

# The pdfcol package

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2007/12/12 v1.2

## Abstract

Since version 1.40 pdfTeX supports color stacks. The driver file `pdfTeX.def` for package `color` defines and uses a main color stack since version v0.04b. Package `pdfcol` is intended for package writers. It defines macros for setting and maintaining new color stacks.

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# 1 Documentation

Version 1.40 of pdfTeX adds new primitives `\pdfcolorstackinit` and `\pdfcolorstack`. Now color stacks can be defined and used. A main color stack is maintained by the driver file `pdfTeX.def` similar to dvips or dvi2pdf. However the number of color stacks is not limited to one in pdfTeX. Thus further color problems can now be solved, such as footnotes across pages or text that is set in parallel columns (e.g. packages `parallel` or `parcolumn`). Unlike the main color stack, the support by additional color stacks cannot be done in a transparent manner.

This package `pdfcol` provides an easier interface to additional color stacks without the need to use the low level primitives.

## 1.1 Requirements

- pdfTeX 1.40 or greater.
- pdfTeX in PDF mode. (I don't know a DVI driver that support several color stacks.)
- `pdfTeX.def` 2007/01/02 v0.04b.

Package `pdfcol` checks the requirements and sets switch `\ifpdfcolAvailable` accordingly.

## 1.2 Interface

`\ifpdfcolAvailable`

If the requirements of section 1.1 are met the switch `\ifpdfcolAvailable` behaves as `\iftrue`. Otherwise the other interface macros in this section will be disabled with a message. Also the first use of such a macro will print a message. The messages are print to the `..log` file only if pdfTeX is not used in PDF mode.

`\pdfcolErrorNoStacks`

The first call of `\pdfcolErrorNoStacks` prints an error message, if color stacks are not available.

`\pdfcolInitStack`  $\langle name \rangle$

A new color stack is initialized by `\pdfcolInitStack`. The  $\langle name \rangle$  is used for indentifying the stack. It usually consists of letters and digits. (The name must survive a `\csname`.)

The intension of the macro is the definition of an additional color stack. Thus the stack is not page bounded like the main color stack. Black (`0 g 0 G`) is used as initial color value. And colors are written with modifier `direct` that means without setting the current transfer matrix and changing the current point (see documentation of pdfTeX for `\pdfliteral direct{...}`).

`\pdfcolIfStackExists`  $\langle name \rangle$   $\langle then \rangle$   $\langle else \rangle$

Macro `\pdfcolIfStackExists` checks whether color stack  $\langle name \rangle$  exists. In case of success argument  $\langle then \rangle$  is executed and  $\langle else \rangle$  otherwise.

`\pdfcolSwitchStack {<name>}`

Macro `\pdfcolSwitchStack` switches the color stack. The color macros of package `color` (or `xcolor`) now uses the new color stack with name `<name>`.

`\pdfcolSetCurrentColor`

Macro `\pdfcolSetCurrentColor` replaces the topmost entry of the stack by the current color (`\current@color`).

`\pdfcolSetCurrent {<name>}`

Macro `\pdfcolSetCurrent` sets the color that is read in the top-most entry of color stack `<name>`. If `<name>` is empty, the default color stack is used.

## 2 Implementation

1 `(*package)`

### 2.1 Reload check and package identification

Reload check, especially if the package is not used with L<sup>A</sup>T<sub>E</sub>X.

```
2 \begingroup
3 \catcode44 12 % ,
4 \catcode45 12 % -
5 \catcode46 12 % .
6 \catcode58 12 % :
7 \catcode64 11 % @
8 \expandafter\let\expandafter\x\csname ver@pdfcol.sty\endcsname
9 \ifcase 0%
10 \ifx\x\relax % plain
11 \else
12 \ifx\x\empty % LaTeX
13 \else
14 1%
15 \fi
16 \fi
17 \else
18 \catcode35 6 % #
19 \catcode123 1 % {
20 \catcode125 2 % }
21 \expandafter\ifx\csname PackageInfo\endcsname\relax
22 \def\x#1#2{%
23 \immediate\write-1{Package #1 Info: #2.}%
24 }%
25 \else
26 \def\x#1#2{\PackageInfo{#1}{#2, stopped}}%
27 \fi
28 \x{pdfcol}{The package is already loaded}%
29 \endgroup
30 \expandafter\endinput
31 \fi
32 \endgroup
```

