siunitx – A comprehensive (SI) units package*

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Released 2021-09-29

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*This file describes v3.0.32, last revised 2021-09-29.

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Part I
siunitx – Overall set up

1 siunitx implementation

Start the DocStrip guards.

```
1 ⟨*package⟩
```

Identify the internal prefix (LaTeX3 DocStrip convention).

```
2 ⟨@@=siunitx⟩
```

1.1 Initial set up

```
3 ⟨*init⟩
```

Set up a couple of commands in recent-ish LaTeX 2_ε releases.

```
4 \providecommand\DeclareRelease[3]{}
5 \providecommand\DeclareCurrentRelease[2]{}
```

Allow rollback to version 2: if we need to, version 1 could eventually be added here too.

```
6 \DeclareRelease{2}{2010-05-23}{siunitx-v2.sty}
7 \DeclareRelease{v2}{2010-05-23}{siunitx-v2.sty}
8 \DeclareCurrentRelease{}{2021-05-17}
```

Load only the essential support (expl3) "up-front", and only if required.

```
9 \@ifundefined{ExplLoaderFileDate}
10  {\RequirePackage{expl3}}
11  {}
```

Make sure that the version of l3kernel in use is sufficiently new. We use `\ExplFileDate` as `\@ifpackagelater` doesn't work for pre-loaded expl3 in the absence of the package.

```
12 \@ifl@t@r\ExplLoaderFileDate{2020-01-09}
13  {}
14  {%
15    \PackageError{siunitx}{Support package expl3 too old}
16      {%
17        You need to update your installation of the bundles 'l3kernel' and
18        'l3packages'.\MessageBreak
19        Loading~siunitx~will~abort!%
20      }%
21    \endinput
22  }%
```

Identify the package and give the over all version information.

```
23 \ProvidesExplPackage {siunitx} {2021-09-29} {3.0.32}
24   {A comprehensive (SI) units package}
```

1.2 Safety checks

`\__siunitx_load_check:`

There are a number of packages that are incompatible with siunitx as they cover the same concepts and in some cases define the same command names. These are all tested at the point of loading to try to trap issues, and a couple are also tested later as it's possible for them to load without an obvious error if siunitx was loaded first.

```
\msg_new:nnnn { siunitx } { incompatible-package }
  { Package~'#1'~incompatible. }
  { The~#1~package~and~siunitx~are~incompatible. }
\cs_new_protected:Npn \__siunitx_load_check:n #1
  {
    \@ifpackageloaded {#1}
      { \msg_error:nnx { siunitx } { incompatible-package } {#1} }
      { }
  }
\clist_map_function:nN
  { SIunits , sistyle , unitsdef , fancyunits }
  \__siunitx_load_check:n
\AtBeginDocument
  {
    \clist_map_function:nN { SIunits , sistyle }
      \__siunitx_load_check:n
  }
```

(*End definition for* `\__siunitx_load_check:`.)

1.3 Provide a kernel command

`\IfFormatAtLeastTF` Not present in older kernels: use the LaTeX 2_ε mechanism as this is correct for this case.

```
\providecommand \IfFormatAtLeastTF { \@ifl@t@r \fmtversion }
```

(*End definition for* `\IfFormatAtLeastTF`. *This function is documented on page* **??**.)

1.4 Top-level scratch space

`\l__siunitx_tmp_tl` Scratch space for the interfaces.

```
\tl_new:N \l__siunitx_tmp_tl
```

(*End definition for* `\l__siunitx_tmp_tl`.)

```
⟨/init⟩
⟨*options⟩
```

1.5 Load time options

`\l__siunitx_column_type_tl`

```
\keys_define:nn { siunitx }
  {
    table-column-type .tl_set:N =
      \l__siunitx_column_type_tl
  }
\keys_set:nn { siunitx }
  {
    table-column-type = S
  }
```

(*End definition for* `\l__siunitx_column_type_tl`.)

1.6 Option handling

```
\RequirePackage { l3keys2e }
\ProcessKeysOptions { siunitx }
```

⟨/options⟩

1.7 User interfaces

⟨*interfaces⟩

The user interfaces are defined in terms of documented code-level ones. This is all done here, and will appear in the `.sty` file before the relevant code. Things could be re-arranged by DocStrip but there is no advantage.

User level interfaces are all created by xparse

```
\IfFormatAtLeastTF { 2020-10-01 }
  { }
  { \RequirePackage { xparse } }
```

1.7.1 Preamble commands

\DeclareSIPower
\DeclareSIPrefix
\DeclareSIQualifier
\DeclareSIUnit

Pass data to the code layer.

```
\NewDocumentCommand \DeclareSIPower { +m +m m }
  {
    \siunitx_declare_power:NNn #1 #2 {#3}
  }
\NewDocumentCommand \DeclareSIPrefix { +m m m }
  {
    \siunitx_declare_prefix:Nnn #1 {#3} {#2}
  }
\NewDocumentCommand \DeclareSIQualifier { +m m }
  {
    \siunitx_declare_qualifier:Nn #1 {#2}
  }
\NewDocumentCommand \DeclareSIUnit { o +m m }
  {
    \IfNoValueTF {#1}
      { \siunitx_declare_unit:Nn #2 {#3} }
      { \siunitx_declare_unit:Nnn #2 {#3} {#1} }
  }
```

(*End definition for* `\DeclareSIPower` *and others. These functions are documented on page* **??**.)

1.7.2 Document commands

\qty

```
\@ifpackageloaded { physics }
  {
    \msg_new:nnn { siunitx } { physics-pkg }
      {
        Detected~the~"physics"~package: \\
        Omitting~definition~of~\token_to_str:N \qty.
      }
    \msg_warning:nn { siunitx } { physics-pkg }
    \use_none:nnnn
  }
```

```
  { }
\NewDocumentCommand \qty { O { } m > { \TrimSpaces } m }
  {
    \mode_leave_vertical:
    \group_begin:
      \siunitx_unit_options_apply:n {#3}
      \keys_set:nn { siunitx } {#1}
      \siunitx_quantity:nn {#2} {#3}
    \group_end:
  }
```

(*End definition for* `\qty`*. This function is documented on page* **??**.)

`\ang` `\num` `\unit`

All of a standard form: start a paragraph (if required), set local key values, do the formatting, print the result.

```
\NewDocumentCommand \ang { O { } > { \SplitArgument { 2 } { ; } } m }
  {
    \mode_leave_vertical:
    \group_begin:
      \keys_set:nn { siunitx } {#1}
      \__siunitx_angle:nnn #2
    \group_end:
  }
\NewDocumentCommand \num { O { } m }
  {
    \mode_leave_vertical:
    \group_begin:
      \keys_set:nn { siunitx } {#1}
      \siunitx_number_format:nN {#2} \l__siunitx_tmp_tl
      \siunitx_print_number:V \l__siunitx_tmp_tl
    \group_end:
  }
\@ifpackageloaded { units }
  {
    \msg_new:nnn { siunitx } { units-pkg }
      {
        Detected~the~"units"~package: \\
        Omitting~definition~of~\token_to_str:N \unit.
      }
    \msg_warning:nn { siunitx } { units-pkg }
    \use_none:nnnn
  }
  { }
\NewDocumentCommand \unit { O { } > { \TrimSpaces } m }
  {
    \mode_leave_vertical:
    \group_begin:
      \siunitx_unit_options_apply:n {#2}
      \keys_set:nn { siunitx } {#1}
      \siunitx_unit_format:nN {#2} \l__siunitx_tmp_tl
      \siunitx_print_unit:V \l__siunitx_tmp_tl
    \group_end:
  }
```

(*End definition for* `\ang`*,* `\num`*, and* `\unit`*. These functions are documented on page* **??**.)

\qtylist
\numlist
\qtyproduct
\numproduct
\qtyrange

Interfaces for compound values.

```
\NewDocumentCommand \qtylist
  { O { } > { \SplitList { ; } } m > { \TrimSpaces } m }
  {
    \mode_leave_vertical:
    \group_begin:
      \siunitx_unit_options_apply:n {#3}
      \keys_set:nn { siunitx } {#1}
      \siunitx_quantity_list:nn {#2} {#3}
    \group_end:
  }
\NewDocumentCommand \numlist { O { } > { \SplitList { ; } } m }
  {
    \mode_leave_vertical:
    \group_begin:
      \keys_set:nn { siunitx } {#1}
      \siunitx_number_list:nn {#2}
    \group_end:
  }
\NewDocumentCommand \qtyproduct
  { O { } > { \SplitList { x } } m > { \TrimSpaces } m }
  {
    \mode_leave_vertical:
    \group_begin:
      \siunitx_unit_options_apply:n {#3}
      \keys_set:nn { siunitx } {#1}
      \siunitx_quantity_product:nn {#2} {#3}
    \group_end:
  }
\NewDocumentCommand \numproduct
  { O { } > { \SplitList { x } } > { \TrimSpaces } m }
  {
    \mode_leave_vertical:
    \group_begin:
      \keys_set:nn { siunitx } {#1}
      \siunitx_number_product:n {#2}
    \group_end:
  }
\NewDocumentCommand \qtyrange { O { } m m > { \TrimSpaces } m }
  {
    \mode_leave_vertical:
    \group_begin:
      \siunitx_unit_options_apply:n {#4}
      \keys_set:nn { siunitx } {#1}
      \siunitx_quantity_range:nnn {#2} {#3} {#4}
    \group_end:
  }
\NewDocumentCommand \numrange { O { } m m }
  {
    \mode_leave_vertical:
    \group_begin:
      \keys_set:nn { siunitx } {#1}
      \siunitx_number_range:nn {#2} {#3}
    \group_end:
```

```
  }
```

(*End definition for* `\qtylist` *and others. These functions are documented on page* **??**.)

`\complexnum` `\complexqty` Interfaces for complex numbers.

```
\NewDocumentCommand \complexnum { O { } m }
  {
    \mode_leave_vertical:
    \group_begin:
      \keys_set:nn { siunitx } {#1}
      \siunitx_complex_number:n {#2} \l__siunitx_tmp_tl
    \group_end:
  }
\NewDocumentCommand \complexqty { O { } m  m }
  {
    \mode_leave_vertical:
    \group_begin:
      \siunitx_unit_options_apply:n {#3}
      \keys_set:nn { siunitx } {#1}
      \siunitx_complex_quantity:nn {#2} {#3}
    \group_end:
  }
```

(*End definition for* `\complexnum` *and* `\complexqty`*. These functions are documented on page* **??**.)

`\tablenum` Slightly odd set up at present: we have to have the `\ignorespaces`.

```
\NewDocumentCommand \tablenum { O { } m }
  {
    \mode_leave_vertical:
    \group_begin:
      \keys_set:nn { siunitx } {#1}
      \siunitx_cell_begin:w
        \ignorespaces #2
      \siunitx_cell_end:
    \group_end:
  }
```

(*End definition for* `\tablenum`*. This function is documented on page* **??**.)

`\sisetup` A very thin wrapper.

```
\NewDocumentCommand \sisetup { m }
  { \keys_set:nn { siunitx } {#1} }
```

(*End definition for* `\sisetup`*. This function is documented on page* **??**.)

1.8 "Glue" commands

`\__siunitx_angle:nnn` The document level interface for `\ang` needs some "glue" to work with the code-level API.

```
\cs_new_protected:Npn \__siunitx_angle:nnn #1#2#3
  {
    \tl_if_novalue:nTF {#2}
      { \siunitx_angle:n {#1} }
      {
```

```
        \tl_if_novalue:nTF {#3}
          { \siunitx_angle:nnn {#1} {#2} { } }
          { \siunitx_angle:nnn {#1} {#2} {#3} }
      }
  }
```

(*End definition for* `\__siunitx_angle:nnn`.)

1.9 Table column

User interfaces in tabular constructs are provided using the mechanisms from the array package.

```
\RequirePackage { array }
```

`\__siunitx_declare_column:Nnn`

Creating numerical columns requires that these are declared before anything else in `\NC@list`: this is necessary to work with optional arguments. This means a bit of manual effort after the simple declaration of a new column type.

```
\cs_new_protected:Npn \__siunitx_declare_column:Nnn #1#2#3
  {
    \cs_if_exist:cT { NC@find@ #1 }
      {
        \cs_undefine:c { NC@find@ #1 }
        \cs_set_protected:Npn \__siunitx_tmp:w ##1 \NC@do #1 ##2 \q_stop
          { \NC@list {##1##2} }
        \exp_after:wN \__siunitx_tmp:w \the \NC@list \q_stop
        \msg_warning:nnn { siunitx } { column-overwritten } {#1}
      }
    \newcolumntype {#1} { }
    \cs_set_protected:Npn \__siunitx_tmp:w \NC@do ##1##2 \NC@do #1
      { \NC@list { \NC@do ##1 \NC@do #1 ##2 } }
    \exp_after:wN \__siunitx_tmp:w \the \NC@list
    \exp_args:NNc \renewcommand * { NC@rewrite@ #1 } [ 1 ] [ ]
      {
        \@temptokena \expandafter
          {
            \the \@temptokena
            > {#2} c < {#3}
          }
        \NC@find
      }
  }
\msg_new:nnn { siunitx } { column-overwritten }
  { Tabular~column~type~"#1"~overwritten~with~siunitx~definition. }
```

When mdwtab is loaded the syntax required is slightly different.

```
\AtBeginDocument
  {
    \@ifpackageloaded { mdwtab }
      {
        \cs_set_protected:Npn \__siunitx_declare_column:Nnn #1#2#3
          {
            \cs_if_exist:cT { NC@find@ #1 }
               {
                 \cs_undefine:c { NC@find@ #1 }
```

```
                \msg_warning:nnn { siunitx } { column-overwritten } {#1}
              }
            \newcolumntype {#1} [ 1 ] [ ]
              { > {#2} c < {#3} }
          }
      }
      { }
    \tl_map_inline:Nn \l__siunitx_column_type_tl
      {
        \__siunitx_declare_column:Nnn #1
          {
            \keys_set:nn { siunitx } {##1}
            \siunitx_cell_begin:w
          }
          { \siunitx_cell_end: }
      }
  }
```

(*End definition for* `\__siunitx_declare_column:Nnn`.)

1.10 Document commands in bookmarks

In bookmarks, the siunitx document commands need to produce simple strings that represent their input as far as possible.

`\__siunitx_bookmark_cmd:Nn`

To keep things fast, expandable versions of the document command are created only once. As here we are at the top-level for internal names, we can use the various parts of siunitx-compound that would otherwise be inaccessible.

```
\cs_new_protected:Npn \__siunitx_bookmark_cmd:Nnn #1#2#3
  {
    \exp_args:Nc \DeclareExpandableDocumentCommand
      { \cs_to_str:N #1 \c_space_tl ( pdfstring ~ context ) }
      {#2} {#3}
  }
\__siunitx_bookmark_cmd:Nnn \qty { o m m } { #2 ~ #3 }
\__siunitx_bookmark_cmd:Nnn \ang { m } { \__siunitx_angle:n {#1} }
\__siunitx_bookmark_cmd:Nnn \num { o m } { #2 }
\__siunitx_bookmark_cmd:Nnn \unit { o m } { #2 }
\__siunitx_bookmark_cmd:Nnn \numlist { o m }
  {
    \__siunitx_list_use:nnVVV {#2} { }
      \l_siunitx_list_separator_pair_tl
      \l_siunitx_list_separator_tl
      \l_siunitx_list_separator_final_tl
  }
\__siunitx_bookmark_cmd:Nnn \qtylist { o m m }
  {
    \__siunitx_list_use:nnVVV {#2} {#3}
      \l_siunitx_list_separator_pair_tl
      \l_siunitx_list_separator_tl
      \l_siunitx_list_separator_final_tl
  }
\__siunitx_bookmark_cmd:Nnn \numproduct { o m } { }
\__siunitx_bookmark_cmd:Nnn \qtyproduct { o m m } { }
```

```
\__siunitx_bookmark_cmd:Nnn \numrange { o m m }
  { #2 \tl_use:N \l_siunitx_range_phrase_tl #3 }
\__siunitx_bookmark_cmd:Nnn \qtyrange { o m m m }
  { #2 ~ #4 \tl_use:N \l_siunitx_range_phrase_tl #3 ~ #4 }
```

(*End definition for* `\__siunitx_bookmark_cmd:Nn`.)

We also need the v2 names.

```
\__siunitx_bookmark_cmd:Nnn \si { o m } { #2 }
\__siunitx_bookmark_cmd:Nnn \SI { o m O { } m } { #3 #2 ~ #4 }
\__siunitx_bookmark_cmd:Nnn \SIlist { o m m }
  {
    \__siunitx_list_use:nnVVV {#2} {#3}
      \l_siunitx_list_separator_pair_tl
      \l_siunitx_list_separator_tl
      \l_siunitx_list_separator_final_tl
  }
\__siunitx_bookmark_cmd:Nnn \SIrange { o m m m }
  { #2 ~ #4 \tl_use:N \l_siunitx_range_phrase_tl #3 ~ #4 }
```

`\c__siunitx_bookmark_seq` Commands usable in bookmarks

```
\seq_const_from_clist:Nn \c__siunitx_bookmark_seq
  {
    \ang , \qty , \num , \unit ,
    \numlist , \qtylist ,
    \numrange , \qtyrange ,
    \si , \SI , \SIlist , \SIrange
  }
```

(*End definition for* `\c__siunitx_bookmark_seq`.)

Activate the document commands here: the unit macros are handled in siunitx-final.

```
\AtBeginDocument
  {
    \@ifpackageloaded { hyperref }
      {
        \pdfstringdefDisableCommands
          {
            \seq_map_inline:Nn \c__siunitx_bookmark_seq
              {
                \cs_set_eq:Nc #1
                  { \cs_to_str:N #1 \c_space_tl ( pdfstring ~ context ) }
              }
          }
        \pdfstringdefDisableCommands
          {
            \siunitx_unit_pdfstring_context:
            \cs_if_exist:NT \FB@fg { \def \fg { \FB@fg } }
            \edef \H
              {
                \exp_not:c { PU-cmd }
                \exp_not:N \H
                \exp_not:c { PU \token_to_str:N \H }
              }
          }
      }
```

```
      { }
  }
```

__siunitx_angle:n
__siunitx_angle:w

Expandable splitting of the angle: simply enough, also outputs the

```
\cs_new:Npn \__siunitx_angle:n #1
  { \__siunitx_angle:w #1 ; ; ; \q_stop }
\cs_new:Npn \__siunitx_angle:w #1 ; #2 ; #3 ; #4 \q_stop
  {
    \tl_if_blank:nF {#1}
      { #1 \degree }
    \tl_if_blank:nF {#2}
      {
        \tl_if_blank:nF {#1} { \c_space_tl }
        #2 \arcminute
      }
    \tl_if_blank:nF {#3}
      {
        \tl_if_blank:nF {#1#2} { \c_space_tl }
        #3 \arcsecond
      }
  }
```

(*End definition for* __siunitx_angle:n *and* __siunitx_angle:w.)

__siunitx_list_use:nnnnn
__siunitx_list_use:nnVVV
__siunitx_list_use_aux:nnnnn
__siunitx_list_use_auxi:w
__siunitx_list_use_auxii:nnw
__siunitx_list_use_auxiii:nnw
__siunitx_list_count:n
__siunitx_list_count:w

Copies of the ideas in the l3clist module but using ; as a list separator. The functions have to be extended to allow for a unit argument.

```
\cs_new:Npn \__siunitx_list_use:nnnnn #1#2#3#4#5
  {
    \tl_if_blank:nTF {#2}
      { \__siunitx_list_use_aux:nnnnn {#1} { } }
      { \__siunitx_list_use_aux:nnnnn {#1} { ~ #2 } }
        {#3} {#4} {#5}
  }
\cs_generate_variant:Nn \__siunitx_list_use:nnnnn { nnVVV }
\cs_new:Npn \__siunitx_list_use_aux:nnnnn #1#2#3#4#5
  {
    \int_case:nnF { \__siunitx_list_count:n {#1} }
      {
        { 0 } { }
        { 1 } { \__siunitx_list_use_auxi:nw {#2} #1 ; ; { } }
        { 2 } { \__siunitx_list_use_auxi:nw {#2} #1 ; {#3} }
      }
      {
        \__siunitx_list_use_auxii:nnw {#2} { } #1 ;
          \q_mark ; { \__siunitx_list_use_auxii:nnw {#2} {#4} }
          \q_mark ; { \__siunitx_list_use_auxiii:nnw {#2} {#5} }
          \q_stop { }
      }
  }
\cs_new:Npn \__siunitx_list_use_auxi:nw #1#2 ; #3 ; #4
  { #2 #1 #4 #3 \tl_if_blank:nF {#3} {#1} }
\cs_new:Npn \__siunitx_list_use_auxii:nnw
  #1#2#3 ; #4 ; #5 ; #6 \q_mark ; #7#8 \q_stop #9
  { #7 {#4} ; {#5} ; #6 \q_mark ; {#7} #8 \q_stop { #9 #2 #3 #1 } }
```

```
\cs_new:Npn \__siunitx_list_use_auxiii:nnw #1#2#3 ; #4 \q_stop #5
  { #5 #2 #3 #1 }
\cs_new:Npx \__siunitx_list_count:n #1
  {
    \exp_not:N \int_eval:n
      {
        0
        \exp_not:N \__siunitx_list_count:w \c_space_tl
        #1 \exp_not:n { ; \q_recursion_tail ; \q_recursion_stop }
      }
  }
\cs_new:Npx \__siunitx_list_count:w #1 ;
  {
    \exp_not:n { \exp_args:Nf \quark_if_recursion_tail_stop:n } {#1}
    \exp_not:N \tl_if_blank:nF {#1} { + 1 }
    \exp_not:N \__siunitx_list_count:w \c_space_tl
  }
```

(*End definition for* `\__siunitx_list_use:nnnnn` *and others.*)

⟨/interfaces⟩

⟨/package⟩

Part II
siunitx-angle – Formatting angles

1 Formatting angles

\siunitx_angle:n
\siunitx_angle:nnn

`\siunitx_angle:n {⟨angle⟩}`
`\siunitx_angle:nnn {⟨degrees⟩} {⟨minutes⟩} {⟨seconds⟩}`

Typeset the ⟨*angle*⟩ (which may be given as separate ⟨*degree*⟩, ⟨*minute*⟩ and ⟨*second*⟩ components). The ⟨*angle*⟩ (or components) may be given as expressions. The ⟨*angle*⟩ should be a number as understood by `\siunitx_format_number:nN`, with no uncertainty, exponent or imaginary part. The unit symbols for degrees, minutes and seconds are `\degree`, `\arcminute` and `\arcsecond`, respectively

1.1 Key–value options

The options defined by this submodule are available within the l3keys `siunitx` tree.

angle-mode

`angle-mode = ⟨choice⟩`

Selects how angles are formatted: a choice from the options `arc`, `decimal` and `input`. The option `arc` means that angles will always be typeset in arc (degree, minute, second) format, whilst `decimal` means that angles are typeset as a single decimal value. The `input` setting means that the input format (*i.e.* difference between `\siunitx_angle:n` and `\siunitx_angle:nnn`) is maintained. The standard setting is `input`.

angle-symbol-degree
angle-symbol-minute
angle-symbol-second

`angle-symbol-degree = ⟨symbol⟩`

Sets the symbol used for arc degrees, minutes or seconds, respectively.

angle-symbol-over-decimal

`angle-symbol-over-decimal = true|false`

Determines if the arc separator is printed over the decimal marker, a format used in astronomy. The standard setting is `false`.

arc-separator

`arc-separator = ⟨separator⟩`

Inserted between arc parts (degree, minute and second components). The standard setting is `\,`.

fill-angle-degrees

`fill-arc-degrees = true|false`

Determines whether a missing degrees part is zero-filled when printing an arc. The standard setting is `false`.

fill-angle-minutes

`fill-arc-minutes = true|false`

Determines whether a missing minutes part is zero-filled when printing an arc. The standard setting is `false`.

`fill-angle-seconds` `fill-arc-seconds = true|false`

Determines whether a missing seconds part is zero-filled when printing an arc. The standard setting is `false`.

`number-angle-product` `number-angle-product =` ⟨*separator*⟩

Inserted between the value of an angle and the unit (degree, minute or second component). The standard setting is `\,`.

2 siunitx-angle implementation

Start the DocStrip guards.

```
1 ⟨*package⟩
```

Identify the internal prefix (LaTeX3 DocStrip convention): only internal material in this *submodule* should be used directly.

```
2 ⟨@@=siunitx_angle⟩
```

`\l__siunitx_angle_tmp_bool` `\l__siunitx_angle_tmp_dim` `\l__siunitx_angle_tmp_tl`

Scratch space.

```
3 \bool_new:N \l__siunitx_angle_tmp_bool
4 \dim_new:N \l__siunitx_angle_tmp_dim
5 \tl_new:N \l__siunitx_angle_tmp_tl
```

(*End definition for* `\l__siunitx_angle_tmp_bool`*,* `\l__siunitx_angle_tmp_dim`*, and* `\l__siunitx_angle_tmp_tl`*.*)

`\l__siunitx_angle_symbol_degree_tl` `\l__siunitx_angle_symbol_minute_tl` `\l__siunitx_angle_symbol_second_tl` `\l__siunitx_angle_force_arc_bool` `\l__siunitx_angle_force_decimal_bool` `\l__siunitx_angle_astronomy_bool` `\l__siunitx_angle_separator_tl` `\l__siunitx_angle_fill_degrees_bool` `\l__siunitx_angle_fill_minutes_bool` `\l__siunitx_angle_fill_seconds_bool` `\l__siunitx_angle_product_tl`

```
6  \keys_define:nn { siunitx }
7    {
8      angle-mode .choice: ,
9      angle-mode / arc .code:n =
10       {
11         \bool_set_true:N \l__siunitx_angle_force_arc_bool
12         \bool_set_false:N \l__siunitx_angle_force_decimal_bool
13       } ,
14     angle-mode / decimal .code:n =
15       {
16         \bool_set_false:N \l__siunitx_angle_force_arc_bool
17         \bool_set_true:N \l__siunitx_angle_force_decimal_bool
18       } ,
19     angle-mode / input .code:n =
20       {
21         \bool_set_false:N \l__siunitx_angle_force_arc_bool
22         \bool_set_false:N \l__siunitx_angle_force_decimal_bool
23       } ,
24     angle-symbol-degree .tl_set:N =
25       \l__siunitx_angle_symbol_degree_tl ,
26     angle-symbol-minute .tl_set:N =
27       \l__siunitx_angle_symbol_minute_tl ,
28     angle-symbol-second .tl_set:N =
29       \l__siunitx_angle_symbol_second_tl ,
30     angle-symbol-over-decimal .bool_set:N =
31       \l__siunitx_angle_astronomy_bool ,
```

```
    angle-separator .tl_set:N =
      \l__siunitx_angle_separator_tl ,
    fill-angle-degrees .bool_set:N =
      \l__siunitx_angle_fill_degrees_bool ,
    fill-angle-minutes .bool_set:N =
      \l__siunitx_angle_fill_minutes_bool ,
    fill-angle-seconds .bool_set:N =
      \l__siunitx_angle_fill_seconds_bool ,
    number-angle-product .tl_set:N =
      \l__siunitx_angle_product_tl
  }
\bool_new:N \l__siunitx_angle_force_arc_bool
\bool_new:N \l__siunitx_angle_force_decimal_bool
```

(*End definition for* `\l__siunitx_angle_symbol_degree_tl` *and others.*)

`\siunitx_angle:n`
`\siunitx_angle:nnn`
`\__siunitx_angle_arc_convert:n`

The first step here is to force format conversion if required. Going to a decimal is easy, going to arc format is a bit more painful: avoid repeating calculations mainly for code readability.

```
\cs_new_protected:Npn \siunitx_angle:n #1
  {
    \bool_if:NTF \l__siunitx_angle_force_arc_bool
      { \exp_args:Ne \__siunitx_angle_arc_convert:n { \fp_eval:n {#1} } }
      {
        \siunitx_number_parse:nN {#1} \l__siunitx_angle_degrees_tl
        \siunitx_number_process:NN \l__siunitx_angle_degrees_tl \l__siunitx_angle_degrees_tl
        \tl_set:Nx \l__siunitx_angle_degrees_tl
          { \siunitx_number_output:NN \l__siunitx_angle_degrees_tl \q_nil }
        \__siunitx_angle_arc_print:VVV
          \l__siunitx_angle_degrees_tl
          \c_empty_tl
          \c_empty_tl
      }
  }
\cs_new_protected:Npn \siunitx_angle:nnn #1#2#3
  {
    \bool_if:NTF \l__siunitx_angle_force_decimal_bool
      {
        \exp_args:Ne \siunitx_angle:n
          { \fp_eval:n { #1 + (#2) / 60 + (#3) / 3600 } }
      }
      { \__siunitx_angle_arc_sign:nnn {#1} {#2} {#3} }
  }
\cs_new_protected:Npn \__siunitx_angle_arc_convert:n #1
  {
    \use:x
      {
        \siunitx_angle:nnn
          { \fp_eval:n { trunc(#1,0) } }
          { \fp_eval:n { trunc((#1 - trunc(#1,0)) * 60,0) } }
          {
            \fp_eval:n
              {
                (
```

```
                        (#1 - trunc(#1,0)) * 60
                    - trunc((#1 - trunc(#1,0)) * 60,0)
                  )
                  * 60
                }
            }
        }
    }
```

(*End definition for* `\siunitx_angle:n`, `\siunitx_angle:nnn`, *and* `\__siunitx_angle_arc_convert:n`. *These functions are documented on page 12.*)

`\l__siunitx_angle_degrees_tl` Space for formatting parsed numbers.

`\l__siunitx_angle_minutes_tl`
`\l__siunitx_angle_seconds_tl`

```
\tl_new:N \l__siunitx_angle_degrees_tl
\tl_new:N \l__siunitx_angle_minutes_tl
\tl_new:N \l__siunitx_angle_seconds_tl
```

(*End definition for* `\l__siunitx_angle_degrees_tl`, `\l__siunitx_angle_minutes_tl`, *and* `\l__siunitx_angle_seconds_tl`.)

`\l__siunitx_angle_sign_tl` For the "sign shuffle".

```
\tl_new:N \l__siunitx_angle_sign_tl
```

(*End definition for* `\l__siunitx_angle_sign_tl`.)

`\__siunitx_angle_arc_sign:nnn` To get the sign in the right place whilst dealing with zero filling means doing some shuffling. That means doing processing of each number manually.

`\__siunitx_angle_arc_sign:nn`
`\__siunitx_angle_extract_sign:nnnnnnnn`
`\__siunitx_angle_sign:nnnnnnn`

```
\cs_new_protected:Npn \__siunitx_angle_arc_sign:nnn #1#2#3
  {
    \group_begin:
      \keys_set:nn { siunitx }
        {
          input-close-uncertainty = ,
          input-exponent-markers  = ,
          input-open-uncertainty  = ,
          input-uncertainty-signs =
        }
      \tl_clear:N \l__siunitx_angle_sign_tl
      \__siunitx_angle_arc_sign:nn {#1} { degrees }
      \__siunitx_angle_arc_sign:nn {#2} { minutes }
      \__siunitx_angle_arc_sign:nn {#3} { seconds }
      \tl_if_empty:NF \l__siunitx_angle_sign_tl
        {
          \clist_map_inline:nn { degrees , minutes , seconds }
            {
              \tl_if_empty:cF { l__siunitx_angle_ ##1 _tl }
                {
                  \tl_set:cx { l__siunitx_angle_ ##1 _tl }
                    {
                      { }
                      { \exp_not:V \l__siunitx_angle_sign_tl }
                      \exp_after:wN \exp_after:wN \exp_after:wN
                        \__siunitx_angle_sign:nnnnnnn
                          \cs:w l__siunitx_angle_ ##1 _tl \cs_end:
                    }
```

```
                \clist_map_break:
              }
          }
      }
    \clist_map_inline:nn { degrees , minutes , seconds }
      {
        \tl_if_empty:cF { l__siunitx_angle_ ##1 _tl }
          {
            \exp_args:Ncc \siunitx_number_process:NN
              { l__siunitx_angle_ ##1 _tl } { l__siunitx_angle_ ##1 _tl }
            \tl_set:cx { l__siunitx_angle_ ##1 _tl }
              {
                \exp_args:Nc \siunitx_number_output:NN
                  { l__siunitx_angle_ ##1 _tl } \q_nil
              }
          }
      }
    \__siunitx_angle_arc_print:VVV
      \l__siunitx_angle_degrees_tl
      \l__siunitx_angle_minutes_tl
      \l__siunitx_angle_seconds_tl
  \group_end:
}
\cs_new_protected:Npn \__siunitx_angle_arc_sign:nn #1#2
{
  \tl_if_blank:nTF {#1}
    {
      \bool_if:cTF { l__siunitx_angle_fill_ #2 _bool }
        {
          \tl_set:cn { l__siunitx_angle_ #2 _tl }
            { { } { } { 0 } { } { } { } { 0 } }
        }
        { \tl_clear:c { l__siunitx_angle_ #2 _tl } }
    }
    {
      \siunitx_number_parse:nN {#1} \l__siunitx_angle_tmp_tl
      \exp_after:wN \__siunitx_angle_extract_sign:nnnnnnnn \l__siunitx_angle_tmp_tl {#2}
    }
}
\cs_new_protected:Npn \__siunitx_angle_extract_sign:nnnnnnnn #1#2#3#4#5#6#7#8
{
  \tl_if_blank:nTF {#2}
    { \tl_set_eq:cN { l__siunitx_angle_ #8 _tl } \l__siunitx_angle_tmp_tl }
    {
      \tl_set:cn { l__siunitx_angle_ #8 _tl }
        { {#1} { } {#3} {#4} {#5} {#6} {#7} }
      \tl_set:Nn \l__siunitx_angle_sign_tl {#2}
      \keys_set:nn { siunitx }
        { input-comparators = , input-signs = }
    }
}
\cs_new:Npn \__siunitx_angle_sign:nnnnnnn #1#2#3#4#5#6#7
  { \exp_not:n { {#3} {#4} {#5} {#6} {#7} } }
```

(*End definition for* `\__siunitx_angle_arc_sign:nnn` *and others.*)

\l__siunitx_angle_marker_box
\l__siunitx_angle_unit_box

For “astronomy style” angles.

```
\box_new:N \l__siunitx_angle_marker_box
\box_new:N \l__siunitx_angle_unit_box
```

(*End definition for* `\l__siunitx_angle_marker_box` *and* `\l__siunitx_angle_unit_box`.)

__siunitx_angle_arc_print:nnn
__siunitx_angle_arc_print:VVV
__siunitx_angle_arc_print_auxi:nnn
__siunitx_angle_arc_print_auxi:nVn
__siunitx_angle_arc_print_auxii:w
__siunitx_angle_arc_print_auxiii:n
__siunitx_angle_arc_print_auxiv:NN
__siunitx_angle_arc_print_auxv:w
__siunitx_angle_arc_print_auxvi:n

The final stage of printing an angle is to put together the three parts: this works even for decimal angles as they will blank arguments for the other two parts The need to handle astronomy-style formatting means that the number has to be decomposed into parts.

```
\cs_new_protected:Npn \__siunitx_angle_arc_print:nnn #1#2#3
  {
    \__siunitx_angle_arc_print_auxi:nVn {#1}
      \l__siunitx_angle_symbol_degree_tl {#2#3}
    \__siunitx_angle_arc_print_auxi:nVn {#2}
      \l__siunitx_angle_symbol_minute_tl {#3}
    \__siunitx_angle_arc_print_auxi:nVn {#3}
      \l__siunitx_angle_symbol_second_tl { }
  }
\cs_generate_variant:Nn \__siunitx_angle_arc_print:nnn { VVV }
\cs_new_protected:Npn \__siunitx_angle_arc_print_auxi:nnn #1#2#3
  {
    \tl_if_blank:nF {#1}
      {
        \bool_if:NTF \l__siunitx_angle_astronomy_bool
          { \__siunitx_angle_arc_print_auxii:nw {#2} #1 \q_stop }
          {
            \__siunitx_angle_arc_print_auxv:w #1 \q_stop
            \__siunitx_angle_arc_print_auxvi:n {#2}
          }
        \tl_if_blank:nF {#3}
          {
            \nobreak
            \l__siunitx_angle_separator_tl
          }
      }
  }
\cs_generate_variant:Nn \__siunitx_angle_arc_print_auxi:nnn { nV }
%     \end{macrocode}
%    To align the two parts of the astronomy-style marker, we need to allow
%    for the |\scriptspace|.
%     \begin{macrocode}
\cs_new_protected:Npn \__siunitx_angle_arc_print_auxii:nw
  #1#2 \q_nil #3 \q_nil #4 \q_nil #5 \q_nil #6 \q_nil #7 \q_nil #8 \q_stop
  {
    \mode_if_math:TF
      { \bool_set_true:N \l__siunitx_angle_tmp_bool }
      { \bool_set_false:N \l__siunitx_angle_tmp_bool }
    \siunitx_print_number:n {#2#3#4}
    \tl_if_blank:nTF {#6}
      { \__siunitx_angle_arc_print_auxvi:n {#1} }
      {
        \hbox_set:Nn \l__siunitx_angle_marker_box
          {
            \__siunitx_angle_arc_print_auxiii:n
```

```
                { \siunitx_print_number:n {#5} }
          }
        \hbox_set:Nn \l__siunitx_angle_unit_box
          {
            \__siunitx_angle_arc_print_auxiii:n
              {
                \siunitx_unit_format:nN {#1} \l__siunitx_angle_tmp_tl
                \siunitx_print_unit:V \l__siunitx_angle_tmp_tl
                \skip_horizontal:n { -\scriptspace }
              }
          }
        \dim_compare:nNnTF { \box_wd:N \l__siunitx_angle_marker_box } >
          { \box_wd:N \l__siunitx_angle_unit_box }
          {
            \__siunitx_angle_arc_print_auxiv:NN
              \l__siunitx_angle_marker_box
              \l__siunitx_angle_unit_box
          }
          {
            \__siunitx_angle_arc_print_auxiv:NN
              \l__siunitx_angle_unit_box
              \l__siunitx_angle_marker_box
          }
        \hbox_set_to_wd:Nnn \l__siunitx_angle_marker_box
          \l__siunitx_angle_tmp_dim
          {
            \hbox_overlap_right:n
              { \box_use_drop:N \l__siunitx_angle_marker_box }
            \hbox_overlap_right:n
              { \box_use_drop:N \l__siunitx_angle_unit_box }
            \tex_hfil:D
          }
        \box_use:N \l__siunitx_angle_marker_box
        \skip_horizontal:N \scriptspace
        \siunitx_print_number:n {#6}
      }
  }
\cs_new_protected:Npn \__siunitx_angle_arc_print_auxiii:n #1
  {
    \bool_if:NTF \l__siunitx_angle_tmp_bool
      { \ensuremath }
      { \use:n }
        {#1}
  }
\cs_new_protected:Npn \__siunitx_angle_arc_print_auxiv:NN #1#2
  {
    \dim_set:Nn \l__siunitx_angle_tmp_dim { \box_wd:N #1 }
    \hbox_set_to_wd:Nnn #2
      \l__siunitx_angle_tmp_dim
      {
        \tex_hss:D
        \hbox_unpack_drop:N #2
        \tex_hss:D
      }
```

```
  }
\cs_new_protected:Npn \__siunitx_angle_arc_print_auxv:w
  #1 \q_nil #2 \q_nil #3 \q_nil #4 \q_nil #5 \q_nil #6 \q_stop
  { \siunitx_print_number:n {#1#2#3#4#5} }
\cs_new_protected:Npn \__siunitx_angle_arc_print_auxvi:n #1
  {
    \nobreak
    \l__siunitx_angle_product_tl
    \siunitx_unit_format:nN {#1} \l__siunitx_angle_tmp_tl
    \siunitx_print_unit:V \l__siunitx_angle_tmp_tl
  }
```

(*End definition for* `\__siunitx_angle_arc_print:nnn` *and others.*)

```
\keys_set:nn { siunitx }
  {
    angle-mode                = input      ,
    angle-symbol-degree       = \degree    ,
    angle-symbol-minute       = \arcminute ,
    angle-symbol-over-decimal = false      ,
    angle-symbol-second       = \arcsecond ,
    angle-separator           =            ,
    fill-angle-degrees        = false      ,
    fill-angle-minutes        = false      ,
    fill-angle-seconds        = false      ,
    number-angle-product      =
  }
```

⟨/package⟩

Part III
siunitx-compound – Compound numbers and quantities

`\siunitx_compound_number:n` `\siunitx_compound_number:n {⟨entries⟩}`

Prints a set of numbers in the ⟨*entries*⟩, each of which should be given as a ⟨*balanced text*⟩. Unlike `\siunitx_number_list:nn`, this function may semantically take any form

`\siunitx_compound_quantity:nn` `\siunitx_compound_quantity:nn {⟨entries⟩} {⟨unit⟩}`

Prints a set of quantities in the ⟨*entries*⟩, each of which should be given as a ⟨*balanced text*⟩. Unlike `\siunitx_quantity_list:nn`, this function may semantically take any form

`\siunitx_number_list:nn` `\siunitx_number_list:nn {⟨entries⟩}`

Prints the list of numbers in the ⟨*entries*⟩, each of which should be given as a ⟨*balanced text*⟩.

`\siunitx_quantity_list:nn` `\siunitx_quantity_list:nn {⟨entries⟩} {⟨unit⟩}`

Prints the list of quantities in the ⟨*entries*⟩, each of which should be given as a ⟨*balanced text*⟩.

`\siunitx_number_product:n` `\siunitx_number_product:n {⟨entries⟩}`

Prints the series of numbers in the ⟨*entries*⟩, each of which should be given as a ⟨*balanced text*⟩.

`\siunitx_quantity_product:nn` `\siunitx_number_product:n {⟨entries⟩} {⟨unit⟩}`

Prints the series of quantities in the ⟨*entries*⟩, each of which should be given as a ⟨*balanced text*⟩.

`\siunitx_number_range:nn` `\siunitx_number_range:nn {⟨start⟩} {⟨end⟩}`

Prints the range of numbers from the ⟨*start*⟩ to the ⟨*end*⟩.

`\siunitx_quantity_range:nnn` `\siunitx_number_range:nn {⟨start⟩} {⟨end⟩} {⟨unit⟩}`

Prints the range of quantities from the ⟨*start*⟩ to the ⟨*end*⟩.

`\l_siunitx_list_separator_pair_tl`
`\l_siunitx_list_separator_tl`
`\l_siunitx_list_separator_final_tl`

Separators for lists of numbers and quantities.

`\l_siunitx_range_phrase_tl` Phrase (or similar) used between limits of a range.

`compound-exponents` `compound-exponents = combine|combine-bracket|individual`

`compound-final-separator` `compound-final-separator =` ⟨*text*⟩

`compound-pair-separator` `compound-pair-separator =` ⟨*text*⟩

`compound-separator` `compound-separator =` ⟨*text*⟩

`compound-separator-mode` `compound-separator-mode = number|text`

`compound-units` `compound-units = bracket|repeat|single`

`list-exponents` `list-exponents = combine|combine-bracket|individual`

`list-final-separator` `list-final-separator =` ⟨*text*⟩

`list-pair-separator` `list-pair-separator =` ⟨*text*⟩

`list-separator` `list-separator =` ⟨*text*⟩

`list-units` `list-units = bracket|repeat|single`

`product-exponents` `product-exponents = combine|combine-bracket|individual`

`product-mode` `product-mode = phrase|choice`

`product-phrase` `product-phrase =` ⟨*text*⟩

`product-symbol` `product-symbol =` ⟨*symbol*⟩

`range-exponents` `range-exponents = combine|combine-bracket|individual`

range-phrase `range-phrase = ⟨text⟩`

range-units `range-units = bracket|repeat|single`

Start the DocStrip guards.

```
⟨*package⟩
```

1 siunitx-compound implementation

```
\cs_generate_variant:Nn \keys_set:nn { nx }
```

1.1 General mechanism

Identify the internal prefix (LaTeX3 DocStrip convention): only internal material in this *submodule* should be used directly.

```
⟨@@=siunitx_compound⟩
```

Typesetting lists, ranges and products of numbers or quantities has shared features which mean they are best handled using a common mechanism. The aim therefore is to abstract out enough of the process such that output-specific aspects can be left to separate processes.

\l__siunitx_compound_tmp_fp
\l__siunitx_compound_tmp_seq
\l__siunitx_compound_tmp_tl

Scratch space.

```
\fp_new:N \l__siunitx_compound_tmp_fp
\seq_new:N \l__siunitx_compound_tmp_seq
\tl_new:N \l__siunitx_compound_tmp_tl
```

(*End definition for* `\l__siunitx_compound_tmp_fp`, `\l__siunitx_compound_tmp_seq`, *and* `\l__siunitx_compound_tmp_tl`.)

\l__siunitx_compound_first_tl

The first number in the list in internal format.

```
\tl_new:N \l__siunitx_compound_first_tl
```

(*End definition for* `\l__siunitx_compound_first_tl`.)

\l__siunitx_compound_exp_tl

For storing the combined exponent, if present.

```
\tl_new:N \l__siunitx_compound_exp_tl
```

(*End definition for* `\l__siunitx_compound_exp_tl`.)

\l__siunitx_compound_start_tl
\l__siunitx_compound_end_tl

Data on the end-of-list.

```
\tl_new:N \l__siunitx_compound_start_tl
\tl_new:N \l__siunitx_compound_end_tl
```

(*End definition for* `\l__siunitx_compound_start_tl` *and* `\l__siunitx_compound_end_tl`.)

\l__siunitx_compound_count_int

Data on the length-of-list.

```
\int_new:N \l__siunitx_compound_count_int
```

(*End definition for* `\l__siunitx_compound_count_int`.)

\l__siunitx_compound_unit_bool
\l__siunitx_compound_unit_tl

```
\bool_new:N \l__siunitx_compound_unit_bool
\tl_new:N \l__siunitx_compound_unit_tl
```

(*End definition for* `\l__siunitx_compound_unit_bool` *and* `\l__siunitx_compound_unit_tl`.)

`\l__siunitx_compound_bracket_close_tl`
`\l__siunitx_compound_bracket_open_tl`

Purely internal for the present.

```
\tl_new:N \l__siunitx_compound_bracket_close_tl
\tl_new:N \l__siunitx_compound_bracket_open_tl
\tl_set:Nn \l__siunitx_compound_bracket_open_tl { ( }
\tl_set:Nn \l__siunitx_compound_bracket_close_tl { ) }
```

(*End definition for* `\l__siunitx_compound_bracket_close_tl` *and* `\l__siunitx_compound_bracket_open_tl`.)

`\l__siunitx_compound_separator_final_tl`
`\l__siunitx_compound_separator_pair_tl`
`\l__siunitx_compound_separator_tl`
`\l__siunitx_compound_separator_text_bool`
`\l__siunitx_compound_exp_bracket_bool`
`\l__siunitx_compound_exp_combine_bool`
`\l__siunitx_compound_unit_bracket_bool`
`\l__siunitx_compound_unit_repeat_bool`

List options.

```
\bool_new:N \l__siunitx_compound_exp_bracket_bool
\bool_new:N \l__siunitx_compound_exp_combine_bool
\bool_new:N \l__siunitx_compound_separator_text_bool
\bool_new:N \l__siunitx_compound_unit_bracket_bool
\bool_new:N \l__siunitx_compound_unit_power_bool
\bool_new:N \l__siunitx_compound_unit_repeat_bool
\keys_define:nn { siunitx }
  {
    compound-exponents .choice: ,
    compound-exponents / combine .code:n =
      {
        \bool_set_false:N \l__siunitx_compound_exp_bracket_bool
        \bool_set_true:N \l__siunitx_compound_exp_combine_bool
      } ,
    compound-exponents / combine-bracket .code:n =
      {
        \bool_set_true:N \l__siunitx_compound_exp_bracket_bool
        \bool_set_true:N \l__siunitx_compound_exp_combine_bool
      } ,
    compound-exponents / individual .code:n =
      {
        \bool_set_false:N \l__siunitx_compound_exp_bracket_bool
        \bool_set_false:N \l__siunitx_compound_exp_combine_bool
      } ,
    compound-final-separator .tl_set:N =
      \l__siunitx_compound_separator_final_tl ,
    compound-pair-separator .tl_set:N =
      \l__siunitx_compound_separator_pair_tl ,
    compound-separator .tl_set:N =
      \l__siunitx_compound_separator_tl ,
    compound-separator-mode .choice: ,
    compound-separator-mode / number .code:n =
      { \bool_set_false:N \l__siunitx_compound_separator_text_bool } ,
    compound-separator-mode / text .code:n =
      { \bool_set_true:N \l__siunitx_compound_separator_text_bool } ,
    compound-units .choice: ,
    compound-units / bracket .code:n =
      {
        \bool_set_true:N  \l__siunitx_compound_unit_bracket_bool
        \bool_set_false:N \l__siunitx_compound_unit_power_bool
        \bool_set_false:N \l__siunitx_compound_unit_repeat_bool
      } ,
```

```
    compound-units / bracket-power .code:n =
      {
        \bool_set_true:N  \l__siunitx_compound_unit_bracket_bool
        \bool_set_true:N  \l__siunitx_compound_unit_power_bool
        \bool_set_false:N \l__siunitx_compound_unit_repeat_bool
      } ,
    compound-units / power .code:n =
      {
        \bool_set_false:N \l__siunitx_compound_unit_bracket_bool
        \bool_set_true:N  \l__siunitx_compound_unit_power_bool
        \bool_set_false:N \l__siunitx_compound_unit_repeat_bool
      } ,
    compound-units / repeat .code:n   =
      {
        \bool_set_false:N \l__siunitx_compound_unit_bracket_bool
        \bool_set_false:N \l__siunitx_compound_unit_power_bool
        \bool_set_true:N  \l__siunitx_compound_unit_repeat_bool
      } ,
    compound-units / single .code:n   =
      {
        \bool_set_false:N \l__siunitx_compound_unit_bracket_bool
        \bool_set_false:N \l__siunitx_compound_unit_power_bool
        \bool_set_false:N \l__siunitx_compound_unit_repeat_bool
      }
  }
```

(*End definition for* `\l__siunitx_compound_separator_final_tl` *and others.*)

`\siunitx_compound_number:n`
`\__siunitx_compound_format:n`
`\__siunitx_compound_format:nn`
`\__siunitx_compound_format:nnn`

Printing a generic set starts with the question of whether we want to extract exponents. If we do, then there is the work to do with extraction. Either way, the printing is handed off to a common function. We do a quick count up-front to avoid excess work when there is not actually a list.

```
\cs_new_protected:Npn \siunitx_compound_number:n #1
  {
    \group_begin:
      \bool_set_false:N \l__siunitx_compound_unit_bool
      \__siunitx_compound_format:nn {#1} { }
      \__siunitx_compound_print:N \siunitx_print_number:x
    \group_end:
  }
\cs_new_protected:Npn \__siunitx_compound_format:nn #1#2
  {
    \seq_clear:N \l__siunitx_compound_tmp_seq
    \bool_if:NTF \l_siunitx_number_parse_bool
      {
        \exp_args:Nxx \__siunitx_compound_format:nnn
          { \tl_head:n {#1} }
          { \tl_tail:n {#1} }
          {#2}
      }
      { \tl_map_function:nN {#1} \__siunitx_compound_unparsed:n }
  }
```

Formatting at a low level needs to know about units and numbers: we have to exchange data between the two. Most of the business of handling the units is left to a dedicated

auxiliary.

```
\cs_new_protected:Npn \__siunitx_compound_format:nnn #1#2#3
  {
    \siunitx_number_parse:nN {#1} \l__siunitx_compound_tmp_tl
    \bool_if:NTF \l__siunitx_compound_unit_bool
      { \__siunitx_compound_format_units:nn {#2} {#3} }
      { \siunitx_number_process:NN \l__siunitx_compound_tmp_tl \l__siunitx_compound_first_tl
    \bool_lazy_and:nnTF
      { \l__siunitx_compound_exp_combine_bool }
      { \int_compare_p:nNn { \tl_count:n {#2} } > 0 }
      { \__siunitx_compound_extract_exponents: }
      {
        \bool_if:NTF \l__siunitx_compound_unit_bool
          {
            \tl_set:Nx \l__siunitx_compound_tmp_tl
              { \siunitx_number_output:NN \l__siunitx_compound_first_tl \q_nil }
            \tl_set:Nx \l__siunitx_compound_tmp_tl
              { \__siunitx_compound_uncert_bracket:N \l__siunitx_compound_tmp_tl }
          }
          {
            \tl_set:Nx \l__siunitx_compound_tmp_tl
              { \siunitx_number_output:N \l__siunitx_compound_first_tl }
          }
        \seq_put_right:NV \l__siunitx_compound_tmp_seq \l__siunitx_compound_tmp_tl
      }
    \tl_map_function:nN {#2} \__siunitx_compound_parsed:n
  }
```

Extracting exponents means dealing with the first entry as a special case. After that, apply fixed processing to all other entries, tidying up using the number formatter.

__siunitx_compound_extract_exponents:
__siunitx_compound_extract_exponents_auxi:w
__siunitx_compound_extract_exponents_auxii:nw
__siunitx_compound_extract_exponents_auxiii:nnnnnnn

```
\cs_new_protected:Npn \__siunitx_compound_extract_exponents:
  {
    \tl_set:Nx \l__siunitx_compound_tmp_tl
      { \siunitx_number_output:NN \l__siunitx_compound_first_tl \q_nil }
    \exp_after:wN \__siunitx_compound_extract_exponents_auxi:w
      \l__siunitx_compound_tmp_tl \q_stop
  }
\cs_new_protected:Npn \__siunitx_compound_extract_exponents_auxi:w
  #1 \q_nil #2 \q_nil #3 \q_nil #4 \q_nil #5 \q_nil #6 \q_nil #7 \q_nil #8
  \q_nil #9 \q_stop
  {
    \__siunitx_compound_extract_exponents_auxii:nw {#1#2#3#4#5#6#7#8} #9 \q_stop
  }
\cs_new_protected:Npn \__siunitx_compound_extract_exponents_auxii:nw
  #1#2 \q_nil #3 \q_nil #4 \q_stop
  {
    \seq_put_right:Nn \l__siunitx_compound_tmp_seq { #1#2 }
    \tl_set:Nn \l__siunitx_compound_exp_tl { #3#4 }
    \exp_after:wN \__siunitx_compound_extract_exponents_auxiii:nnnnnnn
      \l__siunitx_compound_first_tl
  }
\cs_new_protected:Npn \__siunitx_compound_extract_exponents_auxiii:nnnnnnn
  #1#2#3#4#5#6#7
  {
```

```
    \keys_set:nn { siunitx }
      {
        drop-exponent  = true  ,
        exponent-mode  = fixed ,
        fixed-exponent = #6#7
      }
  }
```

(*End definition for* `\siunitx_compound_number:n` *and others. This function is documented on page 20.*)

`\__siunitx_compound_parsed:n`
`\__siunitx_compound_unparsed:n`

The simple cases for parsing (or not) all entries.

```
\cs_new_protected:Npn \__siunitx_compound_parsed:n #1
  {
    \bool_if:NTF \l__siunitx_compound_unit_bool
      {
        \siunitx_number_parse:nN {#1} \l__siunitx_compound_tmp_tl
        \siunitx_number_process:NN \l__siunitx_compound_tmp_tl \l__siunitx_compound_tmp_tl
        \tl_set:Nx \l__siunitx_compound_tmp_tl
          { \siunitx_number_output:NN \l__siunitx_compound_tmp_tl \q_nil }
        \tl_set:Nx \l__siunitx_compound_tmp_tl
          { \__siunitx_compound_uncert_bracket:N \l__siunitx_compound_tmp_tl }
      }
      { \siunitx_number_format:nN {#1} \l__siunitx_compound_tmp_tl }
    \seq_put_right:NV \l__siunitx_compound_tmp_seq \l__siunitx_compound_tmp_tl
  }
\cs_new_protected:Npn \__siunitx_compound_unparsed:n #1
  {
    \seq_put_right:Nn \l__siunitx_compound_tmp_seq { \ensuremath {#1} }
  }
```

(*End definition for* `\__siunitx_compound_parsed:n` *and* `\__siunitx_compound_unparsed:n`.)

`\__siunitx_compound_format_units:nn`
`_siunitx_compound_format_combine-exponent:n`
`_siunitx_compound_format_extract-exponent:n`
`\__siunitx_compound_format_input:n`
`siunitx_compound_format_combine-exponent:nn`
`siunitx_compound_format_extract-exponent:nn`
`nitx_compound_format_combine-exponent_aux:n`
`nitx_compound_format_extract-exponent_aux:n`
`\__siunitx_compound_extract_exp:nN`
`\__siunitx_compound_extract_exp:nnnnnnnN`

Actually formatting the units is much the same as is done in the quantities module, except that we have to cover the multiplication cases too: gets a bit repetitive. Notice that when combining exponents, there is no adjustment to the original exponent: we purely need to extract it.

```
\cs_new_protected:Npn \__siunitx_compound_format_units:nn #1#2
  {
    \bool_if:NTF \l__siunitx_compound_unit_power_bool
      {
        \use:c { __siunitx_compound_format_ \l_siunitx_quantity_prefix_mode_tl :nn }
          {#2} { \tl_count:n {#1} + 1 }
      }
      {
        \use:c { __siunitx_compound_format_ \l_siunitx_quantity_prefix_mode_tl :n } {#2}
      }
  }
\cs_new_protected:cpx { __siunitx_compound_format_combine-exponent:n } #1
  {
    \exp_not:c { __siunitx_compound_format_combine-exponent_aux:n }
      {
        \exp_not:N \siunitx_unit_format_combine_exponent:nnN
          {#1}
      }
```

```
  }
\cs_new_protected:cpx { __siunitx_compound_format_combine-exponent:nn } #1#2
  {
    \exp_not:c { __siunitx_compound_format_combine-exponent_aux:n }
      {
        \exp_not:N \siunitx_unit_format_multiply_combine_exponent:nnnN
          {#1} {#2}
      }
  }
\cs_new_protected:cpn { __siunitx_compound_format_combine-exponent_aux:n } #1
  {
    \bool_set_true:N \l__siunitx_compound_exp_combine_bool
    \siunitx_number_process:NN \l__siunitx_compound_tmp_tl \l__siunitx_compound_first_tl
    \exp_args:NV \__siunitx_compound_extract_exp:nN
      \l__siunitx_compound_first_tl \l__siunitx_compound_tmp_fp
    #1 \l__siunitx_compound_tmp_fp \l__siunitx_compound_unit_tl
  }
\cs_new_protected:cpx { __siunitx_compound_format_extract-exponent:n } #1
  {
    \exp_not:c { __siunitx_compound_format_extract-exponent_aux:n }
      { \exp_not:N \siunitx_unit_format_extract_prefixes:nNN {#1} }
  }
\cs_new_protected:cpx { __siunitx_compound_format_extract-exponent:nn } #1#2
  {
    \exp_not:c { __siunitx_compound_format_extract-exponent_aux:n }
      {
        \exp_not:N \siunitx_unit_format_multiply_extract_prefixes:nnNN
          {#1} {#2}
      }
  }
\cs_new_protected:cpn { __siunitx_compound_format_extract-exponent_aux:n } #1
  {
    #1 \l__siunitx_compound_unit_tl \l__siunitx_compound_tmp_fp
    \tl_set:Nx \l__siunitx_compound_tmp_tl
      { \siunitx_number_adjust_exponent:Nn \l__siunitx_compound_tmp_tl \l__siunitx_compound_t
    \siunitx_number_process:NN \l__siunitx_compound_tmp_tl \l__siunitx_compound_first_tl
    \bool_set_true:N \l__siunitx_compound_exp_combine_bool
  }
\cs_new_protected:Npn \__siunitx_compound_format_input:n #1
  {
    \siunitx_number_process:NN \l__siunitx_compound_tmp_tl \l__siunitx_compound_first_tl
    \siunitx_unit_format:nN {#1} \l__siunitx_compound_unit_tl
  }
\cs_new_protected:Npn \__siunitx_compound_format_input:nn #1#2
  {
    \siunitx_number_process:NN \l__siunitx_compound_tmp_tl \l__siunitx_compound_first_tl
    \siunitx_unit_format_multiply:nnN {#1} {#2} \l__siunitx_compound_unit_tl
  }
\cs_new_protected:Npn \__siunitx_compound_extract_exp:nN #1#2
  { \__siunitx_compound_extract_exp:nnnnnnnN #1 #2 }
\cs_new_protected:Npn \__siunitx_compound_extract_exp:nnnnnnnN #1#2#3#4#5#6#7#8
  { \fp_set:Nn #8 {#6#7} }
```

(*End definition for* `\__siunitx_compound_format_units:nn` *and others.*)

\siunitx_compound_quantity:nn

For quantities, life is more complex as there are interactions between the options for exponents and units.

```
\cs_new_protected:Npn \siunitx_compound_quantity:nn #1#2
  {
    \group_begin:
      \bool_if:NT \l__siunitx_compound_unit_bracket_bool
        { \bool_set_true:N \l__siunitx_compound_exp_bracket_bool }
      \bool_if:NT \l__siunitx_compound_unit_repeat_bool
        { \bool_set_false:N \l__siunitx_compound_exp_combine_bool }
      \bool_lazy_or:nnT
        { \l__siunitx_compound_unit_bracket_bool }
        { ! \l__siunitx_compound_unit_repeat_bool }
        { \bool_set_false:N \l_siunitx_number_bracket_ambiguous_bool }
      \bool_set_true:N \l__siunitx_compound_unit_bool
      \__siunitx_compound_format:nn {#1} {#2}
      \bool_if:NF \l_siunitx_number_parse_bool
        { \siunitx_unit_format:nN {#2} \l__siunitx_compound_unit_tl }
      \str_if_eq:VnT \l_siunitx_quantity_prefix_mode_tl { combine-exponent }
        { \tl_clear:N \l__siunitx_compound_exp_tl }
      \bool_if:NTF \l__siunitx_compound_unit_repeat_bool
        { \__siunitx_compound_print:N \__siunitx_compound_print_quantity:x }
        {
          \bool_lazy_and:nnTF
            { \l__siunitx_compound_unit_bracket_bool }
            { \tl_if_empty_p:N \l__siunitx_compound_exp_tl }
            {
              \siunitx_print_number:V \l__siunitx_compound_bracket_open_tl
              \__siunitx_compound_print:N \siunitx_print_number:x
              \siunitx_print_number:V \l__siunitx_compound_bracket_close_tl
            }
            { \__siunitx_compound_print:N \siunitx_print_number:x }
          \__siunitx_compound_print_quantity:n { }
        }
    \group_end:
  }
```

(*End definition for* `\siunitx_compound_quantity:nn`. *This function is documented on page* 20.)

