

## Modul:Val

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This module implements **Vorlage:TI**.

The following modules are developed:

- **Module:Val** • Main module.
- **Module:Val/units** • Definitions for units built-in to val.

Use **Vorlage:TI** for testing, for example:

- `{{val/sandbox|1234.5678|(23)|u=cm}}` → **Vorlage:Val/sandbox**
- `{{val/sandbox|1234.5678|1.23|u=cm}}` → **Vorlage:Val/sandbox**
- `{{val/sandbox|1234.5678|1.23|4.56|u=cm}}` → **Vorlage:Val/sandbox**
- `{{val/sandbox|1234.5678|e=3|u=cm}}` → **Vorlage:Val/sandbox**
- `{{val/sandbox|1234.5678|(23)|e=3|u=cm}}` → **Vorlage:Val/sandbox**
- `{{val/sandbox|1234.5678|1.23|e=3|u=cm}}` → **Vorlage:Val/sandbox**
- `{{val/sandbox|1234.5678|1.23|4.56|e=3|u=cm}}` → **Vorlage:Val/sandbox**
- `{{val/sandbox|1234.5678|1.23|4.56|e=3|u=cm|end=$|+errend=U$|-errend=L$}}` → **Vorlage:Val/sandbox**
- `{{val/sandbox|1234.5678|(23)|u=deg}}` → **Vorlage:Val/sandbox**
- `{{val/sandbox|1234.5678|1.23|u=deg}}` → **Vorlage:Val/sandbox**
- `{{val/sandbox|1234.5678|1.23|4.56|u=deg}}` → **Vorlage:Val/sandbox**
- `{{val/sandbox|1234.5678|e=3|u=deg}}` → **Vorlage:Val/sandbox**
- `{{val/sandbox|1234.5678|(23)|e=3|u=deg}}` → **Vorlage:Val/sandbox**
- `{{val/sandbox|1234.5678|1.23|e=3|u=deg}}` → **Vorlage:Val/sandbox**
- `{{val/sandbox|1234.5678|1.23|4.56|e=3|u=deg}}` → **Vorlage:Val/sandbox**
- `{{val/sandbox|1234.5678|1.23|4.56|e=3|u=deg|end=$|+errend=U$|-errend=L$}}` → **Vorlage:Val/sandbox**

```
-- For Template:Val, output a number and optional unit.
-- Format options include scientific and uncertainty notations.

local data_module = 'Module:Val/units'
local convert_module = 'Module:Convert'

local function valerror(msg, nocat, iswarning)
    -- Return formatted message text for an error or warning.
    -- Can append "#FormattingError" to URL of a page with a problem to find
    local anchor = '<span id="FormattingError"></span>'
    local body, category
    if nocat or mw.title.getCurrentTitle():inNamespaces(1, 2, 3, 5) then
        -- No category in Talk, User, User_talk, or Wikipedia_talk.
        category = ''
    else
        category = '[[Category:Pages with incorrect formatting templates
    end
    iswarning = false -- problems are infrequent so try showing large error
    if iswarning then
```

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        body = '<sup class="noprint Inline-Template" style="white-space:
              '[[Template:Val|<span title="" ..
              msg:gsub('"', '&quot;') ..
              '">warning</span>]]</sup>'
    else
        body = '<strong class="error">' ..
              'Error in &#123;&#123;[[Template:val|val]]&#125;&#125;:
              msg ..
              '</strong>'
    end
    return anchor .. body .. category
end

local range_types = {
    -- No need for '&nbsp;-' because nowrap applies to all output.
    [","] = ", ",
    ["by"] = " by ",
    ["-"] = "- ",
    ["-"] = "- ",
    ["and"] = " and ",
    ["or"] = " or ",
    ["to"] = " to ",
    ["x"] = " x ",
    ["x"] = " x ",
    ["/"] = "/ ",
}
local range_repeat_unit = {
    -- WP:UNIT wants unit repeated when a "multiply" range is used.
    ["x"] = true,
    ["x"] = true,
}

