c Print title of geoplot,dump buffer and sleep
call letter(0.5,0.5,1,'GEOPLOT',30.0,1)
call clrbuf
call sleep(idelay)

c Set the line width and spacing for letters
call putcom(LINWID+1,1,0.0016)
call putcom(LINSPA+1,1,0.0003)

c Set the software character size.
call putcom(LETHEI,1,0.05)
c

c---- Set the line type
    call putcom(LINTYP, 1, 3.0)
    call putcom(LINTYP + 1, 1, 1.0)
c

c---- Erase the screen and title new plot
    call page
    write(6,1)
    1 format(\"This is an example of drawing vectors.\")
c
    call movdrw(0.0, 0.0, 1)
    call movdrw(0.3, 0.3, 2)
    call movdrw(0.1, 0.2, 4)
    call letter(0.7, 0.7, 2, name(l), 305.0, 1)
    call letter(-0.1, -0.4, 4, name(6), -10.0, 1)
    call clrbuf
    call sleep(idelay)
    call page
c

c---- Set software character size.
    call putcom(LETHEI, 1, 1.0)
    call putcom(LINWID + 1, 1.0)
c

c---- Scale plot spaces
    space(1) = 0.1
    space(2) = pltcom(FULLSP)
    space(3) = 0.1
    space(4) = pltcom(FULLSP + 1) - 0.2
call putcom(PICTSP, 4, space)
call scale(x, length, y, length)
c

c---- Set solid line type
    call putcom(LINTYP, 1, 1.0)
c

c---- Plot x data versus y data
    write(6, 2)
    2 format(\"This is an example of plotting ticmarks for x vs y.\")
call frame
    call label(-1, \"This is the x-axis\")
    call label(3, \"This is the y-axis\")
call plt(x, length, y, length, 3)
call clrbuf
call sleep(idelay)
call page
c

c---- Plot y vs its index plus 10.
    continue
787 continue
787 write(6, 3)
    3 format(\"This is an example of plotting y vs its index as a bar graph\")
    call scale(10.0, 0, y, length)
    call plt(10.0, 0, y, length, 7)
    call scale(x, length, 10.0)
call scale(x, length, 10.0, 0)
call putcom(LINWID + 1, 1.0)
call plt(x, length, 10.0, 0, 6)
call clrbuf
call sleep(idelay)
c

c---- Turn on symbols to draw arrows.
    call putcom(SYMSHA, 1, 0.5)
c
    write(6, 4)
    4 format(\"Now plot x vs y using arrow tipped vectors.\")
call scale(x, length, y, length)
call plt(x,length,y,length,1)
call clrbuf
call sleep(idelay)
call page
c
  c-----Turn off the arrows
call putcom(SYMSHA,1,0.0)
c
  c-----Use pltltr
write(6,5)
  5 format("This is an example of plotting x vs y vs a character array
1.")
call putcom(LINWID+1,1,0.0)
call pltltr(x,length,y,length,1,name,5,length,angle,length,1,0)
call clrbuf
call sleep(idelay)
call page
c
  c-----Use map
write(6,6)
  6 format("Now plot a map in orthographic azimuthal projection.")
call putcom(TRANS,1,21.0)
space(1)=-140.
space(2)=-50.
space(3)=0.
space(4)=65.
call putcom(DATASP,4,space)
call frame
call map("world.co")
call clrbuf
call sleep(idelay)
call page
c
  c-----Set hardware letter size back to next to smallest
call putcom(LETHEI,1,3.0)
c
  c-----Terminate plotting
call gpfin
end
This is an example of drawing vectors.
This is an example of plotting ticmarks for x vs y.
This is an example of plotting $y$ vs its index as a bar graph and $x$ vs its index as triangles about the $y$ axis.

Now plot $x$ vs $y$ using arrow tipped vectors.
This is an example of plotting x vs y vs a character array.
Now plot a map in orthographic azimuthal projection.
Change to orthographic map transformation.
NAME
axis – plot and label an axis

SYNTAX
G: axis which
F: call axis(which)

DESCRIPTION
axis draws one of the axis along the edge of grid space. which may be:
1  lower x axis
2  upper x axis
3  lower y axis
4  upper y axis

The properties of the axis are set by variables in gpcom(GA2).

SEE ALSO
gpcom(GA2), Geoplot Tutorial

AUTHOR
Peter L. Ward, U.S. Geological Survey, Menlo Park, California
NAME

disazm — find distance in km, azimuth and back azimuth between two geographic points

SYNTAX

G: lona lata lonb latb type disazm
F: call disazm (lona, lata, lonb, latb, type)
    real lona, lata, lonb, latb
    integer type

DESCRIPTION

If type = 1, calculate distance, azimuth, and back azimuth between two points assuming an elliptical earth. Return three values to stack in geolab or as first three arguments in fortran.

If type = 2, same as 1 except assume spherical earth.

If type = 3, input longitude and latitude of a point and distance and azimuth to a second point. Return longitude and latitude of second point to stack in geolab or as first two arguments in fortran. Assume elliptical earth.

If type = 4, same as 3 except assume spherical earth.

Earth values assumed: equatorial radius 6378.163 km, polar radius 6356.177 km, mean earth radius 6371. km.

SEE ALSO

ttiapscale(GA2)

AUTHOR

NAME
fare - find crosshair position

SYNTAX
G: [!] fare
F: mode = +_7; call movdrw(x,y,mode)
    real x,y
    integer mode

XOP
op fare (0.0 0.0 if 7 -7 movdrw)

DESCRIPTION
Turns on crosshairs on appropriate plot device. A point is picked by pressing any key. The xy coordinates of the point are returned in page units (G: ifare; F: 7) or in data units (G: fare; F: -7) and the ascii integer value of the key pushed is returned as mode. In Geolab the values left on the stack are mode, y, x (top to bottom).

BUGS
The plot device must be strapped to send a carriage return after the cursor position code. On a Tektronix there are three options for the termination characters. Put the strap in the center position.

AUTHOR
Peter L. Ward, U.S. Geological Survey, Menlo Park, California
NAME
frame – draw and label plot grids.

DESCRIPTION
frame is used to draw axes, tic marks, and auto-label axes. It simply calls axis four times.

AUTHOR
Peter L. Ward, U.S. Geological Survey, Menlo Park, California
NAME

gpcom, getcom, putcom — access elements in geoplot common block

SYNTAX

G: value=(gpcom part index n)
F: call getcom(index,n,array)
call putcom(index,n,array)
    integer index, n
    real array(n)

XOP

Hard op but equivalent, for example, to:
    op pictsp(gpcom part 41 4)

DESCRIPTION

Put in array or get from array the n values in geoplot common beginning at
element index. Geoplot is set up with many defaults that make it easy to
use. An experienced user, however, can control through gpcom a wide
variety of options as described below.

OPTIONS

Geoplot common contains the following variables. In Geolab each variable
may be called by the name given in boldfaced type and treated as an array
or scalar as appropriate. The column n designates the dimension of the
variable. From Geolab if a scalar is set equal to an n-dimensional array, all
values of the array are set equal to the value of the scalar.

