

# The **graphics** package\*

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This file is maintained by the L<sup>A</sup>T<sub>E</sub>X Project team.  
Bug reports can be opened (category **graphics**) at  
<http://latex-project.org/bugs.html>.

## 1 Introduction

This package implements various ‘graphics’ functions. The main features are a) inclusion of ‘graphics’ files. b) Rotation of sections of the page, c) Scaling of sections of the page.

The design is split into three ‘levels’.

- The user interface. This is the collection of commands designed to appear in a document text. Actually two separate user interface have been implemented. The ‘standard’ interface, described here, and a more powerful, and more ‘user-friendly’ interface provided by the **graphicx** package.
- The core functions. These functions, which are also implemented in this file do all the ‘main work’. The ‘user-interface functions just collect together the information from any optional-arguments or star-forms, and then call one of these functions.
- The driver files. It is not possible to achieve the functionality of this package just using T<sub>E</sub>X. The dvi driver used must be given additional instructions. (Using the `\special` command of T<sub>E</sub>X.) Unfortunately, the capabilities of various drivers differ, and the syntax required to pass instructions to the drivers is also not standardised. So the ‘core functions’ never access `\special` directly, but rather call a series of commands that must be defined in a special file customised for each driver. The accompanying file, **drivers.dtx** has suitable files for a range of popular drivers.

## 2 Package Options

Most of the options, such as **dvips**, **textures** etc., specify the driver that is to be used to print the document. You may wish to set up a configuration file so that this option always takes effect, even if not specified in the document. To do this,

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produce a file `graphics.cfg` containing the line:

```
\ExecuteOptions{dvips}
```

(or whichever other driver you wish.)

Apart from the driver options there are a few other options to control the behaviour of the package.

**draft** Do not include graphics files, but instead print a box of the size the graphic would take up, and the file name. This greatly speeds up previewing on most systems.

**final** Turns off the **draft** option.

**debugshow** Show a lot of tracing information on the terminal. If you are not me you probably do not want to use this option.

**hiderotate** Do not show rotated text. Sometimes useful if your previewer can not rotate text.

**hidescale** Do not show scaled text.

**hiresbb** Look for Bounding Box lines of the form `%%HiResBoundingBox` instead of the standard `%%BoundingBox`. These are used by some applications to get round the restriction that BoundingBox comments should only have integer values.

**demo** Instead of including a graphics file, make `\includegraphics` insert a black rectangle of size 150 pt by 100 pt unless either dimension was already specified by another option.

## 3 Standard Interface

### 3.1 Graphics Inclusion

```
\includegraphics *[\llx,\lly][\urx,\ury]{\file}
```

Include a graphics file.

If `*` is present, then the graphic is ‘clipped’ to the size specified. If `*` is omitted, then any part of the graphic that is outside the specified ‘bounding box’ will overprint the surrounding text.

If the optional arguments are omitted, then the size of the graphic will be determined by reading an external file as described below. If `[\urx,\ury]` is present, then it should specify the coordinates of the top right corner of the image, as a pair of TeX dimensions. If the units are omitted they default to `bp`. So `[1in,1in]` and `[72,72]` are equivalent. If only one optional argument appears, the lower left corner of the image is assumed to be at `[0,0]`. Otherwise `[\llx,\lly]` may be used to specify the coordinates of this point.

```
\graphicspath {\dir-list}
```

This optional declaration may be used to specify a list of directories in which to search for graphics files. The format is as for the L<sup>A</sup>T<sub>E</sub>X 2<sub>ε</sub> primitive `\input@path`, a list of directories, each in a `{}` group (even if there is only one in the list). For example: `\graphicspath{{eps/}{tiff/}}` would cause the system to look in the subdirectories `eps` and `tiff` of the current directory. The default setting of this

path is `\input@path` that is: graphics files will be found wherever  $\TeX$  files are found.

`\DeclareGraphicsExtensions`  $\{\langle ext-list \rangle\}$

This specifies the behaviour of the system when the argument to `\includegraphics` does not have an extension specified. Here  $\{\langle ext-list \rangle\}$  should be a comma-separated list of file extensions, each with a leading period (`.`). A file name is produced by appending *sep* and one extension. If a file is found, the system acts as if that extension had been specified. If not, the next extension in *ext-list* is tried.

Each use of `\DeclareGraphicsExtensions` overwrites all previous definitions. It is not possible to add an extension to an existing list.

Early versions of this package defined a default argument for this command. This has been removed.

`\DeclareGraphicsRule`  $\{\langle ext \rangle\}\{\langle type \rangle\}\{\langle read-file \rangle\}\{\langle command \rangle\}$

Any number of these declarations can be made. They determine how the system behaves when a file with extension *ext* is specified. (The extension may be specified explicitly or, if the argument to `\includegraphics` does not have an extension, it may be a default extension from the *ext-list* specified with `\DeclareGraphicsExtensions`.)

*ext* is the *extension* of the file. Any file with this extension will be processed by this graphics rule. Normally a file with an extension for which no rule has been declared will generate an error, however you may use `*` as the extension to define a *default rule*. For instance the `dvips` driver file declares all files to be of type `eps` unless a more specific rule is declared.

Since Version v0.6, extensions should be specified including the `.` that is, `.eps` not `eps`.

*type* is the ‘type’ of file involved. All files of the same type will be input with the same internal command (which must be defined in a ‘driver file’). For example files with extensions `ps`, `eps`, `ps.gz` may all be classed as type `eps`.

*read-file* determines the extension of the file that should be read to determine size information. It may be the same as *ext* but it may be different, for example `.ps.gz` files are not readable easily by  $\TeX$ , so you may want to put the bounding box information in a separate file with extension `.ps.bb`. If *read-file* is empty, `{}`, then the system will not try to locate an external file for size info, and the size must be specified in the arguments of `\includegraphics`. As a special case `*` may be used to denote the same extension as the graphic file. This is mainly of use in conjunction with using `*` as the extension, as in that case the particular graphic extension is not known. For example

```
\DeclareGraphicsRule{*}{eps}{*}{}
```

This would declare a default rule, such that all unknown extensions would be treated as EPS files, and the graphic file would be read for a BoundingBox comment.

If the driver file specifies a procedure for reading size files for *type*, that will be used, otherwise the procedure for reading `eps` files will be used. Thus the size of bitmap files may be specified in a file with a PostScript style `%%BoundingBox` line, if no other specific format is available.