__siunitx_compound_print:N
__siunitx_compound_print:nnN
__siunitx_compound_print:xxN
__siunitx_compound_print:nnnN
__siunitx_compound_print_aux:n
__siunitx_compound_print_aux:nn
__siunitx_compound_print_quantity:n
__siunitx_compound_print_quantity:x
__siunitx_compound_print_separator:n
__siunitx_compound_print_separator:V

We now need to know how many entries there are: the reason we don't use `\seq_use:Nnnn` is that we want to be able to insert `\siunitx_print_...:n` in a controlled way.

```
\cs_new_protected:Npn \__siunitx_compound_print:N #1
  {
    \bool_lazy_and:nnTF
      { \l__siunitx_compound_exp_bracket_bool }
      { ! \tl_if_empty_p:N \l__siunitx_compound_exp_tl }
      {
        \__siunitx_compound_print:xxN
          { \exp_not:V \l__siunitx_compound_bracket_open_tl }
          {
            \exp_not:V \l__siunitx_compound_bracket_close_tl
            \exp_not:V \l__siunitx_compound_exp_tl
          }
          #1
```

```
      }
      { \__siunitx_compound_print:xxN { } { \exp_not:V \l__siunitx_compound_exp_tl } #1 }
  }
\cs_new_protected:Npn \__siunitx_compound_print:nnN #1#2#3
  {
    \exp_args:Nx \__siunitx_compound_print:nnnN
      { \seq_count:N \l__siunitx_compound_tmp_seq } {#1} {#2} #3
  }
\cs_generate_variant:Nn \__siunitx_compound_print:nnN { xx }
```

A rather long auxiliary as we want a way to have the brackets/exponent available. The actual flow is simple enough: see how many entries there are and print as required. To keep everything generic, we have some slightly tricky saving of data to allow everything to go to the mapping.

```
\cs_new_protected:Npn \__siunitx_compound_print:nnnN #1#2#3#4
  {
    \int_case:nnF {#1}
      {
        { 0 } { }
        { 1 }
          {
            #4
              { \seq_item:Nn \l__siunitx_compound_tmp_seq { 1 } }
          }
        { 2 }
          {
            #4
              {
                \exp_not:n {#2}
                \seq_item:Nn \l__siunitx_compound_tmp_seq { 1 }
              }
            \__siunitx_compound_print_separator:V \l__siunitx_compound_separator_pair_tl
            #4
              {
                \seq_item:Nn \l__siunitx_compound_tmp_seq { 2 }
                \exp_not:n {#3}
              }
          }
      }
      {
        \int_set:Nn \l__siunitx_compound_count_int {#1}
        \tl_set:Nn \l__siunitx_compound_start_tl {#2}
        \tl_set:Nn \l__siunitx_compound_end_tl {#3}
        \cs_set_eq:NN \__siunitx_compound_print_aux:n #4
        \seq_map_indexed_function:NN
          \l__siunitx_compound_tmp_seq
          \__siunitx_compound_print_aux:nn
      }
  }
\cs_new_protected:Npn \__siunitx_compound_print_aux:n #1 { }
\cs_new_protected:Npn \__siunitx_compound_print_aux:nn #1#2
  {
    \int_case:nnF {#1}
      {
```

```
        { 1 }
          {
            \__siunitx_compound_print_aux:n
              {
                \exp_not:V \l__siunitx_compound_start_tl
                \exp_not:n {#2}
              }
            \__siunitx_compound_print_separator:V \l__siunitx_compound_separator_tl
          }
        { \l__siunitx_compound_count_int - 1 }
          {
            \__siunitx_compound_print_aux:n { \exp_not:n {#2} }
            \__siunitx_compound_print_separator:V \l__siunitx_compound_separator_final_tl
          }
        { \l__siunitx_compound_count_int }
          {
            \__siunitx_compound_print_aux:n
              {
                \exp_not:n {#2}
                \exp_not:V \l__siunitx_compound_end_tl
              }
          }
      }
      {
        \__siunitx_compound_print_aux:n { \exp_not:n {#2} }
        \__siunitx_compound_print_separator:V \l__siunitx_compound_separator_tl
      }
  }
\cs_new_protected:Npn \__siunitx_compound_print_quantity:n #1
  { \siunitx_quantity_print:nV {#1} \l__siunitx_compound_unit_tl }
\cs_generate_variant:Nn  \__siunitx_compound_print_quantity:n { x }
\cs_new_protected:Npn \__siunitx_compound_print_separator:n #1
  {
    \bool_if:NTF \l__siunitx_compound_separator_text_bool
      { #1 }
      { \siunitx_print_number:n {#1} }
  }
\cs_generate_variant:Nn \__siunitx_compound_print_separator:n { V }
```

(*End definition for* `\__siunitx_compound_print:N` *and others.*)

`\__siunitx_compound_uncert_bracket:N`
`\__siunitx_compound_uncert_bracket:w`
`\__siunitx_compound_uncert_bracket:nnw`

Check for the case where there is a separate uncertainty but not exponent, when we are handling units.

```
\cs_new:Npn \__siunitx_compound_uncert_bracket:N #1
  { \exp_after:wN \__siunitx_compound_uncert_bracket:w #1 \q_stop }
\cs_new:Npn \__siunitx_compound_uncert_bracket:w
  #1 \q_nil #2 \q_nil #3 \q_nil #4 \q_nil #5 \q_nil #6 \q_nil #7 \q_nil
  #8 \q_nil #9 \q_stop
  { \__siunitx_compound_uncert_bracket:nnw {#1#2#3#4#5#6} {#7#8} #9 \q_stop }
\cs_new:Npn \__siunitx_compound_uncert_bracket:nnw #1#2 #3 \q_nil #4 \q_nil #5 \q_stop
  {
    \bool_lazy_or:nnTF
      { \tl_if_blank_p:n {#2#3} }
      { ! \tl_if_blank_p:n {#5} }
```

```
      { \exp_not:n {#1#2#3#4#5} }
      {
        \exp_not:V \l__siunitx_compound_bracket_open_tl
        \exp_not:n {#1#2#3}
        \exp_not:V \l__siunitx_compound_bracket_close_tl
        \exp_not:n {#4#5}
      }
  }
```

(*End definition for* `\__siunitx_compound_uncert_bracket:N`, `\__siunitx_compound_uncert_bracket:w`, *and* `\__siunitx_compound_uncert_bracket:nnw`.)

1.2 Lists

Identify the internal prefix (LaTeX3 DocStrip convention): only internal material in this *submodule* should be used directly.

```
⟨@@=siunitx_list⟩
```

`\l_siunitx_list_separator_tl`
`\l_siunitx_list_separator_final_tl`
`\l_siunitx_list_separator_pair_tl`
`\l__siunitx_list_exp_tl`
`\l__siunitx_list_units_tl`

Options for products.

```
\tl_new:N \l__siunitx_list_exp_tl
\tl_new:N \l__siunitx_list_units_tl
\keys_define:nn { siunitx }
  {
    list-exponents .choices:nn =
      { combine , combine-bracket , individual }
      { \tl_set_eq:NN \l__siunitx_list_exp_tl \l_keys_choice_tl } ,
    list-final-separator .tl_set:N = \l_siunitx_list_separator_final_tl ,
    list-pair-separator .tl_set:N = \l_siunitx_list_separator_pair_tl ,
    list-separator .tl_set:N = \l_siunitx_list_separator_tl ,
    list-units .choices:nn =
      { bracket , repeat , single }
      { \tl_set_eq:NN \l__siunitx_list_units_tl \l_keys_choice_tl }
  }
```

(*End definition for* `\l_siunitx_list_separator_tl` *and others. These variables are documented on page* 20.)

`\siunitx_number_list:nn`
`\siunitx_quantity_list:nn`
`\__siunitx_list_aux:`

Simply recover the settings and use as a list.

```
\cs_new_protected:Npn \siunitx_number_list:nn #1
  {
    \group_begin:
      \__siunitx_list_aux:
      \siunitx_compound_number:n {#1}
    \group_end:
  }
\cs_new_protected:Npn \siunitx_quantity_list:nn #1#2
  {
    \group_begin:
      \__siunitx_list_aux:
      \siunitx_compound_quantity:nn {#1} {#2}
    \group_end:
  }
\cs_new_protected:Npn \__siunitx_list_aux:
  {
```

```
    \keys_set:nx { siunitx }
      {
        compound-exponents       = \l__siunitx_list_exp_tl ,
        compound-final-separator =
          { \exp_not:V \l_siunitx_list_separator_final_tl } ,
        compound-pair-separator  =
          { \exp_not:V \l_siunitx_list_separator_pair_tl } ,
        compound-separator       =
          { \exp_not:V \l_siunitx_list_separator_tl } ,
        compound-separator-mode  = text ,
        compound-units           = \l__siunitx_list_units_tl
      }
  }
```

(*End definition for* `\siunitx_number_list:nn`, `\siunitx_quantity_list:nn`, *and* `\__siunitx_list_aux:`. *These functions are documented on page* 20.)

1.3 Products

Identify the internal prefix (LaTeX3 DocStrip convention): only internal material in this *submodule* should be used directly.

```
⟨@@=siunitx_product⟩
```

`\l__siunitx_product_exp_tl` `\l__siunitx_product_phrase_bool` `\l__siunitx_product_phrase_tl` `\l__siunitx_product_symbol_tl` `\l__siunitx_product_units_tl`

Options for products.

```
\tl_new:N \l__siunitx_product_exp_tl
\bool_new:N \l__siunitx_product_phrase_bool
\tl_new:N \l__siunitx_product_units_tl
\keys_define:nn { siunitx }
  {
    product-exponents .choices:nn =
      { combine , combine-bracket , individual }
      { \tl_set_eq:NN \l__siunitx_product_exp_tl \l_keys_choice_tl } ,
    product-mode .choice: ,
    product-mode / phrase .code:n =
      { \bool_set_true:N \l__siunitx_product_phrase_bool } ,
    product-mode / symbol .code:n =
      { \bool_set_false:N \l__siunitx_product_phrase_bool } ,
    product-phrase .tl_set:N = \l__siunitx_product_phrase_tl ,
    product-symbol .tl_set:N = \l__siunitx_product_symbol_tl ,
    product-units .choices:nn =
      { bracket , bracket-power , power , repeat , single }
      { \tl_set_eq:NN \l__siunitx_product_units_tl \l_keys_choice_tl }
  }
```

(*End definition for* `\l__siunitx_product_exp_tl` *and others.*)

`\siunitx_number_product:n` `\siunitx_quantity_product:nn` `\__siunitx_product_aux:` `\__siunitx_product_aux:n` `\__siunitx_product_aux:x`

Simply recover the settings and use as a list.

```
\cs_new_protected:Npn \siunitx_number_product:n #1
  {
    \group_begin:
      \__siunitx_product_aux:
      \siunitx_compound_number:n {#1}
    \group_end:
  }
```

```
\cs_new_protected:Npn \siunitx_quantity_product:nn #1#2
  {
    \group_begin:
      \__siunitx_product_aux:
      \siunitx_compound_quantity:nn {#1} {#2}
    \group_end:
  }
\cs_new_protected:Npn \__siunitx_product_aux:
  {
    \bool_if:NTF \l__siunitx_product_phrase_bool
      { \__siunitx_product_aux:x { \exp_not:V \l__siunitx_product_phrase_tl } }
      { \__siunitx_product_aux:x { { } \exp_not:V \l__siunitx_product_symbol_tl { } } }
  }
\cs_new_protected:Npn \__siunitx_product_aux:n #1
  {
    \keys_set:nx { siunitx }
      {
        compound-exponents       = \l__siunitx_product_exp_tl ,
        compound-final-separator = { \exp_not:n {#1} } ,
        compound-pair-separator  = { \exp_not:n {#1} } ,
        compound-separator       = { \exp_not:n {#1} } ,
        compound-separator-mode  =
          \bool_if:NTF \l__siunitx_product_phrase_bool { text } { number } ,
        compound-units           = \l__siunitx_product_units_tl
      }
  }
\cs_generate_variant:Nn \__siunitx_product_aux:n { x }
```

(*End definition for* `\siunitx_number_product:n` *and others. These functions are documented on page* 20.)

1.4 Ranges

Identify the internal prefix (LaTeX3 DocStrip convention): only internal material in this *submodule* should be used directly.

```
⟨@@=siunitx_range⟩
```

`\l__siunitx_range_exp_tl`
`\l_siunitx_range_phrase_tl`
`\l__siunitx_range_units_tl`

Options for products.

```
\tl_new:N \l__siunitx_range_exp_tl
\tl_new:N \l__siunitx_range_units_tl
\keys_define:nn { siunitx }
  {
    range-exponents .choices:nn =
      { combine , combine-bracket , individual }
      { \tl_set_eq:NN \l__siunitx_range_exp_tl \l_keys_choice_tl } ,
    range-phrase .tl_set:N = \l_siunitx_range_phrase_tl ,
    range-units .choices:nn =
      { bracket , repeat , single }
      { \tl_set_eq:NN \l__siunitx_range_units_tl \l_keys_choice_tl }
  }
```

(*End definition for* `\l__siunitx_range_exp_tl`, `\l_siunitx_range_phrase_tl`, *and* `\l__siunitx_range_units_tl`. *This variable is documented on page* 21.)

\siunitx_number_range:nn
\siunitx_quantity_range:nnn
__siunitx_range_aux:

Simply recover the settings and use as a list.

```
\cs_new_protected:Npn \siunitx_number_range:nn #1#2
  {
    \group_begin:
      \__siunitx_range_aux:
      \siunitx_compound_number:n { {#1} {#2} }
    \group_end:
  }
\cs_new_protected:Npn \siunitx_quantity_range:nnn #1#2#3
  {
    \group_begin:
      \__siunitx_range_aux:
      \siunitx_compound_quantity:nn { {#1} {#2} } {#3}
    \group_end:
  }
\cs_new_protected:Npn \__siunitx_range_aux:
  {
    \keys_set:nx { siunitx }
      {
        compound-exponents       = \l__siunitx_range_exp_tl ,
        compound-pair-separator  = { \exp_not:V \l_siunitx_range_phrase_tl } ,
        compound-separator-mode  = text ,
        compound-units           = \l__siunitx_range_units_tl
      }
  }
```

(*End definition for* `\siunitx_number_range:nn`, `\siunitx_quantity_range:nnn`, *and* `\__siunitx_range_aux:`. *These functions are documented on page* 20.)

1.5 Standard settings for module options

Some of these follow naturally from the point of definition (*e.g.* boolean variables are always `false` to begin with), but for clarity everything is set here.

```
\keys_set:nn { siunitx }
  {
    compound-exponents       = individual  ,
    compound-final-separator =
      {
        \ifmmode \  \else \space \fi
        \text { and }
        \ifmmode \  \else \space \fi
      } ,
    compound-pair-separator  =
      {
        \ifmmode \  \else \space \fi
        \text { and }
        \ifmmode \  \else \space \fi
      } ,
    compound-separator       =
      { , \ifmmode \  \else \space \fi } ,
    compound-separator-mode  = text        ,
    compound-units           = repeat      ,
    list-exponents           = individual  ,
    list-final-separator     =
```

```
      {
        \ifmmode \  \else \space \fi
        \text { and }
        \ifmmode \  \else \space \fi
      } ,
    list-pair-separator      =
      {
        \ifmmode \  \else \space \fi
        \text { and }
        \ifmmode \  \else \space \fi
      } ,
    list-separator           =
      { , \ifmmode \  \else \space \fi } ,
    list-units               = repeat      ,
    product-exponents        = individual  ,
    product-mode             = symbol      ,
    product-phrase           =
      {
        \ifmmode \  \else \space \fi
        \text { by }
        \ifmmode \  \else \space \fi
      } ,
    product-symbol           = \times      ,
    product-units            = repeat      ,
    range-exponents          = individual  ,
    range-phrase             =
      {
        \ifmmode \  \else \space \fi
        \text { to }
        \ifmmode \  \else \space \fi
      } ,
    range-units              = repeat
  }
```

⟨/package⟩

Part IV
siunitx-locale – Localisation

This submodule is concerned with localisation of siunitx output based on the locale. If the translations package is available, this is loaded here and used to provide various fixed strings for output.

locale `locale = ⟨locale⟩`

Selects the ⟨*locale*⟩ used to apply standard settings for other keys, principally `exponent-product`, `inter-unit-product` and `output-decimal-marker`.

1 siunitx-locale implementation

Start the DocStrip guards.

```
⟨*package⟩
```

Identify the internal prefix (LaTeX3 DocStrip convention): only internal material in this *submodule* should be used directly.

```
⟨@@=siunitx_locale⟩
```

1.1 Locales

The basics for defining locales are easy: these are just meta keys.

```
\keys_define:nn { siunitx }
  {
    locale .choice: ,
    locale / DE .meta:n =
      {
        exponent-product      = \cdot ,
        inter-unit-product    = \,    ,
        output-decimal-marker = { , }
      } ,
    locale / FR .meta:n =
      {
        exponent-product      = \times ,
        inter-unit-product    = \,     ,
        output-decimal-marker = { , }
      } ,
    locale / UK .meta:n =
      {
        exponent-product      = \times ,
        inter-unit-product    = \,     ,
        output-decimal-marker = .
      },
    locale / US .meta:n =
      {
        exponent-product      = \times ,
        inter-unit-product    = \,     ,
        output-decimal-marker = .
      } ,
```

```
    locale / ZA .meta:n =
      {
        exponent-product      = \times ,
        inter-unit-product    = \cdot  ,
        output-decimal-marker = { , }
      }
  }
```

1.2 Localisation

Localisation makes use of the translator package. This only happens if it is available, and is transparent to the user.

```
\file_if_exist:nT { translations.sty }
  {
    \RequirePackage { translations }
    \DeclareTranslation { Catalan } { and } { i }
    \DeclareTranslation { Catalan } { to~(numerical~range) } { a }
    \DeclareTranslation { English } { to~(numerical~range) } { to }
    \DeclareTranslation { French }  { to~(numerical~range) } { à }
    \DeclareTranslation { German }  { to~(numerical~range) } { bis }
    \DeclareTranslation { Spanish } { to~(numerical~range) } { a }
    \keys_set:nn { siunitx }
      {
        list-final-separator =
          {
            \ifmmode \  \else \space \fi
            \text { \GetTranslation { and } }
            \ifmmode \  \else \space \fi
          } ,
        list-pair-separator  =
          {
            \ifmmode \  \else \space \fi
            \text { \GetTranslation { and } }
            \ifmmode \  \else \space \fi
          } ,
        range-phrase         =
          {
            \ifmmode \  \else \space \fi
            \text { \GetTranslation { to~(numerical~range) } }
            \ifmmode \  \else \space \fi
          }
      }
  }
```

Part V
siunitx-number – Parsing and formatting numbers

This submodule is dedicated to parsing and formatting numbers. A small number of LaTeX 2_ε math mode commands are assumed to be available as part of the formatted output. The sign commands `\mp`, `\pm`, `\ll`, `\le`, `\gg` and `\ge` are used to replace two-character input; `\pm` is also required for the output of uncertainties. The standard settings require `\times`. For the display of colored negative numbers, the command `\color` is assumed to be available. Where the latter may apply, numbers should be printed inside a group: note that TeX grouping is not added *within* formatted numbers as they may need to be decomposed into parts (see `\siunitx_number_output:NN`). Such a color will be the *first* part of the result, meaning that a test for an initial `\color` and following brace group may be used to detect/remove/adjust this part.

1 Formatting numbers

`\siunitx_number_parse:nN` `\siunitx_number_parse:VN`

`\siunitx_number_parse:nN {⟨number⟩} ⟨tl var⟩`

Parses the *number* and stores the resulting internal representation in the ⟨*tl var*⟩. The parsing is influenced by the various key–value settings for numerical input. The ⟨*number*⟩ should comprise a single real value, possibly with comparator, uncertainty and exponent parts. If the number is invalid, or if number parsing is disabled, the result will be an entirely empty ⟨*tl var*⟩.

The structure of a valid number is:

`{`⟨*comparator*⟩`}{`⟨*sign*⟩`}{`⟨*integer*⟩`}{`⟨*decimal*⟩`} {`⟨*uncertainty*⟩`}`
`{`⟨*exponent sign*⟩`}{`⟨*exponent*⟩`}`

where the two sign parts must be single tokens if present, and all other components must be given in braces. The number will have at least one digit for both the ⟨*integer*⟩ and ⟨*exponent*⟩ parts: these are required. The ⟨*uncertainty*⟩ part should either be blank or contain an ⟨*identifier*⟩ (as a brace group), followed by one or more data entries. Valid ⟨*identifiers*⟩ currently are

`S` A single symmetrical uncertainty (*e.g.* a statistical standard uncertainty)

`\siunitx_number_process:NN` `\siunitx_number_process:N ⟨tl var1⟩ ⟨tl var2⟩`

Applies a set of number processing operations to the ⟨*internal number*⟩ stored in the ⟨*tl var1*⟩, *viz.* in order

1. Dropping uncertainty
2. Converting to scientific mode (or similar)
3. Rounding
4. Dropping zero decimal part
5. Forcing a minimum number of digits

with the result stored in ⟨*tl var2*⟩.

`\siunitx_number_output:N` ☆ `\siunitx_number_output:N ⟨number⟩`
`\siunitx_number_output:n` ☆ `\siunitx_number_output:NN ⟨number⟩ ⟨marker⟩`
`\siunitx_number_output:NN` ☆
`\siunitx_number_output:nN` ☆

Formats the ⟨*number*⟩ (in the siunitx internal format), producing the result in a form suitable for typesetting in math mode. The details for the formatting are controlled by a number of key–value options. Note that *formatting* does not apply any manipulation (processing) to the number. This function is usable in an `e`- or `x`-type expansion, and further uncontrolled expansion is prevented by appropriate use of `\exp_not:n` internally.

In the `NN` version, the ⟨*marker*⟩ token is inserted at each possible alignment position in the output, *viz.*

- Between the comparator and the integer (*before* any sign for the integer)
- Between the sign and the first digit of the integer
- Both sides of the decimal marker
- Both sides of the separated uncertainty sign (*i.e.* after the decimal part and before any integer uncertainty part)
- Both sides of the decimal marker for a separated uncertainty
- Both sides of the multiplication symbol for the exponent part.

The `n` and `nN` version take a token list, which should be in the internal siunitx format.

`\siunitx_number_format:nN` `\siunitx_number_format:nN {⟨number⟩} ⟨tl var⟩`

Carries out a combination of `\siunitx_number_parse:nN`, `\siunitx_number_process:NN` and `\siunitx_number_output:N` using `x`-type expansion to place the result in the ⟨*tl var*⟩. If `\l_siunitx_number_parse_bool` if `false`, the input is simply stored inside the ⟨*tl var*⟩ inside `\ensuremath`.

`\siunitx_number_adjust_exponent:Nn` ⋆ `\siunitx_number_adjust_exponent:Nn ⟨number⟩ {⟨fp expr⟩}`
`\siunitx_number_adjust_exponent:nn` ⋆

Adjusts the exponent of the ⟨*number*⟩ (in internal format) by the ⟨*fp expr*⟩ and leaves the result in the input stream.

\siunitx_number_normalize_symbols:N \siunitx_number_normalize_symbols:N ⟨*tl var*⟩

Replaces all multi-token signs and comparators in the ⟨*tl var*⟩ with their single-token equivalents. Replaces any active hyphen tokens with non-active versions.

\siunitx_if_number_p:n ⋆
\siunitx_if_number:nTF ⋆ \siunitx_if_number_token:NTF {⟨*tokens*⟩} {⟨*true code*⟩} {⟨*false code*⟩}

Determines if the ⟨*tokens*⟩ form a valid number which can be fully parsed by siunitx.

\siunitx_if_number_token:NTF \siunitx_if_number_token:NTF {⟨*token*⟩} {⟨*true code*⟩} {⟨*false code*⟩}

Determines if the ⟨*token*⟩ is valid in a number based on those tokens currently set up for detection in a number.

\l_siunitx_bracket_ambiguous_bool

A switch to control whether ambiguous numbers are bracketed: this can also be covered in quantity formatting by a setting there.

\l_siunitx_number_parse_bool

A switch to control whether any parsing is attempted for numbers.

\l_siunitx_number_comparator_tl
\l_siunitx_number_exponent_tl
\l_siunitx_number_sign_tl

The list of possible input comparators, exponent markers and signs.

\l_siunitx_number_input_decimal_tl
\l_siunitx_number_output_decimal_tl

The list of possible input decimal marker(s), and the output marker.

1.1 Key–value options

The options defined by this submodule are available within the l3keys siunitx tree.

bracket-ambiguous-numbers bracket-ambiguous-numbers = true|false

bracket-negative-numbers bracket-negative-numbers = true|false

drop-exponent drop-exponent = true|false

drop-uncertainty drop-uncertainty = true|false

drop-zero-decimal drop-zero-decimal = true|false

evaluate-expression evaluate-expression = true|false

exponent-base exponent-base = ⟨*base*⟩

exponent-mode exponent-mode = engineering|fixed|input|scientific

exponent-product exponent-product = ⟨*symbol*⟩

expression expression = ⟨*expression*⟩

fixed-exponent fixed-exponent = ⟨*exponent*⟩

group-digits group-digits = all|decimal|integer|none

group-minimum-digits group-minimum-digits = ⟨*value*⟩

group-separator group-separator = ⟨*symbol*⟩

input-close-uncertainty input-close-uncertainty = ⟨*tokens*⟩

input-comparators input-comparators = ⟨*tokens*⟩

input-close-uncertainty input-close-uncertainty = ⟨*tokens*⟩

input-decimal-markers input-decimal-markers = ⟨*tokens*⟩

input-digits input-digits = ⟨*tokens*⟩

input-exponent-markers input-exponent-markers = ⟨*tokens*⟩

input-open-uncertainty input-open-uncertainty = ⟨*tokens*⟩

input-signs input-signs = ⟨*tokens*⟩

input-uncertainty-signs input-uncertainty-signs = ⟨*tokens*⟩

minimum-decimal-digits minimum-decimal-digits = ⟨*min*⟩

minimum-integer-digits minimum-integer-digits = ⟨*min*⟩

negative-color negative-color = ⟨*color*⟩

output-close-uncertainty output-close-uncertainty = ⟨*symbol*⟩

output-decimal-marker output-decimal-marker = ⟨*symbol*⟩

output-open-uncertainty output-open-uncertainty = ⟨*symbol*⟩

parse-numbers parse-numbers = true|false

print-implicit-plus print-implicit-plus = true|false

print-unity-mantissa print-unity-mantissa = true|false

print-zero-exponent print-zero-exponent = true|false

retain-explicit-plus retain-explicit-plus = true|false

retain-zero-uncertainty retain-zero-uncertainty = true|false

round-half round-half = even|up

round-minimum round-minimum = ⟨*min*⟩

round-mode round-mode = figures|none|places|uncertainty

round-pad round-pad = true|false

round-precision round-precision = ⟨*precision*⟩

tight-spacing tight-spacing = true|false

uncertainty-mode `uncertainty-mode = compact|compact-marker|full|separate`

uncertainty-separator `uncertainty-separator = ⟨separator⟩`

2 siunitx-number implementation

Start the DocStrip guards.

```
1 ⟨*package⟩
```

Identify the internal prefix (LaTeX3 DocStrip convention): only internal material in this *submodule* should be used directly.

```
2 ⟨@@=siunitx_number⟩
```

2.1 Initial set-up

Variants not provided by expl3.

```
3 \cs_generate_variant:Nn \tl_if_blank:nTF { f }
4 \cs_generate_variant:Nn \tl_if_blank_p:n { f }
5 \cs_generate_variant:Nn \tl_if_in:NnTF { NV }
6 \cs_generate_variant:Nn \tl_remove_all:Nn { NV }
7 \cs_generate_variant:Nn \tl_replace_all:Nnn { NnV }
```

\l__siunitx_number_tmp_tl Scratch space.

```
8 \tl_new:N \l__siunitx_number_tmp_tl
```

(*End definition for* `\l__siunitx_number_tmp_tl`.)

2.2 Main formatting routine

\l__siunitx_number_outputted_tl A token list for the final formatted result: may or may not be generated by the parser, depending on settings which are active.

```
9 \tl_new:N \l__siunitx_number_outputted_tl
```

(*End definition for* `\l__siunitx_number_outputted_tl`.)

\l_siunitx_number_parse_bool Tracks whether to parse numbers: public as this may affect other behaviors.

```
10 \tl_new:N \l_siunitx_number_parse_bool
```

(*End definition for* `\l_siunitx_number_parse_bool`. *This variable is documented on page* 40.)

\l_siunitx_number_parse_bool Top-level options.

```
11 \keys_define:nn { siunitx }
12   {
13     parse-numbers .bool_set:N = \l_siunitx_number_parse_bool
14   }
```

(*End definition for* `\l_siunitx_number_parse_bool`. *This variable is documented on page* 40.)

\siunitx_number_format:nN

```
\cs_new_protected:Npn \siunitx_number_format:nN #1#2
  {
    \group_begin:
      \bool_if:NTF \l_siunitx_number_parse_bool
        {
          \siunitx_number_parse:nN {#1} \l__siunitx_number_parsed_tl
          \siunitx_number_process:NN \l__siunitx_number_parsed_tl \l__siunitx_number_parsed_t
          \tl_set:Nx \l__siunitx_number_outputted_tl
            { \siunitx_number_output:N \l__siunitx_number_parsed_tl }
        }
        { \tl_set:Nn \l__siunitx_number_outputted_tl { \ensuremath {#1} } }
    \exp_args:NNNV \group_end:
    \tl_set:Nn #2 \l__siunitx_number_outputted_tl
  }
```

(*End definition for* `\siunitx_number_format:nN`. *This function is documented on page* 39.)

2.3 Parsing numbers

Before numbers can be manipulated or formatted they need to be parsed into an internal form. In particular, if multiple code paths are to be avoided, it is necessary to do such parsing even for relatively simple cases such as converting `1e10` to `1 \times 10^{10}`.

Storing the result of such parsing can be done in a number of ways. In the first version of siunitx a series of separate data stores were used. This is potentially quite fast (as recovery of items relies only on TEX's hash table) but makes managing the various data entries somewhat tedious and error-prone. For version two of the package, a single data structure (property list) was used for each part of the parsed number. Whilst this is easy to manage and extend, it is somewhat slower as at a TEX level there are repeated pack–unpack steps. In particular, the fact that there are a limited number of items to track for a "number" means that a more efficient approach is desirable (contrast parsing units, which is open-ended and therefore fits well with using a property list).

In this release, the structure of a valid number is:

`{`⟨*comparator*⟩`}`⟨*sign*⟩`{`⟨*integer*⟩`}{`⟨*decimal*⟩`}` `{`⟨*uncertainty*⟩`}`
⟨*exponent sign*⟩`{`⟨*exponent*⟩`}`

where all components must be given in braces. *All* of the components must be present in a stored number (*i.e.* at the end of parsing). The number must have at least one digit for both the ⟨*integer*⟩ and ⟨*exponent*⟩ parts.

A non-empty ⟨*uncertainty*⟩ must contain one leading brace group containing an identifier, then zero or more brace groups which contain the uncertainty data. In this release, the known uncertainty types are

- `S`: A symmetrical statistical uncertainty made up of a single value. These are stored as uncertainty in significant digits, with no radix point in the stored value.

\l_siunitx_number_input_decimal_tl

The input decimal markers(s).

```
\tl_new:N \l_siunitx_number_input_decimal_tl
```

(*End definition for* `\l_siunitx_number_input_decimal_tl`. *This variable is documented on page* 40.)

\l__siunitx_number_expression_bool
\l__siunitx_number_input_uncert_close_tl
\l_siunitx_number_input_comparator_tl
\l__siunitx_number_input_digit_tl
\l_siunitx_number_input_exponent_tl
\l__siunitx_number_input_ignore_tl
\l__siunitx_number_input_uncert_open_tl
\l_siunitx_number_input_sign_tl
\l__siunitx_number_input_uncert_sign_tl
\l__siunitx_number_explicit_plus_bool
\l__siunitx_number_zero_uncert_bool
__siunitx_number_expression:n

Options which determine the various valid parts of a parsed number.

```
\keys_define:nn { siunitx }
  {
    evaluate-expression .bool_set:N =
      \l__siunitx_number_expression_bool ,
    expression .code:n =
      \cs_set:Npn \__siunitx_number_expression:n ##1 {#1} ,
    input-close-uncertainty .tl_set:N =
      \l__siunitx_number_input_uncert_close_tl ,
    input-comparators .tl_set:N =
      \l_siunitx_number_input_comparator_tl ,
    input-decimal-markers .tl_set:N =
      \l_siunitx_number_input_decimal_tl ,
    input-digits .tl_set:N =
      \l__siunitx_number_input_digit_tl ,
    input-exponent-markers .tl_set:N =
      \l_siunitx_number_input_exponent_tl ,
    input-ignore .tl_set:N =
      \l__siunitx_number_input_ignore_tl ,
    input-open-uncertainty .tl_set:N =
      \l__siunitx_number_input_uncert_open_tl ,
    input-signs .tl_set:N =
      \l_siunitx_number_input_sign_tl ,
    input-uncertainty-signs .code:n =
      {
        \tl_set:Nn \l__siunitx_number_input_uncert_sign_tl {#1}
        \tl_map_inline:nn {#1}
          {
            \tl_if_in:NnF \l_siunitx_number_input_sign_tl {##1}
              { \tl_put_right:Nn \l_siunitx_number_input_sign_tl {##1} }
          }
      } ,
    parse-numbers .bool_set:N =
      \l_siunitx_number_parse_bool ,
    retain-explicit-plus .bool_set:N =
      \l__siunitx_number_explicit_plus_bool ,
    retain-zero-uncertainty .bool_set:N =
      \l__siunitx_number_zero_uncert_bool
  }
\cs_new:Npn \__siunitx_number_expression:n #1 { }
\tl_new:N \l__siunitx_number_input_uncert_sign_tl
```

(*End definition for* `\l__siunitx_number_expression_bool` *and others. These variables are documented on page* **??**.)

`\l__siunitx_number_arg_tl` The input argument or a part thereof, depending on the position in the parsing routine.

```
\tl_new:N \l__siunitx_number_arg_tl
```

(*End definition for* `\l__siunitx_number_arg_tl`.)

`\l__siunitx_number_comparator_tl` A comparator, if found, is held here.

```
\tl_new:N \l__siunitx_number_comparator_tl
```

(*End definition for* `\l__siunitx_number_comparator_tl`.)

\l__siunitx_number_exponent_tl

The exponent part of a parsed number. It is easiest to find this relatively early in the parsing process, but as it needs to go at the end of the internal format is held separately until required.

```
\tl_new:N \l__siunitx_number_exponent_tl
```

(*End definition for* `\l__siunitx_number_exponent_tl`.)

\l__siunitx_number_flex_tl

In a number with an uncertainty, the exact meaning of a second part is not fully resolved until parsing is complete. That is handled using this "flexible" store.

```
\tl_new:N \l__siunitx_number_flex_tl
```

(*End definition for* `\l__siunitx_number_flex_tl`.)

\l__siunitx_number_parsed_tl

The number parsed into internal format.

```
\tl_new:N \l__siunitx_number_parsed_tl
```

(*End definition for* `\l__siunitx_number_parsed_tl`.)

\l__siunitx_number_input_tl

The numerical input exactly as given by the user.

```
\tl_new:N \l__siunitx_number_input_tl
```

(*End definition for* `\l__siunitx_number_input_tl`.)

\l__siunitx_number_partial_tl

To avoid needing to worry about the fact that the final data stores are somewhat tricky to add to token-by-token, a simple store is used to build up the parsed part of a number before transferring in one go.

```
\tl_new:N \l__siunitx_number_partial_tl
```

(*End definition for* `\l__siunitx_number_partial_tl`.)

\l__siunitx_number_validate_bool

Used to set up for validation with no error production.

```
\bool_new:N \l__siunitx_number_validate_bool
```

(*End definition for* `\l__siunitx_number_validate_bool`.)

\siunitx_number_normalize_symbols:N
__siunitx_number_normalize_aux:nN
__siunitx_number_normalize_sign:N
\c__siunitx_number_normalize_tl

There are two parts to the replacement code. First, any active hyphens signs are normalised: these can come up with some packages and cause issues. Multi-token signs then are converted to the single token equivalents so that everything else can work on a one token basis.

```
\cs_new_protected:Npn \siunitx_number_normalize_symbols:N #1
  {
    \__siunitx_number_normalize_minus:N #1
    \exp_after:wN \__siunitx_number_normalize_aux:NnN \exp_after:wN #1
      \c__siunitx_number_normalize_tl
      { ? } \q_recursion_tail
        \q_recursion_stop
  }
\cs_set_protected:Npn \__siunitx_number_normalize_aux:NnN #1#2#3
  {
    \quark_if_recursion_tail_stop:N #3
    \tl_replace_all:Nnn #1 {#2} {#3}
    \__siunitx_number_normalize_aux:NnN #1
  }
\tl_const:Nn \c__siunitx_number_normalize_tl
```

```
  {
    { -+ } \mp
    { +- } \pm
    { << } \ll
    { <= } \le
    { >> } \gg
    { >= } \ge
  }
\group_begin:
  \char_set_catcode_active:N \-
  \cs_new_protected:Npx \__siunitx_number_normalize_minus:N #1
    {
      \tl_replace_all:Nnn #1
        { \exp_not:N - }  { \token_to_str:N - }
    }
\group_end:
```

(*End definition for* `\siunitx_number_normalize_symbols:N` *and others. This function is documented on page 40.*)

`\siunitx_number_parse:nN`
`\siunitx_number_parse:VN`
`\__siunitx_number_parse:nN`

After some initial set up, the parser expands the input and then replaces as far as possible tricky tokens with ones that can be handled using delimited arguments. To avoid multiple conditionals here, the parser is set up as a chain of commands initially, with a loop only later. This avoids more conditionals than are necessary.

```
\cs_new_protected:Npn \siunitx_number_parse:nN #1#2
  {
    \bool_if:NTF \l_siunitx_number_parse_bool
      { \__siunitx_number_parse:nN {#1} #2 }
      { \tl_clear:N #2 }
  }
\cs_generate_variant:Nn \siunitx_number_parse:nN { V }
\cs_new_protected:Npn \__siunitx_number_parse:nN #1#2
  {
    \group_begin:
      \tl_clear:N \l__siunitx_number_parsed_tl
      \tl_map_inline:Nn \l__siunitx_number_input_ignore_tl
        {
          \token_if_macro:NT ##1
            { \cs_set_eq:NN ##1 \scan_stop: }
        }
      \protected@edef \l__siunitx_number_arg_tl
        {
          \bool_if:NTF \l__siunitx_number_expression_bool
            { \fp_eval:n { \__siunitx_number_expression:n {#1} } }
            {#1}
        }
      \tl_set_eq:NN \l__siunitx_number_input_tl \l__siunitx_number_arg_tl
      \siunitx_number_normalize_symbols:N \l__siunitx_number_arg_tl
      \tl_map_inline:Nn \l__siunitx_number_input_ignore_tl
        { \tl_remove_all:Nn \l__siunitx_number_arg_tl {##1} }
      \tl_if_empty:NF \l__siunitx_number_arg_tl
        { \__siunitx_number_parse_comparator: }
      \__siunitx_number_parse_check:
    \exp_args:NNNV \group_end:
```

```
    \tl_set:Nn #2 \l__siunitx_number_parsed_tl
  }
```

(*End definition for* `\siunitx_number_parse:nN` *and* `\__siunitx_number_parse:nN`. *This function is documented on page 38.*)

`\__siunitx_number_parse_check:`

After the loop there is one case that might need tidying up. If a separated uncertainty was found it will be currently in `\l__siunitx_number_flex_tl` and needs moving. A series of tests pick up that case, then the check is made that some content was found

```
\cs_new_protected:Npn \__siunitx_number_parse_check:
  {
    \tl_if_empty:NF \l__siunitx_number_flex_tl
      {
        \bool_lazy_and:nnTF
          {
            \tl_if_blank_p:f
              { \exp_after:wN \use_iv:nnnn \l__siunitx_number_parsed_tl }
          }
          {
            \tl_if_blank_p:f
              { \exp_after:wN \use_iv:nnnn \l__siunitx_number_flex_tl }
          }
          {
            \tl_set:Nx \l__siunitx_number_tmp_tl
              { \exp_after:wN \use_i:nnnn \l__siunitx_number_flex_tl }
            \tl_if_in:NVTF \l__siunitx_number_input_uncert_sign_tl
              \l__siunitx_number_tmp_tl
              { \__siunitx_number_parse_combine_uncert: }
              { \tl_clear:N \l__siunitx_number_parsed_tl }
          }
          { \tl_clear:N \l__siunitx_number_parsed_tl }
      }
    \tl_if_empty:NTF \l__siunitx_number_parsed_tl
      {
        \bool_if:NF \l__siunitx_number_validate_bool
          {
            \msg_error:nnx { siunitx } { invalid-number }
              { \exp_not:V \l__siunitx_number_input_tl }
          }
      }
      { \__siunitx_number_parse_finalise: }
  }
```

(*End definition for* `\__siunitx_number_parse_check:`.)

`\__siunitx_number_parse_combine_uncert:`
`x_number_parse_combine_uncert_auxi:nnnnnnnn`
`itx_number_parse_combine_uncert_auxii:nnnnn`
`itx_number_parse_combine_uncert_auxii:fnnnn`
`x_number_parse_combine_uncert_auxiii:nnnnnn`
`x_number_parse_combine_uncert_auxiii:fnnnnn`
`nitx_number_parse_combine_uncert_auxiv:nnnn`
`_siunitx_number_parse_combine_uncert_auxv:w`
`siunitx_number_parse_combine_uncert_auxvi:w`

Conversion of a second numerical part to an uncertainty needs a bit of work. The first step is to extract the useful information from the two stores: the sign, integer and decimal parts from the real number and the integer and decimal parts from the second number. That is done using the input stack to avoid lots of assignments.

```
\cs_new_protected:Npn \__siunitx_number_parse_combine_uncert:
  {
    \exp_after:wN \exp_after:wN \exp_after:wN
    \__siunitx_number_parse_combine_uncert_auxi:nnnnnnnn
      \exp_after:wN \l__siunitx_number_parsed_tl \l__siunitx_number_flex_tl
  }
```

Here, `#4`, `#5` and `#8` are all junk arguments simply there to mop up tokens, while `#1` will be recovered later from `\l__siunitx_number_parsed_tl` so does not need to be passed about. The difference in places between the two decimal parts is now found: this is done just once to avoid having to parse token lists twice. The value is then used to generate a number of filler `0` tokens, and these are added to the appropriate part of the number. Finally, everything is recombined: the integer part only needs a test to avoid an empty main number.

```
\cs_new_protected:Npn
  \__siunitx_number_parse_combine_uncert_auxi:nnnnnnnn #1#2#3#4#5#6#7#8
  {
     \__siunitx_number_parse_combine_uncert_auxii:fnnnn
       { \int_eval:n { \tl_count:n {#3} - \tl_count:n {#7} } }
       {#2} {#3} {#6} {#7}
  }
\cs_new_protected:Npn
  \__siunitx_number_parse_combine_uncert_auxii:nnnnn #1
  {
    \__siunitx_number_parse_combine_uncert_auxiii:fnnnnn
      { \prg_replicate:nn { \int_abs:n {#1} } { 0 } }
      {#1}
  }
\cs_generate_variant:Nn \__siunitx_number_parse_combine_uncert_auxii:nnnnn { f }
\cs_new_protected:Npn
  \__siunitx_number_parse_combine_uncert_auxiii:nnnnnn #1#2#3#4#5#6
  {
    \int_compare:nNnTF {#2} > 0
      {
        \__siunitx_number_parse_combine_uncert_auxiv:nnnn
          {#3} {#4} {#5} { #6 #1 }
      }
      {
        \__siunitx_number_parse_combine_uncert_auxiv:nnnn
          {#3} { #4 #1 } {#5} {#6}
      }
  }
\cs_generate_variant:Nn
  \__siunitx_number_parse_combine_uncert_auxiii:nnnnnn { f }
\cs_new_protected:Npn
  \__siunitx_number_parse_combine_uncert_auxiv:nnnn #1#2#3#4
  {
    \tl_set:Nx \l__siunitx_number_parsed_tl
      {
        { \tl_head:V \l__siunitx_number_parsed_tl }
        { \exp_not:n {#1} }
        {
          \bool_lazy_and:nnTF
            { \tl_if_blank_p:n {#2} }
            { ! \tl_if_blank_p:n {#4} }
            { 0 }
            { \exp_not:n {#2} }
        }
        {
          \__siunitx_number_parse_combine_uncert_auxv:w #3#4
```

```
            \q_recursion_tail \q_recursion_stop
        }
      }
  }
```

A short routine to remove any leading zeros in the uncertainty part, which are not needed for the compact representation used by the module.

```
\cs_new:Npn \__siunitx_number_parse_combine_uncert_auxv:w #1
  {
    \quark_if_recursion_tail_stop_do:Nn #1
      {
        \bool_if:NT \l__siunitx_number_zero_uncert_bool
          { { S } { 0 } }
      }
    \str_if_eq:nnTF {#1} { 0 }
      { \__siunitx_number_parse_combine_uncert_auxv:w }
      { \__siunitx_number_parse_combine_uncert_auxvi:w #1 }
  }
\cs_new:Npn \__siunitx_number_parse_combine_uncert_auxvi:w
  #1 \q_recursion_tail \q_recursion_stop
  { { S } { \exp_not:n {#1} } }
```

(*End definition for* `\__siunitx_number_parse_combine_uncert:` *and others.*)

`\__siunitx_number_parse_comparator:`
`\__siunitx_number_parse_comparator_aux:Nw`

A comparator has to be the very first token in the input. A such, the test for this can be very fast: grab the first token, do a check and if appropriate store the result.

```
\cs_new_protected:Npn \__siunitx_number_parse_comparator:
  {
    \exp_after:wN \__siunitx_number_parse_comparator_aux:Nw
      \l__siunitx_number_arg_tl \q_stop
  }
\cs_new_protected:Npn \__siunitx_number_parse_comparator_aux:Nw #1#2 \q_stop
  {
    \tl_if_in:NnTF \l_siunitx_number_input_comparator_tl {#1}
      {
        \tl_set:Nn \l__siunitx_number_comparator_tl {#1}
        \tl_set:Nn \l__siunitx_number_arg_tl {#2}
      }
      { \tl_clear:N \l__siunitx_number_comparator_tl }
    \tl_if_empty:NF \l__siunitx_number_arg_tl
      { \__siunitx_number_parse_sign: }
  }
```

(*End definition for* `\__siunitx_number_parse_comparator:` *and* `\__siunitx_number_parse_comparator_aux:Nw`.)

`\__siunitx_number_parse_exponent:`
`\__siunitx_number_parse_exponent_auxi:w`
`\__siunitx_number_parse_exponent_auxii:nn`
`\__siunitx_number_parse_exponent_auxiii:Nw`
`\__siunitx_number_parse_exponent_auxiv:nn`
`__siunitx_number_parse_exponent_zero_test:N`
`\__siunitx_number_parse_exponent_check:N`
`\__siunitx_number_parse_exponent_cleanup:N`

An exponent part of a number has to come at the end and can only occur once. Thus it is relatively easy to parse. First, there is a check that an exponent part is allowed, and if so a split is made (the previous part of the chain checks that there is some content in `\l__siunitx_number_arg_tl` before calling this function). After splitting, if there is no exponent then simply save a default. Otherwise, check for a sign and then store either this or an implicit plus, and the digits after a check that nothing else is present after the `e`. The only slight complication to all of this is allowing an arbitrary token in the input to represent the exponent: this is done by setting any exponent tokens to the first

of the allowed list, then using that in a delimited argument set up. Once an exponent part is found, there is a loop to check that each of the tokens is a digit then a tidy up step to remove any leading zeros.

```
\cs_new_protected:Npn \__siunitx_number_parse_exponent:
  {
    \tl_if_empty:NTF \l_siunitx_number_input_exponent_tl
      {
        \tl_set:Nn \l__siunitx_number_exponent_tl { { } 0 }
        \tl_if_empty:NF \l__siunitx_number_parsed_tl
          { \__siunitx_number_parse_loop: }
      }
      {
        \tl_set:Nx \l__siunitx_number_tmp_tl
          { \tl_head:V \l_siunitx_number_input_exponent_tl }
        \tl_map_inline:Nn \l_siunitx_number_input_exponent_tl
          {
            \tl_replace_all:NnV \l__siunitx_number_arg_tl
              {##1} \l__siunitx_number_tmp_tl
          }
        \use:x
          {
            \cs_set_protected:Npn
              \exp_not:N \__siunitx_number_parse_exponent_auxi:w
              ####1 \exp_not:V \l__siunitx_number_tmp_tl
              ####2 \exp_not:V \l__siunitx_number_tmp_tl
              ####3 \exp_not:N \q_stop
          }
            { \__siunitx_number_parse_exponent_auxii:nn {##1} {##2} }
        \use:x
          {
            \__siunitx_number_parse_exponent_auxi:w
              \exp_not:V \l__siunitx_number_arg_tl
              \exp_not:V \l__siunitx_number_tmp_tl \exp_not:N \q_nil
              \exp_not:V \l__siunitx_number_tmp_tl \exp_not:N \q_stop
          }
      }
  }
\cs_new_protected:Npn \__siunitx_number_parse_exponent_auxi:w  { }
\cs_new_protected:Npn \__siunitx_number_parse_exponent_auxii:nn #1#2
  {
    \quark_if_nil:nTF {#2}
      { \tl_set:Nn \l__siunitx_number_exponent_tl { { } 0 } }
      {
        \tl_set:Nn \l__siunitx_number_arg_tl {#1}
        \tl_if_blank:nTF {#2}
          { \tl_clear:N \l__siunitx_number_parsed_tl }
          { \__siunitx_number_parse_exponent_auxiii:Nw #2 \q_stop }
      }
    \tl_if_empty:NF \l__siunitx_number_parsed_tl
      { \__siunitx_number_parse_loop: }
  }
\cs_new_protected:Npn \__siunitx_number_parse_exponent_auxiii:Nw #1#2 \q_stop
  {
    \tl_if_in:NnTF \l_siunitx_number_input_sign_tl {#1}
```

```
      { \__siunitx_number_parse_exponent_auxiv:nn {#1} {#2} }
      { \__siunitx_number_parse_exponent_auxiv:nn { } {#1#2} }
    \tl_if_empty:NT \l__siunitx_number_exponent_tl
      { \tl_clear:N \l__siunitx_number_parsed_tl }
  }
\cs_new_protected:Npn \__siunitx_number_parse_exponent_auxiv:nn #1#2
  {
    \bool_lazy_or:nnTF
      { \l__siunitx_number_explicit_plus_bool }
      { ! \str_if_eq_p:nn {#1} { + } }
      { \tl_set:Nn \l__siunitx_number_exponent_tl { {#1} } }
      { \tl_set:Nn \l__siunitx_number_exponent_tl { { } } }
    \tl_if_blank:nTF {#2}
      { \tl_clear:N \l__siunitx_number_parsed_tl }
      {
        \__siunitx_number_parse_exponent_zero_test:N #2
          \q_recursion_tail \q_recursion_stop
      }
  }
\cs_new_protected:Npn \__siunitx_number_parse_exponent_zero_test:N #1
  {
    \quark_if_recursion_tail_stop_do:Nn #1
      { \tl_set:Nn \l__siunitx_number_exponent_tl { { } 0 } }
    \str_if_eq:nnTF {#1} { 0 }
      { \__siunitx_number_parse_exponent_zero_test:N }
      { \__siunitx_number_parse_exponent_check:N #1 }
  }
\cs_new_protected:Npn \__siunitx_number_parse_exponent_check:N #1
  {
    \quark_if_recursion_tail_stop:N #1
    \tl_if_in:NnTF \l__siunitx_number_input_digit_tl {#1}
      {
        \tl_put_right:Nn \l__siunitx_number_exponent_tl {#1}
        \__siunitx_number_parse_exponent_check:N
      }
      { \__siunitx_number_parse_exponent_cleanup:wN }
  }
\cs_new_protected:Npn \__siunitx_number_parse_exponent_cleanup:wN
  #1 \q_recursion_stop
  { \tl_clear:N \l__siunitx_number_parsed_tl }
```

(*End definition for* `\__siunitx_number_parse_exponent:` *and others.*)

`\__siunitx_number_parse_finalise:`
`\__siunitx_number_parse_finalise:nw`

Combine all of the bits of a number together: both the real and imaginary parts contain all of the data.

```
\cs_new_protected:Npn \__siunitx_number_parse_finalise:
  {
    \tl_if_empty:NF \l__siunitx_number_parsed_tl
      {
        \tl_set:Nx \l__siunitx_number_parsed_tl
          {
            { \exp_not:V \l__siunitx_number_comparator_tl }
            \exp_not:V \l__siunitx_number_parsed_tl
            \exp_after:wN \__siunitx_number_parse_finalise:nw
```

```
                \l__siunitx_number_exponent_tl \q_stop
            }
        }
    }
\cs_new:Npn \__siunitx_number_parse_finalise:nw #1#2 \q_stop
    {
      { \exp_not:n {#1} }
      { \exp_not:n {#2} }
    }
```

(*End definition for* `\__siunitx_number_parse_finalise:` *and* `\__siunitx_number_parse_finalise:nw`.)

`\__siunitx_number_parse_loop:`
`\__siunitx_number_parse_loop_first:N`
`\__siunitx_number_parse_loop_main:NNNNN`
`\__siunitx_number_parse_loop_main_end:NN`
`\__siunitx_number_parse_loop_main_digit:NNNNN`
`\__siunitx_number_parse_loop_main_decimal:NN`
`\__siunitx_number_parse_loop_main_uncert:NNN`
`\__siunitx_number_parse_loop_main_sign:NNN`
`\__siunitx_number_parse_loop_main_store:NNN`
`\__siunitx_number_parse_loop_after_decimal:NNN`
`\__siunitx_number_parse_loop_root_swap:NNwNN`
`\__siunitx_number_parse_loop_break:wN`

At this stage, the partial input `\l__siunitx_number_arg_tl` will contain any mantissa, which may contain an uncertainty or complex part. Parsing this and allowing for all of the different formats possible is best done using a token-by-token approach. However, as at each stage only a subset of tokens are valid, the approach take is to use a set of semi-dedicated functions to parse different components along with switches to allow a sensible amount of code sharing.

```
\cs_new_protected:Npn \__siunitx_number_parse_loop:
  {
    \tl_clear:N \l__siunitx_number_partial_tl
    \exp_after:wN \__siunitx_number_parse_loop_first:NNN
      \exp_after:wN \l__siunitx_number_parsed_tl \exp_after:wN \c_true_bool
        \l__siunitx_number_arg_tl
        \q_recursion_tail \q_recursion_stop
  }
```

The very first token of the input is handled with a dedicated function. Valid cases here are

- Entirely blank if the original input was for example `+e10`: simply clean up if in the integer part of issue an error if in a second part (complex number, *etc.*).
- An integer part digit: pass through to the main collection routine.
- A decimal marker: store an empty integer part and move to the main collection routine for a decimal part.

Anything else is invalid and sends the code to the abort function.

```
\cs_new_protected:Npn \__siunitx_number_parse_loop_first:NNN #1#2#3
  {
    \quark_if_recursion_tail_stop_do:Nn #3
      {
        \bool_if:NTF #2
          { \tl_put_right:Nn #1 { { 1 } { } { } } }
          { \__siunitx_number_parse_loop_break:wN \q_recursion_stop }
      }
    \tl_if_in:NnTF \l__siunitx_number_input_digit_tl {#3}
      {
        \__siunitx_number_parse_loop_main:NNNNN
          #1 \c_true_bool \c_false_bool #2 #3
      }
      {
        \tl_if_in:NnTF \l_siunitx_number_input_decimal_tl {#3}
          {
```

```
            \tl_put_right:Nn #1 { { 0 } }
            \__siunitx_number_parse_loop_after_decimal:NNN #1 #2
          }
          { \__siunitx_number_parse_loop_break:wN }
      }
  }
```

A single function is used to cover the "main" part of numbers: finding real, complex or separated uncertainty parts and covering both the integer and decimal components. This works because these elements share a lot of concepts: a small number of switches can be used to differentiate between them. To keep the code at least somewhat readable, this main function deals with the validity testing but hands off other tasks to dedicated auxiliaries for each case.

