

`modernruler` Package Documentation

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1 Outline

This package provides modern hrule (`\mruleh`), vrule (`\mrulev`), and `\undernote` internally uses the two commands.

Input

```
1 % normal rule
2 \mruleh[height=1pt, width=5cm, color=blue]
3
4 % dashed rule
5 \mruleh[height=2pt, width=8cm, color=red, dash=true, dash-len=5pt, gap-len=3
6 pt]
7
8 % inline rule
9 This is \mrulev[height=\zw, depth=1.5\zw, width=1pt, color=green] a modern
10 vrule.
11
12 % inline dashed rule
13 This is \mrulev[height=2\zw, width=1.5pt, color=orange, dash=true, dash-len
14 =2pt, gap-len=1pt] a dashed modern vrule.
15
16 % undernote
17 This is under note. This uses \undernote{these commands}{\texttt{\\
18 textbackslash mruleh}} and \texttt{\textbackslash mrulev} internally and
19 enables make flexible outputs.
```

Output

This is a modern vrule.
This is a dashed modern vrule.
This is under note. This uses these commands internally and enables make flexible out-
puts.
└ \mruleh and \mrulev

2 Acknowledgements / Credits

This package was inspired by discussions on TeX Forum concerning undernote-like constructions using rules.

An improved approach was later presented by Mr. Yusuke Terada, which clarified several implementation details.

The present package is a complete reimplementation and extension, introducing a generalized rule-based engine, redesigned control flow, and additional features such as modern ruler integration and `tcolorbox`-based abstractions.

Any remaining errors or design decisions are entirely the responsibility of the author.

3 Note

This package only supports LuaTeX.

In this package, a unit `\zw` is used in many parts. It is Japanese standard unit, but it's not normal outside of Japan. When you encounter `\zw` in documentations, please understand it as `1em`. In detail, `\zw` and `1em` is different when you use Japanese characters. But only when you use alphabetic characters and numbers, the difference doesn't matter.

4 Installation

```
Input
1 \usepackage[<options>]{modernruler}
```

Detailed information regarding the options will be provided in a later section, specifically during the explanation of the `\undernote` command.

5 Commands

5.1 `\mruleth`, `\mruletv`

In the first place, `\mruleth` and `\mruletv` are extended `\hrule` and `\vrule`. You can use them like this:

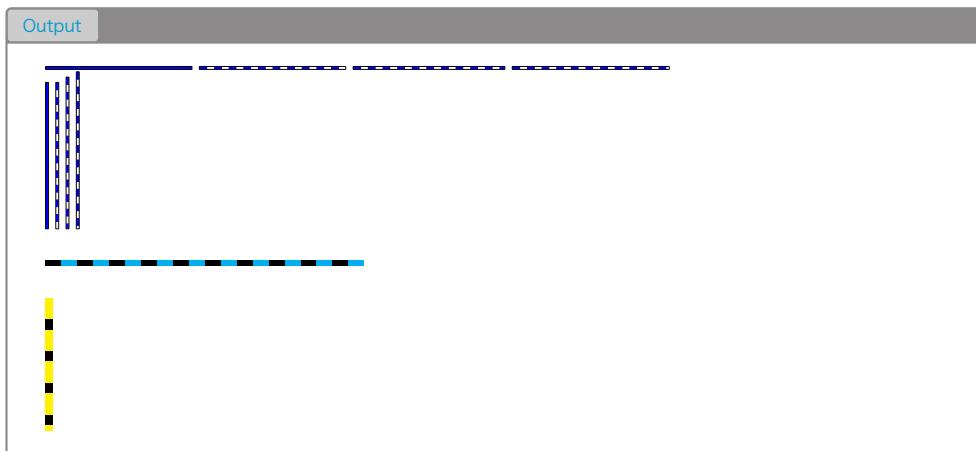
```
Input
1 \mruleth[<keyvaloptions>]
2 \mruletv[<keyvaloptions>]
```

These commands share the same keys.

| Key | Type | Default | Description |
|-----------|------|---------|----------------------------------|
| width | dim | 0pt | Width of the rule |
| height | dim | 0pt | Height above the baseline |
| depth | dim | 0pt | Depth below the baseline |
| color | tl | black | Color of the rule |
| gap-color | tl | white | Color of the gap segments |
| dash | bool | false | Enables dashed line if true |
| dash-len | dim | 3pt | Length of the dash segment |
| gap-len | dim | 2.5pt | Length of the gap between dashes |

The outputs are as follows:

