

The `bitset` package

Heiko Oberdiek*

2016/05/16 v1.2

Abstract

This package defines and implements the data type bit set, a vector of bits. The size of the vector may grow dynamically. Individual bits can be manipulated.

Contents

1	Documentation	3
1.1	Introduction	3
1.2	Glossary	3
1.3	Design principles	4
1.4	Operator overview	5
1.5	Package loading	5
1.6	Operators	5
1.6.1	Miscellaneous	6
1.6.2	Import	6
1.6.3	Export	7
1.6.4	Logical operators	7
1.6.5	Shifting	7
1.6.6	Bit manipulation	8
1.6.7	Bit retrieval	8
1.6.8	Bit set properties	9
1.6.9	Queries	9
2	Implementation	9
2.1	Reload check and package identification	10
2.2	Catcodes	11
2.3	Package loading	12
2.4	Help macros	12
2.4.1	Number constant	12
2.4.2	General basic macros	12
2.4.3	Tail recursion	13
2.4.4	Check macros	13
2.5	Miscellaneous	14
2.6	Import	14
2.6.1	From binary number	14
2.6.2	From octal/hex number	15
2.6.3	From decimal number	17
2.7	Export	18

*Please report any issues at <https://github.com/ho-tex/oberdiek/issues>

2.7.1	To binary number	18
2.7.2	To octal/hexadecimal number	19
2.7.3	To decimal number	22
2.8	Logical operators	24
2.8.1	\bitsetAnd	24
2.8.2	\bitsetAndNot	25
2.8.3	\bitsetOr	26
2.8.4	\bitsetXor	27
2.8.5	Shifting	28
2.8.6	\bitsetShiftLeft	28
2.8.7	\bitsetShiftRight	28
2.9	Bit manipulation	29
2.9.1	Clear operation	30
2.9.2	Set operation	31
2.9.3	Flip operation	31
2.9.4	Range operators	32
2.10	Bit retrieval	34
2.10.1	\bitsetGet	34
2.10.2	\bitsetNextClearBit, \bitsetNextSetBit	35
2.10.3	\bitsetGetSetBitList	37
2.11	Bit set properties	38
2.12	Queries	39
3	Test	40
3.1	Catcode checks for loading	40
3.2	Macro tests	42
3.2.1	Preamble	42
3.2.2	Time	43
3.2.3	Detection of unwanted space	43
3.2.4	Test macros	44
3.2.5	Test sets	45
4	Installation	61
4.1	Download	61
4.2	Bundle installation	61
4.3	Package installation	62
4.4	Refresh file name databases	62
4.5	Some details for the interested	62
5	History	63
	[2007/09/28 v1.0]	63
	[2011/01/30 v1.1]	63
	[2016/05/16 v1.2]	63

1 Documentation

1.1 Introduction

Annotations in the PDF format know entries whose values are integers. This numbers are interpreted as set of flags specifying properties. For example, annotation dictionaries can have a key `/F`. The bits of its integer value are interpreted the following way:

Bit position	Property name
1	Invisible
2	Hidden
3	Print
4	NoZoom
5	NoRotate
6	NoView
7	ReadOnly
...	...

Now, let's see how these values are set in package `hyperref` before it uses this package (before v6.77a):

```
\ifFld@hidden_/F_6\else_/F_4\fi
```

Where are the other flags? The following example for key `/Ff` in a widget annotation supports at least three properties:

```
\ifFld@multiline
  \ifFld@readonly_/Ff_4097\else_/Ff_4096\fi
\else
  \ifFld@password
    \ifFld@readonly_/Ff_8193\else_/Ff_8192\fi
  \else
    \ifFld@readonly_/Ff_1\fi
  \fi
\fi
```

But you see the point. It would be a nightmare to continue this way in supporting the missing flag settings. This kind of integers may have up to 32 bits.

Therefore I wanted a data structure for setting and clearing individual bits. Also it should provide an export as decimal number. The snippets above are executed in expansion contexts without \TeX 's stomach commands. It would be convenient to have an expandable conversion from the data structure to the integer that gets written to the PDF file.

This package `bitset` implements such a data structure. The interface is quite close to Java's class `BitSet` in order not to learn to many interfaces for the same kind of data structure.

1.2 Glossary

Bit set: A bit set is a vector of bits or flags. The vector size is unlimited and grows dynamically. An undefined bit set is treated as bit set where all bits are cleared.

Bit sets are addressed by name. A name should consists of letters or digits. Technically it must survive `\csname`, see \LaTeX 's environment names for other names with such a constraint. Package `babel`'s shorthands are not supported due to technical reasons. Shorthand support would break expandable operations.

Size: A size of a bit set is the number of bits in use. It's the number of the highest index, incremented by one. Sizes are in the range 0 up to 2147483647, the highest number supported by \TeX .

Index: Bit positions in a bit set are addressed by an index number. The bit vector is zero based. The first and least significant bit is addressed by index 0 and the highest possible bit by 2147483646.

Bit: A bit is encoded as 0 for cleared/disabled or 1 for set/enabled.

1.3 Design principles

Name conventions: To avoid conflicts with existing macro names, the operations are prefixed by the package name.

Zero based indexes: The first bit is addressed by zero. (Convention of array indexing in C, Java, ...)

Unlimited size: There is no restriction on the size of a bit set other than usual memory limitations. `\bitsetSetDec` and `\bitsetGetDec` transparently switch to package `bigintcalc` if the numbers get too large for \TeX 's number limit.

Expandability: Any operation that does not change the bit set is expandable. And all operations that extract or calculate some result do this in exact two expansion steps. For example, a macro `\Macro` wants a bit set as decimal number. But the argument must be a plain number without macros. Thus you could prefix `\bitsetGetDec` with `\number`. However this won't work for bit sets with 31 or more bits because of \TeX 's number limit of $2^{31} - 1$. then just hit the operator with two `\expandafter`:

```
\expandafter\expandafter\expandafter
\Macro\bitsetGetDec{foo}
```

`\bitsetGetDec` is hit first by the third `\expandafter` and then by the second one.

Format independence: This package is written as \LaTeX package, but it does not depend on \LaTeX . It will also work for other formats such as plain \TeX .

Independence from \TeX engines: Vanilla \TeX is all you need. Calculations are delegated to packages `intcalc` and `bigintcalc`. They don't need any special features, but they will switch to a little more efficient implementation if features such as `\numexpr` are available.

Numeric arguments: Anything that is accepted by `\number`. If $\varepsilon\text{-}\text{\TeX}$ is detected, also expressions for `\numexpr` are supported. The only exception so far is the number for `\bitsetSetDec`. The number might be too large for `\number` or `\numexpr`.

Error messages: In expandable contexts, only a limited set of \TeX primitive commands work as expected. So called stomach commands behave like `\relax` and don't get expanded or executed. Unhappily also the error commands belong to this category. The expandable operations will throw an unknown control sequence instead to get \TeX 's and user's attention. The name of these control sequences starts with `\BitSetError:` with the type of error after the colon.

1.4 Operator overview

Miscellaneous (section 1.6.1)

<code>\bitsetReset</code>	$\langle BitSet \rangle$
<code>\bitsetLet</code>	$\langle BitSet A \rangle \langle BitSet B \rangle$

Import (section 1.6.2)

<code>\bitsetSetBin</code> , <code>\bitsetSetOct</code> , <code>\bitsetSetHex</code>	$\langle BitSet \rangle \langle Value \rangle$
<code>\bitsetSetDec</code>	$\langle BitSet \rangle \langle Value \rangle$

Export^a (section 1.6.3)

<code>\bitsetGetBin</code> , <code>\bitsetGetOct</code> , <code>\bitsetGetHex</code>	$\langle BitSet \rangle \langle MinSize \rangle$
<code>\bitsetGetDec</code>	$\langle BitSet \rangle$

Logical operators (section 1.6.4)

<code>\bitsetAnd</code> , <code>\bitsetAndNot</code>	$\langle BitSet A \rangle \langle BitSet B \rangle$
<code>\bitsetOr</code> , <code>\bitsetXor</code>	$\langle BitSet A \rangle \langle BitSet B \rangle$

Shifting (section 1.6.5)

<code>\bitsetShiftLeft</code> , <code>\bitsetShiftRight</code>	$\langle BitSet \rangle \langle ShiftAmount \rangle$
--	--

Bit manipulation (section 1.6.6)

<code>\bitsetClear</code> , <code>\bitsetSet</code> , <code>\bitsetFlip</code>	$\langle BitSet \rangle \langle Index \rangle$
<code>\bitsetSetValue</code>	$\langle BitSet \rangle \langle Index \rangle \langle Value \rangle$
<code>\bitsetClearRange</code> , <code>\bitsetSetRange</code> , <code>\bitsetFlipRange</code>	$\langle BitSet \rangle \langle IndexFrom \rangle \langle IndexTo \rangle$
<code>\bitsetSetValueRange</code>	$\langle BitSet \rangle \langle IndexFrom \rangle \langle IndexTo \rangle$

Bit retrieval^a (section 1.6.7)

<code>\bitsetGet</code>	$\langle BitSet \rangle \langle Index \rangle$
<code>\bitsetNextClearBit</code> , <code>\bitsetNextSetBit</code>	$\langle BitSet \rangle \langle Index \rangle$
<code>\bitsetGetSetBitList</code>	$\langle BitSet \rangle$

Bit set properties (section 1.6.8)

<code>\bitsetSize</code> , <code>\bitsetCardinality</code>	$\langle BitSet \rangle$
--	--------------------------

Queries^b (section 1.6.9)

<code>\bitsetIsDefined</code> , <code>\bitsetIsEmpty</code>	$\langle BitSet \rangle \langle Then \rangle \langle Else \rangle$
<code>\bitsetEquals</code> , <code>\bitsetIntersects</code>	$\langle BitSet A \rangle \langle BitSet B \rangle \langle Then \rangle \langle Else \rangle$
<code>\bitsetQuery</code>	$\langle BitSet \rangle \langle Index \rangle \langle Then \rangle \langle Else \rangle$

^aMacros are expandable, full expansion by two steps.

^bMacros are expandable.

1.5 Package loading

The package can be used as normal L^AT_EX package:

```
\usepackage{bitset}
```

Also plain T_EX is supported:

```
\input bitset.sty\relax
```

1.6 Operators

The following macros work on and with bit sets. A bit set $\langle BitSet \rangle$ is represented by a name. The should consist of letters and digits. Technically it must survive

`\csname`. It is the same constraint that must be satisfied by label or environment names in L^AT_EX.

However active characters that are shorthands of package `babel` are not supported. Support for shorthands works by an assignment. But many operators such as `\bitsetGetDec` must be usable in expandable contexts. There assignments will not be executed in the best case or they will cause errors.

The bits in a bit set are addressed by non-negative integers starting from zero. Thus negative index numbers cause an error message. Because index numbers are T_EX numbers. The largest index is 2147483647. But in practice memory limits and patience limits will be very likely reached much before.

1.6.1 Miscellaneous

There isn't a separate operation for bit set creation. For simplicity an undefined bit set is treated as bit set with all bits cleared.

`\bitsetReset {⟨BitSet⟩}`

Macro `\bitsetReset` clears all bits. The result is an empty bit set. It may also be used as replacement for an operation “new”, because an undefined bit set is defined afterwards.

`\bitsetLet {⟨BitSet A⟩} {⟨BitSet B⟩}`

Macro `\bitsetLet` performs a simple assignment similar to T_EX's `\let`. After the operation `⟨BitSet A⟩` has the same value as `⟨BitSet B⟩`. If `⟨BitSet B⟩` is undefined, then `⟨BitSet A⟩` will be the empty bit set.

Note: If `⟨BitSet A⟩` exists, it will be overwritten.

1.6.2 Import

`\bitsetSetBin {⟨BitSet⟩} {⟨BinaryNumber⟩}`
`\bitsetSetOct {⟨BitSet⟩} {⟨OctalNumber⟩}`
`\bitsetSetHex {⟨BitSet⟩} {⟨HexadecimalNumber⟩}`

The numbers are interpreted as bit vectors and the flags in the bit `⟨BitSet⟩` set are set accordingly. These numeric arguments are the only arguments where spaces are allowed. Then the numbers are easier to read.

`\bitsetSetDec {⟨BitSet⟩} {⟨DecimalNumber⟩}`

Macro `\bitsetSetDec` uses `⟨DecimalNumber⟩` to set the bit set `⟨BitSet⟩`. The numeric argument must expand to a plain number consisting of decimal digits without command tokens or spaces. Internally this argument is expanded only. It cannot be passed to `\number` or `\numexpr`, because the number may be too large for them. However `\number` or `\the\numexpr` may be used explicitly. This also helps for unexpandable number command tokens or registers (`\z@`, `\@ne`, `\count@`, ...). Also L^AT_EX' `\value` needs prefixing:

```
\bitsetSetDec{foo}{\number\value{bar}}
```

1.6.3 Export

```
\bitsetGetBin {\langle BitSet \rangle} {\langle MinSize \rangle}  
\bitsetGetOct {\langle BitSet \rangle} {\langle MinSize \rangle}  
\bitsetGetHex {\langle BitSet \rangle} {\langle MinSize \rangle}
```

These macros returns the bit set as binary, octal or hexadecimal number. If the bit size is smaller than $\langle MinSize \rangle$ the gap is filled with leading zeros. Example:

```
\bitsetReset{abc}  
\bitsetSet{abc}{2}  
\bitsetGetBin{abc}{8} → 00000100  
\bitsetSet{abc}{5}\bitsetSet{abc}{7}  
\bitsetGetHex{abc}{16} → 00A2
```

Macro `\bitsetGetHex` uses the uppercase letters A to F. The catcode of the letters is one of 11 (letter) or 12 (other).

```
\bitsetGetDec {\langle BitSet \rangle}
```

Macro `\bitsetGetDec` returns the bit set $\langle BitSet \rangle$ as decimal number. The returned number can be larger than T_EX's number limit of $2^{31} - 1$.

1.6.4 Logical operators

```
\bitsetAnd {\langle BitSet A \rangle} {\langle BitSet B \rangle}
```

$$A_{\text{new}} := A_{\text{old}} \text{ and } B \quad (\forall \text{ bits})$$

```
\bitsetAndNot {\langle BitSet A \rangle} {\langle BitSet B \rangle}
```

$$A_{\text{new}} := A_{\text{old}} \text{ and (not } B) \quad (\forall \text{ bits})$$

```
\bitsetOr {\langle BitSet A \rangle} {\langle BitSet B \rangle}
```

$$A_{\text{new}} := A_{\text{old}} \text{ or } B \quad (\forall \text{ bits})$$

```
\bitsetXor {\langle BitSet A \rangle} {\langle BitSet B \rangle}
```

$$A_{\text{new}} := A_{\text{old}} \text{ xor } B \quad (\forall \text{ bits})$$

1.6.5 Shifting

```
\bitsetShiftLeft {\langle BitSet \rangle} {\langle ShiftAmount \rangle}  
\bitsetShiftRight {\langle BitSet \rangle} {\langle ShiftAmount \rangle}
```

A left shift by one is a multiplication by two, thus left shifting moves the flags to higher positions. The new created low positions are filled by zeros.

A right shift is the opposite, dividing by two, moving the bits to lower positions. The number will become smaller, the lowest bits are lost.

If the $\langle ShiftAmount \rangle$ is negative, it reverts the meaning of the shift operation. A left shift becomes a right shift. A $\langle ShiftAmount \rangle$ of zero is ignored.

1.6.6 Bit manipulation

$\backslash\text{bitsetClear } \{\langle BitSet \rangle\} \{\langle Index \rangle\}$ $\backslash\text{bitsetSet } \{\langle BitSet \rangle\} \{\langle Index \rangle\}$ $\backslash\text{bitsetFlip } \{\langle BitSet \rangle\} \{\langle Index \rangle\}$

This macros manipulate a single bit in $\langle BitSet \rangle$ addressed by $\backslash Index$. Macro $\backslash\text{bitsetClear}$ disables the bit, $\backslash\text{bitsetSet}$ enables it and $\backslash\text{bitsetFlip}$ reverts the current setting of the bit.

$\backslash\text{bitsetSetValue } \{\langle BitSet \rangle\} \{\langle Index \rangle\} \{\langle Bit \rangle\}$

Macro $\backslash\text{bitsetSetValue}$ puts bit $\langle Bit \rangle$ at position $\langle Index \rangle$ in bit set $\langle BitSet \rangle$. $\langle Bit \rangle$ must be a valid T_EX number equals to zero (disabled/cleared) or one (enabled/set).

1.6.7 Bit retrieval

$\backslash\text{bitsetGet } \{\langle BitSet \rangle\} \{\langle Index \rangle\}$
--

Macro $\backslash\text{bitsetGet}$ extracts the status of the bit at position $\langle Index \rangle$ in bit set $\langle BitSet \rangle$. Digit 1 is returned if the bit is set/enabled. If the bit is cleared/disabled and in cases of an undefined bitset or an index number out of range the return value is 0.

$\backslash\text{bitsetNextClearBit } \{\langle BitSet \rangle\} \{\langle Index \rangle\}$

Starting at position $\langle Index \rangle$ (inclusive) the bits are inspected. The first position without a set bit is returned. Possible results are decimal numbers: $\langle Index \rangle$, $\langle Index \rangle + 1$, ..., (∞)

$\backslash\text{bitsetNextSetBit } \{\langle BitSet \rangle\} \{\langle Index \rangle\}$

Starting at position $\langle Index \rangle$ (inclusive) the bits are inspected and the index position of the first found set bit is returned. If there isn't such a bit, then the result is -1. In summary possible results are decimal numbers: -1, $\langle Index \rangle$, $\langle Index \rangle + 1$, ..., (∞)

$\backslash\text{bitsetGetSetBitList } \{\langle BitSet \rangle\}$
--

Macro $\backslash\text{bitsetGetSetBitList}$ is an application for $\backslash\text{bitsetNextSetBit}$. The set bits are iterated and returned as comma separated list of index positions in increasing order. The list is empty in case of an empty bit set.

1.6.8 Bit set properties

`\bitsetSize {⟨BitSet⟩}`

Macro `\bitsetSize` returns number of bits in use. It is the same as the index number of the highest set/enabled bit incremented by one.

`\bitsetCardinality {⟨BitSet⟩}`

Macro `\bitsetCardinality` counts the number of set/enabled bits.