The possibilities are

- The number terminates, meaning that some digits were collected and everything is simply tidied up (as far as the loop is concerned).
- A digit is found: this is the common case and leads to a storage auxiliary (which handles non-significant zeros).
- A decimal marker is found: only valid in the integer part and there leading to a store-and-switch situation.
- An open-uncertainty token: switch to the dedicated collector for uncertainties.
- A sign token (if allowed): stop collecting this number and restart collection for the second part.

```
\cs_new_protected:Npn \__siunitx_number_parse_loop_main:NNNNN #1#2#3#4#5
  {
    \quark_if_recursion_tail_stop_do:Nn #5
      { \__siunitx_number_parse_loop_main_end:NN #1#2 }
    \tl_if_in:NnTF \l__siunitx_number_input_digit_tl {#5}
      { \__siunitx_number_parse_loop_main_digit:NNNNN #1#2#3#4#5 }
      {
        \tl_if_in:NnTF \l_siunitx_number_input_decimal_tl {#5}
          {
            \bool_if:NTF #2
              { \__siunitx_number_parse_loop_main_decimal:NN #1 #4 }
              { \__siunitx_number_parse_loop_break:wN }
          }
          {
            \tl_if_in:NnTF \l__siunitx_number_input_uncert_open_tl {#5}
              { \__siunitx_number_parse_loop_main_uncert:NNN #1#2 #4 }
              {
                \bool_if:NTF #4
                  {
                    \tl_if_in:NnTF \l_siunitx_number_input_sign_tl {#5}
                      {
                        \__siunitx_number_parse_loop_main_sign:NNN
                          #1#2 #5
                      }
                      { \__siunitx_number_parse_loop_break:wN }
                  }
```

```
                  { \__siunitx_number_parse_loop_break:wN }
              }
          }
      }
  }
```

If the main loop finds the end marker then there is a tidy up phase. The current partial number is stored either as the integer or decimal, depending on the setting for the indicator switch. For the integer part, if no number has been collected then one or more non-significant zeros have been dropped. Exactly one zero is therefore needed to make sure the parsed result is correct.

```
\cs_new_protected:Npn \__siunitx_number_parse_loop_main_end:NN #1#2
  {
    \bool_lazy_and:nnT
      {#2} { \tl_if_empty_p:N \l__siunitx_number_partial_tl }
      { \tl_set:Nn \l__siunitx_number_partial_tl { 0 } }
    \tl_put_right:Nx #1
      {
        { \exp_not:V \l__siunitx_number_partial_tl }
        \bool_if:NT #2 { { } }
        { }
      }
  }
```

The most common case for the main loop collector is to find a digit. Here, in the integer part it is possible that zeros are non-significant: that is handled using a combination of a switch and a string test. Other than that, the situation here is simple: store the input and loop.

```
\cs_new_protected:Npn \__siunitx_number_parse_loop_main_digit:NNNNN #1#2#3#4#5
  {
    \bool_lazy_or:nnTF
      {#3} { ! \str_if_eq_p:nn {#5} { 0 } }
      {
        \tl_put_right:Nn \l__siunitx_number_partial_tl {#5}
        \__siunitx_number_parse_loop_main:NNNNN #1 #2 \c_true_bool #4
      }
      { \__siunitx_number_parse_loop_main:NNNNN #1 #2 \c_false_bool #4 }
  }
```

When a decimal marker was found, move the integer part to the store and then go back to the loop with the flags set correctly. There is the case of non-significant zeros to cover before that, of course.

```
\cs_new_protected:Npn \__siunitx_number_parse_loop_main_decimal:NN #1#2
  {
    \__siunitx_number_parse_loop_main_store:NNN #1 \c_false_bool \c_false_bool
    \__siunitx_number_parse_loop_after_decimal:NNN #1 #2
  }
```

Starting an uncertainty part means storing the number to date as in other cases, with the possibility of a blank decimal part allowed for. The uncertainty itself is collected by a dedicated function as it is extremely restricted.

```
\cs_new_protected:Npn \__siunitx_number_parse_loop_main_uncert:NNN #1#2#3
  {
    \__siunitx_number_parse_loop_main_store:NNN #1 #2 \c_false_bool
```

```
    \__siunitx_number_parse_uncert:NN #1
  }
```

If a sign is found, terminate the current number, store the sign as the first token of the second part and go back to do the dedicated first-token function.

```
\cs_new_protected:Npn \__siunitx_number_parse_loop_main_sign:NNN #1#2#3
  {
    \__siunitx_number_parse_loop_main_store:NNN #1 #2 \c_true_bool
    \tl_set:Nn \l__siunitx_number_flex_tl { {#3} }
    \__siunitx_number_parse_loop_first:NNN
      \l__siunitx_number_flex_tl \c_false_bool
  }
```

A common auxiliary for the various non-digit token functions: tidy up the integer and decimal parts of a number. Here, the two flags are used to indicate if empty decimal and uncertainty parts should be included in the storage cycle.

```
\cs_new_protected:Npn \__siunitx_number_parse_loop_main_store:NNN #1#2#3
  {
    \tl_if_empty:NT \l__siunitx_number_partial_tl
      { \tl_set:Nn \l__siunitx_number_partial_tl { 0 } }
    \tl_put_right:Nx #1
      {
        { \exp_not:V \l__siunitx_number_partial_tl }
        \bool_if:NT #2 { { } }
        \bool_if:NT #3 { { } }
      }
    \tl_clear:N \l__siunitx_number_partial_tl
  }
```

After a decimal marker there has to be a digit if there wasn't one before it. That is handled by using a dedicated function, which checks for an empty integer part first then either simply hands off or looks for a digit.

```
\cs_new_protected:Npn \__siunitx_number_parse_loop_after_decimal:NNN #1#2#3
  {
    \tl_if_blank:fTF { \exp_after:wN \use_none:n #1 }
      {
        \quark_if_recursion_tail_stop_do:Nn #3
          { \__siunitx_number_parse_loop_break:wN \q_recursion_stop }
        \tl_if_in:NnTF \l__siunitx_number_input_digit_tl {#1}
          {
            \tl_put_right:Nn \l__siunitx_number_partial_tl {#3}
            \__siunitx_number_parse_loop_main:NNNNN
              #1 \c_false_bool \c_true_bool #2
          }
          { \__siunitx_number_parse_loop_break:wN }
      }
      {
        \__siunitx_number_parse_loop_main:NNNNN
          #1 \c_false_bool \c_true_bool #2 #3
      }
  }
```

Something is not right: remove all of the remaining tokens from the number and clear the storage areas as a signal for the next part of the code.

```
\cs_new_protected:Npn \__siunitx_number_parse_loop_break:wN
```

```
  #1 \q_recursion_stop
  {
    \tl_clear:N \l__siunitx_number_flex_tl
    \tl_clear:N \l__siunitx_number_parsed_tl
  }
```

(*End definition for* `\__siunitx_number_parse_loop:` *and others.*)

`\__siunitx_number_parse_sign:`
`\__siunitx_number_parse_sign_aux:Nw`

The first token of a number after a comparator could be a sign. A quick check is made and if found stored. For the number to be valid it has to be more than just a sign, so the next part of the chain is only called if that is the case.

```
\cs_new_protected:Npn \__siunitx_number_parse_sign:
  {
    \exp_after:wN \__siunitx_number_parse_sign_aux:Nw
      \l__siunitx_number_arg_tl \q_stop
  }
\cs_new_protected:Npn \__siunitx_number_parse_sign_aux:Nw #1#2 \q_stop
  {
    \tl_if_in:NnTF \l_siunitx_number_input_sign_tl {#1}
      {
        \tl_set:Nn \l__siunitx_number_arg_tl {#2}
        \bool_lazy_and:nnTF
          { \token_if_eq_charcode_p:NN #1 + }
          { ! \l__siunitx_number_explicit_plus_bool }
          { \tl_set:Nn \l__siunitx_number_parsed_tl { { } } }
          { \tl_set:Nn \l__siunitx_number_parsed_tl { {#1} } }
      }
      { \tl_set:Nn \l__siunitx_number_parsed_tl { { } } }
    \tl_if_empty:NTF \l__siunitx_number_arg_tl
      { \tl_clear:N \l__siunitx_number_parsed_tl }
      { \__siunitx_number_parse_exponent: }
  }
```

(*End definition for* `\__siunitx_number_parse_sign:` *and* `\__siunitx_number_parse_sign_aux:Nw`.)

`\__siunitx_number_parse_uncert:NN`
`\__siunitx_number_parse_uncert:NNNN`
`\__siunitx_number_parse_uncert_auxi:NN`
`\__siunitx_number_parse_uncert_auxii:NN`
`\__siunitx_number_parse_uncert_auxii:N`
`\__siunitx_number_parse_uncert_marker:N`
`\__siunitx_number_parse_uncert_extend:nnnN`
`\__siunitx_number_parse_uncert_after:N`

Parsing a combined uncertainty has a very restricted range of allowed tokens. A closing uncertainty token in the first place is an error, so we filter that out explicitly. After that, we check for digits, which require checking for significant digits. The non-digit function is separate to make the flow clearer.

```
\cs_new_protected:Npn \__siunitx_number_parse_uncert:NN #1#2
  {
    \quark_if_recursion_tail_stop_do:Nn #2
      { \__siunitx_number_parse_loop_break:wN \q_recursion_stop }
    \tl_if_in:NnTF \l__siunitx_number_input_uncert_close_tl {#2}
      { \__siunitx_number_parse_loop_break:wN }
      {
        \__siunitx_number_parse_uncert:NNNN
          #1 \c_false_bool \__siunitx_number_parse_uncert_auxi:NN #2
      }
  }
```

Deal with digits: a simple question of whether they are significant.

```
\cs_new_protected:Npn \__siunitx_number_parse_uncert:NNNN #1#2#3#4
  {
```

```
    \quark_if_recursion_tail_stop_do:Nn #4
      { \__siunitx_number_parse_loop_break:wN \q_recursion_stop }
    \tl_if_in:NnTF \l__siunitx_number_input_digit_tl {#4}
      {
        \bool_lazy_or:nnTF
          {#2} { ! \str_if_eq_p:nn {#4} { 0 } }
          {
            \tl_put_right:Nn \l__siunitx_number_partial_tl {#4}
            \__siunitx_number_parse_uncert:NNNN #1 \c_true_bool #3
          }
          { \__siunitx_number_parse_uncert:NNNN #1 \c_false_bool #3 }
      }
      { #3 #1#4 }
  }
```

For the two auxiliaries, the difference is the handling of a decimal marker: one may be present, but only exactly one.

```
\cs_new_protected:Npn \__siunitx_number_parse_uncert_auxi:NN #1#2
  {
    \tl_if_in:NnTF \l__siunitx_number_input_uncert_close_tl {#2}
      {
        \__siunitx_number_parse_uncert_auxiii:N #1
        \__siunitx_number_parse_uncert_after:N
      }
      {
        \tl_if_in:NnTF \l_siunitx_number_input_decimal_tl {#2}
          { \__siunitx_number_parse_uncert_marker:N #1 }
          { \__siunitx_number_parse_loop_break:wN }
      }
  }
\cs_new_protected:Npn \__siunitx_number_parse_uncert_auxii:NN #1#2
  {
    \tl_if_in:NnTF \l__siunitx_number_input_uncert_close_tl {#2}
      {
        \__siunitx_number_parse_uncert_auxiii:N #1
        \__siunitx_number_parse_uncert_after:N
      }
      { \__siunitx_number_parse_loop_break:wN }
  }
```

Deal with the closing bracket, which might leave us with nothing if there were no significant digits.

```
\cs_new_protected:Npn \__siunitx_number_parse_uncert_auxiii:N #1
  {
    \tl_if_empty:NTF \l__siunitx_number_partial_tl
      {
        \tl_put_right:Nx #1
          {
            {
              \bool_if:NT \l__siunitx_number_zero_uncert_bool
                { { S } { 0 } }
            }
          }
      }
      {
```

```
        \tl_set:Nx \l__siunitx_number_partial_tl
          { { S } { \exp_not:V \l__siunitx_number_partial_tl } }
         \__siunitx_number_parse_loop_main_store:NNN #1
           \c_false_bool \c_false_bool
      }
  }
```

Handling a decimal marker in the uncertainty is a bit tricky: we need to make sure it's valid. First, we need to be sure that the integer part of the captured uncertainty is not too long. Then we need to check that the decimal part is not too long, and extend the decimal if it is. Both of these require data from the collected partial number, so we extract that first. Checking the decimal part needs the length of the not-yet-collected uncertainty. Handily, we know that it should be a set of digits then a closing marker. So we can use that as a length: if it's too long we can stop.

```
\cs_new_protected:Npn \__siunitx_number_parse_uncert_marker:N #1
  { \exp_after:wN \__siunitx_number_parse_uncert_marker:nnnN #1 #1 }
\cs_new_protected:Npn \__siunitx_number_parse_uncert_marker:nnnN #1#2#3#4
  {
    \int_compare:nNnTF
      { \tl_count:N \l__siunitx_number_partial_tl } > { \tl_count:n {#2} }
      { \__siunitx_number_parse_loop_break:wN }
      { \__siunitx_number_parse_uncert_marker:nNw {#3} #4 }
  }
\cs_new_protected:Npn \__siunitx_number_parse_uncert_marker:nNw
  #1#2#3 \q_recursion_tail \q_recursion_stop
  {
    \int_compare:nNnTF
      { \tl_count:n {#3} - 1 } = { \tl_count:n {#1} }
      {
        \str_if_eq:eeTF
          { \exp_not:V \l__siunitx_number_partial_tl }
          { \prg_replicate:nn { \tl_count:N \l__siunitx_number_partial_tl } { 0 } }
          {
            \__siunitx_number_parse_uncert:NNNN
              #2 \c_false_bool
          }
          {
            \__siunitx_number_parse_uncert:NNNN
              #2 \c_true_bool
          }
            \__siunitx_number_parse_uncert_auxii:NN
      }
      { \exp_after:wN \__siunitx_number_parse_uncert_extend:nnnN #2 #2 }
    #3 \q_recursion_tail \q_recursion_stop
  }
\cs_new_protected:Npn \__siunitx_number_parse_uncert_extend:nnnN #1#2#3#4
  {
    \tl_set:Nn #4 { {#1} {#2} { #3 0 } }
    \__siunitx_number_parse_uncert:NNNN #4 \c_true_bool
      \__siunitx_number_parse_uncert_auxii:NN
  }
```

No further tokens are allowed after an uncertainty in parenthesis.

```
\cs_new_protected:Npn \__siunitx_number_parse_uncert_after:N #1
```

```
  {
    \quark_if_recursion_tail_stop:N #1
    \__siunitx_number_parse_loop_break:wN
  }
```

(*End definition for* `\__siunitx_number_parse_uncert:NN` *and others.*)

2.4 Processing numbers

```
\l__siunitx_number_drop_exponent_bool
\l__siunitx_number_drop_uncertainty_bool
\l__siunitx_number_drop_zero_decimal_bool
\l__siunitx_number_exponent_mode_tl
\l__siunitx_number_exponent_fixed_int
\l__siunitx_number_min_decimal_int
\l__siunitx_number_min_integer_int
\l__siunitx_number_round_half_even_bool
\l__siunitx_number_round_mode_tl
\l__siunitx_number_round_pad_bool
\l__siunitx_number_round_precision_int
```

```
\keys_define:nn { siunitx }
  {
    drop-exponent .bool_set:N =
      \l__siunitx_number_drop_exponent_bool ,
    drop-uncertainty .bool_set:N =
      \l__siunitx_number_drop_uncertainty_bool ,
    drop-zero-decimal .bool_set:N =
      \l__siunitx_number_drop_zero_decimal_bool ,
    exponent-mode .choices:nn =
      { engineering , fixed , input , scientific }
      { \tl_set_eq:NN \l__siunitx_number_exponent_mode_tl \l_keys_choice_tl } ,
    fixed-exponent .int_set:N =
      \l__siunitx_number_exponent_fixed_int ,
    minimum-decimal-digits .int_set:N =
      \l__siunitx_number_min_decimal_int ,
    minimum-integer-digits .int_set:N =
      \l__siunitx_number_min_integer_int ,
    round-half .choice: ,
    round-half / even .code:n =
      { \bool_set_true:N \l__siunitx_number_round_half_even_bool } ,
    round-half / up .code:n =
      { \bool_set_false:N \l__siunitx_number_round_half_even_bool } ,
    round-minimum .code:n =
      { \__siunitx_number_set_round_min:n {#1} } ,
    round-mode .choices:nn =
      { figures , none , places, uncertainty }
      { \tl_set_eq:NN \l__siunitx_number_round_mode_tl \l_keys_choice_tl } ,
    round-pad .bool_set:N =
      \l__siunitx_number_round_pad_bool ,
    round-precision .int_set:N =
      \l__siunitx_number_round_precision_int ,
  }
\bool_new:N \l__siunitx_number_round_half_even_bool
\tl_new:N \l__siunitx_number_exponent_mode_tl
\tl_new:N \l__siunitx_number_round_mode_tl
```

(*End definition for* `\l__siunitx_number_drop_exponent_bool` *and others.*)

`\l__siunitx_number_round_min_tl` For storing the minimum for rounding.

```
\tl_new:N \l__siunitx_number_round_min_tl
```

(*End definition for* `\l__siunitx_number_round_min_tl`.)

__siunitx_number_set_round_min:n
__siunitx_number_set_round_min:nnnnnnn

For setting the rounding minimum, the aim is to do as much of the work now as possible. That's mainly a question of checking if there are any significant digits in the mantissa given.

```
\cs_new_protected:Npn \__siunitx_number_set_round_min:n #1
  {
    \siunitx_number_parse:nN {#1} \l__siunitx_number_tmp_tl
    \exp_after:wN \__siunitx_number_set_round_min:nnnnnnn \l__siunitx_number_tmp_tl
  }
\cs_new:Npn \__siunitx_number_set_round_min:nnnnnnn #1#2#3#4#5#6#7
  {
    \tl_set:Nx \l__siunitx_number_round_min_tl
      {
        \bool_lazy_and:nnF
          { \str_if_eq_p:nn {#3} { 0 } }
          {
            \str_if_eq_p:ee
              { \exp_not:n {#4} }
              { \prg_replicate:nn { \tl_count:n {#4} } { 0 } }
          }
          { \exp_not:n { {#3} {#4} } }
      }
  }
```

(*End definition for* `\__siunitx_number_set_round_min:n` *and* `\__siunitx_number_set_round_min:nnnnnnn`.)

\siunitx_number_process:NN
__siunitx_number_process:nnnnnnnNN

A top-level interface for the processing tools. Rounding happens in all cases, but exponents are only processed if the value is not 0.

```
\cs_new_protected:Npn \siunitx_number_process:NN #1#2
  {
    \tl_if_empty:NTF #1
      { \tl_clear:N #2 }
      {
        \__siunitx_number_drop_uncertainty:NN #1 #2
        \exp_after:wN \__siunitx_number_process:nnnnnnnNN #2 #2 #2
        \__siunitx_number_drop_exponent:NN #2 #2
        \__siunitx_number_zero_decimal:NN #2 #2
        \__siunitx_number_digits:NN #2 #2
      }
  }
\cs_new_protected:Npn \__siunitx_number_process:nnnnnnnNN #1#2#3#4#5#6#7#8#9
  {
    \bool_lazy_and:nnTF
      { \str_if_eq_p:nn {#3} { 0 } }
      {
        \str_if_eq_p:ee
          { \exp_not:n {#4} } { \prg_replicate:nn { \tl_count:n {#4} } { 0 } }
      }
      { \__siunitx_number_round:NN #8 #9 }
      {
        \__siunitx_number_exponent:NN #8 #9
        \__siunitx_number_round:NN #9 #9
      }
  }
```

(*End definition for* `\siunitx_number_process:NN` *and* `\__siunitx_number_process:nnnnnnnNN`. *This function is documented on page 39.*)

__siunitx_number_exponent:NN
siunitx_number_exponent_engineering:nnnnnnn
__siunitx_number_exponent_fixed:nnnnnnn
__siunitx_number_exponent_input:nnnnnnn
_siunitx_number_exponent_scientific:nnnnnnn
__siunitx_number_exponent_fixed:nnnnnnnn
siunitx_number_exponent_scientific:nnnnnnnn
__siunitx_number_exponent_scientific:nnnw
__siunitx_number_exponent_shift:nnn
__siunitx_number_exponent_shift:nnf
__siunitx_number_exponent_shift_down:nnnw
__siunitx_number_exponent_shift_down:nnn
__siunitx_number_exponent_shift_down:nw
__siunitx_number_exponent_shift_up:nnn
__siunitx_number_exponent_shift_up:nnw
__siunitx_number_exponent_shift_up_aux:nnn
__siunitx_number_exponent_shift_up_aux:fnn
__siunitx_number_exponent_shift_up_aux:ffn
__siunitx_number_exponent_shift_uncert:nw
siunitx_number_exponent_shift_uncert_S:nnnn
siunitx_number_exponent_shift_uncert_S:fnnn
__siunitx_number_exponent_uncert:n
__siunitx_number_exponent_finalise:n
itx_number_exponent_engineering_aux:nnnnnnn
_siunitx_number_exponent_engineering_0:nnnn
_siunitx_number_exponent_engineering_1:nnnn
_siunitx_number_exponent_engineering_2:nnnn
__siunitx_number_exponent_engineering:nnNw
unitx_number_exponent_engineering_uncert:nn
tx_number_exponent_engineering_uncert_S:nnn

Manipulating an exponent is done using a single expansion function *unless* dealing with engineering-style output. The latter is easier to handle by first converting to scientific output, then post-processing. (Once e-type expansion is generally available, this will be handling using a single `\tl_set:Nx`.)

```
\cs_new_protected:Npn \__siunitx_number_exponent:NN #1#2
  {
    \tl_set:Nx #2
      {
        \cs:w
          __siunitx_number_exponent_ \l__siunitx_number_exponent_mode_tl :nnnnnnn
          \exp_after:wN
        \cs_end: #1
      }
    \str_if_eq:VnT \l__siunitx_number_exponent_mode_tl { engineering }
      {
        \tl_set:Nx #2
          { \exp_after:wN \__siunitx_number_exponent_engineering_aux:nnnnnnn #2 }
      }
  }
\cs_new:Npn \__siunitx_number_exponent_fixed:nnnnnnn #1#2#3#4#5#6#7
  {
    \exp_args:Nf \__siunitx_number_exponent_fixed:nnnnnnnn
      { \int_eval:n { \l__siunitx_number_exponent_fixed_int - (#6#7) } }
      {#1} {#2} {#3} {#4} {#5} {#6} {#7}
  }
\cs_new:Npn \__siunitx_number_exponent_fixed:nnnnnnnn #1#2#3#4#5#6#7#8
  {
    \exp_not:n { {#2} {#3} }
    \__siunitx_number_exponent_shift:nnn {#1} {#4} {#5}
    \__siunitx_number_exponent_uncert:n {#6}
    \exp_not:n { {#7} } { \int_use:N \l__siunitx_number_exponent_fixed_int }
  }
\cs_new:Npn \__siunitx_number_exponent_input:nnnnnnn #1#2#3#4#5#6#7
  { \exp_not:n { {#1} {#2} {#3} {#4} {#5} {#6} {#7} } }
```

To convert to scientific notation, the key question is to find the number of significant places. That is easy enough if the number has a non-zero integer component. For a pure decimal, we have to trim off leading zeros in a loop.

```
\cs_new:Npn \__siunitx_number_exponent_scientific:nnnnnnn #1#2#3#4#5#6#7
  {
    \exp_args:Nf \__siunitx_number_exponent_scientific:nnnnnnnn
      { \int_eval:n { \tl_count:n {#3} } }
      {#1} {#2} {#3} {#4} {#5} {#6} {#7}
  }
\cs_new:Npn \__siunitx_number_exponent_scientific:nnnnnnnn #1#2#3#4#5#6#7#8
  {
    \exp_not:n { {#2} {#3} }
    \int_compare:nNnTF {#1} = 1
      {
        \str_if_eq:nnTF {#4} { 0 }
          {
```

```
            \__siunitx_number_exponent_scientific:nnnw
              { 0 } {#6} { #7#8 } #5 \q_stop
          }
          { \exp_not:n { {#4} {#5} {#6} {#7} {#8} } }
      }
      {
        \__siunitx_number_exponent_shift:nnn { #1 - 1 } {#4} {#5}
        \__siunitx_number_exponent_uncert:n {#6}
        \__siunitx_number_exponent_finalise:n { #1 + #7#8 - 1 }
      }
  }
\cs_new_eq:NN \__siunitx_number_exponent_engineering:nnnnnnn
  \__siunitx_number_exponent_scientific:nnnnnnn
\cs_new:Npn \__siunitx_number_exponent_scientific:nnnw #1#2#3#4#5 \q_stop
  {
    \str_if_eq:nnTF {#4} { 0 }
      {
        \__siunitx_number_exponent_scientific:nnnw
          { #1 - 1 } {#2} {#3} #5 \q_stop
      }
      {
        \exp_not:n { {#4} {#5} {#2} }
        \__siunitx_number_exponent_finalise:n { #1 + #3 - 1 }
      }
  }
```

When adjusting the exponent position, there are two paths depending on which way the shift takes place.

```
\cs_new:Npn \__siunitx_number_exponent_shift:nnn #1#2#3
  {
    \int_compare:nNnTF {#1} > 0
      { \__siunitx_number_exponent_shift_down:nnnw {#1} {#3} { } #2 \q_stop }
      {
        \int_compare:nNnTF {#1} < 0
          { \__siunitx_number_exponent_shift_up:nnn {#1} {#2} {#3} }
          { {#2} {#3} }
      }
  }
\cs_generate_variant:Nn \__siunitx_number_exponent_shift:nnn { nnf }
```

For shifting the exponent down, there is first a loop to reserve the integer part before doing the work: that of course has to be undone for any remainder at he end of the process.

```
\cs_new:Npn \__siunitx_number_exponent_shift_down:nnnw #1#2#3#4#5 \q_stop
  {
    \tl_if_blank:nTF {#5}
      { \__siunitx_number_exponent_shift_down:nnn {#1} { #4 #3 } {#2} }
      { \__siunitx_number_exponent_shift_down:nnnw {#1} {#2} { #4 #3 } #5 \q_stop }
  }
\cs_new:Npn \__siunitx_number_exponent_shift_down:nnn #1#2#3
  {
    \int_compare:nNnTF {#1} = 0
      { { \tl_reverse:n {#2} } \exp_not:n { {#3} } }
      { \__siunitx_number_exponent_shift_down:nw {#1} #2 \q_stop {#3} }
  }
```

```
\cs_new:Npn \__siunitx_number_exponent_shift_down:nw #1#2#3 \q_stop #4
  {
    \tl_if_blank:nTF {#3}
      { \__siunitx_number_exponent_shift_down:nnn { #1 - 1 } { 0 } { #2#4 } }
      { \__siunitx_number_exponent_shift_down:nnn { #1 - 1 } {#3} { #2#4 } }
  }
```

For shifting the exponent up, we can run out of decimal digits, at which point filling is easy. Other than that a simple loop as we are picking input off the front of the decimal part. We also need to deal with leading zeros: these cannot accumulate.

```
\cs_new:Npn \__siunitx_number_exponent_shift_up:nnn #1#2#3
  {
    \tl_if_blank:nTF {#3}
      {
        \__siunitx_number_exponent_shift_up_aux:ffn
          { \int_eval:n { #1 + 1 } }
          { \str_if_eq:nnF {#2} { 0 } {#2} 0 }
          { }
        \__siunitx_number_exponent_shift_uncert:nw { 1 }
      }
      {  \__siunitx_number_exponent_shift_up:nnw {#1} {#2} #3 \q_stop }
  }
\cs_new:Npn \__siunitx_number_exponent_shift_up:nnw #1#2#3#4 \q_stop
  {
    \__siunitx_number_exponent_shift_up_aux:ffn
      { \int_eval:n { #1 + 1 } }
      { \str_if_eq:nnF {#2} { 0 } {#2} #3 }
      {#4}
  }
\cs_new:Npn \__siunitx_number_exponent_shift_up_aux:nnn #1#2#3
  {
    \int_compare:nNnTF {#1} = 0
      { \exp_not:n { {#2} {#3} } }
      {
        \tl_if_blank:nTF {#3}
          {
            {
              \exp_not:n {#2}
              \prg_replicate:nn { \int_abs:n {#1} } { 0 }
            }
            { }
            \__siunitx_number_exponent_shift_uncert:nw { \int_abs:n {#1} }
          }
          { \__siunitx_number_exponent_shift_up:nnn {#1} {#2} {#3} }
      }
  }
\cs_generate_variant:Nn \__siunitx_number_exponent_shift_up_aux:nnn { f , ff }
```

If the shift has put digits into the integer part, we have to adjust the uncertainty accordingly. First, we grab the data, then adjust by the number of places that have been transferred.

```
\cs_new:Npn \__siunitx_number_exponent_shift_uncert:nw
  #1#2 \__siunitx_number_exponent_uncert:n #3
  {
    \tl_if_blank:nTF {#3}
```

```
      {
        #2
        \__siunitx_number_exponent_uncert:n { }
      }
      {
        \str_if_eq:nnTF {#3} { 0 }
          {
            #2
            \__siunitx_number_exponent_uncert:n { { S } { 0 } }
          }
          {
            \use:c { __siunitx_number_exponent_shift_uncert_ \use_i:nn #3 :fnnn }
              { \prg_replicate:nn {#1} { 0 } }
              {#2}
              #3
          }
      }
  }
\cs_new:Npn \__siunitx_number_exponent_shift_uncert_S:nnnn #1#2#3#4
  {
    #2
    \__siunitx_number_exponent_uncert:n { { S } { #4#1 } }
  }
\cs_generate_variant:Nn \__siunitx_number_exponent_shift_uncert_S:nnnn { f }
\cs_new:Npn \__siunitx_number_exponent_uncert:n #1 { { \exp_not:n {#1} } }
```

Tidy up the exponent to put the sign in the right place.

```
\cs_new:Npn \__siunitx_number_exponent_finalise:n #1
  {
    \int_compare:nNnTF {#1} < 0
      { { - } }
      { { } }
      { \int_abs:n {#1} }
  }
```

This could (and eventually will) be combined with the main function above: that will need e-type expansion. The input has already been normalised such that the integer part is in the range $1 \leq n < 10$. Thus there are only three cases to deal with, depending on the required adjustment to the exponent.

```
\cs_new:Npn \__siunitx_number_exponent_engineering_aux:nnnnnnn #1#2#3#4#5#6#7
  {
    \exp_not:n { {#1} {#2} }
    \use:c
      {
        __siunitx_number_exponent_engineering_
     \int_compare:nNnTF {#6#7} < 0
       {
         \int_case:nnF { \int_mod:nn { #7 } { 3 } }
           {
             { 1 } { 2 }
             { 2 } { 1 }
           }
           { 0 }
       }
       { \int_mod:nn {#7} { 3 } }
```

```
        :nnnn
      }
        {#3} {#4} {#5} {#6#7}
  }
\cs_new:cpn { __siunitx_number_exponent_engineering_0:nnnn } #1#2#3#4
  {
    \exp_not:n { {#1} {#2} {#3} }
    \__siunitx_number_exponent_finalise:n {#4}
  }
\cs_new:cpn { __siunitx_number_exponent_engineering_1:nnnn } #1#2#3#4
  {
    \tl_if_blank:nTF {#2}
      {
        { \exp_not:n { #1 0 } } { }
        { \__siunitx_number_exponent_engineering_uncert:nn {#3} { 0 } }
      }
      {
        { \exp_not:n {#1} \exp_not:o { \tl_head:w #2 \q_stop } }
        { \exp_not:f { \tl_tail:n {#2} } }
        { \exp_not:n {#3} }
      }
    \__siunitx_number_exponent_finalise:n { #4 - 1 }
  }
\cs_new:cpn { __siunitx_number_exponent_engineering_2:nnnn } #1#2#3#4
  {
    \tl_if_blank:nTF {#2}
      {
        { \exp_not:n { #1 00 } } { }
        { \__siunitx_number_exponent_engineering_uncert:nn {#3} { 00 } }
      }
      { \__siunitx_number_exponent_engineering:nnNw {#1} {#3} #2 \q_stop }
    \__siunitx_number_exponent_finalise:n { #4 - 2 }
  }
\cs_new:Npn \__siunitx_number_exponent_engineering:nnNw #1#2#3#4 \q_stop
  {
    \tl_if_blank:nTF {#4}
      {
        { \exp_not:n { #1#3 0 } } { }
        { \__siunitx_number_exponent_engineering_uncert:nn {#2} { 0 } }
      }
      {
        { \exp_not:n {#1#3} \exp_not:o { \tl_head:w #4 \q_stop } }
        { \exp_not:f { \tl_tail:n {#4} } }
        { \exp_not:n {#2} }
      }
  }
\cs_new:Npn \__siunitx_number_exponent_engineering_uncert:nn #1#2
  {
    \tl_if_blank:nF {#1}
      {
        \use:c { __siunitx_number_exponent_engineering_uncert_ \use_i:nn #1 :nnn }
          #1 {#2}
      }
  }
```

```
\cs_new:Npn \__siunitx_number_exponent_engineering_uncert_S:nnn #1#2#3
  {
    { S }
    {
      \exp_not:n {#2}
      \str_if_eq:nnF {#2} { 0 } {#3}
    }
  }
```

(*End definition for* `\__siunitx_number_exponent:NN` *and others.*)

`\__siunitx_number_digits:NN`
`\__siunitx_number_digits:nnnnnnn`
`\__siunitx_number_digits:Nn`
`\__siunitx_number_digits:nn`
`\__siunitx_number_digits_S:n`

Forcing a minimum number of digits in each part is quite easy. As the common case is that we don't do anything here, there is no real need to optimise the calculation (normally also numbers have only a few digits).

```
\cs_new_protected:Npn \__siunitx_number_digits:NN #1#2
  {
    \tl_set:Nx #2
      { \exp_after:wN \__siunitx_number_digits:nnnnnnn #1 }
  }
\cs_new:Npn \__siunitx_number_digits:nnnnnnn #1#2#3#4#5#6#7
  {
    \exp_not:n { {#1} {#2} }
    {
      \__siunitx_number_digits:Nn \l__siunitx_number_min_integer_int {#3}
      \exp_not:n {#3}
    }
    {
      \exp_not:n {#4}
      \__siunitx_number_digits:Nn \l__siunitx_number_min_decimal_int {#4}
    }
    { \tl_if_blank:nF {#5} { \__siunitx_number_digits_uncert:nn #5 } }
    \exp_not:n { {#6} {#7} }
  }
\cs_new:Npn \__siunitx_number_digits:Nn #1#2
  {
    \int_compare:nNnT
      { #1 - \tl_count:n {#2} } > 0
      { \prg_replicate:nn { #1 - \tl_count:n {#2}  } { 0 } }
  }
\cs_new:Npn \__siunitx_number_digits_uncert:nn #1#2
  {
    { #1 }
    { \use:c { __siunitx_number_digits_uncert_ #1 :n } {#2} }
  }
\cs_new:Npn \__siunitx_number_digits_uncert_S:n #1
  {
    \exp_not:n {#1}
    \__siunitx_number_digits:Nn \l__siunitx_number_min_decimal_int {#1}
  }
```

(*End definition for* `\__siunitx_number_digits:NN` *and others.*)

`\__siunitx_number_drop_exponent:NN`
`\__siunitx_number_drop_exponent:nnnnnnn`

Simple stripping of the exponent.

```
\cs_new_protected:Npn \__siunitx_number_drop_exponent:NN #1#2
```

```
  {
    \bool_if:NT \l__siunitx_number_drop_exponent_bool
      {
        \tl_set:Nx #2
          { \exp_after:wN \__siunitx_number_drop_exponent:nnnnnnn #1 }
      }
  }
\cs_new:Npn \__siunitx_number_drop_exponent:nnnnnnn #1#2#3#4#5#6#7
  { \exp_not:n { {#1} {#2} {#3} {#4} {#5} { } { 0 } } }
```

(*End definition for* `\__siunitx_number_drop_exponent:NN` *and* `\__siunitx_number_drop_exponent:nnnnnnn`.)

`\__siunitx_number_drop_uncertainty:NN`
`\__siunitx_number_drop_uncertainty:nnnnnnn`

Simple stripping of the uncertainty.

```
\cs_new_protected:Npn \__siunitx_number_drop_uncertainty:NN #1#2
  {
    \bool_if:NTF \l__siunitx_number_drop_uncertainty_bool
      {
        \tl_set:Nx #2
          { \exp_after:wN \__siunitx_number_drop_uncertainty:nnnnnnn #1 }
      }
      { \tl_set_eq:NN #2 #1 }

  }
\cs_new:Npn \__siunitx_number_drop_uncertainty:nnnnnnn #1#2#3#4#5#6#7
  { \exp_not:n { {#1} {#2} {#3} {#4} { } {#6} {#7} } }
```

(*End definition for* `\__siunitx_number_drop_uncertainty:NN` *and* `\__siunitx_number_drop_uncertainty:nnnnnnn`.)

`\__siunitx_number_round:NN`
`\__siunitx_number_round_none:nnnnnnn`

Rounding is at the top level simple enough: fire off the expandable set up which does the work.

```
\cs_new_protected:Npn \__siunitx_number_round:NN #1#2
  {
    \tl_set:Nx #2
      {
        \cs:w
          __siunitx_number_round_ \l__siunitx_number_round_mode_tl :nnnnnnn
          \exp_after:wN
        \cs_end: #1
      }
  }
\cs_new:Npn \__siunitx_number_round_none:nnnnnnn #1#2#3#4#5#6#7
  { \exp_not:n { {#1} {#2} {#3} {#4} {#5} {#6} {#7} } }
```

(*End definition for* `\__siunitx_number_round:NN` *and* `\__siunitx_number_round_none:nnnnnnn`.)

`\__siunitx_number_round:nnn`
`\__siunitx_number_round:fnn`
`\__siunitx_number_round_auxi:nnnN`
`\__siunitx_number_round_auxii:nnnN`
`\__siunitx_number_round_auxiii:nnnN`
`\__siunitx_number_round_auxiv:nnN`
`\__siunitx_number_round_auxv:nnN`
`\__siunitx_number_round_auxvi:nN`
`\__siunitx_number_round_auxvii:nnN`
`\__siunitx_number_round_auxviii:nnN`
`\__siunitx_number_round_final_integer:nnw`
`\__siunitx_number_round_final_decimal:nnw`
`\__siunitx_number_round_final_signicant:n`
`\__siunitx_number_round_final_signicant:N`
`\__siunitx_number_round_final_signicant:w`
`\__siunitx_number_round_final_output:nn`
`\__siunitx_number_round_final_output:ff`
`\__siunitx_number_round_final:nn`
`\__siunitx_number_round_final:fn`

Actually doing the rounding needs us to work from the least significant digit, so we start by reversing the input. We *could* also drop digits in this phase, but tracking everything would be horrible, so we go slightly slower but clearer and split the steps. First we reverse the decimal part, then the integer.

```
\cs_new:Npn \__siunitx_number_round:nnn #1#2#3
  {
    \__siunitx_number_round_auxi:nnnN {#1} {#2} { }
      #3 \q_recursion_tail \q_recursion_stop
  }
```

```
\cs_generate_variant:Nn \__siunitx_number_round:nnn { f }
\cs_new:Npn \__siunitx_number_round_auxi:nnnN #1#2#3#4
  {
    \quark_if_recursion_tail_stop_do:Nn #4
      {
        \__siunitx_number_round_auxii:nnnN {#1} {#3} { } #2
          \q_recursion_tail \q_recursion_stop
      }
    \__siunitx_number_round_auxi:nnnN {#1} {#2} {#4#3}
  }
\cs_new:Npn \__siunitx_number_round_auxii:nnnN #1#2#3#4
  {
    \quark_if_recursion_tail_stop_do:Nn #4
      {
        \tl_if_blank:nTF {#2}
          {
            \__siunitx_number_round_auxiv:nnnN {#1} { } { } #3
              \q_recursion_tail \q_recursion_stop
          }
          {
            \__siunitx_number_round_auxiii:nnnN {#1} {#3} { } #2
              \q_recursion_tail \q_recursion_stop
          }
      }
    \__siunitx_number_round_auxii:nnnN {#1} {#2} {#4#3}
  }
```

We now have the input reversed plus how many digits we need to discard (`#1`). We have two functions, one which deals with the decimal part, one of which deals with the integer. In the latter, we should never hit the end before we've dropped all the digits: the fixed-zero is a fall-back in case something weird happens. For the integer case, we need to collect up zeros to pad the length back out correctly later. We also have to cover the case where we round to exactly place above the length of the integer: that may product a value of $1\ldots$: we tidy up the case where it comes out as 0 later.

```
\cs_new:Npn \__siunitx_number_round_auxiii:nnnN #1#2#3#4
  {
    \quark_if_recursion_tail_stop_do:Nn #4
      {
        \__siunitx_number_round_auxiv:nnnN {#1} { } {#3} #2
          \q_recursion_tail \q_recursion_stop
      }
    \int_compare:nNnTF {#1} > 0
      {
        \exp_args:Nf \__siunitx_number_round_auxiii:nnnN
          { \int_eval:n { #1 - 1 } } {#2} { #4#3 }
      }
      { \__siunitx_number_round_auxv:nnN {#3} {#2} #4 }
  }
\cs_new:Npn \__siunitx_number_round_auxiv:nnnN #1#2#3#4
  {
    \quark_if_recursion_tail_stop_do:Nn #4
      {
        \int_compare:nNnTF {#1} = 0
          {
```

```
            \__siunitx_number_round_auxvi:nnN {#3} {#2}
              0 \q_recursion_tail \q_recursion_stop
          }
          { { 0 } { } }
      }
    \int_compare:nNnTF {#1} > 0
      {
        \exp_args:Nf \__siunitx_number_round_auxiv:nnnN
          { \int_eval:n { #1 - 1 } } { #2 0 } { #4#3 }
      }
      { \__siunitx_number_round_auxvi:nnN {#3} {#2} #4 }
  }
```

The lead off to rounding proper needs to deal with the half-even rule: it can only apply at this stage, when the *discarded* value can be exactly half.

```
\cs_new:Npn \__siunitx_number_round_auxv:nnN #1#2#3
  {
    \quark_if_recursion_tail_stop_do:Nn #3
      {
        \__siunitx_number_round_auxvi:nnN
          {#1} { } #2 \q_recursion_tail \q_recursion_stop
      }
    \bool_lazy_or:nnTF
      { \int_compare_p:nNn { 0 \tl_head:n {#1} } < 5 }
      {
        \bool_lazy_all_p:n
          {
            { \l__siunitx_number_round_half_even_bool }
            { ! \int_if_odd_p:n {#3} }
            { \__siunitx_number_round_if_half_p:n {#1} }
          }
      }
      { \__siunitx_number_round_final_decimal:nnw }
      { \__siunitx_number_round_auxvii:nnN }
        {#2} { } #3
  }
\cs_new:Npn \__siunitx_number_round_auxvi:nnN #1#2#3
  {
    \quark_if_recursion_tail_stop_do:Nn #3
      { { 0 } { } }
    \bool_lazy_or:nnTF
      { \int_compare_p:nNn { 0 \tl_head:n {#1} } < 5 }
      {
        \bool_lazy_all_p:n
          {
            { \l__siunitx_number_round_half_even_bool }
            { ! \int_if_odd_p:n {#3} }
            { \__siunitx_number_round_if_half_p:n {#1} }
          }
      }
      { \__siunitx_number_round_final_integer:nnw }
      { \__siunitx_number_round_auxviii:nnN }
        { } {#2} #3
  }
```

The main rounding routines. These are only every called when there is rounding to do, so there is no need to carry a flag forward. Thus the question to ask is simple: is the next value a 9 or not (as that continues the sequence). There is a general need to handle the case where a zero is rounded up: that automatically means a need to trim the other end.

```
\cs_new:Npn \__siunitx_number_round_auxvii:nnN #1#2#3
  {
    \quark_if_recursion_tail_stop_do:Nn #3
      {
        \str_if_eq:nnTF {#1} { 0 }
          {
            \__siunitx_number_round_final_output:ff
              { 1 }
              { \__siunitx_number_round_truncate:n {#2} }
          }
          {
            \__siunitx_number_round_auxviii:nnN {#2} { } #1
              \q_recursion_tail \q_recursion_stop
          }
      }
    \int_compare:nNnTF {#3} = 9
      { \__siunitx_number_round_auxvii:nnN {#1} { 0 #2 } }
      {
        \int_compare:nNnTF {#3} = 0
          {
            \__siunitx_number_round_final_decimal:nnw
              {#1} { 1 \__siunitx_number_round_truncate:n {#2} }
          }
          {
            \__siunitx_number_round_final:fn
              { \int_eval:n { #3 + 1 } }
              { \__siunitx_number_round_final_decimal:nnw {#1} {#2} }
          }
      }
  }
\cs_new:Npn \__siunitx_number_round_auxviii:nnN #1#2#3
  {
    \quark_if_recursion_tail_stop_do:Nn #3
      {
        \tl_if_blank:nTF {#1}
          {
            \__siunitx_number_round_final_shift:ff
              {
                \exp_last_unbraced:Nf 1
                  { \__siunitx_number_round_truncate_direct:n {#2} } 0
              }
              { }
          }
          {
            \__siunitx_number_round_final_shift:ff
              { 1 #2 }
              { \__siunitx_number_round_truncate:n {#1} }
          }
```

```
      }
    \int_compare:nNnTF {#3} = 9
      { \__siunitx_number_round_auxviii:nnN {#1} { 0 #2 } }
      {
        \__siunitx_number_round_final:fn
          { \int_eval:n { #3 + 1 } }
          { \__siunitx_number_round_final_integer:nnw {#1} {#2} }
      }
  }
```

Tidying up means grabbing the remaining digits and undoing the reversal.

```
\cs_new:Npn \__siunitx_number_round_final_decimal:nnw
  #1#2#3 \q_recursion_tail \q_recursion_stop
  {
    \__siunitx_number_round_final_output:ff
      { \tl_reverse:n {#1} }
      { \tl_reverse:n {#3} #2 }
  }
\cs_new:Npn \__siunitx_number_round_final_integer:nnw
  #1#2#3 \q_recursion_tail \q_recursion_stop
  {
    \__siunitx_number_round_final_output:ff
      { \exp_args:Ne \__siunitx_number_round_final_significant:n { \tl_reverse:n {#3} #2 } }
      {#1}
  }
\cs_new:Npn \__siunitx_number_round_final_significant:n #1
  {
     \__siunitx_number_round_final_significant:N #1
       \q_recursion_tail \q_recursion_stop
  }
\cs_new:Npn \__siunitx_number_round_final_significant:N #1
  {
    \quark_if_recursion_tail_stop_do:Nn #1 { 0 }
    \int_compare:nNnTF {#1} = 0
      { \__siunitx_number_round_final_significant:N }
      {
        #1
        \__siunitx_number_round_final_significant:w
      }
  }
\cs_new:Npn \__siunitx_number_round_final_significant:w
  #1 \q_recursion_tail \q_recursion_stop
  {#1}
\cs_new:Npn \__siunitx_number_round_final_output:nn #1#2 { {#1} {#2} }
\cs_generate_variant:Nn \__siunitx_number_round_final_output:nn { ff }
\cs_new:Npn \__siunitx_number_round_final:nn #1#2
  { #2 #1 }
\cs_generate_variant:Nn \__siunitx_number_round_final:nn { f }
```

Here we deal with the case where rounding applies along with an exponent set based on number of places. We can only get here if an additional integer digit has been added, so there is no need to test for that. There are two cases for action: when using `scientific` mode, where we always need to shift by one, and when using `engineering` mode if we now have four digits. The latter is a bit more work: we need to trim digits off as required.

```
\cs_new:Npn \__siunitx_number_round_final_shift:nn #1#2
  {
    \str_if_eq:VnTF \l__siunitx_number_round_mode_tl { places }
      {
        \use:c
          { __siunitx_number_round_ \l__siunitx_number_exponent_mode_tl :nn }
          {#1} {#2}
      }
      { {#1} {#2} }
  }
\cs_generate_variant:Nn \__siunitx_number_round_final_shift:nn { ff }
\cs_new:Npn \__siunitx_number_round_engineering:nn #1#2
  {
    \int_compare:nNnTF { \tl_count:n {#1} } = 4
      {
        \__siunitx_number_round_engineering:NNNNn #1 {#2}
        \__siunitx_number_round_final_shift:Nw 3
      }
      { {#1} {#2} }
  }
\cs_new:Npn \__siunitx_number_round_engineering:NNNNn #1#2#3#4#5
  {
    {#1}
    \exp_args:NV \__siunitx_number_round_engineering:nnN
      { \l__siunitx_number_round_precision_int } { }
      #2#3#4#5 \q_recursion_tail \q_recursion_stop
  }
\cs_new:Npn \__siunitx_number_round_engineering:nnN #1#2#3
  {
    \quark_if_recursion_tail_stop_do:Nn #3 { {#2} }
    \int_compare:nNnTF {#1} = { 0 }
      { \use_i_delimit_by_q_recursion_stop:nw { {#2} } }
      { \__siunitx_number_round_engineering:nnN { #1 - 1 } { #2#3 } }
  }
\cs_new:Npn \__siunitx_number_round_fixed:nn #1#2 { {#1} {#2} }
\cs_new:Npn \__siunitx_number_round_input:nn #1#2 { {#1} {#2} }
\cs_new:Npn \__siunitx_number_round_scientific:nn #1#2
  {
    \__siunitx_number_exponent_shift:nnf
      { 1 } {#1} { \__siunitx_number_round_truncate_direct:n {#2} }
    \__siunitx_number_round_final_shift:Nw 1
  }
\cs_new:Npn \__siunitx_number_round_final_shift:Nw #1#2 \__siunitx_number_round_places_end:nn
  {
    \exp_not:n { {#3} }
    \__siunitx_number_exponent_finalise:n { #4#5 + #1 }
  }
```

When we have rounded up to the next power of ten, we need to go back and remove one more digit. That only happens when rounding to a number of figures or when dealing with an integer part.

```
\cs_new:Npn \__siunitx_number_round_truncate:n #1
  {
    \str_if_eq:VnTF \l__siunitx_number_round_mode_tl { figures }
```

```
      { \__siunitx_number_round_truncate_direct:n {#1} }
      {#1}
  }
\cs_new:Npn \__siunitx_number_round_truncate_direct:n #1
  {
    \__siunitx_number_round_truncate:nnN { } { }
      #1 \q_recursion_tail \q_recursion_stop
  }
\cs_new:Npn \__siunitx_number_round_truncate:nnN #1#2#3
  {
    \quark_if_recursion_tail_stop_do:Nn #3 { #1 }
    \__siunitx_number_round_truncate:nnN {#1#2} {#3}
  }
```

(*End definition for* `\__siunitx_number_round:nnn` *and others.*)

`\__siunitx_number_round_if_half_p:n` `\__siunitx_number_round_if_half:N`

A simple test for a valuing being exactly half: we can only test digit-by-digit as there is no limit on the size of the value given.

```
\prg_new_conditional:Npnn \__siunitx_number_round_if_half:n #1 { p }
  {
    \int_compare:nNnTF { \tl_head:n { #1 0 } } = 5
      {
        \exp_after:wN \__siunitx_number_round_if_half:N \use_none:n #1 0
          \q_recursion_tail \q_recursion_stop
      }
      { \prg_return_false: }
  }
\cs_new:Npn \__siunitx_number_round_if_half:N #1
  {
    \quark_if_recursion_tail_stop_do:Nn #1
      { \prg_return_true: }
    \int_compare:nNnTF {#1} = 0
      { \__siunitx_number_round_if_half:N }
      { \use_i_delimit_by_q_recursion_stop:nw { \prg_return_false: } }
  }
```

(*End definition for* `\__siunitx_number_round_if_half_p:n` *and* `\__siunitx_number_round_if_half:N`.)

`\__siunitx_number_round_pad:nnn`

The case where we are short of digits is easy enough to handle: generate zeros to pad it out.

```
\cs_new:Npn \__siunitx_number_round_pad:nnn #1#2#3
  {
    {#2}
    {
      #3
      \bool_if:NT \l__siunitx_number_round_pad_bool
        { \prg_replicate:nn {#1} { 0 } }
    }
  }
```

(*End definition for* `\__siunitx_number_round_pad:nnn`.)

`\__siunitx_number_round_figures:nnnnnnn` `\__siunitx_number_round_figures_aux:nnnnnnn` `\__siunitx_number_round_figures_count:nnN` `\__siunitx_number_round_figures_count:nnnN`

Rounding to figures only makes sense if the number is not 0, so we start by filtering out that case. We then check that there is no uncertainty, and that the number of figures requested is positive: if not, the result is always fixed at zero.

```
\cs_new:Npn \__siunitx_number_round_figures:nnnnnnn #1#2#3#4#5#6#7
  {
    \bool_lazy_and:nnTF
      { \str_if_eq_p:nn {#3} { 0 } }
      {
        \str_if_eq_p:ee
          { \exp_not:n {#4} } { \prg_replicate:nn { \tl_count:n {#4} } { 0 } }
      }
      { \exp_not:n { {#1} {#2} {#3} {#4} {#5} {#6} {#7} } }
      { \__siunitx_number_round_figures_aux:nnnnnnn {#1} {#2} {#3} {#4} {#5} {#6} {#7} }
  }
\cs_new:Npn \__siunitx_number_round_figures_aux:nnnnnnn #1#2#3#4#5#6#7
  {
    \tl_if_blank:nTF {#5}
      {
        \int_compare:nNnTF \l__siunitx_number_round_precision_int > 0
          {
            \exp_not:n { {#1} {#2} }
            \__siunitx_number_round_figures_count:nnN {#3} {#4} #3#4
              \q_recursion_tail \q_recursion_stop
            \exp_not:n { { } {#6} {#7} }
          }
          { { } { } { 0 } { } { } { } { 0 } }
      }
      { \exp_not:n { {#1} {#2} {#3} {#4} {#5} {#6} {#7} } }
  }
```

The first real step is to count up the number of significant figures. The only tricky issue here is dealing with leading zeros.

```
\cs_new:Npn \__siunitx_number_round_figures_count:nnN #1#2#3
  {
    \quark_if_recursion_tail_stop_do:Nn #3
      { { } { } { 0 } { } { } { } { 0 } }
    \int_compare:nNnTF {#3} = 0
      { \__siunitx_number_round_figures_count:nnN {#1} {#2} }
      { \__siunitx_number_round_figures_count:nnnN { 1 } {#1} {#2} }
  }
\cs_new:Npn \__siunitx_number_round_figures_count:nnnN #1#2#3#4
  {
    \quark_if_recursion_tail_stop_do:Nn #4
      {
        \int_compare:nNnTF {#1} > \l__siunitx_number_round_precision_int
          {
            \__siunitx_number_round:fnn
              { \int_eval:n { #1 - \l__siunitx_number_round_precision_int } }
              {#2} {#3}
          }
          {
            \__siunitx_number_round_pad:nnn
              { \l__siunitx_number_round_precision_int - (#1) } {#2} {#3}
          }
      }
    \exp_args:Nf \__siunitx_number_round_figures_count:nnnN
      { \int_eval:n { #1 + 1 } } {#2} {#3}
```

```
}
```

(*End definition for* `\__siunitx_number_round_figures:nnnnnnn` *and others.*)

`\__siunitx_number_round_places:nnnnnnn`
`\__siunitx_number_round_places_end:nnn`
`\__siunitx_number_round_places_decimal:nn`
`\__siunitx_number_round_places_integer:nn`
`\__siunitx_number_round_places_finalise:n`
`iunitx_number_round_places_finalise:nnnnnnn`
`_siunitx_number_round_places_finalise:nnnnn`

The first step when rounding to a fixed number of places is to establish if this is in the decimal or integer parts. The two require different calculations for how many digits to drop from the input. The no-op end function here is to allow tidying up in some cases: see the finalisation of rounding.

```
\cs_new:Npn \__siunitx_number_round_places:nnnnnnn #1#2#3#4#5#6#7
  {
    \tl_if_blank:nTF {#5}
      {
        \exp_args:Ne \__siunitx_number_round_places_finalise:n
          {
            \exp_not:n { {#1} {#2} }
            \int_compare:nNnTF \l__siunitx_number_round_precision_int > 0
              { \__siunitx_number_round_places_decimal:nn }
              { \__siunitx_number_round_places_integer:nn }
                {#3} {#4}
            \__siunitx_number_round_places_end:nnn { } {#6} {#7}
          }
      }
      { \exp_not:n { {#1} {#2} {#3} {#4} {#5} {#6} {#7} } }
  }
\cs_new:Npn \__siunitx_number_round_places_end:nnn #1#2#3 { \exp_not:n { {#1} {#2} {#3} } }
\cs_new:Npn \__siunitx_number_round_places_decimal:nn #1#2
  {
    \int_compare:nNnTF
      { \l__siunitx_number_round_precision_int - 0 \tl_count:n {#2} } > 0
      {
        \__siunitx_number_round_pad:nnn
          { \l__siunitx_number_round_precision_int - 0 \tl_count:n {#2} }
          {#1} {#2}
      }
      {
        \__siunitx_number_round:fnn
           {
             \int_eval:n
               { 0 \tl_count:n {#2} - \l__siunitx_number_round_precision_int }
           }
           {#1} {#2}
      }
  }
\cs_new:Npn \__siunitx_number_round_places_integer:nn #1#2
  {
    \__siunitx_number_round:fnn
       {
         \int_eval:n
           { 0 \tl_count:n {#2} - \l__siunitx_number_round_precision_int }
       }
       {#1} {#2}
  }
```

To finalise rounding to places, we have to worry about a minimum value: that is basically a case of looking for value of zero and rearranging. We also need to worry about a

"negative zero" arising.

```
\cs_new:Npn \__siunitx_number_round_places_finalise:n #1
  { \__siunitx_number_round_places_finalise:nnnnnnn #1 }
\cs_new:Npn \__siunitx_number_round_places_finalise:nnnnnnn #1#2#3#4#5#6#7
  {
    \bool_lazy_and:nnTF
      { \str_if_eq_p:nn {#3} { 0 } }
      {
        \str_if_eq_p:ee
          { \exp_not:n {#4} } { \prg_replicate:nn { \tl_count:n {#4} } { 0 } }
      }
      {
        \tl_if_empty:NTF \l__siunitx_number_round_min_tl
          {
            \exp_not:n { {#1} }
            { \str_if_eq:nnF {#2} { - } { \exp_not:n {#2} } }
            \exp_not:n { {#3} {#4} {#5} {#6} {#7} }
          }
          {
            \exp_after:wN \__siunitx_number_round_places_finalise:nnnnn
              \l__siunitx_number_round_min_tl {#2} {#6} {#7}
          }
      }
      { \exp_not:n { {#1} {#2} {#3} {#4} {#5} {#6} {#7} } }
  }
\cs_new:Npn \__siunitx_number_round_places_finalise:nnnnn #1#2#3#4#5
  {
    {
      \str_if_eq:nnTF {#3} { - }
        { > }
        { < }
    }
    \exp_not:n { {#3} {#1} {#2} { } {#4} {#5} }
  }
```

(*End definition for* `\__siunitx_number_round_places:nnnnnnn` *and others.*)

```
\__siunitx_number_round_uncertainty:nnnnnnn
\__siunitx_number_round_uncertainty_end:nn
\__siunitx_number_round_uncertainty:nnn
\__siunitx_number_round_uncertainty:nnnn
\__siunitx_number_round_uncertainty:nnnnn
nitx_number_round_uncertainty_simple:nnnnnn
unitx_number_round_uncertainty_shift:nnnnnn
__siunitx_number_round_uncertainty_shift:nn
siunitx_number_round_uncertainty_shift:nnnw
tx_number_round_uncertainty_shift_aux:nnnnn
tx_number_round_uncertainty_engineering:nnn
_siunitx_number_round_uncertainty_fixed:nnn
_siunitx_number_round_uncertainty_input:nnn
itx_number_round_uncertainty_scientific:nnn
tx_number_round_uncertainty_engineering_2:n
tx_number_round_uncertainty_engineering_3:n
tx_number_round_uncertainty_engineering_4:n
```

Rounding to an uncertainty can only happen where the result will have some uncertainty left: otherwise we simply drop the uncertainty entirely. Only S-type uncertainties can be used for rounding.

```
\cs_new:Npn \__siunitx_number_round_uncertainty:nnnnnnn #1#2#3#4#5#6#7
  {
    \bool_lazy_or:nnTF
      { \tl_if_blank_p:n {#5} }
      { ! \int_compare_p:nNn \l__siunitx_number_round_precision_int > 0 }
      { \exp_not:n { {#1} {#2} {#3} {#4} { } {#6} {#7} } }
      {
        \str_if_eq:eeTF { \tl_head:n {#5} } { S }
          {
            \exp_not:n { {#1} {#2} }
            \exp_args:Nnno \__siunitx_number_round_uncertainty:nnn
              {#3} {#4} { \use_ii:nn #5 }
            \__siunitx_number_round_uncertainty_end:nn {#6} {#7}
          }
```

```
          { \exp_not:n { {#1} {#2} {#3} {#4} {#5} {#6} {#7} } }
      }
  }
\cs_new:Npn \__siunitx_number_round_uncertainty_end:nn #1#2
  { \exp_not:n { {#1} {#2} } }
```

Round the uncertainty first: this is needed to get the number of places correct. Once that is done, it's just a question of working out the digits in the main part.

```
\cs_new:Npn \__siunitx_number_round_uncertainty:nnn #1#2#3
  {
    \exp_args:Nf \__siunitx_number_round_uncertainty:nnnn
      {
        \int_eval:n
          { \tl_count:n {#3} - \l__siunitx_number_round_precision_int }
      }
      {#1} {#2} {#3}
  }
\cs_new:Npn \__siunitx_number_round_uncertainty:nnnn #1#2#3#4
  {
    \exp_last_unbraced:Nf \__siunitx_number_round_uncertainty:nnnnn
      { \__siunitx_number_round:nnn {#1} { } {#4} }
      {#2} {#3} {#1}
  }
```

Here, we need to work out how many digits to zero-fill the uncertainty, for the case where it crosses into the integer part. This depends on whether the uncertainty rounded up, which also links to additional treatment. We therefore split paths here.

```
\cs_new:Npn \__siunitx_number_round_uncertainty:nnnnn #1#2#3#4#5
  {
    \tl_if_blank:nTF {#1}
      {
        \exp_args:Nf \__siunitx_number_round_uncertainty_simple:nnnnn
          {
            \prg_replicate:nn
              {
                \int_max:nn
                  { 0 - ( \tl_count:n {#4} - \tl_count:n {#2} - #5 +  1 ) }
                  { 0 }
              }
              { 0 }
          }
          {#3} {#4} {#2} {#5}
      }
      { \__siunitx_number_round_uncertainty_shift:nnnnn {#3} {#4} {#1} {#2} {#5} }

  }
```

The simple case: round and pad out the uncertainty as required.

```
\cs_new:Npn \__siunitx_number_round_uncertainty_simple:nnnnn #1#2#3#4#5
  {
    \__siunitx_number_round:nnn
      {#5}
      {#2} {#3}
    { { S } { #4 #1 } }
  }
```

```
\cs_new:Npn \__siunitx_number_round_uncertainty_shift:nnnnn #1#2#3#4#5
  {
    \exp_args:Ne \__siunitx_number_round_uncertainty_shift:nn
      { \__siunitx_number_round:fnn { \int_eval:n { #5 + 1 } } {#1} {#2} }
      {#5}
  }
```

If the padding length is the same as the number of integer digits, then we have a pathological case and need to filter out. They show up as they have the either the precision greater than the length of the integer part, or have a value of exactly 10 when the exponent mode is scientific.

```
\cs_new:Npn \__siunitx_number_round_uncertainty_shift:nn #1#2
  { \__siunitx_number_round_uncertainty_shift:nnnw #1 {#2} }
\cs_new:Npn \__siunitx_number_round_uncertainty_shift:nnnw
  #1#2#3 #4 \__siunitx_number_round_uncertainty_end:nn #5#6
  {
    #4
    \bool_lazy_and:nnTF
      { \int_compare_p:nNn {#3} > { \tl_count:n {#1} } }
      {
        ! \bool_lazy_and_p:nn
          { \str_if_eq_p:Vn \l__siunitx_number_exponent_mode_tl { scientific } }
          { \str_if_eq_p:nn { #1.#2 } { 10. } }
      }
      {
        \exp_args:Nf \__siunitx_number_round_uncertainty_shift_aux:nnnnn
          {
            \prg_replicate:nn
              {
                \tl_if_blank:nTF {#2}
                  { \int_min:nn {#3} { \tl_count:n {#1} - 1 } }
                  { 0 }
              }
              { 0 }
          }
          {#1} {#2}
      }
      {
        \use:c
          { __siunitx_number_round_uncertainty_ \l__siunitx_number_exponent_mode_tl :nnn }
            {#1}
      }
         {#5} {#6}
  }
\cs_new:Npn \__siunitx_number_round_uncertainty_shift_aux:nnnnn #1#2#3#4#5
  {
    \use:c
      { __siunitx_number_round_ \l__siunitx_number_exponent_mode_tl :nn }
        {#2} {#3}
    \__siunitx_number_round_places_end:nnn { { S } { 1 #1 } } {#4} {#5}
  }
```

With the data available, adjust the output such that the uncertainty is of the right length.

```
\cs_new:Npn \__siunitx_number_round_uncertainty_engineering:nnn #1#2#3
```

```
  {
    \use:c
      {
          __siunitx_number_round_uncertainty_
          \l__siunitx_number_exponent_mode_tl _
     \tl_count:n {#1}
          :n
      }
        {#2#3}
  }
\cs_new:cpn { __siunitx_number_round_uncertainty_engineering_2:n } #1
  {
    { 10 } { } { { S } { 10 } }
    \__siunitx_number_exponent_finalise:n {#1}
  }
\cs_new:cpn { __siunitx_number_round_uncertainty_engineering_3:n } #1
  {
    { 100 } { } { { S } { 100 } }
    \__siunitx_number_exponent_finalise:n {#1}
  }
\cs_new:cpn { __siunitx_number_round_uncertainty_engineering_4:n } #1
  {
    { 1 } { } { { S } { 1 } }
    \__siunitx_number_exponent_finalise:n { #1 + 3 }
  }
\cs_new:Npn \__siunitx_number_round_uncertainty_fixed:nnn #1#2#3
  {
    {#1} { }
    { { S } { 1 \prg_replicate:nn { \tl_count:n {#1} - 1 } { 0 } } }
    {#2} {#3}
  }
\cs_new_eq:NN \__siunitx_number_round_uncertainty_input:nnn
   \__siunitx_number_round_uncertainty_fixed:nnn
\cs_new:Npn \__siunitx_number_round_uncertainty_scientific:nnn #1#2#3
  {
    { 1 } { } { { S } { 1 } }
    \__siunitx_number_exponent_finalise:n { #2#3 + \tl_count:n {#1} - 1 }
  }
```

(*End definition for* `\__siunitx_number_round_uncertainty:nnnnnnn` *and others.*)

`\__siunitx_number_zero_decimal:NN`
`\__siunitx_number_zero_decimal:nnnnnnn`

Simple stripping of the decimal part if zero.

```
\cs_new_protected:Npn \__siunitx_number_zero_decimal:NN #1#2
  {
    \bool_if:NT \l__siunitx_number_drop_zero_decimal_bool
      {
        \tl_set:Nx #2
          { \exp_after:wN \__siunitx_number_zero_decimal:nnnnnnn #1 }
      }
  }
\cs_new:Npn \__siunitx_number_zero_decimal:nnnnnnn #1#2#3#4#5#6#7
  {
    \exp_not:n { {#1} {#2} {#3} }
    \str_if_eq:eeTF
```

```
      { \exp_not:n {#4} }
      { \prg_replicate:nn { \tl_count:n {#4} } { 0 } }
      { { } }
      { \exp_not:n { {#4} } }
    \exp_not:n { {#5} {#6} {#7} }
  }
```

(*End definition for* `\__siunitx_number_zero_decimal:NN` *and* `\__siunitx_number_zero_decimal:nnnnnnn`.)