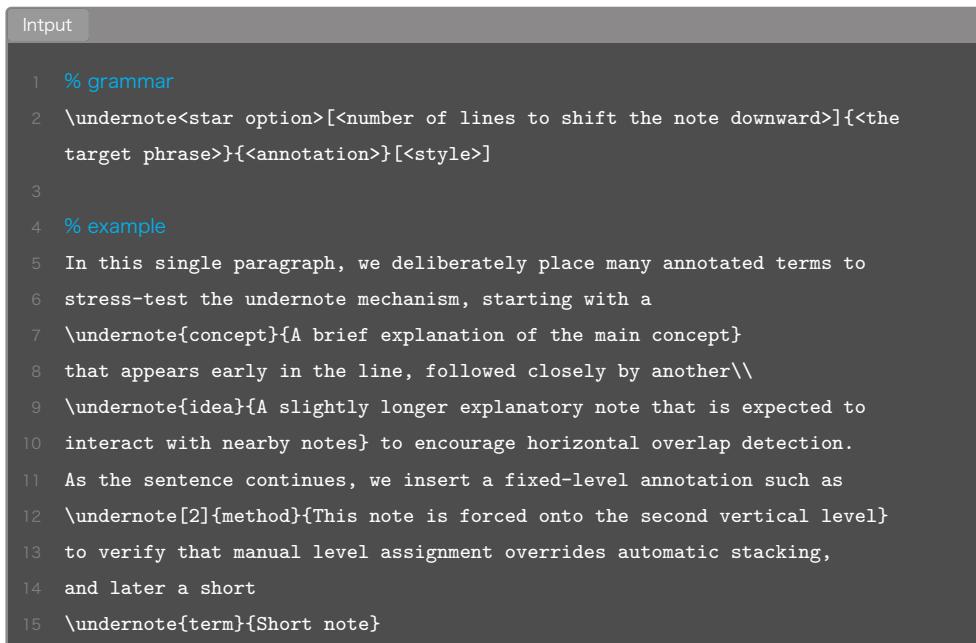
```
Input
1 \fboxsep=0pt\fboxrule=.1pt%
2
3 % horizontal rule
4 \fbox{\mruleh[height=1pt, width=55pt, color=blue]}
5 \fbox{\mruleh[height=1pt, width=55pt, color=blue, dash=true]}
6 \fbox{\mruleh[height=1pt, width=57pt, color=blue, dash=true]}
7 \fbox{\mruleh[height=1pt, width=59pt, color=blue, dash=true]}
8
9 % vertical rule
10 \fbox{\mruletv[width=1pt, height=55pt, color=blue]}
11 \fbox{\mruletv[width=1pt, height=55pt, color=blue, dash=true]}
12 \fbox{\mruletv[width=1pt, height=57pt, color=blue, dash=true]}
13 \fbox{\mruletv[width=1pt, height=59pt, color=blue, dash=true]}\bigskip
14
15 % Horizontal: Alternating Black and Cyan segments
16 \mruleh[width=120pt, height=2pt, dash=true, dash-len=6pt, gap-len=6pt, color=black, gap-color=cyan]\bigskip
17
18 % Vertical: Warning Pattern (Yellow and Black)
19 \mruletv[width=3pt, height=50pt, dash=true, dash-len=8pt, gap-len=4pt, color=yellow, gap-color=black]
```



5.2 \undernote

5.2.1 Basic Usage

This command provides underlined annotation. There are some optional parameters which adjust the position of the annotation text.



```

16 next to a much longer
17 \undernote*{expression}{This is a considerably longer explanatory note
18 designed to increase the occupied width and push subsequent notes
19 downward in the vertical stacking algorithm}.
20 Near the end of the paragraph, we add one more fixed example,
21 \undernote[3]{result}{A third-level note used to confirm deep stacking},
22 followed immediately by an automatic one,
23 \undernote*{observation}{This final note should be placed at a safe
24 vertical distance determined by the collision analysis performed
25 during the previous compilation run}.

```

Output

In this single paragraph, we deliberately place many annotated terms to stress-test the undernote mechanism, starting with a concept that appears early in the line, followed

└ A brief explanation of the main concept

closely by another

idea to encourage horizontal overlap detection. As the sentence continues, we insert a

└ A slightly longer explanatory note that is expected to interact with nearby notes

fixed-level annotation such as method to verify that manual level assignment overrides

└ This note is forced onto the second vertical level

automatic stacking, and later a short term next to a much longer expression. Near the

└ Short note

└ This is a considerably longer explanatory note
designed to increase the
occupied width and push
subsequent notes down-
ward in the vertical stack-
ing algorithm

end of the paragraph, we add one more fixed example, result, followed immediately by an

└ A third-level note
used to confirm
deep stacking

automatic one, observation.

└ This final note should be
placed at a safe verti-
cal distance determined by
the collision analysis per-
formed during the previ-
ous compilation run

As the example above shows, the star option puts the annotation text in a parabox. So when you include a long description in the fourth argument of the \undernote, the option is the best way to avoid overflow.

Regarding the second argument, “number of lines to shift the note downward” is always determined automatically if you don’t specify it. I recommend using this option only when annotations

are too close to each other.