Package identification:

```
33 \begingroup
34 \catcode35 6 % #
35 \catcode40 12 % (
36 \catcode41 12 % )
37 \catcode44 12 % ,
38 \catcode45 12 % -
```

```

39 \catcode46 12 % .
40 \catcode47 12 % /
41 \catcode58 12 % :
42 \catcode64 11 % @
43 \catcode123 1 % {
44 \catcode125 2 % }
45 \expandafter\ifx\csname ProvidesPackage\endcsname\relax
46 \def\x#1#2#3[#4]{\endgroup
47 \immediate\write-1{Package: #3 #4}%
48 \xdef#1{#4}%
49 }%
50 \else
51 \def\x#1#2[#3]{\endgroup
52 #2[#3]}%
53 \ifx#1\relax
54 \xdef#1{#3}%
55 \fi
56 }%
57 \fi
58 \expandafter\x\csname ver@pdfcol.sty\endcsname
59 \ProvidesPackage{pdfcol}%
60 [2007/12/12 v1.2 Maintaining additional color stacks for pdfTeX (HO)]

```

## 2.2 Catcodes

```

61 \begingroup
62 \catcode123 1 % {
63 \catcode125 2 % }
64 \def\x{\endgroup
65 \expandafter\edef\csname PDFCOL@AtEnd\endcsname{%
66 \catcode35 \the\catcode35\relax
67 \catcode64 \the\catcode64\relax
68 \catcode123 \the\catcode123\relax
69 \catcode125 \the\catcode125\relax
70 }%
71 }%
72 \x
73 \catcode35 6 % #
74 \catcode64 11 % @
75 \catcode123 1 % {
76 \catcode125 2 % }
77 \def\TMP@EnsureCode#1#2{%
78 \edef\PDFCOL@AtEnd{%
79 \PDFCOL@AtEnd
80 \catcode#1 \the\catcode#1\relax
81 }%
82 \catcode#1 #2\relax
83 }
84 \TMP@EnsureCode{39}{12}% '
85 \TMP@EnsureCode{40}{12}% (
86 \TMP@EnsureCode{41}{12}% )
87 \TMP@EnsureCode{43}{12}% +
88 \TMP@EnsureCode{44}{12}% ,
89 \TMP@EnsureCode{46}{12}% .
90 \TMP@EnsureCode{47}{12}% /
91 \TMP@EnsureCode{61}{12}% =
92 \TMP@EnsureCode{96}{12}% `

```

## 2.3 Check requirements

ifpdfcolAvailable

```

93 \newif\ifpdfcolAvailable
94 \pdfcolAvailabletrue

```

\PDFCOL@RequirePackage

```

95 \begingroup\expandafter\expandafter\expandafter\endgroup
96 \expandafter\ifx\csname RequirePackage\endcsname\relax
97   \def\PDFCOL@RequirePackage#1[#2]{\input #1.sty\relax}%
98 \else
99   \def\PDFCOL@RequirePackage#1[#2]{%
100     \RequirePackage{#1}[#2]}%
101   }%
102 \fi

```

### 2.3.1 Check package luacolor

```

103 \newif\ifPDFCOL@luacolor
104 \begingroup\expandafter\expandafter\expandafter\endgroup
105 \expandafter\ifx\csname ver@luacolor.sty\endcsname\relax
106   \PDFCOL@luacolorfalse
107 \else
108   \PDFCOL@luacolortrue
109 \fi

```

### 2.3.2 Check PDF mode

```

110 \PDFCOL@RequirePackage{inftwarerr}[2007/09/09]
111 \PDFCOL@RequirePackage{ifpdf}[2007/09/09]
112 \ifcase\ifpdf\ifPDFCOL@luacolor 1\fi\else 1\fi0 %
113   \def\PDFCOL@Message{%
114     \@PackageWarningNoLine{pdfcol}%
115   }%
116 \else
117   \pdfcolAvailablefalse
118   \def\PDFCOL@Message{%
119     \@PackageInfoNoLine{pdfcol}%
120   }%
121   \PDFCOL@Message{%
122     Interface disabled because of %
123     \ifPDFCOL@luacolor
124       package 'luacolor'%
125     \else
126       missing PDF mode of pdfTeX%
127   \fi
128   }%
129 \fi