2.5 Number modification

`\siunitx_number_adjust_exponent:nn`
`\siunitx_number_adjust_exponent:Nn`
`\__siunitx_number_adjust_exp:nnnnnnnn`
`\__siunitx_number_adjust_exp:nn`
`\__siunitx_number_adjust_exp:nNw`

A simply case of breaking down and rebuilding the number.

```
\cs_new:Npn \siunitx_number_adjust_exponent:nn #1#2
  { \__siunitx_number_adjust_exp:nnnnnnnn #1 {#2} }
\cs_new:Npn \siunitx_number_adjust_exponent:Nn #1#2
  {
    \tl_if_empty:NF #1
      { \exp_args:NV \siunitx_number_adjust_exponent:nn #1 {#2} }
  }
\cs_new:Npn \__siunitx_number_adjust_exp:nnnnnnnn #1#2#3#4#5#6#7#8
  {
    \exp_not:n { {#1} {#2} {#3} {#4} {#5} }
    \exp_args:Ne \__siunitx_number_adjust_exp:nn { \fp_eval:n { #6#7 + #8 } } {#6}
  }
\cs_new:Npn \__siunitx_number_adjust_exp:nn #1#2
  { \__siunitx_number_adjust_exp:nNw {#2} #1 \q_stop }
\cs_new:Npn \__siunitx_number_adjust_exp:nNw #1#2#3 \q_stop
  {
    \token_if_eq_meaning:NNTF #2 -
      { { - } { \exp_not:n {#3} } }
      { { \str_if_eq:nnT {#1} { + } { + } } { \exp_not:n {#2#3} } }
  }
```

(*End definition for* `\siunitx_number_adjust_exponent:nn` *and others. These functions are documented on page* 39.)

2.6 Outputting parsed numbers

`\l__siunitx_number_bracket_close_tl`
`\l__siunitx_number_bracket_open_tl`

Purely internal for the present.

```
\tl_new:N \l__siunitx_number_bracket_close_tl
\tl_new:N \l__siunitx_number_bracket_open_tl
\tl_set:Nn \l__siunitx_number_bracket_open_tl { ( }
\tl_set:Nn \l__siunitx_number_bracket_close_tl { ) }
```

(*End definition for* `\l__siunitx_number_bracket_close_tl` *and* `\l__siunitx_number_bracket_open_tl`.)

`\l_siunitx_number_bracket_ambiguous_bool`

```
\bool_new:N \l_siunitx_number_bracket_ambiguous_bool
```

(*End definition for* `\l_siunitx_number_bracket_ambiguous_bool`. *This variable is documented on page* ??.)

`\l_siunitx_number_output_decimal_tl`

```
\tl_new:N \l_siunitx_number_output_decimal_tl
```

(*End definition for* `\l_siunitx_number_output_decimal_tl`. *This variable is documented on page 40.*)

`\l__siunitx_number_bracket_negative_bool`
`\l__siunitx_number_implicit_plus_bool`
`\l__siunitx_number_exponent_base_tl`
`\l__siunitx_number_exponent_product_tl`
`\l__siunitx_number_group_decimal_bool`
`\l__siunitx_number_group_integer_bool`
`\l__siunitx_number_group_minimum_int`
`\l__siunitx_number_group_separator_tl`
`\l__siunitx_number_negative_color_tl`
`\l__siunitx_number_output_exp_marker_tl`
`\l__siunitx_number_output_uncert_close_tl`
`\l__siunitx_number_output_uncert_open_tl`
`\l__siunitx_number_uncert_mode_tl`
`\l__siunitx_number_uncert_separator_tl`
`\l__siunitx_number_tight_bool`
`\l__siunitx_number_unity_mantissa_bool`
`\l__siunitx_number_zero_exponent_bool`

Keys producing tokens in the output.

```
\keys_define:nn { siunitx }
  {
    bracket-ambiguous-numbers .bool_set:N =
      \l_siunitx_number_bracket_ambiguous_bool ,
    bracket-negative-numbers .bool_set:N =
      \l__siunitx_number_bracket_negative_bool ,
    exponent-base .tl_set:N =
      \l__siunitx_number_exponent_base_tl ,
    exponent-product .tl_set:N =
      \l__siunitx_number_exponent_product_tl ,
    group-digits .choice: ,
    group-digits / all .code:n =
      {
        \bool_set_true:N \l__siunitx_number_group_decimal_bool
        \bool_set_true:N \l__siunitx_number_group_integer_bool
      } ,
    group-digits / decimal .code:n =
      {
        \bool_set_true:N  \l__siunitx_number_group_decimal_bool
        \bool_set_false:N \l__siunitx_number_group_integer_bool
      } ,
    group-digits / integer .code:n =
      {
        \bool_set_false:N \l__siunitx_number_group_decimal_bool
        \bool_set_true:N  \l__siunitx_number_group_integer_bool
      } ,
    group-digits / none .code:n =
      {
        \bool_set_false:N \l__siunitx_number_group_decimal_bool
        \bool_set_false:N \l__siunitx_number_group_integer_bool
      } ,
    group-digits .default:n  = all ,
    group-minimum-digits .int_set:N  =
      \l__siunitx_number_group_minimum_int ,
    group-separator .tl_set:N =
      \l__siunitx_number_group_separator_tl ,
    negative-color .tl_set:N =
    \l__siunitx_number_negative_color_tl ,
    output-close-uncertainty .tl_set:N =
      \l__siunitx_number_output_uncert_close_tl ,
    output-decimal-marker .tl_set:N =
      \l_siunitx_number_output_decimal_tl ,
    output-exponent-marker .tl_set:N =
      \l__siunitx_number_output_exp_marker_tl ,
    output-open-uncertainty .tl_set:N =
      \l__siunitx_number_output_uncert_open_tl ,
    print-implicit-plus .bool_set:N =
      \l__siunitx_number_implicit_plus_bool ,
    print-unity-mantissa .bool_set:N =
      \l__siunitx_number_unity_mantissa_bool ,
    print-zero-exponent .bool_set:N =
```

```
      \l__siunitx_number_zero_exponent_bool ,
    tight-spacing .bool_set:N =
      \l__siunitx_number_tight_bool ,
    uncertainty-mode .choices:nn =
      { compact , compact-marker , full , separate }
      { \tl_set_eq:NN \l__siunitx_number_uncert_mode_tl \l_keys_choice_tl } ,
    uncertainty-separator .tl_set:N =
      \l__siunitx_number_uncert_separator_tl
  }
\bool_new:N \l__siunitx_number_group_decimal_bool
\bool_new:N \l__siunitx_number_group_integer_bool
\tl_new:N \l__siunitx_number_uncert_mode_tl
```

(*End definition for* `\l__siunitx_number_bracket_negative_bool` *and others.*)

`\siunitx_number_output:N`
`\siunitx_number_output:n`
`\siunitx_number_output:NN`
`\siunitx_number_output:nN`
`\__siunitx_number_output:Nn`
`\__siunitx_number_output:nn`
`\__siunitx_number_output:nnnnnnn`
`\__siunitx_number_output_bracket:nn`
`\__siunitx_number_output_bracket:w`
`\__siunitx_number_output_comparator:nn`
`\__siunitx_number_output_sign:nnn`
`\__siunitx_number_output_sign:nN`
`\__siunitx_number_output_sign:N`
`\__siunitx_number_output_sign_color:w`
`\__siunitx_number_output_sign_brackets:w`
`\__siunitx_number_output_integer:nnn`
`\__siunitx_number_output_decimal:nn`
`\__siunitx_number_output_decimal:fn`
`\__siunitx_number_output_digits:nn`
`\__siunitx_number_output_integer_aux:n`
`\__siunitx_number_output_integer_aux_0:n`
`\__siunitx_number_output_integer_aux_1:n`
`\__siunitx_number_output_integer_aux_2:n`
`\__siunitx_number_output_decimal_aux:n`
`\__siunitx_number_output_decimal_loop:NNNN`
`\__siunitx_number_output_integer_first:nnNN`
`\__siunitx_number_output_integer_loop:NNNN`
`\__siunitx_number_output_uncertainty:nnn`
`unitx_number_output_uncertainty_unaligned:n`
`\__siunitx_number_output_uncert_S:nnnw`
`\__siunitx_number_output_uncert_S_aux:nnn`
`\__siunitx_number_output_uncert_S_aux:fnn`
`\__siunitx_number_output_uncert_S:nnnw`
`\__siunitx_number_output_uncert_S:fnw`
`\__siunitx_number_output_uncert_S:nnw`
`__siunitx_number_output_uncert_S_compact:nn`
`tx_number_output_uncert_S_compact-marker:nn`
`\__siunitx_number_output_uncert_S_full:nn`
`\__siunitx_number_output_exponent:nnnn`
`\__siunitx_number_output_exponent_auxi:nnnn`
`__siunitx_number_output_exponent_auxii:nnnn`
`\__siunitx_number_output_exponent_auxiii:nn`
`\__siunitx_number_output_end:`

The approach to formatting a single number is to split into the constituent parts. All of the parts are assembled including inserting tabular alignment markers (which may be empty) for each separate unit.

```
\cs_new:Npn \siunitx_number_output:N #1
  { \__siunitx_number_output:Nn #1 { } }
\cs_new:Npn \siunitx_number_output:n #1
  { \__siunitx_number_output:nn #1 { } }
\cs_new:Npn \siunitx_number_output:NN #1#2
  { \__siunitx_number_output:Nn #1 {#2} }
\cs_new:Npn \siunitx_number_output:nN #1#2
  { \__siunitx_number_output:nn #1 {#2} }
\cs_new:Npn \__siunitx_number_output:Nn #1#2
  {
    \tl_if_empty:NF #1
      { \exp_after:wN \__siunitx_number_output:nnnnnnn #1 {#2} }
  }
\cs_new:Npn \__siunitx_number_output:nn #1#2
  {
    \tl_if_empty:nF {#1}
      { \__siunitx_number_output:nnnnnnn #1 {#2} }
  }
\cs_new:Npn \__siunitx_number_output:nnnnnnn #1#2#3#4#5#6#7#8
  {
    \__siunitx_number_output_color:n {#2}
    \__siunitx_number_output_comparator:nn {#1} {#8}
    \__siunitx_number_output_bracket:nn {#5} {#7}
    \__siunitx_number_output_sign:nnn {#1} {#2} {#8}
    \__siunitx_number_output_integer:nnn {#3} {#4} {#7}
    \__siunitx_number_output_decimal:nn {#4} {#8}
    \__siunitx_number_output_uncertainty:nnn {#5} {#4} {#8}
    \__siunitx_number_output_exponent:nnnn {#6} {#7} { #3 . #4 } {#8}
    \__siunitx_number_output_end:
  }
```

Adding brackets for the combination of a separate uncertainty with an exponent may need brackets. This needs testing up-front, so has to come before the main formatting routines.

```
\cs_new:Npn \__siunitx_number_output_bracket:nn #1#2
  {
```

```
    \bool_lazy_all:nT
      {
        { \str_if_eq_p:Vn \l__siunitx_number_uncert_mode_tl { separate } }
        { \l_siunitx_number_bracket_ambiguous_bool }
        { ! \tl_if_blank_p:n {#1} }
        {
          \bool_lazy_or_p:nn
            { \l__siunitx_number_zero_exponent_bool }
            { ! \str_if_eq_p:nn {#2} { 0 } }
        }
      }
    \__siunitx_number_output_bracket:w
  }
\cs_new:Npn \__siunitx_number_output_bracket:w #1 \__siunitx_number_output_exponent:nnnn
  {
    \exp_not:V \l__siunitx_number_bracket_open_tl
    #1
    \exp_not:V \l__siunitx_number_bracket_close_tl
    \__siunitx_number_output_exponent:nnnn
  }
```

As color for negative values applies to the *whole* output, we have to deal with it before anything else.

```
\cs_new:Npn \__siunitx_number_output_color:n #1
  {
    \bool_lazy_and:nnT
      { \str_if_eq_p:nn {#1} { - } }
      { ! \tl_if_empty_p:N \l__siunitx_number_negative_color_tl }
      { \exp_not:N \color { \exp_not:V \l__siunitx_number_negative_color_tl } }
  }
```

To get the spacing correct this needs to be an ordinary math character.

```
\cs_new:Npn \__siunitx_number_output_comparator:nn #1#2
  {
    \tl_if_blank:nF {#1}
      { \exp_not:n { \mathord {#1} } }
    \exp_not:n {#2}
  }
```

Formatting signs has to deal with some additional formatting requirements for negative numbers. Making such numbers by bracketing them needs some rearrangement of the order of tokens, which is set up in the main formatting macro by the dedicated do-nothing end function. We also have the comparator passed here: if it is present, we need to deal with tighter spacing.

```
\cs_new:Npn \__siunitx_number_output_sign:nnn #1#2#3
  {
    \tl_if_blank:nTF {#2}
      {
        \bool_if:NT \l__siunitx_number_implicit_plus_bool
          { \__siunitx_number_output_sign:nN {#1} + }
      }
      {
        \str_if_eq:nnTF {#2} { - }
          {
            \bool_if:NTF \l__siunitx_number_bracket_negative_bool
```

```
            { \__siunitx_number_output_sign_brackets:w }
            { \__siunitx_number_output_sign:nN {#1} #2 }
        }
        { \__siunitx_number_output_sign:nN {#1} #2 }
    }
  \exp_not:n {#3}
 }
\cs_new:Npn \__siunitx_number_output_sign:nN #1#2
 {
  \tl_if_blank:nTF {#1}
    { \__siunitx_number_output_sign:N #2 }
    { \exp_not:n { \mathord {#2} } }
 }
\cs_new:Npn \__siunitx_number_output_sign:N #1
 {
  \bool_if:NTF \l__siunitx_number_tight_bool
    { \exp_not:n { \mathord {#1} } }
    { \exp_not:n {#1} }
 }
\cs_new:Npn
 \__siunitx_number_output_sign_brackets:w #1 \__siunitx_number_output_end:
 {
  \exp_not:V \l__siunitx_number_bracket_open_tl
  #1
  \exp_not:V \l__siunitx_number_bracket_close_tl
  \__siunitx_number_output_end:
 }
```

Digit formatting leads off with separate functions to allow for a few "up front" items before using a common set of tests for some common cases. The code then splits again as the two types of grouping need different strategies.

```
\cs_new:Npn \__siunitx_number_output_integer:nnn #1#2#3
 {
  \bool_lazy_any:nT
    {
      { \l__siunitx_number_unity_mantissa_bool }
      { ! \str_if_eq_p:nn { #1 . #2 } { 1. } }
      {
        \bool_lazy_and_p:nn
          { \str_if_eq_p:nn {#3} { 0 } }
          { ! \l__siunitx_number_zero_exponent_bool }
      }
    }
    { \__siunitx_number_output_digits:nn { integer } {#1} }
 }
\cs_new:Npn \__siunitx_number_output_decimal:nn #1#2
 {
  \exp_not:n {#2}
  \tl_if_blank:nF {#1}
    {
      \str_if_eq:VnTF \l_siunitx_number_output_decimal_tl { , }
        { \exp_not:N \mathord }
        { \use:n }
          { \exp_not:V \l_siunitx_number_output_decimal_tl }
```

```
      }
    \exp_not:n {#2}
    \__siunitx_number_output_digits:nn { decimal } {#1}
  }
\cs_generate_variant:Nn \__siunitx_number_output_decimal:nn { f }
\cs_new:Npn \__siunitx_number_output_digits:nn #1#2
  {
    \bool_if:cTF { l__siunitx_number_group_ #1 _ bool }
      {
        \int_compare:nNnTF
          { \tl_count:n {#2} } < \l__siunitx_number_group_minimum_int
          { \exp_not:n {#2} }
          { \use:c { __siunitx_number_output_ #1 _aux:n } {#2} }
      }
      { \exp_not:n {#2} }
  }
```

For integers, we need to know how many digits there are to allow for the correct insertion of separators. That is done using a two-part set up such that there is no separator on the first pass.

```
\cs_new:Npn \__siunitx_number_output_integer_aux:n #1
  {
     \use:c
       {
         __siunitx_number_output_integer_aux_
         \int_eval:n { \int_mod:nn { \tl_count:n {#1} } { 3 } }
         :n
       } {#1}
  }
\cs_new:cpn { __siunitx_number_output_integer_aux_0:n } #1
  { \__siunitx_number_output_integer_first:nnNN #1 \q_nil }
\cs_new:cpn { __siunitx_number_output_integer_aux_1:n } #1
  { \__siunitx_number_output_integer_first:nnNN { } { } #1 \q_nil }
\cs_new:cpn { __siunitx_number_output_integer_aux_2:n } #1
  { \__siunitx_number_output_integer_first:nnNN { } #1 \q_nil }
\cs_new:Npn \__siunitx_number_output_integer_first:nnNN #1#2#3#4
  {
    \exp_not:n {#1#2#3}
    \quark_if_nil:NF #4
      { \__siunitx_number_output_integer_loop:NNNN #4 }
  }
\cs_new:Npn \__siunitx_number_output_integer_loop:NNNN #1#2#3#4
  {
    \str_if_eq:VnTF \l__siunitx_number_group_separator_tl { , }
      { \exp_not:N \mathord }
      { \use:n }
        { \exp_not:V \l__siunitx_number_group_separator_tl }
    \exp_not:n {#1#2#3}
    \quark_if_nil:NF #4
      { \__siunitx_number_output_integer_loop:NNNN #4 }
  }
```

For decimals, no need to do any counting, just loop using enough markers to find the end of the list. By passing the decimal marker, it is possible not to have to use a check

on the content of the rest of the number. The `\use_none:n(n)` mop up the remaining `\q_nil` tokens.

```
\cs_new:Npn \__siunitx_number_output_decimal_aux:n #1
  {
    \__siunitx_number_output_decimal_loop:NNNN \c_empty_tl
      #1 \q_nil \q_nil \q_nil
  }
\cs_new:Npn \__siunitx_number_output_decimal_loop:NNNN #1#2#3#4
  {
    \quark_if_nil:NF #2
      {
        \exp_not:V #1
        \exp_not:n {#2}
        \quark_if_nil:NTF #3
          { \use_none:n }
          {
            \exp_not:n {#3}
            \quark_if_nil:NTF #4
              { \use_none:nn }
              {
                \exp_not:n {#4}
                \__siunitx_number_output_decimal_loop:NNNN
                  \l__siunitx_number_group_separator_tl
              }
          }
      }
  }
```

Uncertainties which are directly attached are easy to deal with. For those that are separated, the first step is to find if they are entirely contained within the decimal part, and to pad if they are. For the case where the boundary is crossed to the integer part, the correct number of digit tokens need to be removed from the start of the uncertainty and the split result sent to the appropriate auxiliaries.

```
\cs_new:Npn \__siunitx_number_output_uncertainty:nnn #1#2#3
  {
    \tl_if_blank:nTF {#1}
      { \__siunitx_number_output_uncertainty_unaligned:n {#3} }
      {
        \use:c { __siunitx_number_output_uncert_ \tl_head:n {#1} :nnnw }
          {#2} {#3} #1
      }
  }
\cs_new:Npn \__siunitx_number_output_uncertainty_unaligned:n #1
  { \exp_not:n { #1 #1 #1 #1 } }
\cs_new:Npn \__siunitx_number_output_uncert_S:nnnw #1#2#3#4
  {
    \str_if_eq:VnTF \l__siunitx_number_uncert_mode_tl { separate }
      {
        \exp_not:n {#2}
        \__siunitx_number_output_sign:N \pm
        \exp_not:n {#2}
        \__siunitx_number_output_uncert_S_aux:nnn
          { \int_eval:n { \tl_count:n {#4} - \tl_count:n {#1} } }
          {#4} {#2}
```

```
      }
      {
        \exp_not:V \l__siunitx_number_uncert_separator_tl
        \exp_not:V \l__siunitx_number_output_uncert_open_tl
        \use:c { __siunitx_number_output_uncert_S_ \l__siunitx_number_uncert_mode_tl :nn } {#
        \exp_not:V \l__siunitx_number_output_uncert_close_tl
        \__siunitx_number_output_uncertainty_unaligned:n {#2}
      }
  }
\cs_new:Npn \__siunitx_number_output_uncert_S_aux:nnn #1#2#3
  {
    \int_compare:nNnTF {#1} > 0
      {
        \__siunitx_number_output_uncert_S_aux:fnnw
          { \int_eval:n { #1 - 1 } }
          {#3}
          { }
          #2 \q_nil
      }
      {
        0
        \__siunitx_number_output_decimal:fn
          {
            \prg_replicate:nn { \int_abs:n {#1} } { 0 }
            #2
          }
          {#3}
      }
  }
\cs_generate_variant:Nn \__siunitx_number_output_uncert_S_aux:nnn { f }
\cs_new:Npn \__siunitx_number_output_uncert_S_aux:nnnw #1#2#3#4
  {
    \quark_if_nil:NF #4
      {
        \int_compare:nNnTF {#1} = 0
          { \__siunitx_number_output_uncert_S_aux:nnw {#3#4} {#2} }
          {
            \__siunitx_number_output_uncert_S_aux:fnnw
              { \int_eval:n { #1 - 1 } }
              {#2}
              {#3#4}
          }
      }
  }
\cs_generate_variant:Nn \__siunitx_number_output_uncert_S_aux:nnnw { f }
\cs_new:Npn \__siunitx_number_output_uncert_S_aux:nnw #1#2#3 \q_nil
  {
    \__siunitx_number_output_digits:nn { integer } {#1}
    \__siunitx_number_output_decimal:nn {#3} {#2}
  }
```

Handle the content of brackets: the only complex case is the mixed situation.

```
\cs_new:Npn \__siunitx_number_output_uncert_S_compact:nn #1#2
  { \exp_not:n {#2} }
\cs_new:cpn { __siunitx_number_output_uncert_S_compact-marker:nn } #1#2
```

```
  {
    \bool_lazy_or:nnTF
      { \tl_if_blank_p:n {#1} }
      { ! \int_compare_p:nNn { \tl_count:n {#2} } > { \tl_count:n {#1} } }
      { \__siunitx_number_output_uncert_S_compact:nn }
      { \__siunitx_number_output_uncert_S_full:nn }
        {#1} {#2}
  }
\cs_new:Npn \__siunitx_number_output_uncert_S_full:nn #1#2
  {
    \__siunitx_number_output_uncert_S_aux:fnn
      { \int_eval:n { \tl_count:n {#2} - \tl_count:n {#1} } }
      {#2} { }
  }
```

Setting the exponent part requires some information about the mantissa: was it there or not. This means that whilst only the sign and value for the exponent are typeset here, there is a need to also have access to the combined mantissa part (with a decimal marker). The rest of the work is about picking up the various options and getting the combinations right. For signs, the auxiliary from the main sign routine can be used, but not the main function: negative exponents don't have special handling.

```
\cs_new:Npn \__siunitx_number_output_exponent:nnnn #1#2#3#4
  {
    \exp_not:n {#4}
    \bool_lazy_or:nnTF
      { \l__siunitx_number_zero_exponent_bool }
      { ! \str_if_eq_p:nn {#2} { 0 } }
      {
        \tl_if_empty:NTF \l__siunitx_number_output_exp_marker_tl
          { \__siunitx_number_output_exponent_auxi:nnnn }
          { \__siunitx_number_output_exponent_auxii:nnnn }
            {#1} {#2} {#3} {#4}
      }
      { \exp_not:n {#4} }
  }
\cs_new:Npn \__siunitx_number_output_exponent_auxi:nnnn #1#2#3#4
  {
    \bool_lazy_or:nnTF
      { \l__siunitx_number_unity_mantissa_bool }
      { ! \str_if_eq_p:nn {#3} { 1. } }
      {
        \bool_if:NTF \l__siunitx_number_tight_bool
          { \exp_not:N \mathord }
          { \use:n }
            { \exp_not:V \l__siunitx_number_exponent_product_tl }
        \exp_not:n {#4}
      }
      { \exp_not:n {#4} }
    \exp_not:V \l__siunitx_number_exponent_base_tl
    ^
      { \__siunitx_number_output_exponent_auxiii:nn {#1} {#2} }
  }
\cs_new:Npn \__siunitx_number_output_exponent_auxii:nnnn #1#2#3#4
  {
```

```
    \exp_not:n {#4}
    \exp_not:V \l__siunitx_number_output_exp_marker_tl
    \__siunitx_number_output_exponent_auxiii:nn {#1} {#2}
  }
\cs_new:Npn \__siunitx_number_output_exponent_auxiii:nn #1#2
  {
    \tl_if_blank:nTF {#1}
      {
        \bool_lazy_and:nnT
          { \l__siunitx_number_implicit_plus_bool }
          { ! \str_if_eq_p:nn {#2} { 0 } }
          { \__siunitx_number_output_sign:N + }
      }
      { \__siunitx_number_output_sign:N #1 }
    \__siunitx_number_output_digits:nn { integer } {#2}
  }
```

A do-nothing marker used to allow shuffling of the output and so expandable operations for formatting.

```
\cs_new:Npn \__siunitx_number_output_end: { }
```

(*End definition for* `\siunitx_number_output:N` *and others. These functions are documented on page* 39.)

2.7 Miscellaneous tools

`\l__siunitx_number_valid_tl` The list of valid tokens.

```
\tl_new:N \l__siunitx_number_valid_tl
```

(*End definition for* `\l__siunitx_number_valid_tl`.)

`\siunitx_if_number:nTF` Test if an entire number is valid: this means parsing the number but not returning anything.

```
\prg_new_protected_conditional:Npnn \siunitx_if_number:n #1
  { T , F , TF }
  {
    \group_begin:
      \bool_set_true:N \l__siunitx_number_validate_bool
      \bool_set_true:N \l_siunitx_number_parse_bool
      \siunitx_number_parse:nN {#1} \l__siunitx_number_parsed_tl
      \tl_if_empty:NTF \l__siunitx_number_parsed_tl
        {
          \group_end:
          \prg_return_false:
        }
        {
          \group_end:
          \prg_return_true:
        }
  }
```

(*End definition for* `\siunitx_if_number:nTF`. *This function is documented on page* 40.)

\siunitx_if_number_token_p:N
\siunitx_if_number_token:NTF
__siunitx_number_if_token_auxi:NN
__siunitx_number_if_token_auxii:NN
__siunitx_number_if_token_auxiii:NN

A simple conditional to answer the question of whether a specific token is possibly valid in a number.

```
\prg_new_conditional:Npnn \siunitx_if_number_token:N #1
  { p , T , F , TF }
  {
    \__siunitx_number_token_auxi:NN #1
      \l_siunitx_number_input_decimal_tl
      \l__siunitx_number_input_uncert_close_tl
      \l_siunitx_number_input_comparator_tl
      \l__siunitx_number_input_digit_tl
      \l_siunitx_number_input_exponent_tl
      \l__siunitx_number_input_ignore_tl
      \l__siunitx_number_input_uncert_open_tl
      \l_siunitx_number_input_sign_tl
      \l__siunitx_number_input_uncert_sign_tl
      \q_recursion_tail
      \q_recursion_stop
  }
\cs_new:Npn \__siunitx_number_token_auxi:NN #1#2
  {
    \quark_if_recursion_tail_stop_do:Nn #2 { \prg_return_false: }
    \__siunitx_number_token_auxii:NN #1 #2
    \__siunitx_number_token_auxi:NN #1
  }
\cs_new:Npn \__siunitx_number_token_auxii:NN #1#2
  {
    \exp_after:wN \__siunitx_number_token_auxiii:NN \exp_after:wN #1
      #2 \q_recursion_tail \q_recursion_stop
  }
\cs_new:Npn \__siunitx_number_token_auxiii:NN #1#2
  {
    \quark_if_recursion_tail_stop:N #2
    \str_if_eq:nnT {#1} {#2}
      {
        \use_i_delimit_by_q_recursion_stop:nw
          {
            \use_i_delimit_by_q_recursion_stop:nw
              { \prg_return_true: }
          }
      }
    \__siunitx_number_token_auxiii:NN #1
  }
```

(*End definition for* `\siunitx_if_number_token:NTF` *and others. This function is documented on page* 40.)

2.8 Messages

```
\msg_new:nnnn { siunitx } { invalid-number }
  { Invalid~number~'#1'. }
  {
    The~input~'#1'~could~not~be~parsed~as~a~number~following~the~
    format~defined~in~module~documentation.
  }
```

2.9 Standard settings for module options

Some of these follow naturally from the point of definition (*e.g.* boolean variables are always `false` to begin with), but for clarity everything is set here.

```
\keys_set:nn { siunitx }
  {
    bracket-ambiguous-numbers = true                                  ,
    bracket-negative-numbers  = false                                 ,
    drop-exponent             = false                                 ,
    drop-uncertainty          = false                                 ,
    drop-zero-decimal         = false                                 ,
    evaluate-expression       = false                                 ,
    exponent-base             = 10                                    ,
    exponent-mode             = input                                 ,
    exponent-product          = \times                                ,
    expression                = #1                                    ,
    fixed-exponent            = 0                                     ,
    group-digits              = all                                   ,
    group-minimum-digits      = 5                                     ,
    group-separator           = \,                                    , % (
    input-close-uncertainty   = )                                     ,
    input-comparators         = { <=>\approx\ge\geq\gg\le\leq\ll\sim } ,
    input-decimal-markers     = { ., }                                ,
    input-digits              = 0123456789                            ,
    input-exponent-markers    = dDeE                                  ,
    input-ignore              = \,                                    ,
    input-open-uncertainty    = (                                     , % )
    input-signs               = +-\mp\pm                              ,
    input-uncertainty-signs   = \pm                                   ,
    minimum-decimal-digits    = 0                                     ,
    minimum-integer-digits    = 0                                     ,
    negative-color            =                                       , % (
    output-close-uncertainty  = )                                     ,
    output-decimal-marker     = .                                     ,
    output-open-uncertainty   = (                                     , % )
    parse-numbers             = true                                  ,
    print-implicit-plus       = false                                 ,
    print-unity-mantissa      = true                                  ,
    print-zero-exponent       = false                                 ,
    retain-explicit-plus      = false                                 ,
    retain-zero-uncertainty   = false                                 ,
    round-half                = up                                    ,
    round-minimum             = 0                                     ,
    round-mode                = none                                  ,
    round-pad                 = true                                  ,
    round-precision           = 2                                     ,
    tight-spacing             = false                                 ,
    uncertainty-mode          = compact                               ,
    uncertainty-separator     =
  }
```

⟨/package⟩

Part VI
siunitx-print – Printing material with font control

1 Printing quantities

This submodule is focussed on providing controlled printing for numbers and units. Key to this is control of font: conventions for printing quantities mean that the exact nature of the output is important. At the same time, this module provides flexibility for the user in terms of which aspects of the font are responsive to the surrounding general text. Printing material may also take place in text or math mode.

The printing routines assume that normal LaTeX 2_ε font selection commands are available, in particular `\bfseries`, `\mathrm`, `\mathversion`, `\fontfamily`, `\fontseries` and `\fontshape`, `\familydefault`, `\seriesdefault`, `\shapedefault` and `\selectfont`. It also requires the standard LaTeX 2_ε kernel commands `\ensuremath`, `\mbox`, `\textsubscript` and `\textsuperscript` for printing in text mode. The following packages are also required to provide the functionality detailed.

- color: support for color using `\textcolor`
- textcomp: `\textminus`, `\textpm` `\texttimes` and `\textcenteredperiod` for printing in text mode
- amstext: the `\text` command for printing in text mode

For detection of math mode fonts, as well as `\mathrm`, the existence of `\symoperators` is assumed; other math font commands are not *required* to exist.

`\siunitx_print_number:n`
`\siunitx_print_number:(V|x)`
`\siunitx_print_unit:n`
`\siunitx_print_unit:(V|x)`

`\siunitx_print_number:n {⟨material⟩}`
`\siunitx_print_unit:n {⟨material⟩}`

Prints the ⟨*material*⟩ according the the prevailing settings for the submodule as applicable to the ⟨*type*⟩ of content (`number` or `unit`). The ⟨*material*⟩ should comprise normal LaTeX mark-up for numbers or units. In particular, units will typically use `\mathrm` to indicate material to be printed in the current upright roman font, and `^` and `_` will typically be used to indicate super- and subscripts, respectively. These elements will be correctly handled when printing for example using `\mathsf` in math mode, or using only text fonts.

`\siunitx_print_match:n`
`\siunitx_print_math:n`
`\siunitx_print_text:n`

`\siunitx_print_match:n {⟨material⟩}`
`\siunitx_print_math:n {⟨material⟩}`
`\siunitx_print_text:n {⟨material⟩}`

Prints the ⟨*material*⟩ as described for `\siunitx_print_...:n` but with a fixed text or math mode output. The printing does *not* set color (which is managed on a `unit`/`number` basis), but otherwise sets the font as described above. The `match` function uses either the prevailing math or text mode.

1.1 Key–value options

The options defined by this submodule are available within the l3keys `siunitx` tree.

`color` `color = ⟨color⟩`

Color to apply to printed output: the latter should be a named color defined for use with `\textcolor`. The standard setting is empty (no color).

`mode` `mode = match|math|text`

Selects which mode (math or text) the output is printed in: a choice from the options `match`, `math` or `text`. The option `match` matches the mode prevailing at the point `\siunitx_print_...:n` is called. The `math` and `text` options choose the relevant TEX mode for printing. The standard setting is `math`.

`number-color` `number-color = ⟨color⟩`

Color to apply to numbers in output: the latter should be a named color defined for use with `\textcolor`. The standard setting is empty (no color).

`number-mode` `number-mode = match|math|text`

Selects which mode (math or text) the numbers are printed in: a choice from the options `match`, `math` or `text`. The option `match` matches the mode prevailing at the point `\siunitx_prin_number:n` is called. The `math` and `text` options choose the relevant TEX mode for printing. The standard setting is `math`.

`propagate-math-font` `propagate-math-font = true|false`

Switch to determine if the currently-active math font is applied within printed output. This is relevant only when `\siunitx_print_...:n` is called from within math mode: in text mode there is not active math font. When not active, math mode material will be typeset using standard math mode fonts without any changes being made to the supplied argument. The standard setting is `false`.

`reset-math-version` `reset-math-version = true|false`

Switch to determine whether the active `\mathversion` is reset to `normal` when printing in math mode. Note that math version is typically used to select `\boldmath`, though it is also be used by *e.g.* sansmath. The standard setting is `true`.

`reset-text-family` `reset-text-family = true|false`

Switch to determine whether the active text family is reset to `\rmfamily` when printing in text mode. The standard setting is `true`.

`reset-text-series` `reset-text-series = true|false`

Switch to determine whether the active text series is reset to `\mdseries` when printing in text mode. The standard setting is `true`.

`reset-text-shape` `reset-text-shape = true|false`

Switch to determine whether the active text shape is reset to `\upshape` when printing in text mode. The standard setting is `true`.

`text-family-to-math` `text-family-to-math = true|false`

Switch to determine if the family of the current text font should be applied (where possible) to printing in math mode. The standard setting is `false`.

`text-font-command` `text-font-command =` ⟨*cmd*⟩

Command applied to text during output, inserted after any reset of font set-up. This can therefore be used to apply non-standard font set up when printing in text mode. The standard setting is empty.

`text-series-to-math` `text-series-to-math = true|false`

Switch to determine if the weight of the current text font should be applied (where possible) to printing in math mode. This is achieved by setting the `\mathversion`, and so will override `reset-math-version`. The mappings between text and math weight are set . The standard setting is `false`.

`unit-color` `unit-color =` ⟨*color*⟩

Color to apply to units in output: the latter should be a named color defined for use with `\textcolor`. The standard setting is empty (no color).

`unit-mode` `unit-mode = match|math|text`

Selects which mode (math or text) units are printed in: a choice from the options `match`, `math` or `text`. The option `match` matches the mode prevailing at the point `\siunitx_print_...:n` is called. The `math` and `text` options choose the relevant TEX mode for printing. The standard setting is `math`.

`series-version-mapping` `series-version-mapping / ⟨weight⟩ = ⟨version⟩`

Defines how siunitx maps from text font weight to math font version. The pre-defined weights are those used as-standard by autoinst:

- `ul`
- `el`
- `l`
- `sl`
- `m`
- `sb`
- `b`
- `eb`
- `ub`

As standard, the `m` weight maps to `normal` math version whilst all of the `b` weights map to `bold` and all of the `l` weights map to `light`.

2 siunitx-print implementation

Start the DocStrip guards.

```
1 ⟨*package⟩
```

Identify the internal prefix (LaTeX3 DocStrip convention): only internal material in this *submodule* should be used directly.

```
2 ⟨@@=siunitx_print⟩
```

2.1 Initial set up

__siunitx_print_ams_text:n

The printing routines depend on amstext for text mode working. We also save the definition of `\text` here to use it internally, as the nature of the *document* command may need to vary.

```
3 \RequirePackage { amstext }
4 \cs_new_eq:NN \__siunitx_print_ams_text:n \text
```

(*End definition for* `\__siunitx_print_ams_text:n`.)

Color support is always required.

```
5 \RequirePackage { color }
```

\tl_replace_all:NVn

Required variants.

```
6 \cs_generate_variant:Nn \tl_replace_all:Nnn { NV }
```

(*End definition for* `\tl_replace_all:NVn`. *This function is documented on page* ??.)

\l__siunitx_print_tmp_tl

Scratch space.

```
7 \tl_new:N \l__siunitx_print_tmp_tl
```

(*End definition for* `\l__siunitx_print_tmp_tl`.)

2.2 Printing routines

\l__siunitx_print_number_color_tl
\l__siunitx_print_number_mode_tl
\l__siunitx_print_unit_color_tl
\l__siunitx_print_unit_mode_tl
\l__siunitx_print_math_font_bool
\l__siunitx_print_math_version_bool
\l__siunitx_print_math_family_bool
\l__siunitx_print_text_font_tl
\l__siunitx_print_math_series_bool

Options which apply to the main formatting routine, and so are not tied to either symbolic or literal input.

```
8  \tl_new:N \l__siunitx_print_number_mode_tl
9  \tl_new:N \l__siunitx_print_unit_mode_tl
10 \keys_define:nn { siunitx }
11   {
12     color .meta:n =
13       { number-color = #1 , unit-color = #1 } ,
14     mode .meta:n =
15       { number-mode = #1 , unit-mode = #1 } ,
16     number-color .tl_set:N =
17       \l__siunitx_print_number_color_tl ,
18     number-mode .choices:nn =
19       { match , math , text }
20       {
21         \tl_set_eq:NN
22           \l__siunitx_print_number_mode_tl \l_keys_choice_tl
23       } ,
24     propagate-math-font .bool_set:N =
25       \l__siunitx_print_math_font_bool ,
```

```
    reset-math-version .bool_set:N =
      \l__siunitx_print_math_version_bool ,
    reset-text-family .bool_set:N =
      \l__siunitx_print_text_family_bool ,
    reset-text-series .bool_set:N =
      \l__siunitx_print_text_series_bool ,
    reset-text-shape .bool_set:N =
      \l__siunitx_print_text_shape_bool ,
    text-family-to-math .bool_set:N =
      \l__siunitx_print_math_family_bool ,
    text-font-command .tl_set:N =
      \l__siunitx_print_text_font_tl ,
    text-series-to-math .bool_set:N =
      \l__siunitx_print_math_series_bool ,
    unit-color .tl_set:N =
      \l__siunitx_print_unit_color_tl ,
    unit-mode .choices:nn =
      { match , math , text }
      {
        \tl_set_eq:NN
          \l__siunitx_print_unit_mode_tl \l_keys_choice_tl
      }
  }
```

(*End definition for* `\l__siunitx_print_number_color_tl` *and others.*)

`\l__siunitx_print_version_ul_tl`
`\l__siunitx_print_version_el_tl`
`\l__siunitx_print_version_l_tl`
`\l__siunitx_print_version_sl_tl`
`\l__siunitx_print_version_m_tl`
`\l__siunitx_print_version_sb_tl`
`\l__siunitx_print_version_b_tl`
`\l__siunitx_print_version_eb_tl`
`\l__siunitx_print_version_ub_tl`

One set of "focussed" options.

```
\keys_define:nn { siunitx / series-version-mapping }
  {
    ul . tl_set:N = \l__siunitx_print_version_ul_tl ,
    el . tl_set:N = \l__siunitx_print_version_el_tl ,
    l  . tl_set:N = \l__siunitx_print_version_l_tl ,
    sl . tl_set:N = \l__siunitx_print_version_sl_tl ,
    m  . tl_set:N = \l__siunitx_print_version_m_tl ,
    sb . tl_set:N = \l__siunitx_print_version_sb_tl ,
    b  . tl_set:N = \l__siunitx_print_version_b_tl ,
    eb . tl_set:N = \l__siunitx_print_version_eb_tl ,
    ub . tl_set:N = \l__siunitx_print_version_ub_tl
  }
```

(*End definition for* `\l__siunitx_print_version_ul_tl` *and others.*)

`\siunitx_print_number:n`
`\siunitx_print_number:V`
`\siunitx_print_number:x`
`\siunitx_print_unit:n`
`\siunitx_print_unit:V`
`\siunitx_print_unit:x`
`\__siunitx_print_aux:nn`

The main printing function doesn't actually need to do very much: just set the color and select the correct sub-function.

```
\cs_new_protected:Npn \siunitx_print_number:n #1
  { \__siunitx_print_aux:nn { number } {#1} }
\cs_generate_variant:Nn \siunitx_print_number:n { V , x }
\cs_new_protected:Npn \siunitx_print_unit:n #1
  { \__siunitx_print_aux:nn { unit } {#1} }
\cs_generate_variant:Nn \siunitx_print_unit:n { V , x }
\cs_new_protected:Npn \__siunitx_print_aux:nn #1#2
  {
    \tl_if_empty:cTF { l__siunitx_print_ #1 _color_tl }
      { \use:n }
```

```
      { \exp_args:Nv \textcolor { l__siunitx_print_ #1 _color_tl } }
        {
          \use:c
            {
              siunitx_print_
              \tl_use:c { l__siunitx_print_ #1 _mode_tl } :n
            }
              {#2}
        }
  }
```

(*End definition for* `\siunitx_print_number:n`, `\siunitx_print_unit:n`, *and* `\__siunitx_print_aux:nn`. *These functions are documented on page 93.*)

`\siunitx_print_match:n` When the *output* mode should match the input, a simple selection of route can be made.

```
\cs_new_protected:Npn \siunitx_print_match:n #1
  {
    \mode_if_math:TF
      { \siunitx_print_math:n {#1} }
      { \siunitx_print_text:n {#1} }
  }
```

(*End definition for* `\siunitx_print_match:n`. *This function is documented on page 93.*)

`\__siunitx_print_replace_font:N` A simple auxiliary for "zapping" the unit font.

```
\cs_new_protected:Npn \__siunitx_print_replace_font:N #1
  {
    \tl_if_empty:NF \l_siunitx_unit_font_tl
      {
        \tl_replace_all:NVn #1
          \l_siunitx_unit_font_tl
          { \use:n }
      }
  }
```

(*End definition for* `\__siunitx_print_replace_font:N`.)

`\c__siunitx_print_series_uc_tl` `\c__siunitx_print_series_ecl_tl` `\c__siunitx_print_series_c_tl` `\c__siunitx_print_series_sc_tl` `\c__siunitx_print_series_sx_tl` `\c__siunitx_print_series_x_tl` `\c__siunitx_print_series_ex_tl` `\c__siunitx_print_series_ux_tl` Font widths where the `m` for weight is omitted.

```
\clist_map_inline:nn { uc , ec , c , sc , sx , x , ex , ux }
  { \tl_const:cn { c__siunitx_print_series_ #1 _tl } { m } }
```

(*End definition for* `\c__siunitx_print_series_uc_tl` *and others.*)

`\c__siunitx_print_series_l_tl` `\c__siunitx_print_series_m_tl` `\c__siunitx_print_series_b_tl` Font widths with one letter.

```
\clist_map_inline:nn { l , m , b }
  { \tl_const:cn { c__siunitx_print_series_ #1 _tl } { #1 } }
```

(*End definition for* `\c__siunitx_print_series_l_tl`, `\c__siunitx_print_series_m_tl`, *and* `\c__siunitx_print_series_b_tl`.)

`\l__siunitx_print_math_html_tl`

```
\tl_new:N \l__siunitx_print_math_html_tl
```

(*End definition for* `\l__siunitx_print_math_html_tl`.)

\siunitx_print_math:n
__siunitx_print_extract_series:Nw
__siunitx_print_convert_series:n
__siunitx_print_convert_series:v
__siunitx_print_math_version:nn
__siunitx_print_math_version:Vn
__siunitx_print_math_auxi:n
__siunitx_print_math_auxii:n
__siunitx_print_math_replace:Nn
__siunitx_print_math_auxiii:n
__siunitx_print_math_auxiv:n
__siunitx_print_math_auxv:n
__siunitx_print_math_auxvi:Nn
__siunitx_print_math_auxvii:N
__siunitx_print_math_auxviii:w
__siunitx_print_math_auxix:Nn
__siunitx_print_math_sub:n
__siunitx_print_math_super:n
__siunitx_print_math_script:n
__siunitx_print_math_ensure:n

The first step in setting in math mode is to check on the math version. The starting point is the question of whether text series needs to propagate to math mode: if so, check on the mapping, otherwise check on the current math version.

```
\cs_new_protected:Npn \siunitx_print_math:n #1
  {
    \bool_lazy_and:nnTF
      { \l__siunitx_print_math_series_bool }
      { \str_if_eq_p:Vn \math@version { normal } }
      {
        \tl_set:Nx \l__siunitx_print_tmp_tl
          { \exp_after:wN \__siunitx_print_extract_series:Nw \f@series ? \q_stop }
        \tl_if_empty:NTF \l__siunitx_print_tmp_tl
          { \__siunitx_print_math_auxi:n {#1} }
          { \__siunitx_print_math_version:Vn \l__siunitx_print_tmp_tl {#1} }
      }
      { \__siunitx_print_math_auxi:n {#1} }
  }
```

Look up the math version from the text series. The weight is omitted if it is `m` plus there are either one or two letters, so we have a little work to do. To keep things fast, we use a hash table based lookup rather than a sequence or property list.

```
\cs_new:Npn \__siunitx_print_extract_series:Nw #1#2 ? #3 \q_stop
  {
    \cs_if_exist:cTF { c__siunitx_print_series_ #1#2 _tl }
      { \__siunitx_print_convert_series:v { c__siunitx_print_series_ #1#2 _tl } }
      {
        \cs_if_exist:cTF { c__siunitx_print_series_ #1 _tl }
          { \__siunitx_print_convert_series:v { c__siunitx_print_series_ #1 _tl } }
          { \__siunitx_print_convert_series:n {#1#2} }
      }
  }
\cs_new:Npn \__siunitx_print_convert_series:n #1
  { \tl_use:c { l__siunitx_print_version_ #1 _tl } }
\cs_generate_variant:Nn \__siunitx_print_convert_series:n { v }
\cs_new_protected:Npn \__siunitx_print_math_auxi:n #1
  {
    \bool_if:NTF \l__siunitx_print_math_version_bool
      { \__siunitx_print_math_version:nn { normal } {#1} }
      { \__siunitx_print_math_auxii:n {#1} }
  }
```

Any setting which changes the math version can only be set from text mode (as it applies at the level of a formula). As such, the first test is to see if that needs to be to check if the math version has to be set: if so, switch to text mode, sort it out and switch back. That of course means that in such cases, line breaking will not be possible.

```
\cs_new_protected:Npn \__siunitx_print_math_version:nn #1#2
  {
    \str_if_eq:VnTF \math@version { #1 }
      { \__siunitx_print_math_auxii:n {#2} }
      {
        \mode_if_math:TF
          { \text }
          { \use:n }
            {
```

```
              \mathversion {#1}
              \__siunitx_print_math_auxii:n {#2}
            }
        }
  }
\cs_generate_variant:Nn \__siunitx_print_math_version:nn { V }
```

At this point, force math mode then start dealing with setting math font based on text family. If the text family is roman, life is slightly different to if it is sanserif or monospaced. In all cases, the outcomes can be handled using the same routines as for normal math mode treatment. The test here is on a string basis as `\f@family` and the `\...default` commands have different `\long` status.

```
\cs_new_protected:Npn \__siunitx_print_math_auxii:n #1
  {
    \group_begin:
      \cs_set_protected:Npn \text ##1
        {
          \cs_set_eq:NN \text \__siunitx_print_ams_text:n
          \siunitx_print_text:n {##1}
        }
      \tl_set:Nn \l__siunitx_print_tmp_tl {#1}
      \exp_after:wN \__siunitx_print_math_replace:Nn
        \l__siunitx_print_math_html_tl
        \q_recursion_tail { } \q_recursion_stop
      \exp_args:NV \__siunitx_print_math_auxiii:n \l__siunitx_print_tmp_tl
     \group_end:
  }
\cs_new_protected:Npn \__siunitx_print_math_replace:Nn #1#2
  {
    \quark_if_recursion_tail_stop:N #1
    \tl_replace_all:Nnn \l__siunitx_print_tmp_tl {#1} {#2}
    \__siunitx_print_math_replace:Nn
  }
\cs_new_protected:Npn \__siunitx_print_math_auxiii:n #1
  {
    \bool_if:NTF \l__siunitx_print_math_family_bool
      {
        \str_case_e:nnF { \f@family }
          {
            { \rmdefault } { \__siunitx_print_math_auxv:n }
            { \sfdefault } { \__siunitx_print_math_auxix:Nn \mathsf }
            { \ttdefault } { \__siunitx_print_math_auxix:Nn \mathtt }
          }
          { \__siunitx_print_math_auxiv:n }
      }
      { \__siunitx_print_math_auxiv:n }
        {#1}
  }
```

Now we deal with the font selection in math mode. There are two possible cases. First, we are retaining the current math font, and the active one is `\mathsf` or `\mathtt`: that needs to be applied to the argument. Alternatively, if the current font is not retained, ensure that normal math mode rules are active.

```
\cs_new_protected:Npn \__siunitx_print_math_auxiv:n #1
```

```
  {
    \bool_if:NTF \l__siunitx_print_math_font_bool
      {
        \__siunitx_print_math_auxvii:N
          \mathbf \mathit \mathsf \mathtt
          \q_recursion_tail \q_recursion_stop
      }
      { \__siunitx_print_math_auxv:n }
        {#1}
  }
\cs_new_protected:Npn \__siunitx_print_math_auxv:n #1
  {
    \bool_lazy_or:nnTF
      { \int_compare_p:nNn \fam = { -1 } }
      { \int_compare_p:nNn \fam = \symoperators }
      { \__siunitx_print_math_ensure:n }
      { \__siunitx_print_math_auxvi:Nn \mathrm }
        {#1}
  }
\cs_new_protected:Npn \__siunitx_print_math_auxvi:Nn #1#2
  { \__siunitx_print_math_ensure:n { #1 {#2} } }
\cs_new_protected:Npn \__siunitx_print_math_auxvii:N #1
  {
    \quark_if_recursion_tail_stop_do:Nn #1 { \__siunitx_print_math_auxv:n }
    \exp_after:wN \exp_after:wN \exp_after:wN \__siunitx_print_math_auxviii:w
      \cs:w \cs_to_str:N #1 \c_space_tl \cs_end:
        \use@mathgroup ? { -2 } \q_stop #1
  }
\cs_new_protected:Npn \__siunitx_print_math_auxviii:w #1 \use@mathgroup #2#3 #4 \q_stop #5
  {
    \int_compare:nNnTF \fam = {#3}
      { \use_i_delimit_by_q_recursion_stop:nw { \__siunitx_print_math_auxix:Nn #5 } }
      { \__siunitx_print_math_auxvii:N }
  }
```

Search-and-replace fun: deal with any font commands in the argument and also inside sub/superscripts.

```
\cs_new_protected:Npx \__siunitx_print_math_auxix:Nn #1#2
  {
    \group_begin:
      \tl_set:Nn \exp_not:N \l__siunitx_print_tmp_tl {#2}
      \__siunitx_print_replace_font:N \exp_not:N \l__siunitx_print_tmp_tl
      \tl_replace_all:Nnn \exp_not:N \l__siunitx_print_tmp_tl
        { \char_generate:nn { `\_ } { 8 } }
        { \exp_not:N \__siunitx_print_math_sub:n }
      \tl_replace_all:Nnn \exp_not:N \l__siunitx_print_tmp_tl
        { ^ }
        { \exp_not:N \__siunitx_print_math_super:n }
      \exp_not:N \exp_args:NNV \__siunitx_print_math_auxvi:Nn
        #1 \exp_not:N \l__siunitx_print_tmp_tl
    \group_end:
  }
\cs_new_protected:Npx \__siunitx_print_math_sub:n #1
  {
```

```
    \char_generate:nn { `\_ } { 8 }
      { \exp_not:N \__siunitx_print_math_script:n {#1} }
  }
\cs_new_protected:Npn \__siunitx_print_math_super:n #1
  { ^ { \__siunitx_print_math_script:n {#1} } }
\cs_new_protected:Npn \__siunitx_print_math_script:n #1
  {
    \group_begin:
      \tl_set:Nn \l__siunitx_print_tmp_tl {#1}
      \__siunitx_print_replace_font:N \l__siunitx_print_tmp_tl
      \tl_use:N \l__siunitx_print_tmp_tl
    \group_end:
  }
\cs_new_protected:Npn \__siunitx_print_math_ensure:n #1
  {
    \tl_if_blank:nF {#1}
      {
        \mode_if_math:TF
          {#1}
          { $ #1 $ }
      }
  }
```

For tex4ht, we need to have category code 12 ^ tokens in math mode.

```
\AtBeginDocument
  {
    \@ifpackageloaded { tex4ht }
      { \tl_set:Nx \l__siunitx_print_math_html_tl { ^ { \token_to_str:N ^ } } }
      { }
  }
```

(*End definition for* `\siunitx_print_math:n` *and others. This function is documented on page 93.*)

`\siunitx_print_text:n`
`\__siunitx_print_text_replace:n`
`\__siunitx_print_text_replace:N`
`\__siunitx_print_text_replace:NNn`
`\__siunitx_print_text_replace:Nnnn`
`\__siunitx_print_text_replace_frac:n`
`\__siunitx_print_text_sub:n`
`\__siunitx_print_text_super:n`
`\__siunitx_print_text_scripts:NnN`
`\__siunitx_print_text_scripts:`
`\__siunitx_print_text_scripts_one:NnN`
`\__siunitx_print_text_scripts_two:NnNn`
`\__siunitx_print_text_scripts_two:nn`
`\__siunitx_print_text_scripts_two:n`
`\__siunitx_print_text_fraction:Nnn`

Typesetting in text mode is easy in font control terms but more tricky in the manipulation of the input. The easy part comes first.

```
\cs_new_protected:Npn \siunitx_print_text:n #1
  {
    \text
      {
        \bool_if:NT \l__siunitx_print_text_family_bool
          { \fontfamily { \familydefault } }
        \bool_if:NT \l__siunitx_print_text_series_bool
          { \fontseries { \seriesdefault } }
        \bool_if:NT \l__siunitx_print_text_shape_bool
          { \fontshape { \shapedefault } }
        \bool_lazy_any:nT
          {
            { \l__siunitx_print_text_family_bool }
            { \l__siunitx_print_text_series_bool }
            { \l__siunitx_print_text_shape_bool }
          }
          { \selectfont }
        \tl_use:N \l__siunitx_print_text_font_tl
        \exp_args:NnV \tl_if_head_eq_meaning:nNTF {#1} \l_siunitx_unit_fraction_tl
          { \__siunitx_print_text_fraction:Nnn #1 }
```

```
          { \__siunitx_print_text_replace:n {#1} }
      }
  }
```

To get math mode material to print in text mode, various search-and-replace steps are needed.

```
\cs_new_protected:Npn \__siunitx_print_text_replace:n #1
  {
    \group_begin:
    \tl_if_head_eq_meaning:nNTF {#1} \mathchoice
      { \__siunitx_print_text_replace:Nnnnn #1 }
      {
        \tl_set:Nn \l__siunitx_print_tmp_tl {#1}
        \__siunitx_print_text_replace:N \l__siunitx_print_tmp_tl
        \tl_use:N \l__siunitx_print_tmp_tl
      }
    \group_end:
  }
\cs_new_protected:Npx \__siunitx_print_text_replace:N #1
  {
    \__siunitx_print_replace_font:N #1
    \exp_not:N \__siunitx_print_text_replace:NNn #1
      \exp_not:N \mathord { }
      \exp_not:N \pm
        { \exp_not:N \textpm }
      \exp_not:N \mp
        { \exp_not:n { \ensuremath { \mp } } }
      -
        { \exp_not:N \textminus }
      \exp_not:N \times
        { \exp_not:N \texttimes }
      \exp_not:N \cdot
        { \exp_not:N \textperiodcentered }
      \char_generate:nn { `\_ } { 8 }
        { \exp_not:N \__siunitx_print_text_sub:n }
      ^
        { \exp_not:N \__siunitx_print_text_super:n }
      \exp_not:N \q_recursion_tail
        { ? }
      \exp_not:N \q_recursion_stop
  }
\cs_new_protected:Npn \__siunitx_print_text_replace:NNn #1#2#3
  {
    \quark_if_recursion_tail_stop:N #2
    \tl_replace_all:Nnn #1 {#2} {#3}
    \__siunitx_print_text_replace:NNn #1
  }
\cs_new_protected:Npn \__siunitx_print_text_replace:Nnnnn #1#2#3#4#5
  {
    \ensuremath
      {
        \mathchoice
          { \__siunitx_print_print_replace_frac:n {#2} }
          { \__siunitx_print_print_replace_frac:n {#3} }
```

```
          { \__siunitx_print_print_replace_frac:n {#4} }
          { \__siunitx_print_print_replace_frac:n {#5} }
      }
  }
```

Almost the same as the lead-off but here we need to deal with re-inserting a text mode shift.

```
\cs_new_protected:Npn \__siunitx_print_print_replace_frac:n #1
  {
    \exp_args:NnV \tl_if_head_eq_meaning:nNTF {#1} \l_siunitx_unit_fraction_tl
      { \__siunitx_print_text_fraction:Nnn #1 }
      { \mbox { \__siunitx_print_text_replace:n {#1} } }
  }
```

When the bidi package is loaded, we need to make sure that `\text` is doing the correct thing.

```
\sys_if_engine_xetex:T
  {
    \AtBeginDocument
      {
         \@ifpackageloaded { bidi }
           {
             \cs_set_protected:Npn \__siunitx_print_text_replace:n #1
               {
                 \group_begin:
                   \tl_set:Nn \l__siunitx_print_tmp_tl {#1}
                   \__siunitx_print_text_replace:N \l__siunitx_print_tmp_tl
                   \LRE { \tl_use:N \l__siunitx_print_tmp_tl }
                 \group_end:
               }
           }
        { }
      }
  }
```

Sub- and superscripts can be in any order in the source. The first step of handling them is therefore to do a look-ahead to work out whether only one or both are present.

```
\cs_new_protected:Npn \__siunitx_print_text_sub:n #1
  {
    \__siunitx_print_text_scripts:NnN
      \textsubscript {#1} \__siunitx_print_text_super:n
  }
\cs_new_protected:Npn \__siunitx_print_text_super:n #1
  {
    \__siunitx_print_text_scripts:NnN
      \textsuperscript {#1} \__siunitx_print_text_sub:n
  }
\cs_new_protected:Npn \__siunitx_print_text_scripts:NnN #1#2#3
  {
    \cs_set_protected:Npn \__siunitx_print_text_scripts:
      {
        \if_meaning:w \l_peek_token #3
          \exp_after:wN \__siunitx_print_text_scripts_two:NnNn
        \else:
          \exp_after:wN \__siunitx_print_text_scripts_one:Nn
```

```
        \fi:
          #1 {#2}
      }
    \peek_after:Nw \__siunitx_print_text_scripts:
  }
\cs_new_protected:Npn \__siunitx_print_text_scripts: { }
```

In the simple case of one script item, we have to do a search-and-replace to deal with anything inside the argument.

```
\cs_new_protected:Npn \__siunitx_print_text_scripts_one:Nn #1#2
  {
    \group_begin:
      \tl_set:Nn \l__siunitx_print_tmp_tl {#2}
      \__siunitx_print_text_replace:N \l__siunitx_print_tmp_tl
    \exp_args:NNV \group_end:
    #1 \l__siunitx_print_tmp_tl
  }
```

For the two scripts case, we cannot use `\textsubscript`/`\textsuperscript` as they don't stack directly. Instead, we sort out the ordering then use an implementation for both parts that is the same as the kernel text scripts.

```
\cs_new_protected:Npn \__siunitx_print_text_scripts_two:NnNn #1#2#3#4
  {
    \cs_if_eq:NNTF #1 \textsubscript
      { \__siunitx_print_text_scripts_two:nn {#4} {#2} }
      { \__siunitx_print_text_scripts_two:nn {#2} {#4} }
  }
\cs_new_protected:Npx \__siunitx_print_text_scripts_two:nn #1#2
  {
    \group_begin:
      \exp_not:N \m@th
      \exp_not:N \ensuremath
        {
          ^ { \exp_not:N \__siunitx_print_text_scripts_two:n {#1} }
          \char_generate:nn { `\_ } { 8 }
            { \exp_not:N \__siunitx_print_text_scripts_two:n {#2} }
        }
    \group_end:
  }
\cs_new_protected:Npn \__siunitx_print_text_scripts_two:n #1
  {
    \mbox
      {
        \fontsize \sf@size \z@ \selectfont
        \__siunitx_print_text_scripts_one:Nn \use:n {#1}
      }
  }
```

Fraction commands are always math mode, so we have to go back and forth: this is done after general font setting for performance reasons.

```
\cs_new_protected:Npn \__siunitx_print_text_fraction:Nnn #1#2#3
  {
    \ensuremath
      {
        #1
```

```
          { \mbox { \__siunitx_print_text_replace:n {#2} } }
          { \mbox { \__siunitx_print_text_replace:n {#3} } }
      }
  }
```

(*End definition for* `\siunitx_print_text:n` *and others. This function is documented on page 93.*)

2.3 Standard settings for module options

Some of these follow naturally from the point of definition (*e.g.* boolean variables are always `false` to begin with), but for clarity everything is set here.

```
\keys_set:nn { siunitx }
  {
    color               =       ,
    mode                = math  ,
    number-color        =       ,
    number-mode         = math  ,
    propagate-math-font = false ,
    reset-math-version  = true  ,
    reset-text-shape    = true  ,
    reset-text-series   = true  ,
    reset-text-family   = true  ,
    text-family-to-math = false ,
    text-font-command   =       ,
    text-series-to-math = false ,
    unit-color          =       ,
    unit-mode           = math
  }
```

These are separate as they all fall inside the same key.

```
\keys_set:nn { siunitx / series-version-mapping }
  {
    ul = light  ,
    el = light  ,
    l  = light  ,
    sl = light  ,
    m  = normal ,
    sb = bold   ,
    b  = bold   ,
    eb = bold   ,
    ub = bold
  }
```

⟨/package⟩

Part VII
siunitx-quantity – Quantities

This submodule is focussed on providing controlled printing for quantities: the combination of a number and a unit. It largely builds on the submodules siunitx-number and siunitx-unit. A small number of adjustments are made to standard set up in the latter to reflect additional functionality added here.

