

The **intexgral** package*

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Abstract

While integral composition is prevalent in \LaTeX , it often proves to be impractical. When the expression becomes complex, it becomes difficult to modify its various elements in an illegible source code. To address this problem, the **intexgral** package offers a central macro whose only argument is the integrand. Everything else (limits, differentials...) can be modified using a `\keyval` interface. Unlike the traditional method, where the user chooses the limit order with the active characters `_` and `^`, the package had to establish a convention. Thus, for the two keys that will deal with limits, the assumed input will be `_{lower limit}^{upper limit}`. Since this package is written in `expl3`, it depends on the \LaTeX 3 group of packages `l3kernel` and `l3package`. In addition, **intexgral** uses the derivative package to facilitate the manipulation of differentials.

Contents

1	Package options	3
2	Presentation of the main macro	3
3	List of keys	4
3.1	Integration limits	4
3.1.1	Defining the limits	4
3.1.2	Separate the integral	5
3.2	Symbol (and more about limits)	5
3.2.1	Selecting a symbol	6
3.2.2	Generating many integrals	6
3.2.3	Defining limits (when there is only one symbol)	6
3.2.4	Combining symbol and limit	7
3.2.5	Recurring limits motif	7
3.3	Differentials	8
3.3.1	Specifying the variables	8
3.3.2	Including the Jacobian	9
3.3.3	Modifying the symbol	9
3.3.4	Opting for the starred variant	10

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3.3.5	Designating options	10
3.3.6	Creating a path integral	10
4	Auxiliary macros	11
4.1	Package options	11
4.2	Loading new symbols	11
4.3	Looking back at the <code>limits</code> key	11
4.4	Looking back at the <code>variable</code> key	12
4.5	Custom differentials placement	13
4.6	Default differentials configuration	13
	Changelog	15
	Index	15

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Fonts

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Whitney-Medium

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Repository

 See [GitHub repository](#).

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1 Package options

These options can be declared with the following syntax when the package is loaded in the preamble:

```
\usepackage[⟨keyval⟩]{intexgral}
```

<code>invert-limits</code>	⟨boolean⟩	(default: false)
----------------------------	-----------	------------------

This key inverts the limit order convention. The entirety of the document can only follow one convention.

<code>invert-differentials</code>	⟨boolean⟩	(default: false)
-----------------------------------	-----------	------------------

It is common to see the differentials placed before the integrand in physics papers. This key hence swaps their position.

<code>hide-differentials</code>	⟨boolean⟩	(default: false)
---------------------------------	-----------	------------------

If the user wishes to hide the differentials throughout the whole document, this key completely deactivates their automatic composition.

<code>italic</code>	⟨boolean⟩	(default: false)
<code>upright</code>	⟨boolean⟩	(default: true)

These are the two keys of the derivative package.¹

2 Presentation of the main macro

<code>\integral</code>	[⟨keyval list⟩]{⟨integrand⟩}
------------------------	------------------------------

This macro is used to typeset integrals. It must, of course, be used in math mode. Here is a first example.

```
\integral{f(x)}
```

$$\int f(x) \, dx \tag{1}$$

As this macro revolves around the use of keys, the first part of this documentation will present them grouped by themes. The second part will document the auxiliary macros that complement the functionality of certain keys.

¹Available on CTAN as: <https://ctan.org/pkg/derivative>

3 List of keys

3.1 Integration limits

3.1.1 Defining the limits

```
limits {⟨pseudo-clist⟩}, ⟨keyword⟩
limits* {⟨pseudo-clist⟩}, ⟨keyword⟩
```

This key determines the integration limits to be used, following the convention explained in the abstract.

```
\integral[
  limits={1, 10}
]{f(x)}
```

$$\int_1^{10} f(x) \, dx \quad (2)$$

The starred version of the key expresses the limits as an interval. The direction of the brackets automatically adjusts to the presence of $\pm\infty$.

```
\integral[
  limits*={1, 10}
]{f(x)}
```

$$\int_{[1,10]} f(x) \, dx \quad (3)$$

The major strength of `limits` is that it allows you to specify the limits of several integrals and typesets them for you. To do this, the limits must be separated by semicolons to enable the package to correctly evaluate to which integral they belong.

```
\integral[
  limits={0, R; 0, H; 0, 2\pi},
  variable={\rho, z, \phi}
]{\rho z \phi}
```

$$\int_0^R \int_0^H \int_0^{2\pi} \rho z \phi \, d\rho \, dz \, d\phi \quad (4)$$