*command* is usually empty, but if non empty it is used in place of the filename in the `\special`. Within this argument, `#1` may be used to denote the filename. Thus using the `dvips` driver, one may use

`\DeclareGraphicsRule{.ps.gz}{eps}{.ps.bb}{‘zcat #1}`

the final argument causes dvips to use the `zcat` command to unzip the file before inserting it into the PostScript output.

## 3.2 Rotation

`\rotatebox {<angle>}{<text>}`

Rotate *text* *angle* degrees anti-clockwise. Normally the rotation is about the left-hand end of the baseline of *text*.

## 3.3 Scaling

`\scalebox {<h-scale>}[<v-scale>]{<text>}`

Scale *text* by the specified amounts. If *v-scale* is omitted, the vertical scale factor is the same as the horizontal one.

`\resizebox *{<h-length>}{<v-length>}{<text>}`

Scale *text* so that the width is *h-length*. If `!` is used as either length argument, the other argument is used to determine a scale factor that is used in both directions. Normally *v-length* refers to the height of the box, but in the star form, it refers to the ‘height + depth’. As normal for L<sup>A</sup>T<sub>E</sub>X 2<sub>ε</sub> box length arguments, `\height`, `\width`, `\totalheight` and `\depth` may be used to refer to the original size of the box.

## 4 The Key=Value Interface

As mentioned in the introduction, apart from the above ‘standard interface’, there is an alternative syntax to the `\includegraphics` and `\rotatebox` commands that some people may prefer. It is provided by the accompanying `graphicx` package.

## 5 The Graphics Kernel Functions

### 5.1 Graphics Inclusion

`\Ginclude@graphics {<file>}`

Insert the contents of the file *file* at the current point. `\Ginclude@graphics` may use the four macros `\Gin@llx`, `\Gin@lly`, `\Gin@urx`, `\Gin@ury` to determine the ‘bounding box’ of the graphic. The result will be a T<sub>E</sub>X box of width *urx* – *llx* and height *ury* – *lly*. If `\Gin@clip` is *<true>* then part of the graphic that is outside this box should not be displayed. (Not all drivers can support this ‘clipping’.) Normally all these parameters are set by the ‘user interface level’.

`\Gread@eps {<file>}`

For each *type* of graphics file supported, the driver file must define `\Ginclude@type` and, optionally `\Gread@type`. The read command is responsible for obtaining size information from the file specified in the `\DeclareGraphicsRule` command. However the kernel defines a function, `\Gread@eps`, which can read PostScript files to find the `%%BoundingBox` comment. This function will be used for any type for which a specific function has not been declared. `\Gread@eps` accepts a generalised version of the bounding box comment. T<sub>E</sub>X units may be used (but there must be no space before the unit). If the unit is omitted `bp` is assumed. So

`%%BoundingBox 0 0 2in 3in`

Would be accepted by this function, to produce a 2in wide, by 3in high graphic.

## 5.2 Rotation

`\Grot@box`

Rotate the contents of `\box0` through `\Grot@angle` degrees (anti-clockwise). The user-interface is responsible for setting the macro `\Grot@angle`, and putting the appropriate text in `\Grot@box`.

## 5.3 Scaling

`\Gscale@box`  $\{\langle xscale \rangle\}[\langle yscale \rangle]\{\langle text \rangle\}$

(The second argument is not optional.) Scale *text* by the appropriate scale factors.

`\Gscale@box@dd`  $\{\langle dima \rangle\}\{\langle dimb \rangle\}\{\langle text \rangle\}$

Scale *text* in both directions by a factor  $dima/dimb$ .

`\Gscale@box@ddd`  $\{\langle dima \rangle\}\{\langle dimb \rangle\}\{\langle dimc \rangle\}\{\langle dimd \rangle\}\{\langle text \rangle\}$

Scale *text* in horizontally by a factor  $dima/dimb$ , and vertically by a factor of  $dimc/dimd$ .

`\Gscale@div`  $\{\langle cmd \rangle\}\{\langle dima \rangle\}\{\langle dimb \rangle\}$

Define the macro *cmd* to be the ratio of the lengths  $dima/dimb$ .

# 6 Interface to the Driver Files

## 6.1 Graphics Inclusion

Each driver file must declare that its driver can include graphics of certain *types*. It does this by declaring for each type a command of the form:

`\Ginclude@type`

The Graphics kernel function will call this driver-defined function with the filename as argument, and certain additional information will be provided as follows.:

<code>\Gin@llx, \Gin@lly,</code>	Macros storing the ‘bounding box’
<code>\Gin@urx, \Gin@ury</code>	
<code>\Gin@nat@width</code>	Registers storing the natural size.
<code>\Gin@nat@height</code>	
<code>\Gin@req@width</code>	Registers storing the required size, after
<code>\Gin@req@height</code>	scaling.
<code>\Gin@scalex, \Gin@scaley</code>	macros with the scale factors. A value of
	! means: Scale by the same amount as
	the other direction.
<code>\ifGin@clip</code>	<code>\newif</code> token, true if the graphic should
	be ‘clipped’ to the bounding box.

Optionally the driver may define a command of the form:

`\Gread@type`

This is responsible for reading an external file to find the bounding box information. If such a command is not declared, but a read-file is specified the command `\Gread@eps`, which is defined in the Graphics Kernel will be used.

## 6.2 Literal Postscript

Drivers that are producing PostScript output may want to define the following macros. They each take one argument which should be passed to an appropriate special. They are not used directly by this package but allow other packages to use the standard configuration file and package options to customise to various drivers:

`\Gin@PS@raw`, Literal PostScript special.

`\Gin@PS@restored`, Literal PostScript special, the driver will surround this with a save-restore pair.

`\Gin@PS@literal@header`, Postscript to be inserted in the header section of the PostScript file.

`\Gin@PS@file@header`, external file to be inserted in the header section of the PostScript file.

## 6.3 Rotation

`\Grot@start`, `\Grot@end` These macros must be defined to insert the appropriate `\special` to rotate the text between them by `\Grot@angle` degrees. The kernel function will make sure that the correct  $\text{\TeX}$  spacing is produced, these functions only need insert the `\special`.

## 6.4 Scaling

`\Gscale@start`, `\Gscale@end`, as for rotation, but here scale the text by `\Gscale@x` and `\Gscale@y`.