`\siunitx_quantity:nn` `\siunitx_quantity:nn {⟨number⟩} {⟨unit⟩}`

Parses the ⟨*number*⟩ and the ⟨*unit*⟩ as detailed for `\siunitx_number_parse:nN` and `\siunitx_unit_format:nN`, the prints the results using `\siunitx_print_unit:n`.

`\siunitx_quantity_print:nn` `\siunitx_quantity_print:nn {⟨number⟩} {⟨unit⟩}`
`\siunitx_quantity_print:(nV|VV|xV)`

A low-level function which prints the quantity directly: there is no processing applied to either the ⟨*number*⟩ or ⟨*unit*⟩. The two parts are printed using `\siunitx_print_unit:n` and appropriate spacing and break-prevention is applied.

`allow-quantity-breaks` `allow-quantity-breaks = true|false`

Specifies whether breaks are permitted between units. The standard setting is `false`.

`prefix-mode` `prefix-mode = combine-exponent|extract-exponent|input`

Selects the method used for producing prefixes: a choice from the options `combine-exponent`, `extract-exponent` and `input`. The option `combine-exponent` combines any exponent from the number with the prefix of the first unit, and prints the updated prefix. The option `extract-exponent` removes all prefixes from the unit, and combines them with the exponent of number. The option `input` prints prefixes and exponent as given in the source. The standard setting is `input`.

`quantity-product` `quantity-product = ⟨tokens⟩`

The product marker used between a number and the unit. The standard setting is `\,`.

`separate-uncertainty-units` `separate-uncertainty-units = bracket|repeat|single`

Specifies how units are applied when a separated uncertainty is present: a choice from `bracket`, `repeat` and `single`. The option `bracket` places brackets around the number, with the unit given after these. The option `repeat` means that the unit it printed with the main value and with the uncertainty. When `single` is set, the unit is printed only once and no brackets are applied. The standard setting is `bracket`.

1 siunitx-quantity implementation

Start the DocStrip guards.

```
1 ⟨*package⟩
```

Identify the internal prefix (LaTeX3 DocStrip convention): only internal material in this *submodule* should be used directly.

```
2 ⟨@@=siunitx_quantity⟩
```

1.1 Initial set-up

\l__siunitx_quantity_tmp_fp
\l__siunitx_quantity_tmp_tl

Scratch space.

```
\tl_new:N \l__siunitx_quantity_tmp_fp
\tl_new:N \l__siunitx_quantity_tmp_tl
```

(*End definition for* `\l__siunitx_quantity_tmp_fp` *and* `\l__siunitx_quantity_tmp_tl`.)

1.2 Main formatting routine

\l__siunitx_quantity_bracket_close_tl
\l__siunitx_quantity_bracket_open_tl

Purely internal for the present.

```
\tl_new:N \l__siunitx_quantity_bracket_close_tl
\tl_new:N \l__siunitx_quantity_bracket_open_tl
\tl_set:Nn \l__siunitx_quantity_bracket_open_tl { ( }
\tl_set:Nn \l__siunitx_quantity_bracket_close_tl { ) }
```

(*End definition for* `\l__siunitx_quantity_bracket_close_tl` *and* `\l__siunitx_quantity_bracket_open_tl`.)

\l_siunitx_quantity_prefix_mode_tl
\l__siunitx_quantity_break_bool
\l__siunitx_quantity_product_tl
\l__siunitx_quantity_uncert_bracket_bool
\l__siunitx_quantity_uncert_repeat_bool

```
\tl_new:N \l_siunitx_quantity_prefix_mode_tl
\bool_new:N \l__siunitx_quantity_uncert_bracket_bool
\bool_new:N \l__siunitx_quantity_uncert_repeat_bool
\keys_define:nn { siunitx }
  {
    allow-quantity-breaks .bool_set:N =
      \l__siunitx_quantity_break_bool ,
    prefix-mode .choices:nn =
      { combine-exponent , extract-exponent , input }
      { \tl_set_eq:NN \l_siunitx_quantity_prefix_mode_tl \l_keys_choice_tl } ,
    quantity-product .tl_set:N =
      \l__siunitx_quantity_product_tl ,
    separate-uncertainty-units .choice: ,
    separate-uncertainty-units / bracket .code:n =
      {
        \bool_set_true:N \l__siunitx_quantity_uncert_bracket_bool
        \bool_set_false:N \l__siunitx_quantity_uncert_repeat_bool
      } ,
    separate-uncertainty-units / repeat .code:n =
      {
        \bool_set_false:N \l__siunitx_quantity_uncert_bracket_bool
        \bool_set_true:N \l__siunitx_quantity_uncert_repeat_bool
      } ,
    separate-uncertainty-units / single .code:n =
      {
        \bool_set_false:N \l__siunitx_quantity_uncert_bracket_bool
        \bool_set_false:N \l__siunitx_quantity_uncert_repeat_bool
      }
  }
```

(*End definition for* `\l_siunitx_quantity_prefix_mode_tl` *and others. This variable is documented on page* **??**.)

\l__siunitx_quantity_number_tl
\l__siunitx_quantity_unit_tl

```
\tl_new:N \l__siunitx_quantity_number_tl
\tl_new:N \l__siunitx_quantity_unit_tl
```

(*End definition for* `\l__siunitx_quantity_number_tl` *and* `\l__siunitx_quantity_unit_tl`.)

\siunitx_quantity:nn
__siunitx_quantity_parsed:nn
__siunitx_quantity_parsed_combine-exponent:n
__siunitx_quantity_parsed_combine-exponent:n
__siunitx_quantity_parsed_input:n
__siunitx_quantity_parsed_aux:w
__siunitx_quantity_parsed_aux:nnnw
__siunitx_quantity_parsed_aux:nnnn
__siunitx_quantity_parsed_aux:nnn

For quantities, there is bit to do to combine things. The first question is whether we are parsing at all: if not, things are quite short. Notice that within this group we turn off bracketing in the number formatter: we have to deal with quantity-based brackets instead.

```
\cs_new_protected:Npn \siunitx_quantity:nn #1#2
  {
    \group_begin:
      \siunitx_unit_options_apply:n {#2}
      \tl_if_blank:nTF {#1}
        {
          \siunitx_unit_format:nN {#2} \l__siunitx_quantity_unit_tl
          \siunitx_print_unit:V \l__siunitx_quantity_unit_tl
        }
        {
          \bool_if:NTF \l_siunitx_number_parse_bool
            { \__siunitx_quantity_parsed:nn {#1} {#2} }
            {
              \tl_set:Nn \l__siunitx_quantity_number_tl { \ensuremath {#1} }
              \siunitx_unit_format:nN {#2} \l__siunitx_quantity_unit_tl
              \siunitx_quantity_print:VV
                \l__siunitx_quantity_number_tl \l__siunitx_quantity_unit_tl
            }
        }
    \group_end:
  }
```

For parsed numbers, we have two major questions to think about: whether we are combining prefixes, and whether we have a multi-part numbers to handle. Number processing has to be delayed it needs to come after any extracted exponent is combined.

```
\cs_new_protected:Npn \__siunitx_quantity_parsed:nn #1#2
  {
    \bool_set_false:N \l_siunitx_number_bracket_ambiguous_bool
    \siunitx_number_parse:nN {#1} \l__siunitx_quantity_number_tl
    \use:c { __siunitx_quantity_parsed_ \l_siunitx_quantity_prefix_mode_tl :n } {#2}
    \tl_set:Nx \l__siunitx_quantity_number_tl
      { \siunitx_number_output:NN \l__siunitx_quantity_number_tl \q_nil }
    \exp_after:wN \__siunitx_quantity_parsed_aux:w \l__siunitx_quantity_number_tl \q_stop
  }
\cs_new_protected:cpn { __siunitx_quantity_parsed_combine-exponent:n } #1
  {
    \siunitx_number_process:NN \l__siunitx_quantity_number_tl \l__siunitx_quantity_number_tl
    \exp_args:NV \__siunitx_quantity_extract_exp:nNN
      \l__siunitx_quantity_number_tl \l__siunitx_quantity_tmp_fp \l__siunitx_quantity_number_
    \siunitx_unit_format_combine_exponent:nnN {#1}
      \l__siunitx_quantity_tmp_fp \l__siunitx_quantity_unit_tl
  }
\cs_new_protected:cpn { __siunitx_quantity_parsed_extract-exponent:n } #1
  {
```

```
    \siunitx_unit_format_extract_prefixes:nNN {#1}
      \l__siunitx_quantity_unit_tl \l__siunitx_quantity_tmp_fp
    \tl_set:Nx \l__siunitx_quantity_number_tl
      {
        \siunitx_number_adjust_exponent:Nn
          \l__siunitx_quantity_number_tl \l__siunitx_quantity_tmp_fp
      }
    \siunitx_number_process:NN \l__siunitx_quantity_number_tl \l__siunitx_quantity_number_tl
  }
\cs_new_protected:Npn \__siunitx_quantity_parsed_input:n #1
  {
    \siunitx_number_process:NN \l__siunitx_quantity_number_tl \l__siunitx_quantity_number_tl
    \siunitx_unit_format:nN {#1} \l__siunitx_quantity_unit_tl
  }
```

To find out if we need to work harder, we first need to split the formatted number into the constituent parts. That is done using the table-like approach: that avoids needing to both check the settings and break down the input separately.

```
\cs_new_protected:Npn \__siunitx_quantity_parsed_aux:w
  #1 \q_nil #2 \q_nil #3 \q_nil #4 \q_nil #5 \q_nil #6 \q_nil #7 \q_nil
  #8 \q_nil #9 \q_stop
  { \__siunitx_quantity_parsed_aux:nnnw {#1} {#2#3#4#5} {#6#7#8} #9 \q_stop }
\cs_new_protected:Npn \__siunitx_quantity_parsed_aux:nnnw
  #1#2#3 #4 \q_nil #5 \q_nil #6 \q_stop
  { \__siunitx_quantity_parsed_aux:nnnn {#1} {#2} {#3#4} {#5#6} }
\cs_new_protected:Npn \__siunitx_quantity_parsed_aux:nnnn #1#2#3#4
  {
    \tl_if_blank:nTF {#3}
      { \siunitx_quantity_print:nV {#1#2#4} \l__siunitx_quantity_unit_tl }
      {
        \bool_if:NTF \l__siunitx_quantity_uncert_bracket_bool
          {
            \siunitx_quantity_print:xV
              {
                \exp_not:n {#1}
                \exp_not:V \l__siunitx_quantity_bracket_open_tl
                \exp_not:n {#2#3}
                \exp_not:V \l__siunitx_quantity_bracket_close_tl
                \exp_not:n {#4}
              }
            \l__siunitx_quantity_unit_tl
          }
          {
            \bool_if:NTF \l__siunitx_quantity_uncert_repeat_bool
              {
                \tl_if_blank:nTF {#4}
                  { \__siunitx_quantity_parsed_aux:nnn {#1#2} {#3} { } }
                  { \__siunitx_quantity_parsed_aux:nnn {#1#2} {#3} { { } #4 } }
              }
              { \siunitx_quantity_print:nV {#1#2#3#4} \l__siunitx_quantity_unit_tl }
          }
      }
  }
```

For the case of a separated uncertainty with repeated units, we print the two parts

independently. The third argument here is the exponent if there is one, with the spacing correct in either case as we only pass the empty group if one is required.

```
\cs_new_protected:Npn \__siunitx_quantity_parsed_aux:nnn #1#2#3
  {
    \siunitx_quantity_print:nV {#1#3} \l__siunitx_quantity_unit_tl
    \tl_if_blank:nF {#2}
      { \siunitx_quantity_print:nV { { } #2#3 } \l__siunitx_quantity_unit_tl }
  }
```

(*End definition for* `\siunitx_quantity:nn` *and others. This function is documented on page* 107.)

`\__siunitx_quantity_extract_exp:nNN`
`\__siunitx_quantity_extract_exp:nnnnnnnNN`

To extract the exponent part for a combined prefix, we decompose the value and remove it.

```
\cs_new_protected:Npn \__siunitx_quantity_extract_exp:nNN #1#2#3
  { \__siunitx_quantity_extract_exp:nnnnnnnNN #1 #2 #3 }
\cs_new_protected:Npn \__siunitx_quantity_extract_exp:nnnnnnnNN #1#2#3#4#5#6#7#8#9
  {
    \fp_set:Nn #8 {#6#7}
    \tl_set:Nx #9
      { {#1} {#2} {#3} {#4} {#5} { } { 0 } }
  }
```

(*End definition for* `\__siunitx_quantity_extract_exp:nNN` *and* `\__siunitx_quantity_extract_exp:nnnnnnnNN`.)

`\siunitx_quanity_print:nn`
`\siunitx_quanity_print:nV`
`\siunitx_quanity_print:VV`
`\siunitx_quanity_print:xV`

For printing a single part of a quantity. This is needed for compound quantities and so is public: that's also the reason for passing both argument explicitly. The lazy test here is looking for the case where a `1` has been inserted at the start of a format unit *and* we have some other number to print: the `1` is then removed and there is no space inserted.

```
\cs_new_protected:Npn \siunitx_quantity_print:nn #1#2
  {
    \siunitx_print_number:n {#1}
    \tl_if_blank:nF {#2}
      {
        \bool_lazy_or:nnTF
          { \tl_if_blank_p:n {#1} }
          { ! \tl_if_head_eq_charcode_p:nN {#2} { 1 } }
          {
            \tl_use:N \l__siunitx_quantity_product_tl
            \bool_if:NTF \l__siunitx_quantity_break_bool
              { \penalty \binoppenalty }
              { \nobreak }
            \siunitx_print_unit:n {#2}
          }
          {
            \exp_args:No \siunitx_print_unit:n { \use_none:n #2 }
          }
      }
  }
\cs_generate_variant:Nn \siunitx_quantity_print:nn { nV , VV , xV }
```

(*End definition for* `\siunitx_quanity_print:nn`. *This function is documented on page* ??.)

1.3 Standard settings for module options

Some of these follow naturally from the point of definition (*e.g.* boolean variables are always `false` to begin with), but for clarity everything is set here.

```
\keys_set:nn { siunitx }
  {
    allow-quantity-breaks      = false  ,
    prefix-mode                = input ,
    quantity-product           = \,     ,
    separate-uncertainty-units = bracket
  }
```

1.4 Adjustments to units

__siunitx_quantity_non_latin:n
__siunitx_quantity_non_latin:nnnn

As in siunitx-unit, but internal in both cases as it's rather specialised.

```
\bool_lazy_or:nnTF
  { \sys_if_engine_luatex_p: }
  { \sys_if_engine_xetex_p: }
  {
    \cs_new:Npn \__siunitx_quantity_non_latin:n #1
      { \char_generate:nn {#1} { \char_value_catcode:n {#1} } }
  }
  {
    \cs_new:Npn \__siunitx_quantity_non_latin:n #1
      {
        \exp_last_unbraced:Nf \__siunitx_quantity_non_latin:nnnn
          { \char_to_utfviii_bytes:n {#1} }
      }
    \cs_new:Npn \__siunitx_quantity_non_latin:nnnn #1#2#3#4
      {
        \exp_after:wN \exp_after:wN \exp_after:wN
          \exp_not:N \char_generate:nn {#1} { 13 }
        \exp_after:wN \exp_after:wN \exp_after:wN
          \exp_not:N \char_generate:nn {#2} { 13 }
      }
  }
```

(*End definition for* `\__siunitx_quantity_non_latin:n` *and* `\__siunitx_quantity_non_latin:nnnn`.)

\degree

The `\degree` unit is re-declared here: this is needed for using it in quantities. This is done here as it avoids a dependency in siunitx-unit on options it does not contain.

```
\siunitx_declare_unit:Nxn \degree
  { \__siunitx_quantity_non_latin:n { "00B0 } }
  { quantity-product = { } }
```

(*End definition for* `\degree`. *This function is documented on page* 147.)

⟨/package⟩

Part VIII
siunitx-symbol – Symbol-related settings

1 siunitx-symbol implementation

Start the DocStrip guards.

```
1 ⟨*package⟩
```

Identify the internal prefix (LaTeX3 DocStrip convention): only internal material in this *submodule* should be used directly.

```
2 ⟨@@=siunitx_symbol⟩
```

\l__siunitx_symbol_tmpa_tl
\l__siunitx_symbol_tmpb_tl

Scratch space.

```
3 \tl_new:N \l__siunitx_symbol_tmpa_tl
4 \tl_new:N \l__siunitx_symbol_tmpb_tl
```

(*End definition for* \l__siunitx_symbol_tmpa_tl *and* \l__siunitx_symbol_tmpb_tl.)

A small number of commands are needed from the companion fonts when working with 8-bit engines. These are loaded by modern LaTeX 2_ε kernel, so for older ones, force loading them using textcomp.

```
5 \AtBeginDocument
6   {
7     \cs_if_free:cT { T@TS1 }
8       { \RequirePackage { textcomp } }
9   }
```

__siunitx_symbol_non_latin:n
__siunitx_symbol_non_latin:nnnn

As in siunitx-unit, but internal in both cases as it's rather specialised.

```
10 \bool_lazy_or:nnTF
11   { \sys_if_engine_luatex_p: }
12   { \sys_if_engine_xetex_p: }
13   {
14     \cs_new:Npn \__siunitx_symbol_non_latin:n #1
15       { \char_generate:nn {#1} { \char_value_catcode:n {#1} } }
16   }
17   {
18     \cs_new:Npn \__siunitx_symbol_non_latin:n #1
19       {
20         \exp_last_unbraced:Nf \__siunitx_symbol_non_latin:nnnn
21           { \char_to_utfviii_bytes:n {#1} }
22       }
23     \cs_new:Npn \__siunitx_symbol_non_latin:nnnn #1#2#3#4
24       {
25         \__siunitx_symbol_deal_with_utf:
26         \exp_after:wN \exp_after:wN \exp_after:wN
27           \exp_not:N \char_generate:nn {#1} { 13 }
28         \char_generate:nn {#2} { 12 }
29       }
30   }
31 \cs_new:Npn \__siunitx_symbol_deal_with_utf: { }
```

(*End definition for* `\__siunitx_symbol_non_latin:n` *and* `\__siunitx_symbol_non_latin:nnnn`.)

`\__siunitx_symbol_if_replace:NnT` A test to see if the unit definition which applies is still one we expect: here that means it is just using a (Unicode) codepoint. The comparison is string-based as unicode-math (at least) can alter some of them. Active characters are set to `\scan_stop:` so that the code here gives exactly the tokens (bytes) we want: needed for encodings other than UTF-8.

```
\prg_new_protected_conditional:Npnn \__siunitx_symbol_if_replace:Nn #1#2 { T , TF }
  {
    \group_begin:
      \protected@edef \l__siunitx_symbol_tmpa_tl
        { \exp_not:V \l_siunitx_unit_font_tl { \__siunitx_symbol_non_latin:n {#2} } }
      \int_step_inline:nnn { "80 } { "FF }
        { \char_set_active_eq:nN {##1} \scan_stop: }
      \keys_set:nn { siunitx } { parse-units = false }
      \siunitx_unit_format:nN {#1} \l__siunitx_symbol_tmpb_tl
      \str_if_eq:VVTF \l__siunitx_symbol_tmpa_tl \l__siunitx_symbol_tmpb_tl
        {
          \group_end:
          \prg_return_true:
        }
        {
          \group_end:
          \prg_return_false:
        }
  }
```

(*End definition for* `\__siunitx_symbol_if_replace:NnT`.)

At the start of the document, fonts are fixed and the user may have altered unit set up. If things are unchanged, we can alter the settings such that they use something "more sensible".

```
\AtBeginDocument
  {
    \__siunitx_symbol_if_replace:NnT \arcminute { "02B9 }
      {
        \siunitx_declare_unit:Nn \arcminute
          { \ensuremath { { } ' } }
      }
    \__siunitx_symbol_if_replace:NnT \arcsecond { "02BA }
      {
        \siunitx_declare_unit:Nn \arcsecond
          { \ensuremath { { } '' } }
      }
```

For `\degree`, direct input works in text mode so there is only a need to tidy up for math mode.

```
    \__siunitx_symbol_if_replace:NnT \degree { "00B0 }
      {
        \siunitx_declare_unit:Nxn \degree
          {
            \exp_not:N \ifmmode
              { } ^ { \exp_not:N \circ }
            \exp_not:N \else
              \exp_not:N \text
                {
```

```
                \@ifpackageloaded { inputenc }
                  { \exp_not:N \textdegree }
                  { \__siunitx_symbol_non_latin:n { "00B0 } }
              }
            \exp_not:N \fi
          }
          { quantity-product = { } }
      }
```

For `\degreeCelsius`, much the same to think about but the comparison must be done by hand.

```
    \group_begin:
      \tl_set:Nx \l__siunitx_symbol_tmpa_tl { \__siunitx_symbol_non_latin:n { "00B0 } C }
      \protected@edef \l__siunitx_symbol_tmpa_tl
        { \exp_not:V \l_siunitx_unit_font_tl { \l__siunitx_symbol_tmpa_tl } }
      \keys_set:nn { siunitx } { parse-units = false }
      \siunitx_unit_format:nN { \degreeCelsius } \l__siunitx_symbol_tmpb_tl
      \str_if_eq:VVTF \l__siunitx_symbol_tmpa_tl \l__siunitx_symbol_tmpb_tl
        {
          \group_end:
          \siunitx_declare_unit:Nx \degreeCelsius
            {
              \exp_not:N \ifmmode
                { } ^ { \exp_not:N \circ }
              \exp_not:N \else
                \exp_not:N \text
                  {
                    \@ifpackageloaded { inputenc }
                      { \exp_not:N \textdegree }
                      { \__siunitx_symbol_non_latin:n { "00B0 } }
                  }
              \exp_not:N \fi
                  C
            }
        }
        { \group_end: }
```

For `\ohm`, there is a math mode symbol we can use, so there has to be a mode-dependent definition. This doesn't work if the text mode symbol is bust: the fourier package puts us in that position.

```
    \__siunitx_symbol_if_replace:NnT \ohm { "03A9 }
      {
        \tl_set:Nx \l__siunitx_symbol_tmp_tl
          {
            \cs_if_exist:NTF \upOmega
              { \exp_not:N \upOmega }
              { \exp_not:N \Omega }
          }
        \siunitx_declare_unit:Nx \ohm
          {
            \@ifpackageloaded { fourier }
              {
                \exp_not:N \ensuremath
                  { \exp_not:V \l__siunitx_symbol_tmp_tl }
              }
```

```
            {
              \exp_not:N \ifmmode
                \@ifpackageloaded { fontspec }
                  {
                    \exp_not:N \text
                      {
                        \exp_not:N \ensuremath
                          { \exp_not:V \l__siunitx_symbol_tmp_tl }
                      }
                  }
                  { \exp_not:V \l__siunitx_symbol_tmp_tl }
              \exp_not:N \else
                \exp_not:N \text
                  {
                    \bool_lazy_or:nnTF
                      { \sys_if_engine_luatex_p: }
                      { \sys_if_engine_xetex_p: }
                      { \__siunitx_symbol_non_latin:n { "03A9 } }
                      { \exp_not:N \textohm }
                  }
              \exp_not:N \fi
            }
        }
    }
```

Only a text mode command is available for `\micro` in the standard set up.

```
  \__siunitx_symbol_if_replace:NnT \micro { "03BC }
    {
      \siunitx_declare_prefix:Nnx \micro { -6 }
        {
          \exp_not:N \text
            {
              \bool_lazy_or:nnTF
                { \sys_if_engine_luatex_p: }
                { \sys_if_engine_xetex_p: }
                { \__siunitx_symbol_non_latin:n { "00B5 } }
                { \exp_not:N \textmu }
            }
        }
    }
}
```

1.1 Bookmark definitions

Inside PDF strings we disable the text printing function. The definition of `\ohm` is also reset as otherwise engine-dependent strings are generated (XeTeX and LuaTeX give different outcomes using for example `\textohm`).

```
\AtBeginDocument
  {
    \@ifpackageloaded { hyperref }
      {
        \exp_args:Nx \pdfstringdefDisableCommands
          {
            \cs_set_eq:NN \siunitx_print_text:n \exp_not:N \use:n
```

```
            \siunitx_declare_unit:Nn \exp_not:N \ohm
              { \__siunitx_symbol_non_latin:n { "03A9 } }
          }
      }
      { }
  }
```

⟨/package⟩

Part IX
siunitx-table – Formatting numbers in tables

1 Numbers in tables

This submodule is concerned with formatting numbers in table cells or similar fixed-width contexts. The main function, `\siunitx_cell_begin:w`, is designed to work with the normal LaTeX 2_ε tablular cell construct featuring `\ignorespaces`. Therefore, if used outside of a LaTeX 2_ε tabular, it is necessary to provide this token.

`\siunitx_cell_begin:w`
`\siunitx_cell_end:`

```
\siunitx_cell_begin:w ⟨preamble⟩ \ignorespaces
⟨content⟩
\siunitx_cell_end:
```

Collects the ⟨*preamble*⟩ and ⟨*content*⟩ tokens, and determines if it is text or a number (as parsed by `\siunitx_number_parse:nN`). It produces output of a fixed width suitable for alignment in a table, although it is not *required* that the code is used within a cell. Note that `\ignorespaces` must occur in the "cell": it marks the end of the TeX `\halign` template.

1.1 Key–value options

The options defined by this submodule are available within the l3keys `siunitx` tree.

`table-align-comparator`

```
table-align-comparator = true|false
```

Switch which determines whether alignment of comparators is attempted within table cells. The standard setting is `true`.

`table-align-exponent`

```
table-align-exponent = true|false
```

Switch which determines whether alignment of exponents is attempted within table cells. The standard setting is `true`.

`table-align-text-after`

```
table-align-text-after = true|false
```

Switch which determines whether alignment of text falling after a number is attempted within table cells. The standard setting is `true`.

`table-align-text-before`

```
table-align-text-before = true|false
```

Switch which determines whether alignment of text falling before a number is attempted within table cells. The standard setting is `true`.

`table-align-uncertainty`

```
table-align-uncertainty = true|false
```

Switch which determines whether alignment of separated uncertainty values is attempted within table cells. The standard setting is `true`.

`table-alignment` `table-alignment = center|left|right`

Selects the alignment of all tabular content with the margins of the table cell (or other boundary). See also `table-number-alignment` and `table-text-alignment`. The standard setting is `center`.

`table-alignment-mode` `table-alignment-mode = format|marker|none`

Selects the method used to align numbers with the desired position in the cell (set by `table-alignment`). When set to `format`, a dedicated amount of space is calculated from the `table-format`. When `marker` is selected, alignment is carried out symmetrically around the decimal marker. Finally, `none` switches off all alignment: numbers are parsed and formatted but with no attempt at placement within the cell. The standard setting is `marker`.

`table-auto-round` `table-auto-round = true|false`

Switch which determines whether numbers are rounded to fit within the `table-format` specification (if possible). The standard setting is `false`.

`table-column-width` `table-column-width =` ⟨*width*⟩

Sets the width of the table column used for numbers. This is only used when `table-fixed-width` is `true`.

`table-fixed-width` `table-fixed-width = true|false`

Switch which determines whether a fixed-width column is used for numbers in tables. When `true`, the width is taken from `table-column-width`. The standard setting is `false`.

`table-format` `table-format =` ⟨*format*⟩

Describes the amount of space that should be reserved when `table-alignment-mode` is set to `format`. The ⟨*format*⟩ takes the same general form as input for a table cell, with the numerical parts describing how many digits to reserve space for. For example, `1.2e3` would allow space for one digit in the integer part, two in the decimal part and three in the exponent part. Signs can be allowed for using any valid input sign, so for example `+1.2 \pm 1.2` would allow for a sign, a number with one integer and two decimal digits and an uncertainty of the same size.

`table-number-alignment` `table-number-alignment = center|left|right`

Selects the alignment of numerical content with the margins of the table cell (or other boundary). See also `table-alignment` and `table-text-alignment`. The standard setting is `center`.

`table-text-alignment` `table-text-alignment = center|left|none|right`

Selects the alignment of non-numerical content with the margins of the table cell (or other boundary). See also `table-alignment` and `table-number-alignment`. Notice the additional support for `none` here. The standard setting is `center`.

2 siunitx-table implementation

Start the DocStrip guards.

```
1 ⟨*package⟩
```

Identify the internal prefix (LaTeX3 DocStrip convention): only internal material in this *submodule* should be used directly.

```
2 ⟨@@=siunitx_table⟩
```

\l__siunitx_table_tmp_box
\l__siunitx_table_tmp_dim
\l__siunitx_table_tmp_tl

Scratch space.

```
3 \box_new:N \l__siunitx_table_tmp_box
4 \dim_new:N \l__siunitx_table_tmp_dim
5 \tl_new:N \l__siunitx_table_tmp_tl
```

(*End definition for* `\l__siunitx_table_tmp_box`, `\l__siunitx_table_tmp_dim`, *and* `\l__siunitx_table_tmp_tl`.)

2.1 Interface functions

\l__siunitx_table_text_bool

Used to track that a cell is purely text.

```
6 \bool_new:N \l__siunitx_table_text_bool
```

(*End definition for* `\l__siunitx_table_text_bool`.)

\siunitx_cell_begin:w
\siunitx_cell_end:

The start and end of the cell need to deal with the possibility of a cell containing only text.

```
7  \cs_new_protected:Npn \siunitx_cell_begin:w
8    {
9      \bool_set_false:N \l__siunitx_table_text_bool
10     \bool_if:NTF \l_siunitx_number_parse_bool
11       { \__siunitx_table_collect_begin: }
12       { \__siunitx_table_direct_begin: }
13   }
14 \cs_new_protected:Npn \siunitx_cell_end:
15   {
16     \bool_if:NF \l__siunitx_table_text_bool
17       {
18         \bool_if:NTF \l_siunitx_number_parse_bool
19           { \__siunitx_table_collect_end: }
20           { \__siunitx_table_direct_end: }
21       }
22   }
```

(*End definition for* `\siunitx_cell_begin:w` *and* `\siunitx_cell_end:`. *These functions are documented on page* 118.)

2.2 Collecting tokens

\l__siunitx_table_collect_tl

Space for tokens.

```
23 \tl_new:N \l__siunitx_table_collect_tl
```

(*End definition for* `\l__siunitx_table_collect_tl`.)

__siunitx_table_collect_begin:
__siunitx_table_collect_begin:w

Collecting a tabular cell means doing a token-by-token collection. In previous versions of siunitx that was done along with picking out the numerical part, but the code flow ends up very tricky. Here, therefore, we just collect up the unchanged tokens first. The definition of `\cr` is used to allow collection of any tokens inserted after the main content when dealing with the last cell of a row: the "group" around it is needed to avoid issues with the underlying `\halign`. (The approach is based on that in collcell.) Whilst the group formed by a cell will normally tidy up `\cr`, we add an extra one as the collected material could be a tabular in itself. We use an auxiliary to fish out the `\ignorespaces` from the template: that has to go to avoid issues with the peek-ahead code (everything before the `#` needs to be read *before* the Appendix D trick gets applied). Some packages add additional tokens before the `\ignorespaces`, which are dealt with by the delimited argument.

```
\cs_new_protected:Npn \__siunitx_table_collect_begin:
  {
    \group_begin:
      \tl_clear:N \l__siunitx_table_collect_tl
      \if_false: { \fi:
      \cs_set_protected:Npn \cr
        {
          \__siunitx_table_collect_loop:
          \tex_cr:D
        }
      \if_false: } \fi:
      \__siunitx_table_collect_begin:w
  }
\cs_new_protected:Npn \__siunitx_table_collect_begin:w #1 \ignorespaces
  { \__siunitx_table_collect_loop: #1 }
```

(*End definition for* `\__siunitx_table_collect_begin:` *and* `\__siunitx_table_collect_begin:w`.)

__siunitx_table_collect_loop:
__siunitx_table_collect_group:n
__siunitx_table_collect_token:N
__siunitx_table_collect_token_aux:N
__siunitx_table_collect_relax:N
__siunitx_table_collect_search:NnF
__siunitx_table_collect_search_aux:NNn

Collecting up the cell content needs a loop: this is done using a peek approach as it's most natural. (A slower approach is possible using something like the `\text_lowercase:n` loop code.) The set of possible tokens is somewhat limited compared to an arbitrary cell (*cf.* the approach in collcell): the special cases are pulled out for manual handling. The flexible lookup approach is more-or-less the same idea as in the kernel `case` functions. The `\relax` special case covers the case where `\\` has been expanded in an empty cell. This has to be an explicit token as we can get the same meaning from `\protect`.

```
\cs_new_protected:Npn \__siunitx_table_collect_loop:
  {
    \peek_catcode_ignore_spaces:NTF \c_group_begin_token
      { \__siunitx_table_collect_group:n }
      { \__siunitx_table_collect_token:N }
  }
\cs_new_protected:Npn \__siunitx_table_collect_group:n #1
  {
    \tl_put_right:Nn \l__siunitx_table_collect_tl { {#1} }
    \__siunitx_table_collect_loop:
  }
\cs_new_protected:Npn \__siunitx_table_collect_token:N #1
  {
    \__siunitx_table_collect_search:NnF #1
      {
        \unskip            { \__siunitx_table_collect_loop: }
```

```
        \end               { \tabularnewline \end }
        \relax             { \__siunitx_table_collect_relax:N #1 }
        \tabularnewline    { \tabularnewline }
        \siunitx_cell_end: { \siunitx_cell_end: }
      }
      { \__siunitx_table_collect_token_aux:N #1 }
  }
\cs_new_protected:Npn \__siunitx_table_collect_token_aux:N #1
  {
    \tl_put_right:Nn \l__siunitx_table_collect_tl {#1}
    \__siunitx_table_collect_loop:
  }
\cs_new_protected:Npn \__siunitx_table_collect_relax:N #1
  {
    \str_if_eq:nnTF {#1} { \relax }
      { \relax }
      { \__siunitx_table_collect_token_aux:N #1 }
  }
\AtBeginDocument
  {
    \@ifpackageloaded { mdwtab }
      {
        \cs_set_protected:Npn \__siunitx_table_collect_token:N #1
          {
            \__siunitx_table_collect_search:NnF #1
              {
                \@maybe@unskip     { \__siunitx_table_collect_loop: }
                \tab@setcr         { \__siunitx_table_collect_loop: }
                \unskip            { \__siunitx_table_collect_loop: }
                \end                { \tabularnewline \end }
                \relax             { \__siunitx_table_collect_relax:N #1 }
                \tabularnewline    { \tabularnewline }
                \siunitx_cell_end: { \siunitx_cell_end: }
              }
              { \__siunitx_table_collect_token_aux:N #1 }
          }
      }
      { }
  }
\cs_new_protected:Npn \__siunitx_table_collect_search:NnF #1#2#3
  {
    \__siunitx_table_collect_search_aux:NNn #1
      #2
      #1 {#3}
    \q_stop
  }
\cs_new_protected:Npn \__siunitx_table_collect_search_aux:NNn #1#2#3
  {
    \token_if_eq_meaning:NNTF #1 #2
      { \use_i_delimit_by_q_stop:nw {#3} }
      { \__siunitx_table_collect_search_aux:NNn #1 }
  }
```

(*End definition for* `\__siunitx_table_collect_loop:` *and others.*)

2.3 Separating collected material

The input needs to be divided into numerical tokens and those which appear before and after them. This needs a second loop and validation.

\l__siunitx_table_before_tl
\l__siunitx_table_number_tl
\l__siunitx_table_after_tl

Space for tokens.

```
\tl_new:N \l__siunitx_table_before_tl
\tl_new:N \l__siunitx_table_number_tl
\tl_new:N \l__siunitx_table_after_tl
```

(*End definition for* `\l__siunitx_table_before_tl`, `\l__siunitx_table_number_tl`, *and* `\l__siunitx_table_after_tl`.)

__siunitx_table_collect_end:
__siunitx_table_collect_end:n
__siunitx_table_collect_end_aux:n
__siunitx_table_collect_end:w

At the end of the cell, escape the group and check for expansion. We only do that if the entire content is not a brace group: there is more likely to be problematic content in the case of a header.

```
\cs_new_protected:Npn \__siunitx_table_collect_end:
  {
    \exp_args:NNV \group_end:
    \__siunitx_table_collect_end:n \l__siunitx_table_collect_tl
    \exp_args:NV \__siunitx_table_split:nNNN
      \l__siunitx_table_collect_tl
      \l__siunitx_table_before_tl
      \l__siunitx_table_number_tl
      \l__siunitx_table_after_tl
    \tl_if_empty:NTF \l__siunitx_table_number_tl
      { \__siunitx_table_print_text:V \l__siunitx_table_before_tl }
      {
        \__siunitx_table_print:VVV
          \l__siunitx_table_before_tl
          \l__siunitx_table_number_tl
          \l__siunitx_table_after_tl
      }
  }
```

To cover the use of REVTEX, we need to allow for the insertion of `\array@row@rst` into cell content: that explodes inside `\protected@edef`. We use the classical solution of making locally equal to `\scan_stop:`.

```
\cs_new_protected:Npn \__siunitx_table_collect_end:n #1
  {
    \str_if_eq:eeTF { \exp_not:n {#1} }
      { { \__siunitx_table_collect_end_aux:n {#1} } }
      { \tl_set:Nn }
      {
        \cs_if_exist:NT \array@row@rst
          { \cs_set_eq:NN \array@row@rst \scan_stop: }
        \protected@edef
      }
        \l__siunitx_table_collect_tl {#1}
  }
\cs_new:Npn \__siunitx_table_collect_end_aux:n #1
  { \exp_after:wN \__siunitx_table_collect_end:w #1 \q_stop }
\cs_new:Npn \__siunitx_table_collect_end:w #1 \q_stop
  { \exp_not:n {#1} }
```

(*End definition for* `\__siunitx_table_collect_end:` *and others.*)

`\__siunitx_table_split:nNNN`
`\__siunitx_table_split_loop:NNN`
`\__siunitx_table_split_group:NNNn`
`\__siunitx_table_split_token:NNNN`

Splitting into parts uses the fact that numbers cannot contain groups and that we can track where we are up to based on the content of the token lists.

```
\cs_new_protected:Npn \__siunitx_table_split:nNNN #1#2#3#4
  {
    \tl_clear:N #2
    \tl_clear:N #3
    \tl_clear:N #4
    \__siunitx_table_split_loop:NNN #2#3#4 #1 \q_recursion_tail \q_recursion_stop
    \__siunitx_table_split_tidy:N #2
    \__siunitx_table_split_tidy:N #4
  }
\cs_new_protected:Npn \__siunitx_table_split_loop:NNN #1#2#3
  {
    \peek_catcode_ignore_spaces:NTF \c_group_begin_token
      { \__siunitx_table_split_group:NNNn #1#2#3 }
      { \__siunitx_table_split_token:NNNN #1#2#3 }
  }
\cs_new_protected:Npn \__siunitx_table_split_group:NNNn #1#2#3#4
  {
    \tl_if_empty:NTF #2
      { \tl_put_right:Nn #1 { {#4} } }
      { \tl_put_right:Nn #3 { {#4} } }
    \__siunitx_table_split_loop:NNN #1#2#3
  }
\cs_new_protected:Npn \__siunitx_table_split_token:NNNN #1#2#3#4
  {
    \quark_if_recursion_tail_stop:N #4
    \tl_if_empty:NTF \l__siunitx_table_after_tl
      {
        \siunitx_if_number_token:NTF #4
          { \tl_put_right:Nn #2 {#4} }
          {
            \tl_if_empty:NTF #2
              { \tl_put_right:Nn #1 {#4} }
              { \tl_put_right:Nn #3 {#4} }
          }
      }
      { \tl_put_right:Nn #3 {#4} }
    \__siunitx_table_split_loop:NNN #1#2#3
  }
```

(*End definition for* `\__siunitx_table_split:nNNN` *and others.*)

`\__siunitx_table_split_tidy:N`
`\__siunitx_table_split_tidy:Nn`
`\__siunitx_table_split_tidy:NV`

A quick test for the entire content being surrounded by a set of braces: rather than look explicitly, use the fact that a string comparison can detect the same thing. The auxiliary is needed to avoid having to go *via* a `:D` function (for the expansion behaviour).

```
\cs_new_protected:Npn \__siunitx_table_split_tidy:N #1
  {
    \tl_if_empty:NF #1
      { \__siunitx_table_split_tidy:NV #1 #1 }
  }
\cs_new_protected:Npn \__siunitx_table_split_tidy:Nn #1#2
```

```
  {
    \str_if_eq:onT { \exp_after:wN { \use:n #2 } } {#2}
      { \tl_set:No #1 { \use:n #2 } }
  }
\cs_generate_variant:Nn \__siunitx_table_split_tidy:Nn { NV }
```

(*End definition for* `\__siunitx_table_split_tidy:N` *and* `\__siunitx_table_split_tidy:Nn`.)

2.4 Printing numbers in cells: spacing

Getting the general alignment correct in tables is made more complex than one would like by the colortbl package. In the original LaTeX 2$_\varepsilon$ definition, cell material is centred by a construction of the (primitive) form

```
\hfil
#
\hfil
```

which only uses `fil` stretch. That is altered by colortbl to broadly

```
\hskip 0pt plus 0.5fill
\kern 0pt
#
\hskip 0pt plus 0.5fill
```

which means there is `fill` stretch to worry about and the kern as well.

`\__siunitx_table_skip:n`

To prevent combination of skips, a kern is inserted after each one. This is best handled as a short auxiliary.

```
\cs_new_protected:Npn \__siunitx_table_skip:n #1
  {
    \skip_horizontal:n {#1}
    \tex_kern:D \c_zero_skip
  }
```

(*End definition for* `\__siunitx_table_skip:n`.)

`\l__siunitx_table_column_width_dim`
`\l__siunitx_table_fixed_width_bool`

Settings which apply to aligned columns in general.

```
\dim_new:N \l__siunitx_table_column_width_dim
\keys_define:nn { siunitx }
  {
    table-column-width .code:n =
      {
        \dim_set:Nn \l__siunitx_table_column_width_dim {#1}
        \dim_compare:nNnT \l__siunitx_table_column_width_dim > \c_zero_dim
          { \bool_set_true:N \l__siunitx_table_fixed_width_bool }
      } ,
    table-fixed-width .bool_set:N =
      \l__siunitx_table_fixed_width_bool
  }
```

(*End definition for* `\l__siunitx_table_column_width_dim` *and* `\l__siunitx_table_fixed_width_bool`.)

__siunitx_table_align_center:n
__siunitx_table_align_left:n
__siunitx_table_align_right:n
__siunitx_table_align_none:n
__siunitx_table_align_auxi:nn
__siunitx_table_align_auxii:nn

The beginning and end of each table cell have to adjust the position of the content using glue. When colortbl is loaded the glue is done in two parts: one for our positioning and one to explicitly override that from the package. Using a two-step auxiliary chain avoids needing to repeat any code and the impact of the extra expansion should be trivial.

```
\cs_new_protected:Npn \__siunitx_table_align_center:n #1
  { \__siunitx_table_align_auxi:nn {#1} { 0pt~plus~0.5fill } }
\cs_new_protected:Npn \__siunitx_table_align_left:n #1
  { \__siunitx_table_align_auxi:nn {#1} { 0pt } }
\cs_new_protected:Npn \__siunitx_table_align_right:n #1
  { \__siunitx_table_align_auxi:nn {#1} { 0pt~plus~1fill } }
\cs_new_protected:Npn \__siunitx_table_align_none:n #1
  {
    \bool_if:NTF \l__siunitx_table_fixed_width_bool
      { \hbox_to_wd:nn \l__siunitx_table_column_width_dim }
      { \use:n }
        {#1}
  }
\cs_new_protected:Npn \__siunitx_table_align_auxi:nn #1#2
  {
    \bool_if:NTF \l__siunitx_table_fixed_width_bool
      { \hbox_to_wd:nn \l__siunitx_table_column_width_dim }
      { \use:n }
        {
          \__siunitx_table_skip:n {#2}
          #1
          \__siunitx_table_skip:n { 0pt~plus~1fill - #2 }
        }
  }
\AtBeginDocument
  {
    \@ifpackageloaded { colortbl }
      {
        \cs_new_eq:NN
          \__siunitx_table_align_auxii:nn
          \__siunitx_table_align_auxi:nn
        \cs_set_protected:Npn \__siunitx_table_align_auxi:nn #1#2
          {
            \__siunitx_table_skip:n{ 0pt~plus~-0.5fill }
            \__siunitx_table_align_auxii:nn {#1} {#2}
            \__siunitx_table_skip:n { 0pt~plus~-0.5fill }
          }
      }
      { }
  }
```

(*End definition for* `\__siunitx_table_align_center:n` *and others.*)

2.5 Printing just text

In cases where there is no numerical part, siunitx allows alignment of the "escaped" text independent of the underlying column type.

\l__siunitx_table_align_text_tl

Alignment is handled using a `tl` as this allows a fast lookup at the point of use.

```
\keys_define:nn { siunitx }
  {
    table-text-alignment .choices:nn =
      { center , left , right , none }
      { \tl_set:Nn \l__siunitx_table_align_text_tl {#1} } ,
  }
\tl_new:N \l__siunitx_table_align_text_tl
```

(*End definition for* `\l__siunitx_table_align_text_tl`.)

`\__siunitx_table_print_text:n` `\__siunitx_table_print_text:V`

Printing escaped text is easy: just place it in correctly in the column.

```
\cs_new_protected:Npn \__siunitx_table_print_text:n #1
  {
    \bool_set_true:N \l__siunitx_table_text_bool
    \use:c { __siunitx_table_align_ \l__siunitx_table_align_text_tl :n } {#1}
  }
\cs_generate_variant:Nn \__siunitx_table_print_text:n { V }
```

(*End definition for* `\__siunitx_table_print_text:n`.)

2.6 Number alignment: core ideas

`\l__siunitx_table_integer_box` `\l__siunitx_table_decimal_box`

Boxes for the content before and after the decimal marker.

```
\box_new:N \l__siunitx_table_integer_box
\box_new:N \l__siunitx_table_decimal_box
```

(*End definition for* `\l__siunitx_table_integer_box` *and* `\l__siunitx_table_decimal_box`.)

`\__siunitx_table_fil:` `\__siunitx_table_fill:`

Primitives renamed.

```
\cs_new_eq:NN \__siunitx_table_fil: \tex_hfil:D
\cs_new_eq:NN \__siunitx_table_fill: \tex_hfill:D
```

(*End definition for* `\__siunitx_table_fil:` *and* `\__siunitx_table_fill:`.)

`\__siunitx_table_cleanup_decimal:w`

To remove the excess marker tokens in a decimal part.

```
\cs_new:Npn \__siunitx_table_cleanup_decimal:w
  #1 \q_nil #2 \q_nil #3 \q_nil #4 \q_nil #5 \q_nil #6 \q_nil #7 \q_nil
  { #1#2#3#4#5#6#7 }
```

(*End definition for* `\__siunitx_table_cleanup_decimal:w`.)

`\__siunitx_table_color_check:N` `\__siunitx_table_color_check:w` `\__siunitx_table_color_check:Nnw`

Handle the fact that splitting a number can leave a negative color dangling.

```
\cs_new_protected:Npn \__siunitx_table_color_check:N #1
  { \exp_after:wN \__siunitx_table_color_check:w #1 \q_stop }
\cs_new_protected:Npn \__siunitx_table_color_check:w #1 \q_nil #2 \q_stop
  {
    \tl_if_head_eq_meaning:nNT {#1} \color
      { \__siunitx_table_color_check:Nnw #1 \q_stop }
  }
\cs_new_protected:Npn \__siunitx_table_color_check:Nnw #1#2#3 \q_stop
  { \keys_set:nn { siunitx } { number-color = #2 } }
```

(*End definition for* `\__siunitx_table_color_check:N`, `\__siunitx_table_color_check:w`, *and* `\__siunitx_table_color_check:Nnw`.)

__siunitx_table_center_marker:

When centering on the decimal marker, the easiest approach is to simply re-box the two parts. That is needed whether or not we are parsing numbers, so is best as a short auxiliary. Notice that we need to allow for the width of the decimal marker itself. When not aligning non-numerical material, we put the extra space into the boxes around the number.

```
\cs_new_protected:Npn \__siunitx_table_center_marker:
  {
    \hbox_set:Nn \l__siunitx_table_tmp_box
      { \ensuremath { \mathord { \l_siunitx_number_output_decimal_tl } } }
    \dim_compare:nNnTF
      { \box_wd:N \l__siunitx_table_integer_box }
        >
          {
              \box_wd:N \l__siunitx_table_decimal_box
            - \box_wd:N \l__siunitx_table_tmp_box
          }
      {
        \bool_if:NTF \l__siunitx_table_align_after_bool
          {
            \__siunitx_table_center_marker_aux:Nnnn \l__siunitx_table_decimal_box
              {
                  \box_wd:N \l__siunitx_table_integer_box
                + \box_wd:N \l__siunitx_table_tmp_box
              }
           }
           {
             \__siunitx_table_center_marker_aux:Nnnn \l__siunitx_table_after_box
               {
                   \box_wd:N \l__siunitx_table_after_box
                 + \box_wd:N \l__siunitx_table_integer_box
                 - \box_wd:N \l__siunitx_table_decimal_box
                 + \box_wd:N \l__siunitx_table_tmp_box
               }
           }
               { } { \__siunitx_table_fil: }
      }
      {
        \bool_if:NTF \l__siunitx_table_align_before_bool
          {
            \__siunitx_table_center_marker_aux:Nnnn \l__siunitx_table_integer_box
              {
                  \box_wd:N \l__siunitx_table_decimal_box
                - \box_wd:N \l__siunitx_table_tmp_box
              }
          }
          {
            \__siunitx_table_center_marker_aux:Nnnn \l__siunitx_table_before_box
               {
                   \box_wd:N \l__siunitx_table_before_box
                 + \box_wd:N \l__siunitx_table_decimal_box
                 - \box_wd:N \l__siunitx_table_integer_box
                 - \box_wd:N \l__siunitx_table_tmp_box
               }
```

```
          }
              { \__siunitx_table_fil: } { }
      }
  }
\cs_new_protected:Npn \__siunitx_table_center_marker_aux:Nnnn #1#2#3#4
  {
    \hbox_set_to_wd:Nnn #1 {#2}
      {
        #3
        \hbox_unpack:N #1
        #4
      }
  }
```

(*End definition for* `\__siunitx_table_center_marker:`.)

`\l__siunitx_table_auto_round_bool` `\l__siunitx_table_align_mode_tl` `\l__siunitx_table_align_number_tl`

Options for tables with defined space.

```
\keys_define:nn { siunitx }
  {
    table-alignment .meta:n =
      { table-number-alignment = #1 , table-text-alignment = #1 },
    table-alignment-mode .choices:nn =
      { none , format , marker }
      { \tl_set_eq:NN \l__siunitx_table_align_mode_tl \l_keys_choice_tl } ,
    table-auto-round .bool_set:N =
      \l__siunitx_table_auto_round_bool ,
    table-format .code:n =
      {
        \group_begin:
          \protected@edef \l__siunitx_table_tmp_tl {#1}
        \exp_args:NNV \group_end:
        \__siunitx_table_split:nNNN \l__siunitx_table_tmp_tl
          \l__siunitx_table_before_model_tl
          \l__siunitx_table_model_tl
          \l__siunitx_table_after_model_tl
        \exp_args:NV \__siunitx_table_generate_model:n \l__siunitx_table_model_tl
        \tl_set:Nn \l__siunitx_table_align_mode_tl { format }
      } ,
    table-number-alignment .choices:nn =
      { center , left , right }
      { \tl_set_eq:NN \l__siunitx_table_align_number_tl \l_keys_choice_tl }
  }
\tl_new:N \l__siunitx_table_align_mode_tl
\tl_new:N \l__siunitx_table_align_number_tl
```

(*End definition for* `\l__siunitx_table_auto_round_bool`, `\l__siunitx_table_align_mode_tl`, *and* `\l__siunitx_table_align_number_tl`.)

`\l__siunitx_table_format_tl` `\l__siunitx_table_model_tl`

The input and output versions of the model entry in a table.

```
\tl_new:N \l__siunitx_table_format_tl
\tl_new:N \l__siunitx_table_before_model_tl
\tl_new:N \l__siunitx_table_model_tl
\tl_new:N \l__siunitx_table_after_model_tl
```

(*End definition for* `\l__siunitx_table_format_tl` *and* `\l__siunitx_table_model_tl`.)

__siunitx_table_generate_model:n
__siunitx_table_generate_model:nnnnnnn
__siunitx_table_generate_model_S:nnw
__siunitx_table_generate_model_S:nnn

Creating a model for a table at this stage means parsing the format and converting that to an appropriate model. Things are quite straight-forward other than the uncertainty part. At this stage there is no point in formatting the model: that has to happen at point-of-use. Notice that the uncertainty part needs to allow for the case where we cross the decimal.

```
\cs_new_protected:Npn \__siunitx_table_generate_model:n #1
  {
    \group_begin:
      \bool_set_true:N \l_siunitx_number_parse_bool
      \keys_set:nn { siunitx } { retain-explicit-plus = true }
      \siunitx_number_parse:nN {#1} \l__siunitx_table_format_tl
    \exp_args:NNNV \group_end:
    \tl_set:Nn \l__siunitx_table_format_tl \l__siunitx_table_format_tl
    \tl_if_empty:NF \l__siunitx_table_format_tl
      {
        \exp_after:wN \__siunitx_table_generate_model:nnnnnnn
          \l__siunitx_table_format_tl
      }
  }
\cs_new_protected:Npn \__siunitx_table_generate_model:nnnnnnn #1#2#3#4#5#6#7
  {
    \tl_set:Nx \l__siunitx_table_model_tl
      {
        \exp_not:n { {#1} {#2} }
        { \prg_replicate:nn {#3} { 8 } }
        { \prg_replicate:nn { 0 #4 } { 8 } }
        {
          \tl_if_blank:nF {#5}
            {
              \use:c { __siunitx_table_generate_model_ \tl_head:n {#5} :nnw }
                {#4} #5
            }
        }
        \exp_not:n { {#6} }
        {
          \int_compare:nNnTF {#7} = 0
            { 0 }
            { \prg_replicate:nn {#7} { 8 } }
        }
      }
  }
\cs_new:Npn \__siunitx_table_generate_model_S:nnw #1#2#3
  {
    { S }
    {
      \exp_args:Nff \__siunitx_table_generate_model_S:nnn
        { \tl_count:n {#1} } { \tl_count:n {#3} }
        {#3}
    }
  }
\cs_new:Npn \__siunitx_table_generate_model_S:nnn #1#2#3
  {
    \prg_replicate:nn
```

```
      {
        \int_compare:nNnTF {#2} > {#1}
          {
            \str_range:nnn {#3} { 1 } {#1}
            +
            \str_range:nnn {#3} { 1 + #1 } {#2}
          }
          {#3}
      }
      { 8 }
  }
```

(*End definition for* `\__siunitx_table_generate_model:n` *and others.*)

2.7 Directly printing without collection

Collecting the number allows for various effects but is not as fast as simply aligning on the first token that is a decimal marker. The strategy here is that used by dcolumn.