3.1.2 Separate the integral

`int-split` *<boolean>* (default: `false`)

This key separates the different variables of the integral and isolates them. It is therefore necessary to use it *before* `limits` so that the latter knows in which mode to operate in. Moreover, this key requires that we indicate how to separate the integrand. This additional step can be done using the same logic as for the limits, i.e. using a semicolon.

```
\integral[
  int-split=true,
  limits={0, R; 0, H; 0, 2\pi},
  variable={\rho, z, \phi}
]{\rho; z; \phi}
```

$$\int_0^R \rho \, d\rho \int_0^H z \, dz \int_0^{2\pi} \phi \, d\phi \quad (5)$$

To function correctly, it is obvious that the keys `limits` and `variable`², as well as the integrand, have to have the same dimension. If it is not the case, the compilation won't fail, but the integral expression may no longer make any sense. Numerous warning messages will be there to inform you of this and tell you what is wrong. So don't forget the commas and/or semicolons, even if an element remains empty!

`limits-mode` `limits`, `nolimits` (default: `nolimits`)

Equivalent to using `\limits` or `\nolimits`.

```
\integral[
  limits-mode=limits,
  limits={a, b},
]{f(x)}
```

$$\int_a^b f(x) \, dx \quad (6)$$

3.2 Symbol (and more about limits)

The keys `limits` and `limits*` are very useful when the final expression of the integral is determined (in other words, when the limits of each variable have been defined). However, this only covers... the final expression! For more general cases, they are relatively inconvenient. To typeset a double integral over a surface S , one would have to write `limits={, , S}`. Needless to say, it is rather unsuitable for the user and not optimal for the package. Furthermore, the glyph won't be correct. The set of forthcoming keys therefore offers an easy way to modify the integral symbol and limits.

²To be discovered.

3.2.1 Selecting a symbol

`int-symb` \langle *control sequence* \rangle

This key accepts a macro designating an integral symbol. For instance, `int-symb=\oint` is equivalent to using `\oint_{...}^{...}`. By default, the `intexgral` package tries to load all symbols from `unicode-math`³, as it offers the largest variety of them. If a symbol is not defined, a warning message will be issued and the missing macro will be substituted to `\int`.

```
\integral[
  int-symb=\oint,
  lower-lim=\mathcal{C},
  diff-vec=true
]{f(\vec{r})}
```

$$\oint_{\mathcal{C}} f(\vec{r}) \cdot d\vec{r} \quad (7)$$

3.2.2 Generating many integrals

`nint` \langle *integer* \rangle

This key accepts an integer n that allows you to compose n integrals. It is advisable to use this key only if the number of symbols exceeds 4 to favour the glyphs defined by the mathematical font used.

```
\integral[
  nint=5,
  lower-lim=\Omega,
  variable={x_1, x_2, x_3, x_4, x_5}
]{f(x_1, x_2, x_3, x_4, x_5)}
```

$$\iiint\limits_{\Omega} f(x_1, x_2, x_3, x_4, x_5) dx_1 dx_2 dx_3 dx_4 dx_5 \quad (8)$$

3.2.3 Defining limits (when there is only one symbol)

`lower-lim` $\{\langle$ *lower limit* $\rangle\}$

`upper-lim` $\{\langle$ *upper limit* $\rangle\}$

These two keys allow you to specify the lower and upper limits, respectively. They are only suitable if a single symbol is displayed. If you need to specify both limits, the `limits` key should, of course, be used.

³See documentation for the [complete list](#) of symbols.

```
\integral[
  lower-lim={x^2 + y^2 \leq 1},
  variable={x, y}
]{f(x, y)}
```

$$\int_{x^2+y^2 \leq 1} f(x, y) \, dx \, dy \quad (9)$$

The previous keys (excluding nint) cover a fairly — I hope — general use. Nonetheless, further optimisation is possible to save even more time. That is why in addition of int-symb, lower-lim and upper-lim, intexgral offers *shortcut* keys:

3.2.4 Combining symbol and limit

single	*{\limit}	(symbol: \int)
double	*{\limit}	(symbol: \iint)
triple	*{\limit}	(symbol: \iiint)
quadruple	*{\limit}	(symbol: \oiint)
contour	*{\limit}	(symbol: \oiint)
surface	*{\limit}	(symbol: \oiint)
volume	All these keys allow the action of int-symb and lower-lim/upper-lim to be grouped together, making it easier to choose the symbol and the bound at the same time. The value of the key is optional, in which case the symbol will change, but the bound will remain empty. The keys without asterisks modify the lower limit, whereas their starred variants affect the upper limit.	