# 7 Implementation

```
1 (*package)
```

## 7.1 Initialisation

`\Gin@codes` First we save the catcodes of some characters, and set them to fixed values whilst this file is being read.

```
2 \edef\Gin@codes{%
3  \catcode'\noexpand\^^A\the\catcode'\^^A\relax
4  \catcode'\noexpand\" \the\catcode'\ " \relax
5  \catcode'\noexpand*\the\catcode'\ * \relax
6  \catcode'\noexpand!\the\catcode'\ ! \relax
7  \catcode'\noexpand\:\the\catcode'\ : \relax}

8 \catcode'\^^A=\catcode'\%
9 \@makeother\"%
10 \catcode'\*=11
11 \@makeother\!%
12 \@makeother\:%
```

We will need to have an implementation of the trigonometric functions for the rotation feature. May as well load it now.

```
13 \RequirePackage{trig}
```

```

\Grot@start  Initialise the rotation primitives.
\Grot@end    14 \providecommand\Grot@start{\@latex@error{Rotation not supported}\@ehc
              15          \global\let\Grot@start\relax}
              16 \providecommand\Grot@end{}

\Gscale@start  Initialise the scaling primitives.
\Gscale@end    17 \providecommand\Gscale@start{\@latex@error{Scaling not supported}\@ehc
              18          \global\let\Gscale@start\relax}
              19 \providecommand\Gscale@end{}

\Gread@BBox    %%BoundingBox as a macro for testing with \ifx. This may be redefined by the
              hiresbb option.
              20 \edef\Gread@BBox{\@percentchar\@percentchar BoundingBox}

```

## 7.2 Options

```

\ds@draft
\ds@final      21 \DeclareOption{draft}{\Gin@drafttrue}
              22 \DeclareOption{final}{\Gin@draftfalse}

\ifGin@draft    True in draft mode.
              23 \newif\ifGin@draft

\ds@hiresbb     If given this option the package will look for bounding box comments of the form
              %%HiResBoundingBox (which typically have real values) instead of the standard
              %%BoundingBox (which should have integer values).
              24 \DeclareOption{hiresbb}{%
              25   \edef\Gread@BBox{\@percentchar\@percentchar HiResBoundingBox}}

\ds@demo        If given this option the package will disregard the actual graphics file and insert a
              black box unless width or height are already specified.
              26 \DeclareOption{demo}{%
              27   \AtBeginDocument{%
              28     \def\Gin@include@graphics#1{%
              29       \rule{\@ifundefined{Gin@ewidth}{150pt}{\Gin@ewidth}}%
              30       {\@ifundefined{Gin@eheight}{100pt}{\Gin@eheight}}}}

\Gin@driver     Driver in use.
              31 \providecommand\Gin@driver{}

\ds@dvips       Tomas Rockicki's PostScript driver (unix, MSDOS, VMS...). The X11 previewer
\ds@xdvi        xdvi supports basically the same set of \specials.
              32 \DeclareOption{dvips}{\def\Gin@driver{dvips.def}}
              33 \DeclareOption{xdvi}{\ExecuteOptions{dvips}}

\ds@dvipdf      Sergey Lesenko's dvipdf driver.
              34 \DeclareOption{dvipdf}{\def\Gin@driver{dvipdf.def}}

\ds@dvipdfm     Mark Wick's dvipdfm driver.
              35 \DeclareOption{dvipdfm}{\def\Gin@driver{dvipdfm.def}}

```

```

\ds@dvipdfmx The driver for the dvipdfmx project.
               36 \DeclareOption{dvipdfmx}{\def\Gin@driver{dvipdfmx.def}}

\ds@xetex Jonathan Kew's TEX variant.
               37 \DeclareOption{xetex}{\def\Gin@driver{xetex.def}}

\ds@pdftex Han The Thanh's TEX variant.
               38 \DeclareOption{pdftex}{\def\Gin@driver{pdftex.def}}

\ds@luatex LuaTEX TEX variant.
               39 \DeclareOption{luatex}{\def\Gin@driver{luatex.def}}

\ds@luatex dvisvgm driver.
               40 \DeclareOption{dvisvgm}{\def\Gin@driver{dvisvgm.def}}

\ds@dvipsone The drivers for the Y&Y TEX system.
\ds@dviwindo 41 \DeclareOption{dvipsone}{\def\Gin@driver{dvipsone.def}}
               42 \DeclareOption{dviwindo}{\ExecuteOptions{dvipsone}}

\ds@emtex Two freely available sets of drivers for MSDOS, OS/2 and Windows.
\ds@dviwin 43 \DeclareOption{emtex}{\def\Gin@driver{emtex.def}}
               44 \DeclareOption{dviwin}{\def\Gin@driver{dviwin.def}}

\ds@oztex OzTEX (Macintosh). Since release 3 of OzTEX, merge with dvips back end.
               45 \DeclareOption{oztex}{\ExecuteOptions{dvips}}

\ds@textures Textures (Macintosh).
               46 \DeclareOption{textures}{\def\Gin@driver{textures.def}}

\ds@pctexps PCTEX (MSDOS/Windows) .
\ds@pctexwin 47 \DeclareOption{pctexps}{\def\Gin@driver{pctexps.def}}
\ds@pctexhp 48 \DeclareOption{pctexwin}{\def\Gin@driver{pctexwin.def}}
\ds@pctex32 49 \DeclareOption{pctexhp}{\def\Gin@driver{pctexhp.def}}
               50 \DeclareOption{pctex32}{\def\Gin@driver{pctex32.def}}

\ds@truettex Kinch TrueTEX, and its version with extended special support as shipped by Sci-
\ds@tcidvi entific Word.
               51 \DeclareOption{truettex}{\def\Gin@driver{truettex.def}}
               52 \DeclareOption{tcidvi}{\def\Gin@driver{tcidvi.def}}

\ds@vtex VTEX driver.
               53 \DeclareOption{vtex}{\def\Gin@driver{vtex.def}}

\ds@dvi2ps If anyone is using any of these driver options would they let me know. All these
\ds@dviaw are essentially untried and untested as far as I know.
\ds@dvilaser 54 %\DeclareOption{dvi2ps}{\def\Gin@driver{dvi2ps.def}}
\ds@dvitops 55 %\DeclareOption{dviaw}{\def\Gin@driver{dviaw.def}}
\ds@psprint 56 %\DeclareOption{dvilaser}{\def\Gin@driver{dvilaser.def}}
\ds@pubps 57 %\DeclareOption{dvitops}{\def\Gin@driver{dvitops.def}}
\ds@ln 58 %\DeclareOption{psprint}{\def\Gin@driver{psprint.def}}
               59 %\DeclareOption{pubps}{\def\Gin@driver{pubps.def}}
               60 %\DeclareOption{ln}{\def\Gin@driver{ln.def}}