<table>
<thead>
<tr>
<th>Plot spaces (low x, hi x, low y, hi y)</th>
<th>index</th>
<th>n</th>
<th>default</th>
</tr>
</thead>
<tbody>
<tr>
<td>pictsp picture space in page units</td>
<td>21</td>
<td>4</td>
<td>device</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>dependent</td>
</tr>
<tr>
<td>gridsp grid space in page units</td>
<td>27</td>
<td>4</td>
<td>device</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>dependent</td>
</tr>
<tr>
<td>subjsp subject space in page units</td>
<td>33</td>
<td>4</td>
<td>device</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>dependent</td>
</tr>
<tr>
<td>datasp data space in data units</td>
<td>39</td>
<td>4</td>
<td>device</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>dependent</td>
</tr>
<tr>
<td>labsp label space, number of character widths or heights between picture and grid space areas of plot to be omitted</td>
<td>191</td>
<td>4</td>
<td>[7 2 7 2]</td>
</tr>
<tr>
<td>omitsp1</td>
<td>45</td>
<td>16</td>
<td>0.0</td>
</tr>
<tr>
<td>omitsp2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>omitsp3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>omitsp4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>fullsp user adjustable maximum plot width. Must be &lt;= devmax</td>
<td>161</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>pspaces display all plot spaces</td>
<td>272</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>clip clipping factor used in propor</td>
<td>163</td>
<td>3</td>
<td>[1.0 1.0 1.0]</td>
</tr>
</tbody>
</table>

Transformations

<table>
<thead>
<tr>
<th>transformation type</th>
<th>index</th>
<th>n</th>
<th>default</th>
</tr>
</thead>
<tbody>
<tr>
<td>trans</td>
<td>190</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>transcon constants used in map transformations</td>
<td>81</td>
<td>9</td>
<td>usym</td>
</tr>
<tr>
<td>curinc page units between interpolated points on curves</td>
<td>90</td>
<td>1</td>
<td>0.01</td>
</tr>
</tbody>
</table>

XOP

Hard op but equivalent, for example, to:
    op pictsp(gpcom part 41 4)
<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>Value</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>pole</td>
<td>pole of projection for map transformations</td>
<td>97</td>
<td>2</td>
</tr>
<tr>
<td>mapscale</td>
<td>scale of map projection (see mapscale(GA2))</td>
<td>133</td>
<td>1</td>
</tr>
<tr>
<td>lintype</td>
<td>line type (where n=3, elements 1,2,3 refer to lines,letters,symbols respectively)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0 point</td>
<td>181</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>1 line</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 line of points</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3-11 hardware dash patterns</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;11 software dash patterns made up of a concatenation of:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 Draw 0.005 page units</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 Move 0.005 page units</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3 Draw 0.010 page units</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4 Move 0.010 page units</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5 Draw 0.020 page units</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6 Move 0.020 page units</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>7 Draw 0.040 page units</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>8 Move 0.040 page units</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(e.g. 1476 means draw 0.005, move 0.010, draw 0.040, move 0.020, draw 0.005 etc.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>linwidth</td>
<td>line width in page units</td>
<td>84</td>
<td>3</td>
</tr>
<tr>
<td>linspace</td>
<td>spacing in page units between parallel lines used to make width</td>
<td>81</td>
<td>3</td>
</tr>
<tr>
<td>linside</td>
<td>side of line stippling drawn</td>
<td>184</td>
<td>3</td>
</tr>
<tr>
<td>linshade</td>
<td>line intensity or shade or color</td>
<td>87</td>
<td>3</td>
</tr>
<tr>
<td>linclip</td>
<td>clip space for lines: 1=pictsp 2=gridsp, 3=subjsp, 4=datasp</td>
<td>188</td>
<td>1</td>
</tr>
<tr>
<td>cliplines</td>
<td>=1 draw lines on the boundary when data goes out of space and returns</td>
<td>189</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>=2 do not draw lines</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lettering properties</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>letheight</td>
<td>height of letters in page units. Integer values of 1 and above input hardware letter sizes for a given device with 1 being the largest size. A tek 4014, for example, has 4 sizes. The input value is converted to page units.</td>
<td>91</td>
<td>1</td>
</tr>
<tr>
<td>leterror</td>
<td>error allowed between letheight and hardware lettering size to still use hardware lettering</td>
<td>96</td>
<td>0.0002</td>
</tr>
<tr>
<td>letclip</td>
<td>clip space for lettering: 1=pictsp 2=gridsp, 3=subjsp, 4=datasp</td>
<td>187</td>
<td>1</td>
</tr>
<tr>
<td>letaspect</td>
<td>ratio of letter width to height angle upper part of letters rotated from lower part</td>
<td>92</td>
<td>1</td>
</tr>
<tr>
<td>letangle</td>
<td>angle upper part of letters angle upper part of letters rotated from lower part</td>
<td>93</td>
<td>1</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>letspace</td>
<td>width of spaces between letters as a proportion of the letter width</td>
<td>94</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.725</td>
</tr>
<tr>
<td>letspacev</td>
<td>height of spaces between lines as a proportion of the letter height</td>
<td>95</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.61</td>
</tr>
<tr>
<td>up</td>
<td>up position on the plot</td>
<td>206</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
</tr>
</tbody>
</table>

**Symbol properties**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>symshape</td>
<td>symbol type: under 2. = arrows, over 2.0 = n sided polygons</td>
<td>76</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.0</td>
</tr>
<tr>
<td>symlength</td>
<td>length of symbols in page units</td>
<td>77</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.02</td>
</tr>
<tr>
<td>symspace</td>
<td>spacing between concentric symbols in page units. If negative lines</td>
<td>78</td>
</tr>
<tr>
<td></td>
<td>connecting symbols are eliminated</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.001</td>
</tr>
<tr>
<td>symangle</td>
<td>angle of symbol to line</td>
<td>79</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>31.57404</td>
</tr>
<tr>
<td>symfactor</td>
<td>factor multiplied times vector length to get symbol length</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.0</td>
</tr>
</tbody>
</table>

**Frame, Axis, and Grid properties**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ticxin</td>
<td>Internal tic lengths as proportion of gridsp for x axis for different levels</td>
<td>107</td>
</tr>
<tr>
<td></td>
<td>of tics.</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[0.3 0.024 0.018 0.012 0.006]</td>
</tr>
<tr>
<td>ticyin</td>
<td>Internal tic lengths as proportion of gridsp for y axis for different levels</td>
<td>112</td>
</tr>
<tr>
<td></td>
<td>of tics.</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[0.03 0.24 0.018 0.012 0.006]</td>
</tr>
<tr>
<td>ticxout</td>
<td>External tic lengths as proportion of gridsp.</td>
<td>117</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.0</td>
</tr>
<tr>
<td>ticyout</td>
<td>for x and y axis for different levels of tics.</td>
<td>122</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.0</td>
</tr>
<tr>
<td>ticfac</td>
<td>Factor tic lengths multiplied by for given axis.</td>
<td>101</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[1.0 1.0 1.0 1.0]</td>
</tr>
<tr>
<td>ticmin</td>
<td>Minimum tic spacing in page units for given axis.</td>
<td>127</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[0.02 0.02 0.02 0.02]</td>
</tr>
<tr>
<td>labmin</td>
<td>Minimum label spacing in page units for given axis.</td>
<td>142</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[0.04 0.04 0.03 0.03]</td>
</tr>
<tr>
<td>labdist</td>
<td>Distance of label to axis in page units. If 0, do not plot label. Negative</td>
<td>136</td>
</tr>
<tr>
<td></td>
<td>means outside the plot.</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[-1.0 0 -1.0 0]</td>
</tr>
<tr>
<td>labfactor</td>
<td>amount to be factored out of the label</td>
<td>148</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.0</td>
</tr>
<tr>
<td>labangle</td>
<td>angle of label with the axis</td>
<td>154</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[0.0 0.0 -90.0 -90.0]</td>
</tr>
<tr>
<td>maxlevel</td>
<td>maximum number of tic levels.</td>
<td>216</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5.0</td>
</tr>
<tr>
<td>minlabel</td>
<td>minimum number of characters before labels are drawn in E format type</td>
<td>222</td>
</tr>
<tr>
<td></td>
<td>of data.</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8.0</td>
</tr>
<tr>
<td>datatype</td>
<td>type of data.</td>
<td>228</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.0</td>
</tr>
<tr>
<td>noaxis</td>
<td>if =1 do not draw axis line</td>
<td>207</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.0</td>
</tr>
</tbody>
</table>
ticpage
If = 1 for tics to be drawn in page units only

