

The It3rawobjects package

Paolo De Donato

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1 Introduction

Package `lt3rawobjects` introduces a new mechanism to create and manage structured data called “objects” like the well known C structures. The functions exported by this package are quite low level, and many important mechanisms like member protection and name resolution aren’t already defined and should be introduced by intermediate packages. Higher level libraries built on top of `lt3rawobjects` could also implement an improved and simplified syntax since the main focus of `lt3rawobjects` is versatility and expandability rather than common usage.

This packages follows the [SemVer](https://semver.org/) specification (<https://semver.org/>). In particular any major version update (for example from 1.2 to 2.0) may introduce incompatible changes and so it’s not advisable to work with different packages that require different major versions of `lt3rawobjects`. Instead changes introduced in minor and patch version updates are always backward compatible, and any withdrawn function is declared deprecated instead of being removed.

2 Addresses

In this package a *pure address* is any string without spaces (so a sequence of tokens with category code 12 “other”) that uniquely identifies a resource or an entity. An example of pure address is the name of a control sequence `\<name>` that can be obtained by full expanding `\cs_to_str:N \<name>`. Instead an *expanded address* is a token list that contains only tokens with category code 11 (letters) or 12 (other) that can be directly converted to a pure address with a simple call to `\tl_to_str:n` or by assigning it to a string variable.

An *address* is instead a fully expandable token list which full expansion is an expanded address, where full expansion means the expansion process performed inside `c`, `x` and `e` parameters. Moreover, any address should be fully expandable according to the rules of `x` and `e` parameter types with same results, and the name of control sequence resulting from a `c`-type expansion of such address must be equal to its full expansion. For these reasons addresses should not contain parameter tokens like `#` (because they’re threat differently by `x` and `e`) or control sequences that prevents expansion like `\exp_not:n` (because they leave unexpanded control sequences after an `x` or `e` expansion, and expanded addresses can’t have control sequences inside them). In particular, `\tl_to_str:n{ ## }` is *not* a valid address (assuming standard category codes).

Addresses could be not full expanded inside an `f` argument, thus an address expanded in an `f` argument should be `x`, `e` or `c` expended later to get the actual pure address. If you need to fully expand an address in an `f` argument (because, for example, your macro should be fully expandable and your engine is too old to support `e` expansion efficiently) then you can put your address inside `\rwbj_address_f:n` and pass them to your function. For example,

```
\your_function:f{ \rwbj_address_f:n { your \address } }
```

Remember that `\rwbj_address_f:n` only works with addresses, can’t be used to fully expand any token list.

Like functions and variables names, pure addresses should follows some basic naming conventions in order to avoid clashes between addresses in different modules. Each pure

address starts with the $\langle module \rangle$ name in which such address is allocated, then an underscore ($_$) and the $\langle identifier \rangle$ that uniquely identifies the resource inside the module. The $\langle module \rangle$ should contain only lowercase ASCII letters.

A *pointer* is just a \LaTeX string variable that holds a pure address. We don't enforce to use `str` or any special suffix to denote pointers so you're free to use `str` or a custom $\langle type \rangle$ as suffix for your pointers in order to distinguish between them according to their type.

In `lt3rawobjects` all the macros ending with `_adr` or `_address` are fully expandable and can be used to compose valid addresses as explained in their documentation.

3 Objects

An *object* is just a collection of several related entities called *fields*. Objects are themselves entities so they have addresses and could be contained inside other objects. Objects addresses are also used to compose the addresses of each of their inner entity, thus different objects can have fields with the same name without clashing each other. Each object is uniquely identified by its pure address, which is composed by a $\langle module \rangle$ and an $\langle identifier \rangle$ as explained before. The use of underscore character in objects identifiers is reserved. You can retrieve the address of an object via the `\object_address:nn` function.

Objects are always created from already existing objects. An object that can be used to create other objects is called *proxy*, and the proxy that has created an object is its *generator*. In the `rawobjects` module is already allocated a particular proxy that can be used to create every other proxy. Its identifier is just `proxy` and its pure address is stored in `\c_proxy_address_str`. The functions `\object_create` can be used to create new objects.

4 Fields

Remember that objects are just a collection of different fields uniquely identified by a pure address. Here an field could be one of the following entities:

- a \LaTeX variable, in which case the field is called *member*;
- a \LaTeX constant, in which case the field is called just *constant*;
- a \LaTeX function, in which case the field is called *method*;
- generic control sequences, in which case the field is called simply *macro*;
- an entire object, in which case the field is called *embedded object*.

Objects could be declared *local* or *global*. The only difference between a local and a global object is the scope of their members (that are \LaTeX variables). You should always create global object unless you specifically need local members.

4.1 Constants

Constants in an object could be *near* and *remote*. A near constant is just a constant declared in such object and could be referred only by it, instead a remote constant is declared inside its generator and can be referred by any object created from that proxy, thus it's shared between all the generated objects. Functions in this library that work with near constants usually contain `ncmember` in their names, whereas those involving remote constants contain `rcmember` instead.

Both near and remote constants are created in the same way via the `_newconst` functions, however remote constant should be created in a proxy whereas near constant are created directly in the target object.

4.2 Methods

Methods are \LaTeX 3 functions that can't be changed once they're created. Like constant, methods could be near or remote. Moreover, functions in this library dealing with near methods contain `ncmethod` whereas those dealing with remote methods contain `rcmethod` in their names.

4.3 Members

Members are just mutable \LaTeX 3 variables. You can manually create new members in already existing objects or you can put the definition of a new member directly in a proxy with the `\proxy_push_member` functions. In this way all the objects created with that proxy will have a member according to such definition. If the object is local/global then all its members are automatically local/global.

A member can be *tracked* or *not tracked*. A tracked member have additional information, like its type, stored in the object or in its generator. In particular, you don't need to specify the type of a tracked member and some functions in `lt3rawobjects` are able to retrieve the required information. All the members declared in the generator are automatically tracked.

5 Object members

Sometimes it's necessary to store an instance of an object inside another object, since objects are structured entities that can't be entirely contained in a single \LaTeX 3 variable you can't just put it inside a member or constant. However, there are some very easy workarounds to insert object instances as fields of other objects.

For example, we're in module `MOD` and we have an object with id `PAR`. We want to provide `PAR` with a field that holds an instance of an object created by proxy `PRX`. We can achieve this in three ways:

5.1 Create a pointer member

We first create a new object from `PRX`

```
1 \object_create:nnn
2 { \object_address:nn { MOD }{ PRX } }{ MOD }{ INST }
```

then we create an `str` member in `PAR` that will hold the address of the newly created object.

```
1  \object_new_member:nnn
2  {
3      \object_address:nn { MOD }{ PAR }
4  }{ pointer }{ str }
5
6  \object_member_set:nnnx
7  {
8      \object_address:nn { MOD }{ PAR }
9  }
10 { pointer }{ str }
11 {
12     \object_address:nn { MOD }{ INST }
13 }
```

You can then get the pointed object by just using the `pointer` member. Notice that you're not forced to use the `str` type for the pointer member, but you can also use `t1` or any custom `<type>`. In the latter case be sure to at least define the following functions: `\<type>_new:c`, `\<type>_(g)set:cn` and `\<type>_use:c`.

Advantages

- Simple and no additional function needed to create and manage included objects;
- you can share the same object between different containers;
- included objects are objects too, you can use address stored in pointer member just like any object address.

Disadvantages

- You must manually create both the objects and link them;
- if you forgot to properly initialize the pointer member it'll contain the "null address" (the empty string). Despite other programming languages the null address is not treated specially by `lt3rawobjects`, which makes finding null pointer errors more difficult.

5.2 Clone the inner structure

Another solution is to copy the members declared in `PRX` to `PAR`. For example, if in `PRX` are declared a member with name `x` and type `str`, and a member with name `y` and type `int` then

```
1  \object_new_member:nnn
2  {
3      \object_address:nn { MOD }{ PAR }
4  }{ prx-x }{ str }
5  \object_new_member:nnn
6  {
```

```

7   \object_address:nn { MOD }{ PAR }
8   }{ prx-y }{ int }

```

Advantages

- Very simple;
- no hidden item is created, this procedure has the lowest overhead among all the proposed solutions here.

Disadvantages

- If you need the original instance of the stored object then you should create a temporary object and manually copy each field to it. Don't use this method if you later need to retrieve the stored object entirely and not only its fields.

5.3 Embedded objects

From `lt3rawobjects 2.2` you can put *embedded objects* inside objects. Embedded objects are created with `\embedded_create` function

```

1   \embedded_create:nnn
2   {
3     \object_address:nn { MOD }{ PAR }
4   }
5   { PRX }{ emb }

```

and addresses of emmbedded objects can be retrieved with function `\object_embedded_adr`. You can also put the definition of embedded objects in a proxy by using `\proxy_push_embedded` just like `\proxy_push_member`.

Advantages

- You can put a declaration inside a proxy so that embedded objects are automatically created during creation of parent object;
- included objects are objects too, you can use address stored in pointer member just like any object address.

Disadvantages

- Needs additional functions available for version 2.2 or later;
- embedded objects must have the same scope and visibility of parent one;
- creating objects also creates additional hidden variables, taking so (little) additional space.

6 Library functions

6.1 Common functions

`\rwobj_address_f:n` ☆ `\rwobj_address_f:n` {*address*}

Fully expand an address in an f-type argument.
From: 2.3

6.2 Base object functions

`\object_address:nn` ☆ `\object_address:nn` {*module*} {*id*}

Composes the address of object in module *module* with identifier *id* and places it in the input stream. Notice that both *module* and *id* are converted to strings before composing them in the address, so they shouldn't contain any command inside.

From: 1.0

`\object_address_set:Nnn` `\object_address_set:nn` *str var* {*module*} {*id*}

Stores the address of selected object inside the string variable *str var*.
From: 1.1

`\object_embedded_adr:nn` ☆ `\object_embedded_adr:nn` {*address*} {*id*}

Compose the address of embedded object with name *id* inside the parent object with address *address*. Since an embedded object is also an object you can use this function for any function that accepts object addresses as an argument.

From: 2.2

`\object_if_exist_p:n` ☆ `\object_if_exist_p:n` {*address*}

`\object_if_exist_p:V` ☆ `\object_if_exist:nTF` {*address*} {*true code*} {*false code*}

`\object_if_exist:nTF` ☆ Tests if an object was instantiated at the specified address.

`\object_if_exist:VTF` ☆ From: 1.0

`\object_get_module:n` ☆ `\object_get_module:n` {*address*}

`\object_get_module:V` ☆ `\object_get_proxy_adr:n` {*address*}

`\object_get_proxy_adr:n` ☆ Get the object module and its generator.

`\object_get_proxy_adr:V` ☆ From: 1.0

`\object_if_local_p:n` ☆ `\object_if_local_p:n` {*address*}

`\object_if_local_p:V` ☆ `\object_if_local:nTF` {*address*} {*true code*} {*false code*}

`\object_if_local:nTF` ☆ Tests if the object is local or global.

`\object_if_local:VTF` ☆ From: 1.0

`\object_if_global_p:n` ☆

`\object_if_global_p:V` ☆

`\object_if_global:nTF` ☆

`\object_if_global:VTF` ☆

```

\object_if_public_p:n * \object_if_public_p:n {\address}
\object_if_public_p:V * \object_if_public:nTF {\address} {\true code} {\false code}
\object_if_public:nTF * Tests if the object is public or private.
\object_if_public:VTF * From: 1.0
\object_if_private_p:n *
\object_if_private_p:V *
\object_if_private:nTF *
\object_if_private:VTF *

```

6.3 Members

```

\object_member_adr:nnn ☆ \object_member_adr:nnn {\address} {\member name} {\member type}
\object_member_adr:(Vnn|nnv) ☆ \object_member_adr:nn {\address} {\member name}
\object_member_adr:nn ☆
\object_member_adr:Vn ☆

```

Fully expands to the address of specified member variable. If the member is tracked then you can omit the type field.

From: 1.0

```

\object_member_if_exist_p:nnn * \object_member_if_exist_p:nnn {\address} {\member name} {\member
\object_member_if_exist_p:Vnn * type}
\object_member_if_exist:nnnTF * \object_member_if_exist:nnnTF {\address} {\member name} {\member
\object_member_if_exist:VnnTF * type} {\true code} {\false code}

```

Tests if the specified member exist.