```



`\ds@debugshow` You probably don't want to use this...

```
61 \DeclareOption{debugshow}{\catcode'\^^A=9 \let\GDebug\typeout}
```

A local configuration file may define more options. It should also make one driver option the default, by calling `\ExecuteOptions` with the appropriate option.

```
62 \InputIfFileExists{graphics.cfg}{}{}
```

`\ds@hiderotate`

```
63 \DeclareOption{hiderotate}{%
64   \def\Grot@start{\begingroup\setbox\z@\hbox\bgroup}
65   \def\Grot@end{\egroup\endgroup}}
```

`\ds@hidescale`

```
66 \DeclareOption{hidescale}{%
67   \def\Gscale@start{\begingroup\setbox\z@\hbox\bgroup}
68   \def\Gscale@end{\egroup\endgroup}}
```

After the options are processed, load the appropriate driver file. If a site wants a default driver (eg `textures`) it just needs to put `\ExecuteOptions{textures}` in a `graphics.cfg` file.

```
69 \ProcessOptions
```

Check that a driver has been specified (either as an option, or as a default option in the configuration file). Then load the 'def' file for that option, if it has not already been loaded by some other package (for instance the color package).

```
70 \if!\Gin@driver!
71   \PackageError{graphics}
72     {No driver specified}
73     {You should make a default driver option in a file \MessageBreak
74       graphics.cfg\MessageBreak
75       eg: \protect\ExecuteOptions{textures}}%
76   }
77 \else
78   \PackageInfo{graphics}{Driver file: \Gin@driver}
79   \@ifundefined{ver@\Gin@driver}{\input{\Gin@driver}}{}
80 \fi
```

### 7.3 Graphics Inclusion

This Graphics package uses a lot of dimension registers.  $\mathrm{T}_{\mathrm{E}}\mathrm{X}$  only has a limited number of registers, so rather than allocate new ones, re-use some existing  $\mathrm{L}^{\mathrm{A}}\mathrm{T}_{\mathrm{E}}\mathrm{X}$  registers. This is safe as long as all uses of the registers are *local*, and that you can be sure that you *never* need to have access to both uses within the same scope.

`\Gin@llx` In fact these four lengths are now stored as macros not as dimen registers, mainly so that integer bp lengths may be passed exactly.

```
\Gin@lly
\Gin@urx 81 \def\Gin@llx{0}
\Gin@ury 82 \let\Gin@lly\Gin@llx
83 \let\Gin@urx\Gin@llx
84 \let\Gin@ury\Gin@llx
```

`\Gin@nat@width` The ‘natural’ size of the graphic, before any scaling.

`\Gin@nat@height` 85 `\let\Gin@nat@width\leftmarginv`  
86 `\let\Gin@nat@height\leftmarginvi`

`\ifGin@clip` This switch is *<true>* if any graphics outside the specified bounding box (really viewport) should not be printed.  
87 `\newif\ifGin@clip`

`\DeclareGraphicsExtensions` Declare a comma separated list of default extensions to be used if the file is specified with no extension.  
88 `\newcommand\DeclareGraphicsExtensions[1]{%`  
89 `\edef\Gin@extensions{\zap@space#1 \@empty}}`

`\Gin@extensions` Initialise the list of possible extensions.  
90 `\providecommand\Gin@extensions{}`

`\includegraphics` Top level command for the standard interface, just look for a \*.  
91 `\def\includegraphics{%`  
92 `\@ifstar`  
93 `{\Gin@cliptrue\Gin@i}%`  
94 `{\Gin@clipfalse\Gin@i}}`

`\Gin@i` If an optional argument is present, call `\Gin@ii` to process it, otherwise call `\Gin@ii` to process it, otherwise call `\Gin@ii` to process it.  
95 `\def\Gin@i{%`  
96 `\@ifnextchar[%]`  
97 `\Gin@ii`  
98 `{\Gin@bboxfalse\Gin@ii}}`

`\Gin@ii` Look for a second optional argument.  
99 `\def\Gin@ii[#1]{%`  
100 `\@ifnextchar[%]`  
101 `{\Gin@iii[#1]}`  
102 `{\Gin@iii[0,0][#1]}`

`\Gin@iii` Set the coordinates of the lower left corner, and the coordinates of the upper right corner. The coordinates may be any TeX dimension, defaulting to bp.  
103 `\def\Gin@iii[#1,#2][#3,#4]#5{%`  
104 `\begingroup`  
105 `\Gin@bboxtrue`  
106 `\Gin@defaultbp\Gin@llx{#1}%`  
107 `\Gin@defaultbp\Gin@lly{#2}%`  
108 `\Gin@defaultbp\Gin@urx{#3}%`  
109 `\Gin@defaultbp\Gin@ury{#4}%`  
110 `\Gin@ii}`  
111 `\endgroup}`

`\Gin@defaultbp` This macro grabs a length, #2, which may or may not have a unit, and if a unit is supplied, converts to ‘bp’ and stores the value in #1. If a unit is not supplied ‘bp’ is assumed, and #2 is directly stored in #1. Note that supplying ‘bp’ is not quite the same as supplying no units, as in the former case a conversion via ‘pt’ and back to ‘bp’ takes place which can introduce rounding error. The

error is invisibly small but files conforming to Adobe DSC should have *integer* Bounding Box Coordinates, and conceivably some drivers might demand integer values. (Although most seem to accept real values (if they accept bounding box coordinates at all) in the `\special`. This is the reason why the mechanism uses `\def` and not `TEX` lengths, as in earlier releases of the package.

```

112 \def\Gin@defaultbp#1#2{%
113   \afterassignment\Gin@def@bp\dimen@#2bp\relax{#1}{#2}}
114 \def\Gin@def@bp#1\relax#2#3{%
115   \if!#1!%
116     \def#2{#3}%
117   \else
118     \dimen@.99626\dimen@
119     \edef#2{\strip@pt\dimen@}%
120   \fi}