local function extract_item(index, numbers, arg)
    -- Extract an item from arg and store the result in numbers[index].
    -- If no argument or if argument is valid, return nil (no error);
    -- otherwise, return an error message.
    -- The stored result is:
    -- * a table for a number (empty if there was no specified number); or
    -- * a string for range text
    -- Input like 1e3 is regarded as invalid for all except argument 1
    -- which accepts e notation as an alternative to the 'e' argument.
    -- Input commas are removed so 1,234 is the same as 1234.
    local which = index
    local function fail(msg)
        local description
        if which == 'e' then
            description = 'exponent parameter (<b>e</b>)'
        else
            description = 'parameter ' .. which
        end
        return description .. ' ' .. (msg or 'is not a valid number') ..
    end
    local result = {}
    local range = range_types[arg]
    if range then
        if type(index) == 'number' and (index % 2 == 0) then
            if index == 2 then
                if numbers[1] and numbers[1].exp then
                    return fail('cannot use a range if the f
                end
                numbers.has_ranges = true
            else
                if not numbers.has_ranges then
                    return fail('needs a range in parameter 2

```

```

        end
        end
        numbers[index] = range
        if range_repeat_unit[arg] then
            -- Any "repeat" range forces unit (if any) to be
            numbers.isrepeat = true
        end
        return nil
    end
    return fail('does not accept a range')
end
if numbers.has_ranges and type(index) == 'number' and (index % 2 == 0) then
    return fail('should be a range')
end
if index == 'e' then
    local e = numbers[1] and numbers[1].exp
    if e then
        if arg then
            return fail('cannot be used if the first parameter is e')
        end
        arg = e
        which = 1
    end
end
if arg and arg ~= '' then
    arg = arg:gsub(',', '')
    if arg:sub(1, 1) == '(' and arg:sub(-1) == ')' then
        result.parens = true
        arg = arg:sub(2, -2)
    end
    local a, b = arg:match('^(.+)[Ee](.+)$')
    if a then
        if index == 1 then
            arg = a
        else
            result.exp = b
        end
        return fail('cannot use e notation')
    end
end
local isnegative, propersign, prefix
local minus = '-'
prefix, arg = arg:match('^(-)([d.]+)$')
local value = tonumber(arg)
if not value then
    return fail()
end
if arg:sub(1, 1) == '.' then
    arg = '0' .. arg
end
if prefix == '' then
    -- Ignore.
elseif prefix == '±' then
    -- Display for first number, ignore for others.
    if index == 1 then
        propersign = '±'
    end
elseif prefix == '+' then
    propersign = '+'
elseif prefix == '-' or prefix == minus then
    propersign = minus
    isnegative = true
else
    return fail()
end
```

```
        result.clean = arg
        result.sign = propersign or ''
        result.value = isnegative and -value or value
    end
    numbers[index] = result
    return nil -- no error
end

local function get_args(numbers, args)
    -- Extract arguments and store the results in numbers.
    -- Return nothing (no error) if ok; otherwise, return an error message.
    for index = 1, 99 do
        local which = index
        local arg = args[which] -- has been trimmed
        if not arg then
            which = 'e'
            arg = args[which]
        end
        local msg = extract_item(which, numbers, arg)
        if msg then
            return msg
        end
        if which == 'e' then
            break
        end
        if index > 19 then
            return 'too many parameters'
        end
    end
    if numbers.has_ranges and (#numbers % 2 == 0) then
        return 'need a number after the last parameter because it is a range'
    end
end

local function get_scale(text, ucode)
    -- Return the value of text as a number, or throw an error.
    -- This supports extremely basic expressions of the form:
    --   a / b
    --   a ^ b
    -- where a and b are numbers or 'pi'.
    local n = tonumber(text)
    if n then
        return n
    end
    n = text:gsub('pi', math.pi)
    for _, op in ipairs({'/', '^'}) do
        local a, b = n:match('^(-?)' .. op .. '(.*)$')
        if a then
            a = tonumber(a)
            b = tonumber(b)
            if a and b then
                if op == '/' then
                    return a / b
                elseif op == '^' then
                    return a ^ b
                end
            end
            break
        end
    end
    error('Unit "' .. ucode .. '" has invalid scale "' .. text .. '"')
end