1.6.9 Queries

Also the query procedures are expandable. They ask for a piece of information about a bit set and execute code depending on the answer.

`\bitsetIsDefined {⟨BitSet⟩} {⟨Then⟩} {⟨Else⟩}`

If the bit set with the name `⟨BitSet⟩` exists the code given in `⟨Then⟩` is executed, otherwise `⟨Else⟩` is used.

`\bitsetIsEmpty {⟨BitSet⟩} {⟨Then⟩} {⟨Else⟩}`

If the bit set `⟨BitSet⟩` exists and at least one bit is set/enabled, the code in `⟨Then⟩` is executed, `⟨Else⟩` otherwise.

`\bitsetEquals {⟨BitSet A⟩} {⟨BitSet B⟩} {⟨Then⟩} {⟨Else⟩}`

Both bit sets are equal if and only if either both are undefined or both are defined and represents the same bit values at the same positions. Thus this definition is reflexive, symmetric, and transitive, enough for an equivalent relation.

`\bitsetIntersects {⟨BitSet A⟩} {⟨BitSet B⟩} {⟨Then⟩} {⟨Else⟩}`

If and only if `⟨BitSet A⟩` and `⟨BitSet B⟩` have at least one bit at the same position that is set, then code part `⟨Then⟩` is executed.

`\bitsetQuery {⟨BitSet⟩} {⟨Index⟩} {⟨Then⟩} {⟨Else⟩}`

It's just a wrapper for `\bitsetGet`. If the bit at position `⟨Index⟩` is enabled, code `⟨Then⟩` is called.

2 Implementation

The internal format of a bit set is quite simple, a sequence of digits 0 and 1. The least significant bit is left. A bit set without any flag set is encoded by 0. Also undefined bit sets are treated that way. After the highest bit that is set there are no further zeroes. A regular expression of valid bit sets values:

`0|[01]*1`

```
1 <*package>
```

2.1 Reload check and package identification

Reload check, especially if the package is not used with L^AT_EX.

```
2 \begingroup\catcode61\catcode48\catcode32=10\relax%
3   \catcode13=5 % ^~M
4   \endlinechar=13 %
5   \catcode35=6 % #
6   \catcode39=12 % '
7   \catcode44=12 % ,
8   \catcode45=12 % -
9   \catcode46=12 % .
10  \catcode58=12 % :
11  \catcode64=11 % @
12  \catcode123=1 % {
13  \catcode125=2 % }
14  \expandafter\let\expandafter\x\csname ver@bitset.sty\endcsname
15  \ifx\x\relax % plain-TeX, first loading
16  \else
17    \def\empty{}%
18    \ifx\x\empty % LaTeX, first loading,
19      % variable is initialized, but \ProvidesPackage not yet seen
20    \else
21      \expandafter\ifx\csname PackageInfo\endcsname\relax
22        \def\x#1#2{%
23          \immediate\write-1{Package #1 Info: #2.}%
24        }%
25      \else
26        \def\x#1#2{\PackageInfo{#1}{#2, stopped}}%
27      \fi
28      \x{bitset}{The package is already loaded}%
29      \aftergroup\endinput
30    \fi
31  \fi
32 \endgroup%
```

Package identification:

```
33 \begingroup\catcode61\catcode48\catcode32=10\relax%
34   \catcode13=5 % ^~M
35   \endlinechar=13 %
36   \catcode35=6 % #
37   \catcode39=12 % '
38   \catcode40=12 % (
39   \catcode41=12 % )
40   \catcode44=12 % ,
41   \catcode45=12 % -
42   \catcode46=12 % .
43   \catcode47=12 % /
44   \catcode58=12 % :
45   \catcode64=11 % @
46   \catcode91=12 % [
47   \catcode93=12 % ]
48   \catcode123=1 % {
49   \catcode125=2 % }
50  \expandafter\ifx\csname ProvidesPackage\endcsname\relax
51    \def\x#1#2#3[#4]{\endgroup
52      \immediate\write-1{Package: #3 #4}%
```

```

53     \xdef#1{#4}%
54 }%
55 \else
56   \def\x#1#2[#3]{\endgroup
57     #2[{#3}]%
58     \ifx#1\@undefined
59       \xdef#1{#3}%
60     \fi
61     \ifx#1\relax
62       \xdef#1{#3}%
63     \fi
64 }%
65 \fi
66 \expandafter\x\csname ver@bitset.sty\endcsname
67 \ProvidesPackage{bitset}%
68 [2016/05/16 v1.2 Handle bit-vector datatype (H0)]%

```

2.2 Catcodes

```

69 \begingroup\catcode61\catcode48\catcode32=10\relax%
70 \catcode13=5 % ^~M
71 \endlinechar=13 %
72 \catcode123=1 % {
73 \catcode125=2 % }
74 \catcode64=11 % @
75 \def\x{\endgroup
76   \expandafter\edef\csname BitSet@AtEnd\endcsname{%
77     \endlinechar=\the\endlinechar\relax
78     \catcode13=\the\catcode13\relax
79     \catcode32=\the\catcode32\relax
80     \catcode35=\the\catcode35\relax
81     \catcode61=\the\catcode61\relax
82     \catcode64=\the\catcode64\relax
83     \catcode123=\the\catcode123\relax
84     \catcode125=\the\catcode125\relax
85   }%
86 }%
87 \x\catcode61\catcode48\catcode32=10\relax%
88 \catcode13=5 % ^~M
89 \endlinechar=13 %
90 \catcode35=6 % #
91 \catcode64=11 % @
92 \catcode123=1 % {
93 \catcode125=2 % }
94 \def\TMP@EnsureCode#1#2{%
95   \edef\BitSet@AtEnd{%
96     \BitSet@AtEnd
97     \catcode#1=\the\catcode#1\relax
98   }%
99   \catcode#1=#2\relax
100 }
101 \TMP@EnsureCode{33}{12}% !
102 \TMP@EnsureCode{39}{12}% '
103 \TMP@EnsureCode{40}{12}% (
104 \TMP@EnsureCode{41}{12}% )
105 \TMP@EnsureCode{42}{12}% *
106 \TMP@EnsureCode{43}{12}% +
107 \TMP@EnsureCode{44}{12}% ,

```

```

108 \TMP@EnsureCode{45}{12}% -
109 \TMP@EnsureCode{46}{12}% .
110 \TMP@EnsureCode{47}{12}% /
111 \TMP@EnsureCode{58}{11}% : (letter!)
112 \TMP@EnsureCode{60}{12}% <
113 \TMP@EnsureCode{62}{12}% >
114 \TMP@EnsureCode{63}{14}% ? (comment!)
115 \TMP@EnsureCode{91}{12}% [
116 \TMP@EnsureCode{93}{12}% ]
117 \TMP@EnsureCode{96}{12}% `
118 \edef\BitSet@AtEnd{\BitSet@AtEnd\noexpand\endinput}
119 \begingroup\expandafter\expandafter\expandafter\endgroup
120 \expandafter\ifx\csname BitSet@TestMode\endcsname\relax
121 \else
122 \catcode63=9 % ? (ignore)
123 \fi
124 ? \let\BitSet@@TestMode\BitSet@TestMode

```

2.3 Package loading

```

125 \begingroup\expandafter\expandafter\expandafter\endgroup
126 \expandafter\ifx\csname RequirePackage\endcsname\relax
127 \def\TMP@RequirePackage#1[#2]{%
128 \begingroup\expandafter\expandafter\expandafter\endgroup
129 \expandafter\ifx\csname ver@#1.sty\endcsname\relax
130 \input #1.sty\relax
131 \fi
132 }%
133 \TMP@RequirePackage{infwarerr}[2007/09/09]%
134 \TMP@RequirePackage{intcalc}[2007/09/27]%
135 \TMP@RequirePackage{bigintcalc}[2007/09/27]%
136 \else
137 \RequirePackage{infwarerr}[2007/09/09]%
138 \RequirePackage{intcalc}[2007/09/27]%
139 \RequirePackage{bigintcalc}[2007/09/27]%
140 \fi

```

2.4 Help macros

2.4.1 Number constant

```

\BitSet@MaxSize
141 \def\BitSet@MaxSize{2147483647}%

```

2.4.2 General basic macros

```

\BitSet@Empty
142 \def\BitSet@Empty{}

\BitSet@FirstOfOne
143 \def\BitSet@FirstOfOne#1{#1}

\BitSet@Gobble
144 \def\BitSet@Gobble#1{}

\BitSet@FirstOfTwo
145 \def\BitSet@FirstOfTwo#1#2{#1}

\BitSet@SecondOfTwo
146 \def\BitSet@SecondOfTwo#1#2{#2}

```

\BitSet@Space

```
147 \def\BitSet@Space{ }
```

\BitSet@ZapSpace

```
148 \def\BitSet@ZapSpace#1 #2{%
149   #1%
150   \ifx\BitSet@Empty#2%
151   \else
152     \expandafter\BitSet@ZapSpace
153   \fi
154   #2%
155 }
```

2.4.3 Tail recursion

\BitSet@Fi

```
156 \let\BitSet@Fi\fi
```

\BitSet@AfterFi

```
157 \def\BitSet@AfterFi#1#2\BitSet@Fi{\fi#1}
```

\BitSet@AfterFiFi

```
158 \def\BitSet@AfterFiFi#1#2\BitSet@Fi{\fi\fi#1}%
```

\BitSet@AfterFiFiFi

```
159 \def\BitSet@AfterFiFiFi#1#2\BitSet@Fi{\fi\fi\fi#1}%
```

2.4.4 Check macros

\BitSet@IfUndefined

```
160 \def\BitSet@IfUndefined#1{%
161   \expandafter\ifx\csname BS@#1\endcsname\relax
162     \expandafter\BitSet@FirstOfTwo
163   \else
164     \expandafter\BitSet@SecondOfTwo
165   \fi
166 }
```

\BitSet@CheckIndex #1: continuation code
#2: BitSet
#3: Index

```
167 \def\BitSet@CheckIndex#1#2#3{%
168   \BitSet@IfUndefined{#2}{\bitsetReset{#2}}{ }%
169   \expandafter\expandafter\expandafter\BitSet@@CheckIndex
170   \intcalcNum{#3}!%
171   {#2}{#1}%
172 }
```

\BitSet@@CheckIndex #1: plain Index
#2: BitSet
#3: continuation code

```
173 \def\BitSet@@CheckIndex#1!#2#3{%
174   \ifnum#1<0 %
175     \BitSet@AfterFi{%
176       \@PackageError{bitset}{%
177         Invalid negative index (#1)%
```

```

178     }\@ehc
179   }%
180 \else
181   \BitSet@AfterFi{%
182     #3{#2}{#1}%
183   }%
184 \BitSet@Fi
185 }

```

2.5 Miscellaneous

\bitsetReset

```

186 \def\bitsetReset#1{%
187   \expandafter\def\csname BS@#1\endcsname{0}%
188 }

```

\bitsetLet

```

189 \def\bitsetLet#1#2{%
190   \BitSet@IfUndefined{#2}{%
191     \bitsetReset{#1}%
192   }{%
193     \expandafter\let\csname BS@#1\expandafter\endcsname
194       \csname BS@#2\endcsname
195   }%
196 }

```

2.6 Import

2.6.1 From binary number

\bitsetSetBin

```

197 \def\bitsetSetBin#1#2{%
198   \edef\BitSet@Temp{#2}%
199   \edef\BitSet@Temp{%
200     \expandafter\expandafter\expandafter\BitSet@ZapSpace
201     \expandafter\BitSet@Temp\BitSet@Space\BitSet@Empty
202   }%
203   \edef\BitSet@Temp{%
204     \expandafter\BitSet@KillZeros\BitSet@Temp\BitSet@Empty
205   }%
206   \ifx\BitSet@Temp\BitSet@Empty
207     \expandafter\let\csname BS@#1\endcsname\BitSet@Zero
208   \else
209     \expandafter\edef\csname BS@#1\endcsname{%
210       \expandafter\BitSet@Reverse\BitSet@Temp!%
211     }%
212   \fi
213 }

```

\BitSet@KillZeros

```

214 \def\BitSet@KillZeros#1{%
215   \ifx#10%
216     \expandafter\BitSet@KillZeros
217   \else
218     #1%
219   \fi
220 }

```

\BitSet@Reverse

```
221 \def\BitSet@Reverse#1#2!{%
222   \ifx\#2\%
223     #1%
224   \else
225     \BitSet@AfterFi{%
226       \BitSet@Reverse#2!#1%
227     }%
228   \BitSet@Fi
229 }
```

2.6.2 From octal/hex number

\bitsetSetOct

```
230 \def\bitsetSetOct{%
231   \BitSet@SetOctHex\BitSet@FromFirstOct
232 }
```

\bitsetSetHex

```
233 \def\bitsetSetHex{%
234   \BitSet@SetOctHex\BitSet@FromFirstHex
235 }
```

\BitSet@SetOctHex

```
236 \def\BitSet@SetOctHex#1#2#3{%
237   \edef\BitSet@Temp{#3}%
238   \edef\BitSet@Temp{%
239     \expandafter\expandafter\expandafter\BitSet@ZapSpace
240     \expandafter\BitSet@Temp\BitSet@Space\BitSet@Empty
241   }%
242   \edef\BitSet@Temp{%
243     \expandafter\BitSet@KillZeros\BitSet@Temp\BitSet@Empty
244   }%
245   \ifx\BitSet@Temp\BitSet@Empty
246     \expandafter\let\csname BS@#2\endcsname\BitSet@Zero
247   \else
248     \edef\BitSet@Temp{%
249       \expandafter#1\BitSet@Temp!%
250     }%
251     \ifx\BitSet@Temp\BitSet@Empty
252       \expandafter\let\csname BS@#2\endcsname\BitSet@Zero
253     \else
254       \expandafter\edef\csname BS@#2\endcsname{%
255         \expandafter\BitSet@Reverse\BitSet@Temp!%
256       }%
257     \fi
258   \fi
259 }
```

\BitSet@FromFirstOct

```
260 \def\BitSet@FromFirstOct#1{%
261   \ifx#1!%
262   \else
263     \ifcase#1 \BitSet@AfterFiFi\BitSet@FromFirstOct
264     \or 1%
265     \or 10%
266     \or 11%
```

```

267     \or 100%
268     \or 101%
269     \or 110%
270     \or 111%
271     \else \BitSetError:WrongOctalDigit%
272     \fi
273     \expandafter\BitSet@FromOct
274     \BitSet@Fi
275 }

\BitSet@FromOct
276 \def\BitSet@FromOct#1{%
277     \ifx#1!%
278     \else
279         \ifcase#1 000%
280         \or 001%
281         \or 010%
282         \or 011%
283         \or 100%
284         \or 101%
285         \or 110%
286         \or 111%
287         \else \BitSetError:WrongOctalDigit%
288         \fi
289         \expandafter\BitSet@FromOct
290     \fi
291 }

\BitSet@FromFirstHex
292 \def\BitSet@FromFirstHex#1{%
293     \ifx#1!%
294     \else
295         \ifx#10%
296             \BitSet@AfterFiFi\BitSet@FromFirstHex
297         \fi
298         \expandafter\ifx\csname BitSet@Hex#1\endcsname\relax
299             \BitSetError:InvalidHexDigit%
300         \else
301             \expandafter\expandafter\expandafter\BitSet@KillZeros
302             \csname BitSet@Hex#1\endcsname
303         \fi
304         \expandafter\BitSet@FromHex
305     \BitSet@Fi
306 }

\BitSet@FromHex
307 \def\BitSet@FromHex#1{%
308     \ifx#1!%
309     \else
310         \expandafter\ifx\csname BitSet@Hex#1\endcsname\relax
311             \BitSetError:InvalidHexDigit%
312         \else
313             \csname BitSet@Hex#1\endcsname
314         \fi
315         \expandafter\BitSet@FromHex
316     \fi
317 }

```


\BitSet@Hex[0..F]

```
318 \def\BitSet@Temp#1{%
319   \expandafter\def\csname BitSet@Hex#1\endcsname
320 }
321 \BitSet@Temp 0{0000}%
322 \BitSet@Temp 1{0001}%
323 \BitSet@Temp 2{0010}%
324 \BitSet@Temp 3{0011}%
325 \BitSet@Temp 4{0100}%
326 \BitSet@Temp 5{0101}%
327 \BitSet@Temp 6{0110}%
328 \BitSet@Temp 7{0111}%
329 \BitSet@Temp 8{1000}%
330 \BitSet@Temp 9{1001}%
331 \BitSet@Temp A{1010}%
332 \BitSet@Temp B{1011}%
333 \BitSet@Temp C{1100}%
334 \BitSet@Temp D{1101}%
335 \BitSet@Temp E{1110}%
336 \BitSet@Temp F{1111}%
337 \BitSet@Temp a{1010}%
338 \BitSet@Temp b{1011}%
339 \BitSet@Temp c{1100}%
340 \BitSet@Temp d{1101}%
341 \BitSet@Temp e{1110}%
342 \BitSet@Temp f{1111}%
```

2.6.3 From decimal number

\bitsetSetDec

```
343 \def\bitsetSetDec#1#2{%
344   \edef\BitSet@Temp{#2}%
345   \edef\BitSet@Temp{%
346     \expandafter\expandafter\expandafter\BitSet@ZapSpace
347     \expandafter\BitSet@Temp\BitSet@Space\BitSet@Empty
348   }%
349   \edef\BitSet@Temp{%
350     \expandafter\BitSet@KillZeros\BitSet@Temp\BitSet@Empty
351   }%
352   \ifx\BitSet@Temp\BitSet@Empty
353     \expandafter\let\csname BS@#1\endcsname\BitSet@Zero
354   \else
355     \ifcase\bigintcalcSgn{\BitSet@Temp} %
356       \expandafter\let\csname BS@#1\endcsname\BitSet@Zero
357     \or
358       \ifnum\bigintcalcCmp\BitSet@Temp\BitSet@MaxSize>0 %
359         \expandafter\edef\csname BS@#1\endcsname{%
360           \expandafter\BitSet@SetDecBig\BitSet@Temp!%
361         }%
362       \else
363         \expandafter\edef\csname BS@#1\endcsname{%
364           \expandafter\BitSet@SetDec\BitSet@Temp!%
365         }%
366       \fi
367     \else
368       \@PackageError{bitset}{%
369         Bit sets cannot be negative%
370       }\@ehc
```

```

371     \fi
372 \fi
373 }

\BitSet@SetDecBig
374 \def\BitSet@SetDecBig#1#2#3#4#5#6#7#8#9!{%
375     \ifx\#9\%
376         \BitSet@SetDec#1#2#3#4#5#6#7#8!%
377     \else
378         \ifcase\BigIntCalcOdd#1#2#4#5#6#7#8#9! %
379             0%
380         \or
381             1%
382 ?     \else\BitSetError:ThisCannotHappen%
383         \fi
384         \BitSet@AfterFi{%
385             \expandafter\expandafter\expandafter\BitSet@SetDecBig
386             \BigIntCalcShr#1#2#3#4#5#6#7#8#9!!%
387         }%
388     \BitSet@Fi
389 }

\BitSet@SetDec
390 \def\BitSet@SetDec#1!{%
391     \ifcase#1 %
392     \or 1%
393     \else
394         \ifodd#1 %
395             1%
396         \else
397             0%
398         \fi
399         \BitSet@AfterFi{%
400             \expandafter\expandafter\expandafter\BitSet@SetDec
401             \IntCalcShr#1!!%
402         }%
403     \BitSet@Fi
404 }