Of course, this package provides some package options for adjustments.

| Key | Type | Default | Description |
|-------------------|------|---------------|---|
| notesize | tl | \footnotesize | Font size of the note text |
| notepos | dim | 3mm | Minimum vertical length of the line to the note |
| noteshift | dim | 1mm | Vertical shift amount per level for overlapping notes |
| noterulethickness | dim | .4pt | Thickness of the rule used in the note |
| noterulehshift | dim | 1.5mm | Horizontal offset of the vertical line from the underline start |
| noterulehsize | dim | 1.5mm | Length of the horizontal line extending to the note |
| notesep | dim | 2em | Minimum horizontal distance to prevent note overlap |
| noteoverhang | dim | 3em | Extension length of the note parbox (starred version) |
| parstyle | int | 0 | Border style (0: none, 1: solid, 2: dashed) |

When you want to change some settings in the middle of the document, you can use the following commands:

| Key (Command) | Type | Default | Description |
|------------------------|------|---------------|--|
| \SetUNoteSize | tl | \footnotesize | Sets the font size of the note |
| \SetUNoteRuleThickness | dim | .4pt | Sets the thickness of the note rules |
| \SetUNoteRuleHShift | dim | 1.5mm | Sets the horizontal offset of the vertical rule |
| \SetUNoteRuleHSize | dim | 1.5mm | Sets the length of the horizontal rule |
| \SetUNotePos | dim | 3mm | Sets the minimum vertical line length |
| \SetUNoteShift | dim | 4mm | Sets the vertical shift amount per level |
| \SetUNoteSep | dim | 2em | Sets the minimum horizontal separation between notes |
| \SetUNoteOverHang | dim | 3em | Sets the overhang length for parbox notes |
| \SetUNoteParstyle | int | 0 | Updates the border style and drawing logic |

5.2.2 Additional Description

You can use the command in mathmode.

```
Input
1 \[\undernote{x + y}{In the equation envriomnemt.} = \undernote{\frac{a}{b}}{No problem.}\]
```

Output

$$\frac{x+y}{b} = \frac{a}{b}$$

No problem.

In the equation environment.

6 License

Released under the MIT License.

7 Version History

- v1.0.0 — Initial public release.
- v1.1.0 — Add a fallback for `\zw` and `\ltjgetparameter`.
- v1.3.0 — Fixed a bug which occurs when `\undernote` command is used in mathmode. The bug was caused by misreplacement of `\@elt`.

8 Source Code

```
\NeedsTeXFormat{LaTeX2e}
\ProvidesPackage{modernruler}[2026/01/26, Version 1.3.0]

%%% parameters
\unless\ifdefined\zw
  \newdimen\zw
  \zw=1em
\fi
\unless\ifdefined\ltjgetparameter
  \newcommand{\ltjgetparameter}[1]{4}
\fi

%%% basical settings
\RequirePackage{kvoptions}
\RequirePackage{varwidth}
\RequirePackage[most]{tcolorbox}

%%% kv (undernoteの方)
\SetupKeyvalOptions{%
  family=undernote,%
  prefix=undernote@%
}
\DeclareStringOption[\footnotesize]{notesize}
```

```

\DeclareStringOption[3mm]{notepos}
\DeclareStringOption[1mm]{noteshift}
\DeclareStringOption[.4pt]{noterulethickness}
\DeclareStringOption[1.5mm]{noterulehshift}
\DeclareStringOption[1.5mm]{noterulehsize}
\DeclareStringOption[2em]{notesep}
\DeclareStringOption[3em]{noteoverhang}
\DeclareStringOption[0]{parstyle}
\ProcessKeyvalOptions*
```

```

\def\notesize@internal@undernote{\undernote@notesize}
%%% 注釈部分の文字サイズ
\def\notepos@internal@undernote{\undernote@notepos}
%%% 注釈へと伸ばす縦線の長さの最小値
\def\noteshift@internal@undernote{\undernote@noteshift}
%%% 注釈を下にずらす場合の1段階分の移動量
\def\noterulethickness@internal@undernote{\undernote@noterulethickness}
%%% \note で用いる野線の太さ
\def\noterulehshift@internal@undernote{\undernote@noterulehshift}
%%% 注釈へと伸ばす縦線の位置（注釈をつける語句につけた下線の左端から
%%% \noterulehshift@internal@undernote だけ右にずれた位置に縦線を置く）
\def\noterulehsize@internal@undernote{\undernote@noterulehsize}
%%% 注釈へと伸ばす横線の長さ
\def\notesep@internal@undernote{\undernote@notesep}
%%% 前にある注釈が次の注釈の縦線から \notesep@internal@undernote 以内に近づくようなら、
%%% 前にある注釈を下にずらす（「2em」のように文字サイズに依存する
%%% 指定をした場合は、\notesize@internal@undernote（の、現在使用中のフォント）における値）
\def\noteoverhang@internal@undernote{\undernote@noteoverhang}
%%% parbox に入れるタイプ（スターをつけた時）
%%% どの程度後ろに注釈部分を張り出させるか
\def\noteparstyle@internal@undernote{\undernote@parstyle}
%%% 注釈部分を
%%% 1 と 2 以外：囲みなし 1: 実線で囲う 2: 点線で囲う
```

```

% command
>NewDocumentCommand{\SetUNoteSize}{O{\footnotesize}}{%
  \def\notesize@internal@undernote{\#1}%
}
>NewDocumentCommand{\SetUNoteRuleThickness}{O{.4pt}}{%
  \def\noterulethickness@internal@undernote{\#1}%
}
>NewDocumentCommand{\SetUNoteRuleHShift}{O{1.5mm}}{%
  \def\noterulehshift@internal@undernote{\#1}%
}
>NewDocumentCommand{\SetUNoteRuleHSize}{O{1.5mm}}{%
  \def\noterulehsize@internal@undernote{\#1}%
}
>NewDocumentCommand{\SetUNotePos}{O{3mm}}{%
  \def\notepos@internal@undernote{\#1}%
}
```

```

}

\NewDocumentCommand{\SetUNoteShift}{O{4mm}}{%
  \def\noteshift@internal@undernote{#1}%
}

\NewDocumentCommand{\SetUNoteSep}{O{2em}}{%
  \def\notesep@internal@undernote{#1}%
}

\NewDocumentCommand{\SetUNoteOverhang}{O{3em}}{%
  \def\noteoverhang@internal@undernote{#1}%
}

\NewDocumentCommand{\SetUNoteParstyle}{O{0}}{%
  \ifnum#1=1%
    \let\wrap@undernote\wrap@undernote@styleA%
    \let\wrap@undernote@par\wrap@undernote@par@styleA%
    \def\hline@undernote@par{\mruleth[height=\noterulethickness@internal@undernote, width=\
      undernote@textlen@tempo]}%
    \def\vlines@undernote@par{%
      \mruletv[height=\dimen0, width=\noterulethickness@internal@undernote, depth=0pt]%
      \mruleth[height=\noterulethickness@internal@undernote, width=\
        noterulehsize@internal@undernote, depth=0pt]%
    }%
  \else\ifnum#1=2%
    \let\wrap@undernote\wrap@undernote@styleB%
    \let\wrap@undernote@par\wrap@undernote@par@styleB%
    \def\hline@undernote@par{\mruleth[height=\noterulethickness@internal@undernote, width=\
      undernote@textlen@tempo, dash=true]}%
    \def\vlines@undernote@par{%
      \mruletv[height=\dimen0, width=\noterulethickness@internal@undernote, depth=0pt ,dash=\
        true]%
      \mruleth[height=\noterulethickness@internal@undernote, width=\
        noterulehsize@internal@undernote, depth=0pt, dash=true]%
    }%
  \else
    \let\wrap@undernote\wrap@undernote@styleC%
    \let\wrap@undernote@par\wrap@undernote@par@styleC%
    \def\hline@undernote@par{\mruleth[height=\noterulethickness@internal@undernote, width=\
      undernote@textlen@tempo]}%
    \def\vlines@undernote@par{%
      \mruletv[height=\dimen0, width=\noterulethickness@internal@undernote, depth=0pt]%
      \mruleth[height=\noterulethickness@internal@undernote, width=\
        noterulehsize@internal@undernote, depth=0pt]%
    }%
  \fi\fi
}

%%% modern rule commands
\ExplSyntaxOn

% 変数の宣言