From: 2.0

```

\object_member_if_tracked_p:nn * \object_member_if_tracked_p:nn {\address} {\member name}
\object_member_if_tracked_p:Vn * \object_member_if_tracked:nnTF {\address} {\member name} {\true
\object_member_if_tracked:nnTF * code} {\false code}
\object_member_if_tracked:VnTF *

```

Tests if the specified member exist and is tracked.

From: 2.3

```

\object_member_type:nn * \object_member_type:nn {\address} {\member name}
\object_member_type:Vn * Fully expands to the type of specified tracked member.

```

From: 1.0

```

\object_new_member:nnn \object_new_member:nnn {\address} {\member name} {\member type}
\object_new_member:(Vnn|nnv)

```

Creates a new member with specified name and type. The created member is not tracked.

From: 1.0

```

\object_new_member_tracked:nnn \object_new_member_tracked:nnn {\address} {\member name} {\member
\object_new_member_tracked:Vnn type}

```

Creates a new tracked member.

From: 2.3

```

\object_member_use:nnn      * \object_member_use:nnn {<address>} {<member name>} {<member type>}
\object_member_use:(Vnn|nnv) * \object_member_use:nn {<address>} {<member name>}
\object_member_use:nn      *
\object_member_use:Vn      *

```

Uses the specified member variable.

From: 1.0

```

\object_member_set:nnnn     \object_member_set:nnnn {<address>} {<member name>} {<member type>}
\object_member_set:(nnvn|Vnnn) {<value>}
\object_member_set:nnn     \object_member_set:nnn {<address>} {<member name>} {<value>}
\object_member_set:Vnn

```

Sets the value of specified member to $\langle value \rangle$. It calls implicitly $\langle member type \rangle_{-}(g)set:cn$ then be sure to define it before calling this method.

From: 2.1

```

\object_member_set_eq:nnnN   \object_member_set_eq:nnnN {<address>} {<member name>}
\object_member_set_eq:(nnvN|VnnN|nnnc|Vnnc) {<member type>} {<variable>}
\object_member_set_eq:nnN   \object_member_set_eq:nnN {<address>} {<member name>}
\object_member_set_eq:(VnN|nnc|Vnc) {<variable>}

```

Sets the value of specified member equal to the value of $\langle variable \rangle$.

From: 1.0

```

\object_member_generate:NN   \object_member_generate:NN \<name1> \<name2>:<arg1><args>
\object_member_generate_protected:NN

```

Define the new functions $\langle name_1 \rangle:nnn\langle Targs \rangle$ and $\langle name_1 \rangle:nn\langle Targs \rangle$ that pass to $\langle name_2 \rangle:<arg1><args \rangle$ the specified member address as the first argument. $\langle Targs \rangle$ is a list of argument specifications obtained by transforming each element of $\langle args \rangle$ to n, N, w, T or F.

The first three parameters of $\langle name_1 \rangle:nnn\langle args \rangle$ should be in the following order:

1. an object address;
2. a member name;
3. the type of specified member.

Function $\langle name_1 \rangle:nn\langle args \rangle$ only accepts the first two parameters and works only with tracked members. Notice that $\langle arg1 \rangle$ must be only one of the following: n, c, v, x, f, e, o.

From: 2.3

```

\object_member_generate_inline:Nnn   \object_member_generate_inline:Nnn \<name1> {<name2>}
\object_member_generate_protected_inline:Nnn {<arg1><args>}

```

Works as $\langle name_1 \rangle:nnn\langle args \rangle$, however in $\langle name_2 \rangle$ you can use parameters #1 and #2 to compose the needed function. Parameter #1 expands to the (fully expanded) member type and #2 is equal to g if the object is global and it's empty if it is local.

From: 2.3

6.4 Constants

```
\object_ncmember_adr:nnn ☆ \object_ncmember_adr:nnn {<address>} {<member name>} {<member type>}
\object_ncmember_adr:(Vnn|vnn) ☆
\object_rcmember_adr:nnn ☆
\object_rcmember_adr:Vnn ☆
```

Fully expands to the address of specified near/remote constant member.

From: 2.0

```
\object_ncmember_if_exist_p:nnn ☆ \object_ncmember_if_exist_p:nnn {<address>} {<member name>} {<member
\object_ncmember_if_exist_p:Vnn ☆ type>}
\object_ncmember_if_exist:nnnTF ☆ \object_ncmember_if_exist:nnnTF {<address>} {<member name>} {<member
\object_ncmember_if_exist:VnnTF ☆ type>} {<>true code>} {<>false code>}
\object_rcmember_if_exist_p:nnn ☆
\object_rcmember_if_exist_p:Vnn ☆
\object_rcmember_if_exist:nnnTF ☆
\object_rcmember_if_exist:VnnTF ☆
```

Tests if the specified member constant exist.

From: 2.0

```
\object_ncmember_use:nnn ☆ \object_ncmember_use:nnn {<address>} {<member name>} {<member type>}
\object_ncmember_use:Vnn ☆
\object_rcmember_use:nnn ☆ Uses the specified near/remote constant member.
\object_rcmember_use:Vnn ☆ From: 2.0
```

```
\object_ncmember_generate:NN \object_ncmember_generate:NN \<name1> \name2:<arg1><args>
\object_ncmember_protected_generate:NN
\object_rcmember_generate:NN
\object_rcmember_protected_generate:NN
```

Works as `\object_member_generate:NN` but with constants instead of members.

From: 2.3

```
\object_ncmember_generate_inline:Nnn \object_ncmember_generate_inline:Nnn \<name1> {<name2>}
\object_ncmember_protected_generate_inline:Nnn {<arg1><args>}
\object_rcmember_generate_inline:Nnn
\object_rcmember_protected_generate_inline:Nnn
```

Works as `\object_member_generate_inline:Nnn` but with constants instead of members.

From: 2.3

6.5 Methods

```

\object_ncmethod_adr:nnn ☆ \object_ncmethod_adr:nnn {⟨address⟩} {⟨method name⟩} {⟨method
\object_ncmethod_adr:(Vnn|vnn) ☆ variant⟩}
\object_rcmethod_adr:nnn ☆
\object_rcmethod_adr:Vnn ☆

```

Fully expands to the address of the specified

- near constant method if `\object_ncmethod_adr` is used;
- remote constant method if `\object_rcmethod_adr` is used.

From: 2.0

```

\object_ncmethod_if_exist_p:nnn ☆ \object_ncmethod_if_exist_p:nnn {⟨address⟩} {⟨method name⟩} {⟨method
\object_ncmethod_if_exist_p:Vnn ☆ variant⟩}
\object_ncmethod_if_exist:nnnTF ☆ \object_ncmethod_if_exist:nnnTF {⟨address⟩} {⟨method name⟩} {⟨method
\object_ncmethod_if_exist:VnnTF ☆ variant⟩} {⟨true code⟩} {⟨false code⟩}
\object_rcmethod_if_exist_p:nnn ☆
\object_rcmethod_if_exist_p:Vnn ☆
\object_rcmethod_if_exist:nnnTF ☆
\object_rcmethod_if_exist:VnnTF ☆

```

Tests if the specified method constant exist.

From: 2.0

```

\object_new_cmethod:nnnn \object_new_cmethod:nnnn {⟨address⟩} {⟨method name⟩} {⟨method arguments⟩} {⟨code⟩}
\object_new_cmethod:Vnnn

```

Creates a new method with specified name and argument types. The `{⟨method arguments⟩}` should be a string composed only by n and N characters that are passed to `\cs_new:Nn`.

From: 2.0

```

\object_ncmethod_call:nnn ☆ \object_ncmethod_call:nnn {⟨address⟩} {⟨method name⟩} {⟨method variant⟩}
\object_ncmethod_call:Vnn ☆
\object_rcmethod_call:nnn ☆
\object_rcmethod_call:Vnn ☆

```

Calls the specified method. This function is expandable if and only if the specified method was not declared `protected`.

From: 2.0

6.6 Creation of constants

<code>\object_newconst_tl:nnn</code>	<code>\object_newconst_⟨type⟩:nnn {⟨address⟩} {⟨constant name⟩} {⟨value⟩}</code>
<code>\object_newconst_tl:Vnn</code>	Creates a constant variable with type <code>⟨type⟩</code> and sets its value to <code>⟨value⟩</code> .
<code>\object_newconst_str:nnn</code>	From: 1.1
<code>\object_newconst_str:Vnn</code>	
<code>\object_newconst_int:nnn</code>	
<code>\object_newconst_int:Vnn</code>	
<code>\object_newconst_clist:nnn</code>	
<code>\object_newconst_clist:Vnn</code>	
<code>\object_newconst_dim:nnn</code>	
<code>\object_newconst_dim:Vnn</code>	
<code>\object_newconst_skip:nnn</code>	
<code>\object_newconst_skip:Vnn</code>	
<code>\object_newconst_fp:nnn</code>	
<code>\object_newconst_fp:Vnn</code>	

<code>\object_newconst_seq_from_clist:nnn</code>	<code>\object_newconst_seq_from_clist:nnn {⟨address⟩} {⟨constant name⟩}</code>
<code>\object_newconst_seq_from_clist:Vnn</code>	<code>{⟨comma-list⟩}</code>

Creates a seq constant which is set to contain all the items in `⟨comma-list⟩`.

From: 1.1

<code>\object_newconst_prop_from_keyval:nnn</code>	<code>\object_newconst_prop_from_keyval:nnn {⟨address⟩} {⟨constant name⟩}</code>
<code>\object_newconst_prop_from_keyval:Vnn</code>	<code>{</code>
	<code>⟨key⟩ = ⟨value⟩, ...</code>
	<code>}</code>

Creates a prop constant which is set to contain all the specified key-value pairs.

From: 1.1

<code>\object_newconst:nnnn</code>	<code>\object_newconst:nnnn {⟨address⟩} {⟨constant name⟩} {⟨type⟩} {⟨value⟩}</code>
------------------------------------	-------------------------------------------------------------------------------------

Invokes `\⟨type⟩_const:cn` to create the specified constant.

From: 2.1

6.7 Macros

<code>\object_macro_adr:nn</code> ☆	<code>\object_macro_adr:nn {⟨address⟩} {⟨macro name⟩}</code>
<code>\object_macro_adr:Vn</code> ☆	Address of specified macro.

From: 2.2

<code>\object_macro_use:nn</code> ☆	<code>\object_macro_use:nn {⟨address⟩} {⟨macro name⟩}</code>
<code>\object_macro_use:Vn</code> ☆	Uses the specified macro. This function is expandable if and only if the specified macro is it.

From: 2.2

There isn't any standard function to create macros, and macro declarations can't be inserted in a proxy object. In fact a macro is just an unspecialized control sequence at the disposal of users that usually already know how to implement them.

6.8 Proxies and object creation

```

\object_if_proxy_p:n * \object_if_proxy_p:n {<address>}
\object_if_proxy_p:V * \object_if_proxy:nTF {<address>} {<true code>} {<false code>}
\object_if_proxy:nTF * Test if the specified object is a proxy object.
\object_if_proxy:VTF * From: 1.0

```

```

\object_test_proxy_p:nn * \object_test_proxy_p:nn {<object address>} {<proxy address>}
\object_test_proxy_p:Vn * \object_test_proxy:nnTF {<object address>} {<proxy address>} {<true code>} {<false code>}
\object_test_proxy:nnTF *
\object_test_proxy:VnTF * Test if the specified object is generated by the selected proxy, where <proxy variable> is a string variable holding the proxy address.

```

TeXhackers note: Remember that this command uses internally an `e` expansion so in older engines (any different from Lua^ATeX before 2019) it'll require slow processing. Don't use it in speed critical parts, instead use `\object_test_proxy:nN`.

From: 2.0

```

\object_test_proxy_p:nN * \object_test_proxy_p:nN {<object address>} {<proxy variable>}
\object_test_proxy_p:VN * \object_test_proxy:nNTF {<object address>} {<proxy variable>} {<true code>} {<false code>}
\object_test_proxy:nNTF *
\object_test_proxy:VNTF * Test if the specified object is generated by the selected proxy, where <proxy variable> is a string variable holding the proxy address. The :nN variant don't use e expansion, instead of :nn command, so it can be safely used with older compilers.