Plot positioning and scaling on device
poffset x and y offset of origin in page units
pangle angle in degrees plot to be rotated in degrees
pgain factor by which to multiply plot

Beam positioning and output characters
beamtype for devices where plotting is done intermixed with input commands from same device, after plotting:
1 restore beam to next input line
2 restore beam to top of the page
3 leave beam where it is
4 do nothing
-1 to -4 same as above but output is integers rather than plot characters

Miscellaneous constants maintained from Geolab

gpusym missing data symbol
julian if 1, dates are julian
gpzone time zone for dates
gprint prints intermediate output
values from 0 to 10 where 0 means no extra output and 10 means a lot of extra output
timebase base time for date variables
ticbase baseline for ticmarks & bar graphs (pit or pltltr type 3 to 8) on x or y axis as appropriate in data units
lineid line identification number and in pick
numfields number of fields stored for use by pick(GA2)
picktype type of pick to use. See pick(GA2)

READ ONLY VALUES IN GEOPLOT COMMON

pagemax maximum page units in x and y directions.
devunit device units per page unit in x and y directions
home home for cursor in x and y page units
inchscreen inches per page unit on display
inchrepro inches per page unit on hard copy device.
rasmin page units per minimum device unit i.e. raster width in page units.
nchar number hardware character types
**kchar** present hardware character type 285 1
**numdev** device number 253 3 [1 1 0]
**pointp** present pen position in software 16 2
**pfilename** Display name of present plot file 271 1

**BUGS**

*omitsp* not working yet

**AUTHOR**

Peter L. Ward, U.S. Geological Survey, Menlo Park, California
NAME
  gpfin – flush buffers and terminate geoplot process
SYNTAX
  G: gpfin
  F: call gpfin
DESCRIPTION
  Flush plot buffers and terminate the geoplot child process.
AUTHOR
NAME

grid — draw and label a gridded line in any direction

SYNTAX

C: x y mode string datalo datahi transformation grid
F: call grid (x,y,mode,string,datalo,datahi,transf)

real x,y, datalo, datahi
integer mode, tranof
character*? string

DESCRIPTION

grid draws a gridded line from the present pen position to x y where mode may be ± 1,2,3,4 as defined in movdrw(GA2). The line is always straight, even in curvilinear transformations. The tics on the line are scaled from datalo at the beginning to datahi at the end. Transformations may be:

1 linear
2 log base 10
3 natural log

The string is placed in the center of the grid. Options for tic length, lettering position, etc are the same as in axis (gpcm(GA2)) and the values for ticmin, labmin, etc are those for the low x axis, i.e. ticmin:1, labmin:1, etc.

BUGS

grid is not fully debugged.

AUTHOR

Peter L. Ward, U.S. Geological Survey, Menlo Park, California
NAME
label — label the x or y axis

SYNTAX
G: label position string
F: call label (position, string)
   integer position
   character*? string

DESCRIPTION
Prints string centered along x or y axis on inside if position is positive and outside if position is negative. Position is:
   1 lower x axis
   2 upper x axis
   3 lower y axis
   4 upper y axis

SEE ALSO
axis(GA2)

AUTHOR
Peter L. Ward, U.S. Geological Survey, Menlo Park, California
NAME
letter – plot string of characters

SYNTAX
G:  \( x \ y \) mode string angle position letter
F:  call letter (\( x,y,\) mode, string, angle, position)

real \( x,y,\) angle
integer mode, position, slength
character* slength string
slength is passed by Fortran automatically.
From C add it as a long passed by value as the last argument.

DESCRIPTION
Plot the string at an angle (degrees counterclockwise from the x axis) positioned according to position about point \( x,y \).

OPTIONS
Mode may be positive for page coordinates and negative for data coordinates:

1  Move to \( x,y \)
2  Draw a line to \( x,y \)
3  Move to point which is at \( x,y \) relative to present point
4  Draw to point which is at \( x,y \) relative to present point

Lines drawn by letter in modes 2 and 4 have all the features available for lines drawn by movdrw modes 2 and 4

Position may be:

1  Center string around point
2  Center string around right-most character
3  Center string around left most character
4  Center string to right of the point
5  Center string to left of the point
6  Center string above the point
7  Center string below the point
8  Put string above and to right of point

If position 4 to 7 are negative, one half character width will be left between point and closest part of string.

FONTS may be selected by including in the string \( !n \) where \( n \) is 0 thru 9.
Font 0 is the default for each string. Once a font is selected it is kept within that string until changed. An exclamation point may be included in the string by using \( !! \).

SPECIAL CHARACTERS can be selected by including in the string a backslash followed by one of the following letters:

Positioning:

d  subscript (following characters are half size)
u  superscript (following characters are half size)
b  backspace
r  carriage return
l  line feed
v  reverse line feed
n  new line (carriage return and line feed)
Symbols:
1 arrow
2 diamond
3 triangle
4 square
5 star

Mathematical symbols:
= not equal
≈ approximately equal
S subset
C cents
— overline
l integral
R square root
S sum (capital sigma)
i infinity

Greek letters (lower case):
A alpha
B beta
D delta
E epsilon
F phi
G gamma
L lambda
M mu
N eta
O omega
P pi
T theta
Y psi

SEE ALSO
movdrw(GA2) mode 16

BUGS
Only one font is implemented. Selection of any font gives font 0.

AUTHOR
Peter L. Ward, U.S. Geological Survey, Menlo Park, California
NAME
map – plot map data

SYNTAX
G: file map
F: call map (file)
    character*? file

DESCRIPTION
Map plots data from the designated file. Map first looks in the current working directory for the file and then in /usr/maps. Map files are binary lists of geographic coordinates in degrees given as pairs of floating point numbers (longitude or x, latitude or y). North and east are positive, south and west are negative. If the latitude is $\geq 990.0$, the coordinate is interpreted as a command to move the plotting pen to the next coordinate.

Large map files may be broken up so that all points with 10 degree bands of latitude occur in one file. If the map file name given ends in a .m, map will look for files filename.m.n where n is the integer latitude of the lower edge of the band (-90 $\leq$ n $= 80$) and search only those files needed as defined by the users datasp (see gpcmm(GA2)).