```

```

\dim_new:N \l_mrule_width_dim
\dim_new:N \l_mrule_height_dim
\dim_new:N \l_mrule_depth_dim
\dim_new:N \l_mrule_dash_len_dim
\dim_new:N \l_mrule_gap_len_dim
\dim_new:N \l_mrule_total_width_dim
\tl_new:N \l_mrule_color_tl
\bool_new:N \l_mrule_dash_bool
\tl_new:N \l_mrule_leader_cmd_tl
\dim_new:N \l__mrule_tmp_remaining_dim

% キーの定義
\keys_define:nn { modernrule }
{
    width   .dim_set:N = \l_mrule_width_dim,
    height  .dim_set:N = \l_mrule_height_dim,
    depth   .dim_set:N = \l_mrule_depth_dim,
    color   .tl_set:N = \l_mrule_color_tl,
    dash    .bool_set:N = \l_mrule_dash_bool,
    dash-len .dim_set:N = \l_mrule_dash_len_dim,
    gap-len .dim_set:N = \l_mrule_gap_len_dim,
    gap-color .tl_set:N = \l_mrule_gap_color_tl,

    % デフォルト値
    width   .initial:n = Opt,
    height  .initial:n = Opt,
    depth   .initial:n = Opt,
    color   .initial:n = black,
    dash    .initial:n = false,
    dash-len .initial:n = 3pt,
    gap-len .initial:n = 2.5pt,
    gap-color .initial:n = white,
}

% 水平方向：2色点線
\NewDocumentCommand{\mruleth}{O{}}
{
    \group_begin:
    \keys_set:nn { modernrule } { #1 }
    \ifvmode \nointerlineskip \fi

    \bool_if:NTF \l_mrule_dash_bool
    {
        % dash=true: 2色交互の点線描画
        \hbox_to_wd:nn { \l_mrule_width_dim }
        {
            \dim_set:Nn \l__mrule_tmp_remaining_dim { \l_mrule_width_dim }
            \dim_while_do:nNnn { \l__mrule_tmp_remaining_dim } > { Opt }
            {
                \dim_compare:nNnTF { \l__mrule_tmp_remaining_dim } > { \l_mrule_dash_len_dim }