```

From: 2.0

```

\c_proxy_address_str The address of the proxy object in the rawobjects module.
From: 1.0

```

```

\object_create:nnnNN \object_create:nnnNN {<proxy address>} {<module>} {<id>} {<scope>} {<visibility>}
\object_create:VnnNN Creates an object by using the proxy at <proxy address> and the specified parameters. Use this function only if you need to create private objects (at present private objects are functionally equivalent to public objects) or if you need to compile your project with an old version of this library (< 2.3).
From: 1.0

```

```

\object_create:nnnN \object_create:nnnN {<proxy address>} {<module>} {<id>} {<scope>}
\object_create:VnnN \object_create:nnn {<proxy address>} {<module>} {<id>}
\object_create:nnn Same as \object_create:nnnNN but both create only public objects, and the :nnn version only global ones. Always use these two function instead of \object_create:nnnNN unless you strictly need private objects.
\object_create:Vnn From: 2.3

```

```

\embedded_create:nnn \embedded_create:nnn {<parent object>} {<proxy address>} {<id>}
\embedded_create:(Vnn|nvn) Creates an embedded object with name <id> inside <parent object>.
From: 2.2

```

`\c_object_local_str` Possible values for *<scope>* parameter.
`\c_object_global_str` From: 1.0

`\c_object_public_str` Possible values for *<visibility>* parameter.
`\c_object_private_str` From: 1.0

`\object_create_set:NnnnNN` `\object_create_set:NnnnNN` *<str var>* *{<proxy address>}* *{<module>}*
`\object_create_set:(NVnnNN|NnnfNN)` *{<id>}* *<scope>* *<visibility>*
`\object_create_gset:NnnnNN`
`\object_create_gset:(NVnnNN|NnnfNN)`

Creates an object and sets its fully expanded address inside *<str var>*.
From: 1.0

`\object_allocate_incr:NNnnNN` `\object_allocate_incr:NNnnNN` *<str var>* *<int var>* *{<proxy address>}*
`\object_allocate_incr:NNVnNN` *{<module>}* *<scope>* *<visibility>*
`\object_gallocate_incr:NNnnNN`
`\object_gallocate_incr:NNVnNN`
`\object_allocate_gincr:NNnnNN`
`\object_allocate_gincr:NNVnNN`
`\object_gallocate_gincr:NNnnNN`
`\object_gallocate_gincr:NNVnNN`

Build a new object address with module *<module>* and an identifier generated from *<proxy address>* and the integer contained inside *<int var>*, then increments *<int var>*. This is very useful when you need to create a lot of objects, each of them on a different address. the `_incr` version increases *<int var>* locally whereas `_gincr` does it globally.
From: 1.1

`\proxy_create:nnN` `\proxy_create:nnN` *{<module>}* *{<id>}* *<visibility>*
`\proxy_create_set:NnnN` `\proxy_create_set:NnnN` *<str var>* *{<module>}* *{<id>}* *<visibility>*
`\proxy_create_gset:NnnN` These commands are deprecated because proxies should be global and public. Use instead `\proxy_create:nn`, `\proxy_create_set:Nnn` and `\proxy_create_gset:Nnn`.
From: 1.0
Deprecated in: 2.3

`\proxy_create:nn` `\proxy_create:nn` *{<module>}* *{<id>}*
`\proxy_create_set:Nnn` `\proxy_create_set:Nnn` *<str var>* *{<module>}* *{<id>}*
`\proxy_create_gset:Nnn` Creates a global public proxy object.
From: 2.3

`\proxy_push_member:nnn` `\proxy_push_member:nnn` *{<proxy address>}* *{<member name>}* *{<member type>}*
`\proxy_push_member:Vnn` Updates a proxy object with a new member specification, so that every subsequential object created with this proxy will have a member variable with the specified name and type that can be retrieved with `\object_member_type` functions.
From: 1.0

`\proxy_push_embedded:nnn` `\proxy_push_embedded:nnn` `{⟨proxy address⟩}` `{⟨embedded object name⟩}` `{⟨embedded object proxy⟩}`
`\proxy_push_embedded:Vnn`

Updates a proxy object with a new embedded object specification.
 From: 2.2

`\proxy_add_initializer:nN` `\proxy_add_initializer:nN` `{⟨proxy address⟩}` `⟨initializer⟩`
`\proxy_add_initializer:VN`

Pushes a new initializer that will be executed on each created objects. An initializer is a function that should accept five arguments in this order:

- the full expanded address of used proxy as an `n` argument;
- the module name as an `n` argument;
- the full expanded address of created object as an `n` argument.

Initializer will be executed in the same order they're added.
 From: 2.3

`\object_assign:nn` `\object_assign:nn` `{⟨to address⟩}` `{⟨from address⟩}`
`\object_assign:(Vn|nV|VV)`

Assigns the content of each variable of object at `⟨from address⟩` to each correlative variable in `⟨to address⟩`. Both the objects should be created with the same proxy object and only variables listed in the proxy are assigned.

From: 1.0

7 Examples

Example 1

Create a public proxy with id `myproxy` with the specification of a single member variable with name `myvar` and type `tl`, then set its address inside `\g_myproxy_str`.

```

1 \str_new:N \g_myproxy_str
2 \proxy_create_gset:Nnn \g_myproxy_str { example }{ myproxy }
3 \proxy_push_member:Vnn \g_myproxy_str { myvar }{ tl }

```

Then create a new object with name `myobj` with that proxy, assign then token list `\c_dollar_str{}` ~ `dollar` ~ `\c_dollar_str{}` to `myvar` and then print it.

```

1 \str_new:N \g_myobj_str
2 \object_create_gset:NVnn \g_myobj_str \g_myproxy_str
3 { example }{ myobj }
4 \tl_gset:cn
5 {
6   \object_member_adr:Vn \g_myobj_str { myvar }
7 }
8 { \c_dollar_str{ } ~ dollar ~ \c_dollar_str{ } }
9 \object_member_use:Vn \g_myobj_str { myvar }

```

Output: \$ dollar \$

You can also avoid to specify an object identify and use `\object_gallocate_gincr` instead:

```
1 \int_new:N \g_intc_int
2 \object_gallocate_gincr:NNVnNN \g_myobj_str \g_intc_int \g_myproxy_str
3 { example } \c_object_local_str \c_object_public_str
4 \tl_gset:cn
5 {
6   \object_member_adr:Vn \g_myobj_str { myvar }
7 }
8 { \c_dollar_str{} ~ dollar ~ \c_dollar_str{} }
9 \object_member_use:Vn \g_myobj_str { myvar }
```

Output: \$ dollar \$

Example 2

In this example we create a proxy object with an embedded object inside.

Internal proxy

```
1 \proxy_create:nn { mymod }{ INT }
2 \proxy_push_member:nnn
3 {
4   \object_address:nn { mymod }{ INT }
5 }{ var }{ t1 }
```

Container proxy

```
1 \proxy_create:nn { mymod }{ EXT }
2 \proxy_push_embedded:nnn
3 {
4   \object_address:nn { mymod }{ EXT }
5 }
6 { emb }
7 {
8   \object_address:nn { mymod }{ INT }
9 }
```

Now we create a new object from proxy EXT. It'll contain an embedded object created with INT proxy:

```
1 \str_new:N \g_EXTObj_str
2 \int_new:N \g_intcount_int
3 \object_gallocate_gincr:NNnnNN
4 \g_EXTObj_str \g_intcount_int
5 {
6   \object_address:nn { mymod }{ EXT }
7 }
8 { mymod }
9 \c_object_local_str \c_object_public_str
```


and use the embedded object in the following way:

```
1 \object_member_set:nnn
2 {
3   \object_embedded_adr:Vn \g_EXTObj_str { emb }
4 }{ var }{ Hi }
5 \object_member_use:nn
6 {
7   \object_embedded_adr:Vn \g_EXTObj_str { emb }
8 }{ var }
```

Output: Hi

Example 3

Here we show how to properly use `\object_member_generate:NN`. Suppose we don't know `\object_member_use` and we want to use `\tl_use:N` to get the value stored in member `MEM` of object `U` in module `MD3`.

We can do it in this way:

```
1 \tl_use:c
2 {
3   \object_member_adr:nnn
4   { \object_address:nn { MD3 }{ U } }
5   { MEM }{ tl }
6 }
```

but this solution is not so practical since we should write a lot of code each time. We can then use `\object_member_generate:NN` to define an auxiliary macro `\myaux_print_tl:nnn` in this way:

```
1 \object_member_generate:NN \myaux_print_tl \tl_use:c
```

then we can get the content of our member in this way:

```
1 \myaux_print_tl:nnn
2 { \object_address:nn { MD3 }{ U } }
3 { MEM }{ tl }
```

For example if `U` contains `Hi` then the preceding code will output `Hi`. If member `MEM` is tracked then you can use also the following command, which is generated together with `\myaux_print_tl:nnn`

```
1 \myaux_print_tl:nn
2 { \object_address:nn { MD3 }{ U } }
3 { MEM }
```

However, this function only works with `tl` members since we use `\tl_use:N`, so you should define a new function for every possible type, and even if you do it newer types introduced in other packages will not be supported. In such cases you can use `\object_member_generate_inline:Nnn` which allows you to build the called function by specifying its name and its parameters. The preceding code then becomes

```
1 \object_member_generate_inline:Nnn \myaux_print_tl { t1_use }{ c }
```

This function does much more: in the second argument you can put also the parameters #1 and #2 that will expand respectively to the type of specified member and its scope. Let `\myaux_print:nnn` be our version of `\object_member_use:nnn` that retrieves the value of the specified member, we are now able to define it in this way:

```
1 \object_member_generate_inline:Nnn \myaux_print { #1_use }{ c }
```

When you use `\myaux_print:nnn` on a member of type `int` it replaces all the occurrences of #1 with `int`, thus it will call `\int_use:c`.

8 Implementation

```
1 <*package>
2 <@@=rawobjects>
3
4 Deprecation message
5
6 \msg_new:nnn { rawobjects }{ deprecate }
7 {
8   Command ~ #1 ~ is ~ deprecated. ~ Use ~ instead ~ #2
9 }
10
11 \cs_new_protected:Nn \__rawobjects_launch_deprecate:NN
12 {
13   \msg_warning:nnnn{ rawobjects }{ deprecate }{ #1 }{ #2 }
14 }
15
```

`\rwoj_address_f:n` It just performs a `c` expansion before passing it to `\cs_to_str:N`.

```
14
15 \cs_new:Nn \rwoj_address_f:n
16 {
17   \exp_args:Nc \cs_to_str:N { #1 }
18 }
19
```

(End definition for `\rwoj_address_f:n`. This function is documented on page 7.)

```
\c_object_local_str
\c_object_global_str
\c_object_public_str
\c_object_private_str
20 \str_const:Nn \c_object_local_str {l}
21 \str_const:Nn \c_object_global_str {g}
22 \str_const:Nn \c_object_public_str {_}
23 \str_const:Nn \c_object_private_str {__}
24
25
26 \cs_new:Nn \__rawobjects_scope:N
27 {
28   \str_use:N #1
29 }
30
```

```

31 \cs_new:Nn \__rawobjects_scope_pfx:N
32 {
33   \str_if_eq:NNT #1 \c_object_local_str
34   { g }
35 }
36
37 \cs_generate_variant:Nn \__rawobjects_scope_pfx:N { c }
38
39 \cs_new:Nn \__rawobjects_scope_pfx_cl:n
40 {
41   \__rawobjects_scope_pfx:c{
42     \object_ncmember_adr:nnn
43     {
44       \object_embedded_adr:nn { #1 } { /_I_/ }
45     }
46   { S } { str }
47 }
48 }
49
50 \cs_new:Nn \__rawobjects_vis_var:N
51 {
52   \str_use:N #1
53 }
54
55 \cs_new:Nn \__rawobjects_vis_fun:N
56 {
57   \str_if_eq:NNT #1 \c_object_private_str
58   {
59     --
60   }
61 }
62

```

(End definition for `\c_object_local_str` and others. These variables are documented on page 14.)

`\object_address:nn` Get address of an object

```

63 \cs_new:Nn \object_address:nn {
64   \tl_to_str:n { #1 _ #2 }
65 }

```

(End definition for `\object_address:nn`. This function is documented on page 7.)