```

2.7 Export

2.7.1 To binary number

```

\bitsetGetBin
405 \def\bitsetGetBin#1#2{%
406     \romannumeral0%
407     \expandafter\expandafter\expandafter\BitSet@@GetBin
408     \intcalcNum{#2}{#1}%
409 }

\BitSet@@GetBin
410 \def\BitSet@@GetBin#1#2{%
411     \BitSet@IfUndefined{#2}{%
412         \ifnum#1>1 %
413             \BitSet@AfterFi{%
414                 \expandafter\expandafter\expandafter\BitSet@Fill
415                 \IntCalcDec#1!!0%
416             }%

```

```

417     \else
418         \BitSet@AfterFi{ 0}%
419     \BitSet@Fi
420 }{%
421     \expandafter\expandafter\expandafter\BitSet@NumBinRev
422     \expandafter\expandafter\expandafter1%
423     \expandafter\expandafter\expandafter!%
424     \csname BS@#2\endcsname!!#1!%
425 }%
426 }

\BitSet@Fill #1: number of leading digits 0
#2: result
427 \def\BitSet@Fill#1!{%
428     \ifnum#1>0 %
429         \BitSet@AfterFi{%
430             \expandafter\expandafter\expandafter\BitSet@Fill
431             \IntCalcDec#1!!0%
432         }%
433     \else
434         \BitSet@AfterFi{ }%
435     \BitSet@Fi
436 }

\BitSet@NumBinRev #1: bit counter (including #2)
#2#3: reverted number
#4: result
#5: min size
437 \def\BitSet@NumBinRev#1!#2#3!{%
438     \ifx\#3\%
439         \BitSet@AfterFi{%
440             \BitSet@NumBinFill#1!#2%
441         }%
442     \else
443         \BitSet@AfterFi{%
444             \expandafter\expandafter\expandafter\BitSet@NumBinRev
445             \IntCalcInc#1!!#3!#2%
446         }%
447     \BitSet@Fi
448 }

\BitSet@NumBinFill
449 \def\BitSet@NumBinFill#1!#2!#3!{%
450     \ifnum#3>#1 %
451         \BitSet@AfterFi{%
452             \expandafter\expandafter\expandafter\BitSet@Fill
453             \IntCalcSub#3!#1!!#2%
454         }%
455     \else
456         \BitSet@AfterFi{ #2}%
457     \BitSet@Fi
458 }

```

2.7.2 To octal/hexadecimal number

```

\bitsetGetOct
459 \def\bitsetGetOct#1#2{%

```

```

460 \romannumeral0%
461 \bitsetIsEmpty{#1}{%
462   \expandafter\expandafter\expandafter\BitSet@@GetOctHex
463   \intcalcNum{#2}!3!230%
464 }{%
465   \expandafter\expandafter\expandafter\BitSet@@GetOct
466   \expandafter\expandafter\expandafter1%
467   \expandafter\expandafter\expandafter!%
468   \expandafter\expandafter\expandafter!%
469   \csname BS@#1\endcsname00%
470   \BitSet@Empty\BitSet@Empty\BitSet@Empty!{#2}%
471 }%
472 }

```

\bitsetGetHex

```

473 \def\bitsetGetHex#1#2{%
474   \romannumeral0%
475   \bitsetIsEmpty{#1}{%
476     \expandafter\expandafter\expandafter\BitSet@@GetOctHex
477     \intcalcNum{#2}!4!340%
478   }{%
479     \expandafter\expandafter\expandafter\BitSet@@GetHex
480     \expandafter\expandafter\expandafter1%
481     \expandafter\expandafter\expandafter!%
482     \expandafter\expandafter\expandafter!%
483     \csname BS@#1\endcsname000%
484     \BitSet@Empty\BitSet@Empty\BitSet@Empty\BitSet@Empty!{#2}%
485   }%
486 }

```

\BitSet@@GetOct #1: number of digits

#2: result

#3#4#5: bits

```

487 \def\BitSet@@GetOct#1!#2!#3#4#5{%
488   \ifx#5\BitSet@Empty
489     \BitSet@AfterFi{%
490       \expandafter\expandafter\expandafter\BitSet@GetOctHex
491       \IntCalcDec#1!!#2!23%
492     }%
493   \else
494     \BitSet@AfterFi{%
495       \expandafter\expandafter\expandafter\BitSet@@GetOct
496       \number\IntCalcInc#1!\expandafter\expandafter\expandafter!%
497       \csname BitSet@Oct#5#4#3\endcsname#2!%
498     }%
499   \BitSet@Fi
500 }

```

\BitSet@Oct[000...111]

```

501 \def\BitSet@Temp#1#2#3#4{%
502   \expandafter\def\csname BitSet@Oct#1#2#3\endcsname{#4}%
503 }
504 \BitSet@Temp0000%
505 \BitSet@Temp0011%
506 \BitSet@Temp0102%
507 \BitSet@Temp0113%
508 \BitSet@Temp1004%
509 \BitSet@Temp1015%

```

```

510 \BitSet@Temp1106%
511 \BitSet@Temp1117%

\BitSet@@GetHex #1: number of digits
#2: result
#3#4#5#6: bits
512 \def\BitSet@@GetHex#1!#2!#3#4#5#6{%
513   \ifx#6\BitSet@Empty
514     \BitSet@AfterFi{%
515       \expandafter\expandafter\expandafter\BitSet@GetOctHex
516       \IntCalcDec#1!!#2!34%
517     }%
518   \else
519     \BitSet@AfterFi{%
520       \expandafter\expandafter\expandafter\BitSet@@GetHex
521       \number\IntCalcInc#1!\expandafter\expandafter\expandafter!%
522       \csname BitSet@Hex#6#5#4#3\endcsname#2!%
523     }%
524   \BitSet@Fi
525 }

\BitSet@Hex[0000..1111]

526 \def\BitSet@Temp#1#2#3#4#5{%
527   \expandafter\def\csname BitSet@Hex#1#2#3#4\endcsname{#5}%
528 }
529 \BitSet@Temp00000%
530 \BitSet@Temp00011%
531 \BitSet@Temp00102%
532 \BitSet@Temp00113%
533 \BitSet@Temp01004%
534 \BitSet@Temp01015%
535 \BitSet@Temp01106%
536 \BitSet@Temp01117%
537 \BitSet@Temp10008%
538 \BitSet@Temp10019%
539 \BitSet@Temp1010A%
540 \BitSet@Temp1011B%
541 \BitSet@Temp1100C%
542 \BitSet@Temp1101D%
543 \BitSet@Temp1110E%
544 \BitSet@Temp1111F%

\BitSet@GetOctHex Leading zeros  $(\#4 - \#1 * 3 + 2)/3$  if  $\#4 > \#1 * 3$ 
#1: digit size
#2: result
#3: bits per digit - 1
#4: bits per digit #5: garbage
#6: min size
545 \def\BitSet@GetOctHex#1!#2!#3#4#5!#6{%
546   \expandafter\BitSet@@GetOctHex
547   \number\IntCalcNum{#6}\expandafter\expandafter\expandafter!%
548   \IntCalcMul#1!#4!!#3#4#2%
549 }

\BitSet@@GetOctHex #1: plain min size
#2: digits * (bits per digit)

```

```

#3: bits per digit - 1
#4: bits per digit
550 \def\BitSet@@GetOctHex#1!#2!#3#4{%
551   \ifnum#1>#2 %
552     \BitSet@AfterFi{%
553       \expandafter\expandafter\expandafter\expandafter
554       \expandafter\expandafter\expandafter\BitSet@Fill
555       \expandafter\IntCalcDiv\number
556       \expandafter\expandafter\expandafter\IntCalcAdd
557       \IntCalcSub#1!#2!#3!#4!%
558     }%
559   \else
560     \BitSet@AfterFi{ }%
561   \BitSet@Fi
562 }

```

2.7.3 To decimal number

\bitsetGetDec

```

563 \def\bitsetGetDec#1{%
564   \romannumeral0%
565   \BitSet@IfUndefined{#1}{ 0}{%
566     \expandafter\expandafter\expandafter\BitSet@GetDec
567     \csname BS@#1\endcsname!%
568   }%
569 }

```

\BitSet@GetDec

```

570 \def\BitSet@GetDec#1#2!{%
571   \ifx\#2\%
572     \BitSet@AfterFi{ #1}%
573   \else
574     \BitSet@AfterFi{%
575       \BitSet@@GetDec2!#1!#2!%
576     }%
577   \BitSet@Fi
578 }

```

\BitSet@@GetDec #1: power of two
#2: result
#3#4: number

```

579 \def\BitSet@@GetDec#1!#2!#3#4!{%
580   \ifx\#4\%
581     \ifx#31%
582       \BitSet@AfterFiFi{%
583         \expandafter\expandafter\expandafter\BitSet@Space
584         \IntCalcAdd#1!#2!%
585       }%
586     \else
587       \BitSet@AfterFiFi{ #2}%
588     \fi
589   \else
590     \ifx#31%
591       \BitSet@AfterFiFi{%
592         \csname BitSet@N#1%
593         \expandafter\expandafter\expandafter\endcsname
594         \IntCalcAdd#1!#2!#4!%

```

```

595     }%
596     \else
597         \BitSet@AfterFiFi{%
598             \csname BitSet@N#1\endcsname#2!#4!%
599         }%
600     \fi
601     \BitSet@Fi
602 }

```

\BitSet@N[1,2,4,...]

```

603 \def\BitSet@Temp#1#2{%
604     \expandafter\def\csname BitSet@N#1\endcsname{%
605         \BitSet@@GetDec#2!%
606     }%
607 }
608 \BitSet@Temp{1}{2}
609 \BitSet@Temp{2}{4}
610 \BitSet@Temp{4}{8}
611 \BitSet@Temp{8}{16}
612 \BitSet@Temp{16}{32}
613 \BitSet@Temp{32}{64}
614 \BitSet@Temp{64}{128}
615 \BitSet@Temp{128}{256}
616 \BitSet@Temp{256}{512}
617 \BitSet@Temp{512}{1024}
618 \BitSet@Temp{1024}{2048}
619 \BitSet@Temp{2048}{4096}
620 \BitSet@Temp{4096}{8192}
621 \BitSet@Temp{8192}{16384}
622 \BitSet@Temp{16384}{32768}
623 \BitSet@Temp{32768}{65536}
624 \BitSet@Temp{65536}{131072}
625 \BitSet@Temp{131072}{262144}
626 \BitSet@Temp{262144}{524288}
627 \BitSet@Temp{524288}{1048576}
628 \BitSet@Temp{1048576}{2097152}
629 \BitSet@Temp{2097152}{4194304}
630 \BitSet@Temp{4194304}{8388608}
631 \BitSet@Temp{8388608}{16777216}
632 \BitSet@Temp{16777216}{33554432}
633 \BitSet@Temp{33554432}{67108864}
634 \BitSet@Temp{67108864}{134217728}
635 \BitSet@Temp{134217728}{268435456}
636 \BitSet@Temp{268435456}{536870912}
637 \BitSet@Temp{536870912}{1073741824}

```

\BitSet@N1073741824

```

638 \expandafter\def\csname BitSet@N1073741824\endcsname{%
639     \BitSet@@GetDecBig2147483648!%
640 }%

```

\BitSet@@GetDecBig #1: current power of two
#2: result
#3#4: number

```

641 \def\BitSet@@GetDecBig#1!#2!#3#4!{%
642     \ifx\#4\%
643         \ifx#31%
644             \BitSet@AfterFiFi{%

```

```

645     \expandafter\expandafter\expandafter\BitSet@Space
646     \BigIntCalcAdd#1!#2!%
647 }%
648 \else
649     \BitSet@AfterFiFi{ #2}%
650 \fi
651 \else
652     \ifx#31%
653         \BitSet@AfterFiFi{%
654             \expandafter\expandafter\expandafter\BitSet@@GetDecBig
655             \BigIntCalcAdd#1!#2!!#1!#4!%
656         }%
657     \else
658         \BitSet@AfterFiFi{%
659             \expandafter\expandafter\expandafter\BitSet@GetDecBig
660             \BigIntCalcShl#1!!#2!#4!%
661         }%
662     \fi
663 \BitSet@Fi
664 }

\BitSet@@GetDecBig #1: result
#2: power of two
#3#4: number
665 \def\BitSet@@GetDecBig#1!#2!{%
666     \expandafter\expandafter\expandafter\BitSet@GetDecBig
667     \BigIntCalcShl#2!!#1!%
668 }

```

2.8 Logical operators

2.8.1 \bitsetAnd

\bitsetAnd Decision table for \bitsetAnd:

	undef(B)	empty(B)	cardinality(B)>0
undef(A)	A := empty	A := empty	A := empty
empty(A)			
cardinality(A)>0	A := empty	A := empty	A &= B

```

669 \def\bitsetAnd#1#2{%
670     \bitsetIsEmpty{#1}{%
671         \bitsetReset{#1}%
672     }{%
673         \bitsetIsEmpty{#2}{%
674             \bitsetReset{#1}%
675         }{%
676             \expandafter\edef\csname BS@#1\endcsname{%
677                 \expandafter\expandafter\expandafter\BitSet@And
678                 \csname BS@#1\expandafter\expandafter\expandafter\endcsname
679                 \expandafter\expandafter\expandafter!%
680                 \csname BS@#2\endcsname!%!%
681             }%
682             \expandafter\ifx\csname BS@#1\endcsname\BitSet@Empty
683                 \bitsetReset{#1}%
684             \fi
685         }%
686     }%
687 }

```


\BitSet@And

```

688 \def\BitSet@And#1#2!#3#4!#5!{%
689   \ifx\#2\%
690     \ifnum#1#3=11 #51\fi
691   \else
692     \ifx\#4\%
693       \ifnum#1#3=11 #51\fi
694     \else
695       \ifnum#1#3=11 %
696         #51%
697         \BitSet@AfterFiFiFi{%
698           \BitSet@And#2!#4!!%
699         }%
700     \else
701       \BitSet@AfterFiFiFi{%
702         \BitSet@And#2!#4!#50!%
703       }%
704     \fi
705   \fi
706 \BitSet@Fi
707 }

```

2.8.2 \bitsetAndNot

\bitsetAndNot Decision table for \bitsetAndNot:

	undef(B)	empty(B)	cardinality(B)>0
undef(A)	A := empty	A := empty	A := empty
empty(A)			
cardinality(A)>0			A &= !B

```

708 \def\bitsetAndNot#1#2{%
709   \bitsetIsEmpty{#1}{%
710     \bitsetReset{#1}%
711   }{%
712     \bitsetIsEmpty{#2}{%
713     }{%
714       \expandafter\edef\csname BS@#1\endcsname{%
715         \expandafter\expandafter\expandafter\BitSet@AndNot
716         \csname BS@#1\expandafter\expandafter\expandafter\endcsname
717         \expandafter\expandafter\expandafter!%
718         \csname BS@#2\endcsname!!%
719       }%
720       \expandafter\ifx\csname BS@#1\endcsname\BitSet@Empty
721         \bitsetReset{#1}%
722       \fi
723     }%
724   }%
725 }

```

\BitSet@AndNot

```

726 \def\BitSet@AndNot#1#2!#3#4!#5!{%
727   \ifx\#2\%
728     \ifnum#1#3=10 #51\fi
729   \else
730     \ifx\#4\%
731       #5%
732     \ifnum#1#3=10 1\else 0\fi

```

```

733     #2%
734   \else
735     \ifnum#1#3=10 %
736       #51%
737       \BitSet@AfterFiFiFi{%
738         \BitSet@AndNot#2!#4!!%
739       }%
740   \else
741     \BitSet@AfterFiFiFi{%
742       \BitSet@AndNot#2!#4!#50!%
743     }%
744   \fi
745 \fi
746 \BitSet@Fi
747 }

```

2.8.3 \bitsetOr

\bitsetOr Decision table for \bitsetOr:

	undef(B)	empty(B)	cardinality(B)>0
undef(A)	A := empty	A := empty	A := B
empty(A)			A := B
cardinality(A)>0			A = B

```

748 \def\bitsetOr#1#2{%
749   \bitsetIsEmpty{#2}{%
750     \BitSet@IfUndefined{#1}{\bitsetReset{#1}}{}%
751   }{%
752     \bitsetIsEmpty{#1}{%
753       \expandafter\let\csname BS@#1\expandafter\endcsname
754         \csname BS@#2\endcsname
755     }{%
756       \expandafter\edef\csname BS@#1\endcsname{%
757         \expandafter\expandafter\expandafter\BitSet@Or
758         \csname BS@#1\expandafter\expandafter\expandafter\endcsname
759         \expandafter\expandafter\expandafter!%
760         \csname BS@#2\endcsname!%
761       }%
762     }%
763   }%
764 }

```

\BitSet@Or

```

765 \def\BitSet@Or#1#2!#3#4!{%
766   \ifnum#1#3>0 1\else 0\fi
767   \ifx\#2\%
768     #4%
769   \else
770     \ifx\#4\%
771       #2%
772     \else
773       \BitSet@AfterFiFi{%
774         \BitSet@Or#2!#4!%
775       }%
776     \fi
777   \BitSet@Fi
778 }