```

```

{
    % メイン色
    {\color{\l_mrule_color_t1} \vrule width \l_mrule_len_dim height \
     l_mrule_height_dim depth \l_mrule_depth_dim}
    \dim_sub:Nn \l__mrule_tmp_remaining_dim { \l_mrule_dash_dim }

    % ギャップ色
    \dim_compare:nNnTF { \l__mrule_tmp_remaining_dim } > { \l_mrule_gap_dim }
    {
        {\color{\l_mrule_gap_color_t1} \vrule width \l_mrule_gap_dim height \
         l_mrule_height_dim depth \l_mrule_depth_dim}
        \dim_sub:Nn \l__mrule_tmp_remaining_dim { \l_mrule_gap_dim }
    }
    {
        {\color{\l_mrule_gap_color_t1} \vrule width \l__mrule_tmp_remaining_dim \
         height \l_mrule_height_dim depth \l_mrule_depth_dim}
        \dim_set:Nn \l__mrule_tmp_remaining_dim { Opt }
    }
}
\hss
}
{
    \hbox_to_wd:nn { \l_mrule_width_dim } {{%
        \color{\l_mrule_color_t1}%
        \vrule width \l_mrule_width_dim height \l_mrule_height_dim depth \l_mrule_depth_dim
    }}%
}
\ifvmode \nointerlineskip \fi
\group_end:
}

% 垂直方向：2色点線
\NewDocumentCommand{\mruletv}{O{}}{%
{
    \group_begin:
    \keys_set:nn { modernrule } { #1 }

    \bool_if:NTF \l_mrule_dash_bool
    {
        % dash=true: 2色交互の垂直点線
        \dim_set:Nn \l__mrule_tmp_remaining_dim { \l_mrule_height_dim }
        \vbox:n
    }
}

```

```

{
    \dim_while_do:nNnn { \l__mrule_tmp_remaining_dim } > { Opt }
    {
        \dim_compare:nNnTF { \l__mrule_tmp_remaining_dim } > { \l_mrue_dash_len_dim }
        {
            % メイン色
            {\color{\l_mrue_color_t1} \hrule width \l_mrue_width_dim height \
             l_mrue_dash_len_dim}
            \dim_sub:Nn \l__mrule_tmp_remaining_dim { \l_mrue_dash_len_dim }

            % ギャップ色
            \dim_compare:nNnTF { \l__mrule_tmp_remaining_dim } > { \l_mrue_gap_len_dim }
            {
                {\color{\l_mrue_gap_color_t1} \hrule width \l_mrue_width_dim height \
                 l_mrue_gap_len_dim}
                \dim_sub:Nn \l__mrule_tmp_remaining_dim { \l_mrue_gap_len_dim }
            }
            {
                {\color{\l_mrue_gap_color_t1} \hrule width \l_mrue_width_dim height \
                 l__mrue_tmp_remaining_dim}
                \dim_set:Nn \l__mrule_tmp_remaining_dim { Opt }
            }
        }
        {
            {\color{\l_mrue_color_t1} \hrule width \l_mrue_width_dim height \
             l__mrue_tmp_remaining_dim}
            \dim_set:Nn \l__mrule_tmp_remaining_dim { Opt }
        }
    }
    {
        \vbox:n { {\color{\l_mrue_color_t1} \hrule width \l_mrue_width_dim height \
                  l_mrue_height_dim} }
    }
    \group_end:
}
\ExplSyntaxOff
%%%
\DeclareTotalTCBox{\FramedBox@undernote}{ O{} +m }{%
    on line,arc=0pt,
    sharp corners,boxsep=0mm,
    left=.3mm,right=.3mm,top=0.3mm,bottom=0.3mm,
    colback=white,colframe=white,
    enhanced,before={\hspace*{-0.1722zw}},%
    borderline={\noterulethickness@internal@undernote}{0mm}{solid},%
    #1
}{#2}
\DeclareTotalTCBox{\DashedBox@undernote}{ O{} +m }{%