`\object_embedded_adr:nn` Address of embedded object

```

66
67 \cs_new:Nn \object_embedded_adr:nn
68 {
69   #1 \tl_to_str:n{ _SUB_ #2 }
70 }
71
72 \cs_generate_variant:Nn \object_embedded_adr:nn{ Vn }
73

```

(End definition for `\object_embedded_adr:nn`. This function is documented on page 7.)

`\object_address_set:Nnn` Saves the address of an object into a string variable
`\object_address_gset:Nnn`

```

74
75 \cs_new_protected:Nn \object_address_set:Nnn {
76   \str_set:Nn #1 { #2 _ #3 }
77 }
78
79 \cs_new_protected:Nn \object_address_gset:Nnn {
80   \str_gset:Nn #1 { #2 _ #3 }
81 }
82

```

(End definition for `\object_address_set:Nnn` and `\object_address_gset:Nnn`. These functions are documented on page 7.)

`\object_if_exist_p:n` Tests if object exists.
`\object_if_exist:nTF`

```

83
84 \prg_new_conditional:Nnn \object_if_exist:n { p, T, F, TF }
85 {
86   \cs_if_exist:cTF
87   {
88     \object_ncmember_adr:nnn
89     {
90       \object_embedded_adr:nn{ #1 }{ /_I_/ }
91     }
92     { S }{ str }
93   }
94   {
95     \prg_return_true:
96   }
97   {
98     \prg_return_false:
99   }
100 }
101
102 \prg_generate_conditional_variant:Nnn \object_if_exist:n { V }
103 { p, T, F, TF }
104

```

(End definition for `\object_if_exist:nTF`. This function is documented on page 7.)

`\object_get_module:n` Retrieve the name, module and generating proxy of an object
`\object_get_proxy_adr:n`

```

105 \cs_new:Nn \object_get_module:n {
106   \object_ncmember_use:nnn
107   {
108     \object_embedded_adr:nn{ #1 }{ /_I_/ }
109   }
110   { M }{ str }
111 }
112 \cs_new:Nn \object_get_proxy_adr:n {
113   \object_ncmember_use:nnn
114   {
115     \object_embedded_adr:nn{ #1 }{ /_I_/ }
116   }
117   { P }{ str }

```

```

118 }
119
120 \cs_generate_variant:Nn \object_get_module:n { V }
121 \cs_generate_variant:Nn \object_get_proxy_adr:n { V }

```

(End definition for `\object_get_module:n` and `\object_get_proxy_adr:n`. These functions are documented on page 7.)

```

\object_if_local_p:n Test the specified parameters.
\object_if_local:nTF 122 \prg_new_conditional:Nnn \object_if_local:n {p, T, F, TF}
\object_if_global_p:n 123 {
\object_if_global:nTF 124   \str_if_eq:cNTF
\object_if_public_p:n 125   {
\object_if_public:nTF 126     \object_ncmember_adr:nnn
\object_if_private_p:n 127     {
\object_if_private:nTF 128       \object_embedded_adr:nn{ #1 }{ /_I_/ }
129     }
130   { S }{ str }
131 }
132 \c_object_local_str
133 {
134   \prg_return_true:
135 }
136 {
137   \prg_return_false:
138 }
139 }
140
141 \prg_new_conditional:Nnn \object_if_global:n {p, T, F, TF}
142 {
143   \str_if_eq:cNTF
144   {
145     \object_ncmember_adr:nnn
146     {
147       \object_embedded_adr:nn{ #1 }{ /_I_/ }
148     }
149     { S }{ str }
150   }
151   \c_object_global_str
152   {
153     \prg_return_true:
154   }
155   {
156     \prg_return_false:
157   }
158 }
159
160 \prg_new_conditional:Nnn \object_if_public:n {p, T, F, TF}
161 {
162   \str_if_eq:cNTF
163   {
164     \object_ncmember_adr:nnn
165     {
166       \object_embedded_adr:nn{ #1 }{ /_I_/ }

```

```

167     }
168     { V }{ str }
169 }
170 \c_object_public_str
171 {
172     \prg_return_true:
173 }
174 {
175     \prg_return_false:
176 }
177 }
178
179 \prg_new_conditional:Nnn \object_if_private:n {p, T, F, TF}
180 {
181     \str_if_eq:cNTF
182     {
183         \object_ncmember_adr:nnn
184         {
185             \object_embedded_adr:nn{ #1 }{ /_I_/ }
186         }
187         { V }{ str }
188     }
189     \c_object_private_str
190     {
191         \prg_return_true:
192     }
193     {
194         \prg_return_false:
195     }
196 }
197
198 \prg_generate_conditional_variant:Nnn \object_if_local:n { V }
199 { p, T, F, TF }
200 \prg_generate_conditional_variant:Nnn \object_if_global:n { V }
201 { p, T, F, TF }
202 \prg_generate_conditional_variant:Nnn \object_if_public:n { V }
203 { p, T, F, TF }
204 \prg_generate_conditional_variant:Nnn \object_if_private:n { V }
205 { p, T, F, TF }

```

(End definition for \object_if_local:nTF and others. These functions are documented on page 7.)

\object_macro_adr:nn Generic macro address

\object_macro_use:nn

```

206
207 \cs_new:Nn \object_macro_adr:nn
208 {
209     #1 \tl_to_str:n{ _MACRO_ #2 }
210 }
211
212 \cs_generate_variant:Nn \object_macro_adr:nn{ Vn }
213
214 \cs_new:Nn \object_macro_use:nn
215 {
216     \use:c

```

```

217     {
218     \object_macro_adr:nn{ #1 }{ #2 }
219     }
220 }
221
222 \cs_generate_variant:Nn \object_macro_use:nn{ Vn }
223

```

(End definition for `\object_macro_adr:nn` and `\object_macro_use:nn`. These functions are documented on page 12.)

`_rawobjects_member_adr:nnnNN` Macro address without object inference

```

224
225 \cs_new:Nn \_rawobjects_member_adr:nnnNN
226 {
227   \_rawobjects_scope:N #4
228   \_rawobjects_vis_var:N #5
229   #1 \tl_to_str:n { _ MEMBER _ #2 _ #3 }
230 }
231
232 \cs_generate_variant:Nn \_rawobjects_member_adr:nnnNN { VnnNN, nnncc }
233

```

(End definition for `_rawobjects_member_adr:nnnNN`.)

`\object_member_adr:nnn` Get the address of a member variable

```

234
235 \cs_new:Nn \object_member_adr:nnn
236 {
237   \_rawobjects_member_adr:nnncc { #1 }{ #2 }{ #3 }
238   {
239     \object_ncmember_adr:nnn
240     {
241       \object_embedded_adr:nn{ #1 }{ /_I_/ }
242     }
243     { S }{ str }
244   }
245   {
246     \object_ncmember_adr:nnn
247     {
248       \object_embedded_adr:nn{ #1 }{ /_I_/ }
249     }
250     { V }{ str }
251   }
252 }
253
254 \cs_generate_variant:Nn \object_member_adr:nnn { Vnn, vnn, nnv, nnf }
255

```

(End definition for `\object_member_adr:nnn`. This function is documented on page 8.)

`\object_member_if_exist:p:nnn` Tests if the specified member exists

`\object_member_if_exist:nnnTF`

```

256
257 \prg_new_conditional:Nnn \object_member_if_exist:nnn {p, T, F, TF }
258 {

```

```

259   \cs_if_exist:cTF
260   {
261     \object_member_adr:nnn { #1 }{ #2 }{ #3 }
262   }
263   {
264     \prg_return_true:
265   }
266   {
267     \prg_return_false:
268   }
269 }
270
271 \prg_generate_conditional_variant:Nnn \object_member_if_exist:nnn
272 { Vnn }{ p, T, F, TF }
273

```

(End definition for `\object_member_if_exist:nnnTF`. This function is documented on page 8.)

`\object_member_if_tracked_p:nn` Tests if the member is tracked.
`\object_member_if_tracked:nnTF`

```

274
275 \prg_new_conditional:Nnn \object_member_if_tracked:nn {p, T, F, TF }
276 {
277   \cs_if_exist:cTF
278   {
279     \object_rcmember_adr:nnn
280     { #1 }{ #2 _ type }{ str }
281   }
282   {
283     \prg_return_true:
284   }
285   {
286     \cs_if_exist:cTF
287     {
288       \object_ncmember_adr:nnn
289       {
290         \object_embedded_adr:nn { #1 }{ /_T/_ }
291       }
292       { #2 _ type }{ str }
293     }
294     {
295       \prg_return_true:
296     }
297     {
298       \prg_return_false:
299     }
300   }
301 }
302
303 \prg_generate_conditional_variant:Nnn \object_member_if_tracked:nn
304 { Vn }{ p, T, F, TF }
305
306 \prg_new_eq_conditional:NNn \object_member_if_exist:nn
307 \object_member_if_tracked:nn { p, T, F, TF }
308 \prg_new_eq_conditional:NNn \object_member_if_exist:Vn

```



```

309 \object_member_if_tracked:Vn { p, T, F, TF }
310

```

(End definition for `\object_member_if_tracked:nnTF`. This function is documented on page 8.)

`\object_member_type:nn` Deduce the type of tracked members.

```

311
312 \cs_new:Nn \object_member_type:nn
313 {
314   \cs_if_exist:cTF
315   {
316     \object_rcmember_adr:nnn
317     { #1 } { #2 _ type } { str }
318   }
319   {
320     \object_rcmember_use:nnn
321     { #1 } { #2 _ type } { str }
322   }
323   {
324     \cs_if_exist:cT
325     {
326       \object_ncmember_adr:nnn
327       {
328         \object_embedded_adr:nn { #1 } { /_T_/ }
329       }
330       { #2 _ type } { str }
331     }
332     {
333       \object_ncmember_use:nnn
334       {
335         \object_embedded_adr:nn { #1 } { /_T_/ }
336       }
337       { #2 _ type } { str }
338     }
339   }
340 }
341

```

(End definition for `\object_member_type:nn`. This function is documented on page 8.)

`\object_member_adr:nn` Get the address of a member variable

```

342
343 \cs_new:Nn \object_member_adr:nn
344 {
345   \object_member_adr:nnf { #1 } { #2 }
346   {
347     \object_member_type:nn { #1 } { #2 }
348   }
349 }
350
351 \cs_generate_variant:Nn \object_member_adr:nn { Vn }
352

```

(End definition for `\object_member_adr:nn`. This function is documented on page 8.)