```

### 2.3.3 Check version of pdfTeX

```

130 \ifpdfcolAvailable
131   \begingroup\expandafter\expandafter\expandafter\endgroup
132   \expandafter\ifx\csname pdfcolorstack\endcsname\relax
133     \pdfcolAvailablefalse
134     \PDFCOL@Message{%
135       Interface disabled because of too old pdfTeX.\MessageBreak
136       Required is version 1.40+ for \string\pdfcolorstack
137     }%
138   \fi
139 \fi
140 \ifpdfcolAvailable
141   \begingroup\expandafter\expandafter\expandafter\endgroup
142   \expandafter\ifx\csname pdfcolorstack\endcsname\relax
143     \pdfcolAvailablefalse
144     \PDFCOL@Message{%
145       Interface disabled because of too old pdfTeX.\MessageBreak
146       Required is version 1.40+ for \string\pdfcolorstackinit
147     }%
148   \fi

```

149 \fi

### 2.3.4 Check pdftex.def

150 \ifpdfcolAvailable

151 \begingroup\expandafter\expandafter\expandafter\endgroup

152 \expandafter\ifx\csname @pdfcolorstack\endcsname\relax

Try to load package color if it is not yet loaded (L<sup>A</sup>T<sub>E</sub>X case).

153 \begingroup\expandafter\expandafter\expandafter\endgroup

154 \expandafter\ifx\csname ver@color.sty\endcsname\relax

155 \begingroup\expandafter\expandafter\expandafter\endgroup

156 \expandafter\ifx\csname documentclass\endcsname\relax

157 \else

158 \RequirePackage[pdftex]{color}\relax

159 \fi

160 \fi

161 \begingroup\expandafter\expandafter\expandafter\endgroup

162 \expandafter\ifx\csname @pdfcolorstack\endcsname\relax

163 \pdfcolAvailablefalse

164 \PDFCOL@Message{%

165 Interface disabled because ‘pdftex.def’\MessageBreak

166 is not loaded or it is too old.\MessageBreak

167 Required is version 0.04b or greater%

168 }%

169 \fi

170 \fi

171 \fi

172 \let\pdfcolAvailabletrue\relax

173 \let\pdfcolAvailablefalse\relax

## 2.4 Enabled interface macros

174 \ifpdfcolAvailable

\pdfcolErrorNoStacks

175 \let\pdfcolErrorNoStacks\relax

\pdfcol@Value

176 \expandafter\ifx\csname pdfcol@Value\endcsname\relax

177 \def\pdfcol@Value{0 g 0 G}%

178 \fi

\pdfcol@LiteralModifier

179 \expandafter\ifx\csname pdfcol@LiteralModifier\endcsname\relax

180 \def\pdfcol@LiteralModifier{direct}%

181 \fi

\pdfcolInitStack

182 \def\pdfcolInitStack#1{%

183 \expandafter\ifx\csname pdfcol@Stack@#1\endcsname\relax

184 \global\expandafter\chardef\csname pdfcol@Stack@#1\endcsname=

185 \pdfcolorstackinit\pdfcol@LiteralModifier{\pdfcol@Value}%

186 \relax

187 \@PackageInfo{pdfcol}{%

188 New color stack ‘#1’ = \number\csname pdfcol@Stack@#1\endcsname

189 }%

190 \else

191 \@PackageError{pdfcol}{%

192 Stack ‘#1’ is already defined%

193 }\@ehc

194 \fi

195 }%

`\pdfcolIfStackExists`

```
196 \def\pdfcolIfStackExists#1{%
197   \expandafter\ifx\csname pdfcol@Stack@#1\endcsname\relax
198     \expandafter\@secondoftwo
199   \else
200     \expandafter\@firstoftwo
201   \fi
202 }%
```

`\@firstoftwo`

```
203 \expandafter\ifx\csname @firstoftwo\endcsname\relax
204   \long\def\@firstoftwo#1#2{#1}%
205 \fi
```

`\@secondoftwo`

```
206 \expandafter\ifx\csname @secondoftwo\endcsname\relax
207   \long\def\@secondoftwo#1#2{#2}%
208 \fi
```

`\pdfcolSwitchStack`

```
209 \def\pdfcolSwitchStack#1{%
210   \pdfcolIfStackExists{#1}{%
211     \expandafter\let\expandafter\@pdfcolorstack
212       \csname pdfcol@Stack@#1\endcsname
213   }{%
214     \pdfcol@ErrorNoStack{#1}%
215   }%
216 }%
```