FILES
/usr/maps/world.co world coastlines in 5200 points
/usr/maps/world.co.m.* world coastlines in 80,700 points

AUTHOR
Peter L. Ward, U.S. Geological Survey, Menlo Park, California
NAME
mapdig — digitize graphs and maps

SYNTAX
mapdig [-cn num -e -o file -i -n -s yscale -t trans]

DESCRIPTION
mapdig takes x-y coordinates from a tabletop digitizer and converts them to
orthogonal x-y page units using the inverse transformations given in
trans(GA2). It is set up for maps but can be used for any charts. The pro­
gram normally is used interactively and asks for input:
1. westmost longitude, eastmost longitude, southmost latitude, north­
   most latitude
2. digitize four corners in order listed by program

Program now calculates several scale factors and angles of rotation and
prints an error message if these differ by less than 0.001 in scale or 0.0175
radians in angle. Normally if you get an error message, start over again.

OPTIONS
 cn the next argument is the value of transcon(n). See trans(GA2),
gpcom(GA2).
e also output coordinates on standard error. This allows you to pipe
standard out to a file and still see coordinates on terminal.
o next argument is name of output file. If none is given, data are put in
file named mapdig.out
i set to non-interactive mode
n do not put data in mapdig.out or any output file
s next argument is a factor to multiply each y coordinate by when read
in from digitizer. This is useful for digitizers with different scale fac­
tors in x and y.
t next argument is transformation number (see trans(GA2). 14 or mer­
cator is the default.

All these options may be upper or lower case.

Digitizing input options:

(Digitizer input is expected as numbers such as +12345+23456
representing coordinates in thousandths of inches and is thus divided
by 1000. Numbers may be up to 5 digits long and separated by +, -, 0
space. They may include a decimal point and the input stream may
include card numbers which are ignored but are assumed to be a /
followed by three digits.) Other input characters interpreted are:
c repeat first coordinate since last move. Useful when digitizing closed
forms such as an island to be sure coastline closes.
d delete last point digitized
e or g exit, quit
f close current output file and open a new file given by the following
name
m move. Put out move command in map file.
All other characters will be ignored and an error message given.

USING THE DIGITIZER

The tabletop digitizer at 275 Middlefield Road, Menlo Park, Ca., building 8 room 8246 along the left wall can be easily used in an interactive mode.

1. Turn on the ADM terminal over the digitizing table. The switch is under the rear-left edge.

2. Turn on the digitizer. Switch is near wall on top of lower black box to left of the digitizing table.

3. Be sure the digitizer is connected to the terminal and not the card punch. On rear of the top black box, the switch nearest the center of the room should be in the up position.

4. Connect terminal to UNIX. Tan and cream box on top of digitizer electronics should have switch turned to "UNIX".

5. Log in to UNIX.

6. Type the mapdig command.

7. Connect digitizer to UNIX. Turn switch at left of terminal keyboard to "DIGITIZER". Now output from the digitizer and the digitizer keyboard go to UNIX and the terminal keyboard is disconnected. To use terminal keyboard, turn this switch back to "TERMINAL".

8. Zero digitizer by placing cursor in bracket on left side of table, putting slot around pin and rotating slightly clockwise. Press the leftmost button.

9. To digitize slide cursor to desired point and push the second button from the left. Terminal will beep after the program has received the data for a point, processed the data, and is ready for another point. You can digitize several points ahead of the computer. If you move the cursor outside of the rectangular area defined by the four black dots on the table or if you pick the cursor up, you must re-zero as in number 8 above.

10. When done, be sure to leave the terminal-digitizer switch on "TERMINAL" and shut off the power you turned on in items 1 and 2 above.

SEE ALSO

gpcom(GA2), map(GA2), maputil(GA2)

AUTHOR

Peter L. Ward, U.S. Geological Survey, Menlo Park, California

7th Edition August 1983
NAME

mapscale – find and set scale of a map

SYNTAX

C: mapscale is or value = mapscale
F: call getcom (133, 1, value)
    real value
    call putcom (133, 1, value)

DESCRIPTION

When mapscale is requested by getcom, it is calculated based on the current transformation in effect. The distance (see disazm(GA2)) is calculated along the line of mid latitude (transcon:2) from one side of the map (westmost longitude) to the other side (eastmost longitude). This distance is then divided by the physical distance on whatever device is currently selected using inchscreen (see gpcom(GA2) to convert page units to inches. If the tektronix 4014 is selected, for example, the scale will then be true for the screen but not for the hard copy unit. Multiply the scale by inchscreen/inchrepro to get scale on some hard copy devices. However, there are three different types of hardcopy devices in use and you may need to calculate a fudge factor.

When a value is assigned to mapscale the plot spaces are adjusted to set the scale. If the resulting plot will fit within the currently assigned gridspace, gridspace and subject space are reduced to set the correct scale. If the resulting plot will not fit within gridspace then dataspace is reduced until the scale is correct. These adjustments are done iteratively and are only done immediately after mapscale is set. Anytime thereafter that the plotspaces or transformation is changed, the scale will not be reset until specifically requested.

Use mapscale with care!

SEE ALSO

gpcom(GA2), trans(GA2), map(GA2)

AUTHOR

Peter L. Ward, U.S. Geological Survey, Menlo Park, California
NAME
maputil — utility program for handling map files

SYNTAX
maputil [-ai -ao -c confile -e -f 10 -F -l 1000 -m -o outfile -p lon lat -x num -y num] files

DESCRIPTION
Map files are binary lists of geographic coordinates in degrees given as pairs of floating point numbers (longitude or x, and latitude or y). If the latitude is ≥ 990.0, the coordinate is interpreted as a command to move the plotting pen to the next coordinate. Map files are often kept in /usr/maps.

maputil provides a means to convert ascii files to mapfiles, convert mapfiles to ascii, edit the binary or ascii files, and rotate the coordinates around a list of arbitrary poles to, for example, drift continents.

OPTIONS

-ai ascii input files
-ao ascii output files
-c next argument is name of a control file that lists in ascii format groups of four numbers representing the longitude and latitude (in degrees) of a pole of rotation, and the scalar amounts to add to longitude and latitude respectively after rotation. Up to 20 poles may be given. Each coordinate is sequentially rotated about each pole in the list in order and then output.
-e edit map files before output. Do not redirect standard if you use this option since you must use editor interactively. If no output file is specified, last input file read is overwritten by output.
-f next argument is number of first map coordinate to be read in from file
-F if output file exists, force overwriting it
-l next argument is number of last map coordinate to be read in from file.
-m find minimum and maximum values of longitude and latitude and print them on standard output.
-o next argument is name of output file
-p next two arguments are longitude and latitude of a pole of rotation in degrees
-R next four arguments are region data restricted to: low lon, high lon, low lat, high lat. All data outside of this range will be ignored. A move command is inserted each time the data first goes out of the permitted range.
-x scalar amount in degrees to add to longitude after rotating coordinate
-y scalar amount in degrees to add to latitude after rotating coordinate

SEE ALSO
map(GA2), mapdig(GA2), gpcom(GA2)
AUTHOR

Peter L. Ward, U.S. Geological Survey, Menlo Park, California
NAME
movdrw – primary plot subroutine

SYNTAX
G: x, y mode movdrw
F: call movdrw(x, y, mode)
    real x, y integer mode

DESCRIPTION
movdrw is the primary subroutine in geoplot.

OPTIONS
Mode is as follows:
If mode is positive x and y are in page space.
If mode is negative x and y are in data space.
1. Move to the point x, y.
2. Draw a vector to the point x, y.
3. Move to a new point where x, y are relative to present point.
4. Draw a vector to a new point where x, y are relative to present point.
5. Transform x, y to data space
-5. Transform x, y to page space
-9. Draw a great circle to new point (for map projection)
-10. Draw a rhumbline to new point (for map projection)

SEE ALSO
gpcom(GA2)

AUTHOR
Peter L. Ward, U.S. Geological Survey, Menlo Park, California
**NAME**
page – erase screen or move to new page.