Helper functions for `\object*_generate` functions.

```
353
354 \cs_new:Nn \__rawobjects_par_trans:N
355 {
356   \str_case:nnF { #1 }
357   {
358     { N }{ N }
359     { V }{ N }
360     { n }{ n }
361     { v }{ n }
362     { f }{ n }
363     { x }{ n }
364     { e }{ n }
365     { o }{ n }
366     { ~ }{}
367   }
368   { #1 }
369 }
370
371 \cs_new:Nn \__rawobjects_par_trans:n
372 {
373   \str_map_function:nN { #1 } \__rawobjects_par_trans:N
374 }
375
376 \str_new:N \l__rawobjects_tmp_fa_str
377
378 \cs_new_protected:Nn \__rawobjects_save_dat:n
379 {
380   \str_set:Nx \l__rawobjects_tmp_fa_str
381   { \str_tail:n{ #1 } }
382 }
383 \cs_new_protected:Nn \__rawobjects_save_dat:nnN
384 {
385   \str_set:Nx \l__rawobjects_tmp_fa_str
386   { \str_tail:n{ #2 } }
387 }
388 \cs_new_protected:Nn \__rawobjects_save_dat_aux:n
389 {
390   \__rawobjects_save_dat:nnN #1
391 }
392 \cs_generate_variant:Nn \__rawobjects_save_dat_aux:n { f }
393
394 \cs_new_protected:Nn \__rawobjects_save_fun:N
395 {
396   \__rawobjects_save_dat_aux:f { \cs_split_function:N #1 }
397 }
398
399 \cs_new:Nn \__rawobjects_use_dat:nn
400 {
401   #1 : #2 \str_use:N \l__rawobjects_tmp_fa_str
402 }
403
```

`\object_member_generate:NN`

`\object_member_generate_inline:Nnn`

`\object_member_generate_protected:NN`

`object_member_generate_protected_inline:Nnn`

Generate member versions of specified functions.

```
404
405 \cs_new_protected:Nn \__rawobjects_mgen:nN
406 {
407   \__rawobjects_save_fun:N #2
408   \cs_new:cpn { #1 : nnn \str_use:N \l__rawobjects_tmp_fa_str } ##1##2##3
409     {
410       #2
411       {
412         \object_member_adr:nnn{ ##1 }{ ##2 }{ ##3 }
413       }
414     }
415   \cs_new:cpn { #1 : nn \str_use:N \l__rawobjects_tmp_fa_str } ##1##2
416     {
417       #2
418       {
419         \object_member_adr:nn{ ##1 }{ ##2 }
420       }
421     }
422 }
423 \cs_new_protected:Nn \__rawobjects_mgen_pr:nN
424 {
425   \__rawobjects_save_fun:N #2
426   \cs_new_protected:cpn
427     { #1 : nnn \str_use:N \l__rawobjects_tmp_fa_str } ##1##2##3
428     {
429       #2
430       {
431         \object_member_adr:nnn{ ##1 }{ ##2 }{ ##3 }
432       }
433     }
434   \cs_new_protected:cpn
435     { #1 : nn \str_use:N \l__rawobjects_tmp_fa_str } ##1##2
436     {
437       #2
438       {
439         \object_member_adr:nn{ ##1 }{ ##2 }
440       }
441     }
442 }
443
444 \cs_new_protected:Nn \__rawobjects_mgen:nnn
445 {
446   \__rawobjects_save_dat:n { #3 }
447
448   \cs_new:cpn { __rawobjects_auxfun_#1 :nn } ##1##2
449     {
450       \use:c{ #2 : #3 }
451     }
452   \cs_generate_variant:cn { __rawobjects_auxfun_#1 :nn }{ nf, ff }
453
454   \cs_new:cpn { #1 : nnn \str_use:N \l__rawobjects_tmp_fa_str } ##1##2##3
455     {
456       \use:c { __rawobjects_auxfun_#1 :nf }
```

```

457         { ##3 }
458         {
459             \__rawobjects_scope_pfx_cl:n{ ##1 }
460         }
461         {
462             \object_member_adr:nnn{ ##1 }{ ##2 }{ ##3 }
463         }
464     }
465 \cs_new:cpn { #1 : nn \str_use:N \l__rawobjects_tmp_fa_str } ##1##2
466 {
467     \use:c { __rawobjects_auxfun_#1 :ff }
468     {
469         \object_member_type:nn { ##1 }{ ##2 }
470     }
471     {
472         \__rawobjects_scope_pfx_cl:n{ ##1 }
473     }
474     {
475         \object_member_adr:nn{ ##1 }{ ##2 }
476     }
477 }
478 }
479 \cs_new_protected:Nn \__rawobjects_mgen_pr:nnn
480 {
481     \__rawobjects_save_dat:n { #3 }
482
483     \cs_new:cpn { __rawobjects_auxfun_#1 :nn } ##1##2
484     {
485         \use:c{ #2 : #3 }
486     }
487     \cs_generate_variant:cn { __rawobjects_auxfun_#1 :nn }{ nf, ff }
488
489     \cs_new_protected:cpn
490     { #1 : nnn \str_use:N \l__rawobjects_tmp_fa_str } ##1##2##3
491     {
492         \use:c { __rawobjects_auxfun_#1 :nf }
493         { ##3 }
494         {
495             \__rawobjects_scope_pfx_cl:n{ ##1 }
496         }
497         {
498             \object_member_adr:nnn{ ##1 }{ ##2 }{ ##3 }
499         }
500     }
501
502     \cs_new_protected:cpn
503     { #1 : nn \str_use:N \l__rawobjects_tmp_fa_str } ##1##2
504     {
505         \use:c { __rawobjects_auxfun_#1 :ff }
506         {
507             \object_member_type:nn { ##1 }{ ##2 }
508         }
509         {
510             \__rawobjects_scope_pfx_cl:n{ ##1 }
511         }
512     }

```

```

511         {
512             \object_member_adr:nn{ ##1 }{ ##2 }
513         }
514     }
515 }
516
517 \cs_generate_variant:Nn \__rawobjects_mgen:nN { fN }
518 \cs_generate_variant:Nn \__rawobjects_mgen:nnn { fnn }
519 \cs_generate_variant:Nn \__rawobjects_mgen_pr:nN { fN }
520 \cs_generate_variant:Nn \__rawobjects_mgen_pr:nnn { fnn }
521
522 \cs_new_protected:Nn \object_member_generate:NN
523 {
524     \__rawobjects_mgen:fN { \cs_to_str:N #1 } #2
525 }
526
527 \cs_new_protected:Nn \object_member_generate_inline:Nnn
528 {
529     \__rawobjects_mgen:fnn { \cs_to_str:N #1 }{ #2 }{ #3 }
530 }
531 \cs_new_protected:Nn \object_member_generate_protected:NN
532 {
533     \__rawobjects_mgen_pr:fN { \cs_to_str:N #1 } #2
534 }
535
536 \cs_new_protected:Nn \object_member_generate_protected_inline:Nnn
537 {
538     \__rawobjects_mgen_pr:fnn { \cs_to_str:N #1 }{ #2 }{ #3 }
539 }
540

```

(End definition for `\object_member_generate:NN` and others. These functions are documented on page 9.)

\object_ncmember_generate:NN Generate ncmember versions of specified functions.

```

\object_ncmember_generate_inline:Nnn
\object_ncmember_generate_protected:NN
\object_ncmember_generate_protected_inline:Nnn
541
542 \cs_new_protected:Nn \__rawobjects_ncgen:nN
543 {
544     \__rawobjects_save_fun:N #2
545     \cs_new:cpn { #1 : nnn \str_use:N \l__rawobjects_tmp_fa_str } ##1##2##3
546     {
547         #2
548         {
549             \object_ncmember_adr:nnn{ ##1 }{ ##2 }{ ##3 }
550         }
551     }
552 }
553 \cs_new_protected:Nn \__rawobjects_ncgen_pr:nN
554 {
555     \__rawobjects_save_fun:N #2
556     \cs_new_protected:cpn
557     { #1 : nnn \str_use:N \l__rawobjects_tmp_fa_str } ##1##2##3
558     {
559         #2

```

```

560         {
561             \object_ncmember_adr:nnn{ ##1 }{ ##2 }{ ##3 }
562         }
563     }
564 }
565
566 \cs_new_protected:Nn \__rawobjects_ncgen:nnn
567 {
568     \__rawobjects_save_dat:n { #3 }
569
570     \cs_new:cpn { __rawobjects_auxfun_#1 :nn } ##1##2
571     {
572         \use:c{ #2 : #3 }
573     }
574     \cs_generate_variant:cn { __rawobjects_auxfun_#1 :nn }{ nf }
575
576     \cs_new:cpn { #1 : nnn \str_use:N \l__rawobjects_tmp_fa_str } ##1##2##3
577     {
578         \use:c { __rawobjects_auxfun_#1 :nf }
579         { ##3 }
580         {
581             \__rawobjects_scope_pfx_cl:n{ ##1 }
582         }
583         {
584             \object_ncmember_adr:nnn{ ##1 }{ ##2 }{ ##3 }
585         }
586     }
587 }
588 \cs_new_protected:Nn \__rawobjects_ncgen_pr:nnn
589 {
590     \__rawobjects_save_dat:n { #3 }
591
592     \cs_new:cpn { __rawobjects_auxfun_#1 :nn } ##1##2
593     {
594         \use:c{ #2 : #3 }
595     }
596     \cs_generate_variant:cn { __rawobjects_auxfun_#1 :nn }{ nf }
597
598     \cs_new_protected:cpn
599     { #1 : nnn \str_use:N \l__rawobjects_tmp_fa_str } ##1##2##3
600     {
601         \use:c { __rawobjects_auxfun_#1 :nf }
602         { ##3 }
603         {
604             \__rawobjects_scope_pfx_cl:n{ ##1 }
605         }
606         {
607             \object_ncmember_adr:nnn{ ##1 }{ ##2 }{ ##3 }
608         }
609     }
610 }
611
612 \cs_generate_variant:Nn \__rawobjects_ncgen:nN { fN }
613 \cs_generate_variant:Nn \__rawobjects_ncgen:nnn { fnn }

```

```

614 \cs_generate_variant:Nn \__rawobjects_ncgen_pr:nN { fN }
615 \cs_generate_variant:Nn \__rawobjects_ncgen_pr:nnn { fnn }
616
617 \cs_new_protected:Nn \object_ncmember_generate:NN
618 {
619   \__rawobjects_ncgen:fN { \cs_to_str:N #1 } #2
620 }
621
622 \cs_new_protected:Nn \object_ncmember_generate_inline:Nnn
623 {
624   \__rawobjects_ncgen:fnn { \cs_to_str:N #1 }{ #2 }{ #3 }
625 }
626 \cs_new_protected:Nn \object_ncmember_generate_protected:NN
627 {
628   \__rawobjects_ncgen_pr:fN { \cs_to_str:N #1 } #2
629 }
630
631 \cs_new_protected:Nn \object_ncmember_generate_protected_inline:Nnn
632 {
633   \__rawobjects_ncgen_pr:fnn { \cs_to_str:N #1 }{ #2 }{ #3 }
634 }
635

```

(End definition for `\object_ncmember_generate:NN` and others. These functions are documented on page 10.)

`\object_rcmember_generate:NN` Generate rcmember versions of specified functions.

```

\object_rcmember_generate_inline:Nnn
\object_rcmember_generate_protected:NN
\object_rcmember_generate_protected_inline:Nnn
636
637 \cs_new_protected:Nn \__rawobjects_rcgen:nN
638 {
639   \__rawobjects_save_fun:N #2
640   \cs_new:cpn { #1 : nnn \str_use:N \l__rawobjects_tmp_fa_str } ##1##2##3
641   {
642     #2
643     {
644       \object_rcmember_adr:nnn{ ##1 }{ ##2 }{ ##3 }
645     }
646   }
647 }
648 \cs_new_protected:Nn \__rawobjects_rcgen_pr:nN
649 {
650   \__rawobjects_save_fun:N #2
651   \cs_new_protected:cpn
652   { #1 : nnn \str_use:N \l__rawobjects_tmp_fa_str } ##1##2##3
653   {
654     #2
655     {
656       \object_rcmember_adr:nnn{ ##1 }{ ##2 }{ ##3 }
657     }
658   }
659 }
660
661 \cs_new_protected:Nn \__rawobjects_rcgen:nnn
662 {

```

```

663     \__rawobjects_save_dat:n { #3 }
664
665     \cs_new:cpn { __rawobjects_auxfun_#1 :nn } ##1##2
666     {
667         \use:c{ #2 : #3 }
668     }
669     \cs_generate_variant:cn { __rawobjects_auxfun_#1 :nn }{ nf }
670
671     \cs_new:cpn { #1 : nnn \str_use:N \l__rawobjects_tmp_fa_str } ##1##2##3
672     {
673         \use:c { __rawobjects_auxfun_#1 :nf }
674         { ##3 }
675         {
676             \__rawobjects_scope_pfx_cl:n{ ##1 }
677         }
678         {
679             \object_rcmember_adr:nnn{ ##1 }{ ##2 }{ ##3 }
680         }
681     }
682 }
683 \cs_new_protected:Nn \__rawobjects_rcgen_pr:nnn
684 {
685     \__rawobjects_save_dat:n { #3 }
686
687     \cs_new:cpn { __rawobjects_auxfun_#1 :nn } ##1##2
688     {
689         \use:c{ #2 : #3 }
690     }
691     \cs_generate_variant:cn { __rawobjects_auxfun_#1 :nn }{ nf }
692
693     \cs_new_protected:cpn
694     { #1 : nnn \str_use:N \l__rawobjects_tmp_fa_str } ##1##2##3
695     {
696         \use:c { __rawobjects_auxfun_#1 :nf }
697         { ##3 }
698         {
699             \__rawobjects_scope_pfx_cl:n{ ##1 }
700         }
701         {
702             \object_rcmember_adr:nnn{ ##1 }{ ##2 }{ ##3 }
703         }
704     }
705 }
706
707 \cs_generate_variant:Nn \__rawobjects_rcgen:nN { fN }
708 \cs_generate_variant:Nn \__rawobjects_rcgen:nnn { fnn }
709 \cs_generate_variant:Nn \__rawobjects_rcgen_pr:nN { fN }
710 \cs_generate_variant:Nn \__rawobjects_rcgen_pr:nnn { fnn }
711
712 \cs_new_protected:Nn \object_rcmember_generate:NN
713 {
714     \__rawobjects_rcgen:fN { \cs_to_str:N #1 } #2
715 }
716

```



```

717 \cs_new_protected:Nn \object_rcmember_generate_inline:Nnn
718 {
719   \__rawobjects_rcgen:fnn { \cs_to_str:N #1 }{ #2 }{ #3 }
720 }
721 \cs_new_protected:Nn \object_rcmember_generate_protected:NN
722 {
723   \__rawobjects_rcgen_pr:fN { \cs_to_str:N #1 } #2
724 }
725
726 \cs_new_protected:Nn \object_rcmember_generate_protected_inline:Nnn
727 {
728   \__rawobjects_rcgen_pr:fnn { \cs_to_str:N #1 }{ #2 }{ #3 }
729 }
730

```

(End definition for `\object_rcmember_generate:NN` and others. These functions are documented on page 10.)