local function get_built_in_unit(ucode, definitions)
```

```
-- Return table of information for the specified built-in unit, or nil if
-- Each defined unit code must be followed by two spaces (not tab charact
local _, pos = definitions:find('\n' .. ucode .. ' ', 1, true)
if pos then
    local endline = definitions:find('%s*\n', pos)
    if endline then
        local result = {}
        local n = 0
        local text = definitions:sub(pos + 1, endline - 1):gsub(
        for item in (text .. '\t'):gmatch('(%.S.-)\t') do
            if item == 'ALIAS' then
                result.alias = true
            elseif item == 'ANGLE' then
                result.isangle = true
                result.nospace = true
            elseif item == 'NOSPACE' then
                result.nospace = true
            elseif item == 'SI' then
                result.si = true
            else
                n = n + 1
                if n == 1 then
                    local link, symbol = item:match(
                    if link then
                        result.symbol = symbol
                        result.link = link
                        n = 2
                    else
                        result.symbol = item
                    end
                elseif n == 2 then
                    result.link = item
                elseif n == 3 then
                    result.scale_text = item
                    result.scale = get_scale(item, uc
                else
                    result.more_ignored = item
                    break
                end
            end
        end
        if result.si then
            local s = result.symbol
            if ucode == 'mc' .. s or ucode == 'mu' .. s then
                result.unicode = 'μ' .. s -- unit code for
            end
        end
        if n >= 2 or (n >= 1 and result.alias) then
            return result
        end
        -- Ignore invalid definition, treating it as a comment.
    end
end
end

local function convert_lookup(unicode, value, scaled_top, want_link, si, options)
    local lookup = require(convert_module)._unit
    return lookup(unicode, {
        value = value,
        scaled_top = scaled_top,
        link = want_link,
        si = si,
        sort = options.sortable,
    })
end
```

```
end

local function get_unit(ucode, value, scaled_top, options)
    local want_link = options.want_link
    if scaled_top then
        want_link = options.want_per_link
    end
    local data = mw.loadData(data_module)
    local result = options.want_longscale and
        get_builtin_unit(ucode, data.builtin_units_long_scale) or
        get_builtin_unit(ucode, data.builtin_units)
    local si, use_convert
    if result then
        if result.alias then
            ucode = result.symbol
            use_convert = true
        end
        if result.scale then
            -- Setting si means convert will use the unit as given, a
            -- will be calculated from the value without any extra se
            -- occur if convert found the unit code. For example, if
            -- unit 'year' with a scale and if si were not set, conve
            -- its own scale because convert knows that a year is 31
            si = { result.symbol, result.link }
            value = value * result.scale
        end
        if result.si then
            ucode = result.ucode or ucode
            si = { result.symbol, result.link }
            use_convert = true
        end
    end
    else
        result = {}
        use_convert = true
    end
    local convert_unit = convert_lookup(ucode, value, scaled_top, want_link,
    result.sortkey = convert_unit.sortspan
    if use_convert then
        result.text = convert_unit.text
        result.scaled_top = convert_unit.scaled_value
    else
        if want_link then
            result.text = '[' .. result.link .. ']' .. result.symbol
        else
            result.text = result.symbol
        end
        result.scaled_top = value
    end
    return result
end

local function makeunit(value, options)
    -- Return table of information for the requested unit and options, or
    -- return nil if no unit.
    options = options or {}
    local unit
    local ucode = options.u
    local percode = options.per
    if ucode then
        unit = get_unit(ucode, value, nil, options)
    elseif percode then
        unit = { nospace = true, scaled_top = value }
    else
        return nil
    end
end
```

```
end
local text = unit.text or ''
local sortkey = unit.sortkey
if percode then
    local function bracketed(code, text)
        return code:find('[*./]') and '(' .. text .. ')' or text
    end
    local perunit = get_unit(percode, 1, unit.scaled_top, options)
    text = (ucode and bracketed(ucode, text) or '') ..
        '/' .. bracketed(percode, perunit.text)
    sortkey = perunit.sortkey
end
if not (unit.nospace or options.nospace) then
    text = '&nbsp;' .. text
end
return { text = text, isangle = unit.isangle, sortkey = sortkey }
end

local function list_units(mode)
    -- Return wikitext to list the built-in units.
    -- A unit code should not contain wikimarkup so don't bother escaping.
    local data = mw.loadData(data_module)
    local definitions = data.builtin_units .. data.builtin_units_long_scale
    local last_was_blank = true
    local n = 0
    local result = {}
    local function add(line)
        if line == '' then
            last_was_blank = true
        else
            if last_was_blank and n > 0 then
                n = n + 1
                result[n] = ''
            end
            last_was_blank = false
            n = n + 1
            result[n] = line
        end
    end
end

local si_prefixes = {
    -- These are the prefixes recognized by convert; u is accepted for
    y = 'y',
    z = 'z',
    a = 'a',
    f = 'f',
    p = 'p',
    n = 'n',
    u = 'μ',
    ['μ'] = 'μ',
    m = 'm',
    c = 'c',
    d = 'd',
    da = 'da',
    h = 'h',
    k = 'k',
    M = 'M',
    G = 'G',
    T = 'T',
    P = 'P',
    E = 'E',
    Z = 'Z',
    Y = 'Y',
}
local function is_valid(ucode, unit)
```