`\__siunitx_table_direct_begin:`
`\__siunitx_table_direct_begin:w`
`\__siunitx_table_direct_end:`
`\__siunitx_table_direct_marker:`
`\__siunitx_table_direct_marker_switch:`
`\__siunitx_table_direct_marker_end:`
`\__siunitx_table_direct_format:`
`\__siunitx_table_direct_format:nnnnnnn`
`\__siunitx_table_direct_format:w`
`\__siunitx_table_direct_format_switch:`
`\__siunitx_table_direct_format_end:`
`\__siunitx_table_direct_none:`
`\__siunitx_table_direct_none_end:`

After removing the `\ignorespaces` at the start of the cell (see comments for `\__siunitx_table_collect_begin:N`), check to see if there is a `{` and branch as appropriate.

```
\cs_new_protected:Npn \__siunitx_table_direct_begin:
  { \__siunitx_table_direct_begin:w }
\cs_new_protected:Npn \__siunitx_table_direct_begin:w #1 \ignorespaces
  {
    #1
    \peek_catcode_ignore_spaces:NTF \c_group_begin_token
      { \__siunitx_table_print_text:n }
      {
        \m@th
        \use:c { __siunitx_table_direct_ \l__siunitx_table_align_mode_tl : }
      }
  }
\cs_new_protected:Npn \__siunitx_table_direct_end:
  { \use:c { __siunitx_table_direct_ \l__siunitx_table_align_mode_tl _end: } }
```

When centring the content about a decimal marker, the trick is to collect everything into two boxes and then compare the sizes. As we are always in math mode, we can use a math active token to make the switch. The up-front setting of the `decimal` box deals with the case where there is no decimal part.

```
\cs_new_protected:Npn \__siunitx_table_direct_marker:
  {
    \hbox_set:Nn \l__siunitx_table_tmp_box
      { \ensuremath { \mathord { \l_siunitx_number_output_decimal_tl } } }
    \hbox_set_to_wd:Nnn \l__siunitx_table_decimal_box
      { \box_wd:N \l__siunitx_table_tmp_box }
      { \__siunitx_table_fil: }
    \hbox_set:Nw \l__siunitx_table_integer_box
      \c_math_toggle_token
      \tl_map_inline:Nn \l_siunitx_number_input_decimal_tl
        {
          \char_set_active_eq:NN ##1 \__siunitx_table_direct_marker_switch:
          \char_set_mathcode:nn { `##1 } { "8000 }
        }
```

```
  }
\cs_new_protected:Npn \__siunitx_table_direct_marker_switch:
  {
      \c_math_toggle_token
    \hbox_set_end:
    \hbox_set:Nw \l__siunitx_table_decimal_box
      \c_math_toggle_token
      \l_siunitx_number_output_decimal_tl
  }
```

We set the two alignment booleans here so that a single auxiliary can cover this case as well as the one for centering the marker when also parsing.

```
\cs_new_protected:Npn \__siunitx_table_direct_marker_end:
  {
      \c_math_toggle_token
    \hbox_set_end:
    \bool_set_true:N \l__siunitx_table_align_before_bool
    \bool_set_true:N \l__siunitx_table_align_after_bool
    \__siunitx_table_center_marker:
    \use:c { __siunitx_table_align_ \l__siunitx_table_align_text_tl :n }
      {
        \box_use_drop:N \l__siunitx_table_integer_box
        \box_use_drop:N \l__siunitx_table_decimal_box
      }
  }
```

For the version where there is space reserved, first format and decompose that, then create appropriately-sized boxes.

```
\cs_new_protected:Npn \__siunitx_table_direct_format:
  {
    \tl_set:Nx \l__siunitx_table_tmp_tl
      { \siunitx_number_output:NN \l__siunitx_table_model_tl \q_nil }
    \exp_after:wN \__siunitx_table_direct_format_aux:w
      \l__siunitx_table_tmp_tl \q_stop
  }
\cs_new_protected:Npn \__siunitx_table_direct_format_aux:w
  #1 \q_nil #2 \q_nil #3 \q_nil #4 \q_stop
  {
    \hbox_set:Nn \l__siunitx_table_tmp_box
      { \ensuremath { \__siunitx_table_cleanup_decimal:w #4 } }
    \hbox_set_to_wd:Nnn \l__siunitx_table_decimal_box
      { \box_wd:N \l__siunitx_table_tmp_box }
      { \__siunitx_table_fil: }
    \hbox_set:Nn \l__siunitx_table_tmp_box { \ensuremath { #1#2#3 } }
    \hbox_set_to_wd:Nnw \l__siunitx_table_integer_box
      { \box_wd:N \l__siunitx_table_tmp_box }
      \c_math_toggle_token
      \tl_map_inline:Nn \l_siunitx_number_input_decimal_tl
        {
          \char_set_active_eq:NN ##1 \__siunitx_table_direct_format_switch:
          \char_set_mathcode:nn { `##1 } { "8000 }
        }
      \__siunitx_table_fill:
  }
\cs_new_protected:Npn \__siunitx_table_direct_format_switch:
```

```
  {
      \c_math_toggle_token
    \hbox_set_end:
    \hbox_set_to_wd:Nnw \l__siunitx_table_decimal_box
      { \box_wd:N \l__siunitx_table_decimal_box }
      \c_math_toggle_token
      \mathord { \l_siunitx_number_output_decimal_tl }
  }
\cs_new_protected:Npn \__siunitx_table_direct_format_end:
  {
      \c_math_toggle_token
      \__siunitx_table_fil:
    \hbox_set_end:
    \use:c { __siunitx_table_align_ \l__siunitx_table_align_number_tl :n }
      {
        \box_use_drop:N \l__siunitx_table_integer_box
        \box_use_drop:N \l__siunitx_table_decimal_box
      }
  }
```

No parsing and no alignment is easy.

```
\cs_new_protected:Npn \__siunitx_table_direct_none: { \c_math_toggle_token }
\cs_new_protected:Npn \__siunitx_table_direct_none_end: { \c_math_toggle_token }
```

(*End definition for* `\__siunitx_table_direct_begin:` *and others.*)

2.8 Printing numbers in cells: main functions

`\l__siunitx_table_before_box` `\l__siunitx_table_after_box`

For alignment of text outside of a number.

```
\box_new:N \l__siunitx_table_before_box
\box_new:N \l__siunitx_table_after_box
```

(*End definition for* `\l__siunitx_table_before_box` *and* `\l__siunitx_table_after_box`.)

`\l__siunitx_table_before_dim`

Space reserved for any non-numerical text before the number: as we need to allow for this to be available after setting the integer part, we need to carry it along for a bit.

```
\dim_new:N \l__siunitx_table_before_dim
```

(*End definition for* `\l__siunitx_table_before_dim`.)

`\l__siunitx_table_carry_dim`

Used to "carry forward" the amount of white space which needs to be inserted after the decimal marker.

```
\dim_new:N \l__siunitx_table_carry_dim
```

(*End definition for* `\l__siunitx_table_carry_dim`.)

`\l__siunitx_table_align_comparator_bool` `\l__siunitx_table_align_exponent_bool` `\l__siunitx_table_align_after_bool` `\l__siunitx_table_align_before_bool` `\l__siunitx_table_align_uncertainty_bool`

Alignment is handled using a `tl` as this allows a fast lookup at the point of use.

```
\keys_define:nn { siunitx }
  {
    table-align-comparator .bool_set:N =
      \l__siunitx_table_align_comparator_bool ,
    table-align-exponent .bool_set:N =
      \l__siunitx_table_align_exponent_bool ,
    table-align-text-after .bool_set:N =
      \l__siunitx_table_align_after_bool ,
```

```
    table-align-text-before .bool_set:N =
      \l__siunitx_table_align_before_bool ,
    table-align-uncertainty .bool_set:N =
      \l__siunitx_table_align_uncertainty_bool
  }
```

(*End definition for* `\l__siunitx_table_align_comparator_bool` *and others.*)

`\__siunitx_table_print:nnn`
`\__siunitx_table_print:VVV`
`\__siunitx_table_print_marker:nnn`
`\__siunitx_table_print_marker:w`
`\__siunitx_table_print_marker_aux:w`
`\__siunitx_table_print_format:nnn`
`\__siunitx_table_print_format:nnnnnn`
`\__siunitx_table_print_format_auxi:w`
`\__siunitx_table_print_format_auxii:w`
`\__siunitx_table_print_format_auxiii:w`
`\__siunitx_table_print_format_auxiv:w`
`\__siunitx_table_print_format_auxv:w`
`\__siunitx_table_print_format_auxvi:w`
`\__siunitx_table_print_format_auxvii:w`
`\__siunitx_table_print_format_box:Nn`
`\__siunitx_table_print_format_after:N`
`\__siunitx_table_print_none:nnn`

```
\cs_new_protected:Npn \__siunitx_table_print:nnn #1#2#3
  { \use:c { __siunitx_table_print_ \l__siunitx_table_align_mode_tl :nnn } {#1} {#2} {#3} }
\cs_generate_variant:Nn \__siunitx_table_print:nnn { VVV }
```

When centering on the decimal marker, alignment is relatively simple, and close in concept to that used without parsing. First we need to deal with any text before or after the number. For text *before*, there's the case where is has no width and might be a font or color change: that has to be filtered out first. Then we can adjust the size of this material and that after the number such that they are equal. The number itself can then be formatted, splitting at he decimal marker. A bit more size adjustment, then the number itself and any text at the end can be inserted.

```
\cs_new_protected:Npn \__siunitx_table_print_marker:nnn #1#2#3
  {
    \hbox_set:Nn \l__siunitx_table_before_box {#1}
    \dim_compare:nNnT { \box_wd:N \l__siunitx_table_before_box } = { 0pt }
      {
        \box_clear:N \l__siunitx_table_before_box
        #1
      }
    \hbox_set:Nn \l__siunitx_table_after_box {#3}
    \dim_compare:nNnTF
      { \box_wd:N \l__siunitx_table_after_box }
       > { \box_wd:N \l__siunitx_table_before_box }
      {
        \hbox_set_to_wd:Nnn \l__siunitx_table_before_box
          { \box_wd:N \l__siunitx_table_after_box }
          {
            \__siunitx_table_fil:
            \hbox_unpack:N \l__siunitx_table_before_box
          }
      }
      {
        \hbox_set_to_wd:Nnn \l__siunitx_table_after_box
          { \box_wd:N \l__siunitx_table_before_box }
          {
            \hbox_unpack:N \l__siunitx_table_after_box
            \__siunitx_table_fil:
          }
      }
    \siunitx_number_parse:nN {#2} \l__siunitx_table_tmp_tl
    \siunitx_number_process:NN \l__siunitx_table_tmp_tl \l__siunitx_table_tmp_tl
    \tl_set:Nx \l__siunitx_table_tmp_tl
      { \siunitx_number_output:NN \l__siunitx_table_tmp_tl \q_nil }
    \__siunitx_table_color_check:N \l__siunitx_table_tmp_tl
    \exp_after:wN \__siunitx_table_print_marker:w
```

```
      \l__siunitx_table_tmp_tl \q_stop
  }
\cs_new_protected:Npn \__siunitx_table_print_marker:w
  #1 \q_nil #2 \q_nil #3 \q_nil #4 \q_stop
  {
    \hbox_set:Nn \l__siunitx_table_integer_box
      { \siunitx_print_number:n { #1#2#3 } }
    \hbox_set:Nn \l__siunitx_table_decimal_box
      {
        \siunitx_print_number:x
          { \__siunitx_table_print_marker_aux:w #4 }
      }
    \__siunitx_table_center_marker:
    \use:c { __siunitx_table_align_ \l__siunitx_table_align_text_tl :n }
      {
            \box_use_drop:N \l__siunitx_table_before_box
        \box_use_drop:N \l__siunitx_table_integer_box
        \box_use_drop:N \l__siunitx_table_decimal_box
            \box_use_drop:N \l__siunitx_table_after_box
      }
  }
\cs_new:Npn \__siunitx_table_print_marker_aux:w
  #1 \q_nil #2 \q_nil #3 \q_nil #4 \q_nil #5 \q_nil #6 \q_nil #7 \q_nil
  {
    \exp_not:n {#1#2#3#4#5}
    \tl_if_blank:nT {#1#2#3#4#5} { { } }
    \exp_not:n {#6#7}
  }
```

For positioning based on a format, we have to work part-by-part as there are a number of alignment points to get right. As for the `marker` approach, first we check if the material before the numerical content is of zero width. Next we need to format the model and content numbers, before starting an auxiliary chain to pick out the various parts in order. We have to carry the amount of space for the non-numerical material before the cell forward: this may end up being enlarged by unused parts of the integer.

```
\cs_new_protected:Npn \__siunitx_table_print_format:nnn #1#2#3
  {
    \hbox_set:Nn \l__siunitx_table_tmp_box { \l__siunitx_table_before_model_tl }
    \hbox_set:Nn \l__siunitx_table_before_box {#1}
    \dim_compare:nNnT { \box_wd:N \l__siunitx_table_before_box } = { 0pt }
      {
        \box_clear:N \l__siunitx_table_before_box
        #1
      }
    \dim_set:Nn \l__siunitx_table_before_dim { \box_wd:N \l__siunitx_table_tmp_box }
    \siunitx_number_parse:nN {#2} \l__siunitx_table_tmp_tl
    \group_begin:
      \bool_if:NT \l__siunitx_table_auto_round_bool
        {
          \exp_args:Nx \keys_set:nn { siunitx }
            {
              round-mode      = places ,
              round-pad       = true   ,
              round-precision =
```

```
                \exp_after:wN \__siunitx_table_print_format:nnnnnn
                  \l__siunitx_table_format_tl
              }
          }
        \siunitx_number_process:NN \l__siunitx_table_tmp_tl \l__siunitx_table_tmp_tl
      \exp_args:NNNV \group_end:
      \tl_set:Nn \l__siunitx_table_tmp_tl \l__siunitx_table_tmp_tl
      \tl_set:Nx \l__siunitx_table_tmp_tl
        {
          \siunitx_number_output:NN \l__siunitx_table_model_tl \q_nil
          \exp_not:N \q_mark
          \siunitx_number_output:NN \l__siunitx_table_tmp_tl \q_nil
        }
      \exp_after:wN \__siunitx_table_print_format_auxi:w
        \l__siunitx_table_tmp_tl \q_stop
      \hbox_set:Nn \l__siunitx_table_tmp_box { \l__siunitx_table_after_model_tl }
      \hbox_set_to_wd:Nnn \l__siunitx_table_after_box
        { \box_wd:N \l__siunitx_table_tmp_box + \l__siunitx_table_carry_dim }
        {
          \bool_if:NT \l__siunitx_table_align_after_bool
            { \skip_horizontal:n { \l__siunitx_table_carry_dim } }
          #3
          \__siunitx_table_fil:
        }
      \use:c { __siunitx_table_align_ \l__siunitx_table_align_number_tl :n }
        {
          \box_use_drop:N \l__siunitx_table_before_box
          \box_use_drop:N \l__siunitx_table_integer_box
          \box_use_drop:N \l__siunitx_table_decimal_box
          \box_use_drop:N \l__siunitx_table_after_box
        }
    }
  \cs_new:Npn \__siunitx_table_print_format:nnnnnn #1#2#3#4#5#6#7
    { 0 #4 }
```

The first numerical part to handle is the comparator. Any white space we need to add goes into the text part *if* alignment is not active (*i.e.* we are looking "backwards" to place this filler).

```
  \cs_new_protected:Npn \__siunitx_table_print_format_auxi:w
    #1 \q_nil #2 \q_mark #3 \q_nil #4 \q_stop
    {
      \__siunitx_table_color_check:w #3 \q_nil \q_stop
      \__siunitx_table_print_format_box:Nn \l__siunitx_table_tmp_box {#1}
      \bool_if:NTF \l__siunitx_table_align_before_bool
        {
          \hbox_set_to_wd:Nnn \l__siunitx_table_integer_box
            { \box_wd:N \l__siunitx_table_tmp_box }
            {
              \__siunitx_table_fil:
              \tl_if_blank:nF {#3}
               { \siunitx_print_number:n {#3} }
            }
        }
        {
```

```
        \__siunitx_table_print_format_box:Nn \l__siunitx_table_integer_box {#3}
        \dim_add:Nn \l__siunitx_table_before_dim
          {
              \box_wd:N \l__siunitx_table_tmp_box
            - \box_wd:N \l__siunitx_table_integer_box
          }
      }
    \__siunitx_table_print_format_auxii:w #2 \q_mark #4 \q_stop
  }
```

The integer part follows much the same pattern, except now it is control of the comparator alignment that determines where the white space goes. As we already have content in the `integer` box, we need to measure how much *extra* material has been added. To avoid using more boxes or re-setting, we do that by recording sizes before and after the change. (In effect, `\l__siunitx_table_tmp_dim` is here "l_@@_comparator_dim".) As the integer part is completed here, we are able to finalise the width of the pre-numeral part, reboxing it to have the correct width and possibly to force a single overfull warning if appropriate.

```
\cs_new_protected:Npn \__siunitx_table_print_format_auxii:w
  #1 \q_nil #2 \q_nil #3 \q_mark #4 \q_nil #5 \q_nil #6 \q_stop
  {
    \__siunitx_table_print_format_box:Nn \l__siunitx_table_tmp_box {#1#2}
    \bool_lazy_and:nnTF
      { \l__siunitx_table_align_comparator_bool }
      { \dim_compare_p:nNn { \box_wd:N \l__siunitx_table_integer_box } > { 0pt } }
      {
        \hbox_set_to_wd:Nnn \l__siunitx_table_integer_box
          {
              \box_wd:N \l__siunitx_table_integer_box
            + \box_wd:N \l__siunitx_table_tmp_box
          }
          {
            \hbox_unpack:N \l__siunitx_table_integer_box
            \__siunitx_table_fil:
            \siunitx_print_number:n {#4#5}
          }
      }
      {
        \bool_if:NTF \l__siunitx_table_align_before_bool
          {
            \hbox_set_to_wd:Nnn \l__siunitx_table_integer_box
              {
                  \box_wd:N \l__siunitx_table_integer_box
                + \box_wd:N \l__siunitx_table_tmp_box
              }
              {
                \__siunitx_table_fil:
                \hbox_unpack:N \l__siunitx_table_integer_box
                \siunitx_print_number:n {#4#5}
              }
          }
          {
            \dim_set:Nn \l__siunitx_table_tmp_dim
              { \box_wd:N \l__siunitx_table_integer_box }
```

```
            \hbox_set:Nn \l__siunitx_table_integer_box
              {
                \hbox_unpack:N \l__siunitx_table_integer_box
                \siunitx_print_number:n {#4#5}
              }
            \dim_add:Nn \l__siunitx_table_before_dim
              {
                + \box_wd:N \l__siunitx_table_tmp_box
                + \l__siunitx_table_tmp_dim
                - \box_wd:N \l__siunitx_table_integer_box
              }
          }
      }
    \hbox_set_to_wd:Nnn \l__siunitx_table_before_box \l__siunitx_table_before_dim
      {
        \__siunitx_table_fil:
        \hbox_unpack:N \l__siunitx_table_before_box
      }
    \__siunitx_table_print_format_auxiii:w #3 \q_mark #6 \q_stop
  }
```

We now deal with the decimal part: there is nothing already in the `decimal` box, so the basics are easy. We need to "carry forward" any white space, as where it gets inserted depends on the options for subsequent parts.

```
\cs_new_protected:Npn \__siunitx_table_print_format_auxiii:w
  #1 \q_nil #2 \q_nil #3 \q_mark #4 \q_nil #5 \q_nil #6 \q_stop
  {
    \__siunitx_table_print_format_box:Nn \l__siunitx_table_tmp_box {#1#2}
    \__siunitx_table_print_format_box:Nn \l__siunitx_table_decimal_box {#4#5}
    \dim_set:Nn \l__siunitx_table_carry_dim
      {
          \box_wd:N \l__siunitx_table_tmp_box
        - \box_wd:N \l__siunitx_table_decimal_box
      }
    \__siunitx_table_print_format_auxiv:w #3 \q_mark #6 \q_stop
  }
```

Any separated uncertainty is now picked up. That has a number of parts, so the first step is to look for a sign (which will be `#1`). We then split, either simply tidying up the markers if there is no uncertainty, or setting it.

```
\cs_new_protected:Npn \__siunitx_table_print_format_auxiv:w
  #1 \q_nil #2 \q_mark #3 \q_nil #4 \q_stop
  {
    \tl_if_blank:nTF {#1}
      { \__siunitx_table_print_format_auxv:w }
      { \__siunitx_table_print_format_auxvi:w }
        #1#2 \q_mark #3#4 \q_stop
  }
\cs_new_protected:Npn \__siunitx_table_print_format_auxv:w
  #1 \q_nil #2 \q_nil #3 \q_nil #4 \q_mark
  #5 \q_nil #6 \q_nil #7 \q_nil #8 \q_stop
  { \__siunitx_table_print_format_auxvii:w #4 \q_mark #8 \q_stop }
```

Sorting out the placement of the uncertainty requires both the model and real data widths, so we store the former to avoiding needing more boxes. It's then just a case of

putting the carry-over white space in the right place.

```
\cs_new_protected:Npn \__siunitx_table_print_format_auxvi:w
  #1 \q_nil #2 \q_nil #3 \q_nil #4 \q_mark
  #5 \q_nil #6 \q_nil #7 \q_nil #8 \q_stop
  {
    \__siunitx_table_print_format_box:Nn \l__siunitx_table_tmp_box { { } #1#2#3 }
    \dim_set:Nn \l__siunitx_table_tmp_dim { \box_wd:N \l__siunitx_table_tmp_box }
    \__siunitx_table_print_format_box:Nn \l__siunitx_table_tmp_box { { } #5#6#7 }
    \__siunitx_table_print_format_after:N \l__siunitx_table_align_uncertainty_bool
    \__siunitx_table_print_format_auxvii:w #4 \q_mark #8 \q_stop
  }
```

Finally, we get to the exponent part: the multiplication symbol is `#1` and the number itself is `#2`. The code is almost the same as for uncertainties, which allows a shared auxiliary to be used.

```
\cs_new_protected:Npn \__siunitx_table_print_format_auxvii:w
  #1 \q_nil #2 \q_mark #3 \q_nil #4 \q_stop
  {
    \tl_if_blank:nF {#2}
      {
        \__siunitx_table_print_format_box:Nn \l__siunitx_table_tmp_box { { } #1#2 }
        \dim_set:Nn \l__siunitx_table_tmp_dim { \box_wd:N \l__siunitx_table_tmp_box }
        \__siunitx_table_print_format_box:Nn \l__siunitx_table_tmp_box { { } #3#4 }
        \__siunitx_table_print_format_after:N \l__siunitx_table_align_exponent_bool
      }
  }
```

A simple auxiliary to avoid relatively expensive use of the print routine for empty parts.

```
\cs_new_protected:Npn \__siunitx_table_print_format_box:Nn #1#2
  {
    \hbox_set:Nn #1
      {
        \tl_if_blank:nF {#2}
          { \siunitx_print_number:n {#2} }
      }
  }
```

A common routine for placing material after the decimal marker and "shuffling".

```
\cs_new_protected:Npn \__siunitx_table_print_format_after:N #1
  {
    \bool_if:NTF #1
      {
        \hbox_set_to_wd:Nnn \l__siunitx_table_decimal_box
          {
              \box_wd:N \l__siunitx_table_decimal_box
            + \l__siunitx_table_carry_dim
            + \box_wd:N \l__siunitx_table_tmp_box
          }
          {
            \hbox_unpack:N \l__siunitx_table_decimal_box
            \__siunitx_table_fil:
            \hbox_unpack:N \l__siunitx_table_tmp_box
          }
        \dim_set:Nn \l__siunitx_table_carry_dim
          {
```

```
              \l__siunitx_table_tmp_dim
            - \box_wd:N \l__siunitx_table_tmp_box
          }
      }
      {
        \hbox_set:Nn \l__siunitx_table_decimal_box
          {
            \hbox_unpack:N \l__siunitx_table_decimal_box
            \hbox_unpack:N \l__siunitx_table_tmp_box
          }
        \dim_add:Nn \l__siunitx_table_carry_dim
          {
              \l__siunitx_table_tmp_dim
            - \box_wd:N \l__siunitx_table_tmp_box
          }
      }
  }
```

With no alignment, everything supplied is treated more-or-less the same as `\num` (but without the xparse wrapper).

```
\cs_new_protected:Npn \__siunitx_table_print_none:nnn #1#2#3
  {
    \use:c { __siunitx_table_align_ \l__siunitx_table_align_number_tl :n }
      {
        #1
        \siunitx_number_format:nN {#2} \l__siunitx_table_tmp_tl
        \siunitx_print_number:V \l__siunitx_table_tmp_tl
        #3
     }
  }
```

(*End definition for* `\__siunitx_table_print:nnn` *and others.*)

2.9 Standard settings for module options

Some of these follow naturally from the point of definition (*e.g.* boolean variables are always `false` to begin with), but for clarity everything is set here.

```
\keys_set:nn { siunitx }
  {
    table-align-comparator  = true   ,
    table-align-exponent    = true   ,
    table-align-text-after  = true   ,
    table-align-text-before = true   ,
    table-align-uncertainty = true   ,
    table-alignment         = center ,
    table-auto-round        = false  ,
    table-column-width      = 0pt    ,
    table-fixed-width       = false  ,
    table-format            = 2.2    ,
    table-number-alignment  = center ,
    table-text-alignment    = center ,
```

Out of order as `table-format` sets this implicitly too.

```
    table-alignment-mode    = marker
  }
```

857 ⟨/package⟩

Part X
siunitx-unit – Parsing and formatting units

This submodule is dedicated to formatting physical units. The main function, `\siunitx_unit_format:nN`, takes user input specify physical units and converts it into a formatted token list suitable for typesetting in math mode. While the formatter will deal correctly with "literal" user input, the key strength of the module is providing a method to describe physical units in a "symbolic" manner. The output format of these symbolic units can then be controlled by a number of key–value options made available by the module.

A small number of LaTeX 2_ε math mode commands are assumed to be available as part of the formatted output. The `\mathchoice` command (normally the TeX primitive) is needed when using `per-mode = symbol-or-fraction`. The commands `\frac`, `\mathrm`, `\mbox`, `\␣` and `\,` are used by the standard module settings. For the display of colored (highlighted) and cancelled units, the commands `\textcolor` and `\cancel` are assumed to be available.

1 Formatting units

`\siunitx_unit_format:nN` `\siunitx_unit_format:xN`

`\siunitx_unit_format:nN {⟨units⟩} ⟨tl var⟩`

This function converts the input ⟨*units*⟩ into a processed ⟨*tl var*⟩ which can then be inserted in math mode to typeset the material. Where the ⟨*units*⟩ are given in symbolic form, described elsewhere, this formatting process takes place in two stages: the ⟨*units*⟩ are parsed into a structured form before the generation of the appropriate output form based on the active settings. When the ⟨*units*⟩ are given as literals, processing is minimal: the characters `.` and `~` are converted to unit products (boundaries). In both cases, the result is a series of tokens intended to be typeset in math mode with appropriate choice of font for typesetting of the textual parts.

For example,

```
\siunitx_unit_format:nN { \kilo \metre \per \second } \l_tmpa_tl
```

will, with standard settings, result in `\l_tmpa_tl` being set to

```
\mathrm{km}\,\mathrm{s}^{-1}
```

\siunitx_unit_format_extract_prefixes:nNN \siunitx_unit_format_extract_prefixes:nNN {⟨*units*⟩} ⟨*tl var*⟩ ⟨*fp var*⟩

This function formats the ⟨*units*⟩ in the same way as described for `\siunitx_unit_format:nN`. When the input is given in symbolic form, any decimal unit prefixes will be extracted and the overall power of ten that these represent will be stored in the ⟨*fp var*⟩.

For example,

```
\siunitx_unit_format_extract_prefixes:nNN { \kilo \metre \per \second }
  \l_tmpa_tl \l_tmpa_fp
```

will, with standard settings, result in `\l_tmpa_tl` being set to

```
\mathrm{m}\,\mathrm{s}^{-1}
```

with `\l_tmpa_fp` taking value 3. Note that the latter is a floating point variable: it is possible for non-integer values to be obtained here.

\siunitx_unit_format_combine_exponent:nnN \siunitx_unit_format_combine_exponent:nnN {⟨*units*⟩} {⟨*exponent*⟩} ⟨*tl var*⟩

This function formats the ⟨*units*⟩ in the same way as described for `\siunitx_unit_format:nN`. The ⟨*exponent*⟩ is combined with any prefix for the *first* unit of the ⟨*units*⟩, and an updated prefix is introduced.

For example,

```
\siunitx_unit_format_combine_exponent:nnN { \metre \per \second }
  { 3 } \l_tmpa_tl
```

will, with standard settings, result in `\l_tmpa_tl` being set to

```
\mathrm{km}\,\mathrm{s}^{-1}
```

\siunitx_unit_format_multiply:nnN
\siunitx_unit_format_multiply_extract_prefixes:nnNN
\siunitx_unit_format_multiply_combine_exponent:nnnN

\siunitx_unit_format_multiply:nnN {⟨*units*⟩} {⟨*factor*⟩} ⟨*tl var*⟩
\siunitx_unit_format_multiply_extract_prefixes:nnNN {⟨*units*⟩} {⟨*factor*⟩} ⟨*tl var*⟩ ⟨*fp var*⟩
\siunitx_unit_format_multiply_combine_exponent:nnnN {⟨*units*⟩} {⟨*factor*⟩} {⟨*exponent*⟩} ⟨*tl var*⟩

These function formats the ⟨*units*⟩ in the same way as described for `\siunitx_unit_format:nN`. The units are multiplied by the ⟨*factor*⟩, and further processing takes place as previously described.

For example,

```
\siunitx_unit_format_multiply:nnN { \metre \per \second }
  { 3 } \l_tmpa_tl
```

will, with standard settings, result in `\l_tmpa_tl` being set to

```
\mathrm{km}^{3}\,\mathrm{s}^{-3}
```

2 Defining symbolic units

`\siunitx_declare_prefix:Nnn` `\siunitx_declare_prefix:Nnx`

`\siunitx_declare_prefix:Nnn` ⟨*prefix*⟩ {⟨*power*⟩} {⟨*symbol*⟩}

Defines a symbolic ⟨*prefix*⟩ (which should be a control sequence such as `\kilo`) to be converted by the parser to the ⟨*symbol*⟩. The latter should consist of literal content (*e.g.* `k`). In literal mode the ⟨*symbol*⟩ will be typeset directly. The prefix should represent an integer ⟨*power*⟩ of 10, and this information may be used to convert from one or more ⟨*prefix*⟩ symbols to an overall power applying to a unit. See also `\siunitx_declare_prefix:Nn`.

`\siunitx_declare_prefix:Nn`

`\siunitx_declare_prefix:Nn` ⟨*prefix*⟩ {⟨*symbol*⟩}

Defines a symbolic ⟨*prefix*⟩ (which should be a control sequence such as `\kilo`) to be converted by the parser to the ⟨*symbol*⟩. The latter should consist of literal content (*e.g.* `k`). In literal mode the ⟨*symbol*⟩ will be typeset directly. In contrast to `\siunitx_declare_prefix:Nnn`, there is no assumption about the mathematical nature of the ⟨*prefix*⟩, *i.e.* the prefix may represent a power of any base. As a result, no conversion of the ⟨*prefix*⟩ to a numerical power will be possible.

`\siunitx_declare_power:NNn`

`\siunitx_declare_power:NNn` ⟨*pre-power*⟩ ⟨*post-power*⟩ {⟨*value*⟩}

Defines *two* symbolic ⟨*powers*⟩ (which should be control sequences such as `\squared`) to be converted by the parser to the ⟨*value*⟩. The latter should be an integer or floating point number in the format defined for l3fp. Powers may precede a unit or be give after it: both forms are declared at once, as indicated by the argument naming. In literal mode, the ⟨*value*⟩ will be applied as a superscript to either the next token in the input (for the ⟨*pre-power*⟩) or appended to the previously-typeset material (for the ⟨*post-power*⟩).

`\siunitx_declare_qualifier:Nn`

`\siunitx_declare_qualifier:Nn` ⟨*qualifier*⟩ {⟨*meaning*⟩}

Defines a symbolic ⟨*qualifier*⟩ (which should be a control sequence such as `\catalyst`) to be converted by the parser to the ⟨*meaning*⟩. The latter should consist of literal content (*e.g.* `cat`). In literal mode the ⟨*meaning*⟩ will be typeset following a space after the unit to which it applies.

`\siunitx_declare_unit:Nn` `\siunitx_declare_unit:Nx` `\siunitx_declare_unit:Nnn` `\siunitx_declare_unit:Nxn`

`\siunitx_declare_unit:Nn` ⟨*unit*⟩ {⟨*meaning*⟩}
`\siunitx_declare_unit:Nnn` ⟨*unit*⟩ {⟨*meaning*⟩} {⟨*options*⟩}

Defines a symbolic ⟨*unit*⟩ (which should be a control sequence such as `\kilogram`) to be converted by the parser to the ⟨*meaning*⟩. The latter may consist of literal content (*e.g.* `kg`), other symbolic unit commands (*e.g.* `\kilo\gram`) or a mixture of the two. In literal mode the ⟨*meaning*⟩ will be typeset directly. The version taking an ⟨*options*⟩ argument may be used to support per-unit options: these are applied at the top level or using `\siunitx_unit_options_apply:n`.

`\l_siunitx_unit_font_tl`

The font function which is applied to the text of units when constructing formatted units: set by `font-command`.

\l_siunitx_unit_fraction_tl

The fraction function which is applied whne constructing fractional units: set by `fraction-command`.

\l_siunitx_unit_symbolic_seq

This sequence contains all of the symbolic names defined: these will be in the form of control sequences such as `\kilogram`. The order of the sequence is unimportant. This includes prefixes and powers as well as units themselves.

\l_siunitx_unit_seq

This sequence contains all of the symbolic *unit* names defined: these will be in the form of control sequences such as `\kilogram`. In contrast to `\l_siunitx_unit_symbolic_seq`, it *only* holds units themselves

3 Per-unit options

\siunitx_unit_options_apply:n `\siunitx_unit_options_apply:n` ⟨*unit(s)*⟩

Applies any unit-specific options set up using `\siunitx_declare_unit:Nnn`. This allows there use outside of unit formatting, for example to influence spacing in quantities. The options are applied only once at a given group level, which allows for user over-ride *via* `\keys_set:nn { siunitx } { ... }`.

4 Units in (PDF) strings

\siunitx_unit_pdfstring_context:

```
\group_begin:
\siunitx_unit_pdfstring_context:
⟨Expansion context⟩ ⟨units⟩
\group_end:
```

Sets symbol unit macros to generate text directly. This is needed in expansion contexts where units must be converted to simple text. This function is itself not expandable, so must be using within a surrounding group as show in the example.

5 Pre-defined symbolic unit components

The unit parser is defined to recognise a number of pre-defined units, prefixes and powers, and also interpret a small selection of "generic" symbolic parts.

Broadly, the pre-defined units are those defined by the BIPM in the documentation for the *International System of Units* (SI) [1]. As far as possible, the names given to the command names for units are those used by the BIPM, omitting spaces and using only ASCII characters. The standard symbols are also taken from the same documentation. In the following documentation, the order of the description of units broadly follows the SI Brochure.

\kilogram
\metre
\meter
\mole
\kelvin
\candela
\second
\ampere

The base units as defined in the SI Brochure [2]. Notice that `\meter` is defined as an alias for `\metre` as the former spelling is common in the US (although the latter is the official spelling).

\gram

The base unit `\kilogram` is defined using an SI prefix: as such the (derived) unit `\gram` is required by the module to correctly produce output for the `\kilogram`.

\yocto
\zepto
\atto
\femto
\pico
\nano
\micro
\milli
\centi
\deci
\deca
\deka
\hecto
\kilo
\mega
\giga
\tera
\peta
\exa
\zetta
\yotta

Prefixes, all of which are integer powers of 10: the powers are stored internally by the module and can be used for conversion from prefixes to their numerical equivalent. These prefixes are documented in Section 3.1 of the SI Brochure.

Note that the `\kilo` prefix is required to define the base `\kilogram` unit. Also note the two spellings available for `\deca`/`\deka`.

`\becquerel`
`\degreeCelsius`
`\coulomb`
`\farad`
`\gray`
`\hertz`
`\henry`
`\joule`
`\katal`
`\lumen`
`\lux`
`\newton`
`\ohm`
`\pascal`
`\radian`
`\siemens`
`\sievert`
`\steradian`
`\tesla`
`\volt`
`\watt`
`\weber`

The defined SI units with defined names and symbols, as given in Table 4 of the SI Brochure. Notice that the names of the units are lower case with the exception of `\degreeCelsius`, and that this unit name includes "degree".

`\astronomicalunit`
`\bel`
`\dalton`
`\day`
`\decibel`
`\electronvolt`
`\hectare`
`\hour`
`\litre`
`\liter`
`\neper`
`\minute`
`\tonne`

Units accepted for use with the SI: here `\minute` is a unit of time not of plane angle. These units are taken from Table 8 of the SI Brochure.

For the unit `\litre`, both `l` and `L` are listed as acceptable symbols: the latter is the standard setting of the module. The alternative spelling `\liter` is also given for this unit for US users (as with `\metre`, the official spelling is "re").

`\arcminute`
`\arcsecond`
`\degree`

Units for plane angles accepted for use with the SI: to avoid a clash with units for time, here `\arcminute` and `\arcsecond` are used in place of `\minute` and `\second`. These units are taken from Table 8 of the SI Brochure.

`\percent`

The mathematical concept of percent, usable with the SI as detailed in Section 5.4.7 of the SI Brochure.

`\square` `\square` ⟨*prefix*⟩ ⟨*unit*⟩
`\cubic` `\cubic` ⟨*prefix*⟩ ⟨*unit*⟩

Pre-defined unit powers which apply to the next ⟨*prefix*⟩/⟨*unit*⟩ combination.

`\squared` `\cubed`

⟨*prefix*⟩ ⟨*unit*⟩ `\squared`
⟨*prefix*⟩ ⟨*unit*⟩ `\cubed`

Pre-defined unit powers which apply to the preceding ⟨*prefix*⟩/⟨*unit*⟩ combination.

`\per`

`\per` ⟨*prefix*⟩ ⟨*unit*⟩ ⟨*power*⟩

Indicates that the next ⟨*prefix*⟩/⟨*unit*⟩/⟨*power*⟩ combination is reciprocal, *i.e.* raises it to the power −1. This symbolic representation may be applied in addition to a `\power`, and will work correctly if the `\power` itself is negative. In literal mode `\per` will print a slash ("/").

`\cancel`

`\cancel` ⟨*prefix*⟩ ⟨*unit*⟩ ⟨*power*⟩

Indicates that the next ⟨*prefix*⟩/⟨*unit*⟩/⟨*power*⟩ combination should be "cancelled out". In the parsed output, the entire unit combination will be given as the argument to a function `\cancel`, which is assumed to be available at a higher level. In literal mode, the same higher-level `\cancel` will be applied to the next token. It is the responsibility of the calling code to provide an appropriate definition for `\cancel` outside of the scope of the unit parser.

`\highlight`

`\highlight` {⟨*color*⟩} ⟨*prefix*⟩ ⟨*unit*⟩ ⟨*power*⟩

Indicates that the next ⟨*prefix*⟩/⟨*unit*⟩/⟨*power*⟩ combination should be highlighted in the specified ⟨*color*⟩. In the parsed output, the entire unit combination will be given as the argument to a function `\textcolor`, which is assumed to be available at a higher level. In literal mode, the same higher-level `\textcolor` will be applied to the next token. It is the responsibility of the calling code to provide an appropriate definition for `\textcolor` outside of the scope of the unit parser.

`\of`

⟨*prefix*⟩ ⟨*unit*⟩ ⟨*power*⟩ `\of` {⟨*qualifier*⟩}

Indicates that the ⟨*qualifier*⟩ applies to the current ⟨*prefix*⟩/⟨*unit*⟩/⟨*power*⟩ combination. In parsed mode, the display of the result will depend upon module options. In literal mode, the ⟨*qualifier*⟩ will be printed in parentheses following the preceding ⟨*unit*⟩ and a full-width space.

`\raiseto` `\tothe`

`\raiseto` {⟨*power*⟩} ⟨*prefix*⟩ ⟨*unit*⟩
⟨*prefix*⟩ ⟨*unit*⟩ `\tothe` {⟨*power*⟩}

Indicates that the ⟨*power*⟩ applies to the current ⟨*prefix*⟩/⟨*unit*⟩ combination. As shown, `\raiseto` applies to the next ⟨*unit*⟩ whereas `\tothe` applies to the preceding unit. In literal mode the `\power` will be printed as a superscript attached to the next token (`\raiseto`) or preceding token (`\tothe`) as appropriate.

5.1 Key–value options

The options defined by this submodule are available within the l3keys `siunitx` tree.

`bracket-unit-denominator`

`bracket-unit-denominator = true|false`

Switch to determine whether brackets are added to the denominator part of a unit when printed using inline fractional form (with `per-mode` as `repeated-symbol`, `symbol` or `symbol-or-fraction`). The standard setting is `true`.

extract-mass-in-kilograms

`extract-mass-in-kilograms = true|false`

Determines whether prefix extraction treats kilograms as a base unit; when set `false`, grams are used. The standard setting is `true`.

forbid-literal-units

`forbid-literal-units = true|false`

Switch which determines if literal units are allowed when parsing is active; does not apply when `parse-units` is `false`.

fraction-command

`fraction-command =` ⟨*command*⟩

Command used to create fractional output when `per-mode` is set to `fraction`. The standard setting is `\frac`.

inter-unit-product

`inter-unit-product =` ⟨*separator*⟩

Inserted between unit combinations in parsed mode, and used to replace `.` and `~` in literal mode. The standard setting is `\,`.

parse-units

`parse-units = true|false`

Determines whether parsing of unit symbols is attempted or literal mode is used directly. The standard setting is `true`.

per-mode

`per-mode =`
`fraction|power|power-positive-first|repeated-symbol|symbol|symbol-or-fraction`

Selects how the negative powers (`\per`) are formatted: a choice from the options `fraction`, `power`, `power-positive-first`, `repeated-symbol`, `symbol` and `symbol-or-fraction`. The option `fraction` generates fractional output when appropriate using the command specified by the `fraction-command` option. The setting `power` uses reciprocal powers leaving the units in the order of input, while `power-positive-first` uses the same display format but sorts units such that the positive powers come before negative ones. The `symbol` setting uses a symbol (specified by `per-symbol`) between positive and negative powers, while `repeated-symbol` uses the same symbol but places it before *every* unit with a negative power (this is mathematically "wrong" but often seen in real work). Finally, `symbol-or-fraction` acts like `symbol` for inline output and like `fraction` when the output is used in a display math environment. The standard setting is `power`.

per-symbol

`per-symbol =` ⟨*symbol*⟩

Specifies the symbol to be used to denote negative powers when the option `per-mode` is set to `repeated-symbol`, `symbol` or `symbol-or-fraction`. The standard setting is `/`.

qualifier-mode

`qualifier-mode = bracket|combine|phrase|subscript`

Selects how qualifiers are formatted: a choice from the options `bracket`, `combine`, `phrase` and `subscript`. The option `bracket` wraps the qualifier in parenthesis, `combine` joins the qualifier with the unit directly, `phrase` joins the material using `qualifier-phrase` as a link, and `subscript` formats the qualifier as a subscript. The standard setting is `subscript`.

qualifier-phrase

`qualifier-phrase =` ⟨*phrase*⟩

Defines the ⟨*phrase*⟩ used when `qualifier-mode` is set to `phrase`.

sticky-per `sticky-per = true|false`

Used to determine whether `\per` should be applied one a unit-by-unit basis (when `false`) or should apply to all following units (when `true`). The latter mode is somewhat akin conceptually to the TEX `\over` primitive. The standard setting is `false`.

unit-font-command `unit-font-command = ⟨command⟩`

Command applied to text during output of units: should be command usable in math mode for font selection. Notice that in a typical unit this does not (necessarily) apply to all output, for example powers or brackets. The standard setting is `\mathrm`.

6 siunitx-unit implementation

Start the DocStrip guards.

```
1 ⟨*package⟩
```

Identify the internal prefix (LATEX3 DocStrip convention): only internal material in this *submodule* should be used directly.

```
2 ⟨@@=siunitx_unit⟩
```

6.1 Initial set up

The mechanisms defined here need a few variables to exist and to be correctly set: these don't belong to one subsection and so are created in a small general block.

Variants not provided by expl3.

```
3 \cs_generate_variant:Nn \tl_replace_all:Nnn { NnV }
```

\l__siunitx_unit_tmp_fp
\l__siunitx_unit_tmp_int
\l__siunitx_unit_tmp_tl
Scratch space.

```
4 \fp_new:N \l__siunitx_unit_tmp_fp
5 \int_new:N \l__siunitx_unit_tmp_int
6 \tl_new:N  \l__siunitx_unit_tmp_tl
```

(*End definition for* `\l__siunitx_unit_tmp_fp`, `\l__siunitx_unit_tmp_int`, *and* `\l__siunitx_unit_tmp_tl`.)

\c__siunitx_unit_math_subscript_tl
Useful tokens with awkward category codes.

```
7 \tl_const:Nx \c__siunitx_unit_math_subscript_tl
8   { \char_generate:nn { `\_ } { 8 } }
```

(*End definition for* `\c__siunitx_unit_math_subscript_tl`.)

\l__siunitx_unit_parsing_bool
A boolean is used to indicate when the symbolic unit functions should produce symbolic or literal output. This is used when the symbolic names are used along with literal input, and ensures that there is a sensible fall-back for these cases.

```
9 \bool_new:N \l__siunitx_unit_parsing_bool
```

(*End definition for* `\l__siunitx_unit_parsing_bool`.)

\l__siunitx_unit_test_bool
A switch used to indicate that the code is testing the input to find if there is any typeset output from individual unit macros. This is needed to allow the "base" macros to be found, and also to pick up the difference between symbolic and literal unit input.

```
10 \bool_new:N \l__siunitx_unit_test_bool
```

(*End definition for* `\l__siunitx_unit_test_bool`.)

`\__siunitx_unit_if_symbolic:nTF` The test for symbolic units is needed in two places. First, there is the case of "pre-parsing" input to check if it can be parsed. Second, when parsing there is a need to check if the current unit is built up from others (symbolic) or is defined in terms of some literals. To do this, the approach used is to set all of the symbolic unit commands expandable and to do nothing, with the few special cases handled manually.

```
\prg_new_protected_conditional:Npnn \__siunitx_unit_if_symbolic:n #1 { TF }
  {
    \group_begin:
      \bool_set_true:N \l__siunitx_unit_test_bool
      \protected@edef \l__siunitx_unit_tmp_tl {#1}
    \exp_args:NNV \group_end:
    \tl_if_blank:nTF \l__siunitx_unit_tmp_tl
      { \prg_return_true: }
      { \prg_return_false: }
  }
```

(*End definition for* `\__siunitx_unit_if_symbolic:nTF`.)

6.2 Defining symbolic unit

Unit macros and related support are created here. These exist only within the scope of the unit processor code, thus not polluting document-level namespace and allowing overlap with other areas in the case of useful short names (for example `\pm`). Setting up the mechanisms to allow this requires a few additional steps on top of simply saving the data given by the user in creating the unit.

`\l_siunitx_unit_symbolic_seq` A list of all of the symbolic units, *etc.*, set up. This is needed to allow the symbolic names to be defined within the scope of the unit parser but not elsewhere using simple mappings.

```
\seq_new:N \l_siunitx_unit_symbolic_seq
```

(*End definition for* `\l_siunitx_unit_symbolic_seq`. *This variable is documented on page* 145.)

`\l_siunitx_unit_seq` A second list featuring only the units themselves.

```
\seq_new:N \l_siunitx_unit_seq
```

(*End definition for* `\l_siunitx_unit_seq`. *This variable is documented on page* 145.)

`\__siunitx_unit_set_symbolic:Nnn`
`\__siunitx_unit_set_symbolic:Npnn`
`\__siunitx_unit_set_symbolic:Nnnn` The majority of the work for saving each symbolic definition is the same irrespective of the item being defined (unit, prefix, power, qualifier). This is therefore all carried out in a single internal function which does the common tasks. The three arguments here are the symbolic macro name, the literal output and the code to insert when doing full unit parsing. To allow for the "special cases" (where arguments are required) the entire mechanism is set up in a two-part fashion allowing for flexibility at the slight cost of additional functions.

Importantly, notice that the unit macros are declared as expandable. This is required so that literals can be correctly converted into a token list of material which does not depend on local redefinitions for the unit macros. That is required so that the unit formatting system can be grouped.

```
\cs_new_protected:Npn \__siunitx_unit_set_symbolic:Nnn #1
  { \__siunitx_unit_set_symbolic:Nnnn #1 { } }
```

```
\cs_new_protected:Npn \__siunitx_unit_set_symbolic:Npnn #1#2#
  { \__siunitx_unit_set_symbolic:Nnnn #1 {#2} }
\cs_new_protected:Npn \__siunitx_unit_set_symbolic:Nnnn #1#2#3#4
  {
    \seq_put_right:Nn \l_siunitx_unit_symbolic_seq {#1}
    \cs_set:cpn { __siunitx_unit_ \token_to_str:N #1 :w } #2
      {
        \bool_if:NF \l__siunitx_unit_test_bool
          {
            \bool_if:NTF \l__siunitx_unit_parsing_bool
              {#4}
              {#3}
          }
      }
  }
```

(*End definition for* `\__siunitx_unit_set_symbolic:Nnn`, `\__siunitx_unit_set_symbolic:Npnn`, *and* `\__siunitx_unit_set_symbolic:Nnnn`.)

`\siunitx_declare_power:NNn`

Powers can come either before or after the unit. As they always come (logically) in matching, we handle this by declaring two commands, and setting each up separately.

```
\cs_new_protected:Npn \siunitx_declare_power:NNn #1#2#3
  {
    \__siunitx_unit_set_symbolic:Nnn #1
      { \__siunitx_unit_literal_power:nn {#3} }
      { \__siunitx_unit_parse_power:nnN {#1} {#3} \c_true_bool }
    \__siunitx_unit_set_symbolic:Nnn #2
      { ^ {#3} }
      { \__siunitx_unit_parse_power:nnN {#2} {#3} \c_false_bool }
  }
```

(*End definition for* `\siunitx_declare_power:NNn`. *This function is documented on page* 144.)

`\siunitx_declare_prefix:Nn`
`\siunitx_declare_prefix:Nnn`
`\siunitx_declare_prefix:Nnx`
`\l__siunitx_unit_prefixes_forward_prop`
`\l__siunitx_unit_prefixes_reverse_prop`

For prefixes there are a couple of options. In all cases, the basic requirement is to set up to parse the prefix using the appropriate internal function. For prefixes which are powers of 10, there is also the need to be able to do conversion to/from the numerical equivalent. That is handled using two properly lists which can be used to supply the conversion data later.

```
\cs_new_protected:Npn \siunitx_declare_prefix:Nn #1#2
  {
    \__siunitx_unit_set_symbolic:Nnn #1
      {#2}
      { \__siunitx_unit_parse_prefix:Nn #1 {#2} }
  }
\cs_new_protected:Npn \siunitx_declare_prefix:Nnn #1#2#3
  {
    \siunitx_declare_prefix:Nn #1 {#3}
    \prop_put:Nnn \l__siunitx_unit_prefixes_forward_prop {#3} {#2}
    \prop_put:Nnn \l__siunitx_unit_prefixes_reverse_prop {#2} {#3}
  }
\cs_generate_variant:Nn \siunitx_declare_prefix:Nnn { Nnx }
\prop_new:N \l__siunitx_unit_prefixes_forward_prop
\prop_new:N \l__siunitx_unit_prefixes_reverse_prop
```

(*End definition for* `\siunitx_declare_prefix:Nn` *and others. These functions are documented on page 144.*)

`\siunitx_declare_qualifier:Nn`

Qualifiers are relatively easy to handle: nothing to do other than save the input appropriately.

```
\cs_new_protected:Npn \siunitx_declare_qualifier:Nn #1#2
  {
    \__siunitx_unit_set_symbolic:Nnn #1
      { ~ ( #2 ) }
      { \__siunitx_unit_parse_qualifier:nn {#1} {#2} }
  }
```

(*End definition for* `\siunitx_declare_qualifier:Nn`*. This function is documented on page 144.*)

`\siunitx_declare_unit:Nn`
`\siunitx_declare_unit:Nx`
`\siunitx_declare_unit:Nnn`
`\siunitx_declare_unit:Nxn`

For the unit parsing, allowing for variations in definition order requires that a test is made for the output of each unit at point of use.

```
\cs_new_protected:Npn \siunitx_declare_unit:Nn #1#2
  { \siunitx_declare_unit:Nnn #1 {#2} { } }
\cs_generate_variant:Nn \siunitx_declare_unit:Nn { Nx }
\cs_new_protected:Npn \siunitx_declare_unit:Nnn #1#2#3
  {
    \seq_put_right:Nn \l_siunitx_unit_seq {#1}
    \__siunitx_unit_set_symbolic:Nnn #1
      {#2}
      {
        \__siunitx_unit_if_symbolic:nTF {#2}
          {#2}
          { \__siunitx_unit_parse_unit:Nn #1 {#2} }
      }
    \tl_clear_new:c { l__siunitx_unit_options_ \token_to_str:N #1 _tl }
    \tl_if_empty:nF {#3}
      { \tl_set:cn { l__siunitx_unit_options_ \token_to_str:N #1 _tl } {#3} }
  }
\cs_generate_variant:Nn \siunitx_declare_unit:Nnn { Nx }
```

(*End definition for* `\siunitx_declare_unit:Nn` *and* `\siunitx_declare_unit:Nnn`*. These functions are documented on page 144.*)

6.3 Applying unit options

`\l__siunitx_unit_options_bool`

```
\bool_new:N \l__siunitx_unit_options_bool
```

(*End definition for* `\l__siunitx_unit_options_bool`.)

`\siunitx_unit_options_apply:n`

Options apply only if they have not already been set at this group level.

```
\cs_new_protected:Npn \siunitx_unit_options_apply:n #1
  {
    \bool_if:NF \l__siunitx_unit_options_bool
      {
        \tl_if_single_token:nT {#1}
          {
            \tl_if_exist:cT { l__siunitx_unit_options_ \token_to_str:N #1 _tl }
              {
```

```
                \keys_set:nv { siunitx }
                  { l__siunitx_unit_options_ \token_to_str:N #1 _tl }
              }
          }
      }
    \bool_set_true:N \l__siunitx_unit_options_bool
  }
```

(*End definition for* `\siunitx_unit_options_apply:n`. *This function is documented on page 145.*)

6.4 Non-standard symbolic units

A few of the symbolic units require non-standard definitions: these are created here. They all use parts of the more general code but have particular requirements which can only be addressed by hand. Some of these could in principle be used in place of the dedicated definitions above, but at point of use that would then require additional expansions for each unit parsed: as the macro names would still be needed, this does not offer any real benefits.

`\per` The `\per` symbolic unit is a bit special: it has a mechanism entirely different from everything else, so has to be set up by hand. In literal mode it is represented by a very simple symbol!

```
\__siunitx_unit_set_symbolic:Nnn \per
  { / }
  { \__siunitx_unit_parse_per: }
```

(*End definition for* `\per`. *This function is documented on page 148.*)

`\cancel` `\highlight` The two special cases, `\cancel` and `\highlight`, are easy to deal with when parsing. When not parsing, a precaution is taken to ensure that the user level equivalents always get a braced argument.

```
\__siunitx_unit_set_symbolic:Npnn \cancel
  { }
  { \__siunitx_unit_parse_special:n { \cancel } }
\__siunitx_unit_set_symbolic:Npnn \highlight #1
  { \__siunitx_unit_literal_special:nN { \textcolor {#1} } }
  { \__siunitx_unit_parse_special:n { \textcolor {#1} } }
```

(*End definition for* `\cancel` *and* `\highlight`. *These functions are documented on page 148.*)

`\of` The generic qualifier is simply the same as the dedicated ones except for needing to grab an argument.

```
\__siunitx_unit_set_symbolic:Npnn \of #1
  { \  ( #1 ) }
  { \__siunitx_unit_parse_qualifier:nn { \of {#1} } {#1} }
```

(*End definition for* `\of`. *This function is documented on page 148.*)

`\raiseto` `\tothe` Generic versions of the pre-defined power macros. These require an argument and so cannot be handled using the general approach. Other than that, the code here is very similar to that in `\siunitx_unit_power_set:NnN`.

```
\__siunitx_unit_set_symbolic:Npnn \raiseto #1
  { \__siunitx_unit_literal_power:nn {#1} }
  { \__siunitx_unit_parse_power:nnN { \raiseto {#1} } {#1} \c_true_bool }
```

```
\__siunitx_unit_set_symbolic:Npnn \tothe #1
  { ^ {#1} }
  { \__siunitx_unit_parse_power:nnN { \tothe {#1} } {#1} \c_false_bool }
```

(*End definition for* `\raiseto` *and* `\tothe`. *These functions are documented on page 148.*)

6.5 Main formatting routine

Unit input can take two forms, "literal" units (material to be typeset directly) or "symbolic" units (macro-based). Before any parsing or typesetting is carried out, a small amount of pre-parsing has to be carried out to decide which of these cases applies.

`\l_siunitx_unit_font_tl`
`\l__siunitx_unit_product_tl`
`\l__siunitx_unit_mass_kilogram_bool`

Options which apply to the main formatting routine, and so are not tied to either symbolic or literal input.

```
\keys_define:nn { siunitx }
  {
    extract-mass-in-kilograms .bool_set:N =
      \l__siunitx_unit_mass_kilogram_bool ,
    inter-unit-product .tl_set:N =
      \l__siunitx_unit_product_tl ,
    unit-font-command .tl_set:N =
      \l_siunitx_unit_font_tl
  }
```

(*End definition for* `\l_siunitx_unit_font_tl`, `\l__siunitx_unit_product_tl`, *and* `\l__siunitx_unit_mass_kilogram_bool`. *This variable is documented on page 144.*)

`\l__siunitx_unit_formatted_tl`

A token list for the final formatted result: may or may not be generated by the parser, depending on the nature of the input.

```
\tl_new:N \l__siunitx_unit_formatted_tl
```

(*End definition for* `\l__siunitx_unit_formatted_tl`.)

`\siunitx_unit_format:nN`
`\siunitx_unit_format_extract_prefixes:nNN`
`\siunitx_unit_format_combine_exponent:nnN`
`\siunitx_unit_format_multiply:nnN`
`_unit_format_multiply_extract_prefixes:nnNN`
`_unit_format_multiply_combine_exponent:nnnN`
`\__siunitx_unit_format:nNN`
`\__siunitx_unit_format_aux:`

Formatting parsed units can take place either with the prefixes printed or separated out into a power of ten. This variation is handled using two separate functions: as this submodule does not really deal with numbers, formatting the numeral part here would be tricky and it is better therefore to have a mechanism to return a simple numerical power. At the same time, most uses will no want this more complex return format and so a version of the code which does not do this is also provided.

The main unit formatting routine groups all of the parsing/formatting, so that the only value altered will be the return token list. As definitions for the various unit macros are not globally created, the first step is to map over the list of names and active the unit definitions: these do different things depending on the switches set. There is then a decision to be made: is the unit input one that can be parsed ("symbolic"), or is is one containing one or more literals. In the latter case, there is a still the need to convert the input into an expanded token list as some parts of the input could still be using unit macros.