```

2.8.4 \bitsetXor

\bitsetXor Decision table for \bitsetXor:

	undef(B)	empty(B)	cardinality(B)>0
undef(A)	A := empty	A := empty	A := B
empty(A)			A := B
cardinality(A)>0			A $\hat{=}$ B

```

779 \def\bitsetXor#1#2{%
780   \bitsetIsEmpty{#2}{%
781     \BitSet@IfUndefined{#1}{\bitsetReset{#1}}{}%
782   }{%
783     \bitsetIsEmpty{#1}{%
784       \expandafter\let\csname BS@#1\expandafter\endcsname
785         \csname BS@#2\endcsname
786     }{%
787       \expandafter\edef\csname BS@#1\endcsname{%
788         \expandafter\expandafter\expandafter\BitSet@Xor
789         \csname BS@#1\expandafter\expandafter\expandafter\endcsname
790         \expandafter\expandafter\expandafter!%
791         \csname BS@#2\endcsname!!%
792       }%
793       \expandafter\ifx\csname BS@#1\endcsname\BitSet@Empty
794         \bitsetReset{#1}%
795       \fi
796     }%
797   }%
798 }
```

\BitSet@Xor

```

799 \def\BitSet@Xor#1#2!#3#4!#5!{%
800   \ifx\#2\%
801     \ifx#1#3%
802       \ifx\#4\%
803         \else
804           #50#4%
805         \fi
806       \else
807         #51#4%
808       \fi
809     \else
810       \ifx\#4\%
811         #5%
812         \ifx#1#30\else 1\fi
813         #2%
814       \else
815         \ifx#1#3%
816           \BitSet@AfterFiFiFi{%
817             \BitSet@Xor#2!#4!#50!%
818           }%
819         \else
820           #51%
821           \BitSet@AfterFiFiFi{%
822             \BitSet@Xor#2!#4!!%
823           }%
824         \fi
825       \fi
826     \BitSet@Fi
```

827 }

2.8.5 Shifting

2.8.6 \bitsetShiftLeft

\bitsetShiftLeft

```
828 \def\bitsetShiftLeft#1#2{%
829   \BitSet@IfUndefined{#1}{%
830     \bitsetReset{#1}%
831   }{%
832     \bitsetIsEmpty{#1}{%
833       {%
834         \expandafter\expandafter\expandafter\BitSet@ShiftLeft
835         \intcalcNum{#2}!{#1}%
836       }%
837     }%
838 }
```

\BitSet@ShiftLeft

```
839 \def\BitSet@ShiftLeft#1!#2{%
840   \ifcase\intcalcSgn{#1} %
841   \or
842     \begingroup
843     \uccode`m=`0 %
844     \uppercase\expandafter{\expandafter\endgroup
845     \expandafter\edef\csname BS@#2\expandafter\endcsname
846     \expandafter{%
847       \romannumeral#1000\expandafter\BitSet@Space
848       \csname BS@#2\endcsname
849     }%
850   }%
851   \else
852     \expandafter\BitSet@ShiftRight\BitSet@Gobble#1!{#2}%
853   \fi
854 }
```

2.8.7 \bitsetShiftRight

\bitsetShiftRight

```
855 \def\bitsetShiftRight#1#2{%
856   \BitSet@IfUndefined{#1}{%
857     \bitsetReset{#1}%
858   }{%
859     \bitsetIsEmpty{#1}{%
860       {%
861         \expandafter\expandafter\expandafter\BitSet@ShiftRight
862         \intcalcNum{#2}!{#1}%
863       }%
864     }%
865 }
```

\BitSet@ShiftRight

```
866 \def\BitSet@ShiftRight#1!#2{%
867   \ifcase\intcalcSgn{#1} %
868   \or
869     \expandafter\edef\csname BS@#2\endcsname{%
870       \expandafter\expandafter\expandafter\BitSet@Kill
```

```

871     \csname BS@#2\expandafter\endcsname\expandafter\BitSet@Empty
872     \expandafter=%
873     \expandafter{\expandafter}\expandafter{\expandafter}%
874     \romannumeral#1000!%
875   }%
876 \else
877   \expandafter\BitSet@ShiftLeft\BitSet@Gobble#1!{#2}%
878 \fi
879 }

\BitSet@Kill
880 \def\BitSet@Kill#1#2=#3#4#5{%
881   #3#4%
882   \ifx#5!%
883     \ifx#1\BitSet@Empty
884       0%
885     \else
886       #1#2%
887     \fi
888   \else
889     \ifx#1\BitSet@Empty
890       0%
891       \BitSet@AfterFiFi\BitSet@Cleanup
892     \else
893       \BitSet@Kill#2=%
894     \fi
895   \BitSet@Fi
896 }

```

2.9 Bit manipulation

```

\bitsetClear
897 \def\bitsetClear{%
898   \BitSet@CheckIndex\BitSet@Clear
899 }

\bitsetSet
900 \def\bitsetSet{%
901   \BitSet@CheckIndex\BitSet@Set
902 }

\bitsetFlip
903 \def\bitsetFlip{%
904   \BitSet@CheckIndex\BitSet@Flip
905 }

\bitsetSetValue
906 \def\bitsetSetValue#1#2#3{%
907   \expandafter\expandafter\expandafter\BitSet@SetValue
908   \intcalculus{#3}!{#1}{#2}%
909 }

\BitSet@SetValue #1: plain value
#2: BitSet
#3: Index
910 \def\BitSet@SetValue#1!{%
911   \BitSet@CheckIndex{%

```

```

912 \ifcase#1 %
913 \expandafter\BitSet@Clear
914 \or
915 \expandafter\BitSet@Set
916 \else
917 \BitSet@ErrorInvalidBitValue{#1}%
918 \expandafter\expandafter\expandafter\BitSet@Gobble
919 \expandafter\BitSet@Gobble
920 \fi
921 }%
922 }

```

\BitSet@ErrorInvalidBitValue #1: Wrong bit value

```

923 \def\BitSet@ErrorInvalidBitValue#1{%
924 \@PackageError{bitset}{%
925 Invalid bit value (#1) not in range 0..1%
926 }\@ehc
927 }

```

2.9.1 Clear operation

\BitSet@Clear #1: BitSet

#2: plain and checked index

```

928 \def\BitSet@Clear#1#2{%
929 \edef\BitSet@Temp{%
930 \expandafter\expandafter\expandafter\BitSet@@Clear
931 \csname BS@#1\expandafter\endcsname
932 \expandafter\BitSet@Empty\expandafter=\expandafter!%
933 \romannumeral#2000!%
934 }%
935 \expandafter\let\csname BS@#1\expandafter\endcsname
936 \ifx\BitSet@Temp\BitSet@Empty
937 \BitSet@Zero
938 \else
939 \BitSet@Temp
940 \fi
941 }

```

\BitSet@@Clear

```

942 \def\BitSet@@Clear#1#2=#3!#4{%
943 \ifx#4!%
944 \ifx#1\BitSet@Empty
945 \else
946 \ifx\BitSet@Empty#2%
947 \else
948 #30#2%
949 \fi
950 \fi
951 \else
952 \ifx#1\BitSet@Empty
953 \BitSet@AfterFiFi\BitSet@Cleanup
954 \else
955 \ifx#10%
956 \BitSet@AfterFiFiFi{%
957 \BitSet@@Clear#2=#30!%
958 }%
959 \else
960 #31%

```

```

961         \BitSet@AfterFiFiFi{%
962         \BitSet@@Clear#2=!%
963     }%
964     \fi
965     \fi
966 \BitSet@Fi
967 }

```

2.9.2 Set operation

```

\BitSet@Set #1: BitSet
#2: plain and checked Index
968 \def\BitSet@Set#1#2{%
969     \expandafter\edef\csname BS@#1\endcsname{%
970         \expandafter\expandafter\expandafter\BitSet@@Set
971         \csname BS@#1\expandafter\endcsname
972         \expandafter\BitSet@Empty\expandafter=%
973         \expandafter{\expandafter}\expandafter{\expandafter}%
974         \romannumeral#2000!%
975     }%
976 }

\BitSet@@Set
977 \def\BitSet@@Set#1#2=#3#4#5{%
978     #3#4%
979     \ifx#5!%
980         1#2%
981     \else
982         \ifx#1\BitSet@Empty
983             0%
984             \BitSet@AfterFiFi\BitSet@@@Set
985         \else
986             #1%
987             \BitSet@@Set#2=%
988         \fi
989     \BitSet@Fi
990 }

\BitSet@@@Set
991 \def\BitSet@@@Set#1{%
992     \ifx#1!%
993         1%
994     \else
995         0%
996         \expandafter\BitSet@@@Set
997     \fi
998 }

```

2.9.3 Flip operation

```

\BitSet@Flip #1: BitSet
#2: plain and checked Index
999 \def\BitSet@Flip#1#2{%
1000     \edef\BitSet@Temp{%
1001         \expandafter\expandafter\expandafter\BitSet@@Flip
1002         \csname BS@#1\expandafter\endcsname
1003         \expandafter\BitSet@Empty\expandafter=\expandafter!%

```

```

1004     \romannumeral#2000!%
1005 }%
1006 \expandafter\let\csname BS@#1\expandafter\endcsname
1007 \ifx\BitSet@Temp\BitSet@Empty
1008     \BitSet@Zero
1009 \else
1010     \BitSet@Temp
1011 \fi
1012 }

```

\BitSet@@Flip

```

1013 \def\BitSet@@Flip#1#2=#3!#4{%
1014     \ifx#4!%
1015         \ifx#11%
1016             \ifx\BitSet@Empty#2%
1017                 \else
1018                     #30#2%
1019                 \fi
1020             \else
1021                 #31#2%
1022             \fi
1023         \else
1024             \ifx#1\BitSet@Empty
1025                 #30%
1026                 \BitSet@AfterFiFi\BitSet@@@Set
1027             \else
1028                 \ifx#10%
1029                     \BitSet@AfterFiFiFi{%
1030                         \BitSet@@Flip#2=#30!%
1031                     }%
1032                 \else
1033                     #31%
1034                     \BitSet@AfterFiFiFi{%
1035                         \BitSet@@Flip#2=!%
1036                     }%
1037                 \fi
1038             \fi
1039         \BitSet@Fi
1040 }

```

2.9.4 Range operators

\bitsetClearRange

```

1041 \def\bitsetClearRange{%
1042     \BitSet@Range\BitSet@Clear
1043 }

```

\bitsetSetRange

```

1044 \def\bitsetSetRange{%
1045     \BitSet@Range\BitSet@Set
1046 }

```

\bitsetFlipRange

```

1047 \def\bitsetFlipRange{%
1048     \BitSet@Range\BitSet@Flip
1049 }

```



```

\bitsetSetValueRange
1050 \def\bitsetSetValueRange#1#2#3#4{%
1051   \expandafter\expandafter\expandafter\BitSet@SetValueRange
1052   \intcalcNum{#4}!\{#1\}{#2\}{#3}%
1053 }

\BitSet@SetValueRange
1054 \def\BitSet@SetValueRange#1!#2#3#4{%
1055   \ifcase#1 %
1056     \BitSet@Range\BitSet@Clear{#2}{#3}{#4}%
1057   \or
1058     \BitSet@Range\BitSet@Set{#2}{#3}{#4}%
1059   \else
1060     \BitSet@ErrorInvalidBitValue{#1}%
1061   \fi
1062 }

\BitSet@Range #1: clear/set/flip macro
#2: BitSet
#3: Index from
#4: Index to
1063 \def\BitSet@Range#1#2#3#4{%
1064   \edef\BitSet@Temp{%
1065     \noexpand\BitSet@@Range\noexpand#1{#2}%
1066     \intcalcNum{#3}!\intcalcNum{#4}!%
1067   }%
1068   \BitSet@Temp
1069 }

\BitSet@@Range #1: clear/set/flip macro
#2: BitSet
#3: Index from
#4: Index to
1070 \def\BitSet@@Range#1#2#3!#4!{%
1071   \ifnum#3<0 %
1072     \BitSet@NegativeIndex#1{#2}#3!#4!0!#4!%
1073   \else
1074     \ifnum#4<0 %
1075       \BitSet@NegativeIndex#1{#2}#3!#4!#3!0!%
1076     \else
1077       \ifcase\intcalcCmp{#3}{#4} %
1078       \or
1079         \@PackageError{bitset}{%
1080           Wrong index numbers in range [#3..#4]\MessageBreak% hash-ok
1081           for clear/set/flip on bit set `#2'.\MessageBreak
1082           The lower index exceeds the upper index.\MessageBreak
1083           Canceling the operation as error recovery%
1084         }\@ehc
1085       \else
1086         \BitSet@@@Range#3!#4!#1{#2}%
1087       \fi
1088     \fi
1089   \fi
1090 }

\BitSet@NegativeIndex
1091 \def\BitSet@NegativeIndex#1#2#3!#4!#5!#6!{%

```

```

1092 \@PackageError{bitset}{%
1093     Negative index in range [#3..#4]\MessageBreak % hash-ok
1094     for \string\bitset
1095     \ifx#1\BitSet@Clear
1096         Clear%
1097     \else
1098         \ifx#1\BitSet@Set
1099             Set%
1100         \else
1101             Flip%
1102         \fi
1103     \fi
1104     Range on bit set `#2'.\MessageBreak
1105     Using [#5..#6] as error recovery% hash-ok
1106 } \@ehc
1107 \BitSet@@Range#1{#2}#5!#6!%
1108 }

```

\BitSet@@Range

```

1109 \def\BitSet@@Range#1!#2!#3#4{%
1110     \ifnum#1<#2 %
1111         #3{#4}{#1}%
1112     \BitSet@AfterFi{%
1113         \expandafter\expandafter\expandafter\BitSet@@Range
1114         \IntCalcInc#1!!#2!#3{#4}%
1115     }%
1116     \BitSet@Fi
1117 }

```

2.10 Bit retrieval

2.10.1 \bitsetGet

\bitsetGet

```

1118 \def\bitsetGet#1#2{%
1119     \number
1120     \expandafter\expandafter\expandafter\BitSet@Get
1121     \intcalcNum{#2}!{#1}%
1122 }

```

\BitSet@Get #1: plain index
#2: BitSet

```

1123 \def\BitSet@Get#1!#2{%
1124     \ifnum#1<0 %
1125         \BitSet@AfterFi{%
1126             0 \BitSetError:NegativeIndex%
1127         }%
1128     \else
1129         \BitSet@IfUndefined{#2}{0}{%
1130             \expandafter\expandafter\expandafter\BitSet@@Get
1131             \csname BS@#2\expandafter\endcsname
1132             \expandafter!\expandafter=%
1133             \expandafter{\expandafter}\expandafter{\expandafter}%
1134             \romannumeral\intcalcNum{#1}000!%
1135         }%
1136         \expandafter\BitSet@Space
1137     \BitSet@Fi
1138 }

```

\BitSet@@Get

```

1139 \def\BitSet@@Get#1#2=#3#4#5{%
1140   #3#4%
1141   \ifx#5!%
1142     \ifx#1!%
1143       0%
1144     \else
1145       #1%
1146     \fi
1147   \else
1148     \ifx#1!%
1149       0%
1150     \BitSet@AfterFiFi\BitSet@Cleanup
1151   \else
1152     \BitSet@@Get#2=%
1153   \fi
1154   \BitSet@Fi
1155 }

```

2.10.2 \bitsetNextClearBit, \bitsetNextSetBit

\bitsetNextClearBit

```

1156 \def\bitsetNextClearBit#1#2{%
1157   \number
1158   \expandafter\expandafter\expandafter\BitSet@NextClearBit
1159   \intcalculus{#2}!{#1} %
1160 }

```

\BitSet@NextClearBit

```

#1: Index
#2: BitSet
1161 \def\BitSet@NextClearBit#1!#2{%
1162   \ifnum#1<0 %
1163     \BitSet@NextClearBit0!{#2}%
1164     \BitSet@AfterFi{%
1165       \expandafter\BitSet@Space
1166       \expandafter\BitSetError:NegativeIndex\romannumeral0%
1167     }%
1168   \else
1169     \bitsetIsEmpty{#2}{#1}{%
1170       \expandafter\BitSet@Skip
1171       \number#1\expandafter\expandafter\expandafter!%
1172       \csname BS@#2\endcsname!!!!!!!!!=%
1173       {\BitSet@@NextClearBit#1!}%
1174     }%
1175     \BitSet@Fi
1176 }

```

\BitSet@@NextClearBit

```

#1: index for next bit in #2
#2: next bit
1177 \def\BitSet@@NextClearBit#1!#2{%
1178   \ifx#2!%
1179     #1%
1180   \else
1181     \ifx#20%
1182       #1%
1183     \BitSet@AfterFiFi\BitSet@Cleanup
1184   \else

```

```

1185     \BitSet@AfterFiFi{%
1186     \expandafter\expandafter\expandafter\BitSet@@NextClearBit
1187     \IntCalcInc#1!!%
1188     }%
1189     \fi
1190 \BitSet@Fi
1191 }

\bitsetNextSetBit
1192 \def\bitsetNextSetBit#1#2{%
1193     \number
1194     \expandafter\expandafter\expandafter\BitSet@NextSetBit
1195     \intcalcNum{#2}!{#1} %
1196 }

\BitSet@NextSetBit #1: Index
#2: BitSet
1197 \def\BitSet@NextSetBit#1!#2{%
1198     \ifnum#1<0 %
1199     \BitSet@NextSetBit0!{#2}%
1200     \BitSet@AfterFiFi{%
1201     \expandafter\BitSet@Space
1202     \expandafter\BitSetError:NegativeIndex\romannumeral0%
1203     }%
1204     \else
1205     \bitsetIsEmpty{#2}{-1}{%
1206     \expandafter\BitSet@Skip
1207     \number#1\expandafter\expandafter\expandafter!%
1208     \csname BS@#2\endcsname!!!!!!!!!=%
1209     {\BitSet@@NextSetBit#1!}%
1210     }%
1211     \BitSet@Fi
1212 }

\BitSet@@NextSetBit #1: index for next bit in #2
#2: next bit
1213 \def\BitSet@@NextSetBit#1!#2{%
1214     \ifx#2!%
1215     -1%
1216     \else
1217     \ifx#21%
1218     #1%
1219     \BitSet@AfterFiFi\BitSet@Cleanup
1220     \else
1221     \BitSet@AfterFiFi{%
1222     \expandafter\expandafter\expandafter\BitSet@@NextSetBit
1223     \IntCalcInc#1!!%
1224     }%
1225     \fi
1226     \BitSet@Fi
1227 }

\BitSet@Cleanup
1228 \def\BitSet@Cleanup#1!{ }

\BitSet@Skip #1: number of bits to skip
#2: bits
#3: continuation code