`\pdfcolSetCurrentColor`

```
217 \def\pdfcolSetCurrentColor{%
218   \pdfcolorstack\@pdfcolorstack set{\current@color}%
219 }%
```

`\pdfcolSetCurrent`

```
220 \def\pdfcolSetCurrent#1{%
221   \ifx\#1\%
222     \pdfcolorstack\@pdfcolorstack current\relax
223   \else
224     \pdfcolIfStackExists{#1}{%
225       \pdfcolorstack\csname pdfcol@Stack@#1\endcsname current\relax
226     }{%
227       \pdfcol@ErrorNoStack{#1}%
228     }%
229   \fi
230 }%
```

`\pdfcol@ErrorNoStack`

```
231 \def\pdfcol@ErrorNoStack#1{%
232   \@PackageError{pdfcol}{Stack ‘#1’ does not exists}\@ehc
233 }%
```

## 2.5 Disabled interface macros

```
234 \else
```

`\pdfcolErrorNoStacks`

```
235 \def\pdfcolErrorNoStacks{%
236   \@PackageError{pdfcol}{%
237     Color stacks are not available%
238   }{%
```

```

239     Update pdfTeX (1.40) and 'pdftex.def' (0.04b) %
240     if necessary.\MessageBreak
241     Ensure that 'pdftex.def' is loaded %
242     (package 'color' or 'xcolor').\MessageBreak
243     Further messages can be found in TeX's %
244     protocol file '\jobname.log'.\MessageBreak
245     \MessageBreak
246     \@ehc
247   }%
248   \global\let\pdfcolErrorNoStacks\relax
249 }%

```

\PDFCOL@Disabled

```

250 \def\PDFCOL@Disabled{%
251   \PDFCOL@Message{%
252     pdfTeX's color stacks are not available%
253   }%
254   \global\let\PDFCOL@Disabled\relax
255 }%

```

\pdfcolInitStack

```

256 \def\pdfcolInitStack#1{%
257   \PDFCOL@Disabled
258 }%

```

\pdfcolIfStackExists

```

259 \long\def\pdfcolIfStackExists#1#2#3{#3}%

```

\pdfcolSwitchStack

```

260 \def\pdfcolSwitchStack#1{%
261   \PDFCOL@Disabled
262 }%

```

\pdfcolSetCurrentColor

```

263 \def\pdfcolSetCurrentColor{%
264   \PDFCOL@Disabled
265 }%

```

\pdfcolSetCurrent

```

266 \def\pdfcolSetCurrent#1{%
267   \PDFCOL@Disabled
268 }%

```

269 \fi

270 \PDFCOL@AtEnd

271 \</package>

## 3 Test

### 3.1 Catcode checks for loading

```

272 <*test1>
273 \catcode'\{=1 %
274 \catcode'\}=2 %
275 \catcode'\#=6 %
276 \catcode'\@=11 %
277 \expandafter\ifx\csname count@\endcsname\relax
278   \countdef\count@=255 %
279 \fi

```



```

280 \expandafter\ifx\csname @gobble\endcsname\relax
281   \long\def\@gobble#1{}%
282 \fi
283 \expandafter\ifx\csname @firstofone\endcsname\relax
284   \long\def\@firstofone#1{#1}%
285 \fi
286 \expandafter\ifx\csname loop\endcsname\relax
287   \expandafter\@firstofone
288 \else
289   \expandafter\@gobble
290 \fi
291 {%
292   \def\loop#1\repeat{%
293     \def\body{#1}%
294     \iterate
295   }%
296   \def\iterate{%
297     \body
298     \let\next\iterate
299   \else
300     \let\next\relax
301   \fi
302   \next
303 }%
304 \let\repeat=\fi
305 }%
306 \def\RestoreCatcodes{}
307 \count@=0 %
308 \loop
309   \edef\RestoreCatcodes{%
310     \RestoreCatcodes
311     \catcode\the\count@=\the\catcode\count@\relax
312   }%
313 \ifnum\count@<255 %
314   \advance\count@ 1 %
315 \repeat
316
317 \def\RangeCatcodeInvalid#1#2{%
318   \count@=#1\relax
319   \loop
320     \catcode\count@=15 %
321   \ifnum\count@<#2\relax
322     \advance\count@ 1 %
323   \repeat
324 }
325 \expandafter\ifx\csname LoadCommand\endcsname\relax
326   \def\LoadCommand{\input pdfcol.sty\relax}%
327 \fi
328 \def\Test{%
329   \RangeCatcodeInvalid{0}{47}%
330   \RangeCatcodeInvalid{58}{64}%
331   \RangeCatcodeInvalid{91}{96}%
332   \RangeCatcodeInvalid{123}{255}%
333   \catcode'\@=12 %
334   \catcode'\=0 %
335   \catcode'\{=1 %
336   \catcode'\}=2 %
337   \catcode'\#=6 %
338   \catcode'\[=12 %
339   \catcode'\]=12 %
340   \catcode'\%=14 %
341   \catcode'\ =10 %