Updated: v1.1.0

```
\integral[
  double=S,
  variable={x, y}
]{xy}
```

$$\iint_S xy \, dx \, dy \quad (10)$$

3.2.5 Recurring limits motif

As with symbols, lower bounds sometimes follow common patterns that can be generalised with keys, avoiding overloading the expression of lower-lim.

`domain` $\{ \langle * - list \rangle \}$

This key accepts a list delimited by asterisks. Then, each element of the list will be parsed as follows:

- The first token of the item is passed to `\mathbb` (preceded by `\uppercase` in case the SHIFT key is too far away for your fingers).
- The remaining tokens — which may be empty — are interpreted as the Cartesian power of the domain.

```
\integral[
  double,
  domain={r*r},
  variable={x, y}
]{xy}
```

$$\iint_{\mathbb{R} \times \mathbb{R}} xy \, dx \, dy \quad (11)$$

`boundary` $\{ \langle lower \ limit \rangle \}$

This key simply places the ∂ symbol before the lower limit.

```
\integral[
  contour,
  variable=r,
  diff-vec=true,
  boundary=S
]{G(\vec{r})}
```

$$\oint_{\partial S} G(\vec{r}) \cdot d\vec{r} \quad (12)$$

3.3 Differentials

3.3.1 Specifying the variables

`variable` $\{ \langle clist \rangle, \langle keyword \rangle, none \}$

This key allows to specify the integration variables as a comma list. If this key is not specified, the package will display dx by default (or $d\vec{r}$ if `diff-vec` is enabled). The section 4.6 shows how to modify these choices. If `none` is parsed, no differentials will be shown.


```
\integral[
  triple=V,
  variable={x, y, z}
]{f(x, y, z)}
```

$$\iiint_V f(x, y, z) \, dx \, dy \, dz \quad (13)$$

3.3.2 Including the Jacobian

`jacobian` $\langle \text{boolean} \rangle$ (default: false)

This key enables/disables the display of the Jacobian when defined by `\NewDifferentialKeyword` (see section 4.4)

```
V_\text{trm}{sphère} =
\integral[
  int-split=true,
  limits={0, R; 0, 2\pi; 0, \pi},
  variable=spherical,
  jacobian=true
]{; ;}
```

$$V_{\text{sphère}} = \int_0^R r^2 \, dr \int_0^{2\pi} \sin \theta \, d\theta \int_0^\pi d\phi \quad (14)$$

3.3.3 Modifying the symbol

`diff-symb` $\langle \text{control sequence} \rangle$

As mentioned earlier, the derivative package is used to format differentials. This key allows to change the style of the differentials among those defined by `\NewDifferential`

```
\NewDifferential{\feynmandiff}{\mathcal{D}}
\integral[
  variable={q(t)},
  diff-symb=\feynmandiff
]{e^{+\dfrac{\imath \mathcal{S}[q(t)]}{\hbar}}}
```

$$\int e^{+\frac{\imath S[q(t)]}{\hbar}} \mathcal{D}q(t) \quad (15)$$

3.3.4 Opting for the starred variant

`diff-star` $\langle \text{boolean} \rangle$ (default: false)

If this key is set to true, it is equivalent to using `\odif*` or its variants.

```
\integral[
  double,
  variable={x, y},
  diff-star=true,
]{x^2 \exp(y)}
```

$$\iint x^2 \exp(y) \, d_{x,y} \quad (16)$$

3.3.5 Designating options

`diff-options` $\{\langle \text{keyval list} \rangle\}$

This key accepts a list of keys as it would have been written as an optional argument of `\odif` or its variants. For example, `diff-options={order={2, 3}, var=all}` will be interpreted as `\odif[order={2, 3}, var=all]{...}`.

```
\integral[
  diff-options={order=4}
]{\bar{\psi}(x)(\imath\gamma^\mu\partial_\mu - m)\psi(x)}
```

$$\int \bar{\psi}(x)(\imath\gamma^\mu\partial_\mu - m)\psi(x) \, d^4x \quad (17)$$