Auxiliary functions

```

731
732 \cs_generate_variant:Nn \cs_generate_variant:Nn { cx }
733
734 \cs_new_protected:Nn \__rawobjects_genmem_int:nnn
735 {
736   \__rawobjects_mgen:nnn { #1 }{ #2 }{ #3 }
737   \cs_generate_variant:cx
738     { #1 : nnn \str_use:N \l__rawobjects_tmp_fa_str }
739     { Vnn \str_use:N \l__rawobjects_tmp_fa_str, nnv \str_use:N \l__rawobjects_tmp_fa_str }
740   \cs_generate_variant:cx
741     { #1 : nn \str_use:N \l__rawobjects_tmp_fa_str }
742     { Vn \str_use:N \l__rawobjects_tmp_fa_str }
743 }
744 \cs_new_protected:Nn \__rawobjects_genmem_pr_int:nnn
745 {
746   \__rawobjects_mgen_pr:nnn { #1 }{ #2 }{ #3 }
747   \cs_generate_variant:cx
748     { #1 : nnn \str_use:N \l__rawobjects_tmp_fa_str }
749     { Vnn \str_use:N \l__rawobjects_tmp_fa_str, nnv \str_use:N \l__rawobjects_tmp_fa_str }
750   \cs_generate_variant:cx
751     { #1 : nn \str_use:N \l__rawobjects_tmp_fa_str }
752     { Vn \str_use:N \l__rawobjects_tmp_fa_str }
753 }
754
755 \cs_new_protected:Nn \__rawobjects_genncm_int:nnn
756 {
757   \__rawobjects_ncgen:nnn { #1 }{ #2 }{ #3 }
758   \cs_generate_variant:cx
759     { #1 : nnn \str_use:N \l__rawobjects_tmp_fa_str }
760     { Vnn \str_use:N \l__rawobjects_tmp_fa_str }
761 }
762 \cs_new_protected:Nn \__rawobjects_genncm_pr_int:nnn
763 {
764   \__rawobjects_ncgen_pr:nnn { #1 }{ #2 }{ #3 }
765   \cs_generate_variant:cx
766     { #1 : nnn \str_use:N \l__rawobjects_tmp_fa_str }

```

```

767     { Vnn \str_use:N \l__rawobjects_tmp_fa_str }
768   }
769
770 \cs_new_protected:Nn \__rawobjects_genrcm_int:nnn
771 {
772   \__rawobjects_rcgen:nnn { #1 }{ #2 }{ #3 }
773   \cs_generate_variant:cx
774     { #1 : nnn \str_use:N \l__rawobjects_tmp_fa_str }
775     { Vnn \str_use:N \l__rawobjects_tmp_fa_str }
776 }
777 \cs_new_protected:Nn \__rawobjects_genrcm_pr_int:nnn
778 {
779   \__rawobjects_rcgen_pr:nnn { #1 }{ #2 }{ #3 }
780   \cs_generate_variant:cx
781     { #1 : nnn \str_use:N \l__rawobjects_tmp_fa_str }
782     { Vnn \str_use:N \l__rawobjects_tmp_fa_str }
783 }
784
785
786 \msg_new:nnnn { rawobjects }{ noerr }{ Unspecified ~ scope }
787 {
788   Object ~ #1 ~ hasn't ~ a ~ scope ~ variable
789 }
790

```

\object_new_member:nnn Creates a new member variable

\object_new_member_tracked:nnn

```

791
792 \__rawobjects_genmem_pr_int:nnn { object_new_member }{ #1 _ new }{ c }
793
794 \cs_new_protected:Nn \object_new_member_tracked:nnn
795 {
796   \object_new_member:nnn { #1 }{ #2 }{ #3 }
797
798   \str_const:cn
799     {
800       \object_ncmember_adr:nnn
801       {
802         \object_embedded_adr:nn { #1 }{ /_T/ }
803       }
804       { #2 _ type }{ str }
805     }
806     { #3 }
807 }
808
809 \cs_generate_variant:Nn \object_new_member_tracked:nnn { Vnn, nnv }
810

```

(End definition for \object_new_member:nnn and \object_new_member_tracked:nnn. These functions are documented on page 8.)

\object_member_use:nnn Uses a member variable

\object_member_use:nn

```

811
812 \__rawobjects_genmem_int:nnn {object_member_use}{ #1_use }{c}
813

```

```
814 \cs_generate_variant:Nn \object_member_use:nnn {vnn}
815
```

(End definition for `\object_member_use:nnn` and `\object_member_use:nn`. These functions are documented on page 9.)

`\object_member_set:nnnn` `\object_member_set:nnn`
Set the value a member.

```
816
817 \__rawobjects_genmem_pr_int:nnn {object_member_set}{ #1_#2 set }{ cn }
818
```

(End definition for `\object_member_set:nnnn` and `\object_member_set:nnn`. These functions are documented on page 9.)

`\object_member_set_eq:nnnN` `\object_member_set_eq:nnN`
Make a member equal to another variable.

```
819
820 \__rawobjects_genmem_pr_int:nnn { object_member_set_eq }{ #1 _ #2 set_eq }{ cN }
821
822 \cs_generate_variant:Nn \object_member_set_eq:nnnN { nnc, Vnnc }
823
824 \cs_generate_variant:Nn \object_member_set_eq:nnN { nnc, Vnc }
825
```

(End definition for `\object_member_set_eq:nnnN` and `\object_member_set_eq:nnN`. These functions are documented on page 9.)

`\object_ncmember_adr:nnn` Get address of near constant

```
826
827 \cs_new:Nn \object_ncmember_adr:nnn
828 {
829   \tl_to_str:n{ c _ } #1 \tl_to_str:n { _ CONST _ #2 _ #3 }
830 }
831
832 \cs_generate_variant:Nn \object_ncmember_adr:nnn { Vnn, vnn }
833
```

(End definition for `\object_ncmember_adr:nnn`. This function is documented on page 10.)

`\object_rcmember_adr:nnn` Get the address of a remote constant.

```
834
835 \cs_new:Nn \object_rcmember_adr:nnn
836 {
837   \object_ncmember_adr:vnn
838   {
839     \object_ncmember_adr:nnn
840     {
841       \object_embedded_adr:nn{ #1 }{ /_I_/ }
842     }
843     { P }{ str }
844   }
845   { #2 }{ #3 }
846 }
847
848 \cs_generate_variant:Nn \object_rcmember_adr:nnn { Vnn }
```

(End definition for `\object_rcmember_adr:nnn`. This function is documented on page 10.)

```

\object_ncmember_if_exist_p:nnn Tests if the specified member constant exists.
\object_ncmember_if_exist:nnnTF
\object_rcmember_if_exist_p:nnn
\object_rcmember_if_exist:nnnTF
849
850 \prg_new_conditional:Nnn \object_ncmember_if_exist:nnn {p, T, F, TF }
851 {
852   \cs_if_exist:cTF
853   {
854     \object_ncmember_adr:nnn { #1 }{ #2 }{ #3 }
855   }
856   {
857     \prg_return_true:
858   }
859   {
860     \prg_return_false:
861   }
862 }
863
864 \prg_new_conditional:Nnn \object_rcmember_if_exist:nnn {p, T, F, TF }
865 {
866   \cs_if_exist:cTF
867   {
868     \object_rcmember_adr:nnn { #1 }{ #2 }{ #3 }
869   }
870   {
871     \prg_return_true:
872   }
873   {
874     \prg_return_false:
875   }
876 }
877
878 \prg_generate_conditional_variant:Nnn \object_ncmember_if_exist:nnn
879 { Vnn }{ p, T, F, TF }
880 \prg_generate_conditional_variant:Nnn \object_rcmember_if_exist:nnn
881 { Vnn }{ p, T, F, TF }
882

```

(End definition for `\object_ncmember_if_exist:nnnTF` and `\object_rcmember_if_exist:nnnTF`. These functions are documented on page 10.)

```

\object_ncmember_use:nnn Uses a near/remote constant.
\object_rcmember_use:nnn
883
884 \__rawobjects_genncm_int:nnn { object_ncmember_use }{ #1_use}{ c }
885
886 \__rawobjects_genrcm_int:nnn { object_rcmember_use }{ #1_use}{ c }
887

```

(End definition for `\object_ncmember_use:nnn` and `\object_rcmember_use:nnn`. These functions are documented on page 10.)

```

\object_newconst:nnnn Creates a constant variable, use with caution
888
889 \__rawobjects_genncm_pr_int:nnn { object_newconst }{ #1 _ const }{ cn }
890

```

(End definition for `\object_newconst:nnnn`. This function is documented on page 12.)

```

\object_newconst_tl:nnn Create constants
\object_newconst_str:nnn
\object_newconst_int:nnn
\object_newconst_clist:nnn
\object_newconst_dim:nnn
\object_newconst_skip:nnn
\object_newconst_fp:nnn
891
892 \cs_new_protected:Nn \object_newconst_tl:nnn
893 {
894   \object_newconst:nnnn { #1 }{ #2 }{ tl }{ #3 }
895 }
896 \cs_new_protected:Nn \object_newconst_str:nnn
897 {
898   \object_newconst:nnnn { #1 }{ #2 }{ str }{ #3 }
899 }
900 \cs_new_protected:Nn \object_newconst_int:nnn
901 {
902   \object_newconst:nnnn { #1 }{ #2 }{ int }{ #3 }
903 }
904 \cs_new_protected:Nn \object_newconst_clist:nnn
905 {
906   \object_newconst:nnnn { #1 }{ #2 }{ clist }{ #3 }
907 }
908 \cs_new_protected:Nn \object_newconst_dim:nnn
909 {
910   \object_newconst:nnnn { #1 }{ #2 }{ dim }{ #3 }
911 }
912 \cs_new_protected:Nn \object_newconst_skip:nnn
913 {
914   \object_newconst:nnnn { #1 }{ #2 }{ skip }{ #3 }
915 }
916 \cs_new_protected:Nn \object_newconst_fp:nnn
917 {
918   \object_newconst:nnnn { #1 }{ #2 }{ fp }{ #3 }
919 }
920
921 \cs_generate_variant:Nn \object_newconst_tl:nnn { Vnn }
922 \cs_generate_variant:Nn \object_newconst_str:nnn { Vnn }
923 \cs_generate_variant:Nn \object_newconst_int:nnn { Vnn }
924 \cs_generate_variant:Nn \object_newconst_clist:nnn { Vnn }
925 \cs_generate_variant:Nn \object_newconst_dim:nnn { Vnn }
926 \cs_generate_variant:Nn \object_newconst_skip:nnn { Vnn }
927 \cs_generate_variant:Nn \object_newconst_fp:nnn { Vnn }
928
929
930 \cs_generate_variant:Nn \object_newconst_str:nnn { nnx }
931 \cs_generate_variant:Nn \object_newconst_str:nnn { nnV }
932

```

(End definition for `\object_newconst_tl:nnn` and others. These functions are documented on page 12.)