```

```

342 \catcode13=5 %
343 \LoadCommand
344 \RestoreCatcodes
345 }
346 \Test
347 \csname @@end\endcsname
348 \end
349 </test1>

```

### 3.2 Very simple test

```

350 <*test2 | test3>
351 \NeedsTeXFormat{LaTeX2e}
352 \nofiles
353 \documentclass{article}
354 \usepackage{pdfcol}[2007/12/12]
355 \usepackage{qstest}
356 \IncludeTests{*}
357 \LogTests{log}{*}{*}
358 \begin{document}
359   \begin{qstest}{pdfcol}{}%
360     \makeatletter
361 <*test2>
362   \Expect*{\ifpdfcolAvailable true\else false\fi}{false}%
363 </test2>
364 <*test3>
365   \Expect*{\ifpdfcolAvailable true\else false\fi}{true}%
366   \Expect*{\number\@pdfcolorstack}{0}%
367 </test3>
368   \setbox0=\hbox{%
369     \pdfcolInitStack{test}%
370 <*test3>
371   \Expect*{\number\pdfcol@Stack@test}{1}%
372   \Expect*{\number\@pdfcolorstack}{0}%
373 </test3>
374   \pdfcolSwitchStack{test}%
375 <*test3>
376   \Expect*{\number\@pdfcolorstack}{1}%
377 </test3>
378   \pdfcolSetCurrent{test}%
379   \pdfcolSetCurrent{}%
380   }%
381   \Expect*{\the\wd0}{0.0pt}%
382 <*test3>
383   \Expect*{\number\@pdfcolorstack}{0}%
384   \Expect*{\number\pdfcol@Stack@test}{1}%
385   \Expect*{\pdfcolIfStackExists{test}{true}{false}}{true}%
386 </test3>
387   \Expect*{\pdfcolIfStackExists{dummy}{true}{false}}{false}%
388   \end{qstest}%
389 \end{document}
390 </test2 | test3>

```

### 3.3 Detection of package luacolor

```

391 <*test4>
392 \NeedsTeXFormat{LaTeX2e}
393 \documentclass{article}
394 \usepackage{luacolor}
395 \usepackage{pdfcol}
396 \makeatletter
397 \ifpdfcolAvailable
398   \@latex@error{Detection of package luacolor failed}%
399 \fi

```

```
400 \csname @@end\endcsname
401 </test4>
```

## 4 Installation

### 4.1 Download

**Package.** This package is available on CTAN<sup>1</sup>:

[CTAN:macros/latex/contrib/oberdiek/pdfcol.dtx](#) The source file.

[CTAN:macros/latex/contrib/oberdiek/pdfcol.pdf](#) Documentation.

**Bundle.** All the packages of the bundle ‘oberdiek’ are also available in a TDS compliant ZIP archive. There the packages are already unpacked and the documentation files are generated. The files and directories obey the TDS standard.

[CTAN:install/macros/latex/contrib/oberdiek.tds.zip](#)

*TDS* refers to the standard “A Directory Structure for  $\TeX$  Files” ([CTAN:tds/tds.pdf](#)). Directories with `texmf` in their name are usually organized this way.