**SYNTAX**
- G: page
- F: call page

**XOP**
- `op page(0.0 0.0 13 movdrw)`

**AUTHOR**
Peter L. Ward, U.S. Geological Survey, Menlo Park, California
**NAME**

partx, party – divide plot space into parts

**SYNTAX**

G: \texttt{partx part total}

\texttt{party part total}

F: call \texttt{part(axis,part,total)}

**DESCRIPTION**

\texttt{partx} and \texttt{party} divide the total available plot space on the device into parts. Total plot space is defined by \texttt{fullsp (gpcora(GA2))} which is equal to \texttt{devmax (gpcora(GA2))} except for those devices where \texttt{devmax} is greater than 2. If you wish to have \texttt{fullsp} set larger or small, do so before calling \texttt{partx} or \texttt{party}.

\texttt{total} is the total number of parts and \texttt{part} is which part you wish to choose numbered from left to right or top to bottom.

**AUTHOR**

Peter L. Ward, U.S. Geological Survey, Menlo Park, California
NAME

pick, setpick, resetpick — find cross hair position from many superimposed plots

SYNTAX

G: [!] pick

   resetpick
   setpick lineid

F: call pick(x,y,letter,lineid)
call putcom(235, 1, 0.0) (is the same as resetpick)
call putcom(234, 1, lineid) setpick (is the same as setpick)
   real x,y
   integer letter, lineid

XDP

   op pick(f if lineid 0.0 900.0 7 movdrw lineid)
   op resetpick (0 = numfields, 0 = ksubj.)
   op setpick (~ = lineid, 1 = ksubj.)

DESCRIPTION

pick is used to pick data points off of a plot device when several different sets of data are plotted at the same time. Each set of data may have its own data space, subject space, and transformation type. A table of these values is stored at the time the data are plotted along with the first point plotted by any routine except axis, grid, or frame after subject space has changed. pick turns on the crosshairs. After adjusting the crosshairs the operator strokes one key, thus picking a point. To determine which line the pick is on the table is searched for the shortest distance in page units between the first point and the crosshair. This distance is measured according to how picktype (gpcom(GA2)) is set.

   1  x distance only
   2  y distance only
   3  distance in x and y
   4  same as 3 except now that the line is identified, the crosshair is turned on again to make the actual pick

If 'I' is used in Geolab or the x value of movdrw in Fortran is not equal to 0.0, then the integer value of x is considered to be line identifier (lineid).

Values returned to the stack then are from top to bottom.

   lineid
   letter
   Y in data units
   X in data units

To use pick you must first use resetpick before any lines are plotted on the device. page(GA2) and plotom(GA2) also reset pick. Then before each line is plotted, setpick must be used to associate a line identifier lineid in gpcom(GA2) with the line.

SEE ALSO

   gpcom(lineid,numfields,picktype)(GA2)
   fair(GA2)
**Bugs**

Table of plot spaces arbitrarily limited to 32.

**Example**

```plaintext
resetpick
10 do(propor i 10 -1.0 1.0 setpick i !plot 1 Y)
pick
```

**Author**

Peter L. Ward, U.S. Geological Survey, Menlo Park, California
NAME
plot — plot arrays including scaling and frame

SYNTAX
G: [!!][type$] plot xarray yarray
F: call scale (see options under scale(GA2))
call frame
call plt (see options under plt(GA2))

XOP
op plot(f<2 if then scale ~ f if else frame g p)

DESCRIPTION
plot is the main operator for making x-y graphs. When preceded by two excl­
amation points it behaves just like plt(GA2) except the x and y values follow plot. When preceded by one exclamation point the plot is scaled using scale(GA2). By itself plot x y means scale the plot, draw a frame, and then plot the x y values.

Values of type preceding $ may be from 1 to 8 as described in plt(GA2).

AUTHOR
Peter L. Ward, U.S. Geological Survey, Menlo Park, California
NAME
plot10 – imitation Tektronix plot10 graphics package

SYNTAX
f77 program.f -lplot10

DESCRIPTION
Contains simulations for most of the routines in the Tektronix plot10 graphics package. Calls to Geoplot routines are used to perform the desired tasks. Names of entry points and argument lists are the same as documented in the Tektronix Plot10 manual except as noted below. We recommend that plot10 be used only to run existing programs. Geoplot should be used directly for new programs because it is much more efficient.

BUGS
The following routines are not implemented. However, the package does contain entry points to satisfy the loader:

<table>
<thead>
<tr>
<th>Routine</th>
<th>Argument(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>svstat</td>
<td></td>
</tr>
<tr>
<td>rsttab</td>
<td></td>
</tr>
<tr>
<td>toutst</td>
<td></td>
</tr>
<tr>
<td>ainstr</td>
<td></td>
</tr>
<tr>
<td>restat</td>
<td></td>
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<tr>
<td>tabhor</td>
<td></td>
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<tr>
<td>toutpt</td>
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<tr>
<td>setbuf</td>
<td></td>
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<tr>
<td>recover</td>
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<td>tabver</td>
<td></td>
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<td>tinstr</td>
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<tr>
<td>seebuf</td>
<td></td>
</tr>
<tr>
<td>ttblsz</td>
<td></td>
</tr>
<tr>
<td>setmrg</td>
<td></td>
</tr>
<tr>
<td>tinput</td>
<td></td>
</tr>
<tr>
<td>leftio</td>
<td></td>
</tr>
<tr>
<td>settab</td>
<td></td>
</tr>
<tr>
<td>tcslev</td>
<td></td>
</tr>
<tr>
<td>alin</td>
<td></td>
</tr>
</tbody>
</table>

In addition the values of the following arguments in the named routines are ignored or not returned:

<table>
<thead>
<tr>
<th>Argument</th>
<th>Routine</th>
</tr>
</thead>
<tbody>
<tr>
<td>ibaud</td>
<td>initt</td>
</tr>
<tr>
<td>ispeed</td>
<td>initt</td>
</tr>
<tr>
<td>iscale</td>
<td>initt</td>
</tr>
<tr>
<td>mode</td>
<td>initt</td>
</tr>
<tr>
<td>rsuprs</td>
<td>poltrn</td>
</tr>
</tbody>
</table>

EXAMPLE

```c
  c---------------------------------------------------------------------
  c  Draws a line from raster coordinates
  c  (0,0) to (100,100) on the screen
  c---------------------------------------------------------------------
  call term (3, idum)
  call initt (idum)
  call movabs (0,0)
  call drwrel (100,100)
  call finitt (0,0)
  end
```

SEE ALSO

A Very Preliminary Tutorial for Geoplot by Peter L. Ward
TEKTRONIX PLOT10 Terminal Control System Users Manual, 1976, Tektronix Inc.