```

```

1229 \def\BitSet@Skip#1!#2{%
1230   \ifx#2!%
1231     \BitSet@AfterFi{%
1232       \BitSet@SkipContinue%
1233     }%
1234   \else
1235     \ifcase#1 %
1236       \BitSet@AfterFiFi{%
1237         \BitSet@SkipContinue#2%
1238       }%
1239     \or
1240       \BitSet@AfterFiFi\BitSet@SkipContinue
1241     \or
1242       \BitSet@AfterFiFi{%
1243         \expandafter\BitSet@SkipContinue\BitSet@Gobble
1244       }%
1245     \else
1246       \ifnum#1>8 %
1247         \BitSet@AfterFiFiFi{%
1248           \expandafter\BitSet@Skip
1249           \number\IntCalcSub#1!8!\expandafter!%
1250           \BitSet@GobbleSeven
1251         }%
1252       \else
1253         \BitSet@AfterFiFiFiFi{%
1254           \expandafter\expandafter\expandafter\BitSet@Skip
1255           \IntCalcDec#1!!%
1256         }%
1257       \fi
1258     \fi
1259   \BitSet@Fi
1260 }

```

\BitSet@SkipContinue #1: remaining bits
#2: continuation code

```

1261 \def\BitSet@SkipContinue#1!#2=#3{%
1262   #3#1!%
1263 }

```

\BitSet@GobbleSeven

```

1264 \def\BitSet@GobbleSeven#1#2#3#4#5#6#7{}

```

2.10.3 \bitsetGetSetBitList

\bitsetGetSetBitList It's just a wrapper for \bitsetNextSetBit.

```

1265 \def\bitsetGetSetBitList#1{%
1266   \romannumeral0%
1267   \bitsetIsEmpty{#1}{ }{%
1268     \expandafter\BitSet@GetSetBitList
1269     \number\BitSet@NextSetBit0!{#1}!{#1}{ }!%
1270   }%
1271 }

```

\BitSet@GetSetBitList #1: found index
#2: BitSet
#3: comma #4: result

```

1272 \def\BitSet@GetSetBitList#1!#2#3#4!{%

```

```

1273 \ifnum#1<0 %
1274 \BitSet@AfterFi{ #4}%
1275 \else
1276 \BitSet@AfterFi{%
1277 \expandafter\BitSet@GetSetBitList\number
1278 \expandafter\expandafter\expandafter\BitSet@NextSetBit
1279 \IntCalcInc#1!!{#2}!{#2},#4#3#1!%
1280 }%
1281 \BitSet@Fi
1282 }

```

2.11 Bit set properties

\bitsetSize

```

1283 \def\bitsetSize#1{%
1284 \number
1285 \BitSet@IfUndefined{#1}{0 }{%
1286 \expandafter\expandafter\expandafter\BitSet@Size
1287 \expandafter\expandafter\expandafter1%
1288 \expandafter\expandafter\expandafter!%
1289 \csname BS@#1\endcsname!0!%
1290 }%
1291 }

```

\BitSet@Size #1: counter
#2#3: bits
#4: result

```

1292 \def\BitSet@Size#1!#2#3!#4!{%
1293 \ifx#21%
1294 \ifx\#3\%
1295 \BitSet@AfterFiFi{#1 }%
1296 \else
1297 \BitSet@AfterFiFi{%
1298 \expandafter\expandafter\expandafter\BitSet@Size
1299 \IntCalcInc#1!!#3!#1!%
1300 }%
1301 \fi
1302 \else
1303 \ifx\#3\%
1304 \BitSet@AfterFiFi{#4 }%
1305 \else
1306 \BitSet@AfterFiFi{%
1307 \expandafter\expandafter\expandafter\BitSet@Size
1308 \IntCalcInc#1!!#3!#4!%
1309 }%
1310 \fi
1311 \fi
1312 \BitSet@Fi
1313 }

```

\bitsetCardinality

```

1314 \def\bitsetCardinality#1{%
1315 \number
1316 \BitSet@IfUndefined{#1}{0 }{%
1317 \expandafter\expandafter\expandafter\BitSet@Cardinality
1318 \expandafter\expandafter\expandafter0%
1319 \expandafter\expandafter\expandafter!%

```

```

1320     \csname BS@#1\endcsname!%
1321 }%
1322 }

```

```

\BitSet@Cardinality #1: result
#2#3: bits
1323 \def\BitSet@Cardinality#1!#2#3!{%
1324   \ifx#21%
1325     \ifx\#3\%
1326       \BitSet@AfterFiFi{\IntCalcInc#1! }%
1327     \else
1328       \BitSet@AfterFiFi{%
1329         \expandafter\expandafter\expandafter\BitSet@Cardinality
1330         \IntCalcInc#1!!#3!%
1331       }%
1332     \fi
1333   \else
1334     \ifx\#3\%
1335       \BitSet@AfterFiFi{#1 }%
1336     \else
1337       \BitSet@AfterFiFi{%
1338         \BitSet@Cardinality#1!#3!%
1339       }%
1340     \fi
1341   \fi
1342   \BitSet@Fi
1343 }

```

2.12 Queries

\bitsetIsDefined

```

1344 \def\bitsetIsDefined#1{%
1345   \BitSet@IfUndefined{#1}%
1346   \BitSet@SecondOfTwo
1347   \BitSet@FirstOfTwo
1348 }

```

\bitsetIsEmpty

```

1349 \def\bitsetIsEmpty#1{%
1350   \BitSet@IfUndefined{#1}\BitSet@FirstOfTwo{%
1351     \expandafter\ifx\csname BS@#1\endcsname\BitSet@Zero
1352     \expandafter\BitSet@FirstOfTwo
1353   \else
1354     \expandafter\BitSet@SecondOfTwo
1355   \fi
1356 }%
1357 }

```

\BitSet@Zero

```

1358 \def\BitSet@Zero{0}

```

\bitsetQuery

```

1359 \def\bitsetQuery#1#2{%
1360   \ifnum\bitsetGet{#1}{#2}=1 %
1361     \expandafter\BitSet@FirstOfTwo
1362   \else
1363     \expandafter\BitSet@SecondOfTwo

```

```

1364 \fi
1365 }

\bitsetEquals
1366 \def\bitsetEquals#1#2{%
1367 \BitSet@IfUndefined{#1}{%
1368 \BitSet@IfUndefined{#2}\BitSet@FirstOfTwo\BitSet@SecondOfTwo
1369 }{%
1370 \BitSet@IfUndefined{#2}\BitSet@SecondOfTwo{%
1371 \expandafter\ifx\csname BS@#1\expandafter\endcsname
1372 \csname BS@#2\endcsname
1373 \expandafter\BitSet@FirstOfTwo
1374 \else
1375 \expandafter\BitSet@SecondOfTwo
1376 \fi
1377 }%
1378 }%
1379 }

\bitsetIntersects
1380 \def\bitsetIntersects#1#2{%
1381 \bitsetIsEmpty{#1}\BitSet@SecondOfTwo{%
1382 \bitsetIsEmpty{#2}\BitSet@SecondOfTwo{%
1383 \expandafter\expandafter\expandafter\BitSet@Intersects
1384 \csname BS@#1\expandafter\expandafter\expandafter\endcsname
1385 \expandafter\expandafter\expandafter!%
1386 \csname BS@#2\endcsname!%
1387 }%
1388 }%
1389 }

\BitSet@Intersects
1390 \def\BitSet@Intersects#1#2!#3#4!{%
1391 \ifnum#1#3=11 %
1392 \BitSet@AfterFi\BitSet@FirstOfTwo
1393 \else
1394 \ifx\#2\%
1395 \BitSet@AfterFiFi\BitSet@SecondOfTwo
1396 \else
1397 \ifx\#4\%
1398 \BitSet@AfterFiFiFi\BitSet@SecondOfTwo
1399 \else
1400 \BitSet@AfterFiFiFi{%
1401 \BitSet@Intersects#2!#4!%
1402 }%
1403 \fi
1404 \fi
1405 \BitSet@Fi
1406 }

1407 \BitSet@AtEnd%
1408 </package>

```

3 Test

3.1 Catcode checks for loading


```

1409 (*test1)
1410 \catcode`\{=1 %
1411 \catcode`\}=2 %
1412 \catcode`\#=6 %
1413 \catcode`\@=11 %
1414 \expandafter\ifx\csname count@\endcsname\relax
1415   \countdef\count@=255 %
1416 \fi
1417 \expandafter\ifx\csname @gobble\endcsname\relax
1418   \long\def@gobble#1{}%
1419 \fi
1420 \expandafter\ifx\csname @firstofone\endcsname\relax
1421   \long\def@firstofone#1{#1}%
1422 \fi
1423 \expandafter\ifx\csname loop\endcsname\relax
1424   \expandafter@firstofone
1425 \else
1426   \expandafter@gobble
1427 \fi
1428 {%
1429   \def\loop#1\repeat{%
1430     \def\body{#1}%
1431     \iterate
1432   }%
1433   \def\iterate{%
1434     \body
1435     \let\next\iterate
1436   \else
1437     \let\next\relax
1438   \fi
1439   \next
1440 }%
1441 \let\repeat=\fi
1442 }%
1443 \def\RestoreCatcodes{}
1444 \count@=0 %
1445 \loop
1446   \edef\RestoreCatcodes{%
1447     \RestoreCatcodes
1448     \catcode\the\count@=\the\catcode\count@\relax
1449   }%
1450 \ifnum\count@<255 %
1451   \advance\count@ 1 %
1452 \repeat
1453
1454 \def\RangeCatcodeInvalid#1#2{%
1455   \count@=#1\relax
1456   \loop
1457     \catcode\count@=15 %
1458   \ifnum\count@<#2\relax
1459     \advance\count@ 1 %
1460   \repeat
1461 }
1462 \def\RangeCatcodeCheck#1#2#3{%
1463   \count@=#1\relax
1464   \loop
1465     \ifnum#3=\catcode\count@
1466   \else

```

```

1467     \errmessage{%
1468         Character \the\count@\space
1469         with wrong catcode \the\catcode\count@\space
1470         instead of \number#3%
1471     }%
1472     \fi
1473     \ifnum\count@<#2\relax
1474         \advance\count@ 1 %
1475     \repeat
1476 }
1477 \def\space{ }
1478 \expandafter\ifx\csname LoadCommand\endcsname\relax
1479     \def\LoadCommand{\input bitset.sty\relax}%
1480 \fi
1481 \def\Test{%
1482     \RangeCatcodeInvalid{0}{47}%
1483     \RangeCatcodeInvalid{58}{64}%
1484     \RangeCatcodeInvalid{91}{96}%
1485     \RangeCatcodeInvalid{123}{255}%
1486     \catcode`\@=12 %
1487     \catcode`\=0 %
1488     \catcode`\%=14 %
1489     \LoadCommand
1490     \RangeCatcodeCheck{0}{36}{15}%
1491     \RangeCatcodeCheck{37}{37}{14}%
1492     \RangeCatcodeCheck{38}{47}{15}%
1493     \RangeCatcodeCheck{48}{57}{12}%
1494     \RangeCatcodeCheck{58}{63}{15}%
1495     \RangeCatcodeCheck{64}{64}{12}%
1496     \RangeCatcodeCheck{65}{90}{11}%
1497     \RangeCatcodeCheck{91}{91}{15}%
1498     \RangeCatcodeCheck{92}{92}{0}%
1499     \RangeCatcodeCheck{93}{96}{15}%
1500     \RangeCatcodeCheck{97}{122}{11}%
1501     \RangeCatcodeCheck{123}{255}{15}%
1502     \RestoreCatcodes
1503 }
1504 \Test
1505 \csname @@end\endcsname
1506 \end
1507 </test1>

```

3.2 Macro tests

3.2.1 Preamble

```

1508 <*test2>
1509 \NeedsTeXFormat{LaTeX2e}
1510 \nofiles
1511 \documentclass{article}
1512 \makeatletter
1513 <*noetex>
1514 \let\SavedNumexpr\numexpr
1515 \let\SavedIfcsname\ifcsname
1516 \let\SavedCurrentgrouplevel\currentgrouplevel
1517 \def\ETeXDisable{%
1518     \let\ifcsname\@undefined
1519     \let\numexpr\@undefined
1520     \let\currentgrouplevel\@undefined

```

```

1521 }
1522 \ETeXDisable
1523 \noetex
1524 \makeatletter
1525 \chardef\BitSet@TestMode=1 %
1526 \makeatother
1527 \usepackage{bitset}[2016/05/16]
1528 \noetex
1529 \def\ETeXEnable{%
1530   \let\numexpr\SavedNumexpr
1531   \let\ifcsname\SavedIfcsname
1532   \let\currentgrouplevel\SavedCurrentgrouplevel
1533 }
1534 \ETeXEnable
1535 \noetex
1536 \usepackage{qstest}
1537 \IncludeTests{*}
1538 \LogTests{log}{*}{*}
1539 \makeatletter

```

3.2.2 Time

```

1540 \begingroup\expandafter\expandafter\expandafter\endgroup
1541 \expandafter\ifx\csname pdfresettimer\endcsname\relax
1542 \else
1543   \newcount\SummaryTime
1544   \newcount\TestTime
1545   \SummaryTime=\z@
1546   \newcommand*\PrintTime}[2]{%
1547     \typeout{%
1548       [Time #1: \strip@pt\dimexpr\number#2sp\relax\space s]%
1549     }%
1550   }%
1551   \newcommand*\StartTime#[1]{%
1552     \renewcommand*\TimeDescription}{#1}%
1553     \pdfresettimer
1554   }%
1555   \newcommand*\TimeDescription}{}%
1556   \newcommand*\StopTime{%
1557     \TestTime=\pdfelapsedtime
1558     \global\advance\SummaryTime\TestTime
1559     \PrintTime\TimeDescription\TestTime
1560   }%
1561   \let\saved@qstest\qstest
1562   \let\saved@endqstest\endqstest
1563   \def\qstest#1#2{%
1564     \saved@qstest{#1}{#2}%
1565     \StartTime{#1}%
1566   }%
1567   \def\endqstest{%
1568     \StopTime
1569     \saved@endqstest
1570   }%
1571   \AtEndDocument{%
1572     \PrintTime{summary}\SummaryTime
1573   }%
1574 \fi

```

3.2.3 Detection of unwanted space

```

1575 \let\orig@qstest\qstest
1576 \let\orig@endqstest\endqstest
1577 \def\qstest#1#2{%
1578   \orig@qstest{#1}{#2}%
1579   \setbox0\hbox\bgroup\beginingroup\ignorespaces
1580 }
1581 \def\endqstest{%
1582   \endgroup\egroup
1583   \Expect*{\the\wd0}{0.0pt}%
1584   \orig@endqstest
1585 }

```

3.2.4 Test macros

```

1586 \newcounter{Test}
1587
1588 \def\TestError#1#2{%
1589   \beginingroup
1590     \setcounter{Test}{0}%
1591     \sbox0{%
1592       \def\@PackageError##1##2##3{%
1593         \stepcounter{Test}%
1594         \beginingroup
1595           \let\MessageBreak\relax
1596 (*noetex)
1597       \ETEXEnable
1598 (/noetex)
1599       \Expect{##1}{bitset}%
1600       \Expect*{##2}*{#1}%
1601       \endgroup
1602     }%
1603 (*noetex)
1604     \ETEXDisable
1605 (/noetex)
1606     #2%
1607   }%
1608   \Expect*{\theTest}{1}%
1609   \Expect*{\the\wd0}{0.0pt}%
1610 \endgroup
1611 }
1612
1613 \def\TestErrorNegativeIndex#1#2{%
1614   \TestError{Invalid negative index (#1)}{#2}%
1615 }
1616
1617 \def\TestGetterUndefined#1{%
1618   \CheckUndef{dummy}%
1619   \expandafter\expandafter\expandafter\Expect
1620   \expandafter\expandafter\expandafter{#1{dummy}}{0}%
1621 }
1622
1623 \def\ExpectBitSet#1#2{%
1624   \expandafter\expandafter\expandafter\Expect
1625   \expandafter\expandafter\expandafter
1626   {\curname BS@#1\endcsname}*{#2}%
1627 }
1628 \def\Check#1#2{%
1629   \ExpectBitSet{#1}{#2}%
1630 }

```

```

1631 \def\CheckUndef#1{%
1632   \begingroup
1633     \Expect*{%
1634       \expandafter
1635       \ifx\csname BS@#1\endcsname\relax true\else false\fi
1636     }{true}%
1637   \endgroup
1638 }
1639 \def\RevCheck#1#2{%
1640   \ExpectBitSet{#1}{\Reverse#2!!}%
1641 }
1642 \def\Set#1#2{%
1643   \expandafter\def\csname BS@#1\endcsname{#2}%
1644 }
1645 \def\RevSet#1#2{%
1646   \expandafter\edef\csname BS@#1\endcsname{%
1647     \Reverse#2!!%
1648   }%
1649 }
1650 \def\Reverse#1#2!#3!{%
1651   \ifx\#2\%
1652     #1#3%
1653     \expandafter\@gobble
1654   \else
1655     \expandafter\@firstofone
1656   \fi
1657   {\Reverse#2!#1#3!}%
1658 }

```

3.2.5 Test sets

```

1659 \begin{qstest}{Let}{Let}
1660   \CheckUndef{abc}%
1661   \CheckUndef{xyz}%
1662   \bitsetLet{xyz}{abc}%
1663   \CheckUndef{abc}%
1664   \Check{xyz}{0}%
1665   \Set{abc}{1}%
1666   \Check{abc}{1}%
1667   \Check{xyz}{0}%
1668   \bitsetLet{xyz}{abc}%
1669   \Check{abc}{1}%
1670   \Check{xyz}{1}%
1671   \Set{xyz}{11}%
1672   \Check{abc}{1}%
1673   \Check{xyz}{11}%
1674 \end{qstest}
1675
1676 \begin{qstest}{Reset}{Reset}
1677   \bitsetReset{xyz}%
1678   \Check{xyz}{0}%
1679   \bitsetReset{abc}%
1680   \Check{abc}{0}%
1681   \Set{abc}{10101}%
1682   \bitsetReset{abc}%
1683   \Check{abc}{0}%
1684 \end{qstest}
1685
1686 \begin{qstest}{Get/Query}{Get/Query}