```

```

on line,arc=0pt,
sharp corners,boxsep=0mm,
left=.3mm,right=.3mm,top=0.3mm,bottom=0.3mm,
colback=white,colframe=white,
enhanced,before={\hspace*{-.1722\zw}},
borderline={\noterulethickness@internal@undernote}{0mm}{dashed},
#1
}{#2}
\DeclareTotalTCBox{\NoframeBox@undernote}{ 0{} +m }{%
on line,arc=0pt,
sharp corners,boxsep=-.5mm,
left=.8mm,right=.8mm,top=0.3mm,bottom=0.3mm,
colback=white,colframe=white,
enhanced,before={\hspace*{-.1722\zw}},
#1
}{#2}

\newlength{\undernote@textlen@tempo}\newlength{\undernote@textdepth@tempo}

\NewDocumentCommand{\wrap@undernote@par@styleA}{ +m }{%
{%
\FramedBox@undernote{%
\parbox[t]{\dimexpr\undernote@textlen@tempo - \noterulehsize@internal@undernote - \
noterulehshift@internal@undernote + \noteoverhang@internal@undernote\relax}{%
\setlength{\baselineskip}{.2153\zw}#1}}%
}}
\NewDocumentCommand{\wrap@undernote@par@styleB}{ +m }{%
{%
\DashedBox@undernote{%
\parbox[t]{\dimexpr\undernote@textlen@tempo - \noterulehsize@internal@undernote - \
noterulehshift@internal@undernote + \noteoverhang@internal@undernote\relax}{%
\setlength{\baselineskip}{.2153\zw}#1}}%
}}
\NewDocumentCommand{\wrap@undernote@par@styleC}{ +m }{%
{%
\NoframeBox@undernote{%
\parbox[t]{\dimexpr\undernote@textlen@tempo - \noterulehsize@internal@undernote - \
noterulehshift@internal@undernote + \noteoverhang@internal@undernote\relax}{%
\setlength{\baselineskip}{.2153\zw}#1}}%
}}
\NewDocumentCommand{\wrap@undernote@styleA}{ +m }{\{\FramedBox@undernote{#1}}}
\NewDocumentCommand{\wrap@undernote@styleB}{ +m }{\{\DashedBox@undernote{#1}}}
\NewDocumentCommand{\wrap@undernote@styleC}{ +m }{\{\NoframeBox@undernote{#1}}}
\NewDocumentCommand{\wrap@undernote}{ +m }{\{\#1}}
\NewDocumentCommand{\wrap@undernote@par}{ +m }{\{\wrap@undernote@styleC{#1}}}
\ifnum\noteparstyle@internal@undernote=1
\let\wrap@undernote\wrap@undernote@styleA
\let\wrap@undernote@par\wrap@undernote@par@styleA
\def\hline@undernote@par{\rule[height=\noterulethickness@internal@undernote, width=\
undernote@textlen@tempo]{}}

```

```

\def\vlines@undernote@par{%
    \mruletv[height=\dimen0, width=\noterulethickness@internal@undernote, depth=0pt]%
    \mruleth[height=\noterulethickness@internal@undernote, width=\
        noterulehsiz@internal@undernote, depth=0pt]%
}
\else\ifnum\noteparstyle@internal@undernote=2
    \let\wrap@undernote\wrap@undernote@styleB
    \let\wrap@undernote@par\wrap@undernote@par@styleB
    \def\hline@undernote@par{\mruleth[height=\noterulethickness@internal@undernote, width=\
        undernote@textlen@tempo, dash=true]%
    \def\vlines@undernote@par{%
        \mruletv[height=\dimen0, width=\noterulethickness@internal@undernote, depth=0pt ,dash=
            true]%
        \mruleth[height=\noterulethickness@internal@undernote, width=\
            noterulehsiz@internal@undernote, depth=0pt, dash=true]%
    }
\else
    \let\wrap@undernote\wrap@undernote@styleC
    \let\wrap@undernote@par\wrap@undernote@par@styleC
    \def\hline@undernote@par{\mruleth[height=\noterulethickness@internal@undernote, width=\
        undernote@textlen@tempo]%
    \def\vlines@undernote@par{%
        \mruletv[height=\dimen0, width=\noterulethickness@internal@undernote, depth=0pt]%
        \mruleth[height=\noterulethickness@internal@undernote, width=\
            noterulehsiz@internal@undernote, depth=0pt]%
    }
\fi\fi

\newbox\@undernote@maintext
\newbox\@undernote@subtext
\newcounter{undernote@id} \setcounter{undernote@id}{0}
\DeclareDocumentCommand{\undernote}{s O{} m +m O{} }{%
    %% #1 (star) 注釈をparboxに包む
    %% #2 (optional): 注釈を下にすらす「行数」（与えない場合自動設定）
    %% #3: 注釈をつける語句
    %% #4: 注釈
    %% #5: どういう線にするか
\def\key@undernote@ruler{#5}%
% \settowidth{\undernote@textlen@tempo}{#3}%
\begingroup%
\stepcounter{undernote@id}%
\ifmmode%
    % \settowidth{\undernote@textlen@tempo}{\ensuremath{#3}}%
    \cnote@save@conters%
    \savepos%
    \expandafter\cmath@undernote
\else%
    \settowidth{\undernote@textlen@tempo}{#3}%
    \leavevmode%
    \savepos%