`\object_newconst_seq_from_clist:nnn` Creates a seq constant.

```

933
934 \cs_new_protected:Nn \object_newconst_seq_from_clist:nnn
935 {
936   \seq_const_from_clist:cn
937   {
938     \object_ncmember_adr:nnn { #1 }{ #2 }{ seq }
939   }

```

```

940     { #3 }
941   }
942
943 \cs_generate_variant:Nn \object_newconst_seq_from_clist:nnn { Vnn }
944

```

(End definition for `\object_newconst_seq_from_clist:nnn`. This function is documented on page 12.)

`\object_newconst_prop_from_keyval:nnn` Creates a prop constant.

```

945
946 \cs_new_protected:Nn \object_newconst_prop_from_keyval:nnn
947   {
948     \prop_const_from_keyval:cn
949     {
950       \object_ncmember_adr:nnn { #1 } { #2 } { prop }
951     }
952     { #3 }
953   }
954
955 \cs_generate_variant:Nn \object_newconst_prop_from_keyval:nnn { Vnn }
956

```

(End definition for `\object_newconst_prop_from_keyval:nnn`. This function is documented on page 12.)

`\object_ncmethod_adr:nnn` Fully expands to the method address.

`\object_rcmethod_adr:nnn`

```

957
958 \cs_new:Nn \object_ncmethod_adr:nnn
959   {
960     #1 \tl_to_str:n { _ CMETHOD _ #2 : #3 }
961   }
962
963 \cs_generate_variant:Nn \object_ncmethod_adr:nnn { Vnn , vnn }
964
965 \cs_new:Nn \object_rcmethod_adr:nnn
966   {
967     \object_ncmethod_adr:vnn
968     {
969       \object_ncmember_adr:nnn
970       {
971         \object_embedded_adr:nn{ #1 } { /_I/ }
972       }
973       { P } { str }
974     }
975     { #2 } { #3 }
976   }
977
978 \cs_generate_variant:Nn \object_ncmethod_adr:nnn { Vnn , vnn }
979 \cs_generate_variant:Nn \object_rcmethod_adr:nnn { Vnn }
980

```

(End definition for `\object_ncmethod_adr:nnn` and `\object_rcmethod_adr:nnn`. These functions are documented on page 11.)

```

\object_ncmethod_if_exist_p:nnn Tests if the specified member constant exists.
\object_ncmethod_if_exist:nnnTF
\object_rcmethod_if_exist_p:nnn
\object_rcmethod_if_exist:nnnTF
981
982 \prg_new_conditional:Nnn \object_ncmethod_if_exist:nnn {p, T, F, TF }
983 {
984   \cs_if_exist:cTF
985   {
986     \object_ncmethod_adr:nnn { #1 }{ #2 }{ #3 }
987   }
988   {
989     \prg_return_true:
990   }
991   {
992     \prg_return_false:
993   }
994 }
995
996 \prg_new_conditional:Nnn \object_rcmethod_if_exist:nnn {p, T, F, TF }
997 {
998   \cs_if_exist:cTF
999   {
1000     \object_rcmethodr_adr:nnn { #1 }{ #2 }{ #3 }
1001   }
1002   {
1003     \prg_return_true:
1004   }
1005   {
1006     \prg_return_false:
1007   }
1008 }
1009
1010 \prg_generate_conditional_variant:Nnn \object_ncmethod_if_exist:nnn
1011 { Vnn }{ p, T, F, TF }
1012 \prg_generate_conditional_variant:Nnn \object_rcmethod_if_exist:nnn
1013 { Vnn }{ p, T, F, TF }
1014

```

(End definition for `\object_ncmethod_if_exist:nnnTF` and `\object_rcmethod_if_exist:nnnTF`. These functions are documented on page 11.)

`\object_new_cmethod:nnnn` Creates a new method

```

1015
1016 \cs_new_protected:Nn \object_new_cmethod:nnnn
1017 {
1018   \cs_new:cn
1019   {
1020     \object_ncmethod_adr:nnn { #1 }{ #2 }{ #3 }
1021   }
1022   { #4 }
1023 }
1024
1025 \cs_generate_variant:Nn \object_new_cmethod:nnnn { Vnnn }
1026

```

(End definition for `\object_new_cmethod:nnnn`. This function is documented on page 11.)

`\object_ncmethod_call:nnn` Calls the specified method.

`\object_rcmethod_call:nnn`

```
1027
1028 \cs_new:Nn \object_ncmethod_call:nnn
1029 {
1030   \use:c
1031   {
1032     \object_ncmethod_adr:nnn { #1 } { #2 } { #3 }
1033   }
1034 }
1035
1036 \cs_new:Nn \object_rcmethod_call:nnn
1037 {
1038   \use:c
1039   {
1040     \object_rcmethod_adr:nnn { #1 } { #2 } { #3 }
1041   }
1042 }
1043
1044 \cs_generate_variant:Nn \object_ncmethod_call:nnn { Vnn }
1045 \cs_generate_variant:Nn \object_rcmethod_call:nnn { Vnn }
1046
```

(End definition for `\object_ncmethod_call:nnn` and `\object_rcmethod_call:nnn`. These functions are documented on page 11.)

```
1047
1048 \cs_new_protected:Nn \__rawobjects_initproxy:nnn
1049 {
1050   \object_newconst:nnnn
1051   {
1052     \object_embedded_adr:nn{ #3 } { /_I_/ }
1053   }
1054   { ifprox } { bool } { \c_true_bool }
1055 }
1056 \cs_generate_variant:Nn \__rawobjects_initproxy:nnn { VnV }
1057
```

`\object_if_proxy_p:n` Test if an object is a proxy.

`\object_if_proxy:nTF`

```
1058
1059 \cs_new:Nn \__rawobjects_bol_com:N
1060 {
1061   \cs_if_exist_p:N #1 && \bool_if_p:N #1
1062 }
1063
1064 \cs_generate_variant:Nn \__rawobjects_bol_com:N { c }
1065
1066 \prg_new_conditional:Nnn \object_if_proxy:n {p, T, F, TF}
1067 {
1068   \cs_if_exist:cTF
1069   {
1070     \object_ncmember_adr:nnn
1071     {
1072       \object_embedded_adr:nn{ #1 } { /_I_/ }
1073     }
1074     { ifprox } { bool }
1075
```



```

1075     }
1076     {
1077     \bool_if:cTF
1078     {
1079     \object_ncmember_adr:nnn
1080     {
1081     \object_embedded_adr:nn{ #1 }{ /_I_/ }
1082     }
1083     { ifprox }{ bool }
1084     }
1085     {
1086     \prg_return_true:
1087     }
1088     {
1089     \prg_return_false:
1090     }
1091     }
1092     {
1093     \prg_return_false:
1094     }
1095 }
1096

```

(End definition for \object_if_proxy:nTF. This function is documented on page 13.)

\object_test_proxy_p:nn
\object_test_proxy:nnTF
\object_test_proxy_p:nN
\object_test_proxy:nNTF

Test if an object is generated from selected proxy.

```

1097
1098 \prg_generate_conditional_variant:Nnn \str_if_eq:nn { ve }{ TF }
1099
1100 \prg_new_conditional:Nnn \object_test_proxy:nn {p, T, F, TF}
1101 {
1102   \str_if_eq:veTF
1103   {
1104     \object_ncmember_adr:nnn
1105     {
1106     \object_embedded_adr:nn{ #1 }{ /_I_/ }
1107     }
1108     { P }{ str }
1109   }
1110 { #2 }
1111 {
1112   \prg_return_true:
1113   }
1114   {
1115   \prg_return_false:
1116   }
1117 }
1118
1119 \prg_new_conditional:Nnn \object_test_proxy:nN {p, T, F, TF}
1120 {
1121   \str_if_eq:cNTF
1122   {
1123     \object_ncmember_adr:nnn
1124     {

```

```

1125         \object_embedded_adr:nn{ #1 }{ /_I_/ }
1126     }
1127     { P }{ str }
1128 }
1129 #2
1130 {
1131     \prg_return_true:
1132 }
1133 {
1134     \prg_return_false:
1135 }
1136 }
1137
1138 \prg_generate_conditional_variant:Nnn \object_test_proxy:nn
1139 { Vn }{p, T, F, TF}
1140 \prg_generate_conditional_variant:Nnn \object_test_proxy:nN
1141 { VN }{p, T, F, TF}
1142

```

(End definition for `\object_test_proxy:nnTF` and `\object_test_proxy:nNTF`. These functions are documented on page 13.)

```

\object_create:nnnNN Creates an object from a proxy.
\object_create_set:NnnnNN
\object_create_gset:NnnnNN
\object_create:nnnN
\object_create_set:NnnnN
\object_create_gset:NnnnN
\object_create:nnn
\object_create_set:Nnnn
\object_create_gset:Nnnn
\embedded_create:nnn
1143
1144 \msg_new:nnnn { rawobjects }{ notproxy }{ Fake ~ proxy }
1145 {
1146     Object ~ #1 ~ is ~ not ~ a ~ proxy.
1147 }
1148
1149 \cs_new_protected:Nn \__rawobjects_force_proxy:n
1150 {
1151     \object_if_proxy:nF { #1 }
1152     {
1153         \msg_error:nnn { rawobjects }{ notproxy }{ #1 }
1154     }
1155 }
1156
1157 \cs_new_protected:Nn \__rawobjects_create_anon:nnnNN
1158 {
1159     \tl_if_empty:nF{ #1 }
1160     {
1161
1162         \__rawobjects_force_proxy:n { #1 }
1163
1164
1165         \object_newconst_str:nnn
1166         {
1167             \object_embedded_adr:nn{ #3 }{ /_I_/ }
1168         }
1169         { M }{ #2 }
1170     }
1171     \object_newconst_str:nnn
1172     {
1173         \object_embedded_adr:nn{ #3 }{ /_I_/ }
1174     }

```

```

1174     { P }{ #1 }
1175 \object_newconst_str:nnV
1176     {
1177     \object_embedded_adr:nn{ #3 }{ /_I_/ }
1178     }
1179     { S } #4
1180 \object_newconst_str:nnV
1181     {
1182     \object_embedded_adr:nn{ #3 }{ /_I_/ }
1183     }
1184     { V } #5
1185
1186 \seq_map_inline:cn
1187     {
1188     \object_member_adr:nnn { #1 }{ varlist }{ seq }
1189     }
1190     {
1191     \object_new_member:nnv { #3 }{ ##1 }
1192     {
1193     \object_ncmember_adr:nnn { #1 }{ ##1 _ type }{ str }
1194     }
1195     }
1196
1197 \seq_map_inline:cn
1198     {
1199     \object_member_adr:nnn { #1 }{ objlist }{ seq }
1200     }
1201     {
1202     \embedded_create:nnv
1203     { #3 }
1204     {
1205     \object_ncmember_adr:nnn { #1 }{ ##1 _ proxy }{ str }
1206     }
1207     { ##1 }
1208     }
1209
1210 \tl_map_inline:cn
1211     {
1212     \object_member_adr:nnn { #1 }{ init }{ tl }
1213     }
1214     {
1215     ##1 { #1 }{ #2 }{ #3 }
1216     }
1217
1218     }
1219 }
1220
1221 \cs_generate_variant:Nn \__rawobjects_create_anon:nnnNN { xnxNN, vxvcc }
1222
1223 \cs_new_protected:Nn \object_create:nnnNN
1224 {
1225     \__rawobjects_create_anon:xnxNN { #1 }{ #2 }
1226     { \object_address:nn { #2 }{ #3 } }
1227     #4 #5