```

        if unit and not unit.more_ignored then
            assert(type(unit.symbol) == 'string' and unit.symbol ~=
                if unit.alias then
                    if unit.link or unit.scale_text or unit.si then
                        return false
                    end
                end
            end
            if unit.si then
                if unit.scale_text then
                    return false
                end
                ucode = unit.ucode or ucode
                local base = unit.symbol
                if ucode == base then
                    unit.display = base
                    return true
                end
                local plen = #ucode - #base
                if plen > 0 then
                    local prefix = si_prefixes[ucode:sub(1, plen)]
                    if prefix and ucode:sub(plen + 1) == base then
                        unit.display = prefix .. base
                        return true
                    end
                end
            end
            else
                unit.display = unit.symbol
                return true
            end
        end
    end
    return false
end
local lookup = require(convert_module)._unit
local function show_convert(ucode, unit)
    -- If a built-in unit defines a scale or sets the SI flag, any unit
    -- convert is not used (the scale or SI prefix's scale is used for
    -- If there is no scale or SI flag, and the unit is not defined in
    -- the sort key may not be correct; this allows such units to be
    if not (unit.si or unit.scale_text) then
        if mode == 'convert' then
            unit.show = not lookup(unit.alias and unit.symbol)
            unit.show_text = 'CONVERT'
        elseif mode == 'unknown' then
            unit.show = lookup(unit.alias and unit.symbol or
                unit.show_text = 'UNKNOWN'
        elseif not unit.alias then
            -- Show convert's scale in square brackets ('[1]')
            -- Don't show scale for an alias because it's misleading
            -- and an alias is probably not useful for anything
            local scale = lookup(ucode, {value=1, sort='on'})
            if type(scale) == 'number' then
                scale = string.format('%.5g', scale):gsub(' ', '')
            else
                scale = '?'
            end
            unit.show = true
            unit.show_text = '[' .. scale .. ']'
        end
    end
end
end
for line in definitions:gmatch('([^\n]*)\n') do
    local pos, _ = line:find(' ', 1, true)
    if pos then
        local ucode = line:sub(1, pos - 1)
    end
end

```

```

        local unit = get_builtin_unit(ucode, '\n' .. line .. '\n')
        if is_valid(ucode, unit) then
            show_convert(ucode, unit)
            local flags, text
            if unit.alias then
                text = unit.symbol
            else
                text = '[' .. unit.link .. '|' .. unit.g
            end
            if unit.isangle then
                unit.nospace = nil -- don't show redundanc
            end
            for _, f in ipairs({
                { 'alias', 'ALIAS' },
                { 'isangle', 'ANGLE' },
                { 'nospace', 'NOSPACE' },
                { 'si', 'SI' },
                { 'scale_text', unit.scale_text },
                { 'show', unit.show_text },
            }) do
                if unit[f[1]] then
                    local t = f[2]
                    if t:match('^%u+$') then
                        t = '<small>' .. t .. '</small>'
                    end
                    if flags then
                        flags = flags .. ' ' .. t
                    else
                        flags = t
                    end
                end
            end
            if flags then
                text = text .. ' • ' .. flags
            end
            add(ucode .. ' = ' .. text .. '<br />')
        else
            add(line .. ' ♦ <b>invalid definition</b><br />')
        end
    end
    add(line)
end
end
return table.concat(result, '\n')
end

local delimit_groups = require('Module:Gapnum').groups
local function delimit(sign, numstr, fmt)
    -- Return sign and numstr (unsigned digits or '.' only) after formatting
    -- Four-digit integers are not formatted with gaps.
    fmt = (fmt or ''):lower()
    if fmt == 'none' or (fmt == '' and #numstr == 4 and numstr:match('^%d+$'))
        return sign .. numstr
    end
    -- Group number by integer and decimal parts.
    -- If there is no decimal part, delimit_groups returns only one table.
    local ipart, dpart = delimit_groups(numstr)
    local result
    if fmt == 'commas' then
        result = sign .. table.concat(ipart, ',')
        if dpart then
            result = result .. '.' .. table.concat(dpart)
        end
    end
end
else
end

```