```

```

    \expandafter\@text@undernote
\fi%
{#2}{#3}{%
  \ifnum\ltjgetparameter{direction}=4%
    \begin{varwidth}[t]{\maxdimen}%
      \IfBooleanTF{#1}{\wrap@undernote@par{#4}}{\wrap@undernote{#4}}%
    \end{varwidth}%
  \else%
    \raisebox{.38\zw}{%
      \begin{varwidth}[t]{\maxdimen}%
        \IfBooleanTF{#1}{\wrap@undernote@par{#4}}{\wrap@undernote{#4}}%
      \end{varwidth}%
    }%
  \fi%
}%
\endgroup%
}

% 名称カウンタ
\def\@note@save@counters{%
\begingroup%
\def\@elt##1{%
  \expandafter\ifx\csname c@##1\endcsname\c@page\else
    \csname c@##1\endcsname\the\csname c@##1\endcsname\relax
  \fi}%
\edef\@tempa{\cl@ckpt}%
\expandafter\endgroup%
\expandafter\def\expandafter\@note@restore@counters\expandafter{\@tempa}%
}

% 数式モードの場合への対応
\def\@math@undernote#1#2#3{%
\mathchoice{%
  \settowidth{\undernote@textlen@tempo}{\m@th$\displaystyle #2$}%
  \@note@restore@counters\@text@undernote{#1}{\m@th$\displaystyle #2$}{#3}%
}{%
  \settowidth{\undernote@textlen@tempo}{\m@th$\textstyle #2$}%
  \@note@restore@counters\@text@undernote{#1}{\m@th$\textstyle #2$}{#3}%
}{%
  \settowidth{\undernote@textlen@tempo}{\m@th$\scriptstyle #2$}%
  \@note@restore@counters\@text@undernote{#1}{\m@th$\scriptstyle #2$}{#3}%
}{%
  \settowidth{\undernote@textlen@tempo}{\m@th$\scriptstyle #2$}%
  \@note@restore@counters\@text@undernote{#1}{\m@th$\scriptstyle #2$}{#3}%
}%
\settowidth{\undernote@textlen@tempo}{\m@th$\scriptscriptstyle #2$}%
\@note@restore@counters\@text@undernote{#1}{\m@th$\scriptscriptstyle #2$}{#3}%
}%
\long\def\@text@undernote#1#2#3{%
\hbox{%

```

```

\def\@UNDATA@vsize{#1}%
\ifx\@UNDATA@vsize\empty%
    % 指定なしパターン
    % \undernoteの第2引数が空かそうでないか
\expandafter\ifx\csname @UNDATAS@\the\c@undernote@id\endcsname\relax%
    % 1回目のコンパイルではまだ空
    % →\relaxと比較してスルー
    \def\@UNDATA@vsize{1}%
\else%
    % 2回目のコンパイルでは自動設定されている
    % →\@UNDATAS@12のようなデータを \@UNDATA@vsize に格納
    \edef\@UNDATA@vsize{\csname @UNDATAS@\the\c@undernote@id\endcsname}%
\fi%
\fi%
\setbox\@undernote@maintext\hbox{\vphantom{} }% \undernote の第3引数
\setbox\@undernote@subtext\hbox{\notesize@internal@undernote #3}%
\undernote の第4引数
\vtop{%
    \box\@undernote@maintext%
    \begingroup%
        \notesize@internal@undernote%
        \if@filesw%
            .auxへの書き出し okかどうか
            \dimen@\wd\@undernote@subtext%
            \advance\dimen@\notesep@internal@undernote\relax%
            % 注釈の長さと、sepの長さを足す
            % 水平方向にどれだけスペースをとっているか
\edef\@tempa{%
            \write\@auxout{.auxへの書き出し
                \string\undernotedata@internal{\the\c@undernote@id}%
                {\noexpand\the\lastxpos}{\noexpand\the\lastypos}%
                {\number\dimen@}{\number\ht\@undernote@subtext}{\number\dp\@undernote@subtext}%
                {\noexpand\the\c@page}%
                % \undernotedata@internal{<id>}{<xpos>}{<ypos>}{<width of the note>}%
                % {<height of the note>}{<depth of the note>}{<page>}%
                % が書き込まれる
            }%
        }%
        \else%
            \write16{}% 書き出し不可の場合、何もしない
        \fi%
    \endgroup%
    \vskip1pt%
    \hline@undernote@par% アンダーライン
    \hbox{\notesize@internal@undernote}%
        % サイズ指定
        \hskip\noterulehshift@internal@undernote%
        % 横に少しずらす
        \count@\@UNDATA@vsize\relax \advance\count@\m@ne%
}

```

```

% \count0 = 現在の段 - 1
\dimen@noteshift@internal@undernote\relax \multiply\dimen@\count0%
% \count0*\dimen@ i.e.
% ノートの縦幅だけ下へ
\advance\dimen@\notepos@internal@undernote\relax%
% 縦線の長さの分さらに下へ
\vlines@undernote@par%
% 縦線を出力
\hbox to \z@ {\lower.38\zw%
% 注釈テキストを.38\zw下へ
\box\@undernote@subtext\hss%
% 注釈配置
}%
}%
\vskip .3\dimexpr\f@size pt\relax%
}%
}%
}%
\newcount\@UNDATA@min
\newcount\@UNDATA@max
\global\@UNDATA@max -\@M
\global\let\@UNDATA@idlist\@empty
\let\@UNDATA@elt\relax
\def\undernotedata@internal#1#2#3#4#5#6#7{%%
#1: id, #2: xpos, #3: ypos, #4: width of the
note,
%%% #5: height of the note, #6: depth of the note, #7:
page
\@ifundefined{@UNDATA@#1}%
{\@tempcnta\@UNDATA@max \advance\@tempcnta\@ne%
% 連番チェック
\ifnum\@tempcnta=#1\relax%
\global\@UNDATA@max\@tempcnta%
\else%
\ifnum\@UNDATA@max<\z@\else %
% 最初はmaxが-10000なので
% 必ずこの分岐に入り
% idlistが作られる
\xdef\@UNDATA@idlist{\@UNDATA@idlist\@UNDATA@elt{\the\@UNDATA@min}{\the\@UNDATA@max
}}%
% 1回目では\relaxが入ってるので
% 残って2回目へ
\fi%
\global\@UNDATA@min=#1\relax%
\global\@UNDATA@max\@UNDATA@min%
\fi}%
{\gdef\@multiplelabels{\@latex@warning@no@line{There were multiply-defined labels}}%
\@latex@warning@no@line{Note ID '#1' multiply appeared}%
}%
\global\@namedef{@UNDATA@#1}{{#2}{#3}{#4}{#5}{#6}{#7}}%