```

`\DeclareGraphicsRule` Declare what actions should be taken for a particular file extension.  
                   #1 extension, #2 type, #3 read-file, #4 command,

```

121 \def\DeclareGraphicsRule#1#2#3#4{%
122   \edef\@tempa{\string *}\def\@tempb{#3}%
123   \expandafter\edef\csname Gin@rule@#1\endcsname##1%
124     {{#2}%
125      {\ifx\@tempa\@tempb\noexpand\Gin@ext\else#3\fi}%
126      {\ifx\indent#4\indent##1\else#4\fi}}}

```

An example rule base.

```

           ext   type  read  command
\DeclareGraphicsRule{.ps} {eps} {.ps} {}
\DeclareGraphicsRule{.eps} {eps} {.eps} {}
\DeclareGraphicsRule{.ps.gz}{eps} {.ps.bb} {'zcat #1}
\DeclareGraphicsRule{.pcx} {bmp} {} {}

```

`\graphicspath` User level command to set the input path for graphics files. A list of directories, each in a `{}` group.

```

127 \def\graphicspath#1{\def\Gin@path@path{#1}}

```

`\Gin@path` The default graphic path is `\input@path`.

```

128 \ifx\Gin@path\@undefined
129   \let\Gin@path\input@path
130 \fi

```

`\Gin@getbase` Given a possible extension, #1, check whether the file exists. If it does set `\Gin@base` and `\Gin@ext` to the filename stripped of the extension, and the extension, respectively.

```

131 \def\Gin@getbase#1{%
132   \edef\Gin@tempa{%
133     \def\noexpand\@tempa####1#1\space{%
134       \def\noexpand\Gin@base{####1}}}%
135   \IfFileExists{\filename@area\filename@base#1}%
136     {\Gin@tempa
137      \expandafter\@tempa\@filef@und
138      \edef\Gin@ext{#1}}{}}%

```

`\Gin@ext` Initialise the macro to hold the extension.

```

139 \let\Gin@ext\relax

```

`\Gin@sepdefault` This must match the token used by `\filename@parse` to delimit the extension.

```

140 \def\Gin@sepdefault{.}

```

`\Gin@include@graphics` The main internal function implementing graphics file inclusion. #1 is the file name.

```

141 \def\Gin@include@graphics#1{%
142   \begingroup
143   \let\input@path\Gin@input@path
144   \filename@parse{#1}%
145   \ifx\filename@ext\relax
146     \@for\Gin@temp:=\Gin@extensions\do{%
147       \ifx\Gin@ext\relax
148         \Gin@getbase\Gin@temp
149       \fi}%
150   \else
151     \Gin@getbase{\Gin@sepdefault\filename@ext}%

```

If the user supplied an explicit extension, just give a warning if the file does not exist. (It may be created later.)

```

152     \ifx\Gin@ext\relax
153       \@warning{File ‘#1’ not found}%
154       \def\Gin@base{\filename@area\filename@base}%
155       \edef\Gin@ext{\Gin@sepdefault\filename@ext}%
156     \fi
157   \fi

```

If no extension is supplied, it is an error if the file does not exist, as there is no way for the system to know which extension to supply.

```

158     \ifx\Gin@ext\relax
159       \@latex@error{File ‘#1’ not found}%
160       {I could not locate the file with any of these extensions:^^J%
161       \Gin@extensions^^J\@ehc}%
162     \else
163       \@ifundefined{Gin@rule@\Gin@ext}%

```

Handle default rule.

```

164       {\ifx\Gin@rule@\@undefined
165         \@latex@error{Unknown graphics extension: \Gin@ext}\@ehc
166       \else
167         \expandafter\Gin@setfile\Gin@rule@*\{\Gin@base\Gin@ext}%
168       \fi}%
169       {\expandafter\expandafter\expandafter\Gin@setfile
170       \csname Gin@rule@\Gin@ext\endcsname{\Gin@base\Gin@ext}}%
171     \fi
172   \endgroup}

```

`\ifGread@` True if a file should be read to obtain the natural size.

```

173 \newif\ifGread@\Gread@true

```

`\Gin@setfile` Set a file to the size specified in arguments, or in a ‘read file’.

```

174 \def\Gin@setfile#1#2#3{%

```

```

175 \ifx\\#2\\Gread@false\fi
176 \ifGin@bbox\else
177   \ifGread@
178     \csname Gread@%
179       \expandafter\ifx\csname Gread@#1\endcsname\relax
180         eps%
181       \else
182         #1%
183       \fi
184     \endcsname{\Gin@base#2}%
185   \else

```

By now the natural size should be known either from arguments or from the file. If not generate an error. (The `graphicx` interface relaxes this condition slightly.)

```

186   \Gin@nosize{#3}%
187 \fi
188 \fi

```

The following call will modify the ‘natural size’ if the user has supplied a viewport or trim specification. (Not available in the standard interface.)

```

189 \Gin@viewport@code

```

Save the natural size, and then call `\Gin@req@sizes` which (in the key-val interface) will calculate the required size from the natural size, and any scaling info.

```

190 \Gin@nat@height\Gin@ury bp%
191 \advance\Gin@nat@height-\Gin@lly bp%
192 \Gin@nat@width\Gin@urx bp%
193 \advance\Gin@nat@width-\Gin@llx bp%
194 \Gin@req@sizes

```

Call `\Gin@include@type` to include the figure unless this is not defined, or draft mode is being used.

```

195 \expandafter\ifx\csname Gin@include@#1\endcsname\relax
196   \Gin@drafttrue
197   \expandafter\ifx\csname Gread@#1\endcsname\relax
198     \@latex@error{Can not include graphics of type: #1}\@ehc
199     \global\expandafter\let\csname Gread@#1\endcsname\@empty
200   \fi
201 \fi
202 \leavevmode
203 \ifGin@draft
204   \hb@xt@\Gin@req@width{%
205     \vrule\hss
206     \vbox to \Gin@req@height{%
207       \hrule \@width \Gin@req@width
208       \vss
209       \edef\@tempa{#3}%
210       \rlap{ \ttfamily\expandafter\strip@prefix\meaning\@tempa}%
211       \vss
212       \hrule}%
213     \hss\vrule}%
214 \else

```

Support `\listfiles` and then set the final box to the required size.

```

215   \@addtofilelist{#3}%
216   \ProvidesFile{#3}[Graphic file (type #1)]%