```

```

1228 }
1229
1230 \cs_generate_variant:Nn \object_create:nnnNN { VnnNN }
1231
1232 \cs_new_protected:Nn \object_create_set:NnnnNN
1233 {
1234   \object_create:nnnNN { #2 }{ #3 }{ #4 } #5 #6
1235   \str_set:Nx #1 { \object_address:nn { #3 }{ #4 } }
1236 }
1237
1238 \cs_new_protected:Nn \object_create_gset:NnnnNN
1239 {
1240   \object_create:nnnNN { #2 }{ #3 }{ #4 } #5 #6
1241   \str_gset:Nx #1 { \object_address:nn { #3 }{ #4 } }
1242 }
1243
1244 \cs_generate_variant:Nn \object_create_set:NnnnNN { NVnnNN, NnnfNN }
1245 \cs_generate_variant:Nn \object_create_gset:NnnnNN { NVnnNN, NnnfNN }
1246
1247
1248
1249 \cs_new_protected:Nn \object_create:nnnN
1250 {
1251   \object_create:nnnNN { #1 }{ #2 }{ #3 } #4 \c_object_public_str
1252 }
1253
1254 \cs_generate_variant:Nn \object_create:nnnN { VnnN }
1255
1256 \cs_new_protected:Nn \object_create_set:NnnnN
1257 {
1258   \object_create_set:NnnnNN #1 { #2 }{ #3 }{ #4 } #5 \c_object_public_str
1259 }
1260
1261 \cs_new_protected:Nn \object_create_gset:NnnnN
1262 {
1263   \object_create_gset:NnnnNN #1 { #2 }{ #3 }{ #4 } #5 \c_object_public_str
1264 }
1265
1266 \cs_generate_variant:Nn \object_create_set:NnnnN { NVnnN }
1267 \cs_generate_variant:Nn \object_create_gset:NnnnN { NVnnN }
1268
1269 \cs_new_protected:Nn \object_create:nnn
1270 {
1271   \object_create:nnnNN { #1 }{ #2 }{ #3 }
1272   \c_object_global_str \c_object_public_str
1273 }
1274
1275 \cs_generate_variant:Nn \object_create:nnn { Vnn }
1276
1277 \cs_new_protected:Nn \object_create_set:Nnnn
1278 {
1279   \object_create_set:NnnnNN #1 { #2 }{ #3 }{ #4 }
1280   \c_object_global_str \c_object_public_str
1281 }

```

```

1282
1283 \cs_new_protected:Nn \object_create_gset:Nnnn
1284 {
1285   \object_create_gset:NnnnNN #1 { #2 }{ #3 }{ #4 }
1286   \c_object_global_str \c_object_public_str
1287 }
1288
1289 \cs_generate_variant:Nn \object_create_set:Nnnn { NVnn }
1290 \cs_generate_variant:Nn \object_create_gset:Nnnn { NVnn }
1291
1292
1293
1294
1295 \cs_new_protected:Nn \embedded_create:nnn
1296 {
1297   \__rawobjects_create_anon:xvxc { #2 }
1298   {
1299     \object_ncmember_adr:nnn
1300     {
1301       \object_embedded_adr:nn{ #1 }{ /_I_/ }
1302     }
1303     { M }{ str }
1304   }
1305   {
1306     \object_embedded_adr:nn
1307     { #1 }{ #3 }
1308   }
1309   {
1310     \object_ncmember_adr:nnn
1311     {
1312       \object_embedded_adr:nn{ #1 }{ /_I_/ }
1313     }
1314     { S }{ str }
1315   }
1316   {
1317     \object_ncmember_adr:nnn
1318     {
1319       \object_embedded_adr:nn{ #1 }{ /_I_/ }
1320     }
1321     { V }{ str }
1322   }
1323 }
1324
1325 \cs_generate_variant:Nn \embedded_create:nnn { nvn, Vnn }
1326

```

(End definition for `\object_create:nnnNN` and others. These functions are documented on page 13.)

`\proxy_create:nn`
`\proxy_create_set:Nnn`
`\proxy_create_gset:Nnn`

Creates a new proxy object

```

1327
1328 \cs_new_protected:Nn \proxy_create:nn
1329 {
1330   \object_create:VnnNN \c_proxy_address_str { #1 }{ #2 }
1331   \c_object_global_str \c_object_public_str

```

```

1332 }
1333
1334 \cs_new_protected:Nn \proxy_create_set:Nnn
1335 {
1336   \object_create_set:NVnnNN #1 \c_proxy_address_str { #2 }{ #3 }
1337   \c_object_global_str \c_object_public_str
1338 }
1339
1340 \cs_new_protected:Nn \proxy_create_gset:Nnn
1341 {
1342   \object_create_gset:NVnnNN #1 \c_proxy_address_str { #2 }{ #3 }
1343   \c_object_global_str \c_object_public_str
1344 }
1345
1346
1347
1348 \cs_new_protected:Nn \proxy_create:nnN
1349 {
1350   \__rawobjects_launch_deprecate:NN \proxy_create:nnN \proxy_create:nn
1351   \object_create:VnnNN \c_proxy_address_str { #1 }{ #2 }
1352   \c_object_global_str #3
1353 }
1354
1355 \cs_new_protected:Nn \proxy_create_set:NnnN
1356 {
1357   \__rawobjects_launch_deprecate:NN \proxy_create_set:NnnN \proxy_create_set:Nnn
1358   \object_create_set:NVnnNN #1 \c_proxy_address_str { #2 }{ #3 }
1359   \c_object_global_str #4
1360 }
1361
1362 \cs_new_protected:Nn \proxy_create_gset:NnnN
1363 {
1364   \__rawobjects_launch_deprecate:NN \proxy_create_gset:NnnN \proxy_create_gset:Nnn
1365   \object_create_gset:NVnnNN #1 \c_proxy_address_str { #2 }{ #3 }
1366   \c_object_global_str #4
1367 }
1368

```

(End definition for \proxy_create:nn, \proxy_create_set:Nnn, and \proxy_create_gset:Nnn. These functions are documented on page 14.)

\proxy_push_member:nnn Push a new member inside a proxy.

```

1369
1370 \cs_new_protected:Nn \proxy_push_member:nnn
1371 {
1372   \object_newconst_str:nnn { #1 }{ #2 _ type }{ #3 }
1373   \seq_gput_left:cn
1374   {
1375     \object_member_adr:nnn { #1 }{ varlist }{ seq }
1376   }
1377   { #2 }
1378 }
1379
1380 \cs_generate_variant:Nn \proxy_push_member:nnn { Vnn }
1381

```

(End definition for `\proxy_push_member:nnn`. This function is documented on page 14.)

`\proxy_push_embedded:nnn` Push a new embedded object inside a proxy.

```
1382
1383 \cs_new_protected:Nn \proxy_push_embedded:nnn
1384 {
1385   \object_newconst_str:nxx { #1 } { #2 _ proxy } { #3 }
1386   \seq_gput_left:cn
1387     {
1388       \object_member_adr:nnn { #1 } { objlist } { seq }
1389     }
1390   { #2 }
1391 }
1392
1393 \cs_generate_variant:Nn \proxy_push_embedded:nnn { Vnn }
1394
```

(End definition for `\proxy_push_embedded:nnn`. This function is documented on page 15.)

`\proxy_add_initializer:nN` Push a new embedded object inside a proxy.

```
1395
1396 \cs_new_protected:Nn \proxy_add_initializer:nN
1397 {
1398   \tl_gput_right:cn
1399     {
1400       \object_member_adr:nnn { #1 } { init } { tl }
1401     }
1402   { #2 }
1403 }
1404
1405 \cs_generate_variant:Nn \proxy_add_initializer:nN { VN }
1406
```

(End definition for `\proxy_add_initializer:nN`. This function is documented on page 15.)

`\c_proxy_address_str` Variable containing the address of the proxy object.

```
1407
1408 \str_const:Nx \c_proxy_address_str
1409 { \object_address:nn { rawobjects } { proxy } }
1410
1411 \object_newconst_str:nnn
1412 {
1413   \object_embedded_adr:Vn \c_proxy_address_str { /_I_/ }
1414 }
1415 { M } { rawobjects }
1416
1417 \object_newconst_str:nnV
1418 {
1419   \object_embedded_adr:Vn \c_proxy_address_str { /_I_/ }
1420 }
1421 { P } \c_proxy_address_str
1422
1423 \object_newconst_str:nnV
1424 {
```

```

1425     \object_embedded_adr:Vn \c_proxy_address_str { /_I/ }
1426   }
1427   { S } \c_object_global_str
1428
1429 \object_newconst_str:nnV
1430 {
1431   \object_embedded_adr:Vn \c_proxy_address_str { /_I/ }
1432 }
1433 { V } \c_object_public_str
1434
1435
1436 \__rawobjects_initproxy:VnV \c_proxy_address_str { rawobjects } \c_proxy_address_str
1437
1438 \object_new_member:Vnn \c_proxy_address_str { init }{ t1 }
1439
1440 \object_new_member:Vnn \c_proxy_address_str { varlist }{ seq }
1441
1442 \object_new_member:Vnn \c_proxy_address_str { objlist }{ seq }
1443
1444 \proxy_push_member:Vnn \c_proxy_address_str
1445   { init }{ t1 }
1446 \proxy_push_member:Vnn \c_proxy_address_str
1447   { varlist }{ seq }
1448 \proxy_push_member:Vnn \c_proxy_address_str
1449   { objlist }{ seq }
1450
1451 \proxy_add_initializer:VN \c_proxy_address_str
1452   \__rawobjects_initproxy:nnn
1453

```

(End definition for \c_proxy_address_str. This variable is documented on page 13.)

```

\object_allocate_incr:NNnnNN Create an address and use it to instantiate an object
\object_gallocate_incr:NNnnNN
\object_allocate_gincr:NNnnNN
\object_gallocate_gincr:NNnnNN
1454
1455 \cs_new:Nn \__rawobjects_combine_aux:nnn
1456 {
1457   anon . #3 . #2 . #1
1458 }
1459
1460 \cs_generate_variant:Nn \__rawobjects_combine_aux:nnn { Vnf }
1461
1462 \cs_new:Nn \__rawobjects_combine:Nn
1463 {
1464   \__rawobjects_combine_aux:Vnf #1 { #2 }
1465   {
1466     \cs_to_str:N #1
1467   }
1468 }
1469
1470 \cs_new_protected:Nn \object_allocate_incr:NNnnNN
1471 {
1472   \object_create_set:NnnfNN #1 { #3 }{ #4 }
1473   {
1474     \__rawobjects_combine:Nn #2 { #3 }

```



```

1475     }
1476     #5 #6
1477
1478     \int_incr:N #2
1479 }
1480
1481 \cs_new_protected:Nn \object_gallocate_incr:NNnnNN
1482 {
1483   \object_create_gset:NnnfNN #1 { #3 }{ #4 }
1484   {
1485     \__rawobjects_combine:Nn #2 { #3 }
1486   }
1487   #5 #6
1488
1489   \int_incr:N #2
1490 }
1491
1492 \cs_generate_variant:Nn \object_allocate_incr:NNnnNN { NNvNN }
1493
1494 \cs_generate_variant:Nn \object_gallocate_incr:NNnnNN { NNvNN }
1495
1496 \cs_new_protected:Nn \object_allocate_gincr:NNnnNN
1497 {
1498   \object_create_set:NnnfNN #1 { #3 }{ #4 }
1499   {
1500     \__rawobjects_combine:Nn #2 { #3 }
1501   }
1502   #5 #6
1503
1504   \int_gincr:N #2
1505 }
1506
1507 \cs_new_protected:Nn \object_gallocate_gincr:NNnnNN
1508 {
1509   \object_create_gset:NnnfNN #1 { #3 }{ #4 }
1510   {
1511     \__rawobjects_combine:Nn #2 { #3 }
1512   }
1513   #5 #6
1514
1515   \int_gincr:N #2
1516 }
1517
1518 \cs_generate_variant:Nn \object_allocate_gincr:NNnnNN { NNvNN }
1519
1520 \cs_generate_variant:Nn \object_gallocate_gincr:NNnnNN { NNvNN }
1521

```

(End definition for \object_allocate_incr:NNnnNN and others. These functions are documented on page 14.)

\object_assign:nn Copy an object to another one.

```

1522 \cs_new_protected:Nn \object_assign:nn
1523 {

```

```

1524 \seq_map_inline:cn
1525 {
1526   \object_member_adr:vnn
1527   {
1528     \object_ncmember_adr:nnn
1529     {
1530       \object_embedded_adr:nn{ #1 }{ /_I_/ }
1531     }
1532     { P }{ str }
1533   }
1534   { varlist }{ seq }
1535 }
1536 {
1537   \object_member_set_eq:nnc { #1 }{ ##1 }
1538   {
1539     \object_member_adr:nn{ #2 }{ ##1 }
1540   }
1541 }
1542 }
1543
1544 \cs_generate_variant:Nn \object_assign:nn { nV, Vn, VV }

```

(End definition for \object_assign:nn. This function is documented on page 15.)

```

1545 </package>

```