3.3.6 Creating a path integral

`diff-vec` $\langle \text{boolean} \rangle$

This key applies `\vec` to each integration variable and places `\cdot` as a separator.

```
\integral[
  double=S,
  variable=S,
  diff-vec=true
]{\vec{F}}
```

$$\iint_S \vec{F} \cdot d\vec{S} \quad (18)$$

4 Auxiliary macros

4.1 Package options

`\intexgralsetup` $\{\langle package\ options\rangle\}$

New: v2.0.0

This macro offers an alternative way to load package options. It should, of course, be used in the preamble only.

4.2 Loading new symbols

`\NewIntegralSymbol` $\{\langle csname\rangle\}$

If you use a package which defines symbols that are not part of unicode-math, you can load them by using the `\NewIntegralSymbol` macro in the preamble. They will then be accessible via the `int-symb` key. The argument must take the form of a macro *without backslash*: for example, `\NewIntegralSymbol{myint}`. Please note that `\NewIntegralSymbol` is only a means for the package to recognise pre-existing symbols and their corresponding macros internally. It is not a way to create a new glyph. It is the user's responsibility to load the necessary packages so that the desired symbols are defined. The loading order is not important, however.

4.3 Looking back at the `limits` key

`\NewLimitsKeyword` $\{\langle keyword\rangle\}\{\langle limits\rangle\}$

`\RenewLimitsKeyword`

`\ProvideLimitsKeyword`

`\DeclareLimitsKeyword`

It is common to have to specify the same limits in an integral. To make them easier to write, the `limits(*)` key(s) also accept a keyword designating limits defined by one of these four macros:

- `\NewLimitsKeyword` creates a new keyword and issues an error if it already exists.
- `\RenewLimitsKeyword` redefines a keyword and issues an error if it does not already exist.
- `\ProvideLimitsKeyword` creates a keyword only if it doesn't already exist. No error message will be issued if it is the case.
- `\DeclareLimitsKeyword` creates a new keyword no matter what, overwriting any previous definitions.

Using one of the previous examples, we could modify the expression of the integral as follows:

```
\integral[
  limits={radius; height; circle},
  variable={\rho, z, \phi}
]{\rho z \phi}
```

$$\int_0^R \int_0^H \int_0^{2\pi} \rho z \phi \, d\rho \, dz \, d\phi \quad (19)$$

Keyword	Limits
ab	a, b
real	$-\infty, +\infty$
positive	$0, +\infty$
negative	$-\infty, 0$
unit	$0, 1$
circle	$0, 2\pi$
scircle	$0, \pi$
qcircle	$0, \frac{\pi}{2}$
height	$0, H$
radius	$0, R$
length	$0, L$
time	$0, T$

Table 1: List of keywords for limits.

Important: due to the implementation of `\NewLimitsKeyword` and its variants, the user *must* follow the package’s convention on limits order, even if `invert-limits` is set to `true`.

4.4 Looking back at the variable key

```
\NewDifferentialKeyword    {\langle keyword \rangle}{\langle differentials \rangle}[\langle jacobian \rangle]
\RenewDifferentialKeyword
\ProvideDifferentialKeyword
\DeclareDifferentialKeyword
```

Similarly, the same groups of differentials often resurface. It is therefore also possible to define keywords whose comma list is predefined (the variants have the same behaviour). The sole difference is that we can also specify the Jacobian. The latter must also be a comma list, as it allows the package to split it when the `int-split` mode is enabled. Its display is controlled by the `jacobian` key as explained above.

```
\integral[
  triple={V},
  variable=cartesian
]{f(x, y, z)}
```

$$\iiint_V f(x, y, z) \, dx \, dy \, dz \quad (20)$$

Keyword	Differentials	Jacobian
cartesian	x, y, z	–
polar	r, θ	r
cylindrical	r, θ, z	r
spherical	r, θ, ϕ	$r, \sin \theta$

Table 2: List of keywords for differentials.