### 4.2 Bundle installation

**Unpacking.** Unpack the `oberdiek.tds.zip` in the TDS tree (also known as `texmf` tree) of your choice. Example (linux):

```
unzip oberdiek.tds.zip -d ~/texmf
```

**Script installation.** Check the directory `TDS:scripts/oberdiek/` for scripts that need further installation steps. Package `attachfile2` comes with the Perl script `pdfatfi.pl` that should be installed in such a way that it can be called as `pdfatfi`. Example (linux):

```
chmod +x scripts/oberdiek/pdfatfi.pl
cp scripts/oberdiek/pdfatfi.pl /usr/local/bin/
```

### 4.3 Package installation

**Unpacking.** The `.dtx` file is a self-extracting `docstrip` archive. The files are extracted by running the `.dtx` through plain- $\TeX$ :

```
tex pdfcol.dtx
```

**TDS.** Now the different files must be moved into the different directories in your installation TDS tree (also known as `texmf` tree):

<code>pdfcol.sty</code>	→ <code>tex/generic/oberdiek/pdfcol.sty</code>
<code>pdfcol.pdf</code>	→ <code>doc/latex/oberdiek/pdfcol.pdf</code>
<code>test/pdfcol-test1.tex</code>	→ <code>doc/latex/oberdiek/test/pdfcol-test1.tex</code>
<code>test/pdfcol-test2.tex</code>	→ <code>doc/latex/oberdiek/test/pdfcol-test2.tex</code>
<code>test/pdfcol-test3.tex</code>	→ <code>doc/latex/oberdiek/test/pdfcol-test3.tex</code>
<code>test/pdfcol-test4.tex</code>	→ <code>doc/latex/oberdiek/test/pdfcol-test4.tex</code>
<code>pdfcol.dtx</code>	→ <code>source/latex/oberdiek/pdfcol.dtx</code>

If you have a `docstrip.cfg` that configures and enables `docstrip`’s TDS installing feature, then some files can already be in the right place, see the documentation of `docstrip`.

---

<sup>1</sup><http://ftp.ctan.org/tex-archive/>

## 4.4 Refresh file name databases

If your  $\text{\TeX}$  distribution ( $\text{\texttt{teTeX}}$ ,  $\text{\texttt{mikTeX}}$ , ...) relies on file name databases, you must refresh these. For example,  $\text{\texttt{teTeX}}$  users run  $\text{\texttt{texhash}}$  or  $\text{\texttt{mktexlsr}}$ .

## 4.5 Some details for the interested

**Attached source.** The PDF documentation on CTAN also includes the  $\text{\texttt{.dtx}}$  source file. It can be extracted by AcrobatReader 6 or higher. Another option is  $\text{\texttt{pdftk}}$ , e.g. unpack the file into the current directory:

```
pdftk pdfcol.pdf unpack_files output .
```

**Unpacking with  $\text{\LaTeX}$ .** The  $\text{\texttt{.dtx}}$  chooses its action depending on the format:

**plain- $\text{\TeX}$ :** Run  $\text{\texttt{docstrip}}$  and extract the files.

**$\text{\LaTeX}$ :** Generate the documentation.

If you insist on using  $\text{\LaTeX}$  for  $\text{\texttt{docstrip}}$  (really,  $\text{\texttt{docstrip}}$  does not need  $\text{\LaTeX}$ ), then inform the autodetect routine about your intention:

```
latex \let\install=y\input{pdfcol.dtx}
```

Do not forget to quote the argument according to the demands of your shell.

**Generating the documentation.** You can use both the  $\text{\texttt{.dtx}}$  or the  $\text{\texttt{.drv}}$  to generate the documentation. The process can be configured by the configuration file  $\text{\texttt{ltxdoc.cfg}}$ . For instance, put this line into this file, if you want to have A4 as paper format:

```
\PassOptionsToClass{a4paper}{article}
```

An example follows how to generate the documentation with  $\text{\texttt{pdfLaTeX}}$ :

```
pdflatex pdfcol.dtx
makeindex -s gind.ist pdfcol.idx
pdflatex pdfcol.dtx
makeindex -s gind.ist pdfcol.idx
pdflatex pdfcol.dtx
```

## 5 History

[2007/09/09 v1.0]

- First version.

[2007/12/09 v1.1]

- $\text{\texttt{\pdfcolSetCurrentColor}}$  added.

[2007/12/12 v1.2]

- Detection for package  $\text{\texttt{luacolor}}$  added.

## 6 Index

Numbers written in *italic* refer to the page where the corresponding entry is described; numbers underlined refer to the code line of the definition; numbers in roman refer to the code lines where the entry is used.

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