```
-- Delimit with a small gap by default.
local groups = {}
groups[1] = table.remove(ipart, 1)
for _, v in ipairs(ipart) do
    table.insert(groups, '<span style="margin-left:.25em;">'
end
if dpart then
    table.insert(groups, '.' .. (table.remove(dpart, 1) or ''
    for _, v in ipairs(dpart) do
        table.insert(groups, '<span style="margin-left:.25em;">'
    end
end
result = sign .. table.concat(groups)
end
return result
end

local function sup_sub(sup, sub, align)
    -- Return the same result as Module:Su except val defaults to align=right
    if align == 'l' or align == 'left' then
        align = 'left'
    elseif align == 'c' or align == 'center' then
        align = 'center'
    else
        align = 'right'
    end
    return '<span style="display:inline-block;margin-bottom:-0.3em;vertical-align .. ';">' .. sup .. '<br />' .. sub .. '</span>'
end

local function range_text(items, unit_table, options)
    local fmt = options.fmt
    local nend = items.nend or ''
    if items.isrepeat or unit_table.isangle then
        nend = nend .. unit_table.text
    end
    local text = ''
    for i = 1, #items do
        if i % 2 == 0 then
            text = text .. items[i]
        else
            text = text .. delimit(items[i].sign, items[i].clean, fmt)
        end
    end
    return text
end

local function uncertainty_text(uncertainty, unit_table, options)
    local angle, text, need_parens
    if unit_table.isangle then
        angle = unit_table.text
    end
    local upper = uncertainty.upper or {}
    local lower = uncertainty.lower or {}
    local uncl = upper.clean
    if uncl then
        local fmt = options.fmt
        local uncl = lower.clean
        if uncl then
            uncl = delimit('+', uncl, fmt) .. (upper.errend or '')
            uncl = delimit('-', uncl, fmt) .. (lower.errend or '')
            if angle then
                uncl = uncl .. angle
            end
        end
    end
end
```

```
        end
        text = (angle or '') ..
            '<span style="margin-left:0.3em;">' ..
            sup_sub(uncU, uncl, options.align) ..
            '</span>'
    else
        if upper.parens then
            text = '(' .. uncU .. ')' -- old template did not
        else
            text = (angle or '') ..
                '<span style="margin-left:0.3em;margin-right:0.3em;">' ..
                delimiter(' ', uncU, fmt) ..
                need_parens = true
        end
        if uncertainty.errend then
            text = text .. uncertainty.errend
        end
        if angle then
            text = text .. angle
        end
    end
end
else
    if angle then
        text = angle
    end
end
return text, need_parens
end

local function _main(values, unit_spec, options)
    if options.sandbox then
        data_module = data_module .. '/sandbox'
        convert_module = convert_module .. '/sandbox'
    end
    local action = options.action
    if action then
        if action == 'list' then
            -- Kludge: am using the align parameter (a=xxx) for type
            return list_units(options.align)
        end
        return valerror('invalid action "' .. action .. '".', options.no)
    end
    local number = values.number or (values.numbers and values.numbers[1]) or {}
    local e_10 = options.e or {}
    local novalue = (number.value == nil and e_10.clean == nil)
    local fmt = options.fmt
    local want_sort = true
    local sortable = options.sortable
    if sortable == 'off' or (sortable == nil and novalue) then
        want_sort = false
    elseif sortable == 'debug' then
        -- Same as sortable = 'on' but the sort key is displayed.
    else
        sortable = 'on'
    end
    local sort_value = 1
    if want_sort then
        sort_value = number.value or 1
        if e_10.value and sort_value ~= 0 then
            -- The 'if' avoids {{val|0|e=1234}} giving an invalid sort
            sort_value = sort_value * 10^e_10.value
        end
    end
end
local unit_table = makeunit(sort_value, {
```