4.5 Custom differentials placement

`\differentials` Although the option `invert-differentials` exists, it is often desirable to be able to place differentials wherever you want. For instance, they are often seen in the numerator of a fraction when the latter is equal to 1. To meet this need, the package provides the `\differentials` macro. When `int-split=false`, `\differentials` typesets all differentials in the same place. When `int-split=true`, `\differentials` must be rewritten between each semicolon. In both cases, the Jacobian will be attached to the differentials.

```
\integral[
  variable={a},
]{\frac{\differentials}{a}} = \ln(a) + C
```

$$\int \frac{da}{a} = \ln(a) + C \quad (21)$$

4.6 Default differentials configuration

<code>\defaultdiff</code>	<code>{⟨clist⟩}, ⟨token⟩, ⟨keyword⟩</code>	(default: <code>x</code>)
<code>\defaultvdiff</code>	<code>{⟨clist⟩}, ⟨token⟩, ⟨keyword⟩</code>	(default: <code>r</code>)

New: v2.0.0

As mentioned earlier, the package automatically places x (or \vec{r}) as the integration parameters if no variables are given. This can be changed to avoid repeating the `variable` key when a large part of your document uses the same differential. As with the `variable` key, different arguments are possible. The assignment of the two macros is local, and they can therefore be placed in a group if necessary.

`\vdiffstyle {(control sequence)}` (default: `\vec`)

New: v2.0.0

The `diff-vec` key uses `\vec` to apply a vector to differentials. However, there are many different vector styles in \TeX . Thus, the macro presented here uses the control sequence given *without argument* to format the vector. For example, with the `esvect` package loaded, we could define the style to use as follows: `\vdiffstyle{\vv}`. The assignment is also local.

Changelog

2.0.0 (2025-09-09)

Added

- Macro `\intexgralsetup`.
- Macro `\defaultdiff`.
- Macro `\defaultvdiff`.
- Macro `\vdiffstyle`.

Changed

- Warning messages related to non-existing symbols. They are now only triggered when the integral is typeset.

Removed

- Key `diff-vec-style`.
- Warning message about misuse of semi-colon in conjunction with the `int-split` key.

Fixed

- Bug where the integrand was not reset when `\integral` was used successively ([details here](#)).
- `expl3` log leftovers which shouldn't have been there.

1.1.0 (2025-07-29)

Added

- Starred variants for the keys controlling both symbol and limits (section 3.2.4).

1.0.0 (2025-07-26) — Initial version.

Index

B		diff-star 10
boundary 8		diff-symb 9
C		diff-vec 10
\cdot 10		\differentials 13
contour 7		domain 8
		double 7
D		H
\DeclareDifferentialKeyword 12		hide-differentials 3
\DeclareLimitsKeyword 11		
\defaultdiff 13,15		I
\defaultvdiff 13,15		\iiint 7
diff-options 10		\iint 7

<code>\iint</code>	7	<code>\odif*</code>	10
<code>\infty</code>	4	<code>\oiint</code>	7
<code>\int</code>	6,7	<code>\oint</code>	7
<code>int-split</code>	5	<code>\oint</code>	7
<code>int-symb</code>	6		
<code>\integral</code>	3,15	P	
<code>\intexgralsetup</code>	11,15	<code>\ProvideDifferentialKeyword</code>	12
<code>invert-differentials</code>	3	<code>\ProvideLimitsKeyword</code>	11
<code>invert-limits</code>	3		
<code>italic</code>	3	Q	
		<code>quadruple</code>	7
J		R	
<code>jacobian</code>	9	<code>\RenewDifferentialKeyword</code>	12
		<code>\RenewLimitsKeyword</code>	11
L		S	
<code>\limits</code>	5	<code>single</code>	7
<code>limits</code>	4	<code>surface</code>	7
<code>limits*</code>	4		
<code>limits-mode</code>	5	T	
<code>lower-lim</code>	6	<code>triple</code>	7
M		U	
<code>\mathbb</code>	8	<code>upper-lim</code>	6
N		<code>\uppercase</code>	8
<code>\NewDifferential</code>	9	<code>upright</code>	3
<code>\NewDifferentialKeyword</code>	9,12	<code>\usepackage</code>	3
<code>\NewIntegralSymbol</code>	11		
<code>\NewLimitsKeyword</code>	11,12	V	
<code>nint</code>	6	<code>variable</code>	8
<code>\nolimits</code>	5	<code>\vdiffstyle</code>	14,15
O		<code>\vec</code>	10,14
<code>\odif</code>	10	<code>volume</code>	7