AUTHOR

Barbara A. Bekins, Electronic Data Systems, Corp., for U.S. Geological Survey, Menlo Park, California
NAME
plotlet — plot arrays with character strings including scaling and frame

SYNTAX
G: [!!][type$] plotlet xarray yarray string angle position
F: call scale (see options under scale(GA2))
call frame
call pltltr (see options under scale(GA2))

XOP
op plotlet (f < 2 ifthen scale ~ f ifelse frame g ~ ~ pltltr)

DESCRIPTION
plotlet is the main operator for making x y graphs with character strings.
When preceded by two exclamation points it behaves just like pltltr(GA2)
except the x, y string, angle and position values follow plotlet. When pre­
ceded by one exclamation point the plot is scaled using scale(GA2). By
itself, plot x y means scale the plot, draw a frame, and then plot x y values
with the character string or strings at each x y point.

Values of type preceding $ may be from 0 to 8 as described in pltltr(GA2).

AUTHOR
Peter L. Ward, U.S. Geological Survey, Menlo Park, California
NAME
ploton, plotinto, plotfrom — select plotting devices and files

SYNTAX
G: ploton device
    plotinto "path"
    plotfrom "path"

F: call ploton(mode, string, timebase, timezone, usym)
   integer mode, timezone,
   character*? string
   real timebase, usym

XOP
op ploton (lit fa 1$ plotdev)
op plotinto (~ fa 2$plotdev)
op plotfrom (~ fa 3$plotdev)

DESCRIPTION
ploton, plotinto, or plotfrom begin the geoplot child process, if not already
begun, and initialize which device the plot will be output on or which file
name a plot will be put in or plotted from. ploton is followed by one string of
letters and numbers that designate the name and model of the plot device.
This string does not need to be enclosed in quotes. plotinto and plotfrom
must be followed by the pathname of a file given as a string enclosed in
quotes or by an expression that resolves to a string. In Fortran mode 1 is
ploton, mode 2 is plotinto, and mode 3 is plotfrom. When mode 1 is used the
timebase, timezone, and missing data symbol (usym(GA1)) must be
specified (good default values are 0.0, 0, 99999.0).

OPTIONS
Devices presently supported by geoplot are:

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Model</th>
<th>Numdev(gpcom(GA2))</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>numdev:1 numdev:2</td>
</tr>
<tr>
<td>Tektronix</td>
<td>4014 Enhanced graphics</td>
<td>1 1</td>
</tr>
<tr>
<td></td>
<td>4014</td>
<td>1 2</td>
</tr>
<tr>
<td></td>
<td>4012</td>
<td>1 3</td>
</tr>
<tr>
<td></td>
<td>4010</td>
<td>1 4</td>
</tr>
<tr>
<td></td>
<td>4011</td>
<td>1 5</td>
</tr>
<tr>
<td></td>
<td>4025</td>
<td>1 6</td>
</tr>
<tr>
<td>Calcomp</td>
<td>1051</td>
<td>2 1</td>
</tr>
<tr>
<td></td>
<td>1012</td>
<td>2 1</td>
</tr>
<tr>
<td>Houston Instruments</td>
<td>832</td>
<td>3 1</td>
</tr>
<tr>
<td>Anderson-Jacobson</td>
<td>832</td>
<td>4 1</td>
</tr>
<tr>
<td>Hewlett Packard</td>
<td>7221a</td>
<td>5 1</td>
</tr>
<tr>
<td>Versatec</td>
<td>1200a</td>
<td>21 1</td>
</tr>
<tr>
<td>Printronix</td>
<td>600</td>
<td>22 1</td>
</tr>
<tr>
<td>Florida Data</td>
<td>bny78</td>
<td>23 1</td>
</tr>
</tbody>
</table>

4011 is Retrographics emulation of a Tektronix 4010. Any unique set of
letters and numbers may be used to specify a device after ploton. If an
unrecognizable manufacturer or model is specified for device, then defaults
are silently used. The default manufacturer is Tektronix and the default
model is the first one listed for each manufacturer. If plot into or plot from is given and no device has previously been specified at any time since a new plot_com was created, the default device is chosen.

Some capital letters included at the end of a device name have special meanings:

- **R**  
  Reset common to default values.

- **B**  
  Turn off beam positioning. Useful when running plots from a shellfile.

- **T**  
  Test mode. Plot vectors will be printed as integers rather than sent to the plot device.

- **L**  
  On raster devices the plot is normally positioned so that the x axis is parallel to the hardware raster line. Thus a plot typically fills one page of fanfold paper. To rotate the plot so that the x axis may go down the page or perpendicular to the hardware raster line, follow the model by L for long.

- **Q**  
  Raster plots of large data arrays moving down the page (options L) can be done very quickly by designating Q after the model number. The restriction is that these may be only 132 lines or traces. The plot vectors are put into a file. The file is then scanned to be sure that the x values typically increase, and decrease no more than 132 times. These lines or traces are then multiplexed and output directly to the raster device. Lettering must thus be used very sparingly and the axis grid, and frame routines should not be used.

**BUGS**

Only Tektronix 4014 enhanced and Versatec available at this time.

If you execute device for a Tektronix plot in Geolab and continue typing before the Geolab prompt returns, you may lose your input and sometimes may be an error message. The reason is that geoplot asks the Tektronix where its beam position is and may confuse your input with the input sent by the Tektronix.

**EXAMPLES**

- ploton t use Tektronix 4014 with enhanced graphics
- ploton tektronix same
- ploton tek25R use Tektronix 4025, reset common
- ploton versL use Versatec 1200a, long option
- ploton t0T use Tektronix 4010, test option

**AUTHOR**

Peter L. Ward, U.S. Geological Survey, Menlo Park, California
NAME
plots — imitation Versatec graphics package

SYNTAX
f77 program.f -lvtec

DESCRIPTION
Contains simulations for most of the routines in the Versatec graphics package. Calls to geoplot routines are used to perform the desired tasks. Names of entry points and argument lists are the same as documented in the Versatec Plot Manual. We recommend that plots be used only to run existing programs. Geoplot should be used directly for new programs because it is much more efficient. Subroutines implemented are axis, cursor, factor, line, newpen, nplots, number, plot, plots, scale, and symbol.

SEE ALSO
A Very Preliminary Tutorial for Geoplot by Peter L. Ward

AUTHOR
Dave Oppenheimer, U.S. Geological Survey, Menlo Park, California
NAME  
plt – plot arrays

SYNTAX  
G: xarray yarray type plt  
F: call plt(xarray,xlength,yarray,ylength,type)  
real xarray(xlength),yarray(ylength)  
integer xlength,ylength,type

OPTIONS  
plt plots x vs y from the input data arrays. The data is normally in data coordinates and datap must be set equal the the min and max values of the arrays (see scale(GA2)). The data is then plotted in subject space.

Type may be:
0 plot ends of lines only  
1 plot lines  
2 plot segmented lines (alternate draw and move)  
3 plot tic marks along the x axis  
4 plot tic marks along the y axis  
5 plot triangles along the x axis  
6 plot triangles along the y axis  
7 plot bar graph along the x axis  
8 plot bar graph along the y axis

Tic marks, triangles, and bar graphs are plotted relative to ticbase(see getcom(GA2) which is normally set to 0.0.

The arrays are normally in absolute data coordinates. Other options may be selected by making:

type = type + 100*itype

where itype is:
0 absolute coordinates in data space  
1 relative coordinates in data space  
2 absolute coordinates in page space  
3 relative coordinates in page space

In Geolab the xarray or yarray may be a scalar. In this case the values of that "array" then become the counting numbers beginning with the value of the scalar.

In Fortran xarray or yarray may be a scalar if the appropriate length is set <= 1. If xlength and ylength are both > 1, then the number of points plotted will be whichever length is least.