```

```

1687 \expandafter\expandafter\expandafter\Expect
1688 \expandafter\expandafter\expandafter{%
1689   \bitsetGet{dummy}{0}%
1690 }{0}%
1691 \begingroup
1692   \expandafter\def\csname BitSetError:NegativeIndex\endcsname{%
1693     \Set{abc}{1}%
1694     \Expect*{\bitsetQuery{abc}{-1}{true}{false}}{false}%
1695   \endgroup
1696   \def\Test#1#2#3{%
1697     \Set{abc}{#1}%
1698     \expandafter\expandafter\expandafter\Expect
1699     \expandafter\expandafter\expandafter{\bitsetGet{abc}{#2}}{#3}%
1700     \Expect*{\bitsetQuery{abc}{#2}{true}{false}}%
1701     *{\ifcase#3 false\or true\else error\fi}%
1702   }%
1703   \Test{1}{100}{0}%
1704   \Test{0}{0}{0}%
1705   \Test{1}{0}{1}%
1706   \Test{11}{1}{1}%
1707   \Test{111}{1}{1}%
1708   \Test{101}{1}{0}%
1709   \Test{101}{2}{1}%
1710   \Test{10100110011}{10}{1}%
1711 \end{qstest}
1712
1713 \begin{qstest}{Size}{Size}
1714   \TestGetterUndefined\bitsetSize
1715   \def\Test#1#2{%
1716     \Set{abc}{#1}%
1717     \expandafter\expandafter\expandafter\Expect
1718     \expandafter\expandafter\expandafter{\bitsetSize{abc}}{#2}%
1719   }%
1720   \Test{0}{0}%
1721   \Test{1}{1}%
1722   \Test{00}{0}%
1723   \Test{0000000}{0}%
1724   \Test{10}{1}%
1725   \Test{01}{2}%
1726   \Test{11}{2}%
1727   \Test{010}{2}%
1728   \Test{011}{3}%
1729   \Test{100110011}{9}%
1730   \Test{0000011111000001111100000}{20}%
1731   \Test{00000000000000000000000001111111111111111}{45}%
1732 \end{qstest}
1733
1734 \begin{qstest}{Cardinality}{Cardinality}
1735   \TestGetterUndefined\bitsetCardinality
1736   \def\Test#1#2{%
1737     \Set{abc}{#1}%
1738     \expandafter\expandafter\expandafter\Expect
1739     \expandafter\expandafter\expandafter{%
1740       \bitsetCardinality{abc}%
1741     }{#2}%
1742   }%
1743   \Test{0}{0}%
1744   \Test{1}{1}%

```

```

1745 \Test{00}{0}%
1746 \Test{0000000}{0}%
1747 \Test{10}{1}%
1748 \Test{01}{1}%
1749 \Test{11}{2}%
1750 \Test{010}{1}%
1751 \Test{011}{2}%
1752 \Test{100110011}{5}%
1753 \Test{0000011111000001111100000}{10}%
1754 \Test{00000000000000000000000001111111111111111}{20}%
1755 \end{qstest}
1756
1757 \begin{qstest}{NextClearBit/NextSetBit}{NextClearBit/NextSetBit}
1758   \def\Test#1#2{%
1759     \expandafter\expandafter\expandafter\Expect
1760     \expandafter\expandafter\expandafter{%
1761       \TestOp{abc}{#1}%
1762     }{#2}%
1763   }%
1764   \def\Clear{\let\TestOp\bitsetNextClearBit}%
1765   \def\Set{\let\TestOp\bitsetNextSetBit}%
1766   \begingroup
1767     \catcode`\:=11 %
1768     \bitsetSetBin{abc}{1}%
1769     \Clear
1770     \Test{-1}{1\BitSetError:NegativeIndex}%
1771     \Set
1772     \Test{-1}{0\BitSetError:NegativeIndex}%
1773   \endgroup
1774   \let\BS@abc\@undefined
1775   \Clear
1776   \Test{0}{0}%
1777   \Test{1}{1}%
1778   \Test{2}{2}%
1779   \Test{100}{100}%
1780   \Set
1781   \Test{0}{-1}%
1782   \Test{1}{-1}%
1783   \Test{100}{-1}%
1784   \bitsetReset{abc}%
1785   \Clear
1786   \Test{0}{0}%
1787   \Test{1}{1}%
1788   \Test{2}{2}%
1789   \Test{100}{100}%
1790   \Set
1791   \Test{0}{-1}%
1792   \Test{1}{-1}%
1793   \Test{100}{-1}%
1794   \bitsetSetBin{abc}{1}%
1795   \Clear
1796   \Test{0}{1}%
1797   \Test{1}{1}%
1798   \Test{2}{2}%
1799   \Test{100}{100}%
1800   \Set
1801   \Test{0}{0}%
1802   \Test{1}{-1}%

```

```

1803 \Test{100}{-1}%
1804 \bitsetSetBin{abc}{111000111000111000111}%
1805 \Clear
1806 \Test{0}{3}%
1807 \Test{1}{3}%
1808 \Test{2}{3}%
1809 \Test{3}{3}%
1810 \Test{4}{4}%
1811 \Test{5}{5}%
1812 \Test{6}{9}%
1813 \Test{7}{9}%
1814 \Test{8}{9}%
1815 \Test{9}{9}%
1816 \Test{10}{10}%
1817 \Test{11}{11}%
1818 \Test{12}{15}%
1819 \Test{13}{15}%
1820 \Test{14}{15}%
1821 \Test{15}{15}%
1822 \Test{16}{16}%
1823 \Test{17}{17}%
1824 \Test{18}{21}%
1825 \Test{19}{21}%
1826 \Test{20}{21}%
1827 \Test{21}{21}%
1828 \Test{22}{22}%
1829 \Test{100}{100}%
1830 \Set
1831 \Test{0}{0}%
1832 \Test{1}{1}%
1833 \Test{2}{2}%
1834 \Test{3}{6}%
1835 \Test{4}{6}%
1836 \Test{5}{6}%
1837 \Test{6}{6}%
1838 \Test{7}{7}%
1839 \Test{8}{8}%
1840 \Test{9}{12}%
1841 \Test{10}{12}%
1842 \Test{11}{12}%
1843 \Test{12}{12}%
1844 \Test{13}{13}%
1845 \Test{14}{14}%
1846 \Test{15}{18}%
1847 \Test{16}{18}%
1848 \Test{17}{18}%
1849 \Test{18}{18}%
1850 \Test{19}{19}%
1851 \Test{20}{20}%
1852 \Test{21}{-1}%
1853 \Test{22}{-1}%
1854 \Test{100}{-1}%
1855 \bitsetSetBin{abc}{1111111}%
1856 \Clear
1857 \Test{6}{7}%
1858 \Test{7}{7}%
1859 \Test{8}{8}%
1860 \Test{100}{100}%

```



```

1861 \Set
1862 \Test{6}{6}%
1863 \Test{7}{-1}%
1864 \Test{8}{-1}%
1865 \Test{100}{-1}%
1866 \bitsetSetBin{abc}{11111111}%
1867 \Clear
1868 \Test{7}{8}%
1869 \Test{8}{8}%
1870 \Test{9}{9}%
1871 \Test{100}{100}%
1872 \Set
1873 \Test{7}{7}%
1874 \Test{8}{-1}%
1875 \Test{9}{-1}%
1876 \Test{100}{-1}%
1877 \bitsetSetBin{abc}{11111111}%
1878 \Clear
1879 \Test{8}{9}%
1880 \Test{9}{9}%
1881 \Test{10}{10}%
1882 \Test{100}{100}%
1883 \Set
1884 \Test{8}{8}%
1885 \Test{9}{-1}%
1886 \Test{10}{-1}%
1887 \Test{100}{-1}%
1888 \bitsetSetBin{abc}{11111111}%
1889 \Clear
1890 \Test{9}{10}%
1891 \Test{10}{10}%
1892 \Test{11}{11}%
1893 \Test{100}{100}%
1894 \Set
1895 \Test{9}{9}%
1896 \Test{10}{-1}%
1897 \Test{11}{-1}%
1898 \Test{100}{-1}%
1899 \end{qstest}
1900
1901 \begin{qstest}{GetSetBitList}{GetSetBitList}
1902 \let\BS@abc\@undefined
1903 \expandafter\expandafter\expandafter\Expect
1904 \expandafter\expandafter\expandafter{%
1905 \bitsetGetSetBitList{abc}%
1906 }{}%
1907 \def\Test#1#2{%
1908 \bitsetSetBin{abc}{#1}%
1909 \expandafter\expandafter\expandafter\Expect
1910 \expandafter\expandafter\expandafter{%
1911 \bitsetGetSetBitList{abc}%
1912 }{#2}%
1913 }%
1914 \Test{0}{}%
1915 \Test{1}{0}%
1916 \Test{10}{1}%
1917 \Test{11}{0,1}%
1918 \Test{10110100}{2,4,5,7}%

```

```

1919 \Test{101101001010011}{0,1,4,6,9,11,12,14}%
1920 \end{qstest}
1921
1922 \begin{qstest}{GetDec}{GetDec}
1923 \TestGetterUndefined\bitsetGetDec
1924 \def\Test#1#2{%
1925 \RevSet{abc}{#1}%
1926 (*noetex)
1927 \begingroup\expandafter\expandafter\expandafter\endgroup
1928 /noetex)
1929 \expandafter\expandafter\expandafter\Expect
1930 \expandafter\expandafter\expandafter{%
1931 \bitsetGetDec{abc}%
1932 }{#2}%
1933 }%
1934 \Test{0}{0}%
1935 \Test{1}{1}%
1936 \Test{10}{2}%
1937 \Test{11}{3}%
1938 \Test{100}{4}%
1939 \Test{101}{5}%
1940 \Test{110}{6}%
1941 \Test{111}{7}%
1942 \Test{1000}{8}%
1943 \Test{000111}{7}%
1944 \Test{1111111111111111%
1945 1111111111111111}{2147483647}%
1946 \Test{000111111111111111%
1947 1111111111111111}{2147483647}%
1948 \Test{1000000000000000%
1949 0000000000000000}{2147483648}%
1950 \Test{1000000000000000%
1951 0000000000000000}{4294967296}%
1952 \Test{0001000000000000%
1953 0000000000000000}{4294967296}%
1954 \Test{1100000000000000%
1955 0000000000000011}{6442450947}%
1956 \end{qstest}
1957
1958 \begin{qstest}{Clear}{Clear}
1959 \def\Test#1#2#3{%
1960 \RevSet{abc}{#1}%
1961 \bitsetClear{abc}{#2}%
1962 \Expect*{\BS@abc}*{\Reverse#3!!}%
1963 }%
1964 \bitsetClear{abc}{2}%
1965 \RevCheck{abc}{0}%
1966 \TestErrorNegativeIndex{-1}{\bitsetClear{abc}{-1}}%
1967 \RevCheck{abc}{0}%
1968 \Test{0}{0}{0}%
1969 \Test{1}{0}{0}%
1970 \Test{111}{1}{101}%
1971 \Test{111}{30}{111}%
1972 \Test{0000111}{5}{0000111}% 111 would also be ok
1973 \Test{10000111}{5}{10000111}%
1974 \Test{1001001}{3}{1000001}%
1975 \end{qstest}
1976

```

```

1977 \begin{qstest}{Set}{Set}
1978   \def\Test#1#2#3{%
1979     \RevSet{abc}{#1}%
1980     \bitsetSet{abc}{#2}%
1981     \Expect*{\BS@abc}*{\Reverse#3!!}%
1982   }%
1983   \bitsetSet{abc}{2}%
1984   \RevCheck{abc}{100}%
1985   \TestErrorNegativeIndex{-1}{\bitsetSet{abc}{-1}}%
1986   \RevCheck{abc}{100}%
1987   \Test{0}{0}{1}%
1988   \Test{1}{0}{1}%
1989   \Test{100}{1}{110}%
1990   \Test{111}{1}{111}%
1991   \Test{11}{1}{11}%
1992   \Test{11}{2}{111}%
1993   \Test{11}{3}{1011}%
1994   \Test{111}{10}{1000000111}%
1995   \Test{0000111}{5}{0100111}% 100111 would also be ok
1996   \Test{10000111}{5}{10100111}%
1997   \Test{1000001}{3}{1001001}%
1998   \Test{1001001}{3}{1001001}%
1999 \end{qstest}
2000
2001 \begin{qstest}{Flip}{Flip}
2002   \def\Test#1#2#3{%
2003     \RevSet{abc}{#1}%
2004     \bitsetFlip{abc}{#2}%
2005     \Expect*{\BS@abc}*{\Reverse#3!!}%
2006   }%
2007   \bitsetFlip{abc}{2}%
2008   \RevCheck{abc}{100}%
2009   \TestErrorNegativeIndex{-1}{\bitsetFlip{abc}{-1}}%
2010   \RevCheck{abc}{100}%
2011   \Test{0}{0}{1}%
2012   \Test{1}{0}{0}%
2013   \Test{0}{2}{100}%
2014   \Test{100}{1}{110}%
2015   \Test{111}{1}{101}%
2016   \Test{11}{1}{11}%
2017   \Test{11}{2}{111}%
2018   \Test{11}{3}{1011}%
2019   \Test{111}{10}{1000000111}%
2020   \Test{0000111}{5}{0100111}% 100111 would also be ok
2021   \Test{10000111}{5}{10100111}%
2022   \Test{1000001}{3}{1001001}%
2023   \Test{1001001}{3}{1000001}%
2024   \Test{11111}{2}{11011}%
2025 \end{qstest}
2026
2027 \begin{qstest}{SetValue}{SetValue}
2028   \def\Test#1#2{%
2029     \TestError{Invalid bit value (#2) not in range 0..1}{%
2030       \bitsetSetValue{abc}{#1}{#2}%
2031     }%
2032   }%
2033   \Test{0}{-1}%
2034   \Test{0}{2}%

```

```

2035 \Test{0}{10}%
2036 \def\Test#1#2#3{%
2037     \let\BS@abc\@undefined
2038     \bitsetSetValue{abc}{#1}{#2}%
2039     \bitsetSetBin{result}{#3}%
2040     \Expect*{\BS@abc}*{\BS@result}%
2041 }%
2042 \Test{0}{0}{0}%
2043 \Test{0}{1}{1}%
2044 \Test{1}{0}{0}%
2045 \Test{1}{1}{10}%
2046 \def\Test#1#2#3#4{%
2047     \bitsetSetBin{abc}{#1}%
2048     \bitsetSetBin{result}{#4}%
2049     \bitsetSetValue{abc}{#2}{#3}%
2050     \Expect*{\BS@abc}*{\BS@result}%
2051 }%
2052 \Test{0}{0}{0}{0}%
2053 \Test{0}{0}{0}{0}%
2054 \Test{0}{0}{1}{1}%
2055 \Test{0}{1}{0}{0}%
2056 \Test{0}{1}{1}{10}%
2057 \Test{1010}{2}{1}{1110}%
2058 \Test{1010}{4}{1}{11010}%
2059 \Test{1010}{6}{1}{1001010}%
2060 \Test{1010}{1}{0}{1000}%
2061 \Test{1010}{2}{0}{1010}%
2062 \Test{1010}{3}{0}{10}%
2063 \Test{1010}{4}{0}{1010}%
2064 \Test{1010}{6}{0}{1010}%
2065 \Test{1010}{2}{\csname iffalse\endcsname 0\else 1\fi}{1110}%
2066 \Test{1010}{1}{\csname iffalse\endcsname 1\else 0\fi}{1000}%
2067 \end{qstest}
2068
2069 \begin{qstest}{IsDefined}{IsDefined}
2070     \let\BS@abc\@undefined
2071     \Expect*{\bitsetIsDefined{abc}{true}{false}}{false}%
2072     \bitsetReset{abc}%
2073     \Expect*{\bitsetIsDefined{abc}{true}{false}}{true}%
2074 \end{qstest}
2075
2076 \begin{qstest}{IsEmpty}{IsEmpty}
2077     \let\BS@abc\@undefined
2078     \Expect*{\bitsetIsEmpty{abc}{true}{false}}{true}%
2079     \bitsetReset{abc}%
2080     \Expect*{\bitsetIsEmpty{abc}{true}{false}}{true}%
2081     \bitsetSet{abc}{1}%
2082     \Expect*{\bitsetIsEmpty{abc}{true}{false}}{false}%
2083 \end{qstest}
2084
2085 \begin{qstest}{Equals}{Equals}
2086     \def\Test#1#2#3{%
2087         \Expect*{\bitsetEquals{#1}{#2}{true}{false}}{#3}%
2088     }%
2089     \let\BS@abc\@undefined
2090     \Test{abc}{abc}{true}%
2091     \Test{abc}{foo}{true}%
2092     \Test{foo}{abc}{true}%

```

```

2093 \bitsetReset{abc}%
2094 \Test{abc}{abc}{true}%
2095 \Test{abc}{foo}{false}%
2096 \Test{foo}{abc}{false}%
2097 \bitsetReset{foo}%
2098 \Test{abc}{foo}{true}%
2099 \Test{foo}{abc}{true}%
2100 \bitsetSet{abc}{4}%
2101 \Test{abc}{foo}{false}%
2102 \Test{foo}{abc}{false}%
2103 \bitsetFlip{foo}{4}%
2104 \Test{abc}{foo}{true}%
2105 \Test{foo}{abc}{true}%
2106 \end{qstest}
2107
2108 \begin{qstest}{Intersects}{Intersects}
2109 \def\Test#1{%
2110 \Expect*{\bitsetIntersects{abc}{foo}{true}{false}}{#1}%
2111 }%
2112 \let\BS@abc\@undefined
2113 \let\BS@foo\@undefined
2114 \Test{false}%
2115 \Set{abc}{0}%
2116 \Test{false}%
2117 \Set{foo}{0}%
2118 \Test{false}%
2119 \let\BS@abc\@undefined
2120 \Test{false}%
2121 \Set{foo}{1}%
2122 \Test{false}%
2123 \Set{abc}{0}%
2124 \Test{false}%
2125 \Set{abc}{1}%
2126 \Test{true}%
2127 \let\BS@foo\@undefined
2128 \Test{false}%
2129 \Set{foo}{0}%
2130 \Test{false}%
2131 \def\Test#1#2#3{%
2132 \bitsetSetBin{abc}{#1}%
2133 \bitsetSetBin{foo}{#2}%
2134 \Expect*{\bitsetIntersects{abc}{foo}{true}{false}}{#3}%
2135 }%
2136 \Test{1010}{0101}{false}%
2137 \Test{0}{10}{false}%
2138 \Test{1}{11}{true}%
2139 \Test{11}{1}{true}%
2140 \Test{10}{1}{false}%
2141 \end{qstest}
2142
2143 \begin{qstest}{And/AndNot/Or/Xor}{And/AndNot/Or/Xor}
2144 \def\@Test#1#2#3#4#5{%
2145 \begingroup
2146 #5%
2147 \begingroup
2148 \let\BS@foo\@undefined
2149 \csname bitset#1\endcsname{abc}{foo}%
2150 \CheckUndef{foo}%