```

```

217     \setbox\z@\hbox{\csname Ginclude@#1\endcsname{#3}}%
218     \dp\z@\z@
219     \ht\z@\Gin@req@height
220     \wd\z@\Gin@req@width
221     \box\z@
222     \fi}

\Gin@exclamation Catcode 12 !, in case of French, or other language styles.
223 \def\Gin@exclamation{!}

\Gin@req@sizes In the standard interface there is no scaling, so the required size is the same as the
\Gin@scalex natural size. In other interfaces \Gin@req@sizes will be responsible for setting
\Gin@scaley these parameters. Here we can set them globally.
\Gin@req@height 224 \let\Gin@req@sizes\relax
\Gin@req@width 225 \def\Gin@scalex{1}%
226 \let\Gin@scaley\Gin@exclamation
227 \let\Gin@req@height\Gin@nat@height
228 \let\Gin@req@width\Gin@nat@width

\Gin@viewport@code In the standard interface there is no possibility of specifying a viewport, so this is
a no-op.
229 \let\Gin@viewport@code\relax

\Gin@nosize This command is called in the case that the graphics type specifies no ‘read file’ and
the user supplied no size arguments. In the standard interface can only generate
an error.
230 \def\Gin@nosize#1{%
231     \@latex@error
232     {Cannot determine size of graphic in #1 (no size specified)}%
233     \@ehc}

```

## 7.4 Reading the BoundingBox in EPS files

```

\ifGin@bbox This switch should be set <true> once a size has been found, either in an argument,
or in an external file.
234 \newif\ifGin@bbox

\Gread@eps Read an EPS file (#1) and search for a line starting with %%BoundingBox and re-
turns the result by setting four dimension registers \Gin@llx, \Gin@lly, \Gin@urx
and \Gin@ury.
235 \def\Gread@eps#1{%
236     \begingroup

Make it reasonably safe to have binary headers in the EPS file before the bounding
box line.
237     \@tempcnta\z@
238     \loop\ifnum\@tempcnta<\@xxxii
239         \catcode\@tempcnta14 %
240         \advance\@tempcnta\@ne
241     \repeat
242     \catcode'\^^?14 %
243     \let\do\@makeother
244     \dospecials

```

Make sure tab and space are accepted as white space.

```

245 \catcode'\ 10 %
246 \catcode'\^~I10 %
247 \catcode\endlinechar5 %
248 \@makeother\:%
249 \@makeother\-%

```

The first thing we need to do is to open the information file, if possible.

```

250 \immediate\openin\@inputcheck#1 %
251 \ifeof\@inputcheck
252 \latex@error{File '#1' not found}\@ehc
253 \else

```

Now we'll scan lines until we find one that starts with `%%BoundingBox:` We need to reset the catcodes to read the file, and so this is done in a group.

```

254 \Gread@true
255 \let\@tempb\Gread@false
256 \loop
257 \read\@inputcheck to\@tempa
258 \ifeof\@inputcheck
259 \Gread@false
260 \else
261 \expandafter\Gread@find@bb\@tempa:.\%
262 \fi
263 \ifGread@
264 \repeat
265 \immediate\closein\@inputcheck
266 \fi
267 \ifGin@bbox\else
268 \latex@error
269 {Cannot determine size of graphic in #1 (no BoundingBox)}%
270 \@ehc
271 \gdef\@gtempa{0 0 72 72 }%
272 \fi
273 \endgroup
274 \expandafter\Gread@parse@bb\@gtempa\%

```

`\Gread@find@bb` If a line in the EPS file starts with a `%%BoundingBox:`, we will examine it more closely. Note using the 'extra' argument `#2#3` causes any space after the `:` to be gobbled.

```

275 \long\def\Gread@find@bb#1:#2#3\%
276 \def\@tempa{#1}%
277 \ifx\@tempa\Gread@BBBox
278 \Gread@test@atend#2#3()\%
279 \fi

```

`\Gread@test@atend` Determine if the stuff following the `%%BoundingBox` is '(atend)', which will involve further reading of the file. This is accomplished by making `\@tempb` into a no-op, so that finding a `%%BoundingBox` does not stop the loop.

```

280 \def\Gread@test@atend#1(#2)#3\%
281 \def\@tempa{#2}%
282 \ifx\@tempa\Gread@atend
283 \Gread@true
284 \let\@tempb\relax

```

```

285 \else
286 \gdef\@gtempa{#1}%
287 \@tempb
288 \Gin@bboxtrue
289 \fi}

\Gread@parse@bb We have %%BoundingBox and what follows is not ‘(atend)’ so we will parse the
rest of the line as a BB with four elements. PostScript files should never have
units specified in the BoundingBox comment, but we allow arbitrary TeX units in
external files, or in other interfaces.
290 \def\Gread@parse@bb#1 #2 #3 #4 #5\\{%
291 \Gin@defaultbp\Gin@llx{#1}%
292 \Gin@defaultbp\Gin@lly{#2}%
293 \Gin@defaultbp\Gin@urx{#3}%
294 \Gin@defaultbp\Gin@ury{#4}}%

\Gread@atend atend as a macro for testing with \ifx.
295 \def\Gread@atend{atend}

```

## 7.5 Rotation

As above, we will re-use some existing local registers.

```

\Grot@height Final Rotated box dimensions
\Grot@left 296 \let\Grot@height\@ovxx
\Grot@right 297 \let\Grot@left\@ovyy
\Grot@depth 298 \let\Grot@right\@ovdx
299 \let\Grot@depth\@ovdy

\Grot@h Original box dimensions
\Grot@l 300 \let\Grot@l\@ovro
\Grot@r 301 \let\Grot@r\@ovri
\Grot@d 302 \let\Grot@h\@xdim
303 \let\Grot@d\@ydim

\Grot@x Coordinates of centre of rotation.
\Grot@y 304 \let\Grot@x\@linelen
305 \let\Grot@y\@dashdim

\rotatebox The angle is specified by #1. The box to be rotated is #2. In the standard interface
the centre of rotation is (0,0). Then finally call \Grot@box to rotate the box.
306 \long\def\rotatebox#1#2{%
307 \leavevmode
308 \Grot@setangle{#1}%
309 \setbox\z@\hbox{#2}%
310 \Grot@x\z@
311 \Grot@y\z@
312 \Grot@box}

\Grot@setangle Set the internal macro used by \Grot@box. In the standard interface this is trivial,
but other interfaces may have more interesting definitions. For example:
\def\Grot@setangle#1{%

```



```

\dimen@#1\p@
\dimen@-57.2968\dimen@
\edef\Grot@angle{\strip@pt\dimen@}}

```

This would cause the argument of `\rotatebox` to be interpreted as an angle specified in *radians*, *clockwise*.