SEE ALSO  
scale(GA2), ticbase in gpcom(GA2), plltr(GA2)

AUTHOR  
Peter L. Ward, U.S. Geological Survey, Menlo Park, California
NAME
pltltr – plot arrays with character strings

SYNTAX
G: xarray yarray type string angle position pltltr
F: call pltltr(xarray,xlength,yarray,ylength,type,string,
  slength,swidth,angle,alength,position,plenlegth)
real xarray(xlength),yarray(ylength),angle(alength)
integer xlength,ylength,type,alength,position(plenlegth)
integer plenlegth,slength,swidth
character*swidth string(slength)

OPTIONS
pltltr plots x vs y from the input data arrays. The data is normally in data
coordinates and dataset should be set equal the min and max values of the
arrays (see scale(GA2)). The data is then plotted in subject space.

At each point a string is drawn at a given angle and position relative to the
point as in letter(GA2). The string, angle, and position may each indepen­
dently be the same at each point (alength, plenlegth, or slength <=1) or may
be arrays of the same length as the x and y arrays (e.g. alength, plenlegth, or
plenlegth =xlength). If the lengths vary, then the number of points plotted
will be the minimum of all lengths > 1.

Position may be:
  1 Center string around point
  2 Center string around right-most character
  3 Center string around left most character
  4 Center string to right of the point
  5 Center string to left of the point
  6 Center string above the point
  7 Center string below the point
  8 Put string above and to right of point

If position 4 to 7 are negative, one half character width will be left
between point and closest part of string.

Type may be:
  0 plot no lines between points
  1 plot lines
  2 plot segmented lines (alternate draw and move)
  3 plot tic marks along the x axis
  4 plot tic marks along the y axis
  5 plot triangles along the x axis
  6 plot triangles along the y axis
  7 plot bar graph along the x axis
  8 plot bar graph along the y axis

Tic marks, triangles, and bar graphs are plotted relative to ticbase(see
gpcom(GA2) which is normally set to 0.0.

The arrays are normally in absolute data coordinates. Other options may be
selected by making:
  type = type + 100*itype
where itype is:

- 0 absolute coordinates in data space
- 1 relative coordinates in data space
- 2 absolute coordinates in page space
- 3 relative coordinates in page space

In Geolab, `xarray` or `yarray` may be a scalar. In this case the values of that "array" then become the counting numbers beginning with the value of the scalar.

In Fortran if any length is <= 1 the associated value is considered to be a scalar. The number of points plotted is the minimum value of all lengths > 1.

**SEE ALSO**
- scale(GA2), ticbase in gpcom(GA2), plt(GA2)

**AUTHOR**

Peter L. Ward, U.S. Geological Survey, Menlo Park, California
NAME
proporx, propory — proportion grid space in x or y direction

SYNTAX
G: proporx center total lodata hidata
    propory center total lodata hidata
F: call propor(center, total, lodata, hidata, axis)
      real center, total, lodata, hidata
      integer axis

XDP
    op proporx (~ ~ ~ 1 propor_)
    op propory (~ ~ ~ 2 propor_)

DESCRIPTION
proporx and propory set subject space equal to a part of grid space and scale dataspace accordingly. total is the number of equal parts that the x or y direction will be divided into. In Fortran axis = 1 for x direction, = 2 for y direction. The width of one part is the width of grid space divided by total.

center designates which part is to be used from left to right or top to bottom. If center is less than 1.0, it represents the center point of the part in normalized units where the width of grid space is 1 and 0 is at the bottom of grid space. center may not be larger than total. datalo and datahi are the data units at the lower and upper boundaries of the part chosen.

The data plotted is normally clipped at the boundary of subject space. The global variable clip (gpcom(GA2)) may be used, however, to change the clipping values. clip is used in propor for setting subject and data space. The effect of clip is that while the data will be scaled the same, data and subject space will be set so that the effective width of the plot for clipping purposes is the width of subject space times clip. The default value of clip is 1.0. A value of 2.0 would allow the plots in each part to be twice the width of the part, provided they fall within grid space.

EXAMPLES
To plot the same sin wave in array y versus its subscript four times in horizontal strips one below the next, type in Geolab:

4 do (propory i 4 -1 1 !!plot 1 y)

To plot a seismic record section, to make each seismic trace fill 1/4 of the grid space in the y direction, and where the distances to the stations range from distlo to disthi, then for each trace do:

fmax trace =y
propory 1 - ((disthi - distance)/(disthi - distlo)) 4
    -y y !!plot 1 trace

AUTHOR
Peter L. Ward, U.S. Geological Survey, Menlo Park, California
NAME
pspaces – print values of plotting spaces

SYNTAX
G: pspaces
F: call getcom(272,1,0.0)

XOP
op pspaces(gpcom:272 ,)

DESCRIPTION
List on the terminal the values of pictsp, gridsp, subjsp, datasp, lblsp, and omitsp.

AUTHOR
Peter L. Ward, U.S. Geological Survey, Menlo Park, California
NAME
  repro – make a print of a plot on the hard copy device
SYNTAX
  G: repro
  F: call repro
XOP
  op repro(0.0 0.0 14 movdrw)
AUTHOR
  Peter L. Ward, U.S. Geological Survey, Menlo Park, California
NAME
   scale — autoscaling for x vs y plots

SYNTAX
   G:  scale xarray yarray
   F:  call scale(xarray,xlength,yarray,ylength)
       real xarray(xlength,yarray(ylength)) integer xlength,ylength

XOP
   op scale=([[]] 2 do (~ -> h len_ = lenspa:i, xchg [[(!min h) (!max h)]) =
   datasp, 2 do (lenspa:i <=1 ifthen (lenspa:(3-i)+ datasp: (2*i-1)-1 =
   datasp:(2*i)))))

DESCRIPTION
   scale sets datasp for the min and max values of xarray and yarray. In Geolab
   if either xarray or yarray is a scalar or in Fortran if either xlength or
   ylength is <=1, then the corresponding axis is scaled from the value of the
   scalar to the value of the scalar plus the length of the other array minus 1.

SEE ALSO
   plt(GA2), mapscale(GA2)

AUTHOR
   Peter L. Ward, U.S. Geological Survey, Menlo Park, California
NAME
shade — shade in an area of a plot

DESCRIPTION
Not implemented yet.
NAME
  trans – set transformation type for plotting

SYNTAX
  G: n = trans
  F: call putcom(190,1,n)
      real n

DESCRIPTION
  Whenever plotting is done in data space, gptran is called to transform data
to page space. Inverse transformations are used when picking points off of
the plot device. All inverse transformations are done by the same iterative
approximation technique for efficiency in coding.