```

```

2151         \Check{abc}{#2}%
2152     \endgroup
2153     \begingroup
2154         \bitsetReset{foo}%
2155         \csname bitset#1\endcsname{abc}{foo}%
2156         \Check{foo}{0}%
2157         \Check{abc}{#3}%
2158     \endgroup
2159     \begingroup
2160         \def\BS@foo{0101}%
2161         \csname bitset#1\endcsname{abc}{foo}%
2162         \Check{foo}{0101}%
2163         \Check{abc}{#4}%
2164     \endgroup
2165 \endgroup
2166 }%
2167 \def\Test#1{%
2168     \def\Op{#1}%
2169     \Test@
2170 }%
2171 \def\Test@#1#2#3#4#5#6#7#8#9{%
2172     \@Test\Op{#1}{#2}{#3}%
2173     \let\BS@abc\@undefined
2174 }%
2175 \@Test\Op{#4}{#5}{#6}%
2176     \bitsetReset{abc}%
2177 }%
2178 \@Test\Op{#7}{#8}{#9}%
2179     \def\BS@abc{1001}%
2180 }%
2181 }%
2182 \Test{And}%
2183     {0}{0}{0}%
2184     {0}{0}{0}%
2185     {0}{0}{0001}%
2186 \Test{AndNot}%
2187     {0}{0}{0}%
2188     {0}{0}{0}%
2189     {1001}{1001}{1}%
2190 \Test{Or}%
2191     {0}{0}{0101}%
2192     {0}{0}{0101}%
2193     {1001}{1001}{1101}%
2194 \Test{Xor}%
2195     {0}{0}{0101}%
2196     {0}{0}{0101}%
2197     {1001}{1001}{11}%
2198 \def\Test#1#2#3{%
2199     \bitsetSetBin{abc}{#1}%
2200     \bitsetSetBin{foo}{#2}%
2201     \csname bitset\Op\endcsname{abc}{foo}%
2202     \RevCheck{foo}{#2}%
2203     \RevCheck{abc}{#3}%
2204 }%
2205 \def\Op{And}%
2206 \Test{1}{111}{1}%
2207 \Test{111}{1}{1}%
2208 \Test{10}{111}{10}%

```

```

2209 \Test{111}{10}{10}%
2210 \Test{111}{1000}{0}%
2211 \Test{1000}{111}{0}%
2212 \def\Op{AndNot}%
2213 \Test{1010}{11}{1000}%
2214 \Test{100}{100}{0}%
2215 \Test{111}{1111}{0}%
2216 \Test{100}{111}{0}%
2217 \def\Op{Or}%
2218 \Test{0}{0}{0}%
2219 \Test{1}{0}{1}%
2220 \Test{0}{1}{1}%
2221 \Test{1}{1}{1}%
2222 \Test{1000}{10}{1010}%
2223 \Test{10}{1000}{1010}%
2224 \def\Op{Xor}%
2225 \Test{0}{0}{0}%
2226 \Test{1}{0}{1}%
2227 \Test{0}{1}{1}%
2228 \Test{1}{1}{0}%
2229 \Test{1000}{10}{1010}%
2230 \Test{10}{1000}{1010}%
2231 \Test {110011001100}%
2232 {111000111000111}%
2233 {111110100001011}%
2234 \Test{111000111000111}%
2235 {110011001100}%
2236 {111110100001011}%
2237 \end{qstest}
2238
2239 \begin{qstest}{GetUndef}{GetUndef, GetBin, GetOct, GetHex}
2240 \def\TestUndef#1#2{%
2241 \let\BS@abc\@undefined
2242 \expandafter\expandafter\expandafter\Expect
2243 \expandafter\expandafter\expandafter{%
2244 \x{abc}{#1}%
2245 }{#2}%
2246 }%
2247 \let\x\bitsetGetBin
2248 \TestUndef{-1}{0}%
2249 \TestUndef{0}{0}%
2250 \TestUndef{1}{0}%
2251 \TestUndef{2}{00}%
2252 \TestUndef{8}{00000000}%
2253 \let\x\bitsetGetOct
2254 \TestUndef{-1}{0}%
2255 \TestUndef{0}{0}%
2256 \TestUndef{1}{0}%
2257 \TestUndef{2}{0}%
2258 \TestUndef{3}{0}%
2259 \TestUndef{4}{00}%
2260 \TestUndef{5}{00}%
2261 \TestUndef{6}{00}%
2262 \TestUndef{7}{000}%
2263 \TestUndef{8}{000}%
2264 \TestUndef{9}{000}%
2265 \TestUndef{10}{0000}%
2266 \let\x\bitsetGetHex

```

```

2267 \TestUndef{-1}{0}%
2268 \TestUndef{0}{0}%
2269 \TestUndef{1}{0}%
2270 \TestUndef{2}{0}%
2271 \TestUndef{3}{0}%
2272 \TestUndef{4}{0}%
2273 \TestUndef{5}{00}%
2274 \TestUndef{6}{00}%
2275 \TestUndef{7}{00}%
2276 \TestUndef{8}{00}%
2277 \TestUndef{9}{000}%
2278 \TestUndef{10}{000}%
2279 \TestUndef{12}{000}%
2280 \TestUndef{13}{0000}%
2281 \TestUndef{16}{0000}%
2282 \TestUndef{17}{00000}%
2283 \end{qstest}
2284
2285 \begin{qstest}{SetBin}{SetBin}
2286 \def\Test#1#2{%
2287 \let\BS@abc\@undefined
2288 \bitsetSetBin{abc}{#1}%
2289 \expandafter\Expect\expandafter{\BS@abc}{#2}%
2290 }%
2291 \Test{}{0}%
2292 \Test{0}{0}%
2293 \Test{1}{1}%
2294 \Test{10}{01}%
2295 \Test{11}{11}%
2296 \Test{010}{01}%
2297 \Test{011}{11}%
2298 \Test{0010}{01}%
2299 \Test{1010}{0101}%
2300 \end{qstest}
2301
2302 \begin{qstest}{SetOct}{SetOct}
2303 \def\Test#1#2{%
2304 \bitsetSetOct{abc}{#1}%
2305 \expandafter\Expect\expandafter{\BS@abc}{#2}%
2306 }%
2307 \Test{}{0}%
2308 \Test{0}{0}%
2309 \Test{000}{0}%
2310 \Test{1}{1}%
2311 \Test{001}{1}%
2312 \Test{010}{0001}%
2313 \Test{020}{00001}%
2314 \Test{42}{010001}%
2315 \Test{377}{11111111}%
2316 \Test{0377}{11111111}%
2317 \Test{76543210}{000100010110001101011111}%
2318 \Test{ 0 7 0 7 1 }{100111000111}%
2319 \end{qstest}
2320
2321 \begin{qstest}{SetHex}{SetHex}
2322 \def\Test#1#2{%
2323 \bitsetSetHex{abc}{#1}%
2324 \expandafter\Expect\expandafter{\BS@abc}{#2}%

```



```

2325 }%
2326 \Test{}{0}%
2327 \Test{0}{0}%
2328 \Test{000}{0}%
2329 \Test{1}{1}%
2330 \Test{001}{1}%
2331 \Test{010}{00001}%
2332 \Test{020}{000001}%
2333 \Test{42}{0100001}%
2334 \Test{3F}{111111}%
2335 \Test{03F}{111111}%
2336 \Test{43210}{0000100001001100001}%
2337 \Test{98765}{10100110111000011001}%
2338 \Test{FEDCBA}{010111010011101101111111}%
2339 \Test{ O F O F 1 }{1000111100001111}%
2340 \end{qstest}
2341
2342 \begin{qstest}{SetDec}{SetDec}
2343   \def\Test#1#2{%
2344     \bitsetSetDec{abc}{#1}%
2345     \expandafter\Expect\expandafter{\BS@abc}{#2}%
2346   }%
2347   \Test{}{0}%
2348   \Test{0}{0}%
2349   \Test{000}{0}%
2350   \Test{1}{1}%
2351   \Test{7}{111}%
2352   \Test{8}{0001}%
2353   \Test{001}{1}%
2354   \Test{010}{0101}%
2355   \Test{020}{00101}%
2356   \Test{53}{101011}%
2357   \Test{255}{11111111}%
2358   \Test{256}{000000001}%
2359   \Test{999999999}{111111111001001101011001110111}%
2360   \Test{1000000000}{000000000101001101011001110111}%
2361   \Test{4210987654}{01100001010010010111111101011111}%
2362   \Test{2147483647}{111111111111111111111111111111}%
2363   \Test{2147483648}{00000000000000000000000000000001}%
2364 \end{qstest}
2365
2366 \begin{qstest}{GetBin}{GetBin}
2367   \def\TestUndef#1#2{%
2368     \let\BS@abc\@undefined
2369     \expandafter\expandafter\expandafter\Expect
2370     \expandafter\expandafter\expandafter{%
2371       \bitsetGetBin{abc}{#1}%
2372     }{#2}%
2373   }%
2374   \TestUndef{-1}{0}%
2375   \TestUndef{0}{0}%
2376   \TestUndef{1}{0}%
2377   \TestUndef{2}{00}%
2378   \TestUndef{8}{00000000}%
2379   \def\Test#1#2{%
2380     \bitsetSetBin{abc}{#2}%
2381     \expandafter\expandafter\expandafter\Expect
2382     \expandafter\expandafter\expandafter{%

```

```

2383     \bitsetGetBin{abc}{#1}%
2384   }{#2}%
2385 }%
2386 \Test{-1}{0}%
2387 \Test{0}{0}%
2388 \Test{1}{0}%
2389 \Test{1}{1}%
2390 \Test{2}{01}%
2391 \Test{2}{10}%
2392 \Test{3}{010}%
2393 \Test{2}{00}%
2394 \Test{2}{01}%
2395 \Test{8}{00101100}%
2396 \Test{2}{10101}%
2397 \Test{-100}{11011}%
2398 \end{qstest}
2399
2400 \begin{qstest}{GetOct}{GetOct}
2401   \def\Test#1#2#3{%
2402     \edef\x{\zap@space#1 \@empty}%
2403     \edef\x{\noexpand\bitsetSetBin{abc}{\x}}%
2404     \x
2405     \expandafter\expandafter\expandafter\Expect
2406     \expandafter\expandafter\expandafter{%
2407       \bitsetGetOct{abc}{#2}%
2408     }{#3}%
2409   }%
2410   \Test{111 110 101 100 011 010 001 000}{0}{76543210}%
2411   \Test{000 111}{0}{7}%
2412   \Test{101 000}{-1}{50}%
2413   \Test{111}{-1}{7}%
2414   \Test{111}{0}{7}%
2415   \Test{111}{1}{7}%
2416   \Test{111}{3}{7}%
2417   \Test{111}{4}{07}%
2418   \Test{111}{6}{07}%
2419   \Test{111}{7}{007}%
2420   \Test{111 010}{6}{72}%
2421   \Test{111 010}{7}{072}%
2422   \Test{011 111}{0}{37}%
2423   \Test{011 111}{6}{37}%
2424   \Test{011 111}{7}{037}%
2425   \Test{001 111}{0}{17}%
2426   \Test{001 111}{6}{17}%
2427   \Test{001 111}{7}{017}%
2428 \end{qstest}
2429
2430 \begin{qstest}{GetHex}{GetHex}
2431   \def\Test#1#2#3{%
2432     \bitsetSetBin{abc}{#1}%
2433     \expandafter\expandafter\expandafter\Expect
2434     \expandafter\expandafter\expandafter{%
2435       \bitsetGetHex{abc}{#2}%
2436     }{#3}%
2437   }%
2438   \Test{1111 1110 1101 1100 1011 1010 1001 1000}{0}{FEDCBA98}%
2439   \Test{0111 0110 0101 0100 0011 0010 0001 0000}{0}{76543210}%
2440   \Test{0000 1111}{0}{F}%

```

```

2441 \Test{0101 0000}{-1}{50}%
2442 \Test{1111}{-1}{F}%
2443 \Test{1111}{0}{F}%
2444 \Test{1111}{1}{F}%
2445 \Test{1111}{4}{F}%
2446 \Test{1111}{5}{0F}%
2447 \Test{1111}{8}{0F}%
2448 \Test{1111}{9}{00F}%
2449 \Test{1111 0010}{8}{F2}%
2450 \Test{1111 0010}{9}{0F2}%
2451 \Test{0111 1111}{0}{7F}%
2452 \Test{0111 1111}{8}{7F}%
2453 \Test{0111 1111}{9}{07F}%
2454 \Test{0011 1111}{0}{3F}%
2455 \Test{0011 1111}{8}{3F}%
2456 \Test{0011 1111}{9}{03F}%
2457 \Test{0001 1111}{0}{1F}%
2458 \Test{0001 1111}{8}{1F}%
2459 \Test{0001 1111}{9}{01F}%
2460 \end{qstest}
2461
2462 \begin{qstest}{Range}{Range}
2463 \TestError{%
2464     Wrong index numbers in range [9..8]\MessageBreak% hash-ok
2465     for clear/set/flip on bit set `abc'.\MessageBreak
2466     The lower index exceeds the upper index.\MessageBreak
2467     Canceling the operation as error recovery%
2468 }{%
2469     \bitsetSetRange{abc}{9}{8}%
2470 }%
2471 \def\TestErrorNegInd#1#2#3#4#5#6{%
2472     \TestError{%
2473         Negative index in range [#2..#3]\MessageBreak % hash-ok
2474         for \string\bitset #1Range on bit set `abc'.\MessageBreak
2475         Using [#4..#5] as error recovery% hash-ok
2476     }{%
2477         \csname \bitset#1Range\endcsname{abc}{#2}{#3}%
2478         \global\let\BS@global\BS@abc
2479     }%
2480     \Check{global}{#6}%
2481 }%
2482 \Set{abc}{111}%
2483 \TestErrorNegInd{Clear}{-1}{0}{0}{0}{111}%
2484 \TestErrorNegInd{Clear}{0}{-1}{0}{0}{111}%
2485 \TestErrorNegInd{Clear}{-2}{2}{0}{2}{001}%
2486 \bitsetReset{abc}%
2487 \TestErrorNegInd{Set}{-1}{0}{0}{0}{0}%
2488 \TestErrorNegInd{Set}{0}{-1}{0}{0}{0}%
2489 \TestErrorNegInd{Set}{-2}{2}{0}{2}{11}%
2490 \Set{abc}{101}%
2491 \TestErrorNegInd{Flip}{-1}{0}{0}{0}{101}%
2492 \TestErrorNegInd{Flip}{0}{-1}{0}{0}{101}%
2493 \TestErrorNegInd{Flip}{-2}{2}{0}{2}{011}%
2494 \def\Test#1#2#3#4{%
2495     \bitsetSetBin{abc}{#1}%
2496     \csname \bitset\TestOp Range\endcsname{abc}{#2}{#3}%
2497     \Expect*{\bitsetGetBin{abc}{0}}{#4}%
2498 }%

```

[illegible]

Script installation. Check the directory `TDS:scripts/oberdiek/` for scripts that need further installation steps. Package `attachfile2` comes with the Perl script `pdfatfi.pl` that should be installed in such a way that it can be called as `pdfatfi`. Example (linux):

```
chmod +x scripts/oberdiek/pdfatfi.pl
cp scripts/oberdiek/pdfatfi.pl /usr/local/bin/
```

4.3 Package installation

Unpacking. The `.dtx` file is a self-extracting `docstrip` archive. The files are extracted by running the `.dtx` through plain \TeX :

```
tex bitset.dtx
```

TDS. Now the different files must be moved into the different directories in your installation TDS tree (also known as `texmf` tree):

```
bitset.sty          → tex/generic/oberdiek/bitset.sty
bitset.pdf          → doc/latex/oberdiek/bitset.pdf
test/bitset-test1.tex → doc/latex/oberdiek/test/bitset-test1.tex
test/bitset-test2.tex → doc/latex/oberdiek/test/bitset-test2.tex
test/bitset-test3.tex → doc/latex/oberdiek/test/bitset-test3.tex
bitset.dtx          → source/latex/oberdiek/bitset.dtx
```

If you have a `docstrip.cfg` that configures and enables `docstrip`'s TDS installing feature, then some files can already be in the right place, see the documentation of `docstrip`.

4.4 Refresh file name databases

If your \TeX distribution (te \TeX , mik \TeX , ...) relies on file name databases, you must refresh these. For example, te \TeX users run `texhash` or `mktextlsr`.

4.5 Some details for the interested

Unpacking with \LaTeX . The `.dtx` chooses its action depending on the format:

plain \TeX : Run `docstrip` and extract the files.

\LaTeX : Generate the documentation.

If you insist on using \LaTeX for `docstrip` (really, `docstrip` does not need \LaTeX), then inform the autodetect routine about your intention:

```
latex \let\install=y\input{bitset.dtx}
```

Do not forget to quote the argument according to the demands of your shell.

Generating the documentation. You can use both the `.dtx` or the `.drv` to generate the documentation. The process can be configured by the configuration file `ltxdoc.cfg`. For instance, put this line into this file, if you want to have A4 as paper format:

```
\PassOptionsToClass{a4paper}{article}
```

An example follows how to generate the documentation with pdf \LaTeX :

```
pdflatex_x_bitset.dtx
makeindex_x_sugind.ist_x_bitset.idx
pdflatex_x_bitset.dtx
makeindex_x_sugind.ist_x_bitset.idx
pdflatex_x_bitset.dtx
```

5 History

[2007/09/28 v1.0]

- First version.

[2011/01/30 v1.1]

- Already loaded package files are not input in plain T_EX.

[2016/05/16 v1.2]

- Documentation updates.