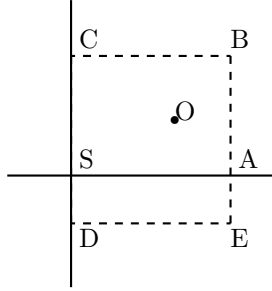
```

313 \def\Grot@setangle#1{\edef\Grot@angle{#1}}

```

## 7.6 Deriving a ‘bounding box’ for rotated object

We want to know the size of a ‘bounding box’ enclosing the rotated box. We define two formulae (as T<sub>E</sub>X macros) to work out the  $x$  and  $y$  coordinates of vertices of the rotated box in relation to its original coordinates (i.e., its width, height and depth). The box we visualize with vertices  $B$ ,  $C$ ,  $D$  and  $E$  is illustrated below. The vertex  $S$  is the reference point on the baseline.  $O$  is the centre of rotation, which in the standard interface is always  $S$ .



The formulae are, for a point  $P$  and angle  $\alpha$ :

$$\begin{aligned}
 P'_x &= P_x - O_x \\
 P'_y &= P_y - O_y \\
 P''_x &= (P'_x \times \cos(\alpha)) - (P'_y \times \sin(\alpha)) \\
 P''_y &= (P'_x \times \sin(\alpha)) + (P'_y \times \cos(\alpha)) \\
 P'''_x &= P''_x + O_x + L_x \\
 P'''_y &= P''_y + O_y
 \end{aligned}$$

The ‘extra’ horizontal translation  $L_x$  at the end is calculated so that the leftmost point of the resulting box has  $x$ -coordinate 0. This is desirable as T<sub>E</sub>X boxes must have the reference point at the left edge of the box.

`\Grot@Px` Work out new  $x$  coordinate of point after rotation. The parameters #2 and #3 are the original  $x$  and  $y$  coordinates of the point. The new  $x$  coordinate is stored in #1.

```

314 \def\Grot@Px#1#2#3{%
315     #1\Grot@cos#2%
316     \advance#1-\Grot@sin#3}

```

`\Grot@Py` Work out new  $y$  coordinate of point after rotation. The parameters #2 and #3 are the original  $x$  and  $y$  coordinates of the point. The new  $y$  coordinate is stored in #1.

```

317 \def\Grot@Py#1#2#3{%
318     #1\Grot@sin#2%
319     \advance#1\Grot@cos#3}

```

`\Grot@box` This is the tricky bit. We can rotate the box, but then need to work out how much space to leave for it on the page.

We simplify matters by working out first which quadrant we are in, and then picking just the right values.

```
320 \def\Grot@box{%
321   \begingroup
```

We are going to need to know the sine and cosine of the angle; simplest to calculate these now.

```
322   \CalculateSin\Grot@angle
323   \CalculateCos\Grot@angle
324   \edef\Grot@sin{\UseSin\Grot@angle}%
325   \edef\Grot@cos{\UseCos\Grot@angle}%
326 ^^A   \GDebug{Rotate: angle \Grot@angle, sine is \Grot@sin,
327 ^^A           cosine is \Grot@cos}%
```

Save the four extents of the original box.

```
328   \Grot@r\wd\z@ \advance\Grot@r-\Grot@x
329   \Grot@l\z@ \advance\Grot@l-\Grot@x
330   \Grot@h\ht\z@ \advance\Grot@h-\Grot@y
331   \Grot@d-\dp\z@ \advance\Grot@d-\Grot@y
```

Now a straightforward test to see which quadrant we are operating in;

```
332   \ifdim\Grot@sin\p@>\z@
333     \ifdim\Grot@cos\p@>\z@
```

First quadrant: Height= $By$ , Right= $Ex$ , Left= $Cx$ , Depth= $Dy$

```
334       \Grot@Py\Grot@height \Grot@r\Grot@h%B
335       \Grot@Px\Grot@right \Grot@r\Grot@d%E
336       \Grot@Px\Grot@left \Grot@l\Grot@h%C
337       \Grot@Py\Grot@depth \Grot@l\Grot@d%D
338     \else
```

Second quadrant: Height= $Ey$ , Right= $Dx$ , Left= $Bx$ , Depth= $Cy$

```
339       \Grot@Py\Grot@height \Grot@r\Grot@d%E
340       \Grot@Px\Grot@right \Grot@l\Grot@d%D
341       \Grot@Px\Grot@left \Grot@r\Grot@h%B
342       \Grot@Py\Grot@depth \Grot@l\Grot@h%C
343     \fi
344   \else
345     \ifdim\Grot@cos\p@<\z@
```

Third quadrant: Height= $Dy$ , Right= $Cx$ , Left= $Ex$ , Depth= $By$

```
346       \Grot@Py\Grot@height \Grot@l\Grot@d%D
347       \Grot@Px\Grot@right \Grot@l\Grot@h%C
348       \Grot@Px\Grot@left \Grot@r\Grot@d%E
349       \Grot@Py\Grot@depth \Grot@r\Grot@h%B
350     \else
```

Fourth quadrant: Height= $Cy$ , Right= $Bx$ , Left= $Dx$ , Depth= $Ey$

```
351       \Grot@Py\Grot@height \Grot@l\Grot@h%C
352       \Grot@Px\Grot@right \Grot@r\Grot@h%B
353       \Grot@Px\Grot@left \Grot@l\Grot@d%D
354       \Grot@Py\Grot@depth \Grot@r\Grot@d%E
355     \fi
356   \fi
```