Notice that for `\siunitx_unit_format:nN` a second return value from the auxiliary has to be allowed for, but is simply discarded.

```
\cs_new_protected:Npn \siunitx_unit_format:nN #1#2
  {
    \bool_set_false:N \l__siunitx_unit_prefix_exp_bool
    \fp_zero:N \l__siunitx_unit_combine_exp_fp
```

```
    \fp_set:Nn \l__siunitx_unit_multiple_fp { \c_one_fp }
    \__siunitx_unit_format:nNN {#1} #2 \l__siunitx_unit_tmp_fp
  }
\cs_new_protected:Npn \siunitx_unit_format_extract_prefixes:nNN #1#2#3
  {
    \bool_set_true:N \l__siunitx_unit_prefix_exp_bool
    \fp_zero:N \l__siunitx_unit_combine_exp_fp
    \fp_set:Nn \l__siunitx_unit_multiple_fp { \c_one_fp }
    \__siunitx_unit_format:nNN {#1} #2 #3
  }
\cs_new_protected:Npn \siunitx_unit_format_combine_exponent:nnN #1#2#3
  {
    \bool_set_false:N \l__siunitx_unit_prefix_exp_bool
    \fp_set:Nn \l__siunitx_unit_combine_exp_fp {#2}
    \fp_set:Nn \l__siunitx_unit_multiple_fp { \c_one_fp }
    \__siunitx_unit_format:nNN {#1} #3 \l__siunitx_unit_tmp_fp
  }
\cs_new_protected:Npn \siunitx_unit_format_multiply:nnN #1#2#3
  {
    \bool_set_false:N \l__siunitx_unit_prefix_exp_bool
    \fp_zero:N \l__siunitx_unit_combine_exp_fp
    \fp_set:Nn \l__siunitx_unit_multiple_fp {#2}
    \__siunitx_unit_format:nNN {#1} #3 \l__siunitx_unit_tmp_fp
  }
\cs_new_protected:Npn \siunitx_unit_format_multiply_extract_prefixes:nnNN
  #1#2#3#4
  {
    \bool_set_true:N \l__siunitx_unit_prefix_exp_bool
    \fp_zero:N \l__siunitx_unit_combine_exp_fp
    \fp_set:Nn \l__siunitx_unit_multiple_fp {#2}
    \__siunitx_unit_format:nNN {#1} #3 #4
  }
\cs_new_protected:Npn \siunitx_unit_format_multiply_combine_exponent:nnnN
  #1#2#3#4
  {
    \bool_set_false:N \l__siunitx_unit_prefix_exp_bool
    \fp_set:Nn \l__siunitx_unit_combine_exp_fp {#3}
    \fp_set:Nn \l__siunitx_unit_multiple_fp {#2}
    \__siunitx_unit_format:nNN {#1} #4 \l__siunitx_unit_tmp_fp
  }
\cs_new_protected:Npn \__siunitx_unit_format:nNN #1#2#3
  {
    \group_begin:
      \seq_map_inline:Nn \l_siunitx_unit_symbolic_seq
        { \cs_set_eq:Nc ##1 { __siunitx_unit_ \token_to_str:N ##1 :w } }
      \tl_clear:N \l__siunitx_unit_formatted_tl
      \fp_zero:N \l__siunitx_unit_prefix_fp
      \bool_if:NTF \l__siunitx_unit_parse_bool
        {
          \__siunitx_unit_if_symbolic:nTF {#1}
            {
              \__siunitx_unit_parse:n {#1}
              \prop_if_empty:NF \l__siunitx_unit_parsed_prop
                { \__siunitx_unit_format_parsed: }
```

```
            }
            {
              \bool_if:NTF \l__siunitx_unit_forbid_literal_bool
                { \msg_error:nnn { siunitx } { unit / literal } {#1} }
                { \__siunitx_unit_format_literal:n {#1} }
            }
        }
        { \__siunitx_unit_format_literal:n {#1} }
      \cs_set_protected:Npx \__siunitx_unit_format_aux:
        {
          \tl_set:Nn \exp_not:N #2
            { \exp_not:V \l__siunitx_unit_formatted_tl }
          \fp_set:Nn \exp_not:N #3
            { \fp_use:N \l__siunitx_unit_prefix_fp }
        }
    \exp_after:wN \group_end:
    \__siunitx_unit_format_aux:
  }
\cs_new_protected:Npn \__siunitx_unit_format_aux: { }
```

(*End definition for* `\siunitx_unit_format:nN` *and others. These functions are documented on page* 142.)

6.6 Formatting literal units

While in literal mode no parsing occurs, there is a need to provide a few auxiliary functions to handle one or two special cases.

`\__siunitx_unit_literal_power:nn`

For printing literal units which are given before the unit they apply to, there is a slight rearrangement. This is ex[EXP]pandable to cover the case of creation of a PDF string.

```
\cs_new:Npn \__siunitx_unit_literal_power:nn #1#2 { #2 ^ {#1} }
```

(*End definition for* `\__siunitx_unit_literal_power:nn`.)

`\__siunitx_unit_literal_special:nN`

When dealing with the special cases, there is an argument to absorb. This should be braced to be passed up to the user level, which is dealt with here.

```
\cs_new:Npn \__siunitx_unit_literal_special:nN #1#2 { #1 {#2} }
```

(*End definition for* `\__siunitx_unit_literal_special:nN`.)

`\__siunitx_unit_format_literal:n`
`\__siunitx_unit_format_literal_tilde:`
`\__siunitx_unit_format_literal_subscript:`
`\__siunitx_unit_format_literal_superscript:`
`\__siunitx_unit_format_literal_auxi:w`
`\__siunitx_unit_format_literal_auxii:w`
`\__siunitx_unit_format_literal_auxiii:w`
`\__siunitx_unit_format_literal_auxiv:n`
`\__siunitx_unit_format_literal_auxv:nw`
`\__siunitx_unit_format_literal_auxvi:nN`
`\__siunitx_unit_format_literal_auxvii:nN`
`\__siunitx_unit_format_literal_auxviii:nN`
`\__siunitx_unit_format_literal_super:nn`
`\__siunitx_unit_format_literal_sub:nn`
`\__siunitx_unit_format_literal_add:n`
`\__siunitx_unit_format_literal_auxix:nn`
`\__siunitx_unit_format_literal_auxx:nw`
`\l__siunitx_unit_separator_tl`

To format literal units, there are two tasks to do. The input is `x`-type expanded to force any symbolic units to be converted into their literal representation: this requires setting the appropriate switch. In the resulting token list, all `.` and `~` tokens are then replaced by the current unit product token list. To enable this to happen correctly with a normal (active) `~`, a small amount of "protection" is needed first. To cover active sub- and superscript tokens, appropriate definitions are provided at this stage. Those have to be expandable macros rather than implicit character tokens.

As with other code dealing with user input, `\protected@edef` is used here rather than `\tl_set:Nx` as LaTeX 2_ε robust commands may be present.

```
\group_begin:
  \char_set_catcode_active:n { `\~ }
  \cs_new_protected:Npx \__siunitx_unit_format_literal:n #1
    {
      \group_begin:
```

```
        \exp_not:n { \bool_set_false:N \l__siunitx_unit_parsing_bool }
        \tl_set:Nn \exp_not:N \l__siunitx_unit_tmp_tl {#1}
        \tl_replace_all:Nnn \exp_not:N \l__siunitx_unit_tmp_tl
          { \token_to_str:N ^ } { ^ }
        \tl_replace_all:Nnn \exp_not:N \l__siunitx_unit_tmp_tl
          { \token_to_str:N _ } { \c__siunitx_unit_math_subscript_tl }
        \char_set_active_eq:NN ^
          \exp_not:N \__siunitx_unit_format_literal_superscript:
        \char_set_active_eq:NN _
          \exp_not:N \__siunitx_unit_format_literal_subscript:
        \char_set_active_eq:NN \exp_not:N ~
          \exp_not:N \__siunitx_unit_format_literal_tilde:
        \exp_not:n
          {
            \protected@edef \l__siunitx_unit_tmp_tl
              { \l__siunitx_unit_tmp_tl }
            \tl_clear:N \l__siunitx_unit_formatted_tl
            \tl_if_empty:NF \l__siunitx_unit_tmp_tl
              {
                \exp_after:wN \__siunitx_unit_format_literal_auxi:w
                  \l__siunitx_unit_tmp_tl .
                  \q_recursion_tail . \q_recursion_stop
              }
            \exp_args:NNNV \group_end:
            \tl_set:Nn \l__siunitx_unit_formatted_tl
              \l__siunitx_unit_formatted_tl
          }
    }
\group_end:
\cs_new:Npx \__siunitx_unit_format_literal_subscript: { \c__siunitx_unit_math_subscript_tl }
\cs_new:Npn \__siunitx_unit_format_literal_superscript: { ^ }
\cs_new:Npn \__siunitx_unit_format_literal_tilde: { . }
```

To introduce the font changing commands while still allowing for line breaks in literal units, a loop is needed to replace one `.` at a time. To also allow for division, a second loop is used within that to handle `/`: as a result, the separator between parts has to be tracked.

```
\cs_new_protected:Npn \__siunitx_unit_format_literal_auxi:w #1 .
  {
    \quark_if_recursion_tail_stop:n {#1}
    \__siunitx_unit_format_literal_auxii:n {#1}
    \tl_set_eq:NN \l__siunitx_unit_separator_tl \l__siunitx_unit_product_tl
    \__siunitx_unit_format_literal_auxi:w
  }
\cs_set_protected:Npn \__siunitx_unit_format_literal_auxii:n #1
  {
    \__siunitx_unit_format_literal_auxiii:w
      #1 / \q_recursion_tail / \q_recursion_stop
  }
\cs_new_protected:Npn \__siunitx_unit_format_literal_auxiii:w #1 /
  {
    \quark_if_recursion_tail_stop:n {#1}
    \__siunitx_unit_format_literal_auxiv:n {#1}
    \tl_set:Nn \l__siunitx_unit_separator_tl { / }
```

```
    \__siunitx_unit_format_literal_auxiii:w
  }
\cs_new_protected:Npn \__siunitx_unit_format_literal_auxiv:n #1
  {
    \__siunitx_unit_format_literal_auxv:nw { }
      #1 \q_recursion_tail \q_recursion_stop
  }
```

To deal properly with literal formatting, we have to worry about super- and subscript markers. That can be complicated as they could come anywhere in the input: we handle that by iterating through the input and picking them out. This avoids any issue with losing braces for mid-input scripts. We also have to deal with fractions, hence needing a series of nested loops and a change of separator.

```
\cs_new_protected:Npn \__siunitx_unit_format_literal_auxv:nw
  #1#2 \q_recursion_stop
  {
    \tl_if_head_is_N_type:nTF {#2}
      { \__siunitx_unit_format_literal_auxvi:nN }
      {
        \tl_if_head_is_group:nTF {#2}
          { \__siunitx_unit_format_literal_auxix:nn }
          { \__siunitx_unit_format_literal_auxx:nw }
      }
        {#1} #2 \q_recursion_stop
  }
\cs_new_protected:Npx \__siunitx_unit_format_literal_auxvi:nN #1#2
  {
    \exp_not:N \quark_if_recursion_tail_stop_do:Nn #2
      { \exp_not:N \__siunitx_unit_format_literal_add:n {#1} }
    \exp_not:N \token_if_eq_meaning:NNTF #2 ^
      { \exp_not:N \__siunitx_unit_format_literal_super:nn {#1} }
      {
        \exp_not:N \token_if_eq_meaning:NNTF
          #2 \c__siunitx_unit_math_subscript_tl
          { \exp_not:N \__siunitx_unit_format_literal_sub:nn {#1} }
          { \exp_not:N \__siunitx_unit_format_literal_auxvii:nN {#1} #2 }
      }
  }
```

We need to make sure `\protect` sticks with the next token.

```
\cs_new_protected:Npn \__siunitx_unit_format_literal_auxvii:nN #1#2
  {
    \str_if_eq:nnTF {#2} { \protect }
      { \__siunitx_unit_format_literal_auxviii:nN {#1} }
      { \__siunitx_unit_format_literal_auxv:nw {#1#2} }
  }
\cs_new_protected:Npn \__siunitx_unit_format_literal_auxviii:nN #1#2
  { \__siunitx_unit_format_literal_auxv:nw { #1 \protect #2 } }
\cs_new_protected:Npn \__siunitx_unit_format_literal_super:nn #1#2
  {
    \quark_if_recursion_tail_stop:n {#2}
    \__siunitx_unit_format_literal_add:n {#1}
    \tl_put_right:Nn \l__siunitx_unit_formatted_tl { ^ {#2} }
    \__siunitx_unit_format_literal_auxvi:nN { }
  }
```

```
\cs_new_protected:Npx \__siunitx_unit_format_literal_sub:nn #1#2
  {
    \exp_not:N \quark_if_recursion_tail_stop:n {#2}
    \exp_not:N \__siunitx_unit_format_literal_add:n {#1}
    \tl_put_right:Nx \exp_not:N \l__siunitx_unit_formatted_tl
      {
        \c__siunitx_unit_math_subscript_tl
          {
            \exp_not:N \exp_not:V
              \exp_not:N \l_siunitx_unit_font_tl
                { \exp_not:N \exp_not:n {#2} }
          }
      }
    \exp_not:N \__siunitx_unit_format_literal_auxvi:nN { }
  }
\cs_new_protected:Npn \__siunitx_unit_format_literal_add:n #1
  {
    \tl_put_right:Nx \l__siunitx_unit_formatted_tl
      {
        \tl_if_empty:NF \l__siunitx_unit_formatted_tl
          { \exp_not:V \l__siunitx_unit_separator_tl }
        \tl_if_empty:nF {#1}
          { \exp_not:V \l_siunitx_unit_font_tl { \exp_not:n {#1} } }
      }
    \tl_clear:N \l__siunitx_unit_separator_tl
  }
\cs_new_protected:Npn \__siunitx_unit_format_literal_auxix:nn #1#2
  { \__siunitx_unit_format_literal_auxv:nw { #1 {#2} } }
\use:x
  {
    \cs_new_protected:Npn \exp_not:N \__siunitx_unit_format_literal_auxx:nw
      ##1 \c_space_tl
  }
  { \__siunitx_unit_format_literal_auxv:nw {#1} }
\tl_new:N \l__siunitx_unit_separator_tl
```

(*End definition for* `\__siunitx_unit_format_literal:n` *and others.*)

6.7 (PDF) String creation

`\siunitx_unit_pdfstring_context:`

A simple function that sets up to make units equal to their text representation.

```
\cs_new_protected:Npn \siunitx_unit_pdfstring_context:
  {
    \bool_set_false:N \l__siunitx_unit_parsing_bool
    \seq_map_inline:Nn \l_siunitx_unit_symbolic_seq
      { \cs_set_eq:Nc ##1 { __siunitx_unit_ \token_to_str:N ##1 :w } }
  }
```

(*End definition for* `\siunitx_unit_pdfstring_context:`*. This function is documented on page* 145.)

6.8 Parsing symbolic units

Parsing units takes place by storing information about each unit in a `prop`. As well as the unit itself, there are various other optional data points, for example a prefix or a power.

Some of these can come before the unit, others only after. The parser therefore tracks the number of units read and uses the current position to allocate data to individual units.

The result of parsing is a property list (`\l__siunitx_unit_parsed_prop`) which contains one or more entries for each unit:

- `prefix-`n The symbol for the prefix which applies to this unit, *e.g.* for `\kilo` with (almost certainly) would be `k`.
- `unit-`n The symbol for the unit itself, *e.g.* for `\metre` with (almost certainly) would be `m`.
- `power-`n The power which a unit is raised to. During initial parsing this will (almost certainly) be positive, but is combined with `per-`n to give a "fully qualified" power before any formatting takes place
- `per-`n Indicates that `per` applies to the current unit: stored during initial parsing then combined with `power-`n (and removed from the list) before further work.
- `qualifier-`n Any qualifier which applies to the current unit.
- `special-`n Any "special effect" to apply to the current unit.
- `command-1` The command corresponding to `unit-`n: needed to track base units; used for `\gram` only.

`\l__siunitx_unit_sticky_per_bool`

There is one option when *parsing* the input (as opposed to *formatting* for output): how to deal with `\per`.

```
\keys_define:nn { siunitx }
  {
    sticky-per .bool_set:N = \l__siunitx_unit_sticky_per_bool
  }
```

(*End definition for* `\l__siunitx_unit_sticky_per_bool`.)

`\l__siunitx_unit_parsed_prop` `\l__siunitx_unit_per_bool` `\l__siunitx_unit_position_int`

Parsing units requires a small number of variables are available: a `prop` for the parsed units themselves, a `bool` to indicate if `\per` is active and an `int` to track how many units have be parsed.

```
\prop_new:N \l__siunitx_unit_parsed_prop
\bool_new:N \l__siunitx_unit_per_bool
\int_new:N \l__siunitx_unit_position_int
```

(*End definition for* `\l__siunitx_unit_parsed_prop`, `\l__siunitx_unit_per_bool`, *and* `\l__siunitx_unit_position_int`.)

`\__siunitx_unit_parse:n`

The main parsing function is quite simple. After initialising the variables, each symbolic unit is set up. The input is then simply inserted into the input stream: the symbolic units themselves then do the real work of placing data into the parsing system. There is then a bit of tidying up to ensure that later stages can rely on the nature of the data here.

```
\cs_new_protected:Npn \__siunitx_unit_parse:n #1
  {
    \prop_clear:N \l__siunitx_unit_parsed_prop
    \bool_set_true:N \l__siunitx_unit_parsing_bool
    \bool_set_false:N \l__siunitx_unit_per_bool
    \bool_set_false:N \l__siunitx_unit_test_bool
```

```
    \int_zero:N \l__siunitx_unit_position_int
    \siunitx_unit_options_apply:n {#1}
    #1
    \int_step_inline:nn \l__siunitx_unit_position_int
      { \__siunitx_unit_parse_finalise:n {##1} }
    \__siunitx_unit_parse_finalise:
  }
```

(*End definition for* `\__siunitx_unit_parse:n`.)

`\__siunitx_unit_parse_add:nnnn` In all cases, storing a data item requires setting a temporary `tl` which will be used as the key, then using this to store the value. The `tl` is set using `x`-type expansion as this will expand the unit index and any additional calculations made for this.

```
\cs_new_protected:Npn \__siunitx_unit_parse_add:nnnn #1#2#3#4
  {
    \tl_set:Nx \l__siunitx_unit_tmp_tl { #1 - #2 }
    \prop_if_in:NVTF \l__siunitx_unit_parsed_prop
      \l__siunitx_unit_tmp_tl
      {
        \msg_error:nnxx { siunitx } { unit / duplicate-part }
          { \exp_not:n {#1} } { \token_to_str:N #3 }
      }
      {
        \prop_put:NVn \l__siunitx_unit_parsed_prop
          \l__siunitx_unit_tmp_tl {#4}
      }
  }
```

(*End definition for* `\__siunitx_unit_parse_add:nnnn`.)

`\__siunitx_unit_parse_prefix:Nn` `\__siunitx_unit_parse_power:nnN` `\__siunitx_unit_parse_qualifier:nn` `\__siunitx_unit_parse_special:n` Storage of the various optional items follows broadly the same pattern in each case. The data to be stored is passed along with an appropriate key name to the underlying storage system. The details for each type of item should be relatively clear. For example, prefixes have to come before their "parent" unit and so there is some adjustment to do to add them to the correct unit.

```
\cs_new_protected:Npn \__siunitx_unit_parse_prefix:Nn #1#2
  {
    \int_set:Nn \l__siunitx_unit_tmp_int { \l__siunitx_unit_position_int + 1 }
    \__siunitx_unit_parse_add:nnnn { prefix }
      { \int_use:N \l__siunitx_unit_tmp_int } {#1} {#2}
  }
\cs_new_protected:Npn \__siunitx_unit_parse_power:nnN #1#2#3
  {
    \tl_set:Nx \l__siunitx_unit_tmp_tl
      { unit- \int_use:N \l__siunitx_unit_position_int }
    \bool_lazy_or:nnTF
      {#3}
      {
        \prop_if_in_p:NV
          \l__siunitx_unit_parsed_prop \l__siunitx_unit_tmp_tl
      }
      {
        \__siunitx_unit_parse_add:nnnn { power }
          {
```

```
            \int_eval:n
              { \l__siunitx_unit_position_int \bool_if:NT #3 { + 1 } }
          }
          {#1} {#2}
      }
      {
        \msg_error:nnxx { siunitx }
          { unit / part-before-unit } { power } { \token_to_str:N #1 }
      }
  }
\cs_new_protected:Npn \__siunitx_unit_parse_qualifier:nn #1#2
  {
    \tl_set:Nx \l__siunitx_unit_tmp_tl
      { unit- \int_use:N \l__siunitx_unit_position_int }
    \prop_if_in:NVTF \l__siunitx_unit_parsed_prop \l__siunitx_unit_tmp_tl
      {
        \__siunitx_unit_parse_add:nnnn { qualifier }
          { \int_use:N \l__siunitx_unit_position_int } {#1} {#2}
      }
      {
        \msg_error:nnnn { siunitx }
          { unit / part-before-unit } { qualifier } { \token_to_str:N #1 }
      }
  }
```

Special (exceptional) items should always come before the relevant units.

```
\cs_new_protected:Npn \__siunitx_unit_parse_special:n #1
  {
    \__siunitx_unit_parse_add:nnnn { special }
      { \int_eval:n { \l__siunitx_unit_position_int + 1 } }
      {#1} {#1}
  }
```

(*End definition for* `\__siunitx_unit_parse_prefix:Nn` *and others.*)

`\__siunitx_unit_parse_unit:Nn`

Parsing units is slightly more involved than the other cases: this is the one place where the tracking value is incremented. If the switch `\l__siunitx_unit_per_bool` is set true then the current unit is also reciprocal: this can only happen if `\l__siunitx_unit_sticky_per_bool` is also true, so only one test is required.

```
\cs_new_protected:Npn \__siunitx_unit_parse_unit:Nn #1#2
  {
    \int_incr:N \l__siunitx_unit_position_int
    \tl_if_eq:nnT {#1} { \gram }
      {
        \__siunitx_unit_parse_add:nnnn { command }
          { \int_use:N \l__siunitx_unit_position_int }
          {#1} {#1}
      }
    \__siunitx_unit_parse_add:nnnn { unit }
      { \int_use:N \l__siunitx_unit_position_int }
      {#1} {#2}
    \bool_if:NT \l__siunitx_unit_per_bool
      {
        \__siunitx_unit_parse_add:nnnn { per }
```

```
          { \int_use:N \l__siunitx_unit_position_int }
          { \per } { true }
      }
  }
```

(*End definition for* `\__siunitx_unit_parse_unit:Nn`.)

`\__siunitx_unit_parse_per:` Storing the `\per` command requires adding a data item separate from the power which applies: this makes later formatting much more straight-forward. This data could in principle be combined with the `power`, but depending on the output format required that may make life more complex. Thus this information is stored separately for later retrieval. If `\per` is set to be "sticky" then after parsing the first occurrence, any further uses are in error.

```
\cs_new_protected:Npn \__siunitx_unit_parse_per:
  {
    \bool_if:NTF \l__siunitx_unit_sticky_per_bool
      {
        \bool_set_true:N \l__siunitx_unit_per_bool
        \cs_set_protected:Npn \per
          { \msg_error:nn { siunitx } { unit / duplicate-sticky-per } }
      }
      {
        \__siunitx_unit_parse_add:nnnn
          { per } { \int_eval:n { \l__siunitx_unit_position_int + 1 } }
          { \per } { true }
      }
  }
```

(*End definition for* `\__siunitx_unit_parse_per:`.)

`\__siunitx_unit_parse_finalise:n` If `\per` applies to the current unit, the power needs to be multiplied by -1. That is done using an `fp` operation so that non-integer powers are supported. The flag for `\per` is also removed as this means we don't have to check that the original power was positive. To be on the safe side, there is a check for a trivial power at this stage.

```
\cs_new_protected:Npn \__siunitx_unit_parse_finalise:n #1
  {
    \tl_set:Nx \l__siunitx_unit_tmp_tl { per- #1 }
    \prop_if_in:NVT \l__siunitx_unit_parsed_prop \l__siunitx_unit_tmp_tl
      {
        \prop_remove:NV \l__siunitx_unit_parsed_prop
          \l__siunitx_unit_tmp_tl
        \tl_set:Nx \l__siunitx_unit_tmp_tl { power- #1 }
        \prop_get:NVNTF
          \l__siunitx_unit_parsed_prop
          \l__siunitx_unit_tmp_tl
          \l__siunitx_unit_part_tl
          {
            \tl_set:Nx \l__siunitx_unit_part_tl
              { \fp_eval:n { \l__siunitx_unit_part_tl * -1 } }
            \fp_compare:nNnTF \l__siunitx_unit_part_tl = 1
              {
                \prop_remove:NV \l__siunitx_unit_parsed_prop
                  \l__siunitx_unit_tmp_tl
              }
```

```
            {
              \prop_put:NVV \l__siunitx_unit_parsed_prop
                \l__siunitx_unit_tmp_tl \l__siunitx_unit_part_tl
            }
        }
        {
          \prop_put:NVn \l__siunitx_unit_parsed_prop
            \l__siunitx_unit_tmp_tl { -1 }
        }
    }
}
```

(*End definition for* `\__siunitx_unit_parse_finalise:n`.)

`\__siunitx_unit_parse_finalise:` The final task is to check that there is not a "dangling" power or prefix: these are added to the "next" unit so are easy to test for.

```
\cs_new_protected:Npn \__siunitx_unit_parse_finalise:
  {
    \clist_map_inline:nn { per , power , prefix }
      {
        \tl_set:Nx \l__siunitx_unit_tmp_tl
          { ##1 - \int_eval:n { \l__siunitx_unit_position_int + 1 } }
        \prop_if_in:NVT \l__siunitx_unit_parsed_prop \l__siunitx_unit_tmp_tl
          { \msg_error:nnn { siunitx } { unit / dangling-part } { ##1 } }
      }
  }
```

(*End definition for* `\__siunitx_unit_parse_finalise:`.)

6.9 Formatting parsed units

`\l_siunitx_unit_fraction_tl` Set up the options which apply to formatting.

`\l__siunitx_unit_denominator_bracket_bool`
`\l__siunitx_unit_forbid_literal_bool`
`\l__siunitx_unit_parse_bool`
`\l__siunitx_unit_per_symbol_tl`
`\l__siunitx_unit_qualifier_mode_tl`
`\l__siunitx_unit_qualifier_phrase_tl`

```
\keys_define:nn { siunitx }
  {
    bracket-unit-denominator .bool_set:N =
      \l__siunitx_unit_denominator_bracket_bool ,
    forbid-literal-units .bool_set:N =
      \l__siunitx_unit_forbid_literal_bool ,
    fraction-command .tl_set:N =
      \l_siunitx_unit_fraction_tl ,
    parse-units .bool_set:N =
      \l__siunitx_unit_parse_bool ,
    per-mode .choice: ,
    per-mode / fraction .code:n =
      {
        \bool_set_false:N \l__siunitx_unit_autofrac_bool
        \bool_set_false:N \l__siunitx_unit_per_symbol_bool
        \bool_set_true:N  \l__siunitx_unit_powers_positive_bool
        \bool_set_true:N  \l__siunitx_unit_two_part_bool
      } ,
    per-mode / power .code:n =
      {
        \bool_set_false:N \l__siunitx_unit_autofrac_bool
        \bool_set_false:N \l__siunitx_unit_per_symbol_bool
```

```
        \bool_set_false:N \l__siunitx_unit_powers_positive_bool
        \bool_set_false:N \l__siunitx_unit_two_part_bool
      } ,
    per-mode / power-positive-first .code:n =
      {
        \bool_set_false:N \l__siunitx_unit_autofrac_bool
        \bool_set_false:N \l__siunitx_unit_per_symbol_bool
        \bool_set_false:N \l__siunitx_unit_powers_positive_bool
        \bool_set_true:N  \l__siunitx_unit_two_part_bool
      } ,
    per-mode / repeated-symbol .code:n =
      {
        \bool_set_false:N \l__siunitx_unit_autofrac_bool
        \bool_set_true:N  \l__siunitx_unit_per_symbol_bool
        \bool_set_true:N  \l__siunitx_unit_powers_positive_bool
        \bool_set_false:N \l__siunitx_unit_two_part_bool
      } ,
    per-mode / symbol .code:n =
      {
        \bool_set_false:N \l__siunitx_unit_autofrac_bool
        \bool_set_true:N  \l__siunitx_unit_per_symbol_bool
        \bool_set_true:N  \l__siunitx_unit_powers_positive_bool
        \bool_set_true:N  \l__siunitx_unit_two_part_bool
      } ,
    per-mode / symbol-or-fraction .code:n =
      {
        \bool_set_true:N \l__siunitx_unit_autofrac_bool
        \bool_set_true:N \l__siunitx_unit_per_symbol_bool
        \bool_set_true:N \l__siunitx_unit_powers_positive_bool
        \bool_set_true:N \l__siunitx_unit_two_part_bool
      } ,
    per-symbol .tl_set:N =
      \l__siunitx_unit_per_symbol_tl ,
    qualifier-mode .choices:nn =
      { bracket , combine , phrase , subscript }
      { \tl_set_eq:NN \l__siunitx_unit_qualifier_mode_tl \l_keys_choice_tl } ,
    qualifier-phrase .tl_set:N =
      \l__siunitx_unit_qualifier_phrase_tl
  }
```

(*End definition for* `\l_siunitx_unit_fraction_tl` *and others. This variable is documented on page* 145.)

`\l__siunitx_unit_bracket_bool` A flag to indicate that the unit currently under construction will require brackets if a power is added.

```
\bool_new:N \l__siunitx_unit_bracket_bool
```

(*End definition for* `\l__siunitx_unit_bracket_bool`.)

`\l__siunitx_unit_bracket_open_tl` `\l__siunitx_unit_bracket_close_tl` Abstracted out but currently purely internal.

```
\tl_new:N \l__siunitx_unit_bracket_open_tl
\tl_new:N \l__siunitx_unit_bracket_close_tl
\tl_set:Nn \l__siunitx_unit_bracket_open_tl { ( }
\tl_set:Nn \l__siunitx_unit_bracket_close_tl { ) }
```

(*End definition for* `\l__siunitx_unit_bracket_open_tl` *and* `\l__siunitx_unit_bracket_close_tl`.)

`\l__siunitx_unit_font_bool` A flag to control when font wrapping is applied to the output.

```
\bool_new:N \l__siunitx_unit_font_bool
```

(*End definition for* `\l__siunitx_unit_font_bool`.)

`\l__siunitx_unit_autofrac_bool` `\l__siunitx_unit_powers_positive_bool` `\l__siunitx_unit_per_symbol_bool` `\l__siunitx_unit_two_part_bool` Dealing with the various ways that reciprocal (`\per`) can be handled requires a few different switches.

```
\bool_new:N \l__siunitx_unit_autofrac_bool
\bool_new:N \l__siunitx_unit_per_symbol_bool
\bool_new:N \l__siunitx_unit_powers_positive_bool
\bool_new:N \l__siunitx_unit_two_part_bool
```

(*End definition for* `\l__siunitx_unit_autofrac_bool` *and others.*)

`\l__siunitx_unit_numerator_bool` Indicates that the current unit should go into the numerator when splitting into two parts (fractions or other "sorted" styles).

```
\bool_new:N \l__siunitx_unit_numerator_bool
```

(*End definition for* `\l__siunitx_unit_numerator_bool`.)

`\l__siunitx_unit_qualifier_mode_tl` For storing the text of options which are best handled by picking function names.

```
\tl_new:N \l__siunitx_unit_qualifier_mode_tl
```

(*End definition for* `\l__siunitx_unit_qualifier_mode_tl`.)

`\l__siunitx_unit_combine_exp_fp` For combining an exponent with the first unit.

```
\fp_new:N \l__siunitx_unit_combine_exp_fp
```

(*End definition for* `\l__siunitx_unit_combine_exp_fp`.)

`\l__siunitx_unit_prefix_exp_bool` Used to determine if prefixes are converted into powers. Note that while this may be set as an option "higher up", at this point it is handled as an internal switch (see the two formatting interfaces for reasons).

```
\bool_new:N \l__siunitx_unit_prefix_exp_bool
```

(*End definition for* `\l__siunitx_unit_prefix_exp_bool`.)

`\l__siunitx_unit_prefix_fp` When converting prefixes to powers, the calculations are done as an `fp`.

```
\fp_new:N \l__siunitx_unit_prefix_fp
```

(*End definition for* `\l__siunitx_unit_prefix_fp`.)

`\l__siunitx_unit_multiple_fp` For multiplying units.

```
\fp_new:N \l__siunitx_unit_multiple_fp
```

(*End definition for* `\l__siunitx_unit_multiple_fp`.)

`\l__siunitx_unit_current_tl` `\l__siunitx_unit_part_tl` Building up the (partial) formatted unit requires some token list storage. Each part of the unit combination that is recovered also has to be placed in a token list: this is a dedicated one to leave the scratch variables available.

```
\tl_new:N \l__siunitx_unit_current_tl
\tl_new:N \l__siunitx_unit_part_tl
```

(*End definition for* `\l__siunitx_unit_current_tl` *and* `\l__siunitx_unit_part_tl`.)

\l__siunitx_unit_denominator_tl

For fraction-like units, space is needed for the denominator as well as the numerator (which is handled using `\l__siunitx_unit_formatted_tl`).

```
\tl_new:N \l__siunitx_unit_denominator_tl
```

(*End definition for* `\l__siunitx_unit_denominator_tl`.)

\l__siunitx_unit_total_int

The formatting routine needs to know both the total number of units and the current unit. Thus an `int` is required in addition to `\l__siunitx_unit_position_int`.

```
\int_new:N \l__siunitx_unit_total_int
```

(*End definition for* `\l__siunitx_unit_total_int`.)

__siunitx_unit_format_parsed:
__siunitx_unit_format_parsed_aux:n

The main formatting routine is essentially a loop over each position, reading the various parts of the unit to build up complete unit combination.

```
\cs_new_protected:Npn \__siunitx_unit_format_parsed:
  {
    \int_set_eq:NN \l__siunitx_unit_total_int \l__siunitx_unit_position_int
    \tl_clear:N \l__siunitx_unit_denominator_tl
    \tl_clear:N \l__siunitx_unit_formatted_tl
    \fp_zero:N \l__siunitx_unit_prefix_fp
    \int_zero:N \l__siunitx_unit_position_int
    \fp_compare:nNnF \l__siunitx_unit_combine_exp_fp = \c_zero_fp
      { \__siunitx_unit_format_combine_exp: }
    \fp_compare:nNnF \l__siunitx_unit_multiple_fp = \c_one_fp
      { \__siunitx_unit_format_multiply: }
    \bool_lazy_and:nnT
      { \l__siunitx_unit_prefix_exp_bool }
      { \l__siunitx_unit_mass_kilogram_bool }
      { \__siunitx_unit_format_mass_to_kilogram: }
    \int_do_while:nNnn
      \l__siunitx_unit_position_int < \l__siunitx_unit_total_int
      {
        \bool_set_false:N \l__siunitx_unit_bracket_bool
        \tl_clear:N \l__siunitx_unit_current_tl
        \bool_set_false:N \l__siunitx_unit_font_bool
        \bool_set_true:N \l__siunitx_unit_numerator_bool
        \int_incr:N \l__siunitx_unit_position_int
        \clist_map_inline:nn { prefix , unit , qualifier , power , special }
          { \__siunitx_unit_format_parsed_aux:n {##1} }
        \__siunitx_unit_format_output:
      }
    \__siunitx_unit_format_finalise:
  }
\cs_new_protected:Npn \__siunitx_unit_format_parsed_aux:n #1
  {
    \tl_set:Nx \l__siunitx_unit_tmp_tl
      { #1 - \int_use:N \l__siunitx_unit_position_int }
    \prop_get:NVNT \l__siunitx_unit_parsed_prop
      \l__siunitx_unit_tmp_tl \l__siunitx_unit_part_tl
      { \use:c { __siunitx_unit_format_ #1 : } }
  }
```

(*End definition for* `\__siunitx_unit_format_parsed:` *and* `\__siunitx_unit_format_parsed_aux:n`.)

__siunitx_unit_format_combine_exp:

To combine an exponent into the first prefix, we first adjust for any power, then deal with any existing prefix, before looking up the final result.

```
\cs_new_protected:Npn \__siunitx_unit_format_combine_exp:
  {
    \prop_get:NnNF \l__siunitx_unit_parsed_prop { power-1 } \l__siunitx_unit_tmp_tl
      { \tl_set:Nn \l__siunitx_unit_tmp_tl { 1 } }
    \fp_set:Nn \l__siunitx_unit_tmp_fp
      { \l__siunitx_unit_combine_exp_fp / \l__siunitx_unit_tmp_tl }
    \prop_get:NnNTF \l__siunitx_unit_parsed_prop { prefix-1 } \l__siunitx_unit_tmp_tl
      {
        \prop_get:NVNF \l__siunitx_unit_prefixes_forward_prop
          \l__siunitx_unit_tmp_tl \l__siunitx_unit_tmp_tl
          {
            \prop_get:NnN \l__siunitx_unit_parsed_prop { prefix-1 } \l__siunitx_unit_tmp_tl
            \msg_error:nnx { siunitx } { unit / non-numeric-exponent }
              { \l__siunitx_unit_tmp_tl }
            \tl_set:Nn \l__siunitx_unit_tmp_tl { 0 }
          }
      }
      { \tl_set:Nn \l__siunitx_unit_tmp_tl { 0 } }
    \tl_set:Nx \l__siunitx_unit_tmp_tl
      { \fp_eval:n { \l__siunitx_unit_tmp_fp + \l__siunitx_unit_tmp_tl } }
    \fp_compare:nNnTF \l__siunitx_unit_tmp_tl = \c_zero_fp
      { \prop_remove:Nn \l__siunitx_unit_parsed_prop { prefix-1 } }
      {
        \prop_get:NVNTF \l__siunitx_unit_prefixes_reverse_prop
          \l__siunitx_unit_tmp_tl \l__siunitx_unit_tmp_tl
          { \prop_put:NnV \l__siunitx_unit_parsed_prop { prefix-1 } \l__siunitx_unit_tmp_tl }
          {
            \msg_error:nnx { siunitx } { unit / non-convertible-exponent }
              { \l__siunitx_unit_tmp_tl }
          }
      }
  }
```

(*End definition for* `\__siunitx_unit_format_combine_exp:`.)

__siunitx_unit_format_multiply:

A simple mapping.

```
\cs_new_protected:Npn \__siunitx_unit_format_multiply:
  {
    \int_step_inline:nn { \prop_count:N \l__siunitx_unit_parsed_prop  }
      {
        \prop_get:NnNF \l__siunitx_unit_parsed_prop { power- ##1 } \l__siunitx_unit_tmp_tl
          { \tl_set:Nn \l__siunitx_unit_tmp_tl { 1 } }
        \fp_set:Nn \l__siunitx_unit_tmp_fp
          { \l__siunitx_unit_tmp_tl * \l__siunitx_unit_multiple_fp }
        \fp_compare:nNnTF \l__siunitx_unit_tmp_fp = \c_one_fp
          { \prop_remove:N \l__siunitx_unit_parsed_prop { power- ##1 } }
          {
            \prop_put:Nnx \l__siunitx_unit_parsed_prop { power- ##1 }
              { \fp_use:N \l__siunitx_unit_tmp_fp }
          }
      }
  }
```

(*End definition for* `\__siunitx_unit_format_multiply:`.)

`\__siunitx_unit_format_mass_to_kilogram:` To deal correctly with prefix extraction in combination with kilograms, we need to coerce the prefix for grams. Currently, only this one special case is recorded in the property list, so we do not actually need to check the value. If there is then no prefix we do a bit of gymnastics to create one and then shift the starting point for the prefix extraction.

```
\cs_new_protected:Npn \__siunitx_unit_format_mass_to_kilogram:
  {
    \int_step_inline:nn \l__siunitx_unit_total_int
      {
        \prop_if_in:NnT \l__siunitx_unit_parsed_prop { command- ##1 }
          {
            \prop_if_in:NnF \l__siunitx_unit_parsed_prop { prefix- ##1 }
              {
                \group_begin:
                  \bool_set_false:N \l__siunitx_unit_parsing_bool
                  \tl_set:Nx \l__siunitx_unit_tmp_tl { \kilo }
                \exp_args:NNNV \group_end:
                \tl_set:Nn \l__siunitx_unit_tmp_tl \l__siunitx_unit_tmp_tl
                \prop_put:NnV \l__siunitx_unit_parsed_prop { prefix- ##1 }
                  \l__siunitx_unit_tmp_tl
                \prop_get:NnNF \l__siunitx_unit_parsed_prop { power- ##1 }
                  \l__siunitx_unit_tmp_tl
                  { \tl_set:Nn \l__siunitx_unit_tmp_tl { 1 } }
                \fp_set:Nn \l__siunitx_unit_prefix_fp
                  { \l__siunitx_unit_prefix_fp - 3 * \l__siunitx_unit_tmp_tl }
              }
          }
      }
  }
```

(*End definition for* `\__siunitx_unit_format_mass_to_kilogram:`.)

`\__siunitx_unit_format_bracket:N` A quick utility function which wraps up a token list variable in brackets if they are required.

```
\cs_new:Npn \__siunitx_unit_format_bracket:N #1
  {
    \bool_if:NTF \l__siunitx_unit_bracket_bool
      {
        \exp_not:V \l__siunitx_unit_bracket_open_tl
        \exp_not:V #1
        \exp_not:V \l__siunitx_unit_bracket_close_tl
      }
      { \exp_not:V #1 }
  }
```

(*End definition for* `\__siunitx_unit_format_bracket:N`.)

`\__siunitx_unit_format_power:`
`\__siunitx_unit_format_power_aux:wTF`
`\__siunitx_unit_format_power_positive:`
`\__siunitx_unit_format_power_negative:`
`\__siunitx_unit_format_power_negative_aux:w`
`\__siunitx_unit_format_power_superscript:`
Formatting powers requires a test for negative numbers and depending on output format requests some adjustment to the stored value. This could be done using an `fp` function, but that would be slow compared to a dedicated if lower-level approach based on delimited arguments.

```
\cs_new_protected:Npn \__siunitx_unit_format_power:
  {
```

```
    \__siunitx_unit_format_font:
    \exp_after:wN \__siunitx_unit_format_power_aux:wTF
      \l__siunitx_unit_part_tl - \q_stop
      { \__siunitx_unit_format_power_negative: }
      { \__siunitx_unit_format_power_positive: }
  }
\cs_new:Npn \__siunitx_unit_format_power_aux:wTF #1 - #2 \q_stop
  { \tl_if_empty:nTF {#1} }
```

In the case of positive powers, there is little to do: add the power as a subscript (must be required as the parser ensures it's $\neq 1$).

```
\cs_new_protected:Npn \__siunitx_unit_format_power_positive:
  { \__siunitx_unit_format_power_superscript: }
```

Dealing with negative powers starts by flipping the switch used to track where in the final output the current part should get added to. For the case where the output is fraction-like, strip off the `~` then ensure that the result is not the trivial power 1. Assuming all is well, addition to the current unit combination goes ahead.

```
\cs_new_protected:Npn \__siunitx_unit_format_power_negative:
  {
    \bool_set_false:N \l__siunitx_unit_numerator_bool
    \bool_if:NTF \l__siunitx_unit_powers_positive_bool
      {
        \tl_set:Nx \l__siunitx_unit_part_tl
          {
            \exp_after:wN \__siunitx_unit_format_power_negative_aux:w
              \l__siunitx_unit_part_tl \q_stop
          }
        \str_if_eq:VnF \l__siunitx_unit_part_tl { 1 }
          { \__siunitx_unit_format_power_superscript: }
      }
      { \__siunitx_unit_format_power_superscript: }
  }
\cs_new:Npn \__siunitx_unit_format_power_negative_aux:w - #1 \q_stop
  { \exp_not:n {#1} }
```

Adding the power as a superscript has the slight complication that there is the possibility of needing some brackets. The superscript itself uses `\sp` as that avoids any category code issues and also allows redirection at a higher level more readily.

```
\cs_new_protected:Npn \__siunitx_unit_format_power_superscript:
  {
    \exp_after:wN \__siunitx_unit_format_power_superscipt:w
      \l__siunitx_unit_part_tl . . \q_stop
  }
\cs_new_protected:Npn \__siunitx_unit_format_power_superscipt:w #1 . #2 . #3 \q_stop
  {
    \tl_if_blank:nTF {#2}
      {
        \tl_set:Nx \l__siunitx_unit_current_tl
          {
            \__siunitx_unit_format_bracket:N \l__siunitx_unit_current_tl
            ^ { \exp_not:n {#1} }
          }
      }
      {
```

```
        \tl_set:Nx \l__siunitx_unit_tmp_tl
          {
            { }
            \tl_if_head_eq_charcode:nNTF {#1} -
              { { - } { \exp_not:o { \use_none:n #1 } } }
              { { } { \exp_not:n {#1} } }
            {#2}
            { }
            { }
            { 0 }
          }
        \tl_set:Nx \l__siunitx_unit_current_tl
          {
            \__siunitx_unit_format_bracket:N \l__siunitx_unit_current_tl
            ^ { \siunitx_number_output:N \l__siunitx_unit_tmp_tl }
          }
      }
    \bool_set_false:N \l__siunitx_unit_bracket_bool
  }
```

(*End definition for* `\__siunitx_unit_format_power:` *and others.*)

`\__siunitx_unit_format_prefix:`
`\__siunitx_unit_format_prefix_exp:`
`\__siunitx_unit_format_prefix_gram:`
`\__siunitx_unit_format_prefix_symbol:`

Formatting for prefixes depends on whether they are to be expressed as symbols or collected up to be returned as a power of 10. The latter case requires a bit of processing, which includes checking that the conversion is possible and allowing for any power that applies to the current unit.

```
\cs_new_protected:Npn \__siunitx_unit_format_prefix:
  {
    \bool_if:NTF \l__siunitx_unit_prefix_exp_bool
      { \__siunitx_unit_format_prefix_exp: }
      { \__siunitx_unit_format_prefix_symbol: }
  }
\cs_new_protected:Npn \__siunitx_unit_format_prefix_exp:
  {
    \prop_get:NVNTF \l__siunitx_unit_prefixes_forward_prop
      \l__siunitx_unit_part_tl \l__siunitx_unit_part_tl
      {
        \bool_if:NT \l__siunitx_unit_mass_kilogram_bool
          {
            \tl_set:Nx \l__siunitx_unit_tmp_tl
              { command- \int_use:N \l__siunitx_unit_position_int }
            \prop_if_in:NVT \l__siunitx_unit_parsed_prop \l__siunitx_unit_tmp_tl
              { \__siunitx_unit_format_prefix_gram: }
          }
        \tl_set:Nx \l__siunitx_unit_tmp_tl
          { power- \int_use:N \l__siunitx_unit_position_int }
        \prop_get:NVNF \l__siunitx_unit_parsed_prop
          \l__siunitx_unit_tmp_tl \l__siunitx_unit_tmp_tl
          { \tl_set:Nn \l__siunitx_unit_tmp_tl { 1 } }
        \fp_add:Nn \l__siunitx_unit_prefix_fp
          { \l__siunitx_unit_tmp_tl * \l__siunitx_unit_part_tl }
      }
      { \__siunitx_unit_format_prefix_symbol: }
  }
```

When the units in use are grams, we may need to deal with conversion to kilograms.

```
\cs_new_protected:Npn \__siunitx_unit_format_prefix_gram:
  {
    \tl_set:Nx \l__siunitx_unit_part_tl
      { \int_eval:n { \l__siunitx_unit_part_tl - 3 } }
    \group_begin:
      \bool_set_false:N \l__siunitx_unit_parsing_bool
      \tl_set:Nx \l__siunitx_unit_current_tl { \kilo }
    \exp_args:NNNV \group_end:
    \tl_set:Nn \l__siunitx_unit_current_tl \l__siunitx_unit_current_tl
  }
\cs_new_protected:Npn \__siunitx_unit_format_prefix_symbol:
  { \tl_set_eq:NN \l__siunitx_unit_current_tl \l__siunitx_unit_part_tl }
```

(*End definition for* `\__siunitx_unit_format_prefix:` *and others.*)

`\__siunitx_unit_format_qualifier:`
`\__siunitx_unit_format_qualifier_bracket:`
`\__siunitx_unit_format_qualifier_combine:`
`\__siunitx_unit_format_qualifier_phrase:`
`\__siunitx_unit_format_qualifier_subscript:`

There are various ways that a qualifier can be added to the output. The idea here is to modify the "base" text appropriately and then add to the current unit. Notice that when the qualifier is just treated as "text", the auxiliary is actually a no-op.

```
\cs_new_protected:Npn \__siunitx_unit_format_qualifier:
  {
    \use:c
      {
        __siunitx_unit_format_qualifier_
        \l__siunitx_unit_qualifier_mode_tl :
      }
    \tl_put_right:NV \l__siunitx_unit_current_tl \l__siunitx_unit_part_tl
  }
\cs_new_protected:Npn \__siunitx_unit_format_qualifier_bracket:
  {
    \__siunitx_unit_format_font:
    \tl_set:Nx \l__siunitx_unit_part_tl
      {
        \exp_not:V \l__siunitx_unit_bracket_open_tl
        \exp_not:V \l_siunitx_unit_font_tl
          { \exp_not:V \l__siunitx_unit_part_tl }
        \exp_not:V \l__siunitx_unit_bracket_close_tl
      }
  }
\cs_new_protected:Npn \__siunitx_unit_format_qualifier_combine: { }
\cs_new_protected:Npn \__siunitx_unit_format_qualifier_phrase:
  {
    \__siunitx_unit_format_font:
    \tl_set:Nx \l__siunitx_unit_part_tl
      {
        \exp_not:V \l__siunitx_unit_qualifier_phrase_tl
        \exp_not:V \l_siunitx_unit_font_tl
          { \exp_not:V \l__siunitx_unit_part_tl }
      }
  }
\cs_new_protected:Npn \__siunitx_unit_format_qualifier_subscript:
  {
    \__siunitx_unit_format_font:
    \tl_set:Nx \l__siunitx_unit_part_tl
```

```
      {
        \c__siunitx_unit_math_subscript_tl
          {
            \exp_not:V \l_siunitx_unit_font_tl
              { \exp_not:V \l__siunitx_unit_part_tl }
          }
      }
  }
```

(*End definition for* `\__siunitx_unit_format_qualifier:` *and others.*)

`\__siunitx_unit_format_special:` Any special odds and ends are handled by simply making the current combination into an argument for the recovered code. Font control needs to be *inside* the special formatting here.

```
\cs_new_protected:Npn \__siunitx_unit_format_special:
  {
    \tl_set:Nx \l__siunitx_unit_current_tl
      {
        \exp_not:V \l__siunitx_unit_part_tl
         {
           \bool_if:NTF \l__siunitx_unit_font_bool
             { \use:n }
             { \exp_not:V \l_siunitx_unit_font_tl }
              { \exp_not:V \l__siunitx_unit_current_tl }
         }
      }
    \bool_set_true:N \l__siunitx_unit_font_bool
  }
```

(*End definition for* `\__siunitx_unit_format_special:`.)

`\__siunitx_unit_format_unit:` A very simple task: add the unit to the output currently being constructed.

```
\cs_new_protected:Npn \__siunitx_unit_format_unit:
  {
    \tl_put_right:NV
      \l__siunitx_unit_current_tl \l__siunitx_unit_part_tl
  }
```

(*End definition for* `\__siunitx_unit_format_unit:`.)

`\__siunitx_unit_format_output:`
`\__siunitx_unit_format_output_aux:`
`\__siunitx_unit_format_output_denominator:`
`\__siunitx_unit_format_output_aux:nn`
`\__siunitx_unit_format_output_aux:nV`
`\__siunitx_unit_format_output_aux:nv`

The first step here is to make a choice based on whether the current part should be stored as part of the numerator or denominator of a fraction. In all cases, if the switch `\l__siunitx_unit_numerator_bool` is true then life is simple: add the current part to the numerator with a standard separator

```
\cs_new_protected:Npn \__siunitx_unit_format_output:
  {
    \__siunitx_unit_format_font:
    \bool_set_false:N \l__siunitx_unit_bracket_bool
    \use:c
      {
        __siunitx_unit_format_output_
        \bool_if:NTF \l__siunitx_unit_numerator_bool
          { aux: }
          { denominator: }
```

```
      }
  }
\cs_new_protected:Npn \__siunitx_unit_format_output_aux:
  {
    \__siunitx_unit_format_output_aux:nV { formatted }
      \l__siunitx_unit_product_tl
  }
```

There are a few things to worry about at this stage if the current part is in the denominator. Powers have already been dealt with and some formatting outcomes only need a branch at the final point of building the entire unit. That means that there are three possible outcomes here: if collecting two separate parts, add to the denominator with a product separator, or if only building one token list there may be a need to use a symbol separator. When the `repeated-symbol` option is in use there may be a need to add a leading `1` to the output in the case where the first unit is in the denominator: that can be picked up by looking for empty output in combination with the flag for using a symbol in the output but not a two-part strategy.

```
\cs_new_protected:Npn \__siunitx_unit_format_output_denominator:
  {
    \bool_if:NTF \l__siunitx_unit_two_part_bool
      {
        \bool_lazy_and:nnT
          { \l__siunitx_unit_denominator_bracket_bool }
          { ! \tl_if_empty_p:N \l__siunitx_unit_denominator_tl }
          { \bool_set_true:N \l__siunitx_unit_bracket_bool }
        \__siunitx_unit_format_output_aux:nV { denominator }
          \l__siunitx_unit_product_tl
      }
      {
        \bool_lazy_and:nnT
          { \l__siunitx_unit_per_symbol_bool }
          { \tl_if_empty_p:N \l__siunitx_unit_formatted_tl }
          { \tl_set:Nn \l__siunitx_unit_formatted_tl { 1 } }
        \__siunitx_unit_format_output_aux:nv { formatted }
          {
            l__siunitx_unit_
            \bool_if:NTF \l__siunitx_unit_per_symbol_bool
              { per_symbol }
              { product }
            _tl
          }
      }
  }
\cs_new_protected:Npn \__siunitx_unit_format_output_aux:nn #1#2
  {
    \tl_set:cx { l__siunitx_unit_ #1 _tl }
      {
         \exp_not:v { l__siunitx_unit_ #1 _tl }
         \tl_if_empty:cF { l__siunitx_unit_ #1 _tl }
           { \exp_not:n {#2} }
         \exp_not:V \l__siunitx_unit_current_tl
      }
  }
\cs_generate_variant:Nn \__siunitx_unit_format_output_aux:nn { nV , nv }
```

(*End definition for* `\__siunitx_unit_format_output:` *and others.*)

`\__siunitx_unit_format_font:` A short auxiliary which checks if the font has been applied to the main part of the output: if not, add it and set the flag.

```
\cs_new_protected:Npn \__siunitx_unit_format_font:
  {
    \bool_if:NF \l__siunitx_unit_font_bool
      {
        \tl_set:Nx \l__siunitx_unit_current_tl
          {
            \exp_not:V \l_siunitx_unit_font_tl
              { \exp_not:V \l__siunitx_unit_current_tl }
          }
        \bool_set_true:N \l__siunitx_unit_font_bool
      }
  }
```

(*End definition for* `\__siunitx_unit_format_font:`.)

`\__siunitx_unit_format_finalise:` `\__siunitx_unit_format_finalise_autofrac:` `\__siunitx_unit_format_finalise_fractional:` `\__siunitx_unit_format_finalise_power:` Finalising the unit format is really about picking up the cases involving fractions: these require assembly of the parts with the need to add additional material in some cases

```
\cs_new_protected:Npn \__siunitx_unit_format_finalise:
  {
    \tl_if_empty:NF \l__siunitx_unit_denominator_tl
      {
        \bool_if:NTF \l__siunitx_unit_powers_positive_bool
          { \__siunitx_unit_format_finalise_fractional: }
          { \__siunitx_unit_format_finalise_power: }
      }
  }
```

For fraction-like output, there are three possible choices and two actual styles. In all cases, if the numerator is empty then it is set here to `1`. To deal with the "auto-format" case, the two styles (fraction and symbol) are handled in auxiliaries: this allows both to be used at the same time! Beyond that, the key here is to use a single `\tl_set:Nx` to keep down the number of assignments.

```
\cs_new_protected:Npn \__siunitx_unit_format_finalise_fractional:
  {
    \tl_if_empty:NT \l__siunitx_unit_formatted_tl
      { \tl_set:Nn \l__siunitx_unit_formatted_tl { 1 } }
    \bool_if:NTF \l__siunitx_unit_autofrac_bool
      { \__siunitx_unit_format_finalise_autofrac: }
      {
        \bool_if:NTF \l__siunitx_unit_per_symbol_bool
          { \__siunitx_unit_format_finalise_symbol: }
          { \__siunitx_unit_format_finalise_fraction: }
      }
  }
```

For the "auto-selected" fraction method, the two other auxiliary functions are used to do both forms of formatting. So that everything required is available, this needs one group so that the second auxiliary receives the correct input. After that it is just a case of applying `\mathchoice` to the formatted output.

```
\cs_new_protected:Npn \__siunitx_unit_format_finalise_autofrac:
```

```
  {
    \group_begin:
      \__siunitx_unit_format_finalise_fraction:
    \exp_args:NNNV \group_end:
    \tl_set:Nn \l__siunitx_unit_tmp_tl \l__siunitx_unit_formatted_tl
    \__siunitx_unit_format_finalise_symbol:
    \tl_set:Nx \l__siunitx_unit_formatted_tl
      {
        \mathchoice
          { \exp_not:V \l__siunitx_unit_tmp_tl }
          { \exp_not:V \l__siunitx_unit_formatted_tl }
          { \exp_not:V \l__siunitx_unit_formatted_tl }
          { \exp_not:V \l__siunitx_unit_formatted_tl }
      }
  }
```

When using a fraction function the two parts are now assembled.

```
\cs_new_protected:Npn \__siunitx_unit_format_finalise_fraction:
  {
    \tl_set:Nx \l__siunitx_unit_formatted_tl
      {
        \exp_not:V \l_siunitx_unit_fraction_tl
          { \exp_not:V \l__siunitx_unit_formatted_tl }
          { \exp_not:V \l__siunitx_unit_denominator_tl }
      }
  }
\cs_new_protected:Npn \__siunitx_unit_format_finalise_symbol:
  {
    \tl_set:Nx \l__siunitx_unit_formatted_tl
      {
        \exp_not:V \l__siunitx_unit_formatted_tl
        \exp_not:V \l__siunitx_unit_per_symbol_tl
        \__siunitx_unit_format_bracket:N \l__siunitx_unit_denominator_tl
      }
  }
```

In the case of sorted powers, there is a test to make sure there was at least one positive power, and if so a simple join of the two parts with the appropriate product.

```
\cs_new_protected:Npn \__siunitx_unit_format_finalise_power:
  {
    \tl_if_empty:NTF \l__siunitx_unit_formatted_tl
      {
        \tl_set_eq:NN
          \l__siunitx_unit_formatted_tl
          \l__siunitx_unit_denominator_tl
      }
      {
        \tl_set:Nx \l__siunitx_unit_formatted_tl
          {
            \exp_not:V \l__siunitx_unit_formatted_tl
            \exp_not:V \l__siunitx_unit_product_tl
            \exp_not:V \l__siunitx_unit_denominator_tl
          }
      }
  }
```

(*End definition for* `\__siunitx_unit_format_finalise:` *and others.*)

6.10 Non-Latin character support

`\__siunitx_unit_non_latin:n`
`\__siunitx_unit_non_latin:nnnn`

A small amount of code to make it convenient to include non-Latin characters in units without having to directly include them in the sources directly. We only make the first token active as some packages (*e.g.* kotex) do this.

```
\bool_lazy_or:nnTF
  { \sys_if_engine_luatex_p: }
  { \sys_if_engine_xetex_p: }
  {
    \cs_new:Npn \__siunitx_unit_non_latin:n #1
      { \char_generate:nn {#1} { \char_value_catcode:n {#1} } }
  }
  {
    \cs_new:Npn \__siunitx_unit_non_latin:n #1
      {
        \exp_last_unbraced:Nf \__siunitx_unit_non_latin:nnnn
          { \char_to_utfviii_bytes:n {#1} }
      }
    \cs_new:Npn \__siunitx_unit_non_latin:nnnn #1#2#3#4
      {
        \exp_after:wN \exp_after:wN \exp_after:wN
          \exp_not:N \char_generate:nn {#1} { 13 }
        \char_generate:nn {#2} { 12 }
      }
  }
```

(*End definition for* `\__siunitx_unit_non_latin:n` *and* `\__siunitx_unit_non_latin:nnnn`.)

6.11 Pre-defined unit components

Quite a number of units can be predefined: while this is a code-level module, there is little point having a unit parser which does not start off able to parse any units!

`\kilogram`
`\metre`
`\meter`
`\mole`
`\kelvin`
`\candela`
`\second`
`\ampere`

The basic SI units: technically the correct spelling is `\metre` but US users tend to use `\meter`.

```
\siunitx_declare_unit:Nn \kilogram { \kilo \gram }
\siunitx_declare_unit:Nn \metre    { m }
\siunitx_declare_unit:Nn \meter    { \metre }
\siunitx_declare_unit:Nn \mole     { mol }
\siunitx_declare_unit:Nn \second   { s }
\siunitx_declare_unit:Nn \ampere   { A }
\siunitx_declare_unit:Nn \kelvin   { K }
\siunitx_declare_unit:Nn \candela  { cd }
```

(*End definition for* `\kilogram` *and others. These functions are documented on page* 146.)

`\gram`

The gram is an odd unit as it is needed for the base unit kilogram.

```
\siunitx_declare_unit:Nn \gram { g }
```

(*End definition for* `\gram`. *This function is documented on page* 146.)