```

```

% データを.aux用に格納
}

\def\@undernotedata#1#2#3#4#5#6#7{%
\def\@tempa{#2}{#3}{#4}{#5}{#6}{#7}}%
\expandafter\ifx\csname @UNDATA@#1\endcsname\@tempa\else \@tempswattrue \fi%
}

\def\checkundernotedata{%
\ifnum\@UNDATA@max<\z@\else%
\begin{group}%
\let\@UNDATA@elt\@check@undernotedata%
\@UNDATA@idlist%
\endgroup%
\fi%
}

\def\@check@undernotedata#1#2{%
\def\@currpage{-10000}%
\@tempcnta\z@ \@tempcntb\z@%
\@tempdima-\p@ \@tempdimb-\p@%
\let\@linelist\@empty%
\let\@lt\relax%
\count@#1\relax %
\advance\count@\m@ne%
\@whilenum\count@<#2\do{%
\advance\count@\@ne%
\@check@undernotedata@split\count@%
\def\@tempz{T}%
\ifnum\@currpage=\@thispage\relax%
\ifdim\@thisy sp<\@tempdima \def\@tempz{F}\fi%
\ifdim\@thisy sp>\@tempdimb \def\@tempz{F}\fi%
\else%
\def\@tempz{F}%
\fi%
\if T\@tempz\relax%
\@tempcntb\count@%
\else%
\ifnum\@tempcnta>\z@%
\edef\@linelist{\@linelist\@elt{\the\@tempcnta}{\the\@tempcntb}}%
\fi%
\@tempcnta\count@ \@tempcntb\count@%
\let\@currpage\@thispage%
\@tempdima\@thisy sp\relax%
\@tempdimb\@tempdima%
\advance\@tempdima -\@UNDATA@yfuzz\relax%
\advance\@tempdimb \@UNDATA@yfuzz\relax%
\fi}%
\edef\@linelist{\@linelist\@elt{\the\@tempcnta}{\the\@tempcntb}}%
}

```

```

\let\@elt\@check@undernotedata@elt%
\@linelist%
}

\def\@UNDATA@yfuzz{3\p@}

\def\@check@undernotedata@split#1{%
\expandafter\expandafter\expandafter\@check@undernotedata@split@%
\csname @UNDATA@\number#1\endcsname 00000\@nnil%
}

\def\@check@undernotedata@split@#1#2#3#4#5#6#7\@nnil{%
\def\@thisx{#1}%
\def\@thisy{#2}%
\def\@thiswd{#3}%
\def\@thisht{#4}%
\def\@thisdp{#5}%
\def\@thispage{#6}%
}

\def\@check@undernotedata@elt#1#2{%
\count#2\relax%
\advance\count@\@ne%
\@whilenum\count@#1\do{%
\advance\count@\@ne%
\@check@undernotedata@split\count@%
\dimen@\@thisx sp\relax%
\advance\dimen@\@thiswd sp\relax%
\advance\dimen@\noterulehsize@internal@undernote\relax%
\advance\dimen@\p@%
\let\@currht\@thisht%
\@tempcntb\@ne%
\@tempcpta\count@%
\@whilenum\@tempcpta<#2\do{%
\advance\@tempcpta\@ne%
\@check@undernotedata@split\@tempcpta%
\ifdim\@thisz sp<\dimen@%
\@tempdima\noteshift@internal@undernote\relax%
\@tempdimb\@thisdp sp\relax%
\advance\@tempdimb\@currht sp\relax%
\advance\@tempdimb\lineskip%
\divide\@tempdimb\@tempdima%
\count\tw@\@tempdimb%
\advance\count\tw@\@ne%
\advance\count\tw@\@nameuse{\@UNDATAS@\the\@tempcpta}\relax%
\ifnum\@tempcntb<\count\tw@\@tempcntb\count\tw@\fi%
\fi%
}%
\expandafter\xdef\csname @UNDATAS@\the\count@\endcsname{\the\@tempcntb}%
}%
}

```

```
}

\AtEndDocument{%
\if@filesw%
  \write\@auxout{\string\checkundernotedata}%
  \let\checkundernotedata\relax%
  \def\undernotedata@internal{\@undernotedata}%
\fi%
}

\endinput
```