6 Index

Numbers written in *italic* refer to the page where the corresponding entry is described; numbers underlined refer to the code line of the definition; plain numbers refer to the code lines where the entry is used.

Symbols	B
\# 1412	\begin 1659, 1676, 1686, 1713,
\% 1488	1734, 1757, 1901, 1922, 1958,
\: 1767	1977, 2001, 2027, 2069, 2076,
\@ 1413, 1486	2085, 2108, 2143, 2239, 2285,
\@PackageError 176, 368, 924, 1079, 1092, 1592	2302, 2321, 2342, 2366, 2400, 2430, 2462, 2526, 2574, 2579, 2583
\@Test 2144, 2172, 2175, 2178, 2527, 2533, 2534	\BigIntCalcAdd 646, 655
\@ehc 178, 370, 926, 1084, 1106	\bigintcalcCmp 358
\@empty 2402	\BigIntCalcOdd 378
\@firstofone 1421, 1424, 1655	\bigintcalcSgn 355
\@gobble 1418, 1426, 1653	\BigIntCalcShl 660, 667
\@undefined . 58, 1518, 1519, 1520, 1774, 1902, 2037, 2070, 2077, 2089, 2112, 2113, 2119, 2127, 2148, 2173, 2241, 2287, 2368, 2528	\BigIntCalcShr 386
\\ 222, 375, 438, 571, 580, 642, 689, 692, 727, 730, 767, 770, 800, 802, 810, 1294, 1303, 1325, 1334, 1394, 1397, 1487, 1651	\bitset 1094, 2474
\{ 1410	\BitSet@@@Range 1086, 1109, 1113
\} 1411	\BitSet@@@Set 984, <u>991</u> , 1026
A	\BitSet@@CheckIndex 169, <u>173</u>
\advance 1451, 1459, 1474, 1558	\BitSet@@Clear 930, <u>942</u>
\aftergroup 29	\BitSet@@Flip 1001, <u>1013</u>
\AtEndDocument 1571	\BitSet@@Get 1130, <u>1139</u>
	\BitSet@@GetBin 407, <u>410</u>
	\BitSet@@GetDec 575, <u>579</u> , 605
	\BitSet@@GetDecBig 654, <u>665</u>
	\BitSet@@GetHex 479, <u>512</u>
	\BitSet@@GetOct 465, <u>487</u>
	\BitSet@@GetOctHex 462, 476, 546, <u>550</u>
	\BitSet@@NextClearBit ... 1173, <u>1177</u>
	\BitSet@@NextSetBit 1209, <u>1213</u>
	\BitSet@@Range . 1065, 1070, 1107, <u>1109</u>

\BitSet@@Set	970, <u>977</u>	\BitSet@Gobble	144, 852, 877, 918, 919, 1243
\BitSet@@TestMode	124	\BitSet@GobbleSeven	1250, <u>1264</u>
\BitSet@AfterFi	157, 175, 181, 225, 384, 399, 413, 418, 429, 434, 439, 443, 451, 456, 489, 494, 514, 519, 552, 560, 572, 574, 1112, 1125, 1164, 1200, 1231, 1274, 1276, 1392	\BitSet@Hex[0..F]	<u>318</u>
\BitSet@AfterFiFi	158, 263, 296, 582, 587, 591, 597, 644, 649, 653, 658, 773, 891, 953, 984, 1026, 1150, 1183, 1185, 1219, 1221, 1236, 1240, 1242, 1295, 1297, 1304, 1306, 1326, 1328, 1335, 1337, 1395	\BitSet@Hex[0000..1111]	<u>526</u>
\BitSet@AfterFiFiFi	159, 697, 701, 737, 741, 816, 821, 956, 961, 1029, 1034, 1247, 1253, 1398, 1400	\BitSet@IfUndefined	160, 168, 190, 411, 565, 750, 781, 829, 856, 1129, 1285, 1316, 1345, 1350, 1367, 1368, 1370
\BitSet@And	677, <u>688</u>	\BitSet@Intersects	1383, <u>1390</u>
\BitSet@AndNot	715, <u>726</u>	\BitSet@Kill	870, <u>880</u>
\BitSet@AtEnd	95, 96, 118, 1407	\BitSet@KillZeros	204, <u>214</u> , 243, 301, 350
\BitSet@Cardinality	1317, <u>1323</u>	\BitSet@MaxSize	141, 358
\BitSet@CheckIndex	167, 898, 901, 904, 911	\BitSet@N1073741824	<u>638</u>
\BitSet@Cleanup	891, 953, 1150, 1183, 1219, <u>1228</u>	\BitSet@N[1,2,4,...]	<u>603</u>
\BitSet@Clear	898, 913, <u>928</u> , 1042, 1056, 1095	\BitSet@NegativeIndex	1072, 1075, <u>1091</u>
\BitSet@Empty	142, 150, 201, 204, 206, 240, 243, 245, 251, 347, 350, 352, 470, 484, 488, 513, 682, 720, 793, 871, 883, 889, 932, 936, 944, 946, 952, 972, 982, 1003, 1007, 1016, 1024	\BitSet@NextClearBit	1158, <u>1161</u>
\BitSet@ErrorInvalidBitValue	917, <u>923</u> , 1060	\BitSet@NextSetBit	1194, <u>1197</u> , 1269, 1278
\BitSet@Fi	156, 157, 158, 159, 184, 228, 274, 305, 388, 403, 419, 435, 447, 457, 499, 524, 561, 577, 601, 663, 706, 746, 777, 826, 895, 966, 989, 1039, 1116, 1137, 1154, 1175, 1190, 1211, 1226, 1259, 1281, 1312, 1342, 1405	\BitSet@NumBinFill	440, <u>449</u>
\BitSet@Fill	414, <u>427</u> , 452, 554	\BitSet@NumBinRev	421, <u>437</u>
\BitSet@FirstOfOne	143	\BitSet@Oct[000..111]	<u>501</u>
\BitSet@FirstOfTwo	145, 162, 1347, 1350, 1352, 1361, 1368, 1373, 1392	\BitSet@Or	757, <u>765</u>
\BitSet@Flip	904, <u>999</u> , 1048	\BitSet@Range	1042, 1045, 1048, 1056, 1058, <u>1063</u>
\BitSet@FromFirstHex	234, <u>292</u>	\BitSet@Reverse	210, <u>221</u> , 255
\BitSet@FromFirstOct	231, <u>260</u>	\BitSet@SecondOfTwo	146, 164, 1346, 1354, 1363, 1368, 1370, 1375, 1381, 1382, 1395, 1398
\BitSet@FromHex	304, <u>307</u>	\BitSet@Set	901, 915, <u>968</u> , 1045, 1058, 1098
\BitSet@FromOct	273, <u>276</u>	\BitSet@SetDec	364, 376, <u>390</u>
\BitSet@Get	1120, <u>1123</u>	\BitSet@SetDecBig	360, <u>374</u>
\BitSet@GetDec	566, <u>570</u>	\BitSet@SetOctHex	231, 234, <u>236</u>
\BitSet@GetDecBig	639, <u>641</u> , 666	\BitSet@SetValue	907, <u>910</u>
\BitSet@GetOctHex	490, 515, <u>545</u>	\BitSet@SetValueRange	1051, <u>1054</u>
\BitSet@GetSetBitList	1268, <u>1272</u>	\BitSet@ShiftLeft	834, <u>839</u> , 877
		\BitSet@ShiftRight	852, 861, <u>866</u>
		\BitSet@Size	1286, <u>1292</u>
		\BitSet@Skip	1170, 1206, <u>1229</u>
		\BitSet@SkipContinue	1232, 1237, 1240, 1243, <u>1261</u>
		\BitSet@Space	147, 201, 240, 347, 583, 645, 847, 1136, 1165, 1201
		\BitSet@Temp	198, 199, 201, 203, 204, 206, 210, 237, 238, 240, 242, 243, 245, 248, 249, 251, 255, 318, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 344, 345, 347, 349, 350, 352, 355, 358, 360, 364, 501, 504, 505, 506, 507, 508, 509, 510, 511, 526, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541,

542, 543, 544, 603, 608, 609,
 610, 611, 612, 613, 614, 615,
 616, 617, 618, 619, 620, 621,
 622, 623, 624, 625, 626, 627,
 628, 629, 630, 631, 632, 633,
 634, 635, 636, 637, 929, 936,
 939, 1000, 1007, 1010, 1064, 1068
 \BitSet@TestMode 124, 1525
 \BitSet@Xor 788, 799
 \BitSet@ZapSpace .. 148, 200, 239, 346
 \BitSet@Zero 207, 246,
 252, 353, 356, 937, 1008, 1351, 1358
 \bitsetAnd 7, 669
 \bitsetAndNot 7, 708
 \bitsetCardinality 9, 1314, 1735, 1740
 \bitsetClear . 8, 897, 1961, 1964, 1966
 \bitsetClearRange 1041
 \bitsetEquals 9, 1366, 2087
 \BitSetError .. 271, 287, 299, 311,
 382, 1126, 1166, 1202, 1770, 1772
 \bitsetFlip 903, 2004, 2007, 2009, 2103
 \bitsetFlipRange 1047
 \bitsetGet
 .. 8, 1118, 1360, 1689, 1699, 2580
 \bitsetGetBin 7, 405,
 2247, 2371, 2383, 2497, 2518, 2545
 \bitsetGetDec 7, 563, 1923, 1931
 \bitsetGetHex 473, 2266, 2435
 \bitsetGetOct 459, 2253, 2407
 \bitsetGetSetBitList
 8, 1265, 1905, 1911
 \bitsetIntersects . 9, 1380, 2110, 2134
 \bitsetIsDefined .. 9, 1344, 2071, 2073
 \bitsetIsEmpty ... 9, 461, 475, 670,
 673, 709, 712, 749, 752, 780,
 783, 832, 859, 1169, 1205, 1267,
 1349, 1381, 1382, 2078, 2080, 2082
 \bitsetLet 6, 189, 1662, 1668
 \bitsetNextClearBit ... 8, 1156, 1764
 \bitsetNextSetBit 8, 1192, 1765
 \bitsetOr 7, 748
 \bitsetQuery 9, 1359, 1694, 1700
 \bitsetReset 6, 168,
 186, 191, 671, 674, 683, 710,
 721, 750, 781, 794, 830, 857,
 1677, 1679, 1682, 1784, 2072,
 2079, 2093, 2097, 2154, 2176, 2486
 \bitsetSet 900,
 1980, 1983, 1985, 2081, 2100, 2575
 \bitsetSetBin .. 6, 197, 1768, 1794,
 1804, 1855, 1866, 1877, 1888,
 1908, 2039, 2047, 2048, 2132,
 2133, 2199, 2200, 2288, 2380,
 2403, 2432, 2495, 2516, 2542, 2543
 \bitsetSetDec 6, 343, 2344
 \bitsetSetHex 233, 2323
 \bitsetSetOct 230, 2304
 \bitsetSetRange 1044, 2469
 \bitsetSetValue 8, 906, 2030, 2038, 2049
 \bitsetSetValueRange 1050, 2517
 \bitsetShiftLeft 7, 828
 \bitsetShiftRight 855
 \bitsetSize 9, 1283, 1714, 1718
 \bitsetXor 7, 779
 \body 1430, 1434
 \BS@abc 1774, 1902, 1962, 1981, 2005,
 2037, 2040, 2050, 2070, 2077,
 2089, 2112, 2119, 2173, 2179,
 2241, 2287, 2289, 2305, 2324,
 2345, 2368, 2478, 2528, 2530, 2576
 \BS@foo 2113, 2127, 2148, 2160
 \BS@global 2478, 2576
 \BS@result 2040, 2050

C

\catcode 2, 3, 5, 6, 7,
 8, 9, 10, 11, 12, 13, 33, 34, 36,
 37, 38, 39, 40, 41, 42, 43, 44, 45,
 46, 47, 48, 49, 69, 70, 72, 73, 74,
 78, 79, 80, 81, 82, 83, 84, 87, 88,
 90, 91, 92, 93, 97, 99, 122, 1410,
 1411, 1412, 1413, 1448, 1457,
 1465, 1469, 1486, 1487, 1488, 1767
 \chardef 1525
 \Check 1628,
 1664, 1666, 1667, 1669, 1670,
 1672, 1673, 1678, 1680, 1683,
 2151, 2156, 2157, 2162, 2163, 2480
 \CheckUndef
 1618, 1631, 1660, 1661, 1663, 2150
 \Clear 1764, 1769, 1775, 1785,
 1795, 1805, 1856, 1867, 1878, 1889
 \count@ 1415, 1444, 1448, 1450,
 1451, 1455, 1457, 1458, 1459,
 1463, 1465, 1468, 1469, 1473, 1474
 \countdef 1415
 \csname 14,
 21, 50, 66, 76, 120, 126, 129,
 161, 187, 193, 194, 207, 209,
 246, 252, 254, 298, 302, 310,
 313, 319, 353, 356, 359, 363,
 424, 469, 483, 497, 502, 522,
 527, 567, 592, 598, 604, 638,
 676, 678, 680, 682, 714, 716,
 718, 720, 753, 754, 756, 758,
 760, 784, 785, 787, 789, 791,
 793, 845, 848, 869, 871, 931,
 935, 969, 971, 1002, 1006, 1131,
 1172, 1208, 1289, 1320, 1351,
 1371, 1372, 1384, 1386, 1414,
 1417, 1420, 1423, 1478, 1505,
 1541, 1626, 1635, 1643, 1646,
 1692, 2065, 2066, 2149, 2155,
 2161, 2201, 2477, 2496, 2529, 2544
 \currentgrouplevel . 1516, 1520, 1532

\numexpr 1514, 1519, 1530

O

\Op 2168, 2172, 2175, 2178, 2201, 2205,
2212, 2217, 2224, 2544, 2547, 2558
\orig@endqstest 1576, 1584
\orig@qstest 1575, 1578

P

\PackageInfo 26
\pdfelapsedtime 1557
\pdfresettimer 1553
\PrintTime 1546, 1559, 1572
\ProvidesPackage 19, 67

Q

\qstest 1561, 1563, 1575, 1577

R

\RangeCatcodeCheck ... 1462, 1490,
1491, 1492, 1493, 1494, 1495,
1496, 1497, 1498, 1499, 1500, 1501
\RangeCatcodeInvalid
.... 1454, 1482, 1483, 1484, 1485
\renewcommand 1552
\repeat ... 1429, 1441, 1452, 1460, 1475
\RequirePackage 137, 138, 139
\RestoreCatcodes 1443, 1446, 1447, 1502
\RevCheck 1639, 1965, 1967,
1984, 1986, 2008, 2010, 2202, 2203
\Reverse 1640,
1647, 1650, 1657, 1962, 1981, 2005
\RevSet ... 1645, 1925, 1960, 1979, 2003
\romannumeral 406,
460, 474, 564, 847, 874, 933,
974, 1004, 1134, 1166, 1202, 1266

S

\saved@endqstest 1562, 1569
\saved@qstest 1561, 1564
\SavedCurrentgrouplevel .. 1516, 1532
\SavedIfcsname 1515, 1531
\SavedNumexpr 1514, 1530
\sbox 1591
\Set . 1642, 1665, 1671, 1681, 1693,
1697, 1716, 1737, 1765, 1771,
1780, 1790, 1800, 1830, 1861,
1872, 1883, 1894, 2115, 2117,
2121, 2123, 2125, 2129, 2482, 2490
\setbox 1579
\setcounter 1590
\space 1468, 1469, 1477, 1548
\StartTime 1551, 1565
\stepcounter 1593
\StopTime 1556, 1568
\strip@pt 1548
\SummaryTime .. 1543, 1545, 1558, 1572

T

\Test 1481, 1504, 1696, 1703,
1704, 1705, 1706, 1707, 1708,
1709, 1710, 1715, 1720, 1721,
1722, 1723, 1724, 1725, 1726,
1727, 1728, 1729, 1730, 1731,
1736, 1743, 1744, 1745, 1746,
1747, 1748, 1749, 1750, 1751,
1752, 1753, 1754, 1758, 1770,
1772, 1776, 1777, 1778, 1779,
1781, 1782, 1783, 1786, 1787,
1788, 1789, 1791, 1792, 1793,
1796, 1797, 1798, 1799, 1801,
1802, 1803, 1806, 1807, 1808,
1809, 1810, 1811, 1812, 1813,
1814, 1815, 1816, 1817, 1818,
1819, 1820, 1821, 1822, 1823,
1824, 1825, 1826, 1827, 1828,
1829, 1831, 1832, 1833, 1834,
1835, 1836, 1837, 1838, 1839,
1840, 1841, 1842, 1843, 1844,
1845, 1846, 1847, 1848, 1849,
1850, 1851, 1852, 1853, 1854,
1857, 1858, 1859, 1860, 1862,
1863, 1864, 1865, 1868, 1869,
1870, 1871, 1873, 1874, 1875,
1876, 1879, 1880, 1881, 1882,
1884, 1885, 1886, 1887, 1890,
1891, 1892, 1893, 1895, 1896,
1897, 1898, 1907, 1914, 1915,
1916, 1917, 1918, 1919, 1924,
1934, 1935, 1936, 1937, 1938,
1939, 1940, 1941, 1942, 1943,
1944, 1946, 1948, 1950, 1952,
1954, 1959, 1968, 1969, 1970,
1971, 1972, 1973, 1974, 1978,
1987, 1988, 1989, 1990, 1991,
1992, 1993, 1994, 1995, 1996,
1997, 1998, 2002, 2011, 2012,
2013, 2014, 2015, 2016, 2017,
2018, 2019, 2020, 2021, 2022,
2023, 2024, 2028, 2033, 2034,
2035, 2036, 2042, 2043, 2044,
2045, 2046, 2052, 2053, 2054,
2055, 2056, 2057, 2058, 2059,
2060, 2061, 2062, 2063, 2064,
2065, 2066, 2086, 2090, 2091,
2092, 2094, 2095, 2096, 2098,
2099, 2101, 2102, 2104, 2105,
2109, 2114, 2116, 2118, 2120,
2122, 2124, 2126, 2128, 2130,
2131, 2136, 2137, 2138, 2139,
2140, 2167, 2182, 2186, 2190,
2194, 2198, 2206, 2207, 2208,
2209, 2210, 2211, 2213, 2214,
2215, 2216, 2218, 2219, 2220,
2221, 2222, 2223, 2225, 2226,
2227, 2228, 2229, 2230, 2231,