OPTIONS
  1  x - linear, y - linear
  2  x - linear, y - log
  3  x - linear, y - ln
  4  x - log,  y - linear
  5  x - log,  y - log
  6  x - log,  y - ln
  7  x - ln,  y - linear
  8  x - ln,  y - log
  9  x - ln,  y - ln
 10 polar: x - degrees, y - distance, counterclockwise from east
 11 polar: x - degrees, y - distance, clockwise from north
 12 polar: x - degrees, y - dip, clockwise from north, equal angle,
           Wulff net
 13 polar: x - degrees, y - dip, clockwise from north, equal area,
           Schmidt net
 14 Mercator Cylindrical
 15 Miller Cylindrical
 16 Transverse Mercator Cylindrical
 17 Universal Transverse Mercator
 18 Equal Areal Azimuthal
 19 Equal Distance Azimuthal
 20 Gnomonic Azimuthal
 21 Orthographic Azimuthal
 22 Perspective Azimuthal
 23 Stereographic Azimuthal
 24 Lambert Conformal Conic
 25 Ptolemy Equal Interval Conic
 26 Kavraiskiy IV Equal Interval Conic
 27 Albers Equal Area Conic
 28 Polyconic
 29 Sinusoidal
 30 Find lon and lat of point around new pole (see pole in
     gptran(GA2))
MAP PROJECTIONS

It is impossible to project the surface of a spheroid onto a plane without distortion. Therefore, a wide variety of map projections have been devised to minimize the distortion for particular cases. Maps are typically projected onto an idealized planar, cylindrical, or conical surface that is either tangent to the earth's surface or secant to the earth's surface (i.e., cutting into and then back out of the earth). A map projection is said to be conformal if all angles and shapes within a small area are true. Equidistant means all distances in any direction from a given point are in proportion. Equal-area means all areas are in proportion. Azimuthal means that all azimuths from the center of the map are true and that straight lines through the center are great circles.

Map projections available in geoplot are as follows:

1: Equirectangular where lines of latitude and longitude are spaced equally. Ideal for maps of small areas such as for a city or local area. Easy to hand plot data on.

14: Mercator conformal cylindrical where the spacing between lines of longitude increases with latitude. A straight line is a compass course or rhumb line and thus this projection is used widely for navigation. There is serious exaggeration of distances and areas at latitudes greater than about 40°. Cannot be used at the poles. Program limits the absolute value of latitude to less than 89.9°.

15: Miller cylindrical is a compromise between the area compression of the equirectangular plot and the extreme scale expansion of the Mercator plot. Most useful for maps of very large areas (scale > 1:1,000,000).

16: Transverse conformal mercator cylindrical is ideal for a 15 to 20 degree band centered around a central meridian (line of longitude). Straight lines are not rhumb lines as in the mercator projection. Often used for topographic maps.

17: Universal transverse mercator is a worldwide grid system in meters based on the transverse mercator projection. Central meridians are constructed every 6° from 80°S. Zones extending 3° to either side of the central meridian are overlaid by a uniform rectangular grid. The central meridian whether input or calculated is rounded to the nearest standard meridian (3°, 9°, 15° etc.). If you use this transformation to calculate grid coordinates add 500,000 to the longitude and 10,000,000 to the latitude. Be careful about precision, while all calculations are done in double precision, input and output through geoplot is limited to single precision (7 + decimal places). Caution, the UTM grid uses 10 different values for the major and minor axis of the earth depending on location. These are not handled automatically in this program and are not important except for high precision in very small areas.

18: Azimuthal equal area invented by Lambert is best suited for maps of continental areas or hemispheres.

19: Azimuthal equal-distance is ideal for radio and seismic work since all distances and azimuths are accurate from the center of the map.

20: Gnomonic has the unique property that any straight line is a great circle or the shortest distance between two points. It is best suited for areas where the longitude differs by less than 40° from the central meridian.
21: **Orthographic** azimuthal is a perspective projection where the viewer is a very long way away from the earth. It is most useful for representing hemispheres centered on any point.

22: **Perspective** azimuthal is useful for viewing slightly less than a hemisphere from a spaceship at any arbitrary elevation above the point on earth that is the center of the map. The projection is often used for orientation. Elevation of viewer is given as a proportion of earth's radius. Thus 1.0 means 1 earth radius above earth surface.

23: **Stereographic** conformal azimuthal is the only projection on which any circle on the earth is shown as a circle on the map. It is useful for showing ranges from various points and is used heavily in polar areas.

24: **Lambert** conformal conic uses two standard parallels and adjusts such that at every latitude the north-south and east-west scales are equal. It is used for large and small scale mapping and is especially accurate at mid latitudes. Great circle lines are approximately straight.

25: **Ptolemy** equal interval conic is a compromise projection that uses one standard parallel and is easy to construct and plot on manually.

26: **Kavraiskiy IV** equal interval conic uses two standard parallels to give the least mean square distortion for the Soviet Union. Excellent for display of areas with large longitudinal extent.

27: **Albers** equal-area conic uses two standard parallels and minimizes scale error. Ideal for maps with large longitudinal extent.

28: **Polyconic** is a compromise projection where each parallel is a standard parallel causing the map to be approximately equivalent and conformal only in small areas bisected by the central meridian. Used by USGS for topographic maps.

29: **Sinusoidal** or Mercator equal area reduces the distortion of cylindrical equal area maps and is ideal for maps with significant latitudinal extent. Convenient for manual plotting of data.

Two lines with special properties often used with maps are the great circle, which is the shortest distance between two points, and the rhumbline, which is a line that intersects all meridians at a constant azimuth. The great circle is a straight line on the gnomonic azimuthal projection whereas the rhumbline is a straight line on a mercator cylindrical projection. These lines can be drawn using `movdrw(UA2)` with mode of -9 for great circle and -10 for rhumbline.
Map transformations use constants that may be changed using `gppcom(UA2)` element transcon. The items used by each projection are:

<table>
<thead>
<tr>
<th>TRANSFORMATION</th>
<th>Default value</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Mid-longitude or central meridian</td>
<td>(max long + min lon)/2</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>2 Mid-latitude</td>
<td>(max lat + min lat)/2</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>3 Lower standard parallel</td>
<td>1/6 way up map</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>4 Upper standard parallel</td>
<td>5/6 way up map</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>5 Major axis of earth</td>
<td>6378388.0</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>6 Minor axis of earth</td>
<td>6356911.9462</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>7 1 for north polar projection, -1 for south polar projection</td>
<td>1.0</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>8 Nature of elevation of observer above earth to radius of earth</td>
<td>1.0</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>9 Earth's radius in nautical miles</td>
<td>3437.9768</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>
REFERENCES


SEE ALSO

map(GA2), mapdig(GA2), gpcom(GA2)

AUTHOR

Peter L. Ward, U.S. Geological Survey, Menlo Park, California
NAME
transform – transform data to page space or visa versa.

SYNTAX
   G:  x, y [!] transform
F: call movdrw(x, y, ±5)

XOP
   op transform(f if 5 -5 movdrw.)

OPTIONS
   transform(-5): transform x, y to page units and leave new values on the stack, y on top, x next down.
   transform; transform x, y to data units.

AUTHOR
   Peter L. Ward, U.S. Geological Survey, Menlo Park, California
NAME
world – set map scale to full world

SYNTAX
G: world

XDP
op world ([ -180 180 -89 89] = datasp.)

DESCRIPTION
world is shorthand to set dataspacce for plotting maps to full scale. 89 is used for latitude to avoid problems with mercator projection.

AUTHOR
Peter L. Ward, U.S. Geological Survey, Menlo Park, California
Change to mercator map transformation.
Change to miller map transformation.
Change to transverse map transformation.
Change to UTM map transformation.
Change to areaequal map transformation.
Change to distequal map transformation.
Change to gnomonic map transformation.
Change to orthographic map transformation.
Change to perspective map transformation.
Change to stereographic map transformation.
Change to lambert map transformation.
Change to ptolemy map transformation.
Change to kavraisky map transformation.
Change to albers map transformation.
Change to polyconic map transformation.
Change to sinusoidal map transformation.