Now we should translate back by  $(O_x, O_y)$ , but  $\text{T}_{\text{E}}\text{X}$  can not really deal with boxes that do not have the reference point at the left edge. (Everything with a  $-ve$   $x$ -coordinate would over-print earlier text). So we modify the horizontal translation so that the reference point as understood by  $\text{T}_{\text{E}}\text{X}$  is at the left edge. This means that the ‘centre of rotation’ is not fixed by `\rotatebox`, but typically moves horizontally. We also need to find the image of the original reference point,  $S$ , as that is where the rotation specials must be inserted.

```

357 \advance\Grot@height\Grot@y
358 \advance\Grot@depth\Grot@y
359 \Grot@Px\dimen@ \Grot@x\Grot@y
360 \Grot@Py\dimen@ii \Grot@x\Grot@y
361 \dimen@-\dimen@ \advance\dimen@-\Grot@left
362 \dimen@ii-\dimen@ii \advance\dimen@ii\Grot@y

363 ^^A \GDebug{Rotate: (l,r,h,d)^J%
364 ^^A Original \the\Grot@l,\the\Grot@r,\the\Grot@h,\the\Grot@d,^^J%
365 ^^A New..... \the\Grot@left,\the\Grot@right,%
366 ^^A \the\Grot@height,\the\Grot@depth}%

367 \setbox\z@\hbox{%
368 \kern\dimen@
369 \raise\dimen@ii\hbox{\Grot@start\box\z@\Grot@end}}%
370 \ht\z@\Grot@height
371 \dp\z@-\Grot@depth
372 \advance\Grot@right-\Grot@left\wd\z@\Grot@right
373 \leavevmode\box\z@
374 \endgroup}

```

## 7.7 Stretching and Scaling

`\scalebox` The top level `\scalebox`. If the vertical scale factor is omitted it defaults to the horizontal scale factor, #1.

```

375 \def\scalebox#1{%
376 \@ifnextchar[{\Gscale@box{#1}}{\Gscale@box{#1}[#1]}

```

`\Gscale@box` Internal version of `\scalebox`.

```

377 \long\def\Gscale@box#1[#2]#3{%
378 \leavevmode
379 \def\Gscale@x{#1}\def\Gscale@y{#2}%
380 \setbox\z@\hbox{{#3}}%
381 \setbox\tw@\hbox{\Gscale@start\rlap{\copy\z@}\Gscale@end}%
382 \ifdim#2\p<\z@
383 \ht\tw@-#2\dp\z@
384 \dp\tw@-#2\ht\z@
385 \else
386 \ht\tw@#2\ht\z@
387 \dp\tw@#2\dp\z@
388 \fi
389 \ifdim#1\p<\z@
390 \hb@xt@-#1\wd\z@{\kern-#1\wd\z@\box\tw@\hss}%
391 \else
392 \wd\tw@#1\wd\z@
393 \box\tw@
394 \fi}

```

`\reflectbox` Just an abbreviation for the appropriate scale to get reflection.

```

395 \def\reflectbox{\Gscale@box-1[1]}

```

`\resizebox` Look for a \*, which specifies that a final vertical size refers to ‘height + depth’ not just ‘height’.

```

396 \def\resizebox{%
397   \leavevmode
398   \@ifstar{\Gscale@@box\totalheight}{\Gscale@@box\height}}

```

`\Gscale@@box` Look for the ! in the arguments.

```

399 \def\Gscale@@box#1#2#3{%
400   \let\@tempa\Gin@exclamation
401   \expandafter\def\expandafter\@tempb\expandafter{\string#2}%
402   \expandafter\def\expandafter\@tempc\expandafter{\string#3}%
403   \ifx\@tempb\@tempa
404     \ifx\@tempc\@tempa
405       \toks@{\mbox}%
406     \else
407       \toks@{\Gscale@box@dd{#3}#1}%
408     \fi
409   \else
410     \ifx\@tempc\@tempa
411       \toks@{\Gscale@box@dd{#2}\width}%
412     \else
413       \toks@{\Gscale@box@ddd{#2}\width{#3}#1}%
414     \fi
415   \fi
416   \the\toks@}

```

`\Gscale@box@dd` Scale the text #3 in both directions by a factor #1/#2.

```

417 \long\def\Gscale@box@dd#1#2#3{%
418   \@begin@tempboxa\hbox{#3}%
419   \setlength\@tempdima{#1}%
420   \setlength\@tempdimb{#2}%
421   \Gscale@div\@tempa\@tempdima\@tempdimb
422   \Gscale@box\@tempa[\@tempa]{\box\@tempboxa}%
423   \@end@tempboxa}

```

`\Gscale@box@ddd` Scale the text #5 horizontally by a factor #1/#2 and vertically by a factor #3/#4.

```

424 \long\def\Gscale@box@ddd#1#2#3#4#5{%
425   \@begin@tempboxa\hbox{#5}%
426   \setlength\@tempdima{#1}%
427   \setlength\@tempdimb{#2}%
428   \Gscale@div\@tempa\@tempdima\@tempdimb
429   \setlength\@tempdima{#3}%
430   \setlength\@tempdimb{#4}%
431   \Gscale@div\@tempb\@tempdima\@tempdimb
432   \ifGin@iso
433     \ifdim\@tempa\p>\@tempb\p@
434       \let\@tempa\@tempb
435     \else
436       \let\@tempb\@tempa
437     \fi

```

```

438     \fi
439     \Gscale@box\@tempa[\@tempb]{\box\@tempboxa}%
440     \@end@tempboxa}

\ifGin@iso If this flag is true, then specifying two lengths to \resizebox scales the box by
the same factor in either direction, such that neither length exceeds the stated
amount. No user interface to this flag in the standard package, but it is used by
the keepaspectratio key to \includegraphics in the graphicx package.
441 \newif\ifGin@iso

\Gscale@div The macro #1 is set to the ratio of the lengths #2 and #3.
442 \def\Gscale@div#1#2#3{%
443     \setlength\dimen@{#3}%
444     \ifdim\dimen@=\z@
445         \PackageError{graphics}{Division by 0}\@eha
446         \dimen@#2%
447     \fi
448     \edef\@tempd{\the\dimen@}%
449     \setlength\dimen@{#2}%
450     \count@65536\relax
451     \ifdim\dimen@<\z@
452         \dimen@-\dimen@
453         \count@-\count@
454     \fi
455     \ifdim\dimen@>\z@
456         \loop
457             \ifdim\dimen@<8192\p@
458                 \dimen@\tw@\dimen@
459                 \divide\count@\tw@
460             \repeat
461             \dimen@ii\@tempd\relax
462             \divide\dimen@ii\count@
463             \divide\dimen@\dimen@ii
464     \fi
465     \edef#1{\strip@pt\dimen@}}

Restore Catcodes
466 \Gin@codes
467 \let\Gin@codes\relax
468 \end{package}

```