\yocto
\zepto
\atto
\femto
\pico
\nano
\micro
\milli
\centi
\deci

The various SI multiple prefixes are defined here: first the small ones.

```
\siunitx_declare_prefix:Nnn \yocto { -24 } { y }
\siunitx_declare_prefix:Nnn \zepto { -21 } { z }
\siunitx_declare_prefix:Nnn \atto  { -18 } { a }
\siunitx_declare_prefix:Nnn \femto { -15 } { f }
\siunitx_declare_prefix:Nnn \pico  { -12 } { p }
\siunitx_declare_prefix:Nnn \nano  {  -9 } { n }
\siunitx_declare_prefix:Nnx \micro { -6 } { \__siunitx_unit_non_latin:n { "03BC } }
\siunitx_declare_prefix:Nnn \milli { -3 } { m }
\siunitx_declare_prefix:Nnn \centi { -2 } { c }
\siunitx_declare_prefix:Nnn \deci  { -1 } { d }
```

(*End definition for* `\yocto` *and others. These functions are documented on page* 146.)

\deca
\deka
\hecto
\kilo
\mega
\giga
\tera
\peta
\exa
\zetta
\yotta

Now the large ones.

```
\siunitx_declare_prefix:Nnn \deca  { 1 }  { da }
\siunitx_declare_prefix:Nnn \deka  { 1 }  { da }
\siunitx_declare_prefix:Nnn \hecto { 2 }  { h }
\siunitx_declare_prefix:Nnn \kilo  { 3 }  { k }
\siunitx_declare_prefix:Nnn \mega  { 6 }  { M }
\siunitx_declare_prefix:Nnn \giga  { 9 }  { G }
\siunitx_declare_prefix:Nnn \tera  { 12 } { T }
\siunitx_declare_prefix:Nnn \peta  { 15 } { P }
\siunitx_declare_prefix:Nnn \exa   { 18 } { E }
\siunitx_declare_prefix:Nnn \zetta { 21 } { Z }
\siunitx_declare_prefix:Nnn \yotta { 24 } { Y }
```

(*End definition for* `\deca` *and others. These functions are documented on page* 146.)

\becquerel
\degreeCelsius
\coulomb
\farad
\gray
\hertz
\henry
\joule
\katal
\lumen
\lux

Named derived units: first half of alphabet.

```
\siunitx_declare_unit:Nn \becquerel { Bq }
\siunitx_declare_unit:Nx \degreeCelsius { \__siunitx_unit_non_latin:n { "00B0 } C }
\siunitx_declare_unit:Nn \coulomb   { C }
\siunitx_declare_unit:Nn \farad     { F }
\siunitx_declare_unit:Nn \gray      { Gy }
\siunitx_declare_unit:Nn \hertz     { Hz }
\siunitx_declare_unit:Nn \henry     { H }
\siunitx_declare_unit:Nn \joule     { J }
\siunitx_declare_unit:Nn \katal     { kat }
\siunitx_declare_unit:Nn \lumen     { lm }
\siunitx_declare_unit:Nn \lux       { lx }
```

(*End definition for* `\becquerel` *and others. These functions are documented on page* 147.)

\newton
\ohm
\pascal
\radian
\siemens
\sievert
\steradian
\tesla
\volt
\watt
\weber

Named derived units: second half of alphabet.

```
\siunitx_declare_unit:Nn \newton    { N }
\siunitx_declare_unit:Nx \ohm       { \__siunitx_unit_non_latin:n { "03A9 } }
\siunitx_declare_unit:Nn \pascal    { Pa }
\siunitx_declare_unit:Nn \radian    { rad }
\siunitx_declare_unit:Nn \siemens   { S }
\siunitx_declare_unit:Nn \sievert   { Sv }
\siunitx_declare_unit:Nn \steradian { sr }
\siunitx_declare_unit:Nn \tesla     { T }
\siunitx_declare_unit:Nn \volt      { V }
\siunitx_declare_unit:Nn \watt      { W }
\siunitx_declare_unit:Nn \weber     { Wb }
```

(*End definition for* `\newton` *and others. These functions are documented on page 147.*)

`\astronomicalunit` `\bel` `\dalton` `\day` `\decibel` `\electronvolt` `\hectare` `\hour` `\litre` `\liter` `\minute` `\neper` `\tonne`

Non-SI, but accepted for general use. Once again there are two spellings, here for litre and with different output in this case.

```
\siunitx_declare_unit:Nn \astronomicalunit { au }
\siunitx_declare_unit:Nn \bel              { B }
\siunitx_declare_unit:Nn \decibel          { \deci \bel }
\siunitx_declare_unit:Nn \dalton           { Da }
\siunitx_declare_unit:Nn \day              { d }
\siunitx_declare_unit:Nn \electronvolt     { eV }
\siunitx_declare_unit:Nn \hectare          { ha }
\siunitx_declare_unit:Nn \hour             { h }
\siunitx_declare_unit:Nn \litre            { L }
\siunitx_declare_unit:Nn \liter            { \litre }
\siunitx_declare_unit:Nn \minute           { min }
\siunitx_declare_unit:Nn \neper            { Np }
\siunitx_declare_unit:Nn \tonne            { t }
```

(*End definition for* `\astronomicalunit` *and others. These functions are documented on page 147.*)

`\arcminute` `\arcsecond` `\degree`

Arc units: again, non-SI, but accepted for general use.

```
\siunitx_declare_unit:Nx \arcminute { \__siunitx_unit_non_latin:n { "02B9 } }
\siunitx_declare_unit:Nx \arcsecond { \__siunitx_unit_non_latin:n { "02BA } }
\siunitx_declare_unit:Nx \degree { \__siunitx_unit_non_latin:n { "00B0 } }
```

(*End definition for* `\arcminute`, `\arcsecond`, *and* `\degree`. *These functions are documented on page 147.*)

`\percent`

For percent, the raw character is the most flexible way of handling output.

```
\siunitx_declare_unit:Nx \percent { \cs_to_str:N \% }
```

(*End definition for* `\percent`. *This function is documented on page 147.*)

`\square` `\squared` `\cubic` `\cubed`

Basic powers.

```
\siunitx_declare_power:NNn \square \squared { 2 }
\siunitx_declare_power:NNn \cubic  \cubed   { 3 }
```

(*End definition for* `\square` *and others. These functions are documented on page 147.*)

6.12 Messages

```
\msg_new:nnnn { siunitx } { unit / dangling-part }
  { Found~#1~part~with~no~unit. }
  {
    Each~#1~part~must~be~associated~with~a~unit:~a~#1~part~was~found~
    but~no~following~unit~was~given.
  }
\msg_new:nnnn { siunitx } { unit / duplicate-part }
  { Duplicate~#1~part:~#2. }
  {
    Each~unit~may~have~only~one~#1:\\
    the~additional~#1~part~'#2'~will~be~ignored.
  }
\msg_new:nnnn { siunitx } { unit / duplicate-sticky-per }
  { Duplicate~\token_to_str:N \per. }
```

```
  {
    When~the~'sticky-per'~option~is~active,~only~one~
    \token_to_str:N \per \  may~appear~in~a~unit.
  }
\msg_new:nnnn { siunitx } { unit / literal }
  { Literal~units~disabled. }
  {
    You~gave~the~literal~input~'#1'~
    but~literal~unit~output~is~disabled.
  }
\msg_new:nnnn { siunitx } { unit / non-convertible-exponent }
  { Exponent~'#1'~cannot~be~converted~into~a~symbolic~prefix. }
  {
    The~exponent~'#1'~does~not~match~with~any~of~the~symbolic~prefixes~
    set~up.
  }
\msg_new:nnnn { siunitx } { unit / non-numeric-exponent }
  { Prefix~'#1'~does~not~have~a~numerical~value. }
  {
    The~prefix~'#1'~needs~to~be~combined~with~a~number,~but~it~has~no
    numerical~value.
  }
\msg_new:nnnn { siunitx } { unit / part-before-unit }
  { Found~#1~part~before~first~unit:~#2. }
  {
    The~#1~part~'#2'~must~follow~after~a~unit:~
    it~cannot~appear~before~any~units~and~will~therefore~be~ignored.
  }
```

6.13 Standard settings for module options

Some of these follow naturally from the point of definition (*e.g.* boolean variables are always `false` to begin with), but for clarity everything is set here.

```
\keys_set:nn { siunitx }
  {
    bracket-unit-denominator  = true      ,
    forbid-literal-units      = false     ,
    fraction-command          = \frac     ,
    inter-unit-product        = \,        ,
    extract-mass-in-kilograms = true      ,
    parse-units               = true      ,
    per-mode                  = power     ,
    per-symbol                = /         ,
    qualifier-mode            = subscript ,
    qualifier-phrase          =           ,
    sticky-per                = false     ,
    unit-font-command         = \mathrm
  }
```

Cover the case where the default font is sanserif.

```
\AtBeginDocument
  {
    \str_if_eq:eeT
      { \exp_not:o { \familydefault } }
      { \exp_not:n { \sfdefault } }
```

```
    { \keys_set:nn { siunitx } { unit-font-command = \mathsf } }
  }
```
⟨/package⟩

References

[1] *The International System of Units (SI)*, https://www.bipm.org/en/measurement-units/.

[2] *SI base units*, https://www.bipm.org/en/measurement-units/si-base-units.

Part XI
siunitx-abbreviations – Abbreviatons

`\A` `\pA` `\nA` `\uA` `\mA` `\kA`

Abbreviations for currents.

`\fg` `\pg` `\ng` `\ug` `\mg` `\g` `\kg`

Abbreviations for masses.

`\K`

Abbreviations for temperature.

`\m` `\pm` `\nm` `\um` `\mm` `\cm` `\dm` `\km`

Abbreviations for lengths.

`\s` `\as` `\fs` `\ps` `\ns` `\us` `\ms`

Abbreviations for times.

`\Hz` `\mHz` `\kHz` `\MHz` `\GHz` `\THz`

Abbreviations for frequencies.

`\mol`
`\fmol`
`\pmol`
`\nmol`
`\umol`
`\mmol`
`\kmol`
	Abbreviations for moles.

`\V`
`\pV`
`\nV`
`\uV`
`\mV`
`\kV`
	Abbreviations for potentials.

`\hl`
`\l`
`\ml`
`\ul`
`\hL`
`\L`
`\mL`
`\uL`
	Abbreviations for volumes.

`\W`
`\uW`
`\mW`
`\kW`
`\MW`
`\GW`
	Abbreviations for powers.

`\kJ`
`\J`
`\mJ`
`\uJ`
`\eV`
`\meV`
`\keV`
`\MeV`
`\GeV`
`\TeV`
	Abbreviations for energies.

`\N`
`\mN`
`\kN`
`\MN`
	Abbreviations for forces.

\Pa
\kPa
\MPa
\GPa

Abbreviations for pressures.

\mohm
\kohm
\Mohm

Abbreviations for resistance.

\F
\fF
\pF
\nF
\uF

Abbreviations for capacitance.

\dB

Abbreviation for decibel.

\kWh

Abbreviation for kilowatt–hours.

1 siunitx-abbreviation implementation

Start the DocStrip guards.

```
1 ⟨*package⟩
```

The abbreviation file contains a number of short (mainly two or three letter) versions of the usual long names. They are divided up into related groups, mainly to avoid an overly long list in one place.

\A
\pA
\nA
\uA
\mA
\kA

Currents.

```
2 \siunitx_declare_unit:Nn \A  {        \ampere }
3 \siunitx_declare_unit:Nn \pA { \pico  \ampere }
4 \siunitx_declare_unit:Nn \nA { \nano  \ampere }
5 \siunitx_declare_unit:Nn \uA { \micro \ampere }
6 \siunitx_declare_unit:Nn \mA { \milli \ampere }
7 \siunitx_declare_unit:Nn \kA { \kilo  \ampere }
```

(*End definition for* `\A` *and others. These functions are documented on page* 183.)

\Hz
\mHz
\kHz
\MHz
\GHz
\THz

Then frequencies.

```
8 \siunitx_declare_unit:Nn \Hz  {        \hertz }
9 \siunitx_declare_unit:Nn \mHz { \milli \hertz }
10 \siunitx_declare_unit:Nn \kHz { \kilo  \hertz }
11 \siunitx_declare_unit:Nn \MHz { \mega  \hertz }
12 \siunitx_declare_unit:Nn \GHz { \giga  \hertz }
13 \siunitx_declare_unit:Nn \THz { \tera  \hertz }
```

(*End definition for* `\Hz` *and others. These functions are documented on page 183.*)

`\mol` `\fmol` `\pmol` `\nmol` `\umol` `\mmol` `\kmol`

Amounts of substance (moles).

```
\siunitx_declare_unit:Nn \mol  {        \mole }
\siunitx_declare_unit:Nn \fmol { \femto \mole }
\siunitx_declare_unit:Nn \pmol { \pico  \mole }
\siunitx_declare_unit:Nn \nmol { \nano  \mole }
\siunitx_declare_unit:Nn \umol { \micro \mole }
\siunitx_declare_unit:Nn \mmol { \milli \mole }
\siunitx_declare_unit:Nn \kmol { \kilo  \mole }
```

(*End definition for* `\mol` *and others. These functions are documented on page 184.*)

`\V` `\pV` `\nV` `\uV` `\mV` `\kV`

Potentials.

```
\siunitx_declare_unit:Nn \V  {        \volt }
\siunitx_declare_unit:Nn \pV { \pico  \volt }
\siunitx_declare_unit:Nn \nV { \nano  \volt }
\siunitx_declare_unit:Nn \uV { \micro \volt }
\siunitx_declare_unit:Nn \mV { \milli \volt }
\siunitx_declare_unit:Nn \kV { \kilo  \volt }
```

(*End definition for* `\V` *and others. These functions are documented on page 184.*)

`\hl` `\l` `\ml` `\ul` `\hL` `\L` `\mL` `\uL`

Volumes.

```
\siunitx_declare_unit:Nn \hl { \hecto \litre }
\siunitx_declare_unit:Nn \l  {        \litre }
\siunitx_declare_unit:Nn \ml { \milli \litre }
\siunitx_declare_unit:Nn \ul { \micro \litre }
\siunitx_declare_unit:Nn \hL { \hecto \liter }
\siunitx_declare_unit:Nn \L  {        \liter }
\siunitx_declare_unit:Nn \mL { \milli \liter }
\siunitx_declare_unit:Nn \uL { \micro \liter }
```

(*End definition for* `\hl` *and others. These functions are documented on page 184.*)

`\fg` `\pg` `\ng` `\ug` `\mg` `\g` `\kg`

Masses.

```
\siunitx_declare_unit:Nn \fg  { \femto \gram }
\siunitx_declare_unit:Nn \pg  { \pico  \gram }
\siunitx_declare_unit:Nn \ng  { \nano  \gram }
\siunitx_declare_unit:Nn \ug  { \micro \gram }
\siunitx_declare_unit:Nn \mg  { \milli \gram }
\siunitx_declare_unit:Nn \g   { \gram }
\siunitx_declare_unit:Nn \kg  { \kilo \gram }
```

(*End definition for* `\fg` *and others. These functions are documented on page 183.*)

`\W` `\uW` `\mW` `\kW` `\MW` `\GW` `\kJ` `\J` `\mJ` `\uJ` `\eV` `\meV` `\keV` `\MeV` `\GeV` `\TeV` `\kWh`

Energies and powers

```
\siunitx_declare_unit:Nn \W   {        \watt }
\siunitx_declare_unit:Nn \uW  { \micro \watt }
\siunitx_declare_unit:Nn \mW  { \milli \watt }
\siunitx_declare_unit:Nn \kW  { \kilo  \watt }
\siunitx_declare_unit:Nn \MW  { \mega  \watt }
\siunitx_declare_unit:Nn \GW  { \giga  \watt }
\siunitx_declare_unit:Nn \J   { \joule }
\siunitx_declare_unit:Nn \uJ  { \micro \joule }
```

```
\siunitx_declare_unit:Nn \mJ  { \milli \joule }
\siunitx_declare_unit:Nn \kJ  { \kilo \joule }
\siunitx_declare_unit:Nn \eV  { \electronvolt }
\siunitx_declare_unit:Nn \meV { \milli \electronvolt }
\siunitx_declare_unit:Nn \keV { \kilo  \electronvolt }
\siunitx_declare_unit:Nn \MeV { \mega  \electronvolt }
\siunitx_declare_unit:Nn \GeV { \giga  \electronvolt }
\siunitx_declare_unit:Nn \TeV { \tera  \electronvolt }
\siunitx_declare_unit:Nnn \kWh { \kilo \watt \hour }
  { inter-unit-product = }
```

(*End definition for* `\W` *and others. These functions are documented on page* 184.)

`\m` `\pm` `\nm` `\um` `\mm` `\cm` `\dm` `\km` Lengths.

```
\siunitx_declare_unit:Nn \m  {        \metre }
\siunitx_declare_unit:Nn \pm { \pico  \metre }
\siunitx_declare_unit:Nn \nm { \nano  \metre }
\siunitx_declare_unit:Nn \um { \micro \metre }
\siunitx_declare_unit:Nn \mm { \milli \metre }
\siunitx_declare_unit:Nn \cm { \centi \metre }
\siunitx_declare_unit:Nn \dm { \deci  \metre }
\siunitx_declare_unit:Nn \km { \kilo  \metre }
```

(*End definition for* `\m` *and others. These functions are documented on page* 183.)

`\K` Temperatures.

```
\siunitx_declare_unit:Nn \K { \kelvin }
```

(*End definition for* `\K`*. This function is documented on page* 183.)

`\dB`

```
\siunitx_declare_unit:Nn \dB { \deci \bel }
```

(*End definition for* `\dB`*. This function is documented on page* 185.)

`\F` `\fF` `\pF` `\nF` `\uF` Capacitance.

```
\siunitx_declare_unit:Nn \F  {        \farad }
\siunitx_declare_unit:Nn \fF { \femto \farad }
\siunitx_declare_unit:Nn \pF { \pico  \farad }
\siunitx_declare_unit:Nn \nF { \nano  \farad }
\siunitx_declare_unit:Nn \uF { \micro \farad }
```

(*End definition for* `\F` *and others. These functions are documented on page* 185.)

`\H` `\mH` `\uH` Capacitance.

```
\siunitx_declare_unit:Nn \H  {        \henry }
\siunitx_declare_unit:Nn \mH { \milli \henry }
\siunitx_declare_unit:Nn \uH { \micro \henry }
```

(*End definition for* `\H`*,* `\mH`*, and* `\uH`*. These functions are documented on page* **??**.)

`\N` `\mN` `\kN` `\MN` Forces.

```
\siunitx_declare_unit:Nn \N  {        \newton }
\siunitx_declare_unit:Nn \mN { \milli \newton }
\siunitx_declare_unit:Nn \kN { \kilo  \newton }
\siunitx_declare_unit:Nn \MN { \mega  \newton }
```

(*End definition for* `\N` *and others. These functions are documented on page 184.*)

`\Pa` `\kPa` `\MPa` `\GPa` Pressures.

```
\siunitx_declare_unit:Nn \Pa  {        \pascal }
\siunitx_declare_unit:Nn \kPa { \kilo  \pascal }
\siunitx_declare_unit:Nn \MPa { \mega  \pascal }
\siunitx_declare_unit:Nn \GPa { \giga  \pascal }
```

(*End definition for* `\Pa` *and others. These functions are documented on page 185.*)

`\mohm` `\kohm` `\Mohm` Resistances.

```
\siunitx_declare_unit:Nn \mohm { \milli \ohm }
\siunitx_declare_unit:Nn \kohm { \kilo  \ohm }
\siunitx_declare_unit:Nn \Mohm { \mega  \ohm }
```

(*End definition for* `\mohm`, `\kohm`, *and* `\Mohm`. *These functions are documented on page 185.*)

`\s` `\as` `\fs` `\ps` `\ns` `\us` `\ms` Finally, times.

```
\siunitx_declare_unit:Nn \s  { \second }
\siunitx_declare_unit:Nn \as { \atto  \second }
\siunitx_declare_unit:Nn \fs { \femto \second }
\siunitx_declare_unit:Nn \ps { \pico  \second }
\siunitx_declare_unit:Nn \ns { \nano  \second }
\siunitx_declare_unit:Nn \us { \micro \second }
\siunitx_declare_unit:Nn \ms { \milli \second }
```

(*End definition for* `\s` *and others. These functions are documented on page 183.*)

⟨/package⟩

Part XII
siunitx-binary – Binary units

This submodule provides binary units and prefixes. These are not formally part of the SI but are recommended by BIPM as units of information.

\kibi
\mebi
\gibi
\tebi
\pebi
\exbi
\zebi
\yobi

Prefixes, all of which are integer powers of 2: the powers are *not* stored or available for conversion.

\bit
\byte

Units for bits and bytes.

1 siunitx-binary implementation

Start the DocStrip guards.

```
1 ⟨*package⟩
```

\kibi
\mebi
\gibi
\tebi
\pebi
\exbi
\zebi
\yobi

All very simple.

```
2 \siunitx_declare_prefix:Nn \kibi { Ki }
3 \siunitx_declare_prefix:Nn \mebi { Mi }
4 \siunitx_declare_prefix:Nn \gibi { Gi }
5 \siunitx_declare_prefix:Nn \tebi { Ti }
6 \siunitx_declare_prefix:Nn \pebi { Pi }
7 \siunitx_declare_prefix:Nn \exbi { Ei }
8 \siunitx_declare_prefix:Nn \zebi { Zi }
9 \siunitx_declare_prefix:Nn \yobi { Yi }
```

(*End definition for* `\kibi` *and others. These functions are documented on page* 189.)

\bit
\byte

```
10 \siunitx_declare_unit:Nn \bit  { bit }
11 \siunitx_declare_unit:Nn \byte { B }
```

(*End definition for* `\bit` *and* `\byte`. *These functions are documented on page* 189.)

```
12 ⟨/package⟩
```

Part XIII
siunitx-command – Units as document command

This submodule provides support for creating free-standing document commands for unit macros.

1 Creating units as document commands

`\siunitx_command_create:` `\siunitx_command_create:`

Maps over the list of know unit commands and creates the appropriate document command to support them, as controlled by the options below.

1.1 Key–value options

The options defined by this submodule are available within the l3keys `siunitx` tree. These options are all preamble-only.

`free-standing-units` `free-standing-units = true|false`

Switch to determine whether free standing document commands are created for symbolic units. This will include not only units themselves but also prefixes, *etc.* The standard setting is `false`.

`overwrite-commands` `overwrite-commands = true|false`

Switch to determine whether when creating free standing document commands, any existing document commands are overwritten. The standard setting is `false`.

`space-before-unit` `space-before-unit = true|false`

Switch to determine whether a space is inserted before free standing document commands. The standard setting is `false`.

`unit-optional-argument` `unit-optional-argument = true|false`

Switch to determine whether free standing document commands take an optional argument (a number). The standard setting is `false`.

`use-xspace` `use-xspace = true|false`

Switch to determine whether free standing document commands use the xparse package to insert space after the command names. The standard setting is `false`. When set `true`, the xparse package will be loaded at the start of the document if not already available.

2 siunitx-command implementation

Start the DocStrip guards.

```
1 ⟨*package⟩
```

Identify the internal prefix (LaTeX3 DocStrip convention): only internal material in this *submodule* should be used directly.

```
2 ⟨@@=siunitx_command⟩
```

\l__siunitx_command_tmp_tl

```
3 \tl_new:N \l__siunitx_command_tmp_tl
```

(*End definition for* `\l__siunitx_command_tmp_tl`.)

2.1 Options

\l__siunitx_command_create_bool
\l__siunitx_command_overwrite_bool
\l__siunitx_command_prespace_bool
\l__siunitx_command_optarg_bool
\l__siunitx_command_xspace_bool

```
4  \keys_define:nn { siunitx }
5    {
6      free-standing-units .bool_set:N =
7        \l__siunitx_command_create_bool ,
8      overwrite-commands .bool_set:N =
9        \l__siunitx_command_overwrite_bool ,
10     space-before-unit .bool_set:N =
11       \l__siunitx_command_prespace_bool ,
12     unit-optional-argument .bool_set:N =
13       \l__siunitx_command_optarg_bool ,
14     use-xspace .bool_set:N =
15       \l__siunitx_command_xspace_bool
16   }
```

(*End definition for* `\l__siunitx_command_create_bool` *and others.*)

These preamble-only options are all disabled at the start of the document.

```
17 \AtBeginDocument
18   {
19     \clist_map_inline:nn
20       {
21         free-standing-units    ,
22         overwrite-commands     ,
23         space-before-unit      ,
24         unit-optional-argument ,
25         use-xspace
26       }
27       {
28         \keys_define:nn { siunitx }
29           {
30             #1 .code:n =
31               { \msg_warning:nnn { siunitx } { option-preamble-only } {#1} }
32           }
33       }
34   }
35 \msg_new:nnn { siunitx } { option-preamble-only }
36   { Option~'#1'~only~available~in~the~preamble. }
```

2.2 Creation of unit document commands

\siunitx_command_create:
__siunitx_command_create:
__siunitx_command_create:N

Creating document commands is all done by a single function which is set up using expansion: that way the tests are only run once. Other than that, this is all just a question of picking up all the various routes.

```
\cs_new_protected:Npn \siunitx_command_create:
  {
    \bool_if:NT \l__siunitx_command_create_bool
      { \__siunitx_command_create: }
```

At the beginning of table cells and inside x-type expansion, all symbolic units need to have *some* definition.

```
    \seq_map_inline:Nn \l_siunitx_unit_symbolic_seq
      {
        \cs_if_free:NT ##1
          { \cs_set_protected:Npn ##1 { \ERROR } }
      }
```

Where the soulpos package is loaded *after* siunitx, the commands `\hl` and `\ul` will be created only after the hook is used. The soul package creates those using `\newcommand`, so we have to avoid an issue.

```
    \@ifpackageloaded { soulpos }
      {
        \@ifpackageloaded { soul }
          { }
          {
            \cs_undefine:N \hl
            \cs_undefine:N \ul
          }
      }
      { }
  }
\AtBeginDocument { \siunitx_command_create: }
\cs_new_protected:Npn \__siunitx_command_create:
  {
    \bool_if:NT \l__siunitx_command_xspace_bool
      { \RequirePackage { xspace } }
    \bool_if:NT \l__siunitx_command_overwrite_bool
      {
        \seq_map_inline:Nn \l_siunitx_unit_symbolic_seq
          { \cs_undefine:N ##1 }
      }
    \cs_set_protected:Npx \__siunitx_command_create:N ##1
      {
        \ProvideDocumentCommand ##1 { \bool_if:NT \l__siunitx_command_optarg_bool { o } }
          {
            \mode_leave_vertical:
            \group_begin:
              \bool_if:NTF \l__siunitx_command_optarg_bool
                { \exp_not:N \IfNoValueTF {####1} }
                { \use_i:nn }
                {
                  \siunitx_unit_options_apply:n {##1}
                  \siunitx_unit_format:nN {##1}
```

```
                \exp_not:N \l__siunitx_command_tmp_tl
              \bool_if:NTF \l__siunitx_command_prespace_bool
                { \siunitx_quantity_print:nV { } }
                { \siunitx_print_unit:V }
                  \exp_not:N \l__siunitx_command_tmp_tl
            }
            { \siunitx_quantity:nn {####1} {##1} }
        \group_end:
        \bool_if:NT \l__siunitx_command_xspace_bool { \exp_not:N \xspace }
      }
  }
  \seq_map_function:NN \l_siunitx_unit_seq \__siunitx_command_create:N
}
\cs_new_protected:Npn \__siunitx_command_create:N #1 { }
```

(*End definition for* `\siunitx_command_create:` , `\__siunitx_command_create:` , *and* `\__siunitx_command_create:N`. *This function is documented on page* 190.)

2.3 Standard settings for module options

Some of these follow naturally from the point of definition (*e.g.* boolean variables are always `false` to begin with), but for clarity everything is set here.

```
\keys_set:nn { siunitx }
  {
    free-standing-units    = false ,
    overwrite-commands     = false ,
    space-before-unit      = false ,
    unit-optional-argument = false ,
    use-xspace             = false
  }
```

⟨/package⟩

Part XIV
siunitx-emulation – Emulation

1 siunitx-emulation implementation

Identify the internal prefix (LaTeX3 DocStrip convention). In contrast to other parts of the bundle, the functions here may need to redefine those from various submodules.

```
⟨@@=siunitx⟩
```

Start the DocStrip guards.

```
⟨*package⟩
⟨*options⟩
```

Some messages.

```
\msg_new:nnn { siunitx } { option-deprecated }
  {
    Option~"#1"~has~been~deprecated~in~this~release.\\ \\
    Use~"#2"~as~a~replacement.
  }
\msg_new:nnn { siunitx } { option-removed }
  { Option~"#1"~has~been~removed~in~this~release. }
```

__siunitx_option_deprecated:nn
__siunitx_option_deprecated:nnn
__siunitx_option_deprecated:nnV

Abstract out a simple wrapper.

```
\cs_new_protected:Npn \__siunitx_option_deprecated:nn #1#2
  {
    \msg_info:nnnn { siunitx } { option-deprecated } {#1} {#2}
    \keys_set:nn { siunitx } {#2}
  }
\cs_new_protected:Npn \__siunitx_option_deprecated:nnn #1#2#3
  {
    \msg_info:nnnn { siunitx } { option-deprecated } {#1} {#2}
    \keys_set:nn { siunitx } { #2 = #3 }
  }
\cs_generate_variant:Nn \__siunitx_option_deprecated:nnn { nnV }
```

(*End definition for* `\__siunitx_option_deprecated:nn` *and* `\__siunitx_option_deprecated:nnn`.)

__siunitx_option_removed:n
__siunitx_option_removed:V

Abstract out a simple wrapper.

```
\cs_new_protected:Npn \__siunitx_option_removed:n #1
  {
    \msg_warning:nnx { siunitx } { option-removed }
      {#1}
  }
\cs_generate_variant:Nn \__siunitx_option_removed:n { V }
```

(*End definition for* `\__siunitx_option_removed:n`.)

1.1 Load-time option

```
\clist_map_inline:nn
  {
    abbreviations           ,
    binary-units            ,
    load-configurations     ,
    version-1-compatibility
  }
  {
    \keys_define:nn { siunitx } { #1 .code:n = \__siunitx_option_removed:n {#1} }
  }
```

1.2 Angle options

All straight-forward emulation.

```
\keys_define:nn { siunitx }
  {
    add-arc-degree-zero .code:n =
      {
        \__siunitx_option_deprecated:nnV
          { add-arc-degree-zero }
          { fill-angle-degrees }
          \l_keys_value_tl
      } ,
    add-arc-degree-zero .default:n = true ,
    add-arc-minute-zero .code:n =
      {
        \__siunitx_option_deprecated:nnV
          { add-arc-minute-zero }
          { fill-angle-minutes }
          \l_keys_value_tl
      } ,
    add-arc-minute-zero .default:n = true ,
    add-arc-second-zero .code:n =
      {
        \__siunitx_option_deprecated:nnV
          { add-arc-second-zero }
          { fill-angle-seconds }
          \l_keys_value_tl
      } ,
    add-arc-second-zero .default:n = true ,
    arc-separator .code:n =
      {
        \__siunitx_option_deprecated:nnV
          { arc-separator }
          { angle-separator }
          \l_keys_value_tl
      }
  }
```

1.3 Combination functions options

```
\keys_define:nn { siunitx }
  {
```

```
    list-units / brackets .code:n =
      {
        \__siunitx_option_deprecated:nn
          { list-units~=~brackets }
          { list-units~=~bracket }
      } ,
    range-units / brackets .code:n =
      {
        \__siunitx_option_deprecated:nn
          { range-units~=~brackets }
          { range-units~=~bracket }
      } ,
    product-units / brackets .code:n =
      {
        \__siunitx_option_deprecated:nn
          { product-units~=~brackets }
          { product-units~=~bracket }
      }
  }
```

1.4 Command options

```
\keys_define:nn { siunitx }
  {
    overwrite-functions .code:n =
      {
        \__siunitx_option_deprecated:nnV
          { overwrite-functions }
          { overwrite-commands }
          \l_keys_value_tl
      } ,
    overwrite-functions .default:n = true
  }
```

1.5 Print options

```
\keys_define:nn { siunitx }
  {
    detect-all .code:n =
      {
        \__siunitx_option_deprecated:nn
          { detect-all }
          {
            mode~=~match , ~
            propagate-math-font~=~true , ~
            reset-math-version~=~false , ~
            reset-text-family~=~false , ~
            reset-text-series~=~false , ~
            text-family-to-math~=~true , ~
            text-series-to-math~=~true
          }
      } ,
    detect-family .code:n =
      {
        \__siunitx_option_deprecated:nn
          { detect-family }
```

```
          {
            reset-text-family~=~false , ~
            text-family-to-math~=~true
          }
      } ,
    detect-mode .code:n =
      {
        \__siunitx_option_deprecated:nn
          { detect-mode }
          { mode~=~match }
      } ,
    detect-none .code:n =
      {
        \__siunitx_option_deprecated:nn
          { detect-none }
          {
            mode~=~math , ~
            propagate-math-font~=~false , ~
            reset-math-version~=~true , ~
            reset-text-family~=~true , ~
            reset-text-series~=~true , ~
            text-family-to-math~=~false , ~
            text-series-to-math~=~false
          }
      } ,
    detect-shape .code:n =
      {
        \__siunitx_option_deprecated:nn
          { detect-shape }
          { reset-text-shape~=~false }
      } ,
    detect-weight .code:n =
      {
        \__siunitx_option_deprecated:nn
          { detect-weight }
          {
            reset-text-series~=~false , ~
            text-series-to-math~=~true
          }
      }
  }
\clist_map_inline:nn
  {
    detect-display-math  ,
    detect-inline-family ,
    detect-inline-weight
  }
  {
    \keys_define:nn { siunitx } { #1 .code:n = \__siunitx_option_removed:n {#1} }
  }
```

The old font insertion options.

```
\clist_map_inline:nn
  {
    math-rm        ,
```

```
    math-sf        ,
    math-tt        ,
    number-math-rm ,
    number-math-sf ,
    number-math-tt ,
    number-text-rm ,
    number-text-sf ,
    number-text-tt ,
    text-rm        ,
    text-sf        ,
    text-tt        ,
    unit-math-rm   ,
    unit-math-sf   ,
    unit-math-tt   ,
    unit-text-rm   ,
    unit-text-sf   ,
    unit-text-tt
  }
  {
    \keys_define:nn { siunitx } { #1 .code:n = \__siunitx_option_removed:n {#1} }
  }
```

1.6 Symbol options

```
\clist_map_inline:nn
  {
    math-angstrom  ,
    math-arcminute ,
    math-arcsecond ,
    math-celsius   ,
    math-degree    ,
    math-micro     ,
    math-ohm       ,
    text-angstrom  ,
    text-arcminute ,
    text-arcsecond ,
    text-celsius   ,
    text-degree    ,
    text-micro     ,
    text-ohm       ,
  }
  {
    \keys_define:nn { siunitx } { #1 .code:n = \__siunitx_option_removed:n {#1} }
  }
```

1.7 Number options

```
\keys_define:nn { siunitx }
  {
    group-digits / false .code:n =
      {
        \__siunitx_option_deprecated:nn
          { group-digits ~ = ~ false }
          { group-digits ~ = ~ none }
      } ,
    group-digits / true .code:n =
```

```
      {
        \__siunitx_option_deprecated:nn
          { group-digits ~ = ~ true }
          { group-digits ~ = ~ all }
      } ,
    input-symbols .code:n =
      {
        \msg_info:nnnn { siunitx } { option-deprecated }
          { input-symbols } { input-digits }
        \tl_put_right:Nn \l__siunitx_number_input_digit_tl {#1}
      } ,
    separate-uncertainty .choice: ,
    separate-uncertainty / false .code:n =
      {
        \__siunitx_option_deprecated:nn
          { separate-uncertainty }
          { uncertainty-mode~=~compact }
      } ,
    separate-uncertainty / true .code:n =
      {
        \__siunitx_option_deprecated:nn
          { separate-uncertainty }
          { uncertainty-mode~=~separate }
      } ,
    separate-uncertainty .default:n = true
  }
```

A small number of removed options.

```
\clist_map_inline:nn
  {
    input-protect-tokens ,
    input-quotient       ,
    output-product       ,
    quotient-mode
  }
  {
    \keys_define:nn { siunitx } { #1 .code:n = \__siunitx_option_removed:n {#1} }
  }
```

Options for number processing: largely removals.

```
\keys_define:nn { siunitx }
  {
    add-decimal-zero .choice: ,
    add-decimal-zero / false .code:n =
      {
        \__siunitx_option_deprecated:nn
          { add-decimal-zero }
          { minimum-decimal-digits~=~0 }
      } ,
    add-decimal-zero / true .code:n =
      {
        \__siunitx_option_deprecated:nn
          { add-decimal-zero }
          { minimum-decimal-digits~=~1 }
      } ,
```

```
    add-decimal-zero .default:n = true ,
    add-integer-zero .code:n =
      { \__siunitx_option_removed:V \l_keys_key_tl } ,
    close-bracket .code:n =
      { \__siunitx_option_removed:V \l_keys_key_tl } ,
    bracket-numbers .choice: ,
    bracket-numbers / false .code:n =
      {
        \__siunitx_option_deprecated:nn
          { bracket-numbers }
          { bracket-ambiguous-numbers~=~false }
      } ,
    bracket-numbers / true .code:n =
      {
        \__siunitx_option_deprecated:nn
          { bracket-numbers }
          { bracket-ambiguous-numbers~=~true }
      } ,
    bracket-numbers .default:n = true ,
    explicit-sign .code:n =
      {
        \str_if_eq:nnTF {#1} { + }
          {
            \__siunitx_option_deprecated:nn
              { explicit-sign }
              { print-implicit-plus~=~true  }
          }
          { \__siunitx_option_removed:V \l_keys_key_tl }
      } ,
    group-four-digits .choice: ,
    group-four-digits / false .code:n =
      {
        \__siunitx_option_deprecated:nn
          { group-four-digits~=~false }
          { group-minimum-digits~=~5 }
      } ,
    group-four-digits / true .code:n =
      {
        \__siunitx_option_deprecated:nn
          { group-four-digits~=~false }
          { group-minimum-digits~=~4 }
      } ,
    bracket-numbers .default:n = true ,
    omit-uncertainty .code:n =
      {
        \__siunitx_option_deprecated:nnV
          { omit-uncertainty }
          { drop-uncertainty }
          \l_keys_value_tl
      } ,
    omit-uncertainty .default:n = true ,
    open-bracket .code:n =
      { \__siunitx_option_removed:V \l_keys_key_tl } ,
    retain-unity-mantissa .code:n =
```

```
    {
      \__siunitx_option_deprecated:nnV
        { retain-unity-mantissa }
        { print-unity-mantissa }
        \l_keys_value_tl
    } ,
  retain-unity-mantissa .default:n = true ,
  retain-zero-exponent .code:n =
    {
      \__siunitx_option_deprecated:nnV
        { retain-zero-exponent }
        { print-zero-exponent }
        \l_keys_value_tl
    } ,
  retain-zero-exponent .default:n = true ,
  round-integer-to-decimal .code:n =
    { \__siunitx_option_removed:V \l_keys_key_tl } ,
  scientific-notation .choice: ,
  scientific-notation / engineering .code:n =
    {
      \__siunitx_option_deprecated:nn
        { scientific-notation~=~engineering }
        { exponent-mode~=~engineering }
    } ,
  scientific-notation / fixed .code:n =
    {
      \__siunitx_option_deprecated:nn
        { scientific-notation~=~fixed }
        { exponent-mode~=~fixed }
    } ,
  scientific-notation / false .code:n =
    {
      \__siunitx_option_deprecated:nn
        { scientific-notation~=~false }
        { exponent-mode~=~input }
    } ,
  scientific-notation / true .code:n =
    {
      \__siunitx_option_deprecated:nn
        { scientific-notation~=~true }
        { exponent-mode~=~scientific }
    } ,
  scientific-notation .default:n = true ,
  zero-decimal-to-integer .code:n =
    {
      \__siunitx_option_deprecated:nnV
        { zero-decimal-to-integer }
        { drop-zero-decimal }
        \l_keys_value_tl
    } ,
  zero-decimal-to-integer .default:n = true
}
```

1.7.1 Table options

All straight-forward emulation.

```
\keys_define:nn { siunitx }
  {
    table-align-text-post .code:n =
      {
        \__siunitx_option_deprecated:nnV
          { table-align-text-post }
          { table-align-text-after }
          \l_keys_value_tl
      } ,
    table-align-text-post .default:n = true ,
    table-align-text-pre .code:n =
      {
        \__siunitx_option_deprecated:nnV
          { table-align-text-pre }
          { table-align-text-before }
          \l_keys_value_tl
      } ,
    table-align-text-pre .default:n = true ,
    table-number-alignment / center-decimal-marker .code:n =
      {
        \msg_info:nnnn { siunitx } { option-deprecated }
          { table-number-alignment~=~center-decimal-marker }
          { table-alignment-mode~=~marker }
        \keys_set:nn
          { siunitx }
          { table-alignment-mode = marker }
      } ,
    table-omit-exponent .code:n =
      {
        \__siunitx_option_deprecated:nnV
          { table-omit-exponent }
          { drop-exponent }
          \l_keys_value_tl
      } ,
    table-omit-exponent .default:n = true ,
    table-parse-only .code:n =
      {
        \msg_info:nnnn { siunitx } { option-deprecated }
          { table-parse-only }
          { table-alignment-mode~=~none }
        \str_if_eq:VnTF \l_keys_value_tl { false }
          {
            \keys_set:nn
              { siunitx }
              { table-alignment-mode = marker }
          }
          {
            \keys_set:nn
              { siunitx }
              { table-alignment-mode = none }
          }
```

```
      } ,
    table-space-text-post .code:n =
      {
        \msg_info:nnnn { siunitx } { option-deprecated }
          { table-space-text-post }
          { table-format }
        \tl_set:Nn \l__siunitx_table_after_model_tl {#1}
      } ,
    table-space-text-pre .code:n =
      {
        \msg_info:nnnn { siunitx } { option-deprecated }
          { table-space-text-post }
          { table-format }
        \tl_set:Nn \l__siunitx_table_before_model_tl {#1}
      }
  }

\__siunitx_option_table_format:n
\__siunitx_option_table_comparator:nnnnnnnn
unitx_option_table_figures-decimal:nnnnnnnn
nitx_option_table_figures-exponent:nnnnnnnn
unitx_option_table_figures-integer:nnnnnnnn
x_option_table_figures-uncertainty:nnnnnnnn
siunitx_option_table_sign-exponent:nnnnnnnn
siunitx_option_table_sign-mantissa:nnnnnnnn
\cs_new_protected:Npn \__siunitx_option_table_format:n #1
  {
    \msg_info:nnnn { siunitx } { option-deprecated }
      { table- #1 }
      { table-format }
    \tl_set:Nx \l__siunitx_table_format_tl
      {
        \cs:w __siunitx_option_table_ #1 :nnnnnnnn
          \exp_after:wN \exp_after:wN \exp_after:wN \cs_end:
          \exp_after:wN \l__siunitx_table_format_tl
          \exp_after:wN { \l_keys_value_tl }
      }
    \exp_after:wN \__siunitx_table_generate_model:nnnnnnn
      \l__siunitx_table_format_tl
  }
\cs_new:Npn \__siunitx_option_table_comparator:nnnnnnnn #1#2#3#4#5#6#7#8
  { \exp_not:n { {#8} {#2} {#3} {#4} {#5} {#6} {#7} } }
\cs_new:cpn { __siunitx_option_table_figures-decimal:nnnnnnnn }
  #1#2#3#4#5#6#7#8
  { \exp_not:n { {#1} {#2} {#3} {#8} {#5} {#6} {#7} } }
\cs_new:cpn { __siunitx_option_table_figures-exponent:nnnnnnnn }
  #1#2#3#4#5#6#7#8
  { \exp_not:n { {#1} {#2} {#3} {#4} {#5} {#6} {#8} } }
\cs_new:cpn { __siunitx_option_table_figures-integer:nnnnnnnn }
  #1#2#3#4#5#6#7#8
  { \exp_not:n { {#1} {#2} {#8} {#4} {#5} {#6} {#7} } }
\cs_new:cpn { __siunitx_option_table_figures-uncertainty:nnnnnnnn }
  #1#2#3#4#5#6#7#8
  { \exp_not:n { {#1} {#2} {#3} {#4} { { S } {#8} } {#6} {#7} } }
\cs_new:cpn { __siunitx_option_table_sign-exponent:nnnnnnnn }
  #1#2#3#4#5#6#7#8
  { \exp_not:n { {#1} {#2} {#3} {#4} {#5} {#8} {#7} } }
\cs_new:cpn { __siunitx_option_table_sign-mantissa:nnnnnnnn }
  #1#2#3#4#5#6#7#8
  { \exp_not:n { {#1} {#8} {#3} {#4} {#5} {#6} {#7} } }
```

(*End definition for* `\__siunitx_option_table_format:n` *and others.*)

Options which all use the same emulation set up.

```
\keys_define:nn { siunitx }
  {
    table-comparator .code:n =
      { \__siunitx_option_table_format:n { comparator } } ,
    table-figures-decimal .code:n =
      { \__siunitx_option_table_format:n { figures-decimal } } ,
    table-figures-exponent .code:n =
      { \__siunitx_option_table_format:n { figures-exponent } } ,
    table-figures-integer .code:n =
      { \__siunitx_option_table_format:n { figures-integer } } ,
    table-figures-uncertainty .code:n =
      { \__siunitx_option_table_format:n { figures-uncertainty } } ,
    table-sign-exponent .code:n =
      { \__siunitx_option_table_format:n { sign-exponent } } ,
    table-sign-mantissa .code:n =
      { \__siunitx_option_table_format:n { sign-mantissa } }
  }
```

1.8 Unit options

```
\keys_define:nn { siunitx }
  {
    fraction-function .code:n =
      {
        \__siunitx_option_deprecated:nnV
          { fraction-function }
          { fraction-command }
          \l_keys_value_tl
      } ,
    literal-superscript-as-power .code:n =
      { \__siunitx_option_removed:V \l_keys_key_tl } ,
    per-mode / reciprocal .code:n =
      {
        \__siunitx_option_deprecated:nn
          { per-mode~=~reciprocal }
          { per-mode~=~power }
      } ,
    per-mode / reciprocal-positive-first .code:n =
      {
        \__siunitx_option_deprecated:nn
          { per-mode~=~reciprocal-positive-first }
          { per-mode~=~power-positive-first }
      } ,
    power-font .code:n =
      { \__siunitx_option_removed:V \l_keys_key_tl } ,
    qualifier-mode / brackets .code:n =
      {
        \__siunitx_option_deprecated:nn
          { qualifier-mode~=~brackets }
          { qualifier-mode~=~bracket }
      } ,
    qualifier-mode / space .code:n =
      {
```

```
      \msg_info:nnnn { siunitx } { option-deprecated }
        { qualifier-mode~=~space }
        { qualifier-mode~=~phrase"~plus~"qualifier-phrase=\  }
      \keys_set:nn
        { siunitx }
        { qualifier-mode = phrase, qualifier-phrase = \  }
    } ,
  qualifier-mode / text .code:n =
    {
      \__siunitx_option_deprecated:nn
        { qualifier-mode~=~text }
        { qualifier-mode~=~combine }
    }
}
```

1.9 Quantity units

```
\keys_define:nn { siunitx }
  {
    allow-number-unit-breaks .code:n =
      {
        \__siunitx_option_deprecated:nnV
          { allow-number-unit-breaks  }
          { allow-quantity-breaks }
          \l_keys_value_tl
      } ,
    allow-number-unit-breaks .default:n = true ,
    exponent-to-prefix .choice: ,
    exponent-to-prefix / false .code:n =
      {
        \__siunitx_option_deprecated:nn
          { exponent-to-prefix~=~false }
          { prefix-mode~=~input }
      } ,
    exponent-to-prefix / true .code:n =
      {
        \__siunitx_option_deprecated:nn
          { exponent-to-prefix~=~true }
          { prefix-mode~=~combine-exponent }
      } ,
    exponent-to-prefix .default:n = true ,
    multi-part-units .choice: ,
    multi-part-units / brackets . code:n =
      {
        \__siunitx_option_deprecated:nn
          { multi-part-units~=~brackets }
          { separate-uncertainty-units~=~bracket }
      } ,
    multi-part-units / repeat . code:n =
      {
        \__siunitx_option_deprecated:nn
          { multi-part-units~=~repeat }
          { separate-uncertainty-units~=~repeat }
      } ,
    multi-part-units / single . code:n =
```

```
      {
        \__siunitx_option_deprecated:nn
          { multi-part-units~=~single }
          { separate-uncertainty-units~=~single }
      } ,
    number-unit-product .code:n =
      {
        \__siunitx_option_deprecated:nnV
          { number-unit-product }
          { quantity-product }
          \l_keys_value_tl
      } ,
    number-unit-separator .code:n =
      {
        \__siunitx_option_deprecated:nnV
          { number-unit-separator }
          { quantity-product }
          \l_keys_value_tl
      } ,
    prefixes-as-symbols .choice: ,
    prefixes-as-symbols / false . code:n =
      {
        \__siunitx_option_deprecated:nn
          { prefixes-as-symbols~=~false }
          { prefix-mode~=~extract-exponent }
      } ,
    prefixes-as-symbols / true . code:n =
      {
        \__siunitx_option_deprecated:nn
          { prefixes-as-symbols~=~true }
          { prefix-mode~=~input }
      } ,
    prefixes-as-symbols .default:n = true
  }
```

⟨/options⟩

1.10 Preamble commands

⟨*interfaces⟩

\DeclareBinaryPrefix We simply drop #3.

```
\NewDocumentCommand \DeclareBinaryPrefix { +m m m }
  {
    \siunitx_declare_prefix:Nn #1 {#2}
  }
```

(*End definition for* \DeclareBinaryPrefix*. This function is documented on page* ??.)

\DeclareSIPrePower
\DeclareSIPostPower Simply use a throw-away command for the part we do not need: this can be followed by some clean-up.

```
\NewDocumentCommand \DeclareSIPrePower { +m m }
  {
    \siunitx_declare_power:NNn #1 \__siunitx_tmp:w {#2}
    \seq_remove_all:Nn \l_siunitx_unit_symbolic_seq { \__siunitx_tmp:w }
  }
```

```
\NewDocumentCommand \DeclareSIPostPower { +m m }
  {
    \siunitx_declare_power:NNn \__siunitx_tmp:w #1 {#2}
    \seq_remove_all:Nn \l_siunitx_unit_symbolic_seq { \__siunitx_tmp:w }
  }
```

(*End definition for* `\DeclareSIPrePower` *and* `\DeclareSIPostPower`*. These functions are documented on page* ??.)

1.11 Document commands

`\si` A straight copy of `\unit`.

```
\NewDocumentCommand \si { O { } m }
  {
    \mode_leave_vertical:
    \group_begin:
      \keys_set:nn { siunitx } {#1}
      \siunitx_unit_format:nN {#2} \l__siunitx_tmp_tl
      \siunitx_print_unit:V \l__siunitx_tmp_tl
    \group_end:
  }
```

(*End definition for* `\si`*. This function is documented on page* ??.)

`\SI` Almost the same as `\qty`, but with the addition pre-unit.

```
\NewDocumentCommand \SI { O { } m o m }
  {
    \mode_leave_vertical:
    \group_begin:
      \keys_set:nn { siunitx } {#1}
      \IfNoValueF {#3}
        {
          \siunitx_unit_format:nN {#3} \l__siunitx_tmp_tl
          \siunitx_print_unit:V \l__siunitx_tmp_tl
          \nobreak
        }
      \siunitx_quantity:nn {#2} {#4}
    \group_end:
  }
```

(*End definition for* `\SI`*. This function is documented on page* ??.)

`\SIlist` `\SIrange` Straight copies.

```
\NewDocumentCommand \SIlist
  { O { } > { \SplitList { ; } } m > { \TrimSpaces } m }
  {
    \mode_leave_vertical:
    \group_begin:
      \siunitx_unit_options_apply:n {#3}
      \keys_set:nn { siunitx } {#1}
      \siunitx_quantity_list:nn {#2} {#3}
    \group_end:
  }
\NewDocumentCommand \SIrange { O { } m m > { \TrimSpaces } m }
```

```
  {
    \mode_leave_vertical:
    \group_begin:
      \siunitx_unit_options_apply:n {#4}
      \keys_set:nn { siunitx } {#1}
      \siunitx_quantity_range:nnn {#2} {#3} {#4}
    \group_end:
  }
```

(*End definition for* `\SIlist` *and* `\SIrange`*. These functions are documented on page* **??**.)

1.12 Symbol commands

⟨@@=siunitx_emulation⟩

`\__siunitx_emulation_non_latin:n`
`\__siunitx_emulation_non_latin:nnnn`

As in siunitx-unit, but internal in both cases as it's rather specialised.

```
\bool_lazy_or:nnTF
  { \sys_if_engine_luatex_p: }
  { \sys_if_engine_xetex_p: }
  {
    \cs_new:Npn \__siunitx_emulation_non_latin:n #1
      { \char_generate:nn {#1} { \char_value_catcode:n {#1} } }
  }
  {
    \cs_new:Npn \__siunitx_emulation_non_latin:n #1
      {
        \exp_last_unbraced:Nf \__siunitx_emulation_non_latin:nnnn
          { \char_to_utfviii_bytes:n {#1} }
      }
    \cs_new:Npn \__siunitx_emulation_non_latin:nnnn #1#2#3#4
      {
        \exp_after:wN \exp_after:wN \exp_after:wN
          \exp_not:N \char_generate:nn {#1} { 13 }
        \exp_after:wN \exp_after:wN \exp_after:wN
          \exp_not:N \char_generate:nn {#2} { 13 }
      }
  }
```

(*End definition for* `\__siunitx_emulation_non_latin:n` *and* `\__siunitx_emulation_non_latin:nnnn`.)

`\SIUnitSymbolAngstrom`
`\SIUnitSymbolArcminute`
`\SIUnitSymbolArcsecond`
`\SIUnitSymbolCelsius`
`\SIUnitSymbolDegree`
`\SIUnitSymbolMicro`
`\SIUnitSymbolOhm`

The same setup as elsewhere but localised to the emulation module

```
\AtBeginDocument
  {
    \cs_new_protected:Npn \SIUnitSymbolArcminute
       { \ensuremath { { } ' } }
    \cs_new_protected:Npn \SIUnitSymbolArcsecond
       { \ensuremath { { } '' } }
    \@ifpackageloaded { fontspec }
      {
        \cs_new_protected:Npx \SIUnitSymbolAngstrom
           { \__siunitx_emulation_non_latin:n { "00C5 } }
        \cs_new_protected:Npx \SIUnitSymbolDegree
           { \__siunitx_emulation_non_latin:n { "00B0 } }
        \cs_new_protected:Npx \SIUnitSymbolCelsius
           { \__siunitx_emulation_non_latin:n { "00B0 } C }
```

```
    }
    {
      \cs_new_protected:Npx \SIUnitSymbolAngstrom
        {
          \siunitx_print_text:n
            { \__siunitx_emulation_non_latin:n { "00C5 } }
        }
      \cs_new_protected:Npx \SIUnitSymbolCelsius
        {
          \siunitx_print_text:n
            { \__siunitx_emulation_non_latin:n { "00B0 } } C
        }
      \cs_new_protected:Npx \SIUnitSymbolDegree
        {
          \siunitx_print_text:n
            { \__siunitx_emulation_non_latin:n { "00B0 } }
        }
    }
  \cs_new_protected:Npx \SIUnitSymbolMicro
     {
        \siunitx_print_text:n
          {
            \bool_lazy_or:nnTF
              { \sys_if_engine_luatex_p: }
              { \sys_if_engine_xetex_p: }
              { \__siunitx_emulation_non_latin:n { "00B5 } }
              { \exp_not:N \textmu }
          }
     }
  \cs_new_protected:Npx \SIUnitSymbolOhm
     {
        \exp_not:N \ifmmode
          \cs_if_exist:NTF \upOmega
            { \exp_not:N \upOmega }
            { \exp_not:N \Omega }
        \exp_not:N \else
          \siunitx_print_text:n
            {
              \bool_lazy_or:nnTF
                { \sys_if_engine_luatex_p: }
                { \sys_if_engine_xetex_p: }
                { \__siunitx_emulation_non_latin:n { "03A9 } }
                { \exp_not:N \textohm }
            }
        \exp_not:N \fi
     }
}
```

(*End definition for* `\SIUnitSymbolAngstrom` *and others. These functions are documented on page* **??**.)

1.13 Unit commands

`\celsius` Deprecated but should work.

```
\siunitx_declare_unit:Nn \celsius { \degreeCelsius }
```

(*End definition for* `\celsius`. *This function is documented on page* ??.)

Units that have been removed: to avoid issues, we mark them as deprecated.

```
\msg_new:nnn { siunitx } { unit-deprecated }
  {
    Unit~macro~#1~has~been~deprecated~in~this~release. \\ \\
    The~BIPM~have~removed~this~unit~from~the~SI~Brochure.~
    You~should~define~it~yourself~using~\token_to_str:N \DeclareSIUnit\ %
    in~your~source.~The~current~definition~is\\ \\
    \token_to_str:N \DeclareSIUnit #1 \{ #2 \}
  }
\cs_gset_protected:Npn \__siunitx_emulation_tmp:w #1#2
  {
    \quark_if_recursion_tail_stop:N #1
    \bool_new:c { g__siunitx_emulation_unit_warning_ \token_to_str:N #1 _bool }
    \siunitx_declare_unit:Nx #1
      {
        \exp_not:N \bool_if:NF
          \exp_not:c { g__siunitx_emulation_unit_warning_ \token_to_str:N #1 _bool  }
          {
            \exp_not:N \bool_gset_true:N
              \exp_not:c { g__siunitx_emulation_unit_warning_ \token_to_str:N #1 _bool  }
            \msg_warning:nnnn { siunitx } { unit-deprecated }
              { \token_to_str:N #1 } {#2}
          }
        #2
      }
    \__siunitx_emulation_tmp:w
  }
\__siunitx_emulation_tmp:w
  \atomicmassunit   { u }
  \bar              { bar }
  \barn             { b }
  \bohr
    {
      \exp_not:N \text
        { \exp_not:N \ensuremath { a } } \char_generate:nn { `\_ } { 8 } { 0 }
    }
  \clight
    {
      \exp_not:N \text
        { \exp_not:N \ensuremath { c } } \char_generate:nn { `\_ } { 8 } { 0 }
    }
  \electronmass
    {
      \exp_not:N \text { \exp_not:N \ensuremath { m } }
      \char_generate:nn { `\_ } { 8 } { \exp_not:N \mathrm { e } }
    }
  \elementarycharge { \text { \ensuremath { e } } }
  \hartree
    {
      \exp_not:N \text { \exp_not:N \ensuremath { E } }
      \char_generate:nn { `\_ } { 8 } { \exp_not:N \mathrm { h } }
    }
  \knot             { kn }
```

```
  \mmHg             { mmHg }
  \nauticalmile     { M }
  \planckbar
    { \exp_not:N \text { \exp_not:N \ensuremath { \exp_not:N \hbar } } }
  \q_recursion_tail { }
  \q_recursion_stop
\@ifpackageloaded { fontspec }
  {
    \__siunitx_emulation_tmp:w \angstrom { \__siunitx_emulation_non_latin:n { "00C5 } }
  }
  {
    \__siunitx_emulation_tmp:w \angstrom
      { \exp_not:N \text { \__siunitx_emulation_non_latin:n { "00C5 } } }
  }
  \q_recursion_tail { }
  \q_recursion_stop
```

1.14 Communication with **pgf**

```
⟨@@=siunitx_number⟩
```

\SendSettingsToPgf

```
\NewDocumentCommand \SendSettingsToPgf { }
  {
    \use:x
      {
        \exp_not:N \pgfqkeys { /pgf/number~format }
          {
            \str_if_eq:VnT \l__siunitx_number_round_mode_tl { figures }
              {
                fixed ,
                fixed~zerofill = true ,
              }
            precision = \int_use:N \l__siunitx_number_round_precision_int ,
            set~decimal~separator =
              \str_if_eq:VnTF \l_siunitx_number_output_decimal_tl { , }
                { \exp_not:N \mathord }
                { \use:n }
                  { \exp_not:V \l_siunitx_number_output_decimal_tl } ,
            set~thousands~separator =
            set~decimal~separator =
              \str_if_eq:VnTF \l__siunitx_number_group_separator_tl { , }
                { \exp_not:N \mathord }
                { \use:n }
                  { \exp_not:V \l__siunitx_number_group_separator_tl } ,
            min~exponent~for~1000~sep =
              \int_eval:n { \l__siunitx_number_group_minimum_int - 1 } ,
            \bool_lazy_or:nnF
              { \l__siunitx_number_group_decimal_bool }
              { \l__siunitx_number_group_integer_bool }
              { min~exponent~for~1000~sep = 999 , }
            showpos =
              \bool_if:NTF \l__siunitx_number_implicit_plus_bool
                { true }
```

```
                    { false }
                }
            }
        }
```

(*End definition for* `\SendSettingsToPgf`. *This function is documented on page* **??**.)

⟨/interfaces⟩

⟨/package⟩

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