```
        u = unit_spec.u,
        want_link = unit_spec.want_link,
        per = unit_spec.per,
        want_per_link = unit_spec.want_per_link,
        nospace = novalue,
        want_longscale = unit_spec.want_longscale,
        sortable = sortable,
    })
    local sortkey
    if unit_table then
        if want_sort then
            sortkey = unit_table.sortkey
        end
    else
        unit_table = { text = '' }
        if want_sort then
            sortkey = convert_lookup('dummy', sort_value, nil, nil, nil)
        end
    end
    local final_unit = unit_table.isangle and '' or unit_table.text
    local e_text, n_text, need_parens
    local uncertainty = values.uncertainty
    if uncertainty then
        if number.clean then
            n_text = delimit(number.sign, number.clean, fmt) .. (number.clean)
            local text
            text, need_parens = uncertainty_text(uncertainty, unit_table)
            if text then
                n_text = n_text .. text
            end
        else
            n_text = ''
        end
    else
        if values.numbers.isrepeat then
            final_unit = ''
        end
        n_text = range_text(values.numbers, unit_table, options)
        need_parens = true
    end
    if e_10.clean then
        if need_parens then
            n_text = '(' .. n_text .. ')'
        end
        e_text = '10<sup>' .. delimit(e_10.sign, e_10.clean, fmt) .. '</sup>'
        if number.clean then
            e_text = '<span style="margin-left:0.25em;margin-right:0.25em">' .. e_text .. '</span>'
        end
    else
        e_text = ''
    end
    local result =
        (sortkey or '') ..
        (options.prefix or '') ..
        n_text ..
        e_text ..
        final_unit ..
        (options.suffix or '')
    if result ~= '' then
        result = '<span class="nowrap">' .. result .. '</span>'
    end
    return result .. (options.warning or '')
end
```

```
local function check_parameters(args, has_ranges, nocat)
  -- Return warning text for the first problem parameter found, or nothing
  local whitelist = {
    a = true,
    action = true,
    debug = true,
    e = true,
    ['end'] = true,
    errend = true,
    ['+errend'] = true,
    ['-errend'] = true,
    fmt = true,
    ['long scale'] = true,
    long_scale = true,
    longscale = true,
    nocategory = true,
    p = true,
    s = true,
    sortable = true,
    u = true,
    ul = true,
    up = true,
    upl = true,
  }
  for k, v in pairs(args) do
    if type(k) == 'string' and not whitelist[k] then
      local warning = 'Val parameter "' .. k .. '=' .. v .. '"'
      return valerror(warning, nocat, true)
    end
  end
  if not has_ranges and args[4] then
    return valerror('Val parameter 4 ignored', nocat, true)
  end
end

local function main(frame)
  local getArgs = require('Module:Arguments').getArgs
  local args = getArgs(frame, {wrappers = { 'Template:Val' }})
  local nocat = args.nocategory
  local numbers = {} -- table of number tables, perhaps with range text
  local msg = get_args(numbers, args)
  if msg then
    return valerror(msg, nocat)
  end
  if args.u and args.ul then
    return valerror('unit (<b>u</b>) and unit with link (<b>ul</b>) a
  end
  if args.up and args.upl then
    return valerror('unit per (<b>up</b>) and unit per with link (<b>
  end
  local values
  if numbers.has_ranges then
    -- Multiple values with range separators but no uncertainty.
    numbers.nend = args['end']
    values = {
      numbers = numbers,
    }
  else
    -- A single value with optional uncertainty.
    local function setfield(i, dst, src)
      local v = args[src]
      if v then
        if numbers[i] then
          numbers[i][dst] = v
        end
      end
    end
  end
end
```

```
                else
                    numbers[i] = { [dst] = v }
                end
            end
        end
        setfield(1, 'nend', 'end')
        setfield(2, 'errend', '+errend')
        setfield(3, 'errend', '-errend')
        values = {
            number = numbers[1],
            uncertainty = {
                upper = numbers[2],
                lower = numbers[3],
                errend = args.errend,
            }
        }
    end
    local unit_spec = {
        u = args.ul or args.u,
        want_link = args.ul ~= nil,
        per = args.upl or args.up,
        want_per_link = args.upl ~= nil,
        want_longscale = (args.longscale or args.long_scale or a
    }
    local options = {
        action = args.action,
        align = args.a,
        e = numbers.e,
        fmt = args.fmt,
        nocat = nocat,
        prefix = args.p,
        sandbox = string.find(frame:getTitle(), 'sandbox', 1, true)
        sortable = args.sortable or (args.debug == 'yes' and 'de
        suffix = args.s,
        warning = check_parameters(args, numbers.has_ranges, nocat
    }
    return _main(values, unit_spec, options)
end

return { main = main, _main = _main }
```